iCAP 6000 Series ICP-OES Spectrometer

Hardware Manual

Thermo
ELECTRON CORPORATION

1 Contents

2 User Documentation

2.1 Hardware Manual

This manual includes the information required to operate and maintain the iCAP 6000 Series Spectrometers.
It describes the safety hazards involved in working with the spectrometer and its accessories, and the means by which such hazards can be minimised.

2.2 Pre-Installation Manual

The manual is included with the Hardware manual, it provides the details of the services and environment that must be available before an iCAP 6000 ICP-OES can be installed.

2.3 iTEVA Software Manual

This manual is supplied with all instrumentation and describes the functions and features of the Data Station software, it includes an On-line Help system.

2.4 Data Station On-line Help System

The Data Station On-Line Help describes features and functions of the software.

3 Safety

3.1 iCAP 6000 Safety

Read this page carefully before installing and operating the instrument and its accessories.
The safety standards contained in this manual comply with the requirements of the Health and Safety at Work Act 1974.

3.1.1 Introduction

The instrument and accessories described in this manual are designed to be used by properly trained personnel only.
Any adjustment, maintenance and repair of this equipment must only be carried out by qualified Service Engineers who are aware of the hazards involved.

3.1.2 Safety Precautions

For the correct and safe use of the instrument and its accessories it is essential that the operating and service personnel follow generally accepted safety procedures in addition to the specific precautions specified in this manual.
Specific Warning and Caution statements and symbols are included in the relevant sections of this manual.
Warning and Caution statements and symbols are marked on the apparatus where appropriate. The symbols are described in the table below:

	Yellow/black or Red/white	Warning: the operator must refer to an explanation in the User Documentation.
	White/black/moulded	Protective earth (ground) terminal
	Yellow/black	Surfaces which may be hot
	Yellow/black	Hazardous voltages present. Handle by insulation only. Do not touch terminal points.
	Yellow/black	Radio Frequency Radiation, Specific safety details in user manuals.

	Yellow/black	UV Radiation, Specific safety details in user manuals.
	Yellow/black	Do not remove covers or open, No User Serviceable parts inside.

Unless otherwise stated in this manual, the covers of the instrument and accessories should only be removed by qualified, appropriately trained Service personnel.
All spare parts and consumables items must be approved by Thermo Electron Corporation.
Some of the chemicals used in spectrometry are corrosive and/or flammable, and samples maybe radioactive, toxic or potentially infective.
Normal laboratory procedures and regulations for handling such materials should be followed.

3.1.3 Electrical Safety

All mains powered equipment is designed for operation with a fully earthed mains supply. The mains earth connection to the equipment must be connected, otherwise safety may be impaired.
Where reference is made to electrical safety the National Regulations for the country of use when fitting the power cord plugs should followed. A qualified electrician should be consulted for all electrical connections. If liquid is spilled on, or adjacent, to the instrument immediately isolate the instrument and accessories from the electrical supply, by turning off the power remote to the instrumentation.

3.1.4 Equipment Cleaning and Decontamination

It is the user's responsibility to carry out appropriate cleaning and decontamination of the equipment if hazardous material is spilt on or inside the equipment. Cleaning and decontamination are specified in the relevant sections of this manual. Before using any other procedures, users should check with the manufacturers that the proposed method will not damage the equipment.

3.1.5 Impaired Safety Protection

Whenever Safety Protection has been impaired the instrument and accessories must be made inoperative and secured against any unintended operation. The matter should then be referred to the nearest Thermo Electron service organisation. Safety protection is likely to be impaired if the instrument fails to operate normally, or shows visible damage. If the equipment is used in a manner not specified by the manufacturer the safety protection provided by the equipment may be impaired.

3.1.6 WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the symbol:

Thermo Electron has contracted with one or more recycling/disposal companies in each EU Member State and this product should be disposed of or recycled through them. Further information on Thermo Electron's compliance with these Directives the recyclers in your country and information on Thermo Electrons products which may assist the directive are available at www.thermo.com/WEEERoHS.

3.2 iCAP 6000 Sicherheit

Lesen sie dieten desonders sorgfályig vor der installation und dem gebrauch des gerätes.

3.2.1 EInfúhrung

Die hier beschriebenen Garäte erfordern gründlich ausgebildetes Bedienungspersonal. Spezielle justierungen, Wartungen und Reparaturen am geöffneten Gerät dürfen nur von autorisierten Personendurchgeführt warden.

3.2.2 Allgemeine richtlinien zur sicheren handhabung des Gerätes

Fūr die korrekte und sichere Handhabung des Gerātes und des entsprecheden Zubehörs ist es unbedingt erforderlich, daβ das Bedienungs und Service-Personal den in der Bedienungsanleitung angegbenen richtlinien Folge leistet.
Spezielle Vorsichts- und Warnungshinweise finden Sie der Bedienungsanleitung besonders vermerkt.

	Gelb/Schwarz oder Rot/weiss	Warnung: muss das entsprechende kapitel der bedienungsanleitung.
	Gelb/Schwarz	Masse/schutzkontakt
	Gelb/Schwarz	Heisse oberflache
	Gelb/Schwarz	Gefährliche hochspannung. Nur an der isolierung berühren. Niemals knotakte anfassen.
	Gelb/Schwarz	Radiofrequenzbestrahlung, Spezifische Sicherheit schildert genau in Benutzerhandbuchn.
	Gelb/Schwarz	UV Bestrahlung, Spezifische Sicherheit schildert genau in Benutzerhandbuchn.
	Gelb/Schwarz	Nehmen Sie Decken oder offen, Keine vom Benutzer Haltbaren Teile hinein nicht heraus.

Auβderdem befinden sich am Gerät, wo erforderlich, Hinweisschilder.
Die Geräteabdeckung sollte ausschlieβlich durch einen qualifizierten Thermo Electron Corporation Service-Ingenieur enfernt warden.
Alle Ersazteile und verbrauchbaren benutzten Einzelteile müssen Thermo Electron Corporation genehmigt warden.
Einige der in der Spektroskopie zur Anwendung kommenden Chemikalien sind corrosive, leight entzūdbar, radioactive, infektiōs oder toxisch.
Daher muβ dafūr Sorge getraden warden daβ die normalen Laborrichtlinien zur Handhabung dieser Chemikaline zur Anwendung kommen.

3.2.3 Elektrische Sicherheit

Vom Netz gespeiste Geräte sind so entwickelt das seine Masseverbindung vorhanden sein sollte. Diese Masseverbindung sollte vorheinden sein da sonst die elektrische Sicherheit beeinflusst warden könnte.
Im Hinblick auf die elektrische Sichrheit müssen die folgenden Punkte beachtet warden.
Die elektrische Installation muβ den jeweiligen Bestimmungen des Landes durch qualifiziertes Fachpersonal erfolgen.
Verschūttete Flüssigkeiten: Das Gerät und/oder Zubehör sofort ausschalten.

3.2.4 Reinigung und Dekontamination der Geräte

Es liegt in der direkten Verantwortung des ANWENDER und nicht des Geräteherstellers, eine Dekontamination des Gerätes durchzuführen, falls sich toxische Substanzen im oder dem System befinde.
Reinigungs- und Dekontaminationsarbiten sind in der Bedienungsanleitung beschrieben.
Bevor Sie eine Reinigungs-bzw. Dekontaminierungsmethode einsetzen, die nicht vom Hersteller empfoohlem wird (vgl. Wartungshinweise dieser Bedienungsanleitung), sollten zusammen mit demhersteller sicherstellen, daβ diese Vorgehensweise da Systemnicht beschädigt.

3.2.5 Beeinträchtigung der Sicherheitseintichtungen.

Immer dann, wenn eine Beintrāchtigung der Sicherheit vorliegt, muβ dafür Sorge getragen

warden, daβ keine weitere unbefugte Bedienung des Gerātes oder des Zubehörs erfolgen kann unde der autoisierte Service-Ingenieur informiert wird.
Eine Sicherheitsbeintrāchtigung liegt z.B. dann vor, wenn nicht mehr die erwarteten Ergebnisse oder eine sichtbare Beschādigung vorliegen.
Wenn das Gerāt nicht gemass Spezifikationen des Herstellers eingesetzt, könnte die Sicherheit beeintrāchtigt werden

3.2.6 WEEE Konformität:

Dieses Produkt muss die EU Waste Electrical & Electronic Equipment (WEEE) Richtlinie 2002/96/EC erfūllen. Das Produkt ist durch folgendes Symbol gekennzeichnet:

Thermo Electron hat Vereinbarungen getroffen mit Verwertungs-/Entsorgungsanlagen in allen EU-Mitgliederstaaten und dieses Produkt muss durch diese Firmen wiederverwertet oder entsorgt warden. Mehr Informationen über die Einhaltung dieser Anweisungen durch Thermo Electron, die Verwerter und Hinweise die Ihnen nūtzlich sein kōnnen, die Thermo Electron Produkte zu identifizieren, die unter diese RoHS Anweisung fallen, finden Sie unter www.thermo.com/WEEERoHS.

3.3 Sécurité pour iCAP 6000

Lire attentivement cette page avant d'installer et d'utiliser l'instrument et ses accessoires. Les normes de sécurité contenues dans ce manuel sont conformes aux recommandations du «Health and security at work act 1974».

3.3.1 Introduction

L'instrument et les accessoires décrient dans ce manuel sont conçus pour être utiliser uniquement par un personnel proprement qualifié.
Le réglage, la maintenance et les réparations de l'équipement doivent être seulement réalisés par des ingénieurs de maintenance qualifiés qui connaissent les risques encourus.

3.3.2 Précautions de Sécurité

Pour un usage correct et sûr de l'instrument et de ses accessoires, il est essentiel que les utilisateurs et le personnel de maintenance suivent les procédures de sécurité généralement acceptées en plus des précautions spécifiques indiquées dans ce manuel.
Les indications et les symboles spécifiques de mis en garde et de précaution sont incluses dans les sections appropriées de ce manuel.
Les indications et les symboles de mis en garde et de précaution sont marqués sur l'instrument où cela est approprié. Ces symboles sont décris dans le tableau suivant :

	Jaune/Noir ou Rouge/Blanc	Avertissement : l'opérateur doit se référer à une explication dans la Documentation d'utilisateur.
	Blanc/noir	Terminaison de mise à la terre (masse)
	Jaune/Noir	Surfaces pouvant être brûlantes
	Jaune/Noir	Présence de tensions dangereuses. Manipuler uniquement par l'isolation. Ne pas toucher les extrémités.
	Jaune/Noir	Rayonnement de Radiofréquence, détails spécifiques de sûreté dans le manuel de l'utilisateur.

	Jaune/Noir	Le rayonnement ULTRAVIOLET, détails spécifiques de sûreté dans le manuel de l'utilisateur.
	Jaune/Noir	Ne pas retirer les panneaux de l'instrument ou l'ouvrir. Aucune pièce requière maintenance à l'intérieur.

Sauf indication contraire dans ce manuel, les panneaux de l'instrument et des accessoires doivent être seulement retirés par un ingénieur de maintenance proprement qualifié de Thermo Electron Corporation. Toutes les pièces de rechange et les articles consommables utilisés doivent être approuvés par Thermo Electron Corporation. Certains produits chimiques utilisés en spectrométrie sont corrosifs et/ou inflammables, et les échantillons peuvent être radioactifs, toxiques ou potentiellement contagieux. Les procédures et règlements normaux de laboratoire pour la manipulation de tels matériels doivent être observés.

3.3.3 Sécurité Electrique

Tous les équipements alimentés par un courant électrique sont conçus pour fonctionner avec une alimentation électrique avec prise de terre. L'équipement doit être raccorder à la terre, dans le cas contraire, la sécurité peut être compromise.
Suivre les règlements nationaux du pays d'utilisation lors de l'installation électrique. Un électricien qualifié doit être consulté.
Si un liquide est renversé ou est à proximité de l'instrument, isoler immédiatement l'instrument et les accessoires de l'alimentation électrique.

3.3.4 Nettoyage et Décontamination de l'Equipement

C'est la responsabilité de l'utilisateur de procéder au nettoyage et à la décontamination appropriés de l'équipement si des matériaux dangereux ont été renversés sur, ou dans, l'équipement.
Les procédures de nettoyage et de décontamination sont spécifiées dans les sections appropriées de ce manuel.
Avant d'utiliser toutes autres procédures, les utilisateurs doivent vérifier avec le constructeur que la méthode proposée ne peut pas endommager l'équipement.

3.3.5 Altération des Protections de Sécurité

Si jamais les Protections de Sécurité ont été altérées, l'instrument et les accessoires doivent être rendus inopérants et protégés contre toute utilisation involontaire. La cause du problème doit alors être communiquée au Service Après Vente le plus proche de Thermo Electron Corporation.
Les Protections de Sécurité sont susceptibles d'être altérées si l'instrument ne fonctionne normalement, ou montre des dommages évidents.
Les Protections de Sécurité peuvent être compromises si l'utilisation de l'équipement n'est pas conforme aux spécifications du fabriquant.

3.3.6 Conformité DEEE:

Ce produit doit être conforme á la directive européenne (2002/96/EC) des Déchets d'Equipments Electriques (DEEE). Il est marqué par le symbole suivant:

Thermo Electron s'est associé avec une ou plusieurs compagnies de recyclage dans chaque état membre de l'union européenne et ce produit devra être collecté ou recyclé par celles-ci. Davantage d'informations sur la conformité de Thermo Electron à ces directives, les recycleurs dans votre pays, et les informations sur les produits Thermo Electron qui peuvent aider la détection des substances sujettes à la directive RoHS sont disponibles sur www.thermo.com/WEEERoHS.

3.4 Regulatory Notices

The iCAP 6000 spectrometer and accessories are CE marked, indicating compliance with the following European Directives:

89/336/EEC Electromagnetic Compatibility Directive (EMC Directive)
72/23/EEC Electrical Equipment designed for use within certain voltage limits (Low Voltage Directive).

For further details, refer to the regulatory notice for the iCAP 6000 spectrometers and accessories, which is reproduced below.

3.5 Übereinstimmung mit Regularien

Alle Spektrometer der iCAP 6000 tragen das CE Zeichen und entsprechen damit den europäischen Regelwerken.

89/336/EEC Electromagnetische Kompatibilität (EMC)
72/23/EEC Elekrische Geräte, die für denEinsatz innerhalb bestimmter Spannungsgrenzen konsipert sind (Regularien zur minimalspannung)

Weitere Angaben über die oben genannten Standards finden Sie auf der nächstenSeite im Auszug aus den Regelwerken für die specktrometer der iCAP 6000.

3.6 Conformitè Normative

Tous les Spectromètres Série iCAP 6000 et accessoires sont marqués CE, indiquant leur conformité avec les Directives Européennes suivantes:

89/336/EEC Directive de Compatibilité Electromagnétique (Directive EMC).
72/23/EEC Equipement Electrique conçu pour une utilisation avec des limites de tension fixées (Directive Basse Tension).

Pour plus de détails sur ces normes, se référer à la notice de conformité fournie avec les spectromètres Série iCAP 6000, reprodute sur la page suivante.

4 EC Declaration of Conformity

EC DECLARATION OF CONFORMITY

No. : UIC080601

The undersigned, representing the following manufacturer

manufacturer :	Thermo Electron Manufacturing Ltd
address :	SOLAAR House, 19 Mercers Row, Cambridge CB5 8BZ, UK

herewith declares that the product

product identification :	iCAP 6000 Series Inductively Coupled Plasma Spectrometer System (6500 and 6300)

is in conformity with the provisions of the following EC directive(s)

reference no	title
73/23/EEC	Low Voltage Directive
89/336/EEC	EMC Directive

and that the standard(s) and/or technical specifications referenced overleaf have been applied.

Last two digits of the year in which the CE marking was affixed : 06

Place : Cambridge, CB5 8BZ, UK **Date :** 31st March 2006

Signature : M. P. Wassall

Name : Dr Michael P Wassall **Function :** Product Director

EC DECLARATION OF CONFORMITY

No. : UIC080601

References of standards and/or technical specifications applied for this declaration of conformity, or parts thereof :

- harmonized standards :

number	title	result
safety:		
BS EN 61010-1:2001	General Requirements	Pass
IEC1010-2-061:1995	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use	Pass
EMC:		
Conducted & Radiated Emissions		
EN61326	Conducted & Radiated Emissions	Pass
Methods:		
CISPR16	Conducted Emissions	Pass
CISPR16	Radiated Emissions	Pass
EN61000-3-3	Flicker	Pass
Immunity		
EN61326	Immunity	Pass
Methods:		
IEC1000-4-3	Radiated Field Immunity	Pass
IEC1000-4-6	Conducted RF Immunity	Pass
IEC1000-4-4	Electrical Fast Transients	Pass
IEC1000-4-2	Electrostatic Discharge	Pass
IEC1000-4-5	Surges	Pass
IEC1000-4-11	Voltage Dips & Interruptions	Pass
IEC1000-4-8	Power Frequency Magnetic Field	Pass

- other standards and/or technical specifications :

- other technical solutions, the details of which are included in the technical documentation or the technical construction file :

Other references or information required by the applicable EC directive(s):

The documentation relating to this declaration is on file.

Notices:

1. About the system: Use only with Thermo Electron approved computer and accessories
2. About Shielded Cables: Use only shielded cables supplied by Thermo Electron when connecting this instrument to the computer and other accessories

Compliance with the above notices is necessary to ensure that the appropriate radio frequency emissions will be maintained within the limits of the specifications referred to in this declaration.

5 Introduction to the iCAP 6000

5.1 Overview

The iCAP 6000 Spectrometer Series is a range of inductively coupled argon plasma optical emission spectrometers (ICP-OES) which use an Echelle optical design and a Charge Injection Device (CID) solid-state detector to provide elemental analysis.
Most samples are liquids that are pumped through a nebuliser to produce a fine spray. The large droplets are removed by a spray chamber and the small droplets then pass through to the plasma. The solvent is evaporated. The residual sample decomposed to atoms and ions that become excited and emit characteristic light which is measured, giving a measurement of the concentration of each element type in the original sample.
Control of the spectrometer is provided by PC based iTEVA software.
To avoid loss of analytical performance and compromising safety only Thermo Electron specified parts should be used.

5.2 System Configuration

iCAP 6300radial – standard gas box and radial plasma view optics
iCAP 6500radial – full mass flow control gas box, radial optics and enhanced software
iCAP 6300duo – standard gas box, axial and radial plasma view optics
iCAP 6500duo – full mass flow control gas box, axial, radial optics and enhanced software

The iCAP 6000 spectrometer consists of several major components:
an optical system; a radio frequency power generator; a CID detector with thermoelectric cooling; interlocks; a plasma torch and sample introduction parts.

6 Spectrometer Installation

To comply with safety and warranty requirements the iCAP 6000, accessories and associated equipment must be installed by a Thermo Electron trained and certified engineer.

6.1 Pre-installation Manual

Specific site requirements are required for the iCAP 6000. Please see the separate Pre-Installation Manual section.

6.2 Standard Sample Introduction Glassware Assembly

Warning: Appropriate care and safety procedures should be followed to avoid breaking any glassware and causing injury to the operator. Broken glassware should be handled with appropriate care.

6.2.1 Dual Torch Assembly

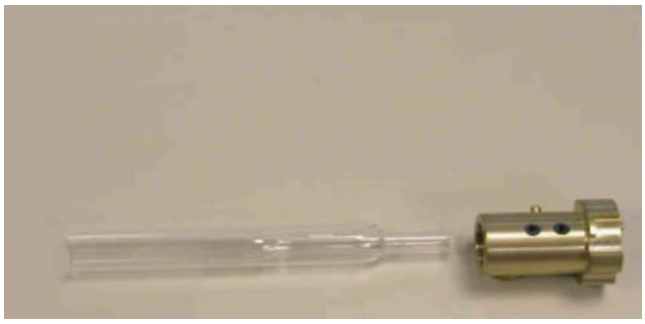
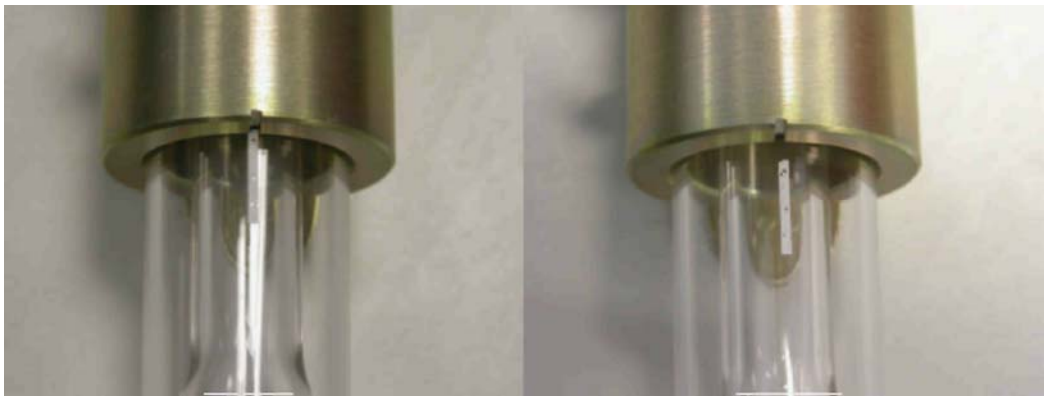


Figure 1 Dual Torch Assembly – Metal Torch Mount

The O-rings in the metal torch mount (internally and externally) should be inspected and replaced if any wear, or damage, is visible.

The quartz body of the torch should be pushed into the metal torch mount. Ensure the torch body is pushed **fully** into the metal torch mount. The marked line on the quartz torch is used to locate the radial view hole correctly and should touch the metal body.



Correct Incorrect

Figure 2 Torch Assembly – torch body

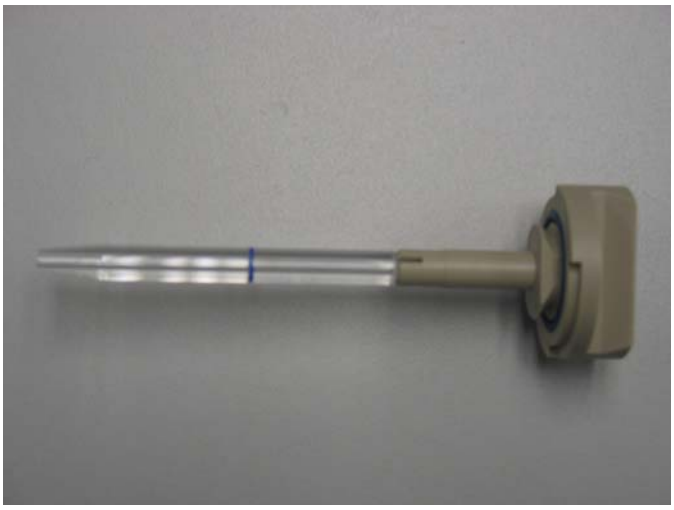


Figure 3 Torch Assembly – centre tube

Insert the centre tube (ground glass joint) **fully** into the plastic centre tube holder.

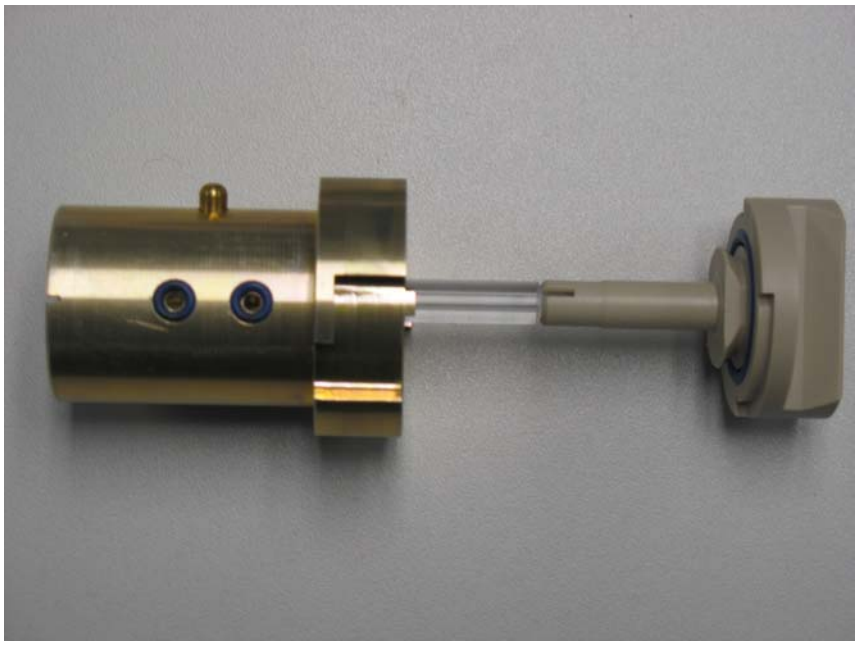


Figure 4 Torch Assembly – centre tube insertion

Insert the centre tube assembly into the metal holder.

Figure 5 Torch Assembly – centre tube insertion

Push the centre tube assembly **fully** into the metal holder and turn to lock into position.

Figure 6 Torch assembly holder

Make sure metal holder is turned and locked in position.

Figure 7 – Drain tubing

Cut the end of the drain tube capillary at an angle as shown.

Figure 8 – Spray chamber drain

Insert drain tube capillary until it meets the main chamber.

Figure 9 – Nebuliser to Spray Chamber Figure 10 – Nebuliser to Spray Chamber

The O-rings in the spray chamber should be inspected and replaced if any wear, or damage, is visible. Push the Teflon insert with the attached sample tubing (supplied with the nebuliser) into the rear of the nebuliser as far as possible without exerting undue pressure.
Using a twisting motion insert the nebuliser into the spray chamber so that the collar is a tight fit. The collar will set the insertion depth and aid reproducibility of results.

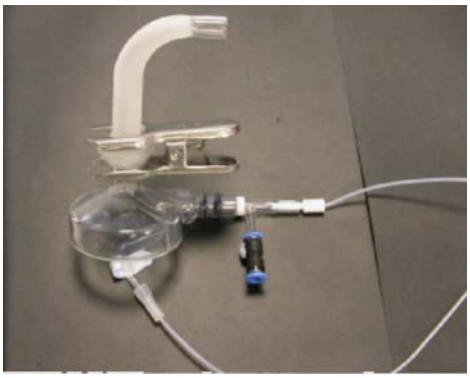


Figure 11 – Spray chamber assembly

Attach the swan neck fitting to the Spray chamber with the fitting clamp provided. The swan neck provided with the instrument is specially designed to prevent UV radiation from escaping from the torch box.

Figure 12 – Spray Chamber fitted

Insert swan neck fitting into torch assembly holder as far as it will go, and connect up the Nebuliser gas supply to the push-fit fitting.

Warning: It is extremely important that the correct Thermo part is used for the swan neck. In addition, systems interlocks on the torch holder and elsewhere are there for safety reasons and must not be bypassed. Operators could be exposed to dangerous UV and radio frequency radiation if alternate parts are used for the swan neck.

After assembly of the sample introduction system, a check for gas leaks at each joint should be undertaken. This may be done by dabbing with brush dipped in a solution of detergent in water or soap solution at each joint.

Figure 13 – Sample Capillary Tubing

Feed the sample capillary tubing from the rear of the nebuliser through the upper holder in the cover and towards the pump.

Ensure there are no twists or bends in the nebuliser and drain PTFE tubing that may prevent flow of the sample. Insert the sample and drain PTFE tubing into their respective Tygon pump tubing, making sure that the drain tubing is threaded through the lower hole in the case (see Figure 14 below) for the drain sensor to work correctly.

Please note: the drain tubing should be connected correctly to account for the counter-clockwise flow.

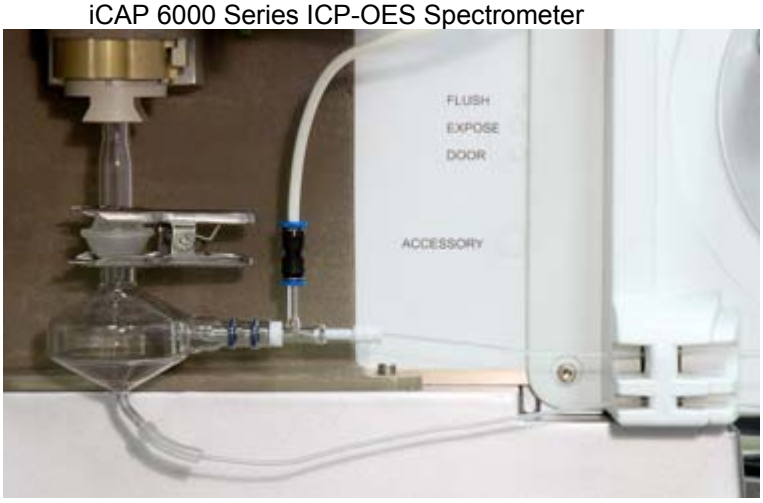


Figure 14 – Sample Capillary Tubing

Pass the drain capillary tubing through the lower holder in the cover and towards the pump. This holder contains a sensor detecting bubbles produced when the spray chamber is draining normally. The plasma and the pump will be switched off after 2 minutes if no bubbles are detected.

Figure 15 – Pump Tubing

Release the pump tubing clamps and locate the sample and drain pump tubing over the pump rollers, locking the lugs on the pump tubing into the left and right clamps.
Connect the sample pump tubing to the sample capillary tubing and the drain pump tubing to the drain capillary tubing; remember to allow for the direction of flow.
Pump tubing should be inspected before each analysis and should be replaced if there are indications of wear.
Additional lengths of capillary tubing should be used to allow connection to the input of the sample pump tubing to the sample and the output of the drain pump tubing to a waste container.

Figure 16 – Pump Tension Adjustment

The pump tension can be adjusted with the plasma running and the pump stopped. Lock the sample pump tubing and clamp into position. Release the tension adjustment and allow the nebuliser to free aspirate. Tighten the tension adjustment until the flow just stops then tighten by one turn. Turn on the pump and, if necessary, tighten the tension until a smooth flow is

produced. Do not over-tighten the pump clamps as it will result in excessive wear and tear of the pump tubing and require replacement tubing at more frequent intervals.

6.2.2 Radial Torch Assembly

Figure 17 Radial Torch Assembly – Metal Torch Mount

The O-rings in the metal torch mount (internally and externally) should be inspected and replaced if any wear, or damage, is visible.

Figure 18 Torch Assembly – torch body

The quartz body of the torch should be pushed fully into the metal torch mount.

Figure 19 Torch Assembly –spray chamber adaptor

Insert the spray chamber adaptor (ground glass joint) into the rear of the centre tube holder

Figure 20 Torch Assembly – centre tube

Insert the centre tube **fully** into the centre tube holder.

Figure 21 Torch Assembly – centre tube to torch mount

Insert the centre tube assembly into the torch mount assembly

Push the centre tube completely in and turn to lock into position.

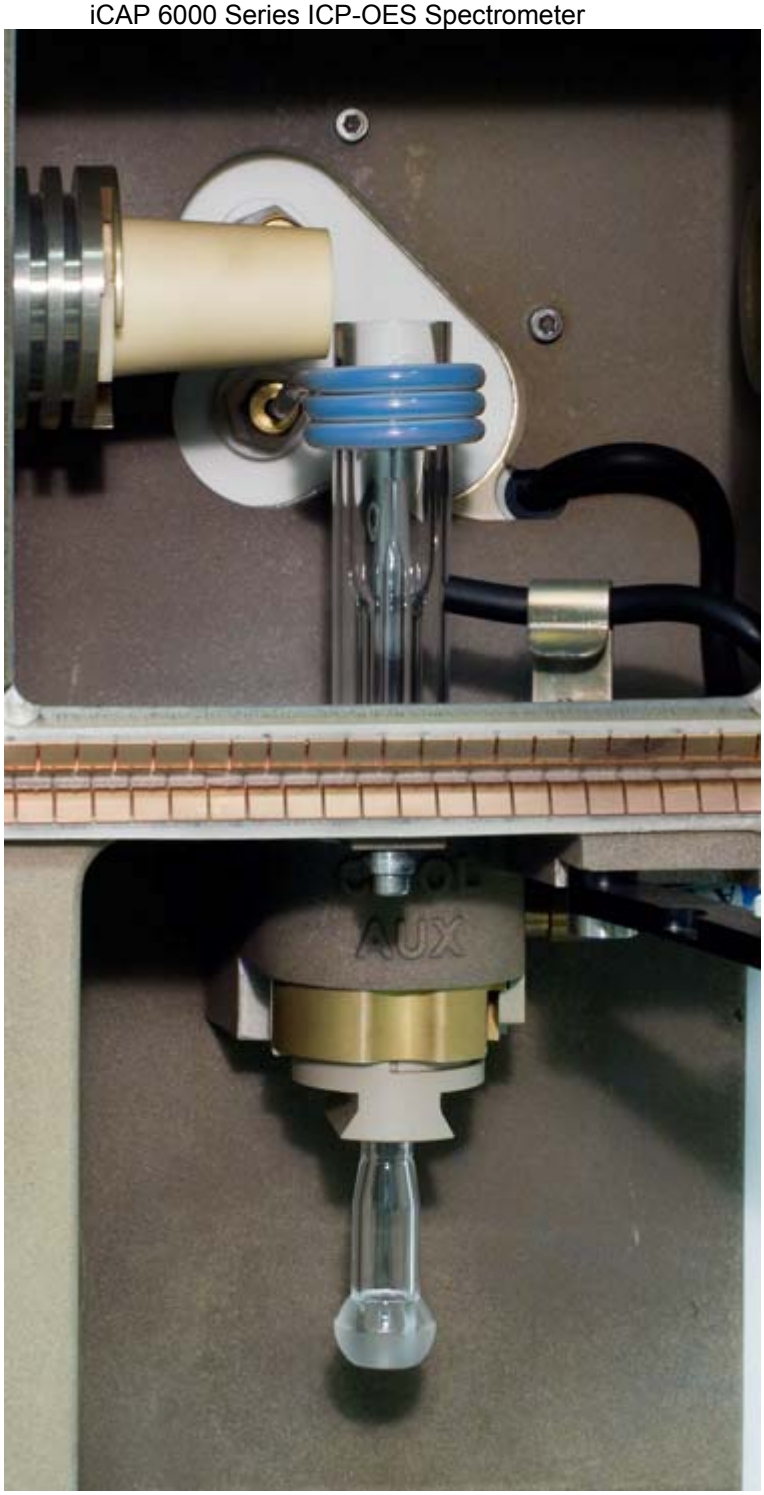


Figure 22 – Torch Holder

Push the torch assembly up into the holder and twist to lock.

Figure 23 – Cyclone Spray chamber

Attach the drain capillary tubing to the bottom of the spray chamber and the nebuliser gas tubing to the nebuliser via the push fit connector.

Figure 24 – Nebuliser to Spray Chamber

The O-rings in the spray chamber should be inspected and replaced if any wear, or damage, is visible.
Using a twisting motion insert the nebuliser into the spray chamber so that the spacing collar fits against the inlet. The collar will set the insertion depth and aid reproducibility of results.

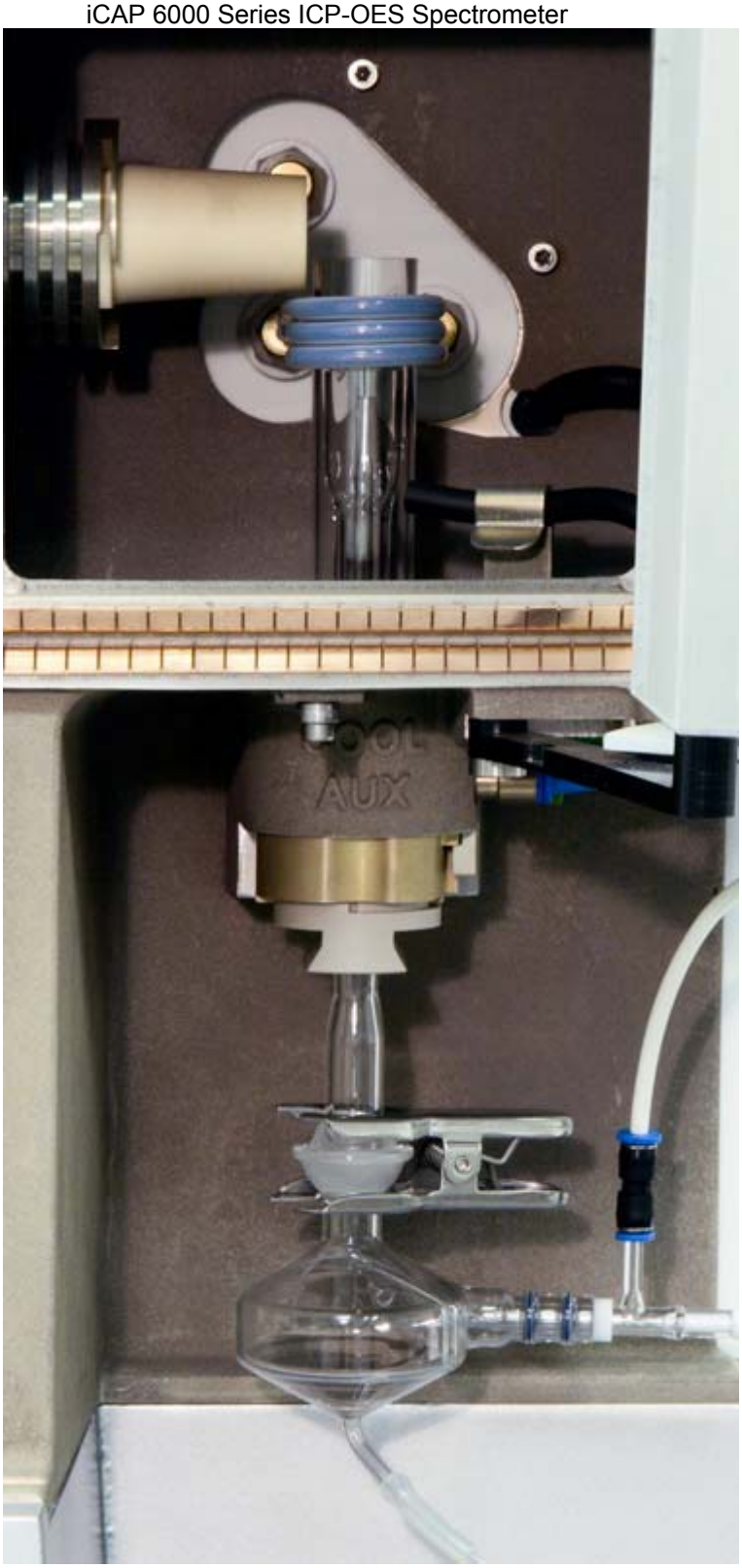


Figure 25 – Nebuliser sample tubing

Attach the sample tubing to the nebuliser using the Teflon insert.

Connect spray chamber and nebuliser assembly to the torch assembly, locked in the instrument, using the clamp.
The torch compartment door must be closed before use.

Warning: It is extremely important that the safety interlocks are not disabled. This could result in exposure to dangerous radio and UV frequency radiation.

After assembly of the sample introduction system, a check for gas leaks at each joint should be undertaken. This may be done by dabbing with a brush dipped in a solution of detergent in water or soap solution at each joint.

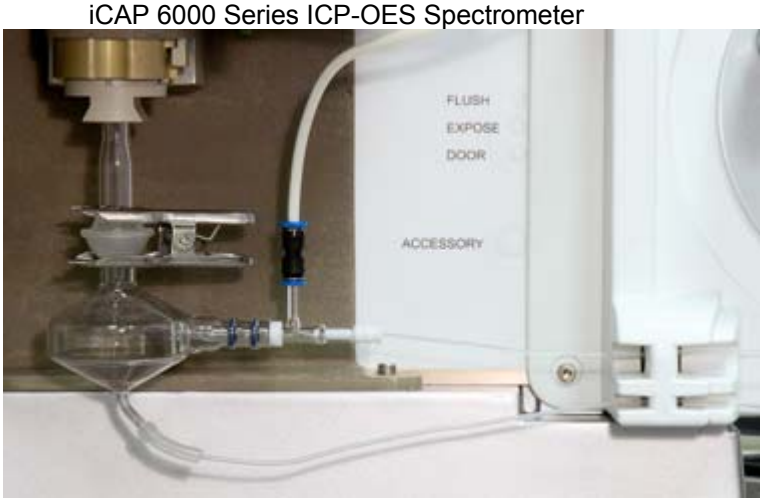


Figure 26 – Sample Capillary Tubing

Feed the sample capillary tubing from the rear of the nebuliser through the upper holder in the cover and towards the pump.

Ensure there are no twists or bends that may prevent flow of the sample.

Pass the drain capillary tubing through the lower holder in the cover and towards the pump. This holder contains a sensor detecting bubbles produced when the spray chamber is draining normally. The plasma and the pump will be switched off after 2 minutes if no bubbles are detected.

Figure 27 – Pump Tubing

Release the pump tubing clamps and locate the sample and drain pump tubing over the pump rollers, locking the lugs on the pump tubing into the left and right clamps.
Connect the sample pump tubing to the sample capillary tubing and the drain pump tubing to the drain capillary tubing; remember to allow for the direction of flow.
Pump tubing should be inspected before each analysis and be replaced if there are indications of wear.
Additional lengths of capillary tubing should be used to allow connection to the input of the sample pump tubing to the sample and the output of the drain pump tubing to a waste container.

Figure 28 – Pump Tension Adjustment

The pump tension can be adjusted with the plasma running and the pump stopped. Lock the

sample pump tubing and clamp into position. Release the tension adjustment and allow the nebuliser to free aspirate. Tighten the tension adjustment until the flow just stops then tighten by one turn. Turn on the pump and, if necessary, increase the tension until a smooth flow is produced. Do not over-tighten the pump clamps as it will result in excessive wear and tear of the pump tubing and require replacement tubing at more frequent intervals.

7 Sample Introduction System Set-up

7.1 Introduction

When a sample is aspirated and a proportion of the aerosol generated by the nebuliser is passed to plasma through the torch assembly, it generates a load on the plasma. The RF generator, the plasma conditions and the sample introduction system should be optimised for the particular sample and solvent type being introduced.

7.2 Centre tube Options

One of the options to alter the characteristics of the sample reaching the plasma is to use a different centre tube in the torch. The options are:
1.5mm quartz for aqueous solutions (single red ring)
1.0mm quartz for organic solutions (double red ring)
2.0mm quartz for high dissolved solids solutions (single blue ring, standard on Duo configurations)
2.0mm Ceramic for HF solutions

7

Figure 29 – Torch Centre Tube Options

7.3 Nebuliser Options

There are a variety of nebuliser options for the iCAP 6000. The use of each type is application and method specific, this is discussed below.
Control of the nebuliser pressure, or flow, is either through the control software or via a manual adjustment. The control is specific to the model of the iCAP 6000.

Figure 30 – Manual Control of nebuliser pressure

7.4 Peristaltic Pump Tubing Options

The iCAP 6000 requires pump tubing with two clamping points (two bridges).
Two types of tubing are available:
Tygon® for aqueous samples, strong acids and highly polar solvents (methanol and ethanol).
Viton® Rubber for low polarity solvents (alkanes, aromatics and halogenated hydrocarbons such as gasoline, kerosene, toluene, xylene, chloroform and carbon tetrachloride).

7.5 Internal Standards

An internal standard is a reference element that can be used to correct for changes in signal intensity caused external factors. By definition it should not occur naturally in the sample, but is added to compensate for sampling differences. It must behave the same as other elements requiring analysis in the sample.
The use of internal standards is not required for all types of analysis but is typically employed where fluctuations in sample loading of the plasma may vary. This is often caused by differing sample physical properties, for example viscosity, dissolved solids, surface tension or volatility.
Rather than adding an internal standard manually to all the solutions to be analysed it is possible to add it automatically on-line using the Internal Standards Kit.
To minimise sample dilution the tubing for the internal standard solution has a smaller bore than that of the sample solution.
To ensure a thorough mixing of the internal standard with the sample a mixing loop is provided after the Y-piece prior to connecting to the nebuliser.
Pump tubing for the internal standard kit should be installed in a similar manor to the sample tube and the correct tension set. Detailed instructions are given in Section 6.2.

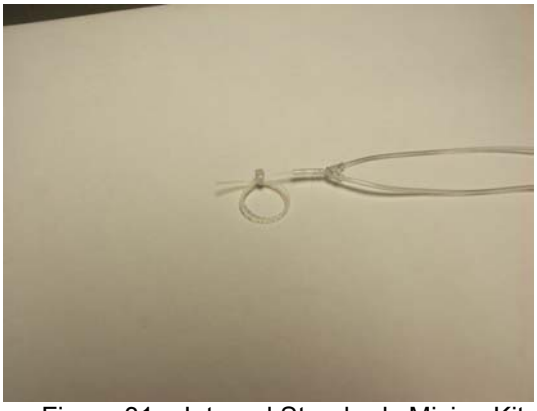


Figure 31 – Internal Standards Mixing Kit

7.6 Organic Solvent analysis

When an organic, rather than aqueous, solvent is used, the lower boiling point of the solvent leads to more sample and matrix loading of the plasma. This may impair the analysis, or even

extinguish the plasma.
A specific sample introduction system should be used for organic samples.

Warning: Organic solvents are a fire hazard and no build up is permitted in the sample introduction system, or vicinity.

7.6.1 Light Organic Samples

Figure 32 – Spray Chambers for aqueous and organic sample analysis

The organic sample spray chamber has a baffle tube inside. This will reduce the sample aerosol density; an organic centre tube is also used.

7.6.2 Heavy Organic Samples

Figure 33 – V-groove nebuliser for heavy organic sample analysis

In addition to the sample introduction options for light organic samples a quartz V-grove nebuliser is essential for heavy organic samples.
It is important to note that this design of nebuliser will not free flow. Flow rates must be carefully controlled by adjusting the pump speed.

7.6.3 Volatile Organic Samples

Figure 34 – Water cooled spray chamber for volatile organic samples

The analysis of highly volatile organic samples requires a temperature controlled spray

chamber, where the spray chamber is jacketed with a recirculating fluid that can maintain a temperature of about 4ºC. A separate chiller should be used; the chiller cooling the instrument is not suitable.

7.7 High Dissolved Solid Samples

A standard nebuliser maybe used in a wide range of applications. Samples containing raised levels of dissolved solids may cause the standard nebuliser to block. Cleaning a nebuliser is very difficult and should be done with great care.
To help prevent nebuliser blocking a variety of sample introduction accessories are available. These include: an Argon Humidifier; an AeroSalt Nebuliser; and a V-grove nebuliser.

7.7.1 Argon Humidifier

The argon supply to the nebuliser is first passed through a humidifier, where the nebuliser gas is bubbled through a small water reservoir (as below).
Humidified argon will permit the use of a standard nebuliser for samples with a dissolved solid content of up to 5% m/v.

Figure 35 – Argon Humidifier

Connect the 4mm nebuliser argon tubing to the inlet of the accessory ensuring that the in-line non return valve is fitted.
Connect the outlet of the accessory to the nebuliser with the 4mm tubing supplied.

Warning: The accessory is rated to a maximum pressure of 75psi and has an automatic overpressure safety valve fitted. Do not attempt to use inlet pressures greater than 65psi.

7.7.2 AeroSalt Nebuliser

Above 5% m/v dissolved solids in a sample will require the use of an AeroSalt Nebuliser. A high solids centre tube and argon humidifier should also be used.

7.7.3 V-Groove Nebuliser

Above 15% m/v dissolved solids in a sample will require the use of a V-groove nebuliser. A high solids centre tube and argon humidifier should also be used.

7.8 HF Samples

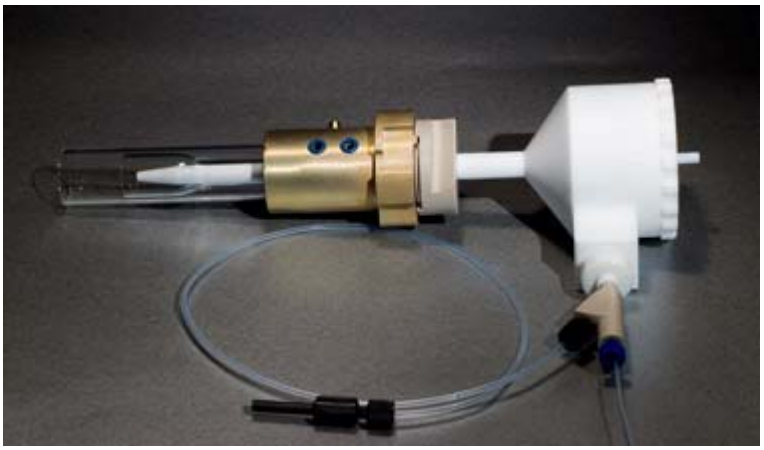


Figure 36 – HF Sample Introduction Configuration

For certain applications hydrofluoric (HF) has to be used to dissolve a sample. HF will react and dissolve the standard sample introduction glassware supplied with an iCAP 6000. Most of the glassware will have to be replaced with optional HF resistant components.
Replacing the components follows the same procedure as detailed for the standard sample introduction parts.
The components that must be exchanged are: Ceramic centre tube; HF resistant nebuliser: HF resistant spray chamber, with spray chamber adaptor.
There is a Duo and a Radial configuration HF Kit.

8 Autosampler Use

8.1 Introduction

The autosampler can be configured to suit an application, or several applications.
The volume, number and type of sample will all influence the set-up of the autosampler.

8.2 Autosampler Installation

To comply with safety and warranty requirements the iCAP 6000, accessories and associated equipment must be installed by a Thermo Electron trained and certified engineer.

8.3 Autosampler Set-up

Figure 37 Autosampler Tubing Set-up

For analysis with an autosampler the capillary tubing attached to the end of the autosampler probe should be attached to the end of the sample pump tubing on the iCAP 6000. To minimise the sample volume required the length of the capillary tubing should be minimised, but should allow free movement over the whole sample area of the autosampler.

9 Hydride Generation

9.1 On-line Hydride Generation Kit

The on-line hydride generation kit is used with the iCAP 6300 ICP spectrometer. It consists of two pump tubes linked to a Y-piece and mixing loop. Acidified sample solution and sodium borohydride solution are mixed in the loop to generate the hydride gases. The mixture is passed to the spray chamber where separation of liquid and hydride gases takes place.

9.1.1 Set Up

To ensure a thorough mixing of the internal standard with the sample a mixing loop is provided after the Y-piece prior to connecting to the nebuliser.
Pump tubing for the internal standard kit should be installed in a similar manor to the sample tube and the correct tension set. Detailed instructions are given in Section 6.2.

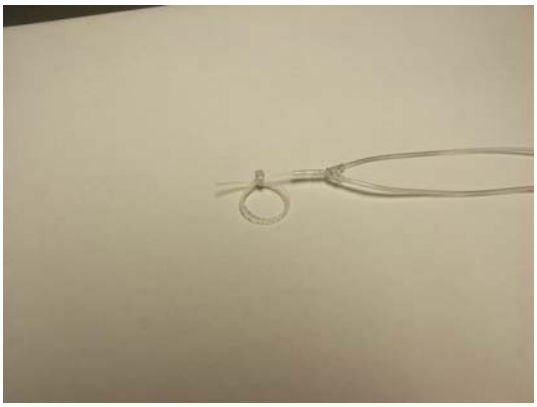


Figure 38 – On-line hydride generation kit with mixing loop

All standard and sample solutions must be acidified with 2-5% hydrochloric acid prior to analysis. A solution of 0.5% sodium borohydride prepared in 0.05% sodium hydroxide solution is used as the reducing agent.
Place the white/white pump tubing in the sodium borohydride solution, the orange/orange pump tubing is used for the sample and standard solutions.
For best plasma stability it is recommended that sodium borohydride and an acidified wash solution are pumped continuously between measurements.

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9.1.2 Optimisation

Ignite the plasma and set the following operating parameters using the plasma control dialogue:-

RF Power	1100w
Auxiliary Gas	0.5lpm
Nebuliser gas	0.18mPa
Pump Speed	45rpm

Aspirate a solution of 50 ug/L arsenic solution and check the signal in the subarray window. Compare the net signal intensity to the intensity of the background signal.
Vary the nebuliser pressure over the range 0.15-0.20mPa checking the signal to background ratio until a maximum is found. This will give a good compromise set of operating conditions. If better sensitivity is required for a particular element then that element should be used for optimisation.

9.2 Enhanced Hydride Generation Kit

The enhanced hydride generation accessory requires the use of a four channel sample pump and may only be used with iCAP 6500 instruments. It consists of an integrated acrylic reaction cell and gas/liquid separator for generation and separation of the hydride gases and is connected directly to the plasma torch following removal of the spraychamber.

Figure 39 – Enhanced hydride kit

9.2.1 Set Up

Assembly of Enhanced Hydride Generation Accessory for use with the iCAP 6500

- The unit is supplied with all the pump tubing connected.
- The user will need to attach the pump tubing to the peristaltic pump on the iCAP and set up the Gas Liquid Separator.
- The unit should sit comfortably in the kitchen area of the ICP (to the left of the peristaltic pump), and the lengths of Tygon peristaltic pump tubing supplied are sufficiently long so that the acid blank (orange/yellow) and reductant (black) pump tubing will go directly into their respective solution containers.
- The sample and drain Tygon peristaltic tubing are supplied connected to the Ultem sampling probe and 3mm ID PTFE drain tubing respectively.
- The Gas Liquid Separator needs to be prepared as described below before use.

Gas Liquid Separator (GLS)
When assembled, the Reaction Zone of the GLS contains 4mm glass beads, which minimise the dead volume of the zone and ensure proper mixing of the carrier gas and liquid reagents. It also contains a semi-permeable Teflon membrane to prevent moisture and salts from being carried over into the tube leading to the ICP torch. These parts are supplied with the unit, and must be fitted before the accessory is used.

To prepare the Gas Liquid Separator

1. Refer to the figure below, and unscrew the cap of the GLS.
2. Add a sufficient quantity of the 4mm glass beads supplied to fill the Reaction Zone. There should be no beads on the floor of the Expansion Volume (at the top of the reaction zone column).
3. Take care to prevent the glass beads from falling into the Drain, where they may cause blockage.
4. Take one of the 47mm Teflon membranes supplied. Orientate it so that the Teflon covered face is on the underside, and place it in position.
5. Carefully re-fit the 'O' Ring seal and cap, ensuring that the position of the membrane is not disturbed.

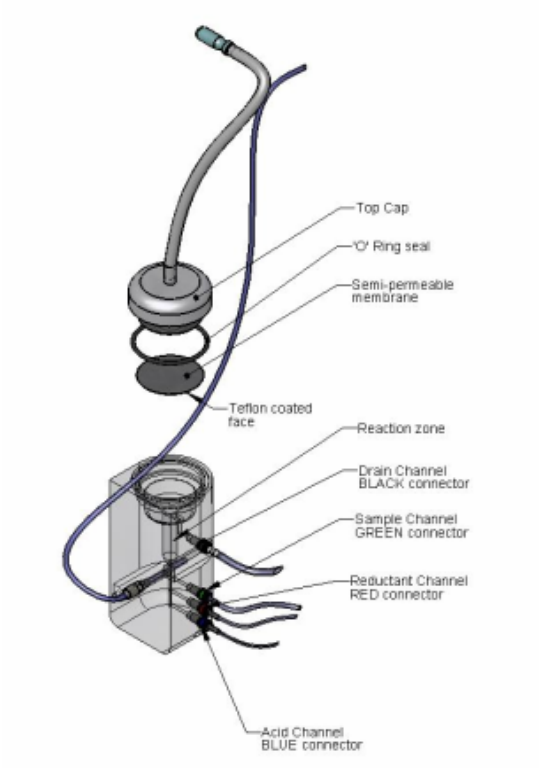


Figure 40 - Schematic of the Gas Liquid Separator

Pump Tubing
The unit is supplied with four types of pump tubing which fit onto the iCAP 6500 four channel peristaltic pump. The colours of the pump tubing bridges correspond to the colour coded connectors on the Gas Liquid Separator unit, as follows:

BLACK channel Drain
GREEN/YELLOW channel Sample
RED channel Reductant reagent
BLUE channel Acid reagent

Fitting pump tubing to the iCAP 6500 ICP Emission Spectrometer
(Please refer to the figure below as a visual aid)

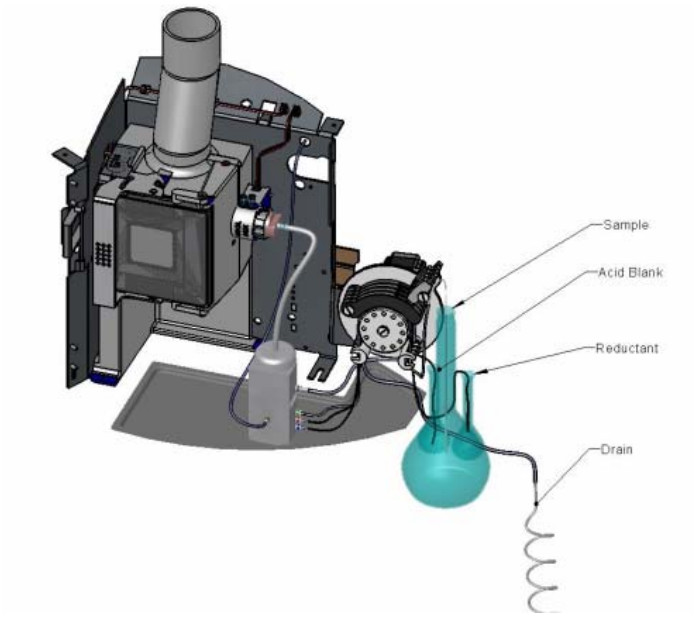


Figure 41 - Schematic of Assembly of Enhanced Hydride Generation Accessory

The peristaltic pump of the iCAP 6500 operates in an anti-clockwise direction.

- Place the GLS to the left of the pump, in the kitchen area.
- All of the pump tubing (with the exception of the drain) will attach with the inlet on the right hand side of the pump i.e. from the sample/reductant/acid blank solutions across the pump and into the GLS.
- The drain is the only tubing that needs to be connected in the opposite direction, i.e. the tubing is passed under the pump so that the drain outlet is on the left hand side.

Drain
The BLACK (Drain) channel must be fitted to pump tubing with BLACK/WHITE bridges i.e. a single piece of pump tubing will have a black bridge fitted at one end, and white bridge fitted at the other end. This tubing has an ID of 3.17mm and an OD of 4.85mm. It runs from the black connector of the GLS, across the peristaltic pump and to a drain. Connect a suitable length of the 1.6mm OD tubing, using the barbed connector supplied, from the end of the black/white pump tubing (at the peristaltic pump) to a suitable low level drain or wide necked plastic container. Please note that the drain tubing is connected anti-clockwise to the unit, to allow draining from the GLS.

Sample Uptake
The GREEN/YELLOW (sample) channel must be fitted to pump tubing with two GREEN bridges. This tubing has an ID of 1.85mm and an OD of 3.53mm. This pump tubing goes from the sample, across the pump to the Gas Liquid Separator.

Reductant
The RED (Reductant) channel must be fitted to pump tubing with two BLACK bridges. This tubing has an ID of 0.76mm and an OD of 2.43mm. This pump tubing goes from the reductant, across the pump to the Gas Liquid Separator. The PEEK barb is fitted with an additional piece of 1.6mm ID Tygon tubing, for easy connection to the peristaltic pump tubing.

Acid
The BLUE (Acid) channel must be fitted to pump tubing with YELLOW/ORANGE bridges. This tubing has an ID of 0.5mm and an OD of 2.33mm. This pump tubing goes from the acid, across the pump to the Gas Liquid Separator. The PEEK barb is fitted with an additional piece of 1.6mm ID Tygon tubing, for easy connection to the peristaltic pump tubing.

To fit the pump tubing:

1. Release the plungers to free the pump platens.
2. Take the pump tubing, and feed it around the pump rollers.
3. Stretch the pump tubing slightly, and fit the bridges under the bridge retaining pillars.
4. Push the ends of the tubing over the appropriate push on connectors on the Gas Liquid Separator connection panel.
5. Move the platen arm back over the rollers, and confirm that the tubing is properly located beneath it.
6. Return the plunger to the normal position, and adjust the pressure screw to release the pressure on the tubing.

Gas Supply
Connect a supply of argon (normally from the nebuliser supply on the front of the sample introduction area of the iCAP 6500), with the supplied 4mm o.d. rigid black tubing. The flow should be regulated between 0.4 – 0.6 lpm, to the gas inlet at the rear of the Gas Liquid Separator.

9.2.2 Optimisation

Ignite the plasma and set the following operating parameters using the plasma control dialogue:-

RF Power	1100w
Coolant Gas	14lpm
Auxiliary Gas	0.5lpm
Nebuliser gas	0.5lpm
Pump Speed	45rpm

Aspirate a solution of 50 ug/L arsenic solution and check the signal in the subarray window. Compare the net signal intensity to the intensity of the background signal.
Vary the nebuliser flow over the range 0.4-0.6lpm checking the signal to background ratio until a maximum is found. This will give a good compromise set of operating conditions.
If better sensitivity is required for a particular element then that element should be used for optimisation.

For each hydride group element, there is an optimum nebuliser gas flow rate that will give the maximum sensitivity for that element. For mercury, the analytical sensitivity increases as the Nebuliser gas rate decreases. Low Nebuliser gas rates require longer flush times (to allow the hydride to travel to the plasma), and, except for mercury, offer no benefits. Higher nebuliser gas flows allow the use of shorter flush times, at the expense of some analytical sensitivity, and can be used if you want to complete your analysis as quickly as possible.

The sample pump speed will also have an influence on the sensitivity. As the pump speed is increased, the analytical sensitivity increases, but so does the consumption of samples and reagents. The flush time required will be decreased at higher pump speeds. Reducing the pump speed reduces the reagent consumption at the expense of the analytical sensitivity and increased flush time. The default pump speed is 30RPM, and good results can be obtained with pump speeds up to 45RPM.

10 Ultrasonic Nebuliser

10.1 Introduction

Using an ultrasonic nebuliser can provide a 5 to 50 fold enhancement in detection limit performance, when compared to a standard sample introduction.

10.2 Ultrasonic Nebuliser Installation

To comply with safety and warranty requirements the iCAP 6000, accessories and associated

equipment must be installed by a Thermo Electron trained and certified engineer.

10.3 Ultrasonic Nebuliser Set-up

Locate the Ultrasonic nebuliser accessory on the bench to the right of the iCAP 6000 ICP Spectrometer.
Remove the cyclone spray chamber, concentric nebuliser and associated pump tubing if fitted. Refer to section 6.2 for removal instructions.

Connect the iCAP 6000 sample pump tubing to the sample capillary tubing of the ultrasonic nebuliser, figure 26.

Figure 42 – Ultrasonic Nebuliser Sample Tubing Set-up

Use the 4mm argon tubing supplied with the accessory to connect the nebuliser outlet of the iCAP 6000 with the inlet on the rear panel of the ultrasonic nebuliser, figure 27.

Using the adaptor provided with the accessory connect the sample outlet from the ultrasonic nebuliser to the plasma torch. Push the adapter firmly into the base of the torch until it “bottoms out” to prevent leaks, see figure 44.

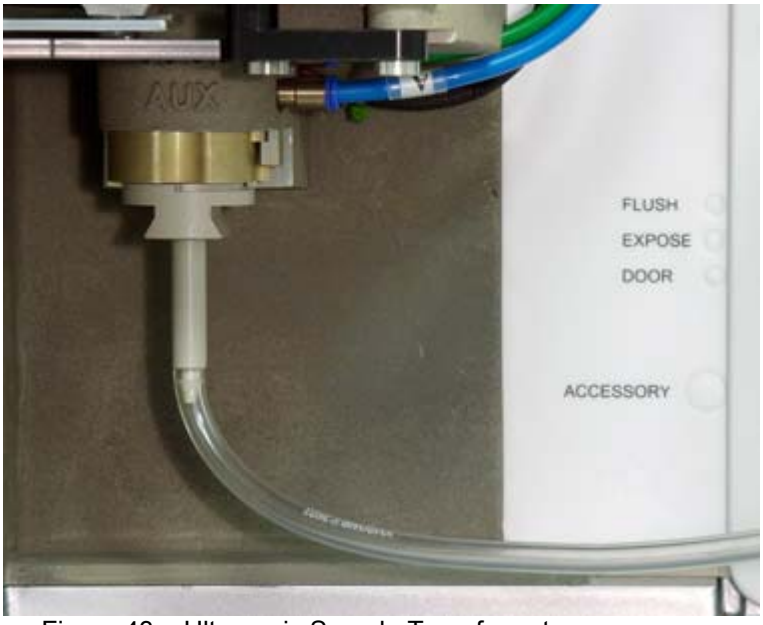


Figure 43 – Ultrasonic Sample Transfer set-up

Place the three drain tubes from the outlet of the pump on the rear panel in to a suitable waste container.

11 System Operation

11.1 Introduction

The iCAP 6000 is designed to be constantly powered up and the optical system continuously purged.
The instrument is powered via an on/off switch at the rear of the left side.

Figure 44 – iCAP 6000 Power On/Off

11.2 Preparing the System for Use

If the gas supplies have been switched off, the optical components should be purged for at least one hour before powering the instrument.
If the instrument is switched off, allow at least two hours after restoring power to thermally stabilise the instrument before the chiller is turned on.
A blank sample should be aspirated for ten minutes to allow the instrument to fully stabilise before analysis.

11.3 Instrument Shut-down

After an analysis is finished a blank sample should be aspirated for five minutes to insure the sample introduction part have been rinsed of sample. To remove the blank sample deionised or distilled water should be aspirated for a further minute.
When organic solvent based samples are being analysed the final rinse should be the pure solvent. Air should be aspirated for two minutes to remove organic vapours.
After completing the above the plasma should be turned off. The optical components will move to a parked position after about thirty seconds.
Allow five minutes after switching off the instrument, or accessories, before disconnecting the electrical power or other supplies.

12 Instrument Optimisation

12.1 Introduction

The iCAP 6000 will require optimisation that is dependent on the sample being analysed and the method requirements.
It is important that the method development verifies the data produced by the method.
It is also important that a suitable quality control regime is established that verifies the

continuing validity of data.
Training courses are available through a local Thermo Electron Sales Office; contact details are available on http://www.Thermo.com.

12.2 Method Optimisation

The following parameters can all affect the data obtained and should be optimised. Usually a default setting will give data that is satisfactory, but may not be optimal for the analysis requirements:
Nebuliser Gas flow
Plasma viewing height
RF Power
Pump speed
Auxiliary gas flow
Coolant gas
All these instrument parameters are separate to the development of the chemical requirements of the method, for example variation in sample ionisation and solvent effects.

12.3 Example Standard Operating Procedures

This method setup procedure, which by no means covers all the possible parameters used in iTEVA, should be enough for setting up a basic Analysis. It is recommended that the user reads the iCAP software manual for more advanced use of the system.

12.3.1 Preparing the system

Turn Argon Gas on at Cylinder and set for 90psi pressure on gauge near instrument **Note: for normal use gas should be left purging constantly**
Switch on power to iCAP Spectrometer. **Note: for normal use power should be left on constantly**
Switch on Water Chiller
Push Platen on to rollers of pump by way of the 4 (3) pressure screws
Make sure the drain tube is placed in an open neck vessel
Place sample tube in a blank solution
Switch on computer

iTEVA

Click on the **iTEVA** Icon on desktop	
Type **admin** in user name field	

12.3.2 Striking the Plasma

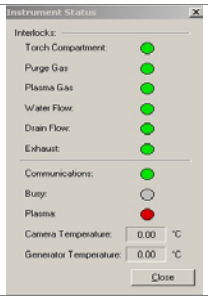
Click on the Plasma Icon and then make sure the interlock indicators all show green, click on **Plasma On**. When the plasma strikes click on the close box

Note: To allow the plasma to stabilise leave Plasma on with blank solution running for about 10 minutes before carrying out an analysis.

Plasma Status

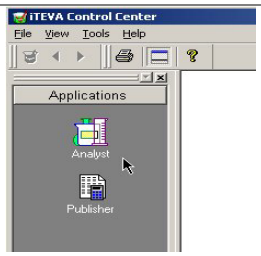
			Instrument Status
RF Power:	0	750 - 1600 W	—
Pump Rate:	0	0 - 125 rpm	0
Aux. Gas Flow:	0.0	0.0 - 2.0 L/min	—
Neb. Gas Flow:	0.00	0.00 - 1.50 L/min	0.00
Coolant Gas Flow:	0	10 - 20 L/min	—
Additional Gas Flow:	0.00	0.00 - 1.00 L/min	—
Purge Gas Flow:	Trickle		Trickle

Plasma ●
Interlocks ●

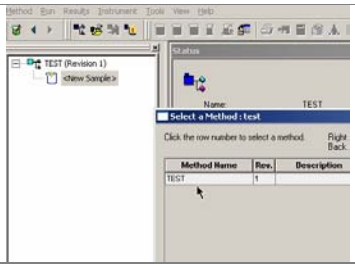


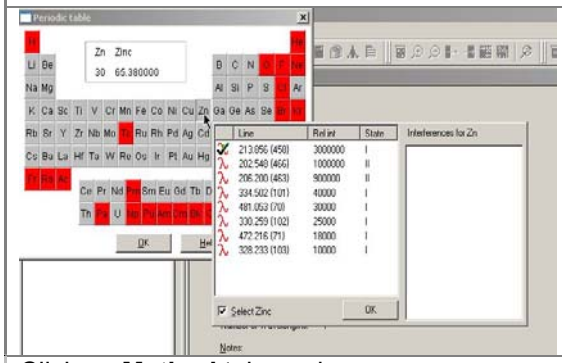
12.3.3 Setting up Analyses

Click on the Analyst icon



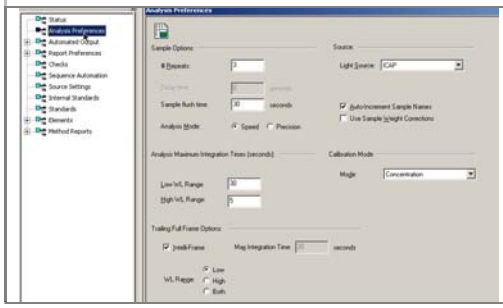
Either select one of the stored methods or create a New method. To create a new method click on Cancel





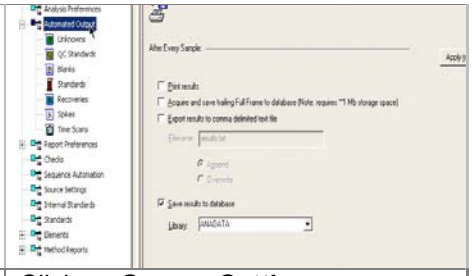
Click on the **Method** drop down menu
Click on **New** and select the Elements required from the Periodic table.
To select suitable lines from the list displayed click **OK** and **OK** again

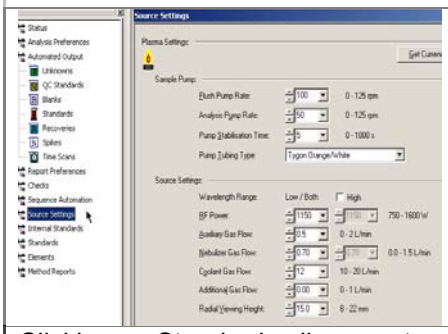
Click on **Method** tab as shown



Click on **Analysis Preferences**
Set Parameters as required (see iTEVA software manual for fuller explanation of the various parameters that can be selected)
Note: The parameters shown will be a good starting point for an Analysis

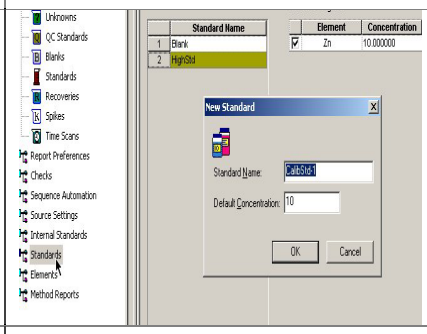
Click on Automated Output and fill in the relevant boxes
Note: Make sure you tick **save results to database** if you require a record of your results





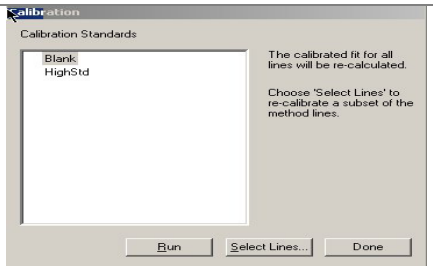
Click on **Source Settings**
Note: the source settings will depend on the particular analysis that is to be performed but for test purposes the defaults should give reasonable results for an aqueous solution.

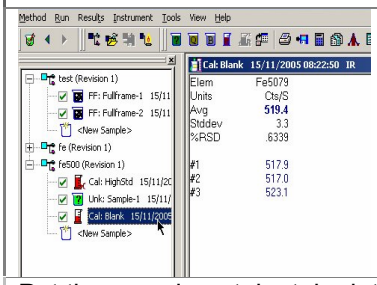
Clicking on Standards allow you to edit the concentration of the standards in the box.
Note: by clicking on **Add** you can add more standards if required.



12.3.4 Running the Analysis

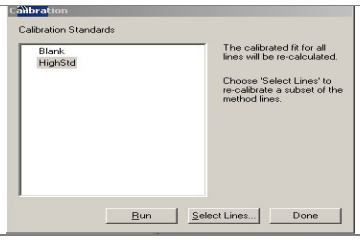
Put the sample uptake tube in the blank solution. Click on the Analysis tab and then click on the Calibration Icon, click on **Run** in the Calibration box this will then analyze the blank solution

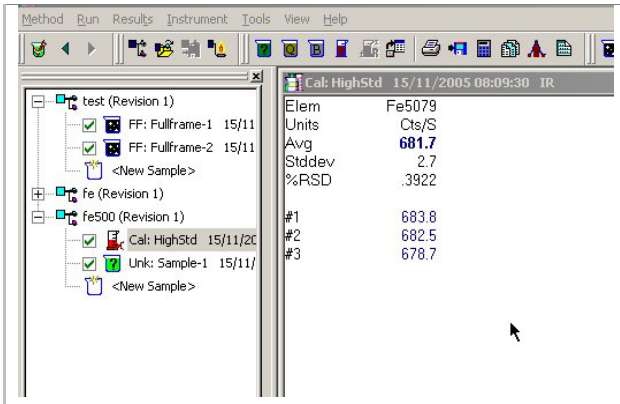




Display of Blank solution results showing the Elements selected in the method setup.

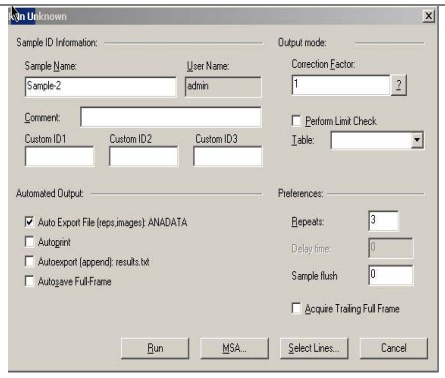
Put the sample uptake tube into the High standard solution
The **HighStd** is now highlighted so click on **Run**

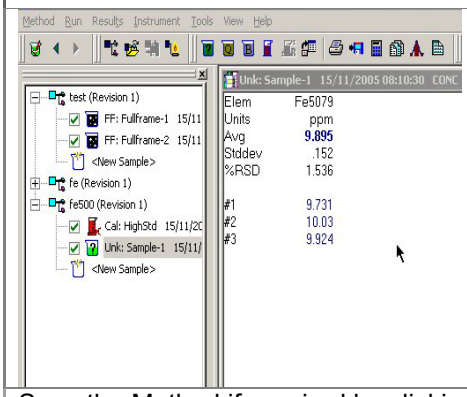




Display of High Std results showing elements selected in the method setup.

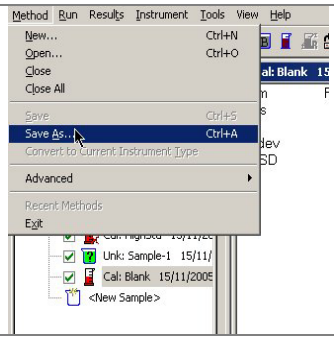
Click on **Unknown** sample Icon then fill in **Run Unknown** box as required Place the sample tube in unknown and Click on **Run**





Display of the Results page

Save the Method if required by clicking on **Method** drop down menu and **Save As,** filling in the appropriate name.



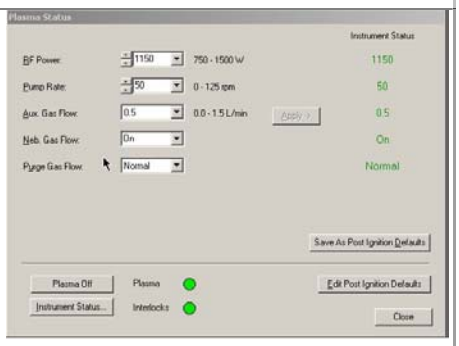
12.3.5 Shutting down the system

Place the sample tube in Deionised water and let it pump through the system for 3 to 5 minutes.

Click on the Plasma Icon 
and then click on **Plasma Off.**

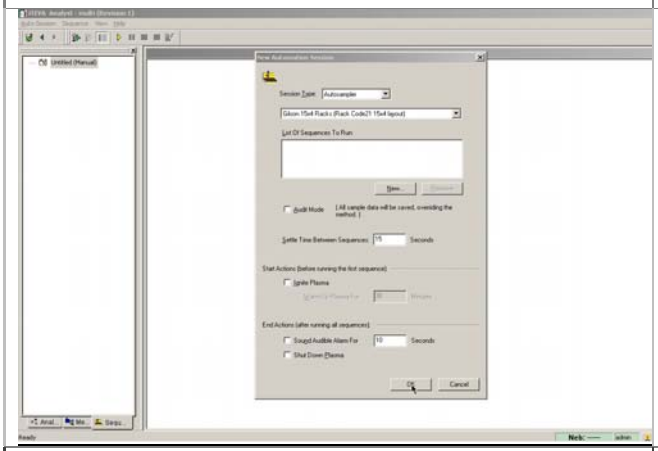
Release the tension on the sample pump Platen.

Switch off water circulator.



12.3.6 Autosampler Operation

Click on Sequence tab at bottom of page

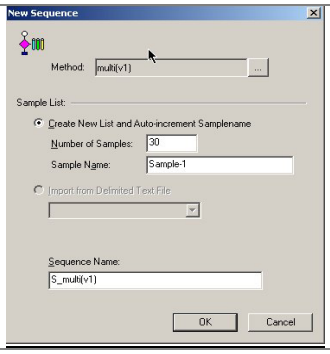


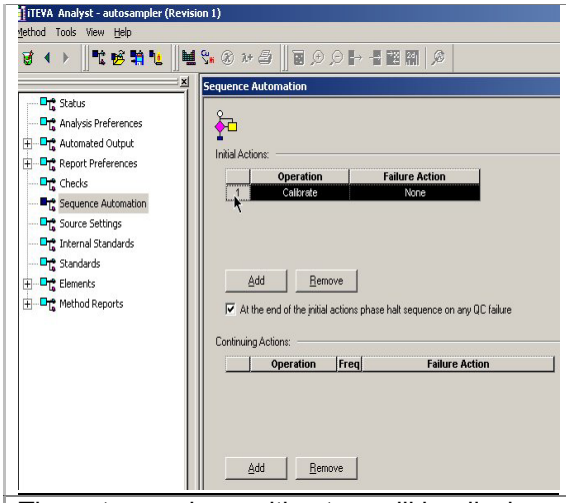
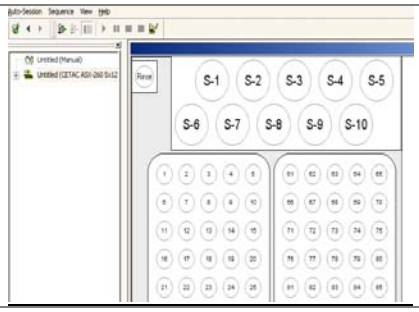
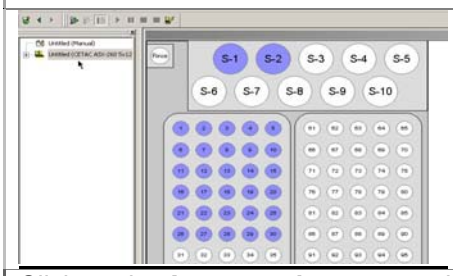
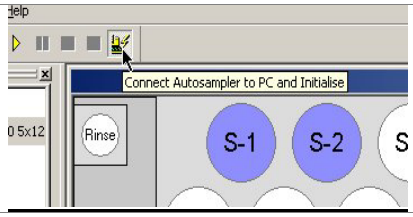
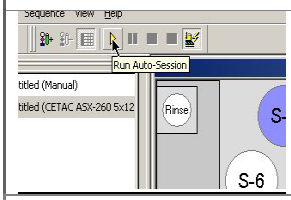
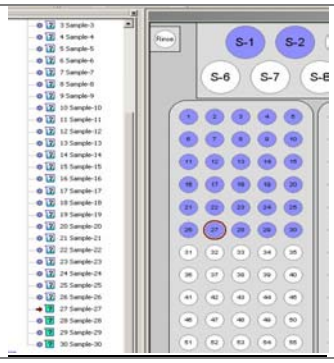
Select **New Autosampler** on the **Auto-Session** Menu. This will pop up the dialog box shown.

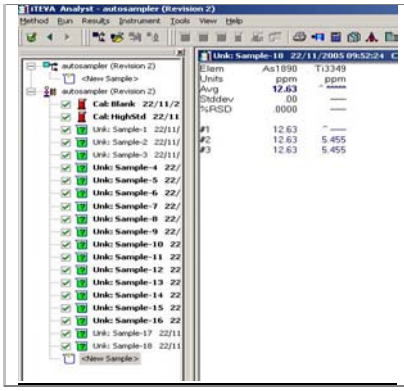
Select the Autosampler rack type from the drop down box. Click on OK

Select **New** this will enable you to select an already saved method to run the Autosampler.

Input the number of samples, and a sample name as required. Click on OK and OK again

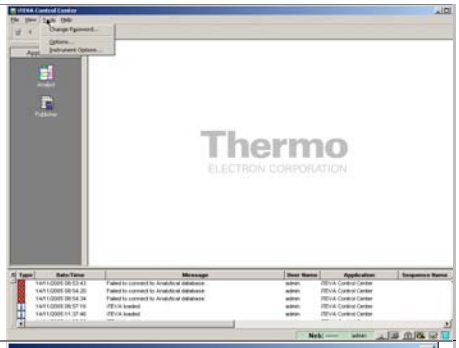


	Make sure the saved method has a Calibration routine selected in the AUTOMATION PARAMETERS SEQUENCE page. Note: The sequence Automation page must be edited and method saved before running samples with the autosampler.
The autosampler position tray will be displayed.	
	Right click on the session name and select **Auto-Locate** this will then highlight the sample and standard positions. Note: Make sure the Plasma is ignited
Click on the **Autosampler connect** icon as shown.	
	Click on **Run icon**
Image of Autosampler showing progress of sample run.	

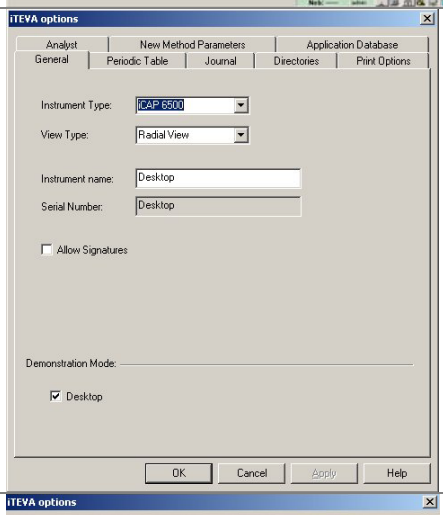
	Results as shown on Analysis page

12.3.7 Local Database Creation

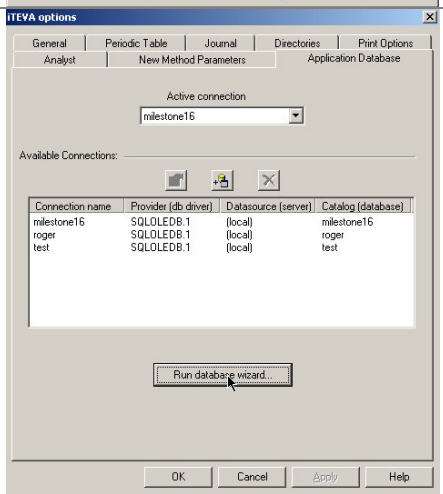
- Click on *TOOLS/OPTIONS* on iTEVA control panel.



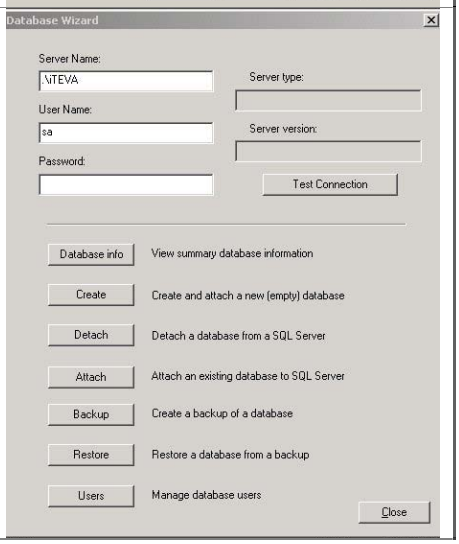
- Click on *Application Database* Tab



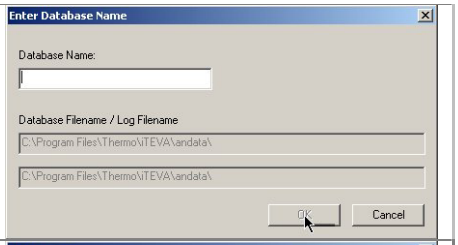
- Click on, *Run database wizard* box



- Type .\iTEVA in Server Name box
- Type *sa* in User Name box
- Type *teva* in Password box
- Click on *Test connection* box
- This should fill in the Server type and Server version boxes
- Click on *Create* box

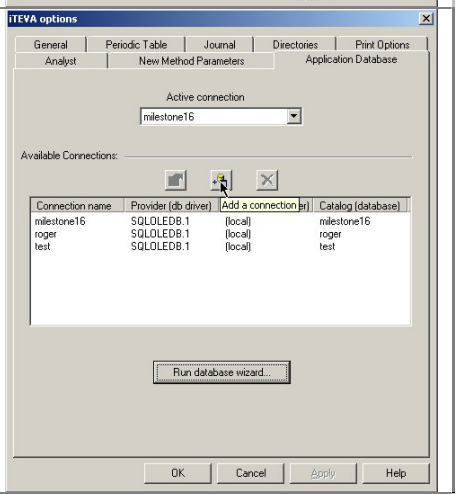


- Enter required name for Database click OK and click on close box

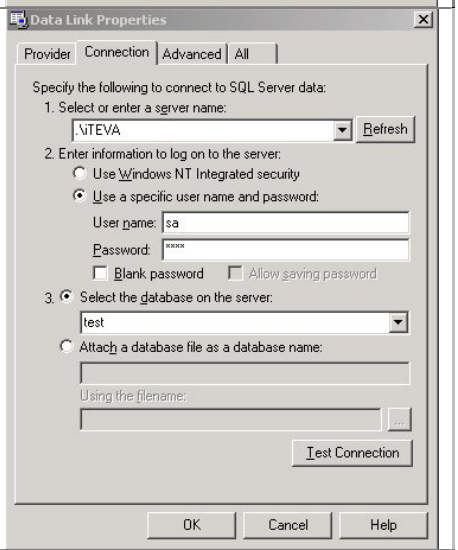


12.3.8 Creating a Database Connection

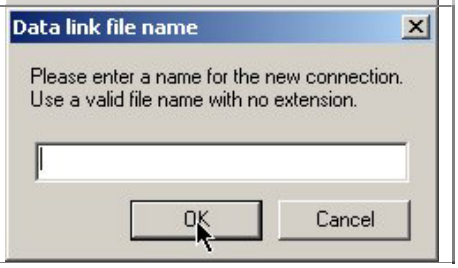
- Click on the *add a connection* box as shown



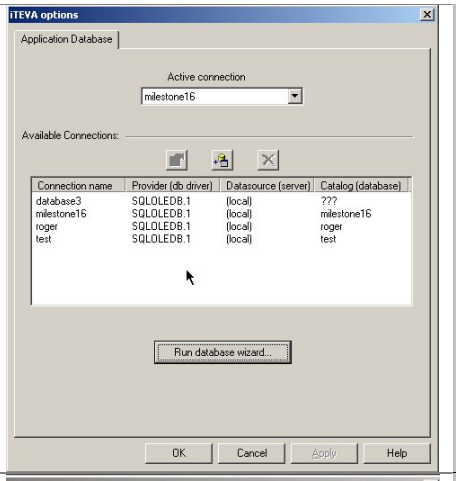
- Type .\iTEVA in server name box
- Type *sa* in User name box
- Type *teva* in Password box
- From the, *Select the database on the server* box choose the Database required
- Click on *test Connection*
- Click OK



- Follow instructions on box shown, fill in an appropriate name.

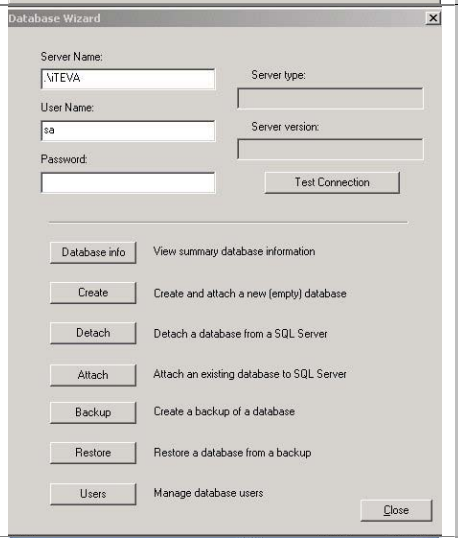


- The newly created database will now appear in the list of databases
- Select the created database form the *Active connection drop down box and click on OK*
- This will now make the new database active

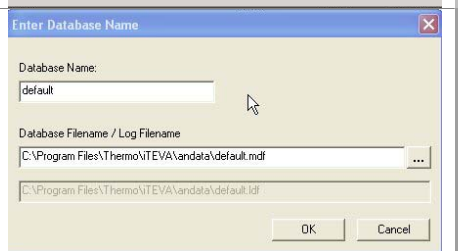


12.3.9 Attaching a database

- After running data base wizard click on *Attach*

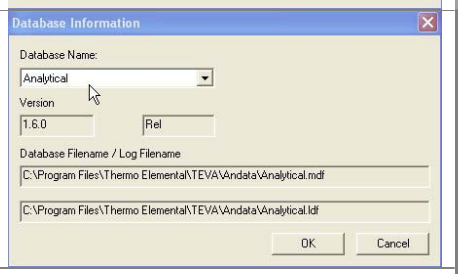


- Click on *Database Filename/Log Filename*
- *Select database to Attach*
- *Click on OK*
- *Database will now be attached*



12.3.10 Detaching a database

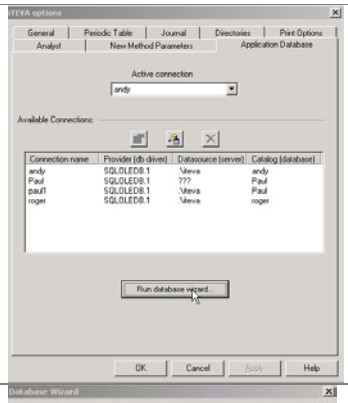
- Carry out the same procedure as Attaching a Database but click on Detach in the Database Wizard



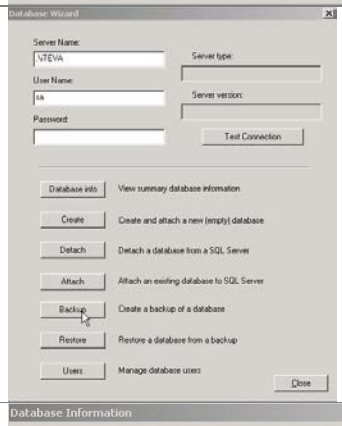
Note: The maximum database size is 4Gb. A new database must be created before this limit is reached.

12.3.11 Backing up databases

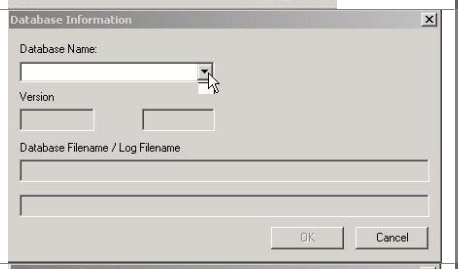
- Click on, *Run database wizard* box



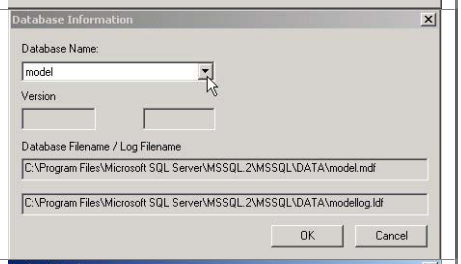
- Type .\iTEVA in server name box
- Type *sa* in User name box
- Type *teva* in Password box
- Click on *Backup*



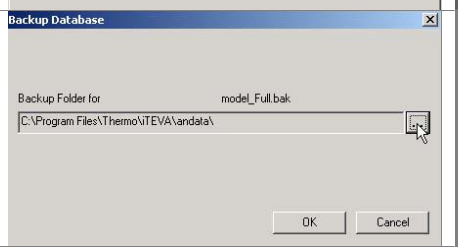
- Select database name from drop down list



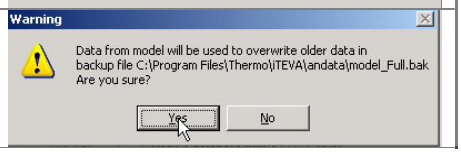
- Click OK



- Choose path for Backup and click OK

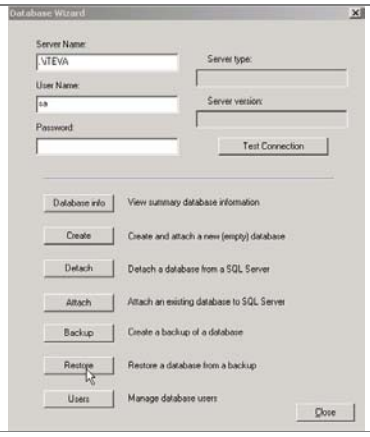


- Click Yes
- Backup is now complete



12.3.12 Restoring a database

- From Data base wizard select *Restore* and carry out the same procedure as *Backup* database above



13 Technical Specification

The technical specification is attached at the end of this manual.

14 Maintenance

14.1 Introduction

The iCAP 6000 has been designed for minimum maintenance; however the sample introduction components should be checked regularly for contamination and wear.

14.2 User Maintenance

Routine operator maintenance of the iCAP 6000 is mainly concerned with keeping the instrument clean.

14.2.1 Instrument Cleaning

'Before using any cleaning or decontamination methods except those specified by the manufacturer, USERS should check with the manufacturer that the proposed method will not damage the equipment.'

Warning: The iCAP 6000 instrument covers are made of ABS plastic materials, which can be damaged by strong solvents and concentrated acids.

Any spillage on the external covers or within the sample introduction areas should be cleaned up immediately, using appropriate safety precautions.
Stains and marks on the covers should be removed with a soft cloth moistened with a dilute detergent solution. Do not use any solvent based cleaners.

14.2.2 Sample Introduction System Cleaning and Decontamination

Failure to maintain the sample introduction system can result in erroneous results, poor precision, poor detection limits and blockages.
After use, the instrument shut down procedures should be followed.
Components contaminated with sample residues should be cleaned.
It is recommended that several spares for each part are available as blockages, sample contamination and breakages often happen at critical moments during analysis.
Suitable protective clothing, glasses and gloves should be worn.

14.2.2.1 Torch Cleaning

Reverse the torch assembly process detailed previously.

Warning: Allow at least 10 minutes for any hot components to cool before removing them from the torch compartment. Care should be taken to remove any broken glass from the Duo radial POP window, if a breakage occurs in the torch box.

To remove salt deposits wash the torch in an ultrasonic bath for five minutes in a dilute

surfactant.
To remove metallic deposits from the tip, separate the torch quartz section, immerse the tip of the torch in hot acid (a mixture of nitric and hydrochloric similar to Aqua Regia is suitable)
After cleaning, rinse the torch with de-ionised water and place in a drying oven at 95º until it is dry. Rinsing with a volatile zero residue organic solvent (propanol is suitable) will aid drying.
To clean the torch of carbon deposits, place the torch in a muffle furnace and heat to 750º.
Open the door for a few seconds to allow air to enter, close and allow the oven to reach 750º again. Repeat this several times to remove all the carbon. Allow the furnace to cool over several hours, as this will prevent stress building up in the quartz.

14.2.2.2 Spray Chamber Cleaning

Reverse the spray chamber assembly process detailed previously.
Soak the spray chamber in cold acid for two hours (a mixture of nitric and hydrochloric similar to Aqua Regia is suitable). After cleaning rinse the spray chamber in deionised water.

14.2.2.3 Nebuliser Cleaning

Reverse the nebuliser assembly process detailed previously.
Introduce a rinsing agent into the gas input and fill all areas previously exposed to sample solutions, a squeeze bottle is suitable for this. Attach a low pressure clean gas line to the nebuliser gas inlet to expel the liquid. Repeat several times.

Warning: On no account put the concentric nebuliser in an ultrasonic bath or heated in an oven.

14.3 Purged Optical Path Window Cleaning

Before attempting to clean the Purged Optical Path (POP) window (note: there are two on a Duo configuration instrument) turn off the plasma and allow thirty minutes for any hot areas to cool down.
Open the small access door next to the sample compartment door and withdraw the POP window assembly.

Warning: do not open this access door when the plasma is running, there is a potential UV radiation hazard.
All mirrors in the optical system are coated do not to touch the mirror below the radial view POP window in the Duo configuration.

Remove the quartz window from the POP and soak in cold acid for two hours (a mixture of nitric and hydrochloric similar to Aqua Regia is suitable). After acid soaking rinse in de-ionised water, then with a volatile zero residue organic solvent (propanol is suitable) to aid drying.

14.4 Preventative Maintenance

The iCAP 6000 has been designed for minimum maintenance; however periodic checking of performance is required by many laboratories. This is particularly important for customers subject to external standards and regulations (for example ISO9000, EPA or NAMAS). Details of these options are available from a local Thermo Electron Office.
All electrical supplies, gas supplies and extraction must be checked to insure local health and safety guidelines and regulations are complied with. The gas and cooling water should be checked for leaks at regular intervals.

15 Optional hardware

15.1 Additional Gas Accessory

This accessory must be factory fitted and ordered at the time of purchase of the iCAP 6000. It provides the ability to add an additional gas to the plasma to modify the source conditions. For example air or oxygen can be added to the auxiliary or nebuliser gas to prevent the build up of carbon and reduce the background signals when analysing organic solvents. For best performance it is recommended that the addition is made to the auxiliary gas in preference to the nebuliser gas.

Disconnect the green auxiliary gas tubing at the bulkhead on the torch box by depressing the red collar while simultaneously pulling on the tubing.
If the gas is to be added to the nebuliser line then disconnect the nebuliser tubing at the

bulkhead in the rear of the sample compartment.
Install the short length of 6mm tubing and supplied T-piece into the gas connection point and then connect the other side of the T-piece to the Additional Gas connection on the rear panel of the sample compartment with another piece of 6mm tubing.
Finally complete the installation by connecting the remaining arm of the T-piece to the auxiliary or nebuliser gas tubing that was removed initially.

Figure 45 Additional Gas Accessory Aux Gas Connections

Warning: Appropriate precautions that are dependent on the gas used should be followed. These precautions must comply with local and national safety requirements and guidelines.

15.2 Accessory Interface Kit

This accessory must be fitted by Thermo Electron. It provides control for a variety of optional accessories such as the Separate Sample Excitation Accessory or Laser ablation unit. These accessories and associated equipment must be installed by a suitably trained, and certified, engineer approved by Thermo Electron.

When Installed the interface kit provides additional connections for communications and control on the rear panel of the sample compartment (see Figure 47, below).
Installation and operating instructions for accessories requiring the accessory interface kit are included with the accessory.

Figure 46 Accessory Interface Kit Connections

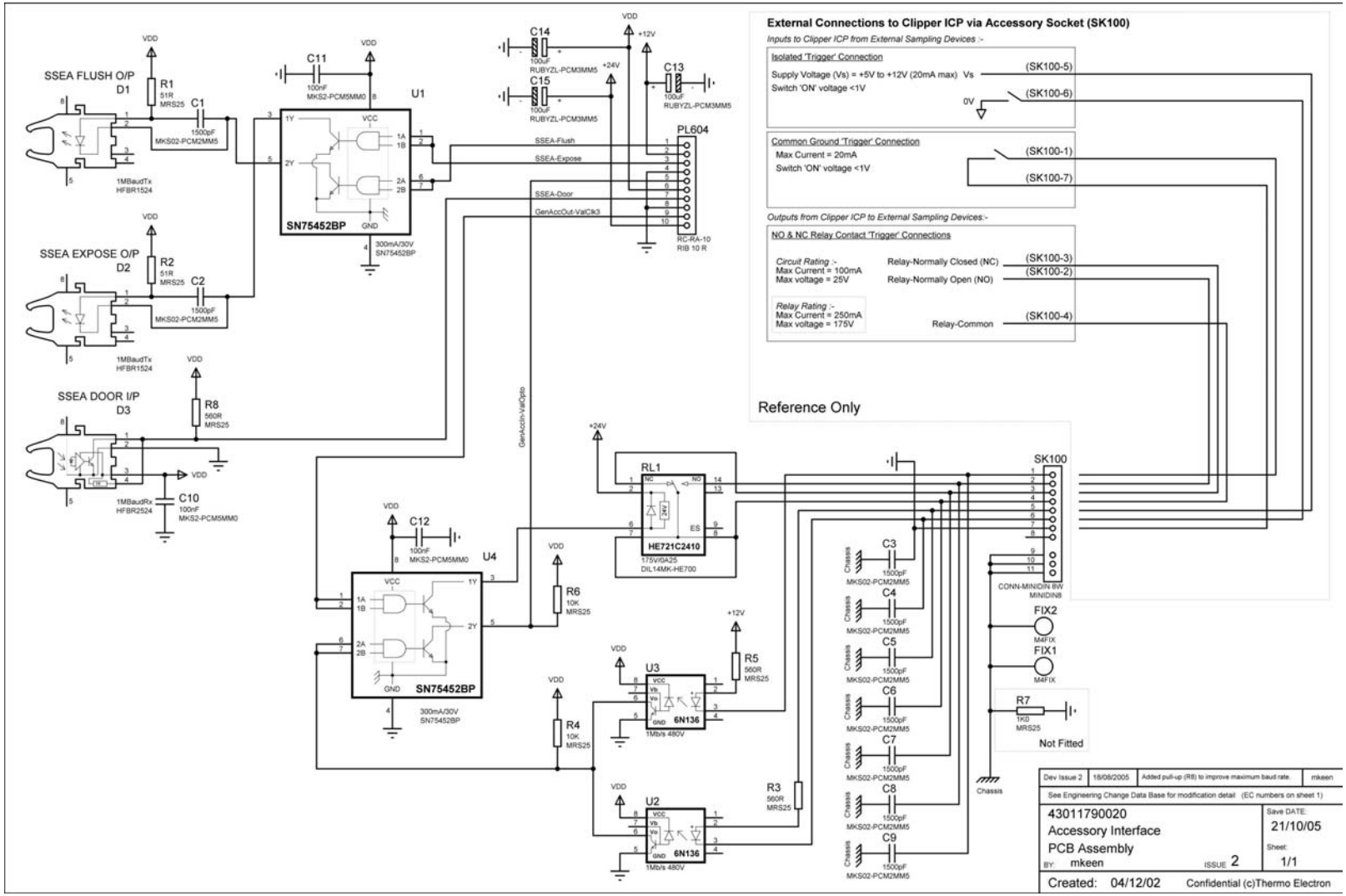


Figure 47 – Accessory Interface Kit