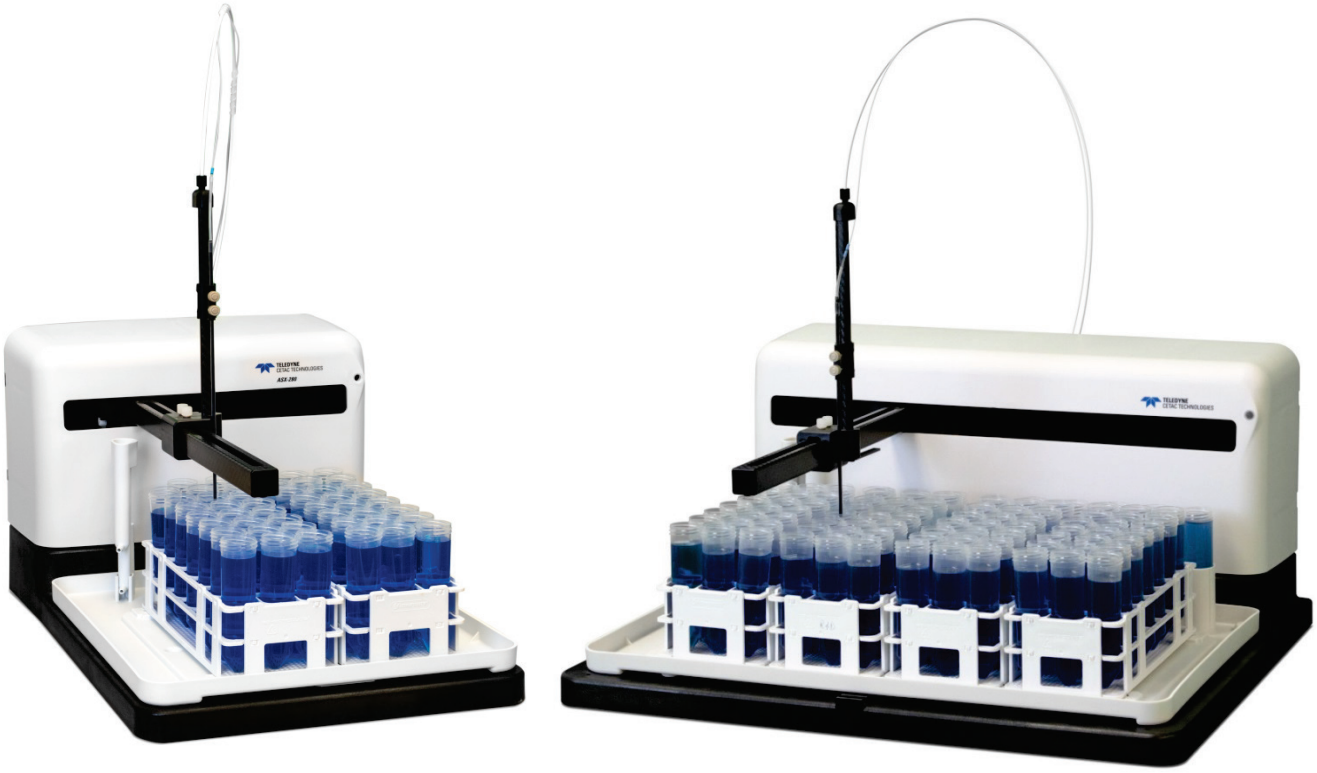
TELEDYNE
CETAC TECHNOLOGIES
Everywhereyoulook™

ASX-560 / ASX-280 Autosampler



Operator's Manual

Manual Part Number **480215** Rev2

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Teledyne CETAC Technologies
Customer Service & Support
14306 Industrial Road
Omaha, Nebraska 68144, USA
Phone (800) 369-2822 (USA only)
Phone (402) 733-2829
Fax (402) 733-1932
E-mail custserv@cetac.com

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1 Introduction

Overview

The CETAC ASX-560 and ASX-280 autosamplers are designed to be sturdy, reliable, and easy to use. It provides automated sample introduction that enables you to perform other tasks while the autosampler runs. The ASX-560 autosampler automatically introduces up to 360 samples when fully loaded; the ASX-280 has a capacity of 180 samples. It contains a microprocessor that allows sequential or random sampling, providing flexibility.

The autosampler is typically interfaced to and controlled by the analytical instrument host computer using a serial or USB connection. You can also connect the autosampler to other devices, such as an autodilutor, or use it with accessory equipment, such as a syringe pump or the CETAC *ASXPRESS PLUS* rapid sample introduction system.

About This Manual

This manual describes the procedures for installing, using, and maintaining your CETAC ASX-560 or ASX-280 autosampler. It also provides information about troubleshooting minor problems and describes the design of the autosampler.

This manual shows common versions of the ASX-560 autosampler. Your autosampler may have different racks, a different probe, or other minor differences from what is shown.

Who Should Read This Book

The primary audience for this manual consists of analytical chemists and lab technicians. To use this manual effectively, you should have a basic knowledge of chemistry, a basic knowledge of electronic sampling equipment, at least a beginning level of computer experience, and working knowledge of the analytical instrument used with the autosampler.

WARNING

CHEMICAL INJURY HAZARD
The autosampler is intended for use only by qualified operators who have been trained in safe laboratory practices. Make sure you know the hazards associated with all of the chemicals you are using, and take the appropriate precautions. Exposure to laboratory chemicals may result in serious injury.

Autosampler Standard Components

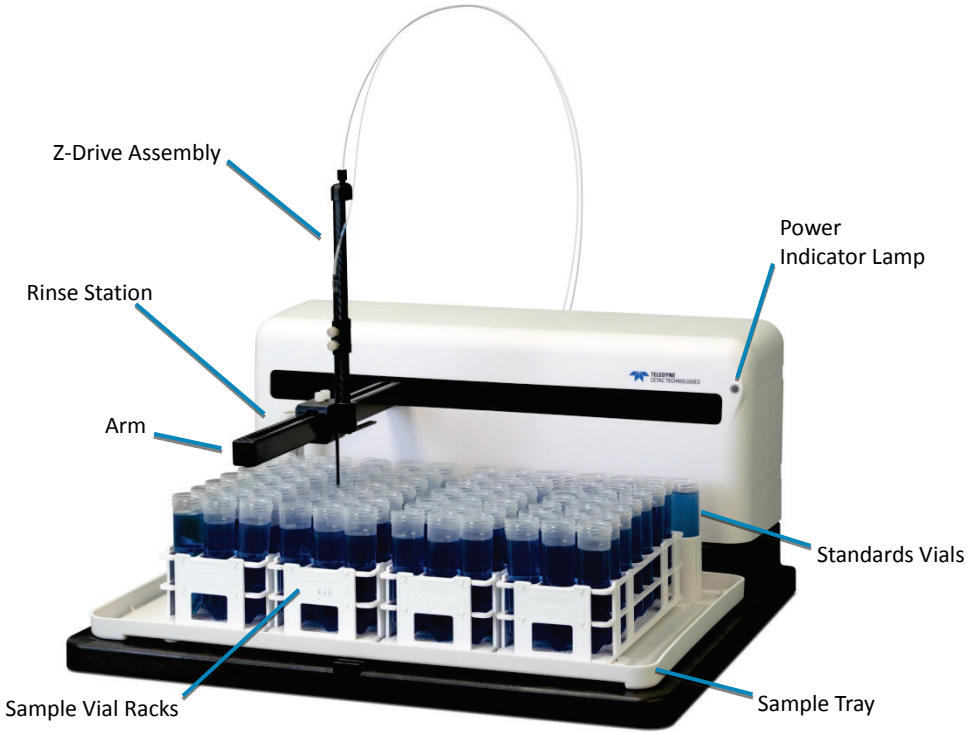

Figure 1-1 ASX-560 Autosampler—Front View

The following components are located on the front of the autosampler and are shipped with the autosampler (see Figure 1-1).

- **Sample Tray.** The sample tray holds the rinse station, sample racks, and standards vials in place. The tray also contains small spills.
- **Sample Vial Racks. T**he ASX-560 includes four sample vial racks; the ASX-280 includes two racks. You can choose from different rack sizes (common sizes fit 21, 24, 40, 60 or 90 vials per rack). You can combine racks of different sizes as long as the host computer's software accepts the combination.
- **Standards Vials.** Ten standards vials are included with the autosampler. The standards vials, which fit into the standards positions at the back of the sample tray, are 50-milliliter conical centrifuge vials with caps.
- **Rinse Station.** The flowing rinse station is located at the left end of the standards positions at the back of the sample base. It comes with tubing

used to connect the rinse station to the rinse source and the waste container.

- **Arm.** The arm moves the sample probe horizontally.
- **Z-Drive.** The Z-drive moves the sample probe vertically. The Z-drive assembly includes a Y-axis slider block and guide plate as well as the sample probe. The Z-drive attaches onto the autosampler arm.
- **Power Indicator Lamp.** The LED indicates that the autosampler is connected to a power source and turned on.

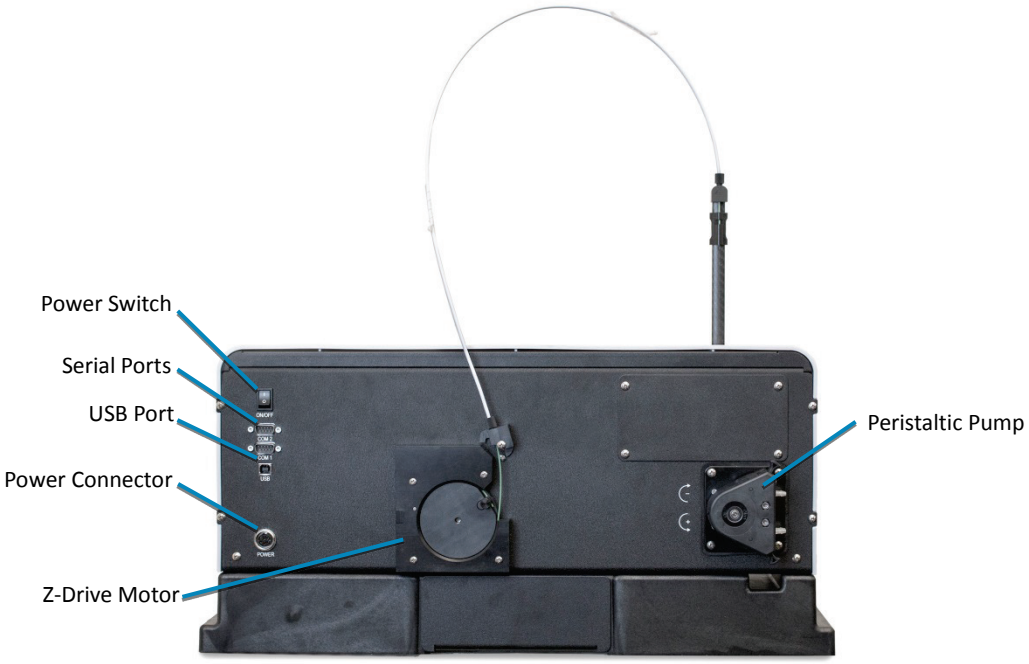

Figure 1-2 ASX-560 Autosampler—Back View

The following components are located on the back of the autosampler and are shipped with the autosampler.

- **On-board peristaltic pump.** A two-channel peristaltic pump moves the rinse solution from the rinse source through the flowing rinse station.
- **Serial Ports.** The COM1 port connects the autosampler with the analytical instrument's host computer. The COM2 port connects the autosampler to other external devices, such as an autodilutor.
- **USB Port.** The USB port can be used to interface the autosampler with the host computer.

The following standard components are also shipped with the autosampler:

- **Power Supply.** A desktop "brick" transformer powers the autosampler.
- **Sample Probe Kit.** The kit includes the sample probe. The sample probe fits into the Z-drive.
- **Communication Cables.** The contents of the kit depend on the version of the autosampler. Most kits include a 1.828-meter serial cable and a USB cable.

- **CD**. The CD contains, if applicable:
  - Utility software
  - USB device drivers
  - Manuals
  - Other application-specific information

Supplied components depend on the application and the exact version of the autosampler. See the packing list in the shipping container to see exactly which components are supplied.

Additional Equipment Required

In addition to the provided equipment, you will need:

- A host computer which has been configured with the control software for your instrument. This computer must have an additional free USB or serial port beyond the ports required to control the instrument and other system components.

Optional Accessories

You may need optional accessories in addition to the standard components included with the autosampler. See the *ASX-560 / ASX-280 Autosampler Spare Parts and Accessories Catalog* for details. Available accessories include:

- **Sample Vials and Racks.**
- **Sample Probes.** Extra probes are available in a variety of diameters. See table below for common probe sizes.

0.3 mm ID	Black band
0.5 mm ID	Blue band
0.8 mm ID	Red band
0.9 mm ID	Yellow band
1.0 mm ID	2 Blue bands

Table 1: Sample Probe Sizes and Color Coding

- **Dual Rinse Station.** The dual-rinse option allows more thorough rinsing to reduce sample contamination and carryover.
- **Enclosure.** The enclosure protects samples from contamination and contains and exhausts fumes.
- ***ASXPRESS PLUS*** **Rapid Sample Introduction System.** 6-port valve system which enables rapid sample loading and probe wash out.

NOTE:

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

Chemical Compatibility

The autosampler operates reliably under a wide variety of conditions. No metallic components are exposed above the sample vials. The top cover and base are made from polypropylene. The arm and Z-drive are made from carbon fiber.

The back and frame are made from a high-strength aluminum alloy that is treated with a RoHS-compliant chemfilm and finished with an epoxy powder coating. Long-term exposure to aqueous acids greater than 15% may cause discoloration or bubbling of the epoxy coating.

Internal splash shields protect against occasional exposure to corrosive chemicals. The covers are not sealed against liquid or vapor intrusion. Long-term exposure of the internal components to corrosive materials may cause damage.

Exposure to corrosive vapors can be minimized by using an enclosure with airflow directed down and away from the electronic components.

Components in the sample flow path are made of polyetherimide (PEI) and polytetrafluoroethylene (PTFE). When these inert, non-metallic materials are used at temperatures less than 135 °C, they can withstand repeated exposure to the following substances:

- Predominantly aqueous solutions of strong acids (less than 20%)
- Predominantly aqueous solutions of strong bases (less than 10%)
- Common organic solvents such as acetone, alcohols, ethyl acetate, methylethylketone (MEK), petroleum oils and derived fuels, and kerosene.

CAUTION

DAMAGE FROM CHEMICAL EXPOSURE
Prolonged or repeated exposure to temperatures greater than 135 °C and to the following substances can cause failure of the flow path components:
• Solutions of concentrated acids (greater than 40%).
• Solutions of concentrated bases (greater than 10% potassium, ammonium, or sodium hydroxides).
• Partially halogenated hydrocarbons or extremely aggressive organic solvents (chloroform, methylene dichloride, 1,1,2-trichloroethane).

Prolonged exposure to carbon tetrachloride can damage the autosampler.

WARNING

CHEMICAL HAZARD
Do not use the autosampler with substances which could pose a hazard of serious injury to the operator if spilled or injected, such as biological substances or formic acid.

Where to Go for More Information

In addition to this manual, you can refer to the following resources:

- New versions of this manual may be available under "Support" on CETAC's Web site:

  www.cetac.com

- *ASX-560 / ASX-280 Autosampler Spare Parts and Accessories Catalog*, available on the CETAC Web site.
- *CETAC Autosampler Safety Guide* provides basic safety-related information in a variety of languages.
- Online help within the ASX Dashboard software.
- Teledyne CETAC Technologies Customer Service and Support:
  Phone: 1 (800) 369-2822 (USA only)
  1 (402) 733-2829
  Fax: 1 (402) 733-1932
  E-mail: custserv@cetac.com
- The software manual for the instrument you are using.

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2 Preparing for Installation

Installing the autosampler requires preparation. Before you install the autosampler, you should evaluate the physical arrangement of the laboratory to choose a suitable location.

Choosing a Location

For the system to function optimally, the location you select must meet specific requirements.

Space Requirements

Most analytical applications benefit from using the shortest sample flow path. Therefore, you should place the autosampler in close proximity to the analytical instrument. The recommended footprint for the autosampler is shown in the following tables.

Height	28 cm (14") without Z-Drive	62 cm (24.4") with Z-drive and tubing
Width	58 cm (232.5)	
Depth	55 cm (21.6")	59 cm (23.5") with cables and tubing
Weight	11.7 kg (26 lbs) without racks or vials	

Table 2: Physical Characteristics – ASX-560

Height	28 cm (14") without Z-Drive	66 cm (26") with Z-drive and tubing
Width	36 cm (14.0")	
Depth	54 cm (21.0")	58 cm (22.8") with cables and tubing
Weight	8.1 kg (17.8 lbs) without racks or vials	

Table 3: Physical Characteristics – ASX-280

The weight shown is that of the autosampler itself, without the desktop power supply, tray, vials, sample probe, or tubing.

Allow *at least* 5 cm behind the autosampler for cable egress and access to the power switch. Always position the equipment so that it is easy to disconnect the power cord.

Work Surface Requirements

The autosampler must be placed on a sturdy countertop or table. Do not place the autosampler on a wheeled cart or folding table.

During operation, the autosampler produces both vertical and horizontal forces. If the work surface is allowed to shake or wobble, the autosampler may "walk" across the surface, liquids may spill, or data quality may be affected.

Rinse Solution Requirements

For most applications, deionized water or kerosene is used as the rinse agent. Place the rinse agent source within two meters of the autosampler.

Liquid Waste Routing Requirements

Ensure that there is a liquid waste receptacle within two meters of the autosampler. The waste receptacle inlet should be 30 to 60 centimeters lower than the autosampler rinse station outlet and set up so that the rinse drain tubing drops directly into the waste receptacle with no coiling and without being submerged below the liquid level of the waste receptacle.

CAUTION

SUBMERGED DRAIN TUBING MAY CAUSE EQUIPMENT DAMAGE
Ensure that the rinse drain tubing is not submerged in the waste liquid. If the tubing is submerged, waste liquid can back up in the rinse station, flooding the sample tray.

Power Requirements

The autosampler is powered by the supplied external desktop "brick" power supply. Place the autosampler within 1.2 meters of a power outlet.

WARNING

SHOCK AND FIRE HAZARD
Use only the provided power supply. The power supply must be plugged into an outlet which has a protective ground connection.

The autosampler is intended to operate from DC power supplied through the provided power supply. The power supply is provided power through an AC

power source that will not apply more than 240 VAC between the supply conductors and ground. A protective ground connection by way of the grounding connector in the power cord is required for safe operation.

Ensure that you position the autosampler so that the location where the power supply cord plugs into it is easily accessible (is not blocked) so that it can be quickly disconnected if needed. In case of hazard, the autosampler should be disconnected from the power source.

The power supply socket is on the back of the autosampler below the power switch. Connect the power supply to the autosampler first and then connect a line cord to the power supply. Do not apply power to the power supply until ready to operate the autosampler.

Unpacking the Autosampler

Inspect external packaging upon receipt for signs of shipping damage. Inspect all items during unpacking and notify the carrier immediately of any concealed damage. Check for kinked or bent tubing.

If the system is shipped or removed from storage during cold weather, allow the packaged equipment to equilibrate to room temperature before opening and exposing to warm, humid air. It is usually sufficient to provide four to eight hours for this purpose.

CAUTION

EQUIPMENT DAMAGE FROM CONDENSATION
If condensation forms on or inside the autosampler, allow it to dry thoroughly before connecting it to a power source and operating it. Failure to do so may cause equipment damage.

Remove the packing checklist from the shipping container, and check off items against it. Leave accessories in the packing until you are ready to install them.

NOTE

Keep the factory packaging for use in case the product ever needs to be returned or shipped to another location.

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3 Installing the Autosampler

The autosampler can be installed with minimal effort; no tools are required. You can remove thumbscrews with tools if necessary, but do not tighten them with anything other than your fingers.

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

- Mount the Z-drive.
- Connect the rinse station.
- Assemble the sample vial racks.
- Connect the sample tubing to the analytical instrument.
- Connect the autosampler to the power supply and to the host computer.

WARNING

PINCH/PUNCTURE HAZARD
Ensure the power switch is off and the power cord is unplugged before proceeding with installation. If the power is left on, motors may move unexpectedly and cause injury.

Mounting the Tray and Rinse Station

1. Place the tray on the base of the autosampler.
2. Place the rinse station on the post on the back left corner of the tray. Press straight down until it is fully seated.

Figure 3-1 Mounting the Rinse Station

Mounting the Z-Drive

The Z-drive moves the probe up and down. The Z-drive is shipped detached from the autosampler.

Attaching the Z-Drive to the Autosampler Arm

1 Carefully remove any packaging materials from the Z-drive.

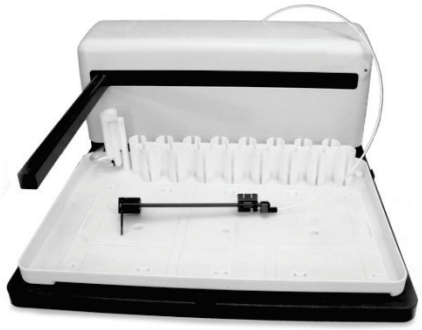

Figure 3-2 Z-Drive Before Installation

2 Find the Y-axis carriage on the arm of the autosampler. The Z-drive will be attached to this carriage.

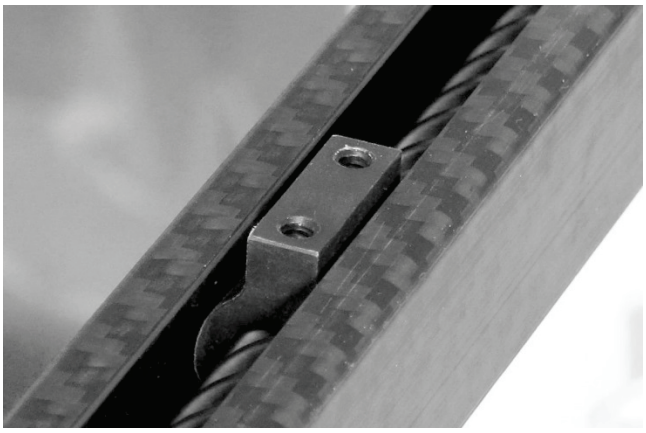

Figure 3-3 Y-Axis Carriage

3 Slide the Z-drive onto the y-arm until the two holes in the Y-axis slider block align with the matching holes in the Y-axis carriage.

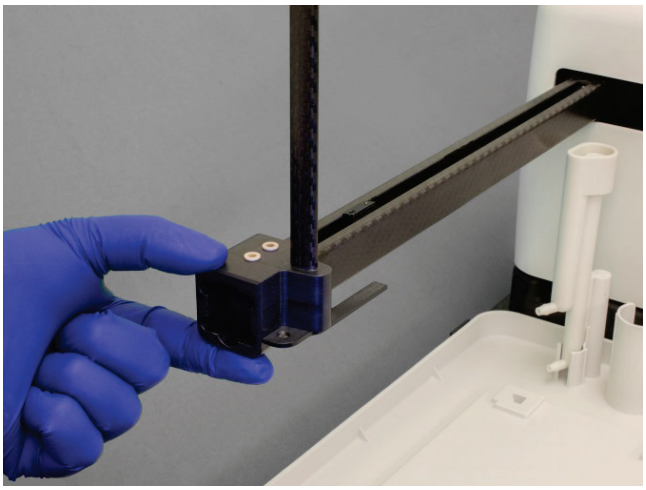

Figure 3-4 Sliding the Z-Drive Onto the Arm

4 Secure the Z-drive to the carriage using the two thumbscrews.

CAUTION Do not tighten the thumbscrews with anything other than your fingers.

Figure 3-5 Securing Z-Drive Onto the Arm

5 Feed the cable through the rear guide block and around the rotor, then tighten the nut to secure the cable sleeve to the guide block.

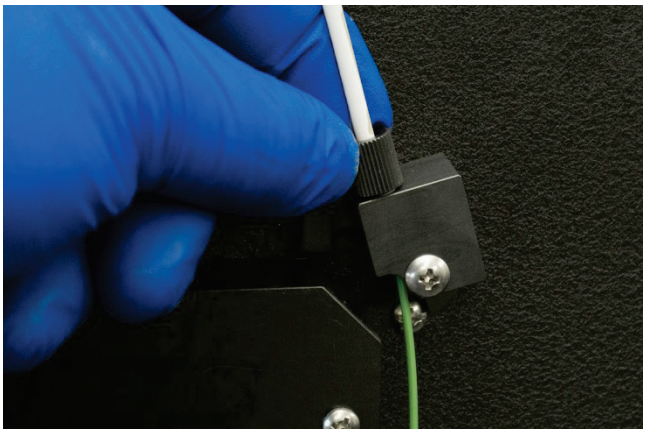

Figure 3-6 Guide Block with Nut

6 Turn the rotor clockwise as far as it will go.

7 Finish sliding the cable around the rotor on the back of the autosampler. Loosen the thumbscrew on the rotor to allow the cable to pass through the clamp, with about 2 mm of cable extending past the clamp.

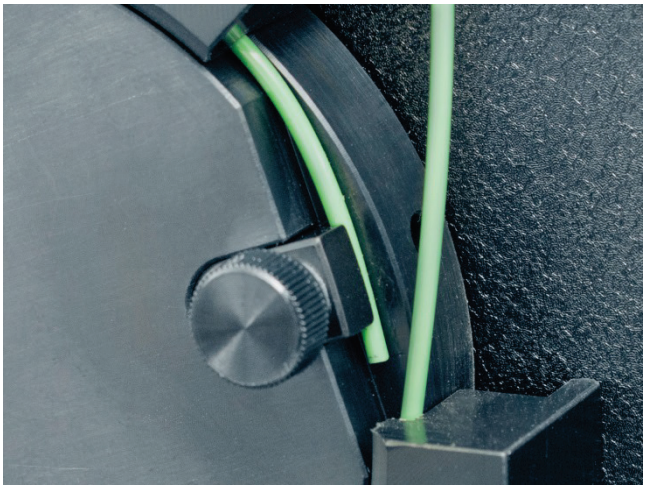

Figure 3-7 Position of Cable on Rotor

8 Verify that there is a small gap between the Z-axis slider and cap at the top of the Z-drive (approximately 1-3 mm). Adjust the cable a bit if necessary.

Figure 3-8 Z-Drive at Top Position With Gap

9 Hold the cable flat against the rotor and secure the cable by tightening thumbscrew on the rotor. The thumbscrew should be as tight as possible using just your fingers.

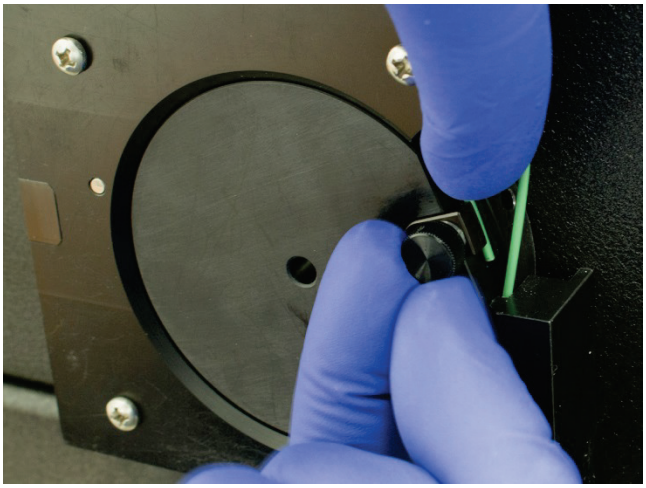

Figure 3-9 Securing Cable to Rotor

The cable is pre-cut to the proper length and does not need to be trimmed when properly installed.

10 Rotate the Z-drive rotor back and forth to ensure that the Z-drive moves up and down freely.

CAUTION Never push the Z-axis slider to move it up or down. Pushing on the Z-axis slider can kink the drive cable. Instead, rotate the Z-drive rotor on the back of the autosampler.

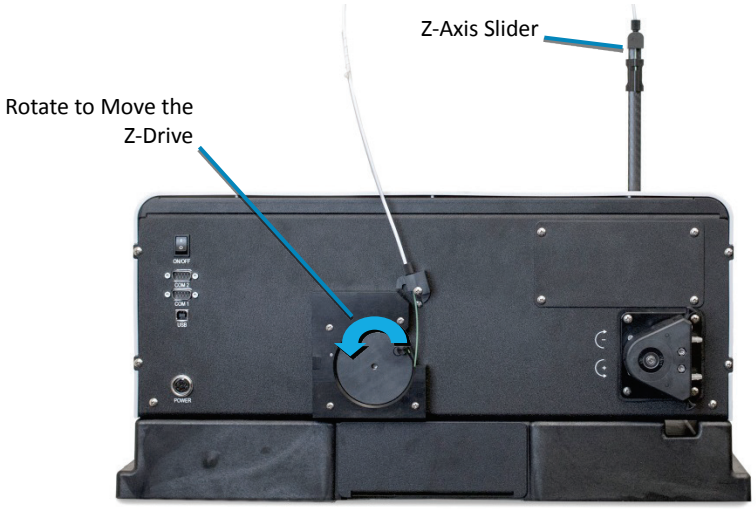

Figure 3-10 Z-Drive Rotor

If the rotor does not rotate freely, STOP and reinstall the drive cable (see "Replacing the Z-Drive" on page 75).

Connecting the Rinse Station

The rinse station is mounted to the tray of the autosampler, at the left end of the standards rack.

Typically, deionized water, an acid rinse such as a 2% HNO_3, or a solution from the kerosene family, is used as the rinse solution.

The rinse solution flows from the sample probe reservoir to the drain (rinse out) reservoir within the rinse station. The waste rinse solution is then drained from the rinse station.

The inlet of the rinse station is at the bottom of the rinse station. The rinse solution flows from the bottom to the top of the sample probe reservoir. Up-flow rinsing is the most effective method for decontaminating the sample probe tube between samples. Reversing the connections will reverse the flow direction, resulting in cross-contamination and unsatisfactory performance.

Waste Rinse Solution

In most cases, rinse solution will be "recycled" by returning it to the rinse solution bottle. If necessary, rinse solution can be pulled from a fresh bottle and used solution drained to a waste container. Remember to label the waste container according to your laboratory policy and local regulations.

Ensure that the tubing outlet is placed so that it will remain above the surface of the liquid in the waste container. If the end of the tube is immersed, the waste solution might back up and overflow.

Tubing Considerations

Verify that the supplied tubing material is compatible with the rinse solution you are using. There are many different types of tubing that can be used for the rinse station. Clear Tygon® tubing is provided. Viton®, Tygon® Fuel and Lube (yellow), and PharMed® (opaque) may also be used for pump tubing depending on the application and user preference. Clear Superthane® tubing can used everywhere other than the pump tubing. Contact CETAC if you need different tubing material.

The fittings on the rinse station use $^3/_{16}$ inch (4.8 mm) ID tubing, but the fittings on the peristaltic pump use smaller ⅛ inch (3.2 mm) ID tubing. If tubing needs to be replaced, a tubing kit with a adapter fittings can be ordered from CETAC.

Carefully press the tubing straight on to the fittings to avoid breaking the fittings. If you find it difficult to get a good connection to the rinse station, remove the rinse station and press the tubing firmly so that it completely covers the barb of the fitting. It helps to use your other hand to apply counter-pressure.

Pumped Drain Arrangement

In a pumped drain arrangement, one channel of the peristaltic pump to supply rinse solution to the rinse station, while the other channel of the pump drains the used rinse solution.

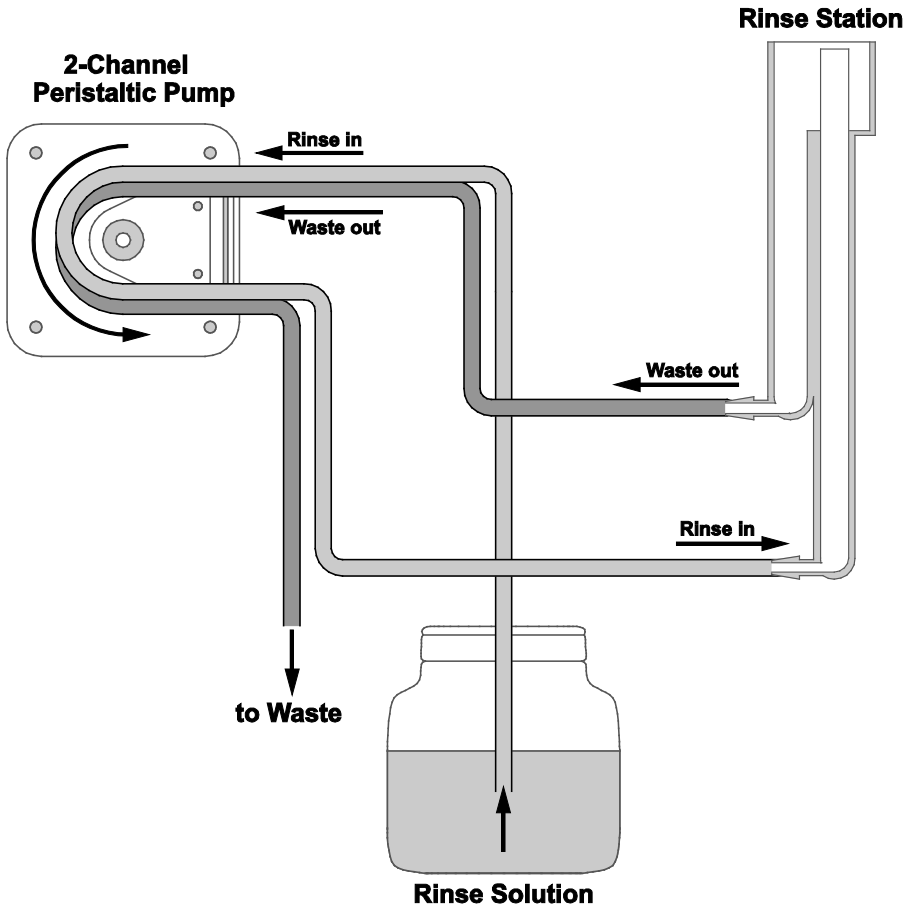

Figure 3-11 Typical Pumped Drain Arrangement

To connect the rinse station using the pumped drain, complete the following steps:

1 Locate the two pieces of adapter tubing.

Figure 3-12 Adapter Tubing

2 Connect the smaller end of one of the pieces of adapter tubing to the fitting at the bottom of the pump, closest to the back of the autosampler.

Figure 3-13 Connecting the Pump Output

3 Connect the larger end of the tubing to the bottom fitting of the rinse station.

Figure 3-14 Connecting the Rinse Station Input

4 Find the pump channel which is connected to the rinse station. Use an appropriate length of the smaller ⅛ inch (3.2 mm) ID tubing to connect the rinse solution source to the fitting at the top of this channel.

Figure 3-15 Connecting the Rinse Solution Input

5 Locate the other piece of adapter tubing.

6 Connect the larger end of the adapter tubing to the outlet fitting of the rinse station.

Figure 3-16 Connecting the Rinse Station Drain

7 Connect the smaller end of the adapter tubing to the input of the second pump channel.

Figure 3-17 Connecting the Rinse Station Drain to the Pump Input

8 Connect up to 1.8 meters of the larger $^{3}/_{16}$ inch (4.8 mm) ID tubing between the outlet fitting of the pump and the waste container.

Figure 3-18 Connecting the Rinse Station Drain

Ensure that the tubing outlet is placed so that it will remain above the surface of the liquid in the waste container. If the end of the tube is immersed, the waste solution might back up and overflow.

Gravity Drain Arrangement

The simplest arrangement is for one channel of the peristaltic pump to supply rinse solution to the rinse station, while the used rinse solution drains by gravity.

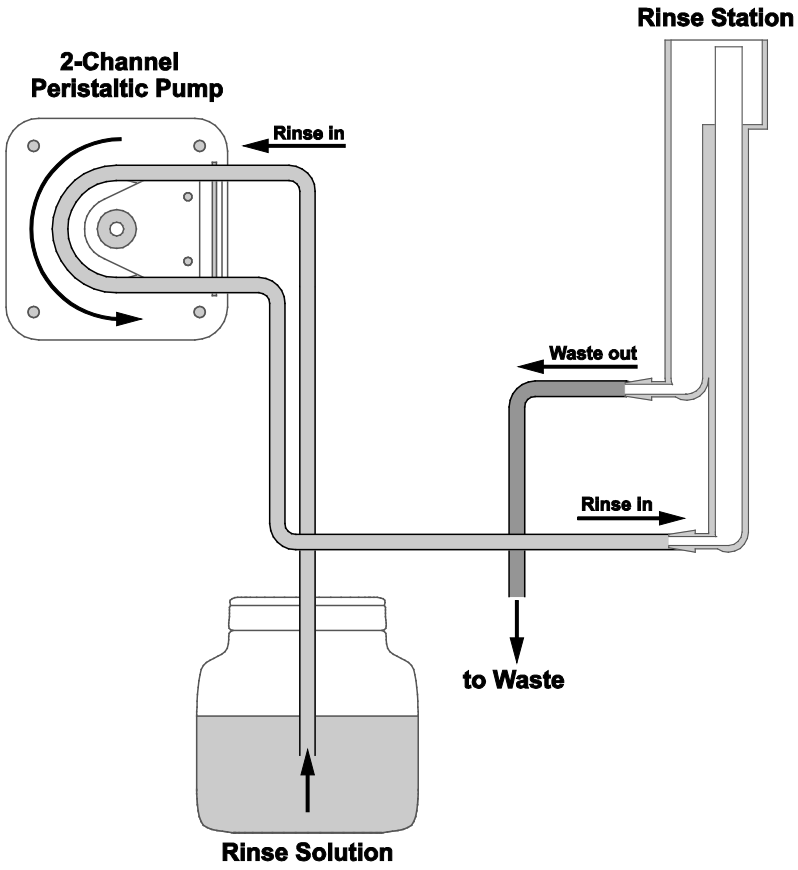

Figure 3–5 Gravity Drain Arrangement

In a gravity drain arrangement, the rinse solution moves through the peristaltic pump to the inlet at the bottom of the rinse station, as shown in Figure 3-5. It then drains out the top of the rinse station by means of a gravity drain.

Depending on your application, the waste rinse solution may be returned to the rinse solution container and recycled, or it may be directed to a separate waste container.

To connect the rinse station using a gravity drain, complete the following steps:

1 Locate one of the pieces of adapter tubing.

Figure 3-19 Adapter Tubing

2 Connect the smaller end of the adapter tubing to the fitting at the bottom of the pump, closest to the back of the autosampler.

Figure 3-20 Connecting the Pump Output

3 Connect the larger end of the tubing to the bottom fitting of the rinse station.

Figure 3-21 Connecting the Rinse Station Input

4 Use an appropriate length of the smaller ⅛ inch (3.2 mm) ID tubing to connect the rinse solution source to the fitting at the top of this channel.

Figure 3-22 Connecting the Rinse Solution Input

5 Connect up to 1.8 meters of the larger $^{3}/_{16}$ inch (4.8 mm) ID tubing between the outlet fitting of the rinse station and the waste container.

Figure 3-23 Connecting the Rinse Station Drain

Ensure that the tubing outlet is placed so that it will remain above the surface of the liquid in the waste container. If the end of the tube is immersed, the waste solution might back up and overflow.

Dual-Rinse Gravity Drain Arrangement

A dual rinse station can be used to reduce sample contamination and carryover.

With a gravity drain arrangement, the peristaltic pump supplies rinse solution to both tubes the rinse station, while the used rinse solution drains from both tubes by gravity. The rinse solution can come from one container, or it can come from two different containers.

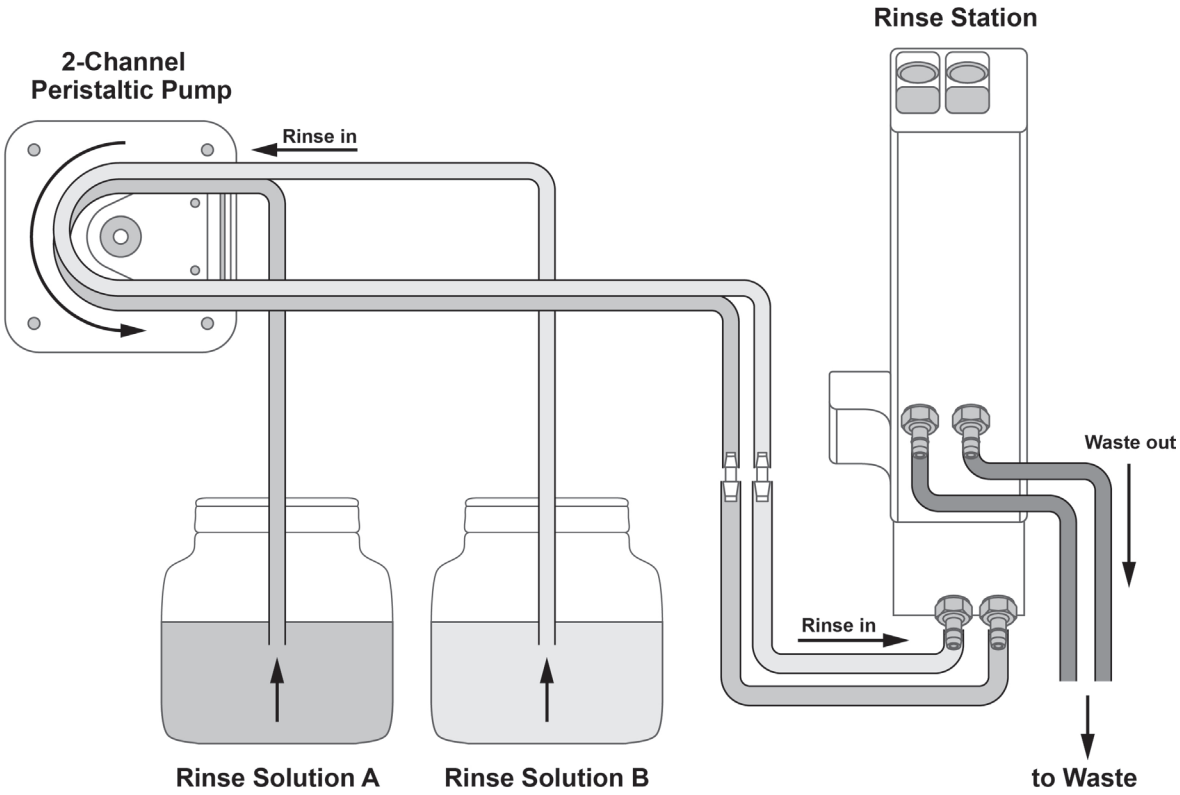

Figure 3-24 Dual-Rinse Gravity Drain Tubing Arrangement

Figure 3-25 Dual Rinse Station

1 Install a peristaltic pump tubing cartridge which has 2 mm ID tubing on both channels. (On Teledyne CETAC tubing cartridges, this is indicated by black endplates.) See page 71 for instructions on how to install the tubing cartridge.

2 Locate the two pieces of adapter tubing.

Figure 3-26 Adapter Tubing

3 Route the adapter tubing through the "tunnel" under the autosampler head, with the smaller end facing the peristaltic pump and the larger end facing the rinse station.

4 Connect the tubing to the bottom two connectors of the rinse station.

5 Connect the tubing to the fittings at the bottom of the pump.

6 Use an appropriate length of the smaller ⅛ inch (3.2 mm) ID tubing to connect the rinse solution source(s) to the fittings at the top of the pump.

7 Connect two pieces of $^{3}/_{16}$ inch (4.8 mm) ID drain tubing to the upper connectors of the rinse station.

When first setting up the system, use two separate drain tubes. If the flow rate is low enough, and if the waste container is very close to the autosampler, it may be possible to join the tubes with a Y connector.

Ensure that the tubing outlet is placed so that it will remain above the surface of the liquid in the waste container. If the end of the tube is immersed, the waste solution might back up and overflow.

8 Once the autosampler has been set up and connected to a computer, use the ASX Dashboard software to enable the dual-rinse option and adjust the timing and flow rate. See page 68 for more information.

Dual-Rinse Pumped Drain Arrangement

If the rinse solution backs up and overflows with the dual-rinse gravity drain arrangement, even when the tubing is free of obstructions, you can use a pumped drain arrangement.

With a pumped drain arrangement, one channel of the peristaltic pump supplies rinse solution to both tubes the rinse station, while the other channel of the pump drains the used rinse solution from both tubes.

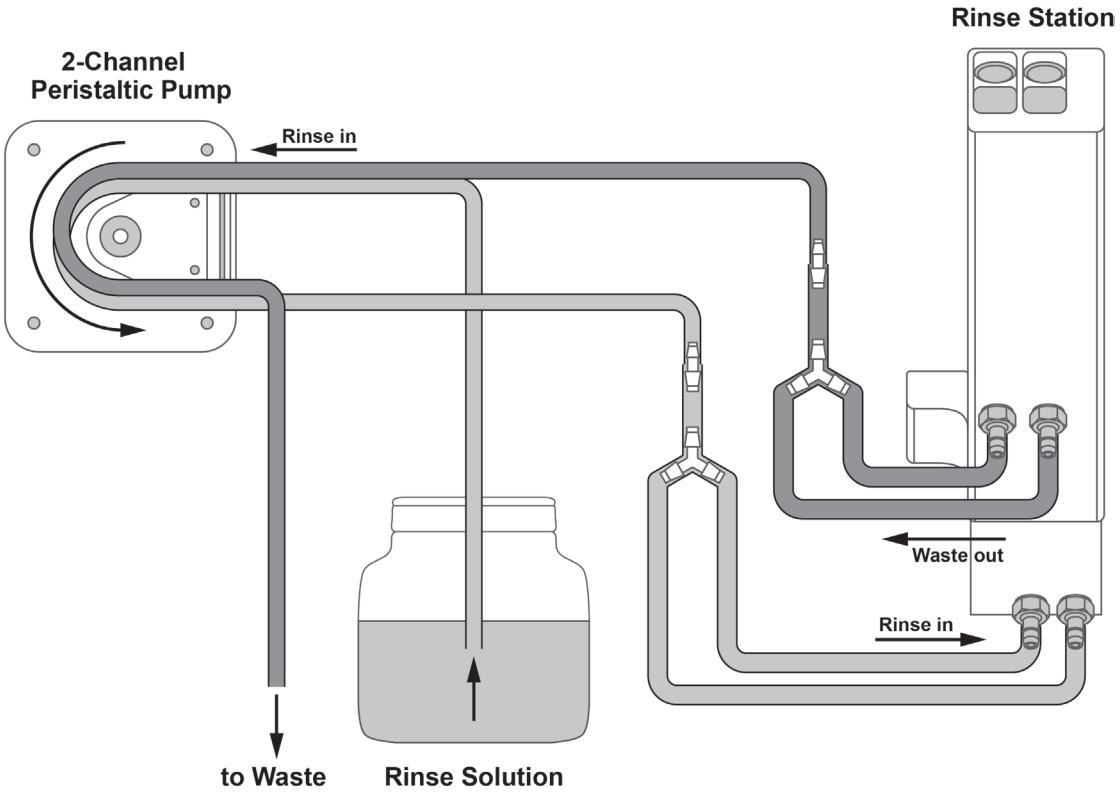

Figure 3-27 Dual Rinse Tubing Arrangement

1. Install a peristaltic pump tubing cartridge which has 2 mm ID tubing on the inner channel and 3 mm ID tubing on the outer channel. (On Teledyne CETAC tubing cartridges, this is indicated by red endplates.) See page 71 for instructions on how to install the tubing cartridge.

2. Locate the two pieces of Y-adapter tubing.

Figure 3-28 Adapter Tubing

3 Route the adapter tubing through the "tunnel" under the autosampler head, with the smaller end facing the peristaltic pump and the Y end facing the rinse station.

4 Connect one of the Y-tubing assemblies to the bottom two fittings of the rinse station. This tubing will supply fresh rinse solution to both rinse ports.

5 Connect one of the Y-tubing assemblies to the top two fittings of the rinse station. This tubing will drain rinse solution from the rinse station.

6 Connect the rinse supply tubing assembly to the bottom, inner fitting of the peristaltic pump.

7 Connect the drain tubing assembly to the top, outer fitting of the peristaltic pump.

> **NOTE**
>
> It is important that the drain tubing is connected to the *outer* channel of the pump, which is equipped with the larger-diameter tubing.

8 Use an appropriate length of the smaller ⅛ inch (3.2 mm) ID tubing to connect the rinse solution source(s) to the fitting at the top, inner fitting of the peristaltic pump.

9 Connect a piece of the larger $^{3}/_{16}$ inch (4.8 mm) ID drain tubing to the bottom, outer fitting of the peristaltic pump.

Ensure that the tubing outlet is placed so that it will remain above the surface of the liquid in the waste container. If the end of the tube is immersed, the waste solution might back up and overflow.

10 Once the autosampler has been set up and connected to a computer, use the ASX Dashboard software to enable the dual-rinse option and adjust the timing and flow rate. See page 68 for more information.

Assembling and Placing the Sample Vial Racks

The sample vial racks are shipped unassembled. You can easily assemble them without using tools.

WARNING

PUNCTURE HAZARD
Never attempt to load, unload or reposition the sample vial rack or sample vial while the autosampler is operating. The sample probe may move unexpectedly and cause an injury.

1. Before loading or unloading any sample vial racks on the sample tray, park the sampling arm and probe in the home position by cycling the power on and off. The home position is the initial position at power up.

2. Snap the racks together as shown in the instructions included with each rack.

   You can disassemble the racks if you need to ship or store them.

   NOTE:

   Keep at least one copy of the rack assembly instructions.

3. Place the first sample vial rack at the extreme left-hand side of the sample tray.

   Ensure the rack is not tilted and is fully seated on the tray.

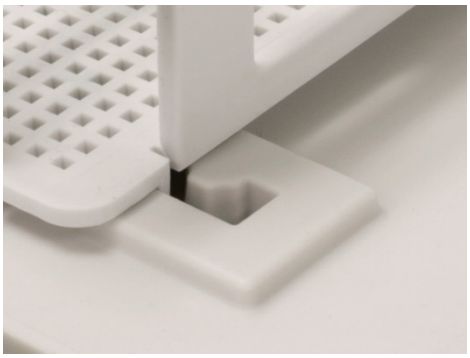

Figure 3-29 Rack Fully Seated on Tray

4. Place the next sample vial rack to the right of the previous rack.

Figure 3-30 Typical Arrangement of Racks

5 Repeat until you place all the sample vial racks.

When viewed from the front of the autosampler, the sample vial racks should now be arranged on the sample tray as follows: Rack #1 at the extreme left position, Rack #2 at the left center position, Rack #3 at the right center position and Rack #4 at the extreme right position.

Installing the Sample Probe

> **NOTE**
>
> To prevent contamination, wear gloves when handling the probe.

1 Shut down and unplug the autosampler.

2 Rotate the rotor on the back of the autosampler to move the Z-axis slider to the top of the Z-drive.

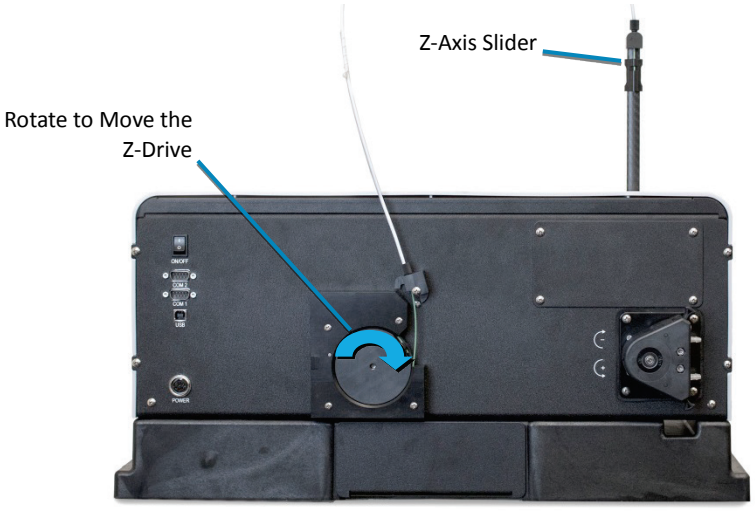

Figure **3-31** Raising the Z-Axis Slider

3 Loosen the nuts of the two probe clamps.

4 Insert the clamps onto the Z-axis slider.

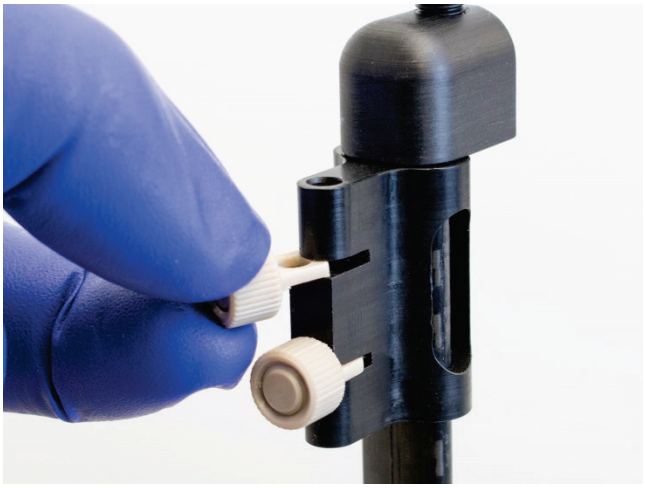

Figure 3-32 Installing the Probe Clamps

5 Guide the probe straight down until the tip of the probe is level with the bottom of the Z-Drive. See "Setting the Z-Axis Travel" on page 74.

6 Tighten the probe clamps.

7 Use the provided spiral wraps to secure the sample tube to the Z-drive cable. Position the spiral wraps 2 cm above he top of the Z-drive and at the highest point of the Z-drive cable. Sometimes it works better to use tie points approximately 15 and 40 centimeters above the top of the Z-drive. There should be just a little curve to the free sample tube when the probe is lowered, and an untangled loop when the probe is raised.

Always position the sample transfer tubing so that it does not pull on the probe. The tubing should naturally curve away from the probe so that it won't rub or get caught. Be sure to check that the tubing will not be stretched and will not snag on an obstacle when the probe is moved to the far corner sample positions.

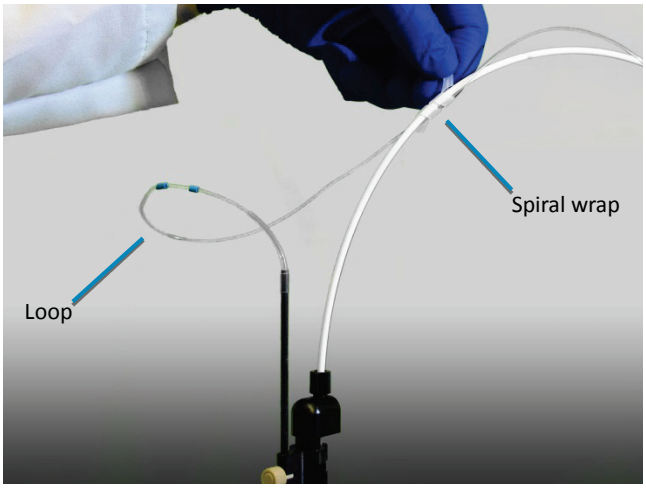

Figure 3-33 Positioning the Sample Tubing

8 Optional: Moisten a Kimwipes® wiper with 10% HNO_3 and wipe the probe to remove any aqueous or inorganic contamination from the surface. Then moisten a new Kimwipes wiper with a chromatography grade solvent such as n-propanol, isopropanol, or hexane and wipe the probe again to remove any oil. Let the probe air dry. Be careful not to touch the probe without gloves—residue from handling the probe can cause the surface tension properties of the probe surface to change and can lead to material dripping off the probe during use. Periodic cleaning may be necessary depending on the application.

Connecting to the Analytical Instrument's Sample Port

You can connect the autosampler directly to a sample introduction peristaltic pump and then to any sample introduction device, such as the CETAC U5000AT+ or U6000AT+ Ultrasonic Nebulizer.

One end of the sample transfer tubing is preconnected to the sample probe.

The transfer tubing should be long enough so that it there will be no strain on the tubing connectors even when the sample probe is at the position farthest from the analytical instrument. On the other hand, keep the sample transfer tubing as short as possible. This will:

- Minimize washout time
- Minimize sample carryover
- Reduce the chance of tangled tubing

1 Determine the length of the sample transfer tubing you need, and cut it to size.

2 Connect the free end of the sample transfer tubing to the inlet of the analytical instrument's peristaltic pump.

Enclosure Connections

If an enclosure is present, connect the trimmed tubing from the sample probe to the inside bulkhead using the nut and ferrule provided with the enclosure.

Then attach tubing from the outside bulkhead to the input of the analytical instrument.

Connecting the Autosampler to the Power Supply

The autosampler is powered by the supplied external desktop "brick" power supply. Ensure that you position the autosampler so that the location where the power supply cord plugs into it is easily accessible (is not blocked) and it can be quickly disconnected if needed. In case of hazard, the system should be disconnected from the power source.

1. Turn the power switch on the autosampler OFF.
2. Check the plug on the power cord to verify that it is of the correct type for your country.
3. Plug the power cord into a power outlet.
4. Plug the power cord into the power supply.

Figure 3-34 Power Supply

5. Plug the power supply into the 24 V connector on the autosampler.
6. Turn the power switch on the autosampler ON.

It is important to use the appropriate power cord for your country. See

- "Power requirements" on page 94.
- "Power Cord Set Requirements" on page 95.

WARNING

FIRE AND SHOCK HAZARD
Use only the provided desktop power supply. The power supply must be plugged into an outlet which has a protective ground connection.

Connecting the Autosampler to the Host Computer

Software on the host computer controls both the analytical instrument and the autosampler. You cannot operate the autosampler until you establish a communication interface between the autosampler and the host computer. It is through this interface that the host computer directs the operation of the autosampler. The autosampler supports the following communication interfaces:

- The USB interface is the standard configuration. A virtual COM port is created so that the connection looks like a standard RS-232 serial port to the host PC software.
- The serial (RS-232) interface is simple and reliable, but the host computer may lack a free serial port.

> **NOTE:**
>
> Although the autosampler supports several communications protocols, the host computer governs which protocol is used. To determine which protocol is required for the analytical instrument you are using, refer to the hardware or software manual provided with the instrument.

Connecting a Serial Cable

Use either a serial cable or a USB cable (not both).

You will need a serial cable equipped with two male DB-9 connectors.

1. Plug one end of the cable into the host computer's serial (COM) port.

   If the computer has more than one serial port, make sure to use the same port which is selected in the instrument control software.

2. Finger-tighten both screws of the connector.

3. Connect the other end of the cable to the autosampler's COM1 port.

4. Finger-tighten both screws of the connector.

> **NOTES**
>
> If a host computer serial port with a DB-9F, a DB-25M, or a DB-25F connector (9 pin D-subminiature receptacle or 25 pin D-subminiature plug or receptacle) must be used, use an adapter to convert the serial port to a DB-9M. **Do not use a "null modem" adapter.**
>
> Ensure you are connecting the serial cable to the COM1 port. Connecting the adapter to the COM2 port on the autosampler will cause a malfunction.
>
> When interconnecting any computing devices, keep the communications cables away from sources of electromagnetic or radio frequency (RF) interference, such as electric motors, transformers, fluorescent light ballasts, or RF energy sources. Limit cable runs for RS-232C to less than 16 meters. If

these conditions cannot be satisfied, use low-impedance, fully shielded cables to provide satisfactory operation. The cables are available from many sources, but you will need to specify the correct mating connectors and "straight-through" (DTE-DCE) wiring.

Connecting a USB Cable

Use either a serial cable or a USB cable (not both).

You will need an "A-B" USB cable.

Figure 3-35 USB Cable

1. Power on both the computer and the autosampler.
2. Plug one end of the cable into the host computer's USB port and the other end into the autosampler's USB port.

   The computer screen should display a "New Hardware Found" window. A USB driver must be installed to make the USB port emulate an RS-232 COM port, and the installation must be repeated for each USB connection.
3. Allow the Windows Found New Hardware Wizard to use Windows Update to search for a driver.

   In most cases, the driver will be found online and installed automatically. This process may take several minutes.

   If the driver is not installed automatically, insert the CD-ROM and allow the wizard to search the CD-ROM and install the driver (the exact procedure depends on the version of the Windows operating system). For Microsoft Windows 7, you may need to navigate to the "FTDI Driver" folder on the CD-ROM to find the driver file named "ftdiport.inf". The hardware will be identified as an "FT 232R USB UART" and then as a "USB Serial Converter."

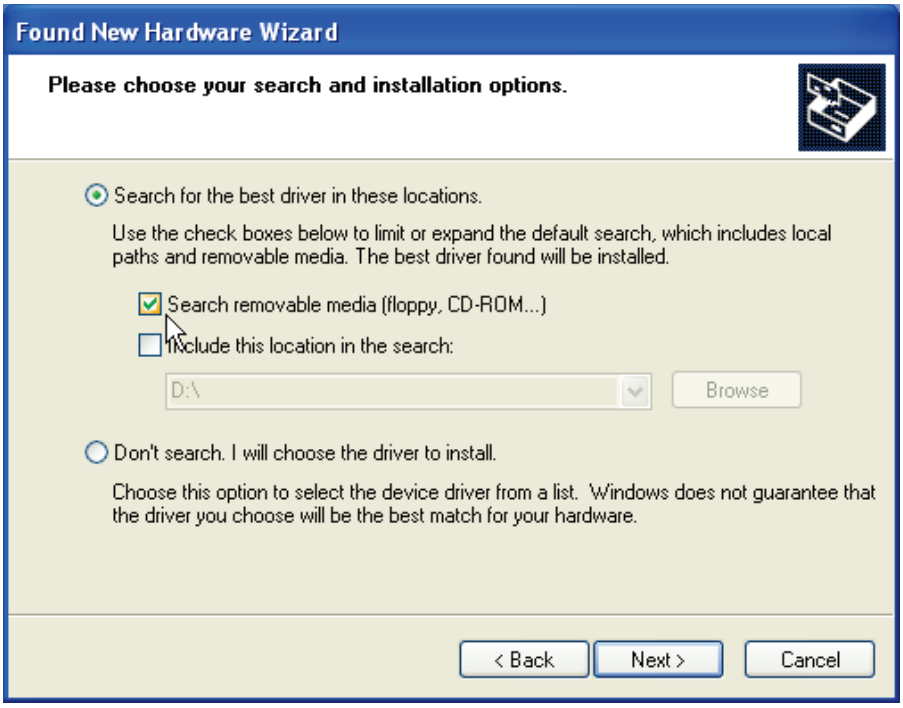

Figure 3-36 Windows Found New Hardware Wizard (Windows 7)

4 When driver installation is complete, make a note of which COM port number was assigned. The COM port number may be displayed in a "bubble" in the lower right corner of the screen.

5 Confirm that the COM port selected for the USB matches the port selected in the host computer's instrument control software.

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4 Verifying Installation (IQ and OQ)

Once installation of the autosampler is complete, it is important to verify that you have installed it correctly. Attempting to use it before ensuring that it is installed correctly may result in damage to the autosampler.

Installation qualification (IQ), operational qualification (OQ), and performance qualification (PQ) for this autosampler is typically performed by the user. IQ demonstrates that the autosampler was shipped, unpacked, and installed correctly. OQ demonstrates that the measurement system (typically consisting of the autosampler, the host computer, the analytical instrument, and other equipment) performs as required by the experimental method. PQ demonstrates that the measurement system consistently meets the requirements of the tests and methods performed at your laboratory.

Qualification testing is required for laboratories in some industries with Good Laboratory Practices (GLP) or Good Manufacturing Practices (GMP) requirements. Even in unregulated laboratory environments, these tests can provide an extra degree of confidence that the autosampler will work as expected.

Basic Verification

Even if you do not plan to complete the full IQ procedure, you should verify the following two items:

- Ensure that the communications interface between the autosampler and the host computer is working.
- Ensure that the sample probe functions properly.

This can be done using your ICP-MS or other instrument control software, or with the provided ASX Dashboard (see page 49).

Installation Qualification (IQ)

IQ verifies that the autosampler was shipped, unpacked, and installed correctly.

Qualification consists of the following:

- Inventory of supplied equipment
- Operating environment checklist
- Visual inspection
- Installation checklist
- Communication test
- X/Y/Z movement and alignment test
- Peristaltic pump test

An IQ checklist is provided on page 52.

Inventory of Supplied Equipment

1 Verify that the following items are present:

- Autosampler
- Power cord with the appropriate connector
- Sample probe of appropriate type, with attached sample tubing
- Software and documentation CD

2 Verify that all other items on the included packing list are present.

3 Verify that all standard components are present. See page 8.

Operating Environment Checklist

1 Verify that the requirements in Chapter 2, "Preparing for Installation," have been met.

Visual Inspection

The following autosampler components may be damaged during shipping or installation: the sample probe, the peristaltic pump tubing, and the rinse station and tubing. It is important that you check these components for damage before you operate the autosampler. To do so, complete the following steps:

1 Shut down and unplug the autosampler.

2 Visually inspect the sample probe, peristaltic pump tubing, and rinse station and tubing for leaks or signs of damage.

3 Visually check for moisture condensation which may have occurred during shipment.

If you detect a leak or other damage to an autosampler component, you must replace it. For more information, see the appropriate section in Chapter 6, "Maintaining the Autosampler."

Installation Checklist

1 Mount the Z-drive and connect tubing and cables, following the instructions in Chapter 3, "Installing the Autosampler," beginning on page 19.

Communication Test

If the communications interface between the autosampler and the host computer is not established correctly, the autosampler will not function.

1 Check that the communication cables are properly attached between the host computer and the autosampler.

2 Turn the autosampler power switch on and verify that the LED power indicator lamp is on.

3 If you have not already done so, install the ASX Dashboard software on the host computer. See page 65.

4 Start the ASX Dashboard software.

5 From the ASX Dashboard, click **Autosampler IQ-OQ**.

If properly connected, the autosampler will appear on the list of available autosamplers at the top of the window.

> **ALTERNATIVE:**
>
> From the ICP-MS or other instrument control software, command the autosampler to go to the HOME position.

X/Y/Z Movement and Alignment Test

The sample probe must descend into the center of each sample vial to ensure satisfactory sample uptake. Shipping or rough handling can disturb the autosampler's cabinet-to-base alignment. If it is incorrectly aligned, the sample probe will not function properly. It is therefore important to test the sample probe before you actually run samples with the autosampler.

> **NOTE:**
>
> Before testing the sample probe, ensure that you have installed all autosampler components correctly. Also, ensure that you have securely tightened all thumbscrews and connected the communications cable from the host computer to the autosampler.

Testing the sample probe involves observing the operation of the sample probe. To do so, complete the following steps:

1 Remove all vials, racks, and standards from the autosampler tray.

CAUTION

Remove everything from the autosampler tray. The "4 Corners" test will lower the sample probe at the edges of the autosampler range of motion. If vials or racks are present, the probe may be damaged.

2. Turn the autosampler power switch on and verify that the LED power indicator lamp is on.
3. From the ASX Dashboard, click **Autosampler IQ-OQ**.
4. If any obstacles remain on the tray or base of the autosampler which cannot easily be removed, set the **Z Depth** so that the sample probe will not collide with anything when it is lowered.
5. Click **4 Corners** to move the sample probe to the four corners of the sample tray.
6. Observe the motion of the autosampler and verify that the sample probe descends at each of the four corners of the autosampler.

ALTERNATIVE:

Use the instrument control software on the host computer, command the autosampler to move to the sample positions at the left rear, left front, right rear, and right front of the sample tray.

Peristaltic Pump Test

1. From the Autosampler IQ-OQ utility, click **Pump On** then **Pump Off**.
2. Visually verify that the pump turns on and off.

Saving the Test Record

1. From the Autosampler IQ-OQ utility, click **Generate**.

   Include the generated report in your IQ test records.

Clearance Inspection

1. Turn the autosampler off.
2. Load the standards vials into the autosampler tray.
3. Load the racks with sample vials and place them on the tray.
4. Visually check that the tops of all the vials are below the bottom of the Z-drive, and below the bottom of the sample probe when it is in its highest position.
5. Visually check that there are no obstructions which might block movement of the autosampler arm or which might tangle the sample transfer tubing as the autosampler moves.

Operational Qualification (OQ)

The autosampler is always an element of a larger measurement system. Furthermore, the autosampler has no operational parameters which can or should be calibrated. Therefore, OQ should be performed for the measurement system as a whole rather than for the autosampler by itself.

Where OQ is needed for the autosampler as a part of the larger measurement system, commonly used tests might include:

- Tests of communication and timing between the autosampler and other system components.
- Replicate measurements of samples with two distinct concentrations, to check that carryover is within the limits required by the experimental method.
- Measurements using blanks, to check for contamination of the sample flow path.
- Measurements of sample flow rate or volume.
- Tests to ensure that the instrument control software is directing the autosampler to draw samples from the correct locations.

Where OQ is needed for the autosampler by itself, the tests are typically a subset of the IQ tests:

- Operating environment checklist
- Visual inspection
- Communication test
- X/Y/Z movement and alignment test
- Peristaltic pump test

The OQ report should include information about the configuration of the autosampler. See the sample OQ checklist on page 55.

Performance Qualification (PQ)

The autosampler is always an element of a larger measurement system. Furthermore, the autosampler has no operational parameters which can or should be calibrated. Therefore, Teledyne CETAC Technologies does not specify tests or acceptance criteria for PQ.

Where PQ is needed, a laboratory should develop requirements which are relevant to the complete measurement system and the experimental method which is chosen.

Autosampler IQ Checklist

Checklist from manufacturer's *Operator's Manual*, Teledyne CETAC Technologies part number 480215 Rev2.

Instrument Identification

Autosampler model	
Autosampler serial number	
Location of installation	
IQ performed by	
Date	

Inventory of Supplied Equipment

Description	Page	Pass	Fail	N/A	Comment
Autosampler		☐	☐	☐	
Power cord with the appropriate connector		☐	☐	☐	
Sample probe of appropriate type, with attached sample tubing		☐	☐	☐	
Software and documentation CD		☐	☐	☐	
Other items listed on packing list		☐	☐	☐	

Operating Environment Checklist

Description	Page	Pass	Fail	N/A	Comment
Space adequate for autosampler, no mechanical interference for moving parts	15	☐	☐	☐	
5 cm clearance for cable egress and power switch access	15	☐	☐	☐	
Sturdy work surface	16	☐	☐	☐	
Provisions for liquid waste routing	16	☐	☐	☐	
Power outlet has protective ground connection	16	☐	☐	☐	
Power outlet accessible for rapid disconnection	16	☐	☐	☐	
Temperature is 50–95 °F (10–35 °C)	59	☐	☐	☐	
Humidity is 20–70% non-condensing	59	☐	☐	☐	
Excessive flammable or corrosive vapors are not present	59	☐	☐	☐	
Sources of strong electromagnetic interference are not present	59	☐	☐	☐	

Visual Inspection

Description	Page	Pass	Fail	N/A	Comment
No visible leaks in sample tubing		☐	☐	☐	
No visible leaks in peristaltic pump tubing		☐	☐	☐	
No visible damage to sample probe or rinse station		☐	☐	☐	
No visible moisture condensation in/on body of autosampler	17	☐	☐	☐	

Installation

Description	Page	Pass	Fail	N/A	Comment
Z-drive mounted	21	☐	☐	☐	
Z-drive cable attached to rotor	21	☐	☐	☐	
Sample probe installed on Z-drive	39	☐	☐	☐	
Sample tubing secured to Z-drive cable	39	☐	☐	☐	
Source of rinse solution routed to peristaltic rinse pump	26	☐	☐	☐	
Rinse station tubing routed to waste container	26	☐	☐	☐	
Power supply connected to autosampler	42	☐	☐	☐	
Communication cable connected between host computer and autosampler	43	☐	☐	☐	

Communication Test

Description	Page	Pass	Fail	N/A	Comment
LED power indicator lamp is on when power switch is on		☐	☐	☐	
Autosampler appears in ASX Dashboard	49	☐	☐	☐	

X/Y/Z Movement and Alignment Test

Description	Page	Pass	Fail	N/A	Comment
"4 Corners" moves to all four corners	49	☐	☐	☐	

Peristaltic Pump Test

Description	Page	Pass	Fail	N/A	Comment
Peristaltic pump runs upon "Pump On"	50	☐	☐	☐	
Peristaltic pump stops upon "Pump Off"	50	☐	☐	☐	

Clearance Inspection

Description	Page	Pass	Fail	N/A	Comment
Height of all standards vials below bottom of sample probe		☐	☐	☐	
Height of all sample vials is below bottom of sample probe		☐	☐	☐	
No obstructions for movement of autosampler arm or sample transfer tubing		☐	☐	☐	

Autosampler OQ Checklist

Checklist from manufacturer's *Operator's Manual*, Teledyne CETAC Technologies part number 480215 Rev2. OQ should be performed for the measurement system as a whole; this checklist shows autosampler-related items which could be incorporated into OQ.

Instrument Identification

Autosampler model _____

Autosampler serial number _____

Location of autosampler _____

OQ performed by _____

Date _____

Instrument Configuration

Autosampler personality, if changed from manufacturer's default _____

X-Y axis movement speed _____

Z axis movement speed _____

Peristaltic pump speed _____

Sample probe type _____

Sample probe tubing length _____

Rinse pump configuration ☐ Gravity drain ☐ Pump drain ☐ Other _____

Rinse solution in use _____

Rinse tubing material _____

Operating Environment Checklist

Description	Page	Pass	Fail	N/A	Comment
Space adequate for autosampler, no mechanical interference for moving parts	15	☐	☐	☐	
5 cm clearance for cable egress and power switch access	15	☐	☐	☐	
Sturdy work surface	16	☐	☐	☐	
Provisions for liquid waste routing	16	☐	☐	☐	
Power outlet has protective ground connection	16	☐	☐	☐	
Power outlet accessible for rapid disconnection	16	☐	☐	☐	
Temperature is 50–95 °F (10–35 °C)	59	☐	☐	☐	
Humidity is 20–70% non-condensing	59	☐	☐	☐	

Excessive flammable or corrosive vapors are not present	59	☐	☐	☐	
Sources of strong electromagnetic interference are not present	59	☐	☐	☐	

Visual Inspection

Description	Page	Pass	Fail	N/A	Comment
No visible leaks in sample tubing		☐	☐	☐	
No visible deterioration of tubing		☐	☐	☐	
No kinks in sample tubing		☐	☐	☐	
No visible leaks in peristaltic pump tubing		☐	☐	☐	
No visible damage to sample probe or other components		☐	☐	☐	

Installation

Description	Page	Pass	Fail	N/A	Comment
Sample probe is of appropriate type for sample matrix and desired flow rate		☐	☐	☐	
Tubing is of appropriate type for sample matrix and desired flow rate	21	☐	☐	☐	
Sample tubing secured to Z-drive cable and is free of mechanical interferences	39	☐	☐	☐	
Source of rinse solution routed to peristaltic rinse pump	26	☐	☐	☐	
Rinse station tubing routed to waste container	26	☐	☐	☐	
Bottom of rinse station waste tube is above liquid surface in waste container	26	☐	☐	☐	
Power supply connected to autosampler	42	☐	☐	☐	
Communication cable connected between host computer and autosampler	43	☐	☐	☐	

Communication Test

Description	Page	Pass	Fail	N/A	Comment
LED power indicator lamp is on when power switch is on		☐	☐	☐	
Autosampler appears in ASX Dashboard or host software	49	☐	☐	☐	

X/Y/Z Movement and Alignment Test

Description	Page	Pass	Fail	N/A	Comment
"4 Corners" moves to all four corners	49	☐	☐	☐	

Peristaltic Pump Test

Description	Page	Pass	Fail	N/A	Comment
Peristaltic pump runs upon "Pump On"	50	☐	☐	☐	
Peristaltic pump stops upon "Pump Off"	50	☐	☐	☐	

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5 Using the Autosampler

Before using the autosampler, ensure that your lab environment provides operating conditions that will prolong the life of the autosampler. Once the proper operating conditions are met, you can arrange the sample vial racks and start the autosampler sequence run. When you finish using the autosampler, you may need to flush the rinse station and flow path before shutting the autosampler down.

Establishing Optimal Operating Conditions

The autosampler 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 autosampler components that wear out under normal use, and purchase the appropriate supplies for use with the autosampler. 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 autosampler in a conventional lab environment where the temperature is 50–95 °F (10–35 °C), the humidity is 20–70% non-condensing, and the unit is not exposed to excessive flammable or corrosive materials. (See also "Environmental Characteristics" on page 93.)
- Avoid rough handling of the autosampler. If possible, do not expose the autosampler to vibration or shock.
- Protect the autosampler from long-term exposure to condensation, corrosive materials, solvent vapor, continual standing liquids, or large

spills into the autosampler cabinet or arm. Exposures of this type can damage the drive mechanisms as well as the electronics.

- Observe the same general electrostatic discharge precautions as with any integrated circuit electronic device. Low humidity environments, especially when combined with static-generating materials, require maximum care.

CAUTION Discharge static buildup and ground to the autosampler base or cabinet before performing any maintenance. Do not touch or short-circuit contacts on the communication ports.

- Avoid using the autosampler if strong electromagnetic interference, radio frequency interference, or radioactivity is present. Interference fields can cause erratic operation of the autosampler. The autosampler might not function properly if the level of radioactivity is significantly above background.

Replacing Autosampler Components

The following components wear out under normal use and must be replaced periodically:

- Peristaltic pump tubing
- Sample probe

If you fail to replace these components when they deteriorate, the autosampler will not function properly. For information about replacing autosampler components, see Chapter 6, "Maintaining the Autosampler."

Purchasing Supplies

Because the lifespan of the sample and standards vials varies, you should maintain an adequate supply of spare vials. When you need to purchase additional supplies, it is extremely important that you choose the appropriate sizes and materials.

When you purchase vials for samples or standards, make sure they meet the following requirements:

- The diameter of the sample vials must matches the rack size you are using.
- The diameter of the standards vial must match the rinse tray. The most common size is a 50 mL, 30 mm diameter, conical-bottom centrifuge vial. The standards vials must have tapered bottoms to remain properly positioned in the standards rack. Alternative standards racks are available to accommodate different vial sizes and arrangements.
- The height of the vials must not exceed 125 millimeters.
- If purchasing vials which are different from the ones you are currently using, pay particular attention to the height of the vials. Vials which are too tall could result in the sample probe crashing into the vials.
- The vial material must be compatible with the samples you are analyzing or the reference standards you are using.

CAUTION Use of mismatched sample vials and sample vial racks may result in malfunctions or sample spills. Be sure your vials meet the given requirements.

To order additional supplies, refer to the *CETAC Accessories and Supplies Catalog* for the autosampler, available on the CETAC Web site, www.cetac.com.

Arranging the Sample Vial Racks

You can change the arrangement of the sample vial racks to meet your needs. The autosampler accommodates many different sample vial racks, including (but not limited to) racks with 21, 24, 40, 60, or 90 positions. The autosampler physically accepts any size combination and arrangement of sample vial racks. However, you can use racks of mixed sizes only if the host computer's software enables you to do so.

For more information about placing sample vial racks in the sample tray, see page 38.

CAUTION Incorrectly defining the position count in the instrument control software can result in sample spills and invalid analysis results.

Starting the Autosampler

Once you arrange the sample vial racks and ensure that the arrangement is correctly defined in the software, you can start the autosampler and let it run until the sampling sequence is finished.

WARNING

PINCH HAZARD
Keep fingers, hair, and loose clothing away from the moving parts of the autosampler.

1. Ensure that the rinse station is properly connected.
2. Visually inspect the sample area for misplaced vials and obstructions. Also make sure that any caps have been removed from the vials.
3. Turn the autosampler power switch on.

   The LED power indicator lights up when the power is on.
4. Purge air from the rinse system by placing the rinse solution uptake tubing in the rinse solution source and running the rinse solution through the rinse station.

   Ensure there are no air bubbles visible in the rinse uptake tubing before you run samples with the autosampler.

NOTE FOR AQUEOUS APPLICATIONS

If you are flushing the rinse system during initial startup, first use a 2% nitric acid solution as the rinse agent. Flush the rinse system a second time using deionized water as the rinse agent.

5 In the instrument control software, start a sampling sequence.

The autosampler will run until it reaches the end of the sampling sequence.

Shutting Down the Autosampler

To shut down the autosampler, complete the following steps:

1 Drain the rinse system by removing the rinse solution uptake tubing from the rinse solution source. Let the peristaltic pump run until all solution drains from the tube attached to the rinse station outlet.

If you use a rinse solution other than deionized water, flush the rinse system with deionized water before shutting down the autosampler. For more information, see "Flushing the Rinse Station and Flow Path" on page 62.

2 Turn off the autosampler power switch.

3 If you will be performing maintenance, unplug the power cord either at the power supply or at the wall outlet.

Flushing the Rinse Station and Flow Path

Generally, you can operate the autosampler without flushing the rinse system. Under normal circumstances, you can simply drain the rinse system prior to shutting down the autosampler. However, you need to flush the rinse station and flow path under two circumstances:

- During initial startup of the autosampler after installation.
- After the use of strong bases, acids, or organic solvents as rinse agents.

Flushing the rinse system during initial startup of the autosampler removes any contaminants that could cause interference during sample analysis. Flushing the rinse system after using strong rinse agents prevents degradation and failure of the flow path components.

To flush the rinse station and flow path, complete the following steps:

1 Insert the rinse uptake tubing into a deionized water source.

> **NOTE**
>
> If you are flushing the rinse system during initial startup, first use a 2% nitric acid solution as the rinse agent, followed by deionized water.

2 Run the rinse solution through the rinse station and flow path for 5 to 10 minutes.

Once you flush the rinse system, you can proceed with the sampling sequence or drain the rinse system as part of the shutdown procedure.

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6 Using the Autosampler Utility

The ASX Dashboard software is supplied on the included CD. Other software on the CD includes the C-Term program for communicating directly with the autosampler and a USB driver.

The ASX Dashboard software includes the following utilities:

- **Autosampler IQ-OQ** assists with qualification (IQ and OQ) by performing a set of predefined movements.
- **Log Extractor** saves error codes and operating history information so that it can be sent to CETAC support.
- **Firmware Updater** provides a way to program the autosampler with new firmware. Changing the firmware can give the autosampler a new "personality" to make it compatible with certain analytical instruments. Note that you should connect the autosampler with a USB cable, not an RS-232 serial cable, to update firmware.
- **Autosampler Config** lets you set the X-Y-Z motion speed and peristaltic pump speed.

This chapter provides instructions for installing and starting the ASX Dashboard. The Help menu within each utility provides additional information.

Installing the ASX Dashboard Software

1. On the included CD, find the DashboardInstall folder.
2. Double-click setup.exe.

Starting the ASX Dashboard

1. Check that the autosampler is connected to the PC and that it is turned on.
2. Open the tool.

Figure 6-1 ASX Dashboard Icon

3. Click on the utility you wish to run.

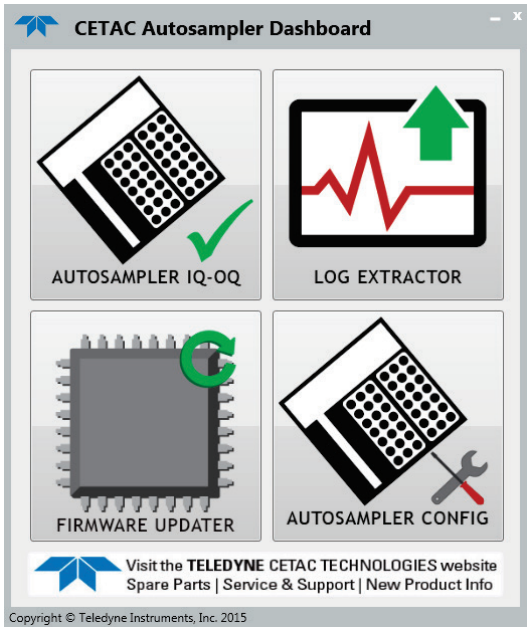


Figure 6-2 ASX Dashboard—Main Screen

Changing the Movement Speed and Rinse Pump Speed

1. On the ASX Dashboard, click **Autosampler Config**.
2. Select an autosampler (if more than one autosampler is connected).
3. Configure the motion speed and pump speed as needed.
4. Click **Set Changes** to store the settings in the autosampler's nonvolatile memory.

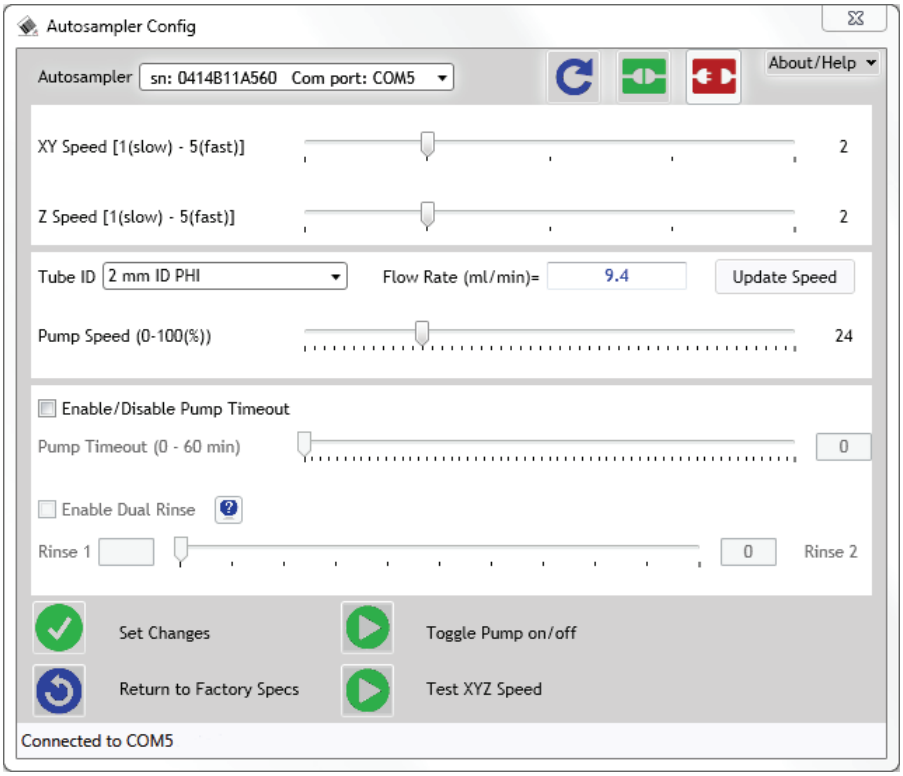


Figure 6-3 Autosampler Config

Dual Rinse

For autosamplers with a dual rinse station, check the box to enable dual rinse. When dual rinse is enabled, the probe will go to the first rinse station and remain there for the number of seconds specified for Rinse 1. The probe will then move to the second rinse station and remain there for the number of seconds specified for Rinse 2 or until commanded to move. See Dual Rinse Timing.

Dual Rinse Timing

When dual rinse support is enabled, the rinse cycle consists of three actions:

Step	How Long It Takes
Pre-rinse, at rinse port #1	Set by entering a value in the Pre-Rinse Time field in the ASX Dashboard.
Movement to rinse port #2	About 2 seconds.
Second rinse, at rinse port #2	Set by entering a total rinse time in the ICP/ICP-MS software. The time at rinse port #2 is the total rinse time, minus the time already spent at rinse port #1 and moving between the rinse ports.

NOTE

Always set the total rinse time in the ICP/ICP-MS software to be greater than the Pre-Rinse Time plus 2 seconds.

Pump Speed

When using dual rinse, you should set the pump speed for a flow rate of at least 30 mL/min.

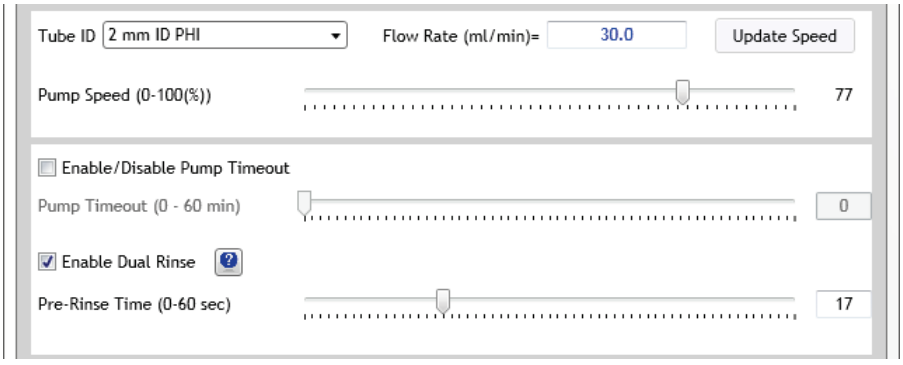


Figure 6-4 Autosampler Config—Settings for Dual Rinse

7 Maintaining the Autosampler

Routine maintenance of the autosampler consists of daily and weekly cleaning of specific autosampler components. Routine maintenance also includes checking for leaks or other damage. Additional periodic maintenance tasks may be required, including replacement of the following autosampler components: peristaltic pump tubing, sample probe, rinse station, rinse station tubing, and sample tray.

CAUTION Discharge static buildup and ground to the autosampler base or cabinet before performing any maintenance. Do not touch or short-circuit the contacts on the communication ports.

Cleaning the Autosampler

Cleaning the autosampler is the primary maintenance task you perform. A dirty autosampler causes increased wear and reduces the autosampler's life.

You must clean the autosampler both daily and weekly to prevent damage and extend its life. It is especially important to clean up spills and remove contaminants, such as abrasives, from the autosampler's moving parts. It may also be necessary to chemically neutralize spills. The following sections explain daily and weekly cleaning procedures.

Daily External Cleaning

Use of the autosampler often results in spills on autosampler components such as the sample tray. Good maintenance requires that you clean the autosampler daily. To do so, complete the following steps:

1. Shut down and unplug the autosampler.

   For information about shutting down the autosampler, see page 62.

2. Wipe the sample tray, autosampler cabinet, and autosampler arm using a towel dampened with a lab-grade cleaning agent.

CAUTION Do not allow the cleaning agent to come into contact with the lead screws. Also, never lubricate either of the two lead screws.

CAUTION Do not clean with carbon tetrachloride.

3 Wipe again with a towel dampened with clear water.

This process removes any remaining contaminants.

4 Dry the sample tray, autosampler cabinet, and autosampler arm using a dry towel.

The autosampler must be thoroughly dry before you turn the power on.

Weekly Cleaning

Although cleaning it daily removes spills and contaminants from most of the autosampler components, it is necessary to clean the autosampler more thoroughly approximately once a week. To do so, complete the following steps:

1 Shut down and unplug the autosampler.

2 Remove the sample tray.

For information about removing the sample tray, see "Replacing the Sample Tray" later in this chapter.

3 Wipe loose particles off the Y-axis lead screw with a dry, lint-free cloth.

The Y-axis lead screw is the large metal screw located inside the autosampler arm.

Figure 7-1 Y-Axis Lead Screw

CAUTION Never lubricate the lead screws. The lead screw nuts are compounded with a dry film lubricant. Oiling the lead screws will cause gumming, galling, and binding of the moving parts.

4 Wipe the autosampler exterior and base until they are clean, using a towel dampened with a lab-grade cleaning agent, followed by a towel dampened with clear water.

Pay special attention to the Y-axis slider block and the autosampler arm.

5 Wash the sample tray in a warm detergent solution.

Make sure you remove all spills and stains.

6 Rinse the sample tray with water and then dry it.

Ensure that the sample tray is thoroughly dry.

7 Replace the sample tray on the autosampler base.

8 Clean the sample probe.

Cleaning the Sample Probe

1 Moisten a Kimwipes® wiper with 10% HNO_3 and wipe the probe to remove any aqueous or inorganic contamination from the surface.

2 Then moisten a new Kimwipes wiper with a chromatography grade solvent such as n-propanol, isopropanol, or hexane and wipe the probe again to remove any oil.

3 Let the probe air dry.

Be careful not to touch the probe without gloves—residue from handling the probe can cause the surface tension properties of the probe surface to change and can lead to material dripping off the probe during use. Periodic cleaning may be necessary depending on the application.

Checking for Leaks

You should regularly check all tubing for leaks.

1 Shut down and unplug the autosampler.

2 Visually inspect the sample probe, peristaltic pump tubing, and rinse station and tubing for leaks or signs of deterioration.

If you detect a leak or other damage to an autosampler component, you must replace it. For more information, see the appropriate section in this chapter.

Replacing Peristaltic Pump Tubing

Routine maintenance of the autosampler includes replacement of the peristaltic pump tubing. This tubing will probably be the most frequently replaced item on the autosampler. If you use strong bases, acids, or solvents as rinse agents, the tubing may break down rapidly.

The tubing is installed as a single cartridge. The plates at the ends of the cartridge are color coded according to the tubing size and material.

Figure 7-2 Peristaltic Pump Tubing Cartridge

ID (mm)	Endplate Color
2, 2	Black
2, 3	Red
3, 3	White

Table 4: Sample Probe Sizes and Color Coding

To replace the peristaltic pump tubing, complete the following steps:

WARNING

PINCH HAZARD
Turn off power before servicing the peristaltic pump or pump tubing.

1. Shut down and unplug the autosampler.
2. Release the pressure shoe by lifting the handle. The shoe is a flexible band which is held in place by spring-loaded handles.

Figure 7-3 Releasing the Peristaltic Pump Shoe

3. Lift the end of the tubing cartridge straight up.

Figure 7-4 Removing the Peristaltic Pump Tubing Cartridge

4 Replace the tubing by sliding the plates on the end of the tubing cartridge into the slots in the pump.

5 Reinstall the pressure shoe.

Aligning the Autosampler

An autosampler may need alignment if:

- A motor or leadscrew has been replaced.
- The autosampler has been subjected to extreme shock or vibration.
- The probe is not centered over the rinse station or over any of the sample vials.

An alignment utility is provided on the CD. For instructions, see the *Alignment Guide* on the CD or the online help in the alignment utility. Note that there are several kinds of alignment, some of which can be performed with the software alone, and some which require the use of special tools or fixtures.

Checking the Home Position Alignment

1 Make sure the autosampler is turned off.

2 Turn the power on. This will move the sample probe to the home position.

3 Turn the power back off.

4 Turn the rotor to move the sample probe down into the rinse station.

5 Visually check that the sample probe is centered in the rinse station.

6 If the sample probe is not centered, use the alignment utility to adjust the home position.

Setting the Z-Axis Travel

To set the vertical travel of the Z-drive, complete the following steps:

1 Loosen the clamp on the Z-axis rotor.

2 Adjust the Z-axis slider (with attached sample probe) so that the slider is approximately 1-3 millimeters below the top of Z-axis drive.

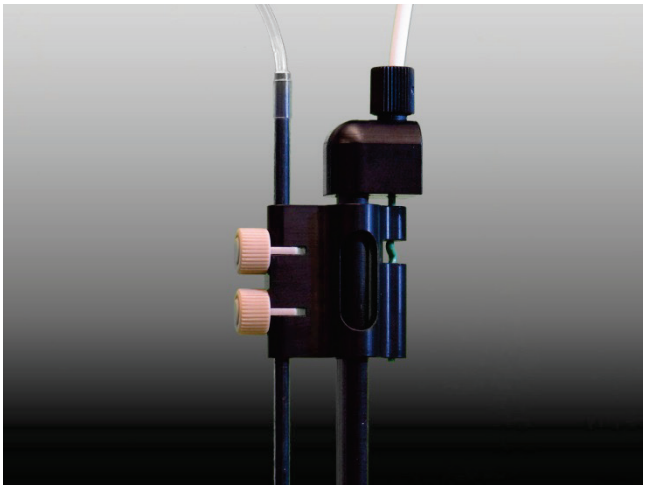


Figure 7-5 Sample Probe at Top Position With Gap

3 Rotate the Z-axis rotor clockwise as far as it will go.

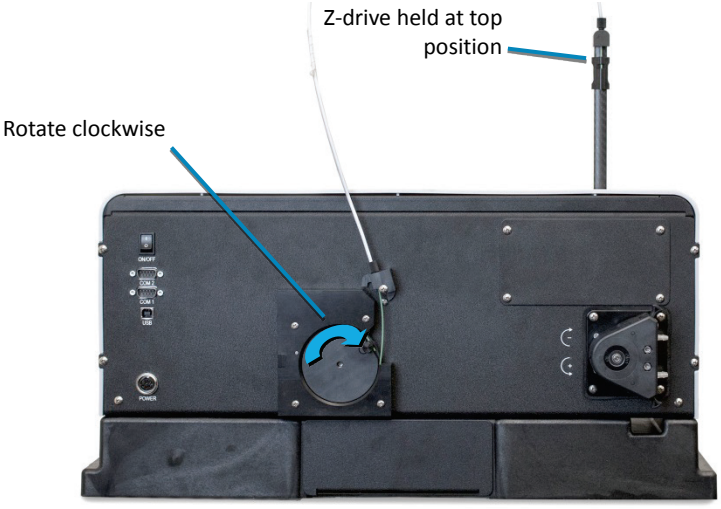


Figure 7-6 Z-Drive Rotor

4 Finger tighten the rotor clamp.

Ensure that the Z-drive cable is fully located in the rotor clamp groove. Otherwise the cable will slip, resulting in no movement of the Z-axis slider.

5 Manually rotate the Z-axis rotor back and forth several times and check for full unhindered movement of the Z-axis slider.

6 Loosen the thumbscrews on the sample probe.

7 With the Z-axis in the top position, hold the Z-axis slider and move the sample probe up and down until the tip of the probe is level with the bottom of the Z-Drive.

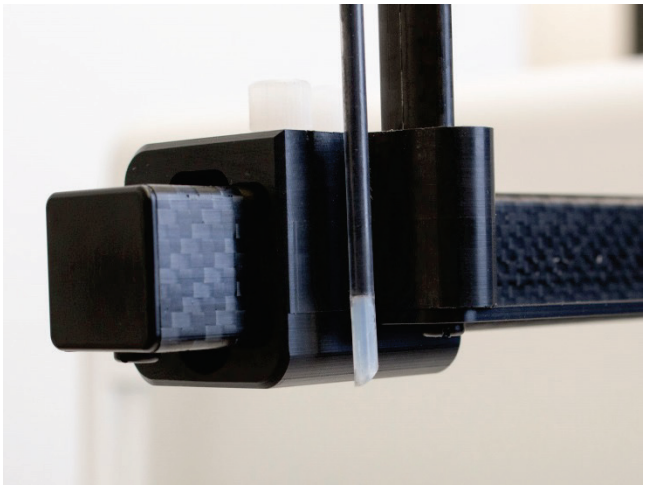


Figure 7-7 Adjusting the Probe Height

8 Tighten the thumbscrews on the sample probe.

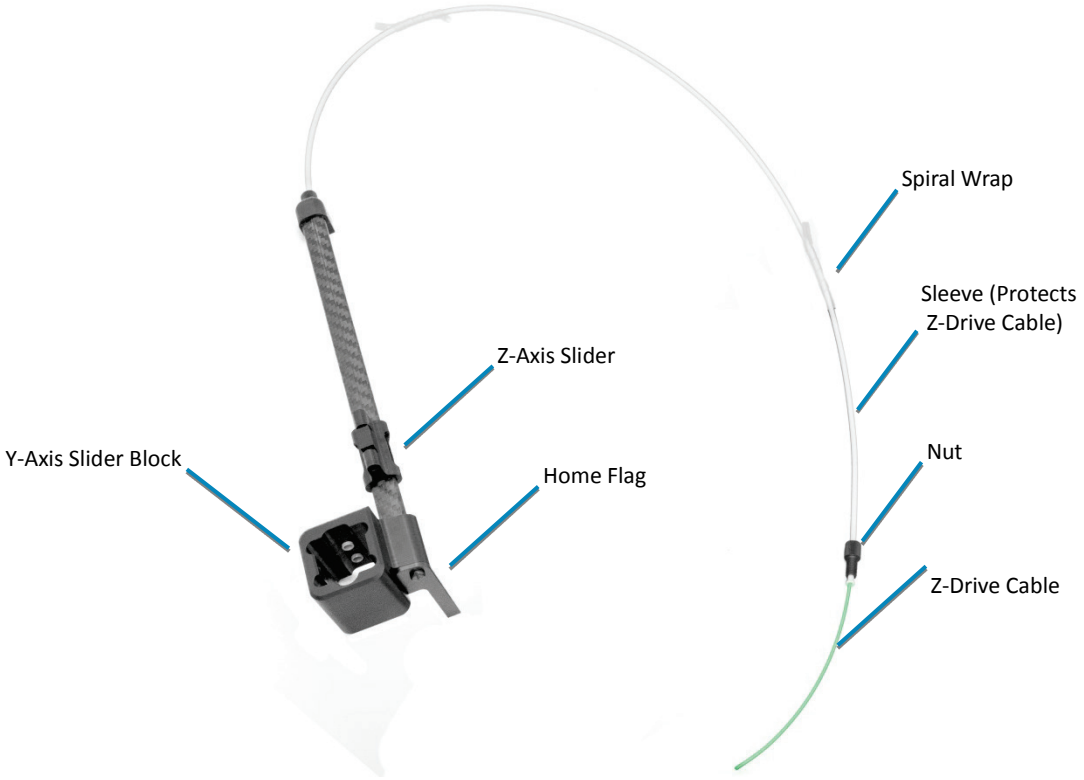
CAUTION Do not move the sample probe directly as damage may result.

Replacing the Z-Drive

These instructions assume you are installing a new, standard-model Z-drive.

How Does the Z-Drive Work?

The Z-drive is driven by a length of cable. A rotor on the back of the autosampler moves the cable, which slides the probe up and down on the Z-drive. A mounting block on the back of the autosampler pivots back and forth to allow free motion of the cable while preventing the cable from kinking.



How Should I Care for the Z-Drive?

CAUTION Do not allow the cable to bend sharply. Avoid pushing up on the slider or pushing on the Z-drive cable.

Do not tighten the thumbscrews or nuts with anything other than your fingers.

Removing the Old Z-Drive

WARNING **Ensure the power cord is disconnected before proceeding with installation.**

1. Place the autosampler on a flat surface and turn the unit off.
2. Remove the two thumbscrews from the Y-axis slider block.
3. Remove the cable from the rotor by loosening the thumbscrew on the rotor and also removing the two thumbscrews from the guide block. Remove the old Z-drive from the arm by pulling the whole Z-drive forward and off the autosampler arm.

Installing the New Z-Drive

1. Remove Z-drive from the bag.

2 Slide the Z-drive onto the y-arm until the two holes in the Y-axis slider block align with the matching holes in the Y-axis carriage.

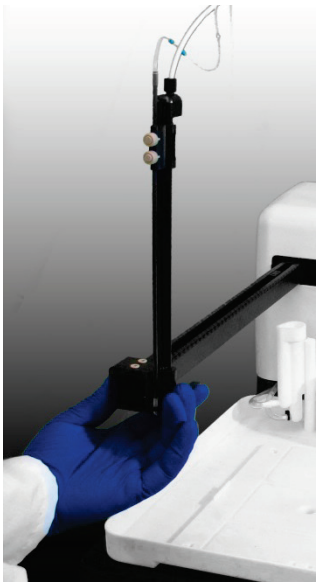


Figure 7-8 Sliding the Z-Drive Onto the Arm

3 Secure the Z-drive to the carriage using the two thumbscrews.

Tighten the thumbscrews using your fingers.

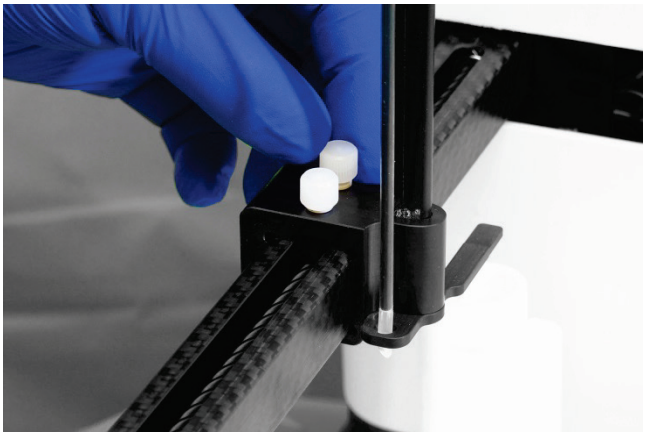


Figure 7-9 Securing Z-Drive Onto the Arm

4 Feed the cable through the rear guide block and around the rotor, then tighten the nut to secure the cable sleeve to the guide block.

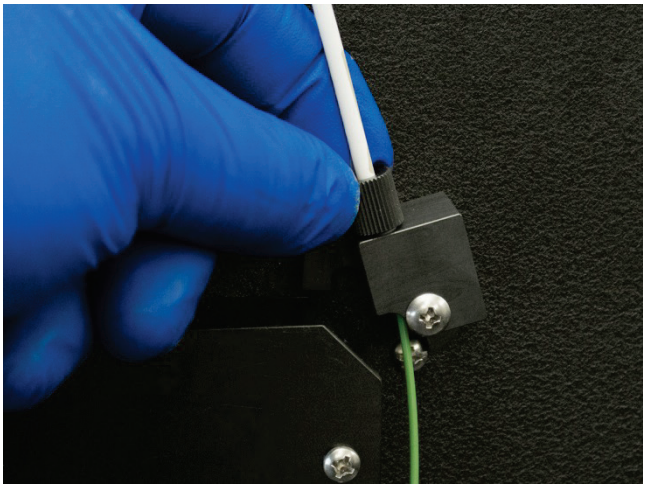


Figure 7-10 Guide Block with Nut

5 Turn the rotor clockwise as far as it will go.

6 Finish sliding the cable around the rotor on the back of the autosampler. Loosen the thumbscrew on the rotor to allow the cable to pass through the clamp, with about 2 mm of cable extending past the clamp.

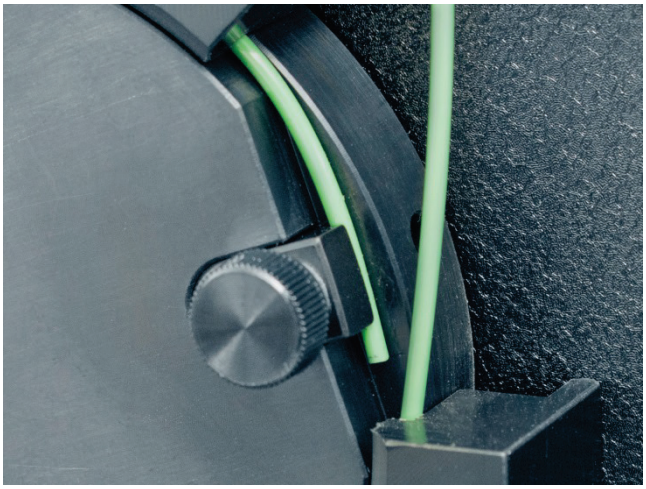


Figure 7-11 Position of Cable on Rotor

7 Verify that there is a small gap between the Z-axis slider and cap at the top of the Z-drive (approximately 1-3 mm). Adjust the cable a bit if necessary.

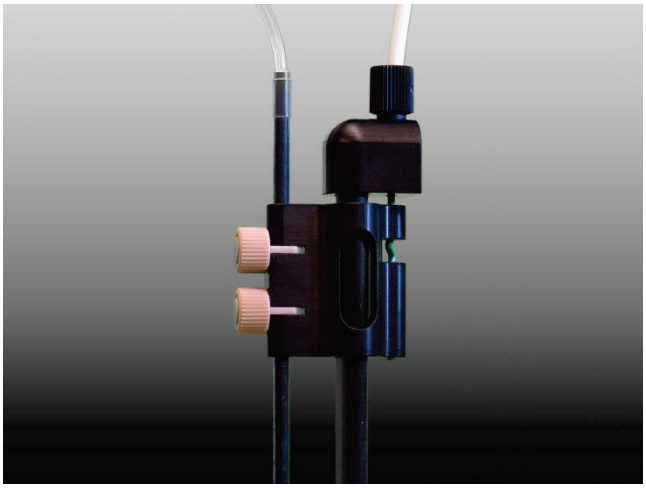


Figure 7-12 Sample Probe at Top Position With Gap

8 Hold the cable flat against the rotor and secure the cable by tightening thumbscrew on the rotor. The thumbscrew should be as tight as possible using just your fingers.

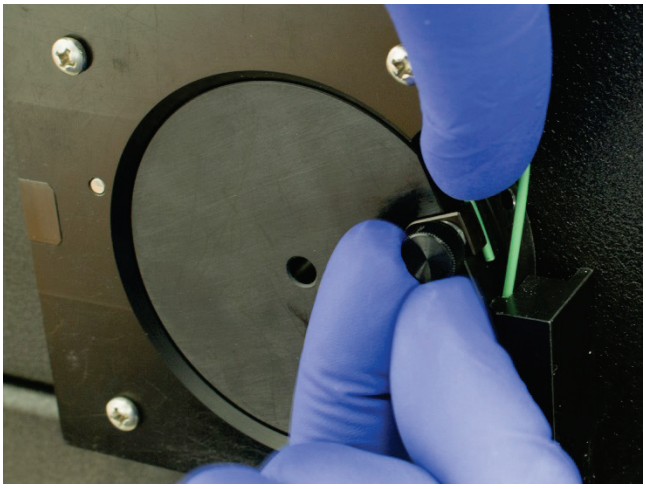


Figure 7-13 Securing Cable to Rotor

The cable is pre-cut to the proper length and does not need to be trimmed when properly installed.

9 Rotate the rotor back and forth to ensure that it moves freely. If there is excessive friction, check that the full width of the cable is under the clamp. Also check that the end of the cable is not rubbing on the shroud around the rotor.

CAUTION Never push the Z-axis slider to move it up or down. Pushing on the Z-axis slider can kink the drive cable. Instead, rotate the Z-drive rotor on the back of the autosampler.

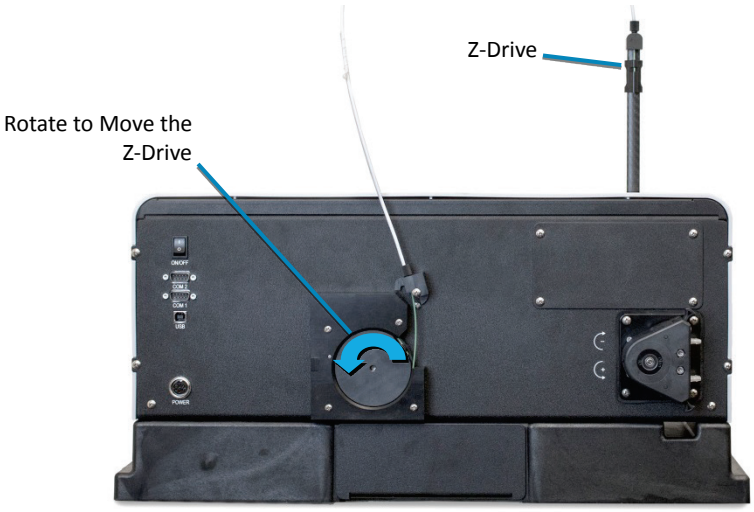


Figure 7-14 Z-Drive Rotor

10 Install a sample probe (page 39).

11 Use the utility software to align the probe over the rinse station.

12 Use the utility or your instrument control software to move the probe to several rack positions to make sure the probe is hitting positions correctly.

Replacing the Rinse Station

If the rinse station tubing is typically exposed to deionized water as a rinsing agent, you do not need to replace it often. However, if you use other rinsing agents, such as acids or solvents, the tubing is likely to deteriorate more rapidly. To replace the rinse station tubing, complete the following steps:

1 Shut down and unplug the autosampler.

2 Move the autosampler arm 20 to 30 centimeters away from the home position by gently pushing it.

Moving the autosampler arm ensures that the sample probe will not be damaged while you replace the rinse station tubing.

3 Disconnect the rinse solution uptake and drain tubing.

Apply only a linear force when removing the tubing to prevent the fittings from breaking.

4 Remove the rinse station from the mounting post by lifting the rinse station straight up.

5 Push the new rinse station straight down on the mounting post.

6 Reconnect the rinse solution uptake and drain tubing.

Replacing the Sample Tray

Cleaning the sample tray each week extends its life and makes frequent replacement unnecessary. However, if the sample tray needs to be replaced, complete the following steps:

1. Shut down and unplug the autosampler.
2. Remove all sample vial racks.
3. Move the Y-arm 20 to 30 centimeters away from the home position by gently pushing it.

   Moving the arm ensures that the sample probe assembly will not be damaged while you replace the sample tray.
4. Remove the rinse station from the mounting post by lifting the rinse station straight up.
5. Lift the old tray from the base of the autosampler.
6. Install the new tray.
7. Move the arm back to the home position.
8. Replace the sample vial racks.

Replacing the Home Flag/Guide Plate

The autosampler uses a Y-axis home position flag to verify that the Z-drive is fully in the home position (over the rinse station). Some applications use a version of this part which also extends forward to provide a guide plate for the sample probe.

The home flag can be replaced if it is damaged. You will need a short-handled slotted screwdriver.

1. Shut down and unplug the autosampler.
2. Remove the screw.
3. Replace the home flag.
4. Replace the screw.

   The home flag does not need to be adjusted or trimmed.

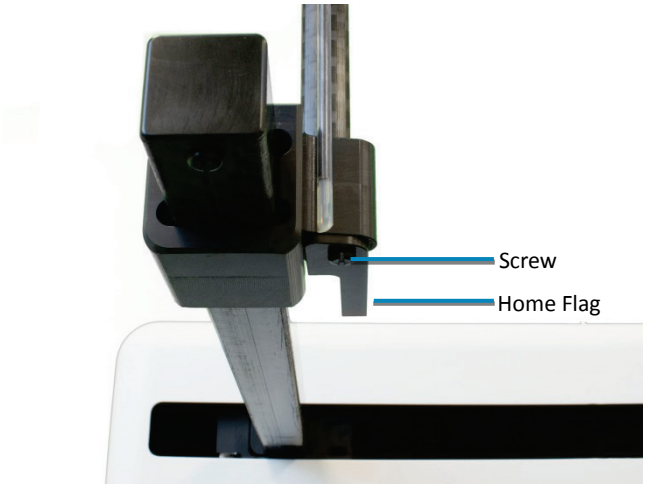


Figure 7-15 Home Flag

8 Troubleshooting the Autosampler

In the event that the product does not function properly, isolate the problem to determine if it originates in the host computer, the analytical instrument, or the autosampler.

This chapter explains how to troubleshoot autosampler problems. If you cannot solve a problem using the steps given in this chapter, you should contact Teledyne CETAC Technologies Customer Service and Support.

Power System Problems

A possible cause of system malfunction is a problem in the power system. If the system is not functional, it is possible that it is not receiving power. If this is the case, the LED power indicator light on the autosampler will be off. To troubleshoot this problem, complete the following steps in sequence until the problem is solved:

1. Check that the power switch on the autosampler is turned on.
2. Check that the power cord is plugged in firmly between the power input on the autosampler and the external power supply and also between the power supply and the wall outlet.

   If the cable is plugged in, ensure that it is not damaged in any way.
3. Check that the LED on the power supply is illuminated.

   If the LED is not illuminated, check the wall outlet using a device approved for that purpose.

   If the wall outlet is working and the voltage is acceptable, unplug the external power supply from the autosampler, but leave it plugged into the wall.

   ➢ If the LED is not lit, the power supply is faulty and requires replacement.

- If the LED is lit when unplugged from the autosampler but turns off when plugged into the autosampler, the autosampler may have an internal short and requires repair.

4 Check the wall outlet.

5 If the external power supply LED is illuminated while plugged into the autosampler, cycle the autosampler power switch. The autosampler sample probe should move up and the autosampler should initialize. After initialization, the power LED on the front of the autosampler should light up.

- If the cords are properly connected, power is available, the external power supply is good, and the unit still does not initiate, continue troubleshooting.

Communications Interface Problems

Operation of the autosampler is directed by the host computer. A malfunction can indicate a problem with the RS-232 or USB cable (connected between the host computer and the autosampler) or with the configuration of the software on the host computer. The following sections explain how to troubleshoot these problems.

RS-232 Serial Cable Problems

1 Check the RS-232 cable to ensure it is plugged in to the COM1 port on the autosampler.

If the cable is plugged in, ensure that it is tightened properly and not damaged in any way.

Note that the cable must be plugged into the COM1 port, not the COM2 port.

2 Check the host computer to ensure that the RS-232 cable is connected to the appropriate COM port.

If the cable is plugged in, ensure that it is tightened properly and not damaged in any way.

3 Check the serial port settings (9600, N, 8, 1).

If the wrong port or baud rate is selected, change the configuration.

USB Cable Problems

Either RS-232 or USB may be used, but not both at once.

1 Check that the USB cable to ensure it is plugged into the port on the autosampler.

2 Check the host computer to ensure that the USB cable is connected to the appropriate USB port.

Note that if you move the USB cable to a different USB port, the driver may assign a new COM port number.

3 Check that the USB cable is not damaged in any way.

4 Check the host computer to ensure that the USB drivers are installed for USB operation of the autosampler.

Load the proper USB drivers to the host computer from the CD that was provided with the autosampler.

Software Configuration Problems

If the communication cable is connected properly and the system is still not functioning with the instrument control software, ensure that the software is communicating correctly with the autosampler. To do so, use the supplied ASX Dashboard software (page 65).

1 Connect to the autosampler using the Autosampler IQ-OQ utility which in the ASX Dashboard.

2 Toggle the pump on and off..

If the commands have no effect, and a USB connection is being used, check that the autosampler is plugged into the *same* USB port as it was when the driver software was configured. Unlike many consumer devices, each USB port used as a "virtual" COM port must be individually configured.

3 If manual controls work, but the autosampler does not operate with the instrument control software, carefully check that the software is configured to use the COM port where the autosampler is plugged in.

If a USB connection is used, and if the manual commands work, but the instrument control software fails to operate the autosampler, check that the same COM port number is configured in the software and in the USB device driver.

Z-Drive Problems

An autosampler malfunction may be caused by a problem in the Z-drive assembly. You can easily determine that a malfunction is related to the Z-drive if you hear a loud chattering noise when the autosampler power switch is on or if the sample probe is not moving. To troubleshoot Z-drive problems, complete the following steps:

1 Ensure that the Z-drive is installed correctly.

If the Z-drive is not installed, see page 21.

2 Check the Y-axis home position flag.

When the Z-drive returns to the home position, the flag should enter the corresponding slot.

If the flag is damaged, replace it.

3 Ensure the sample probe is moving freely.

Gently rotate the rotor on the back of the autosampler to move the sample probe up and down. If the sample probe is binding, free the sample probe assembly.

> **NOTE:**
>
> If you cannot free the Z-drive, you will need to replace it. See page 75 for information about mounting a new Z-drive. You can order a new Z-drive from Teledyne CETAC Technologies.

4. Inspect the Z-drive cable for sharp bends, kinks, or rough spots.

   If the cable is damaged, replace the Z-drive.

5. Check the home position alignment (see page 73).

Contamination and Carryover Problems

1. Check the rinse station tubing. Rinse solution should flow upward from the bottom of the rinse station.
2. Check the end of the rinse solution drain tube. It should be above the surface of the liquid in the waste container.
3. If recycling the rinse solution, check whether the solution needs to be changed.
4. Examine the sample transfer tubing. Make sure that it is as short as possible while still free to move. Make sure that there are no unnecessary fittings on the sample transfer tubing—fittings can create small reservoirs where contaminants can hide.
5. Watch for liquid dripping from the sample probe as it moves. It may be necessary to slow the autosampler down to reduce droplet shedding. This can be adjusted using the ASX Dashboard utility (see page 67). Dripping may also occur if the sample probe is contaminated (see page 71 for cleaning instructions).
6. Check that the sample probe remains in the rinse station long enough. This can be adjusted using the Autosampler Config utility in the ASX Dashboard (see page 67).

Saving a Log File

The autosampler records error codes and configuration changes in its nonvolatile memory. Use the Log Extractor to save the autosampler log as a text file. This is mainly useful when working with CETAC Customer Support to diagnose a problem with the autosampler or system configuration.

1. On the ASX Dashboard, click **Log Extractor**.
2. Enter your name and contact information, which will appear in the log file.

3 Click **Retrieve Error Log**.

4 Choose where to save the log file.

Using the C-Term™ Terminal Program

The autosampler can be controlled by sending it simple commands. This can be helpful for troubleshooting. You can use any terminal emulation program. This chapter explains how to operate a CETAC autosampler using the C-Term terminal program, which is provided on the software CD.

C-Term is a simple terminal program developed to validate the installation and functionality of various CETAC devices. C-Term communicates through a serial (RS-232) port on the host computer. If the autosampler is connected to a USB port, the device driver will create a virtual serial port.

Installing C-Term

1 On the included CD, find the C-Term folder.

2 Double-click CTerm_setup.exe.

Starting C-Term

1 Check that the autosampler is connected to the PC.

2 Close any programs which might be communicating with the autosampler.

3 On the Start Menu, click All Programs | Teledyne CETAC Technologies | Support Tools | C-Term.

Overview of the C-Term Window

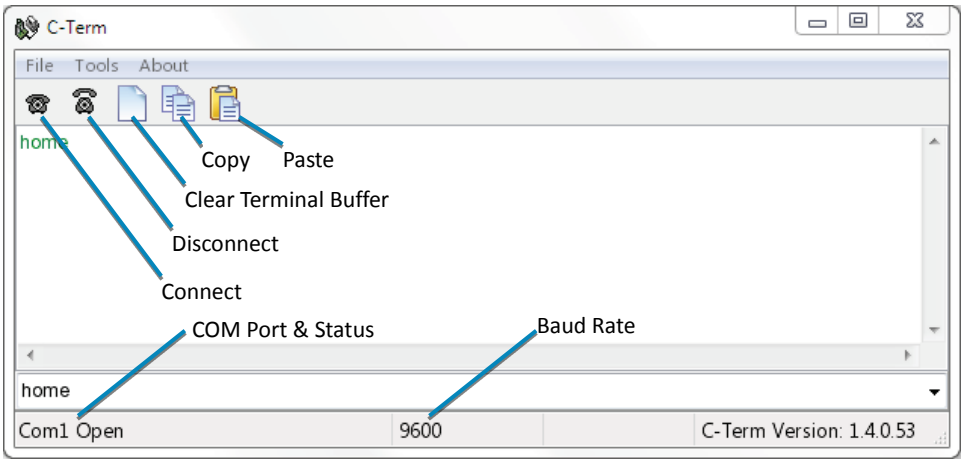


Figure 8-1 C-Term Window

Commands typed in this window are sent to the CETAC device connected to the opened port. The typed commands will appear in light green in the terminal buffer. Responses from the autosampler will appear in red. Non-printing

characters such as carriage returns will appear as ASCII hexadecimal numbers surrounded by square brackets; for example, **[0D]** is the carriage return character**.**

Configuring C-Term

By default, C-Term attempts to open COM1 the first time it is executed. If the autosampler is connected to another COM port, configure C-Term to use the desired port.

1 On the Tools menu, click Setup Serial Port.

2 Select the desired COM port and click OK.

> **NOTE**
>
> The autosampler communicates at 9600 baud (which is the default.)
>
> Only installed COM ports, including USB virtual COM ports, will appear in the **Comm Port** menu.

Autosampler Commands

The following commands are helpful for verifying autosampler operation. This is not a comprehensive list of commands.

Command	Description
VER	Returns firmware version.
HOME	Returns probe to home position.
ABS=x-y-z	Moves to position defined in steps of 0.1 mm from the home position. Example: `ABS=1000-1000-0` moves to X=100 mm, Y=100 mm, Z=top.
PMP ON	Turn the peristaltic pump on.
PMP OFF	Turn the peristaltic pump off.
RINSE	Moves probe to the rinse position, extends and retracts the probe 3 times and starts rinse pump. Stays in down position with pump running. `UP`, `PMP OFF` stops the pump.
DOWN=*n*	Moves the z-axis down by *n* mm.
UP	Moves z-axis to the top position.

Table 8-1 Autosampler Commands

CAUTION **Make sure that there is enough space for the probe to move.** Equipment damage can occur if the probe collides with an obstruction such as a vial or rack.

Returning the Product to CETAC for Service

Refer to the following information if you need to return the product to Teledyne CETAC Technologies for service.

Shipping the Product

Follow these guidelines when shipping the product:

- **Use the original packing materials.** If the original shipping materials are not available, place a generous amount of shock-absorbing material around the instrument and place it in a box that does not allow movement during shipping. Seal the box securely.
- Contact Teledyne CETAC Technologies before shipping the product.
- Pre-pay all shipping expenses including adequate insurance.
- Write the following information on a tag and attach it to the product:
  - Name and address of the owner
  - Product model number and serial number
  - Description of service required or failure indications
- Mark the shipping container as FRAGILE.
- In all correspondence, refer to the instrument by model name or number and full serial number.
- **Do not return products which are contaminated by radioactive materials, infectious agents, or other materials constituting health hazards to CETAC employees.**

Product Warranty Statement

> **NOTE**
>
> Contact Teledyne CETAC Technologies or refer to the warranty card which came with your product for the exact terms of your warranty. The following copy is provided for your convenience, but warranty terms may be different for your purchase or may have changed after this manual was published.

TELEDYNE CETAC TECHNOLOGIES warrants automation instruments for (2) two years from the date of shipment. Any CETAC manufactured unit sold directly to the End-User found in reasonable judgment of CETAC to be defective in material or workmanship will be repaired by CETAC without charge for parts and labor. Only CETAC manufactured automation instruments are covered by the (2) two year warranty. For a complete listing of our Automation products please visit our web site at www.cetac.com and follow the Automation link.

The unit, including any defective part, must be returned to CETAC within the warranty period. The expense of returning the unit to CETAC for warranty service will be paid for by the buyer. CETAC's responsibility in respect to warranty claims is limited to making the required repairs or replacements, and no claim of breach of warranty shall be cause for cancellation or recession of the contract of sale of any unit.

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

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 operating or maintenance instructions as specified in the CETAC Instruction and Operations Manual. The warranty does not cover any unit that has been altered or modified so as to change its intended use. Any attempt to repair or alter any CETAC unit by anyone other than by CETAC authorized personnel or agents will void this warranty.

In addition, the warranty does not extend to the 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 reserves the right to change or improve the design of any unit without assuming any obligation to modify any unit previously manufactured.

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'S OBLIGATION UNDER THIS WARRANTY IS STRICTLY AND EXCLUSIVELY LIMITED TO THE REPAIR OR REPLACEMENT OF DEFECTIVE PARTS, AND CETAC DOES NOT ASSUME OR AUTHORIZE ANYONE TO ASSUME FOR THEM ANY OTHER OBLIGATION.

CETAC ASSUMES NO RESPONSIBILITY FOR INCIDENTAL CONSEQUENTIAL OR OTHER DAMAGES (EVEN IF ADVISED OF SUCH 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.

This warranty and all matters arising pursuant of it shall be governed by the laws of the State of Nebraska, United States.

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.

Do not return products 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 buyer's expense.

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9 Safety and Regulatory Information

Review this product and related documentation to familiarize with safety markings and instructions before you operate the instrument.

Characteristics

Environmental Characteristics

These environmental characteristics indicate the conditions for *safe* operation. See "Establishing Optimal Operating Conditions" on page 59 for the recommended environment for the best performance.

Operating Temperature	+5° C to +40° C (+41° F to +104° F)
Non-Operating Temperature	+0° C to +55° C (+32° to +131° F)
Operating Altitude	Up to 2,000 m (6,562 ft)
Operating Relative Humidity	0% to 80% non-condensing for temperatures up to 31° C, decreasing linearly to 50% at 40° C
Non-Operating Relative Humidity	0% to 95% non-condensing
Pollution Degree	Pollution Degree 2 Normally no pollution or only dry, non-conductive pollution occurs. The pollution has no influence. Occasionally, however, a temporary conductivity caused by condensation may be expected.

Table 2: Environmental Characteristics

For indoor use only.

Avoid sudden, extreme temperature changes which could cause condensation on circuit boards in the product.

See page 12 for information on chemical compatibility.

Electrical Characteristics

Power requirements

Power Supply	**Input:** AC Voltage, Frequency, and Current 100-240 V ~ 47-63 Hz 1.07 A Installation Category: CAT II (Line voltage in appliance and to wall outlet) **Output:** 24 V DC, 3.33 A
Autosampler	**Input:** DC Voltage and Current ⎓ 24 V 3.33 A Installation Category: CAT I (Mains isolated) Use only with the provided power supply.

Table 3: Power Requirements

Input and output connectors

COM 1	DB-9 RS-232 serial connection to a controller PC. (max ±12 VDC, 8 mA)
COM 2	DB-9 RS-232 serial connection to accessories or instruments. (max ±12 VDC, 8 mA)
USB	USB connection to a controller PC. (max 5 VDC)

Safety Notices

WARNING

INJURY HAZARD
If the equipment is used in a manner not specified by Teledyne CETAC Technologies, the protection provided the equipment may be impaired.

Repair or service that this not covered in this manual should only be performed by qualified personnel.

Power Cord Set Requirements

The power cord set supplied with your instrument meets the requirements of the country where you purchased the instrument. Power is supplied to the autosampler through the included 24 V power supply.

Power Cord Safety Maintenance

The operator should check the power/signal supply cord condition. The equipment should not be operated if the mains inlet is cracked or broken. Any obvious damage to the case (from a drop or fall) should be checked by service personnel for loose or damaged parts. See individual parts lists for approved replacement parts.

Mains Disconnect

The power switch on the rear panel is not the mains disconnect. Power mains disconnect is accomplished by unplugging the power cord at the power supply or at the wall outlet. Ensure the power cord is easily accessible and removable, in the event of an emergency which requires immediate disconnection.

WARNING

SHOCK HAZARD
Ensure that power cord is disconnected before removal of any covers.

Cleaning Instructions

For additional cleaning information, see "cleaning" in the index.

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

SHOCK HAZARD
Do not allow any liquid to enter the instrument cabinet other than as intended through the specified tubing, or come into contact with any electrical components. The instrument must be thoroughly dry before you reconnect power, or turn the instrument on.

Mechanical Hazards

If you insert any part of your body between the moving parts of the autosampler, you could be injured. Figure 9-1 shows the location of potential hazards.

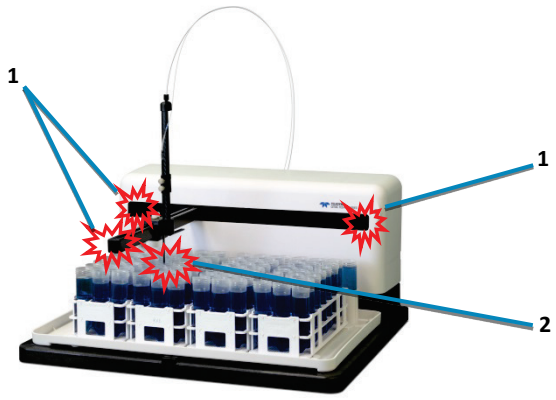

Figure 9-1 Overview of the Mechanical Hazards of an Autosampler

WARNING

1 - PINCH HAZARD
Keep fingers, hair, and loose clothing away from the moving parts of the autosampler.
2 - PUNCTURE/INJECTION HAZARD
Keep hands away from the probe while the autosampler is operating.

Operating Environment

WARNING	**SHOCK HAZARD** **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.**

WARNING	**SHOCK HAZARD** **Equipment is not intended for wet locations. Miscellaneous liquids in the equipment could cause hazardous conditions.**

WARNING	**EXPLOSION HAZARD** **Do not operate in an explosive atmosphere.**

WARNING	**CHEMICAL HAZARDS** **Learn about the chemicals which will be used in and near the autosampler, and observe the necessary precautions. Always use appropriate personal protective equipment, including protective eyewear.**

Explanation of Caution and Warning Notices

Warning symbol marked on equipment. This symbol means "Attention! Refer to the manual."

Crush Hazard / Pinch Point – Keep hands clear of moving parts**. X, Y, Z axis movement may crush hand.**

WARNING	**The WARNING notice denotes a hazard. It calls attention to a procedure, practice, or the like, that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood**
CAUTION	The CAUTION notice denotes a hazard. It calls attention to a procedure, practice, or the like, that, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

Electromagnetic Interference

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 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 Teledyne CETAC Technologies 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-001 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-001 edictee par le ministre des Communications.

Explanation of Regulatory Marks

Do not dispose in domestic household waste.

The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste, in compliance with the European Waste Electrical and Electronic Equipment Directive (WEEE, 2002/96/EC).

For instructions on how to return end-of-life equipment, producer-supplied electrical accessories, or auxiliary items for proper disposal please contact the supplier or importer. In the event a supplier cannot be reached, contact Teledyne CETAC Technologies customer service department at 1 (800) 369 2822.

CE

The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.

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10 Glossary

Analytical Instrument: The instrument, typically an ICP or ICP-MS, to which the autosampler is connected.

Arm: The autosampler arm that extends from the front of the autosampler cabinet. The arm moves left/right and the Z-drive moves forward/back on the arm.

ETFE: Ethylenetetraflouroethylene (Tefzel®).

FEP: Fluorinated ethylene propylene.

Home Block: See *Y-Axis Slider Block*.

Host Computer: The computer that controls operation of the ICP / ICP-MS instrument to which the CETAC autosampler is attached, and through which the autosampler is controlled.

Hz: Hertz.

ID: Inside diameter.

ICP/ICP-AES/ICP-MS: Inductively Coupled Plasma / Inductively Coupled Plasma Atomic Emission Spectrometer / Inductively Coupled Plasma-Mass Spectrometer.

ICP Software: The measurement automation software on the host computer which controls the measurement system. In addition to controlling the spectrometer, this software sends commands to the autosampler so that samples are introduced at the right time. “ICP” in this context can refer to both Instrument Control Program and Inductively Coupled Plasma spectroscopy.

ID: Inside diameter.

LED: Light-emitting diode.

PEEK: Polyetheretherketone.

Peristaltic Pump: In the context of this manual, usually refers to the on-board peristaltic pump controlling the movement of the rinse solution to the rinse station on the autosampler.

PPS: Polyphenylene sulphide.

PTFE: Polytetraflouroethylene.

PVDF: Polyvinylidene fluoride resin.

Rinse Solution: The solution used to clean the sample probe.

Rinse Station: The autosampler component used to clean the sample probe with a rinse solution.

Sample Probe: The rigid tube that moves the analyte from the sample vial to the sample transfer tubing.

Sipper: Another name for the sample probe.

Rinse Station: The autosampler component used to clean the sample probe with a rinse solution.

UHMW-PE: Ultra-high molecular weight polyethylene.

VAC: Volts alternating current.

VDC: Volts direct current.

X-Axis: The left-to-right axis of the autosampler.

Y-Axis: The front-to-back axis of the autosampler.

Y-Axis Slider Block: The component that fits over the autosampler arm and moves the Z-drive forward and backward along the autosampler arm.

Z-Axis: The up-and-down axis of the autosampler.

Z-Axis Rotor: The motorized wheel which moves the Z-drive cable, which in turn moves the Z-axis slider up and down.

Z-Drive: The portion of the autosampler which moves along the arm and moves the sample probe up and down. The Z-drive assembly includes the Y-axis slider block and the cable which transfers motion from the rotor on the back of the autosampler.

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