U-5000AT+ Ultrasonic Nebulizer Operator Manual

Product Warranty Statement

SD Acquisition, Inc., DBA CETAC Technologies ("CETAC"), warrants any CETAC unit manufactured or supplied by CETAC for a period beginning on the date of shipment and ending on the sooner to occur of: (a) the date that is twelve (12) months from the date of installation, or (b) the date that is thirteen (13) months from the date of shipment. Units found in the reasonable judgement of CETAC to be defective in material or workmanship will be repaired or replaced by CETAC without charge for parts and labor. CETAC reserves the right to change or improve the design of any unit without assuming any obligation to modify any unit previously manufactured.

This warranty does not cover any unit that has been subject to misuse, neglect, negligence, or accident. The warranty does not apply to any damage to the unit that is the result of improper installation or maintenance, or to any unit that has been operated or maintained in any way contrary to the instructions specified in the CETAC instruction and operation manual. Operation of the CETAC unit inside a laboratory fume hood is contra-indicated and will void the warranty. Any attempt to repair or alter any CETAC unit by anyone other than by CETAC authorized personnel or agents will void this warranty. If any non-CETAC component is installed in the CETAC manufactured unit without the approval of CETAC, the warranty will be voided. In addition, this warranty does not extend to repairs made necessary by the use of parts, accessories or fluids which are either incompatible with the unit or adversely affect its operation, performance or durability. CETAC'S obligation under this warranty is strictly and exclusively limited to repair or replacement of defective CETAC parts, and no claim of breach of warranty shall be cause for cancellation or recission of the contract of sale of any unit.

The foregoing express warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability and fitness for a particular purpose. CETAC shall not be bound by any representations or statements on the part of its employees or agents whether oral or in writing and including any made in catalogues and other promotional material including technical details and specifications except where such representations and statements are expressly made part of this contract. CETAC assumes no responsibility for incidental, consequential or other damages, even if advised of such a possibility, including but not limited to loss or damage of property, loss of revenue, loss of use of the unit, loss of time, or inconvenience. CETAC's liability on any claim for loss or damage arising out of the sale, resale or use of any of its products shall in no event exceed the selling price of the unit.

Purchaser shall indemnify CETAC against any claim or liability which may be asserted as relates to the following: (i) the use to which any product supplied hereunder is put infringes the patent, copyright or other intellectual property rights of any third party; or (ii) any liability resulting from the failure by Purchaser to observe the terms of this Warranty.

Returned Product Procedures

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. CETAC must be notified within ninety (90) days of shipment of incorrect materials. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from CETAC. No replacements will be provided nor repairs made for products returned without such approval. Any returned product must be accompanied by a return authorization number. The expense of returning the unit to CETAC for service will be paid by the buyer. The status of any product returned later than thirty (30) days after issuance of a return authorization number will be subject to review. Shipment of repaired products will generally be made forty eight (48) hours after the receipt.

Products may not be returned which are contaminated by radioactive materials, infectious agents, or other materials constituting health hazards to CETAC employees.

Returned Product Warranty Determination

After CETAC'S examination, warranty or out of warranty status will be determined. If a warranted defect exists, the product will be repaired at no charge and shipped prepaid back to the buyer. If the buyer desires an air freight return, the product will be shipped collect. Warranty repairs do not extend the original warranty period.

If an out of warranty defect exists, the buyer shall be notified of the repair cost. At such time the buyer must issue a valid purchase order to cover the cost of repair and freight, or authorize the products to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number approval within fifteen (15) days of notification will result in the products being returned as is, at the buyers expense.

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480021 Version 1.1, April, 1997

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REVISIONS

CETAC Technologies strives to provide the scientific community with an unparalleled combination of effective technology and continuing value. Modular upgrades for existing instruments will continue to be a prime consideration as designs progress.

CETAC Technologies reserves the right to revise this document and/or improve products described herein at any time without notice or obligation. Warranty registration entitles the named owner exclusively to manual change pages/new editions as they are published.

SAFETY

Instruments, accessories, components or other associated materials **may not** be returned to CETAC Technologies if contaminated with biohazard or radioactive materials, infectious agents, or any other materials and/or conditions that could constitute a health or injury hazard to CETAC employees. Call Customer Service and Support if there is any question or doubt relative to decontamination requirements.

CAUTION and WARNING statements, as applied in this document, shall be interpreted consistent with the following context: CAUTION applies only to potential property damage conditions; WARNING applies to potential personal injury conditions, in combination with or exclusive of potential property damage.

WARNING

The handling of organomercurial concentrates which may be used in the preparation of process standards presents a substantial (potentially lethal) safety hazard. Only an experienced, professionally trained organo-metallic chemist, knowledgeable and skilled specifically in the safe handling of organomercurials (using approved apparatus and approved protection measures in an approved facility) should attempt to prepare diluted organomercurial process standards from concentrates.

NOTE

SD Acquisition, Inc., DBA CETAC Technologies assumes no liability for the handling of organomercurial concentrates or the preparation, handling, or use of diluted organomercurial process standards. Instead, CETAC Technologies recommends use of appropriate standard reference materials to validate sample preparation (dissolution/digestion) and use of inorganic mercury standards for instrument calibration.

All user-serviceable components are specifically identified in this document as such; the balance shall be assumed to require the expertise of a factory service technician/engineer for adjustment, repair,

replacement, modification, etc. Others not so qualified and performing these actions shall do so at their own risk. Furthermore, never operate the instrument without first reading and understanding the *U-5000 AT+ Ultrasonic Nebulizer Operator Manual* and ensuring that it is operated safely and properly.

ORIGINAL PACKAGING

Retain original factory packaging for moves and factory return shipments. Shipping in anything other than the original fitted foam and container can result in incidental damage from which the purchaser will not be protected under warranty.

WARNING

Under all conditions the user must observe safe laboratory procedures during the operation of this product.

FEDERAL COMMUNICATIONS COMMISSION (FCC) NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential environment is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

MODIFICATIONS

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by CETAC Technologies, Inc. may void the user's authority to operate the equipment.

CABLES

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods to maintain compliance with FCC Rules and Regulations.

CANADIAN NOTICE

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled "Digital Apparatus." ICES-003 of the Department of Communications.

AVIS CANADIEN

Cet appareil numerique respecte les limites de bruits radioelectriques applicables aux appareils numeriques de Classe A prescrites dans la norme sur le materiel brouilleur: "Appareils Numeriques," NMB-003 edictee par le ministre des Communications.

POWER CORD SET REQUIREMENTS

The power cord set supplied with your instrument meets the requirements of the country where you purchased the instrument.

If you use the instrument in another country, you must use a power cord set that meets the requirements of that country.

WARNING

This equipment is designed for connection to a grounded (earthed) outlet. The grounding type plug is an important safety feature. To reduce the risk of electrical shock or damage to the instrument, do not disable this feature.

CAUTION

To reduce the risk of fire hazard and electrical shock, do not expose the unit to rain or humidity. To reduce the risk of electrical shock, do not open the cabinet. All maintenance is to be performed by an Authorized CETAC Service Provider.

Protection provided by the equipment may be impaired if the equipment is used in a manner not specified by the manufacturer.

CLEANING INSTRUCTIONS

To clean the exterior surfaces of the instrument, complete the following steps:

1 Shut down and unplug the instrument.

2 Wipe the instrument exterior surfaces only using a towel dampened with a lab-grade cleaning agent.

3 Repeat step 2, using a towel dampened with clear water.

4 Dry the instrument exterior using a dry towel.

WARNING

Do not allow any liquid to enter the instrument cabinet, or come into contact with any electrical components. The instrument must be thoroughly dry before you reconnect power, or turn the instrument on.

COOLING FAN OBSTRUCTION

The instrument cooling fan(s) shall remain unobstructed at all times. Do not operate the instrument if the cooling fan(s) are blocked or obstructed in any manner.

ENVIRONMENTAL

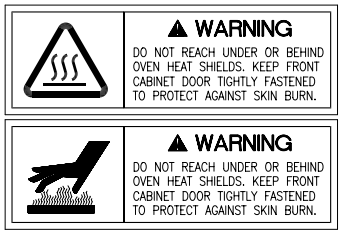
Operating Temperature:	10° to 30°C
Relative Humidity:	0% to 95%

WARNING
FOR CONTINUED PROTECTION AGAINST RISK OF FIRE, REPLACE ONLY WITH FUSES OF THE SPECIFIED TYPE AND CURRENT RATING.

FOR CONTINUED PROTECTION AGAINST RISK OF FIRE, REPLACE ONLY WITH FUSES OF THE SPECIFIED TYPE AND CURRENT RATING.

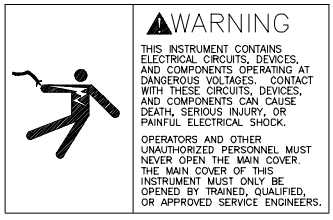
⚠ AVERTISSEMENT

POUR UNE PROTECTION CONTINUÉ CONTRE LES RISQUES D'INCENDIE, REMPLACER UNIQUEMENT PAR DES FUSIBLES DE MÊME TYPE ET AMPÈRAGE.



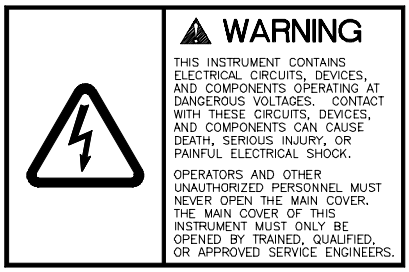
⚠ AVERTISSEMENT

NE PAS GLISSER LA MAIN SOUS OU DERIERE LES ECRANS THERMIQUES DU FOUR. GARDER LA PORTE D'ACCES AU DEVANT DU BOITIER BIEN FERMEE POUR ASSURER LA PROTECTION CONTRE LES BRULURES



⚠ AVERTISSEMENT

TOUT CONTACT AVEC LES HAUTES TENSIONS PEUT ENTRAINER LA MORT OU DES BLESSURES SÉVÈRES. CE PANNEAU NE DOIT ÊTRE ENLEVE QUE PAR UN RÉPARATEUR QUALIFIÉ.



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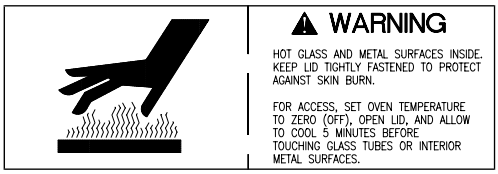
⚠ AVERTISSEMENT

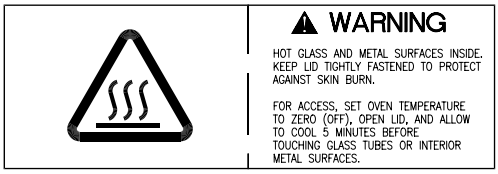
TOUT CONTACT AVEC LES HAUTES TENSIONS PEUT ENTRAINER LA MORT OU DES BLESSURES SÉVÈRES. CE PANNEAU NE DOIT ÊTRE ENLEVE QUE PAR UN RÉPARATEUR QUALIFIÉ.

⚠ **WARNING**
HIGH LEAKAGE CURRENT - ENSURE PROPER GROUNDING

⚠ AVERTISSEMENT

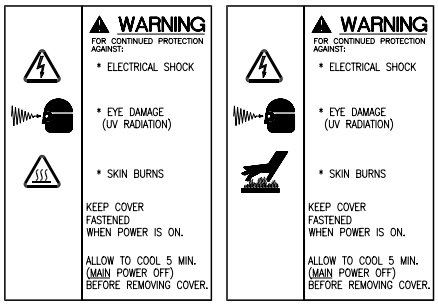
COURANT DE FUITE ÉLEVÉ — FORNIR UNE MISE À LA TERRE EFFICACE.





⚠ AVERTISSEMENT

SURFACES CHAUDES, LAISSER LE COUVERCLE HERMÉTIQUEMENT FERMÉ.
POUR ACCÉDER, METTRE LA TEMPÉRATURE DU FOUR À ZÉRO, OUVRIR LE COUVERCLE ET LAISSER REFROIDIR 5 MINUTES AVANT DE TOUCHER LA VERRERIE OU TOUTE SURFACE MÉTALLIQUE INTÉRIEURE.



⚠ AVERTISSEMENT

POUR LA PROTECTION PERMANENTE CONTRE UN CHOC ÉLECTRIQUE, UNE BRÛLURE DES YEUX (RADIATION UV) OU DE LA PEAU, LAISSER LE COUVERCLE HERMÉTIQUEMENT FERMÉ LORSQUE L'APPAREIL EST SOUS TENSION.
LAISSER REFROIDIR 5 MINUTES (APPAREIL ÉTEINT) AVANT D'ENLEVER LE COUVERCLE.

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Preface

Preface

The *U-5000AT+ Ultrasonic Nebulizer Operator's Manual* explains the procedures for installing, using, and maintaining the CETAC U-5000AT+ Ultrasonic Nebulizer. It also provides information about troubleshooting minor U-5000AT+ problems and describes the design of the system.

Who Should Read This Manual

The primary audience for the *U-5000AT+ Ultrasonic Nebulizer Operator's Manual* consists of analytical chemists and lab technicians. To use this manual effectively, you should have a strong knowledge of chemistry, a basic knowledge of electronic sampling equipment, at least a beginning level of computer experience, and working knowledge of ICP-AES or ICP-MS systems.

How to Use This Manual

The *U-5000AT+ Ultrasonic Nebulizer Operator's Manual* contains seven chapters. You should read the chapters sequentially the first time. Thereafter, refer to the chapters separately as needed. The first chapter provides an introduction to the Ultrasonic Nebulizer. Subsequent chapters detail the primary tasks associated with the U-5000AT+.

The *U-5000AT+ Ultrasonic Nebulizer Operator's Manual* contains the following chapters:

Chapter 1, "**Introduction,**" provides you with an overview of the U-5000AT+ Ultrasonic Nebulizer's function and design.

Chapter 2, "**Preparing for Installation,**" discusses space and power requirements that must be met before the U-5000AT+ is installed. It

also provides instructions for unpacking the Ultrasonic and the ICP requirements.

Chapter 3, "**Installing the U-5000AT+ Ultrasonic Nebulizer,**" provides step-by-step procedures for installing the U-5000AT+ and connecting it to the analytical instrument.

Chapter 4, "**Verifying Installation,"** explains initial operation of the U-5000AT+, ICP operation and system optimization.

Chapter 5, "**Using the U-5000AT+ Ultrasonic Nebulizer,**" describes the tasks you perform during daily operation of the U-5000AT+.

Chapter 6, "**Maintaining the U-5000AT+ Ultrasonic Nebulizer,**" explains daily, weekly, and periodic maintenance tasks.

Chapter 7, "**Troubleshooting the U-5000AT+ Ultrasonic Nebulizer,"** describes how to diagnose and correct minor U-5000AT+ problems.

These chapters are followed by an index.

Conventions Used in This Manual

This manual uses certain conventions to distinguish different types of information easily. This section describes these conventions.

Instructions

All step-by-step instructions are numbered and in bold, as in the following example.

1 Replace the sample vial racks.

Many numbered instructions are followed by more detailed explanations.

Terminology

This manual frequently uses the following terms:

U-5000AT+	Ultrasonic Nebulizer.
Hz	Hertz.
ICP-AES	An inductively coupled plasma atomic emission spectrometer.
ICP-MS	An inductively coupled plasma mass spectrometer.
ID	Inside diameter.
LED	Light-emitting diode.
PEEK	Polyetheretherketone.
PTFE	Polytetrafluoroethylene
VAC	Volts alternating current.
PSI	Pounds per square inch.
VDC	Volts direct current.

Notes

Notes contain a reminder about the effect of particular actions. They are indicated as follows:

Note:

This example shows how a note is displayed.

Cautions

Cautions indicate situations that require immediate attention to prevent harm to the DSX-100 system. Cautions are indicated as follows:

CAUTION This example shows how a caution is displayed.

Warnings

Warning indicate situations that could cause bodily harm. Warnings are indicated as follows:

WARNING **This example shows how a warning is displayed.**

Where to Go for More Information

In addition to the *U-5000AT+ Ultrasonic Nebulizer Operator's Manual*, you can refer to the following resources:

- The software manual for the ICP instrument you are using.
- CETAC Technologies Customer Service and Support:

  Phone 1 (800) 369-2822 (U.S. only)

  Phone 1 (402) 733-2829

  Fax 1 (402) 733-1932

  E-mail custserv@cetac.com

1

Introduction

Introduction

The U-5000AT+ Ultrasonic Nebulizer is the central component of CETAC Technologies' modular enhanced sample introduction system for ICP spectroscopy. The U-5000AT+ improves detection limits by enhancing analyte transport efficiency and reducing solvent loading to the plasma. Compared to pneumatic nebulization, detection of sample analytes is typically improved by an order of magnitude with the ultrasonic nebulizer. This sensitivity increase is typically found when used with either an ICP-AES or ICP-MS instrument.

In operation, liquid sample is pumped onto the face of the piezoelectric transducer of the ultrasonic nebulizer where it is converted to a fine, dense aerosol. The nebulizer gas flow transports the wet aerosol through the heated U-tube where the solvent is vaporized. Solvent vapors are then condensed by the thermo-electric cooler and removed by the drain pump. The sample output is a dry, analyte-laden aerosol which is introduced to the plasma.

Ultrasonic Nebulizer Components

The U-5000AT+ ultrasonic nebulizer consists of two sub-modules: glassware (top) and electronics (bottom). The glassware module houses a piezolectric transducer, aerosol chamber, temperature-controlled heated U-tube evaporator and a thermo-electric condenser. The electronics module contains a drain pump, dual PID temperature controllers and an auto-tuned RF power supply to provide excellent reproducibility and reliability.

The following components are located on the front of the U-5000AT+ Ultrasonic Nebulizer. Each lettered item corresponds with a callout in Figure 1–1.

A Transducer assembly. Piezoelectric transducer that converts RF energy to ultrasonic oscillations and nebulizes the liquid sample.

B **Aerosol chamber stand**. This component holds the aerosol chamber and transducer on the front of the glassware module.

C **Aerosol chamber.** Glassware that holds the transducer assembly, where the sample is introduced, nebulized and mixed with argon carrier gas before entering the U-tube.

D **Sample/rinse adapter.** Internal o-rings retain it on the spray chamber inlet tube, and a compression fitting holds the sample inlet tubing in place.

E **U-tube.** The nebulized sample is vaporized in the U-tube before entering the condenser.

F **Heat cords.** The heat cords are wrapped around the exterior of the U-tube. Temperature regulation is achieved by the "Heater" controller.

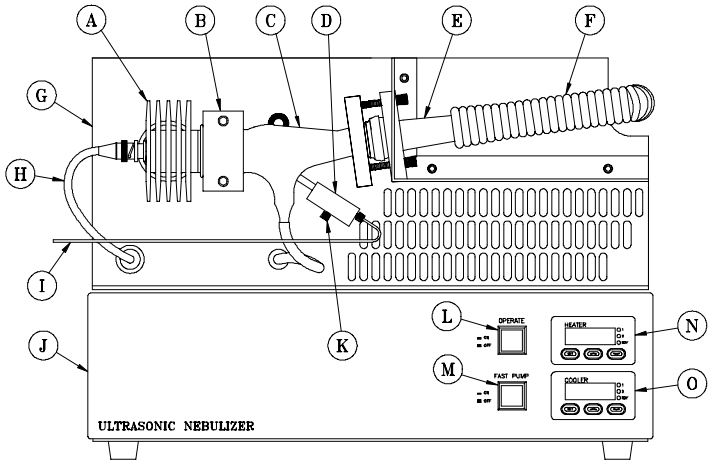

Figure 1–1. U-5000AT+ Design--Front View.

G **Glassware module.** Top module of ultrasonic nebulizer; houses transducer assembly, aerosol chamber, U-tube and condenser.

H **Transducer RF cable.** Cable that transmits the RF energy from the RF power supply to the transducer assembly.

I **Sample inlet tubing.** This tube delivers the liquid sample onto the transducer face for nebulization.

J **Electronics module.** Bottom module of ultrasonic nebulizer; houses drain pump, temperature controllers and RF power supply.

K **Auxiliary rinse port.** The luer fitting allows fast system rinse-out between samples.

L **Operate switch.** The push-on/push-off RF power control switch. It illuminates when the RF system is energized and operating.

M **Fast pump switch.** The push-on/push-off high-speed drain pump control switch. It illuminates during rapid pumping of the spray chamber and drain tubing after rinse-out.

N **Heater controller.** PID controller that regulates the temperature of the ultrasonic nebulizer's heat cords.

O **Cooler controller.** PID controller that regulates the temperature of the ultrasonic nebulizer's thermo-electric condenser.

The following components are located on the back of the U-5000AT+ Ultrasonic Nebulizer. Each lettered item corresponds with a callout in Figure 1–2.

A **Sample out tubing.** Tubing that transfers the sample directly to the ICP.

B **Top cover captive screws.** Threaded fastener that securely locks the top cover to the chassis.

C **Cooling fan.** Removes the heat generated by the thermoelectric coolers.

D **Top cover captive screws.** Threaded fastener that securely locks the top cover to the chassis.

E **Top cover.** Removable, protects user from the heat cords and gives access to the sample out interface.

F **Glassware module.** Top module of ultrasonic nebulizer; houses transducer assembly, aerosol chamber, U-tube and condenser.

G **Argon inlet fitting.** Connection for the argon carrier gas.

H **Drain tubing.** There are three places of drainage, aerosol chamber, primary condenser (heated tube), and the secondary condenser (thermoelectrics).

I **Electronics module.** Bottom module of ultrasonic nebulizer; houses drain pump, temperature controllers and RF power supply.

J **Waste drain tubing.** The three drains (from H above) after the peristaltic pump.

K **Drain pump.** Three channel, four roller peristaltic pump used to pump the drains.

L **Drain pump tubing.** Three pieces of peristaltic pump tubing.

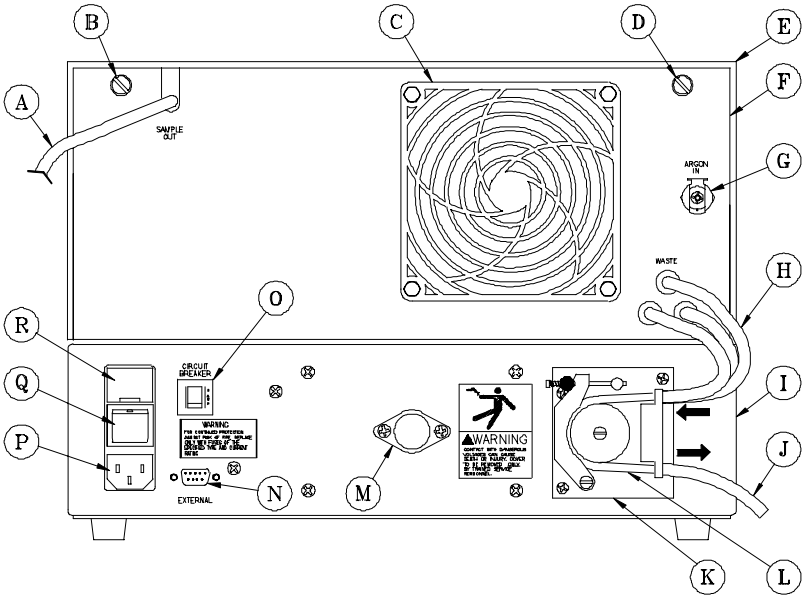

Figure 1–2. U-5000AT+ Design—Back View.

M MOSFET transistor. Amplifier for the oscillator circuitry.

N External connection. Used to check the oscillator bias voltage and also to interface to other CETAC peripherals.

O RF circuit breaker. This breaker protects the oscillator circuitry from faulty transducers or connections.

P AC power module. Mains voltage connected here.

Q AC power switch (nebulizer). Turns the ultrasonic nebulizer power on or off.

R Fuse drawer (nebulizer). Mains fuses for the ultrasonic nebulizer.

The following standard components/accessories are also included with each U-5000AT+ Ultrasonic Nebulizer:

- **ICP interface kit.** All parts to successfully interface to the ICP, including torch adapters and spray chambers, if needed.
- **Spare fuse kit.** Contains replacement fuses for the U-5000AT+.
- **Spare drain pump tubing kit.** Replacement tubing for the drain peristaltic pump.
- **Utility cart.** Holds the U-5000AT+ and related pieces.
- **Sample inlet extension tubing kit.** This is used when the sample peristaltic pump cannot be placed close enough to the U-5000AT+ to make a proper connection.
- **Argon tubing kit.** Contains all the necessary tubing to interface argon with the U-5000AT+.

Optional Accessories

If you are connecting the U-5000AT+ to a second ICP, want to automate sample introduction or between sample rinse-out, you may wish to purchase optional accessories for the Ultrasonic Nebulizer. The following accessories are available for the U-5000AT+:

- **Acid-proof O-ring kit.**
- **Organics tubing kit.**
- **AutoRinse-2000 system.**
- **ASX-500 Auto sampler.**
- **ASX-100 Auto Sampler.**

Note:

Contact CETAC Technologies if you need additional accessories not listed, need added features to integrate the U-5000AT+ Ultrasonic Nebulizer into your analytical system, or have unique requirements. Research and development of new features and accessories for the U-5000AT+ Ultrasonic Nebulizer, often inspired by customer requests, is a continuing activity of CETAC Technologies.

2

Preparing for Installation

Preparing for Installation

Installing the U-5000AT+ requires preparation. Before you install the system you should evaluate the physical arrangement of the laboratory to choose a suitable location. Once you choose a location, you must carefully unpack the U-5000AT+ prior to beginning the installation.

This chapter discusses what requirements must be met when you choose a location for the U-5000AT+. It also describes how to unpack the U-5000AT+ before installation.

Choosing a Location

Choosing a location for the U-5000AT+ involves evaluating the lab environment for the availability of space and power. For the U-5000AT+ to function optimally, the location you select must meet specific requirements associated with each of these items. The following sections discuss space and power requirements.

Space Requirements

Most analytical applications benefit from the shortest sample flow path. Therefore, you should place the U-5000AT+ close to the analytical instrument. The recommended minimum footprint for countertop installation of the U-5000AT+ is 18" x 18" (45 cm x 45 cm).

Power Requirements

Place the U-5000AT+ within 1.2 meters of a power outlet. The voltage input requirements are 100-120 VAC ± 10%, 50/60 Hz, 4.5A or 220-240 VAC ± 10%, 50/60 Hz, 2.5A, depending on the model.

There is a fuse drawer at the rear of the electronic module on the ultrasonic Nebulizer. The fuse drawer contains two fuses. You can remove the fuse drawer by unlatching the fuse holder with a small screwdriver.

WARNING

Disconnect the input power before attempting any fuse servicing.

Replace the fuses with a GMC 5A, 250V Slo-Blo type for 100-120 VAC input voltage or a GMC 2.5A, 250V Slo-Blo type for 220-240 VAC input voltage.

WARNING

Replacement with a higher-rated fuse without first consulting CETAC Technologies or an authorized representative is done solely at the user's risk and is not recommended. Blown fuses indicate an abnormal condition, and replacement should be uncommon. Call Customer Service and Support if repeated fuse blowing occurs.

Power Cord Set Requirements

The power cord set supplied with the U-5000AT+ meets the requirements of the country where you purchased the instrument. If you use the instrument in another country, you must use a power cord set that meets the requirements of that country.

WARNING

This equipment is designed for connection to a grounded (earthed) outlet. The grounding-type plug is an important safety feature. To reduce the risk of electrical shock or damage to the instrument, do not disable this feature.

Unpacking the U-5000AT+

Inspect external packaging upon receipt for holes, tears, smashed corners, or any other outward signs of damage from rough handling or abuse during shipment. Inspect all items during unpacking and notify the carrier immediately of any concealed damage.

Remove packing checklist from the shipping container, and check off items against it. Leave accessories in the packing unit until you are ready to install them on the U-5000AT+.

> **Note:**
>
> Do not throw away the factory packaging. Keep it for possible future use. This is one of the warranty conditions.

CAUTION If condensation forms on or inside the U-5000AT+, allow it to dry thoroughly before connecting it to an AC power source and operating it. Failure to do so may cause equipment damage.

ICP Requirements

To achieve optimum performance from the U-5000AT+, the ICP system must be in good operating condition. Check the ICP performance using a conventional pneumatic Nebulizer before the U-5000AT+ installation. If the detection limits do not meet instrument specifications, consult the ICP manufacturer for assistance. If the detection limits are within the manufacturer's specifications, begin installation of the U-5000AT+ system.

3

Installing the Ultrasonic Nebulizer

Installing the Ultrasonic Nebulizer

The U-5000AT+ is designed for easy installation.

To install the ultrasonic Nebulizer, you must complete the following tasks. Each of these task will be discussed in detail later in this chapter.

1 **Drainage system assembly.**

2 **Liquid sample delivery and rinse system.**

3 **Establishing external connections.**

4 **Connecting the U-5000AT+ to the ICP torch.**

WARNING

Ensure that AC power is off (0 showing at the top edge of the rocker switch) before proceeding with installation.

Drainage System Assembly

The U-5000AT+ drainage system removes both sample waste from the spray chamber and condensed solvent from the condenser. It consists of a built-in four roller peristaltic pump and the associated pump tubing and connectors.

1 **Connect the length of 1/8" I.D. Tygon tubing to the outlet of the fittings from the pump (K), (Figure 1-2).**

2 **Place the other end of the tubing into a waste bottle.**

The drain pump tubing on the U-5000AT+ is user replaceable (see Chapter 6, “Maintaining the U-5000AT+ Ultrasonic Nebulizer”.)

Liquid Sample Delivery and Rinse System

Liquid Sample Delivery

Sample liquid is delivered to the U-5000AT+ transducer through 0.5 mm I.D. PEEK sample tubing which is inserted through the glass sample inlet tube (located at the base of the aerosol chamber) and held in place by the sample rinse adapter. The sample/rinse adapter is mounted and aligned at the factory and should require no adjustment prior to use. However, it may become necessary to adjust this adapter or remove it and re-cut the end of the tubing periodically for optimum sample delivery. To re-cut and adjust the sample inlet tubing refer to Figure 3-1 and follow the instructions below:

1 **Remove the sample/rinse adapter (G) from the glass sample inlet tube (H).**

Carefully slide the adapter along the glass sample inlet tube.

2 **Re-cut the sample tubing (F) at a 60 degree angle using a sharp razor blade.**

An improper cut or a blunt tip may cause inefficient nebulization.

3 **Loosen the compression fitting nut (J) which holds the PEEK sample inlet tubing.**

Adjust the tubing position to account for the removed section. Tighten the sample inlet compression fitting nut to hold the tubing in place.

4 **To replace the adapter, first insert the sample inlet tubing, then slide the sample/rinse adapter back onto the glass tube.**

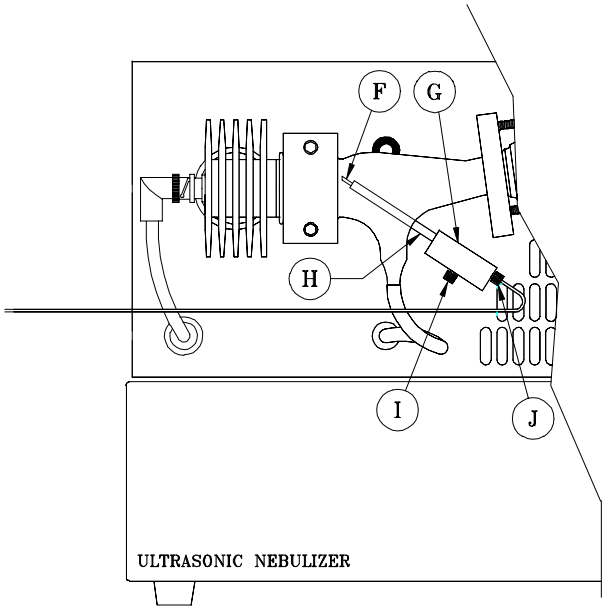

Figure 3-1. Sample Tubing and Sample/Rinse Adapter.

5 Slide the adapter until the sample tubing touches the face of the transducer.

Then, lightly pull the adapter back to form a very narrow gap (approximately 0.2 to 0.4 mm) between the transducer and the tubing. This position allows proper adhesion of sample solution onto the transducer without any contact between the tubing and the transducer. At this point, the end of the sample tubing should be parallel to the transducer face.

6 If the length of the sample inlet tubing is not correct, remove the sample inlet adapter and repeat steps 3 through 5 until proper adjustment is achieved.

Note:

For high concentrations of sulfuric and nitric acid it is recommended that the PEEK sample inlet tubing be replaced with the clear Tefzel sample inlet tubing (supplied as an accessory with the U-5000AT+.) To install the Tefzel tubing, follow the previously described procedure for the PEEK sample inlet tubing.

Sample Inlet Tubing Extension

Connecting the sample uptake peristaltic pump tubing directly to the U-5000AT+ is the most desirable arrangement. However, this may not always be possible. A sample inlet tubing extension kit is provided to accommodate this situation. The components of the sample inlet tubing extension kit are shown in Figure 3-2, A-D.

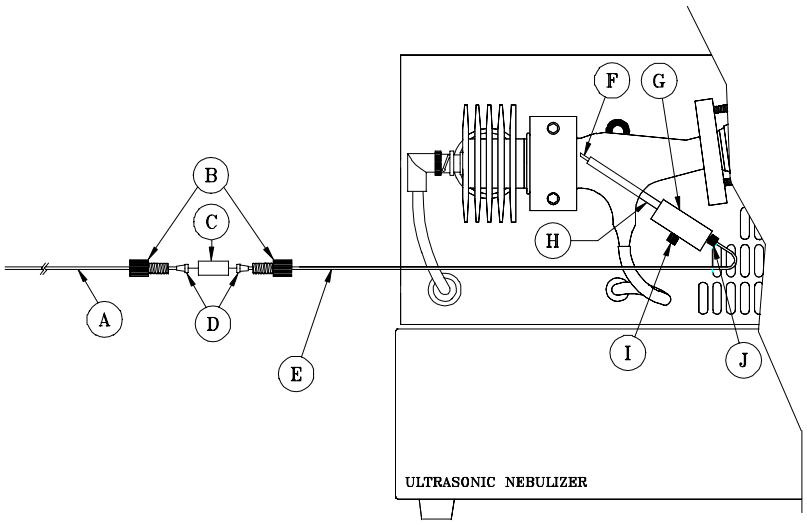

Figure 3-2. Sample Inlet Tubing Extension.

Rinse System

To reduce memory effects, the auxiliary rinse port on the sample/rinse inlet adapter (I, Figure 3-2) provides the capability for rapidly cleaning the transducer face plate between samples. The CETAC Auto Rinse System 2000 is available for automatic rinsing when an auto-sampler is used. To rinse between samples:

1 **Remove the male luer plug from the auxiliary rinse port (I) of the sample/rinse adapter with a counter-clockwise twist.**

2 **Attach the male luer (fitting on the end of the gum rubber tubing of the rinse bottle) into the rinse port using a clockwise motion.**

3 **Fill the auxiliary rinse bottle with deionized water.**

4 **Gently squeeze the rinse bottle handle 2-5 times to deliver deionized water to the transducer face.**

Rinse water should splash around the transducer area of the aerosol chamber each time the handle is squeezed.

> **Note:**
>
> To reduce memory effect, the auxiliary rinse port should always have the male luer plug inserted if the rinse port is not utilized.

Establishing External Connections

The next step in the installation process involves connecting the U-5000AT+ to the power source and to an analytical instrument. The following sections explain how to establish these connections.

Connecting the Ultrasonic Nebulizer to the Power Source.

A voltage-specific power cord is supplied with each U-5000AT+.

WARNING

Use only this power cord or exact replacement.

To connect the ultrasonic Nebulizer to a power source, plug the cord into the power module located on the back panel of the U-5000AT+. Then, plug the cord into a 110 or 220 VAC ± 10%, 50/60-Hz utility power outlet, depending on the model.

Connecting the U-5000AT+ to the ICP Torch

Depending on the ICP manufacturer and the model of the ICP, a torch adapter or spray chamber adapter is supplied for the interfacing of the U-5000AT+ to the ICP.

Note:

If using a torch adapter, the pneumatic Nebulizer and the spray chamber must be removed. If using a spray chamber adapter, the pneumatic Nebulizer and the spray chamber baffle must be removed leaving the spray chamber in place.

Connecting the Ultrasonic Nebulizer to an Analytical Instrument

1 **Make sure that AC power is disconnected from the U-5000AT+ and the heated U-tube is cooled off before beginning.**

2 Mount the spray chamber/torch adapter on the ICP plasma torch.

3 Remove the U-5000AT+ top cover.

Release captive panel screws, carefully slide forward & lift off. Locate the glass sample outlet tube located at the condenser outlet (Figure 3-1.)

4 Connect the glass sample outlet tube of the U-5000AT+ to the ICP torch/spray chamber adapter using the 3/16" I.D. Tygon tubing.

Place the Tygon tubing in the SAMPLE OUT opening or it will become pinched when the top cover is reinstalled and will cause unacceptable Nebulizer performance.

5 Replace the top cover and tighten captive panel screws.

Ensure the ICP torch has remained properly aligned and located in the induction coil according to the ICP manufacturers instructions.

6 Connect the Nebulizer carrier gas from the ICP instrument to the U-5000AT+ using the ARGON IN connector (Figure 3-1) and 3/16" I.D. Tygon tubing.

> **Note:**
>
> Some ICPs utilize a pressure switch on the argon Nebulizer gas that will not allow the user to reduce the pressure enough to get the 0.7 L/min. flow required by the U-5000AT+. With these ICPs, it is necessary to use an auxiliary flow restrictor between the Nebulizer gas supply and the U-5000AT+ ARGON IN connector for control of the Nebulizer argon flow. This flow restrictor will be provided by CETAC when necessary.

4

Verifying Installation

Verifying Installation

Once installation of the U-5000AT+ is complete, it is important to verify that you have installed the ultrasonic Nebulizer correctly. Attempting to use the U-5000AT+ before ensuring that it is installed correctly may result in damage to the ultrasonic Nebulizer.

Verifying installation of the U-5000AT+ consists of three parts:

1 **Initial operation procedure**

2 **ICP operation**

3 **System Optimization**

Initial Operating Procedure

1 **Plug the supplied power cord into the U-5000AT+ and the AC supply outlet.**

2 **Turn on the power switch and allow the heater and condenser stages to preheat and precool.**

After approximately 10-15 minutes, both stages should be operating at a steady state as indicated by HEATER and COOLER temperature readings of 140°C ± 2°C and 3°C ± 1°C, respectively.

> **Note:**
>
> Both temperature controllers are factory programmed and preset. Temperature settings should not be changed unless absolutely necessary to obtain acceptable Nebulizer performance. Do not exceed controller settings of 120ºC to 160ºC (HEATER) and -5ºC to +10º C (COOLER).

3 Ensure the drain pump pressure shoe is engaged and all lines are connected.

4 With the heating and cooling and temperatures stabilized at 140 °C and 3 °C respectively, turn on the Nebulizer gas from the ICP and adjust flow to 0.7 L/min.

5 Connect the sample peristaltic pump to the 0.5 mm I.D. PEEK sample tubing.

If the PEEK sample tubing is not long enough to connect to the sample peristaltic pump, a three foot piece of 0.5 mm I.D. Tefzel extension tubing and necessary fittings has been included with the unit.

6 Turn on the sample delivery pump and deliver deionized water at 2.5 mL/min.

7 Press the OPERATE switch.

The yellow switch light will illuminate and a dense mist should be observed inside the aerosol chamber.

> **Note:**
>
> OPERATE switch illumination indicates the delivery of RF power to the transducer. If the OPERATE switch does not illuminate after the OPERATE switch is pressed or the lamp goes out during operation, this indicates a fault in the RF system. Immediately shut down the unit and see Chapter 7, "*Troubleshooting the Ultrasonic Nebulizer*."

8 **Prepare 250 mL of a 0.5% (v/v) solution of hydrofluoric acid and nebulize it for 20 to 30 seconds.**

The mist in the aerosol chamber should be dense and steady at this point. If not, see chapter 7 - "Troubleshooting."

> **Note:**
>
> Although dilute hydrofluoric acid solutions will not harm the glassware of the U-5000AT+ or the ICP when nebulized for short periods, it should only be used when the transducer face becomes dirty, which is evidenced by weak or intermittent mist generation. Reserve the remaining solution for future use.

9 **Change the sample to deionized water and observe aerosol chamber drainage after 10-15 minutes of operation.**

If drainage is sufficient, there will be no fluid buildup in the aerosol chamber drain. Should a buildup occur, press the FAST PUMP switch until the fluid is cleared and check for drain tubing for leaks, restrictions, disconnected or insufficient pump shoe pressure. Repeat the drainage test. If drainage is still insufficient, shut down the U-5000AT+ and see chapter 7 - "Troubleshooting".

10 **Turn off the OPERATE switch, the sample peristaltic pump, and the Nebulizer gas supply to the ICP.**

ICP Operation

1 **Ignite the ICP plasma as instructed in the ICP operating manual. The Nebulizer gas flow rate should be set at 0.7 L/min.**

2 **Press the OPERATE switch to energize the transducer of the U-5000AT+.**

3 **Prepare and aspirate a 100 mg/L solution of yttrium into the plasma.**

The emission color and intensity in the plasma should be similar to that found when 1000 mg/L of yttrium is aspirated with a pneumatic Nebulizer. If the yttrium emission is weak, check for gas leaks in the U-5000AT+ or ICP system.

System Optimization

It may be necessary to optimize the ICP system after installation of the ultrasonic Nebulizer. Usually the signal-to-noise ratio or signal-to-background ratio is the primary criterion for optimization.

Optimization procedures may include adjustment of the Nebulizer gas and the auxiliary gas flow rates, the sample uptake rate, the plasma gas flow rate and the viewing height. During optimization, ensure the plasma is properly sustained. For detailed instructions on system optimization, perform the ICP/U-5000AT+ Optimization procedure. After the system has been optimized, the ultrasonic Nebulizer is ready for routine operation.

Note:

Extreme conditions which may cause unstable plasma formation, torch erosion, or high reflected power should be avoided.

ICP/U-5000AT+ Optimization

Recommended operating conditions and operating ranges for aqueous sample analysis:

	Normal Condition	Range
ICP forward power	1200 W	800-1500 W
Outer gas flow rate (plasma)	15 L/min.	12-20 L/min.
Intermediate gas flow rate (auxiliary)	0.5 L/min.	0.0-2.0 L/min.
Injector gas flow rate (Nebulizer)	0.7 L/min.	0.3-1.5 L/min.
Observation height	15 mm	10-20 mm
U-5000AT+ sample uptake rate	2.5 mL/min.	1.0-3.0 mL/min.
U-5000AT+ heating temperature	140° C	120-160° C
U-5000AT+ cooling temperature	3° C	-5-10° C

Optimization of the ICP and the USN systems may be necessary to achieve the optimum sensitivity for specific elements in various aqueous samples. S/B ratios or S/N ratios may be used as the objective function for optimization procedures.

For the initial start-up procedure, the recommended operating conditions may be used. These parameters represent compromise operating conditions for most elements and most aqueous samples and may be used satisfactorily for many applications. Optimum conditions may vary, depending upon the ICP system used.

The recommended operating ranges for the ICP and the USN are also listed above. Optimization of other parameters is usually not required; they are usually preset to the nominal values listed above.

Note:

The most sensitive operating parameters are injector gas flow, forward power, and observation height; these particular parameters should be the first optimized.

Simplex optimization may be used to optimize all the above parameters simultaneously. The above ranges of operating conditions may be used as the boundary limits of the simplex method.

Note:

An optimization data sheet has been included on the following page. The parameters specified are for a standard ICP torch. Conditions will vary for instruments utilizing low gas flow torches or for ICP/MS instruments.

ICP/U-5000AT+ Optimization Data Sheet

Make/model USN _____
Settings:

Injector gas flow rate (Nebulizer)	_____
Forward RF power	_____
Observation height	_____
Outer gas flow rate (plasma)	_____
Intermediate gas flow rate (auxiliary)	_____
Reflected RF power	_____
Integration time	_____
U-5000AT+ Heating temperature	_____
U-5000AT+ Cooling temperature	_____
Sample uptake rate	_____
No. of replicated measurements	_____

Element	Wavelength	LOD U-5000AT+
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Remarks

5

Using the U-5000AT+ Ultrasonic Nebulizer

Using the U-5000AT+ Ultrasonic Nebulizer

The U-5000AT+ is both reliable and easy to use. Before using the U-5000AT+, however, ensure that your lab environment provides operating conditions that will prolong the life of the U-5000AT+. Once the proper operating conditions are met, you can setup the Ultrasonic Nebulizer.

This chapter explains how to create the proper operating conditions for using the U-5000AT+.

Establishing Optimal Operating Conditions

The U-5000AT+ operates reliably even under less than ideal conditions. It is not, however, indestructible. Malfunction or damage can occur if specific operating conditions are not met. Meeting these conditions requires that you create the proper lab environment, replace components that wear out under normal use, and purchase the appropriate supplies for use with the ultrasonic Nebulizer. The following sections explain how to meet these conditions.

Note:

Damage or malfunction that results from unsatisfactory operating conditions may constitute misuse and abuse and be excluded from warranty coverage.

Creating the Lab Environment

To create satisfactory operating conditions in your lab environment, follow these guidelines:

- Operate the U-5000AT+ in conventional lab environment where the temperature is 10-35°C; the humidity is 20-70% non-condensing; and the unit is not exposed to excessive flammable or corrosive materials.
- Avoid rough handling of the U-5000AT+. If possible, do not expose the ultrasonic Nebulizer to vibration or shock.
- Protect the U-5000AT+ from long-term exposure to condensation, corrosive materials, solvent vapor, continual standing liquids, or large spills. Exposures of this type can damage the electronics.
- Observe the same general electrostatic discharge precautions as with any other integrated circuit electronic device. Low humidity environments, especially when combined with static-generating materials, require maximum care.

WARNING

Discharge static buildup and ground to the ultrasonic Nebulizer cabinet before performing any maintenance. Do not touch or short-circuit bare contacts.

Avoid using the U-5000AT+ if strong electromagnetic interference or radio frequency interference is present.

Replacing U-5000AT+ Components

The following U-5000AT+ components wear out under normal use and must be replaced periodically.

- Peristaltic Pump Tubing
- Sample Inlet Tubing
- Sample Inlet Extension Tubing

If you fail to replace these components when they deteriorate, the ultrasonic Nebulizer will not function properly. For more information

about replacing the ultrasonic Nebulizer components, see Chapter 6, "*Maintaining the Ultrasonic Nebulizer*."

Start-up Procedure

1 If the U-5000AT+ has been turned off for an extended period of time, turn on the AC power switch and allow HEATER and COOLER temperatures to reach operating values and stabilize (approximately 10-15 minutes).

2 Ignite the ICP plasma according to the ICP operating manual.

Adjust operating parameters to optimized values.

3 Press the U-5000AT+ OPERATE switch.

4 Turn on the sample peristaltic pump and deliver deionized water to the transducer. The ultrasonic Nebulizer should stabilize in 15 minutes or less. If necessary, aspirate the dilute hydrofluoric solution to achieve a dense aerosol.

The ultrasonic Nebulizer is now ready for routine analysis.

Shutdown Procedure

1 Aspirate deionized water for at least 3 minutes.

> **Note:**
>
> Rinse-out is recommended preventative maintenance that will retard erosion and accumulation of deposits on the transducer face plate and inside the glassware from corrosive samples.

2 Turn off the sample peristaltic pump.

Let the Nebulizer run dry for about 15 seconds.

3 Turn off the OPERATE switch.

4 Press the FAST PUMP switch and allow the pump to drain all liquid from the system.

All liquid is considered drained when none can be observed flowing in the drain tubing.

5 Turn off the FAST PUMP switch followed by the AC power switch.

Turn off the ICP plasma and the gas supplies according to the ICP system operating manual.

Temperature Controller Operation

The temperature controllers normal operation displays the actual heater and cooler temperature. The setpoint for each temperature controller can be viewed by simply pressing the button labeled SET on the respective temperature controller. When the SET button is released, the actual temperature is again displayed. To change the temperature controller setpoint temperature:

1 Press and hold the SET button.

Press the up or down arrow until the desired setpoint is displayed.

2 Release the SET button.

The actual temperature will be displayed.

6

Maintaining the Ultrasonic Nebulizer

Maintaining the Ultrasonic Nebulizer

Routine maintenance of the U-5000AT+ ultrasonic Nebulizer consists of daily and weekly cleaning of specific components. Routine maintenance also includes checking the U-5000AT+ components for leaks or other damage.

Additional periodic maintenance task may be required, including replacement of the following ultrasonic Nebulizer components: transducer, peristaltic pump tubing, sample inlet tubing, and sample inlet extension tubing U-5000AT+, inspecting it for leaks, and replacing damaged components.

WARNING

The U-5000AT+ must be turned off and the AC power cord unplugged before performing any maintenance.

Transducer Assembly Removal

Refer to component illustrations (Figure 1-1).

1 **Turn off the ultrasonic Nebulizer and the ICP as described in the shutdown procedure.**

2 **Disconnect the RF cable (H) from the transducer assembly (A).**

> **Note:**
>
> Note the orientation of the assembly and the transducer mounting screws, before removal, so the new transducer is reinstalled with the same orientation.

3 Remove the transducer using the hex-head transducer wrench supplied with the U-5000AT+.

Hold the transducer assembly firmly with one hand and remove the three spring-loaded socket head screws using the wrench.

4 Carefully slide the transducer assembly and O-ring straight out of the aerosol chamber neck.

Take extreme care to avoid damaging the glass sample introduction tube while removing the transducer - fragile! Wipe off any liquids or other contaminants inside the neck of the aerosol chamber.

Transducer Assembly Installation

1 Remove the spare transducer from the box and examine the crystal face for cleanliness.

The spare transducer assembly and screw/spring set is mounted to a protective collar which should not be discarded.. Cleaning the crystal face can be accomplished by gently wiping the crystal face with a water moistened lint-free tissue.

2 Place the O-ring back into the aerosol chamber.

Ensure the O-ring is smoothly seated against the glass bezel inside.

3 Align the spare transducer assembly with the screw holes in the aerosol chamber stand.

Gently slide it straight into the aerosol chamber.

4 Holding the transducer assembly with one hand, replace the spring-loaded socket head screws.

When tightened properly , the screw heads should be flush with the second fin (from the cable connector end) of the transducer heat sink. Proper seating of the O-ring can be observed through the aerosol chamber.

CAUTION Do not over-tighten the transducer mounting screws.

5 Reconnect the RF cable to the transducer assembly.

Store the transducer wrench for future use.

RF Circuit Breaker

To protect the RF generator electronics, a resetable circuit breaker will trip (open) in approximately seven seconds if a fault occurs anywhere in the RF output circuit or cable when the OPERATE switch is on.

To reset a tripped RF circuit breaker:

1 Turn the AC power switch (Figure 1-2.) off (Q).

2 Check the RF cable (H), Figure 1-1.

Connections are at the transducer, bulkhead feed through on the glassware module, and at the electronics module.

3 Reset the RF circuit breaker (O), Figure 1-2.

Press the rocker switch down until it latches.

4 Turn AC power and OPERATE switches on (L), Figure 1-1.

If the RF circuit breaker trips again, contact your authorized service representative or CETAC Technologies for assistance.

Main Fuse Replacement

The main fuses are located in the AC power module fuse drawer located at the right rear of the electronics module. To replace blown fuses:

1 Turn the AC power switch (Q), off (0), Figure 1-2, and disconnect the AC power cord.

2 Remove the fuse drawer (R), Figure 1-3.

Use a small flat blade screwdriver to unlatch the fuse holder.

3 Replace the defective fuse(s).

Replace with GMC 5A, 125V fuse if operating on 100/115 VAC or 230 VAC.

WARNING

Use of a different fuse other than those specified can damage the electrical components of the U-5000AT+, constitute a fire hazard or result in personal injury.

4 Replace the power cord, turn AC power and OPERATE switches on.

If the new fuses blow, do not attempt to operate the unit. Contact your authorized service representative or CETAC Technologies for assistance.

Drain Pump Tubing Replacement

To replace drain pump tubing:

1 Disconnect the condenser drain and waste tubes from the drain pump, (J) and (H), Figure 1-2.

2 Unlatch the drain pump pressure shoe.

3 Remove the old pump tubing, (L), Figure 1-2.

Snap the tubing connectors out of the tubing keeper.

4 Install new pump tubing on the plastic connectors.

Phar-Med tubing (3/32" I.D., 1/32" wall) is used on the drain pump; it may be purchased pre-cut from CETAC Technologies. If using bulk tubing, cut 3-3/4" lengths using a sharp single-edge razor blade.

5 Place the new pump tubing (with connectors) in the tubing keeper.

Firmly press the connectors into the tubing keeper slots until they lock in place.

6 Carefully push the tubing onto each glass drain until it stops; each drain tube should be pushed on at least 1/4".

7 Reconnect the condenser drain and waste tubing.

8 Latch the pump pressure shoe.

9 Plug in the AC power cord and operate the U-5000AT+.

Check for leaks in the drainage system.

> **Note:**
>
> Do not stretch the condenser drain tubing to make attachment to the drain pump tubing connectors easier. Leaks and unsatisfactory Nebulizer performance will result.

7

Troubleshooting the Ultrasonic Nebulizer

Troubleshooting the Ultrasonic Nebulizer

The U-5000AT+ is both easy to operate and reliable. However, problems with the ultrasonic Nebulizer may occur. When the ultrasonic Nebulizer does not function properly, isolate the problem to determine if it originates in the analytical instrument, sample preparation, or in the ultrasonic Nebulizer.

This chapter explains how to troubleshoot the U-5000AT+ problems. If you cannot solve a problem using the steps given in this chapter, contact CETAC Technologies Customer Service and Support.

Heater and Cooler Temperature Controller Problems

If the temperature controllers do not illuminate:

1 The power cord is not connected to AC power.

Plug in power cord.

2 Main fuses blown

Replace main fuses.

If the display of temperature controller reads "Er 4" or heat cords do not warm up:

1 There is an open thermocouple junction or broken thermocouple wire.

Repair or replace the thermocouple.

2 The thermocouple is unplugged.

Plug in the thermocouple.

If the COOLER temperature controller will not reach setpoint:

1 **The thermoelectric cooler is malfunctioning.**

Replace the thermoelectric cooler.

2 **The fan (glassware module) is not running.**

Restore power to the fan or replace if defective.

If the HEATER or COOLER temperature controllers read room temperature:

1 **The heat cord or cooler heating element fuse(s) is blown.**

Replace blown fuses.

If the HEATER temperature drops to room temperature:

1 **The thermal safety switch is tripped due to excessive heat cord temperature.**

Determine if heater controller or solid state relay is defective. Replace defective component(s).

Mist/Aerosol Chamber Problems

If there is poor or unstable mist generation:

1 **The sample inlet tubing is improperly cut or adjusted.**

Re-cut and adjust the sample inlet tubing per Chapter 3, “Liquid Sample Delivery”.

2 **The sample uptake rate is too low, the Nebulizer gas flow too high, or the ultrasonic transducer face is dirty.**

Adjust the sample uptake or Nebulizer gas flow rates to optimization values (Chapter 4), or clean the transducer face with a 0.5% hydrofluoric acid solution.

If the operate switch does not illuminate, or no mist is present in the aerosol chamber:

1 The RF circuit breaker is tripped (open).

Reset the RF circuit breaker.

If the RF circuit breaker is not tripped, and there is no mist in the aerosol chamber:

1 The ultrasonic transducer has failed.

Replace the ultrasonic transducer.

If there is water backing up into aerosol chamber:

1 The drainage system is not functioning properly.

Tighten the pump pressure shoe, or replace the drain pump tubing.

2 The sample uptake flow is too high.

Reduce the sample uptake flow.

Plasma Problems

If the plasma flickers excessively or is unstable:

1 The condenser drain system is not functioning properly.

Thaw the condenser if frozen, or find the blockage or leaks in the drainage system.

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