
CETAC

ADX-500 Online AutoDilution Accessory



Operator's Manual

Manual Part Number **480065** Revision 2

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1 Introduction

Overview

The CETAC ADX-500 Online AutoDilution Accessory adds unattended, online dilution to the included CETAC ASX-520 autosampler. A dual probe system is used to separate uptake for sample dilution from delivery of the diluted sample to the analytical instrument. As the analytical instrument makes measurements, samples with over-range concentrations are automatically diluted and re-sampled.

The ADX-500 Online AutoDilution Accessory is compatible with a variety of analytical instruments; please call CETAC for detailed compatibility information.



Figure 1-1. Front view of the ADX-500 Online AutoDilution Accessory.

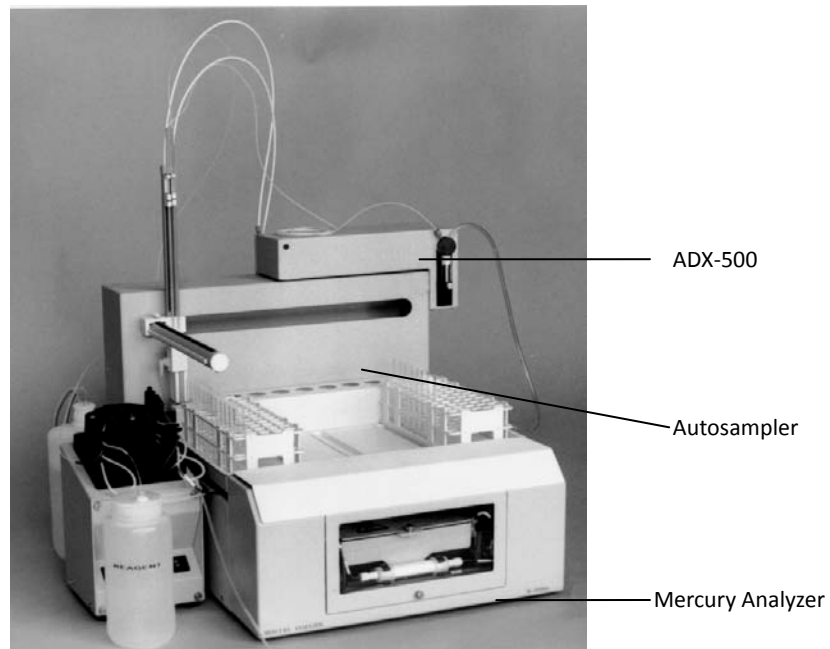


Figure 1-2. Front view of the ADX-500 with an autosampler and a CETAC mercury analyzer.

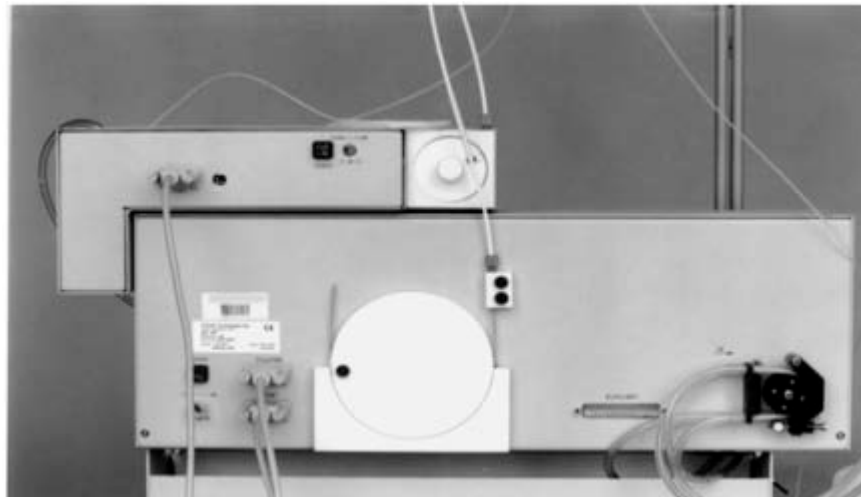


Figure 1-3. Back view.

The ADX-500 adds the following components to an ASX-520 autosampler:

- An additional probe to inject diluent into a sample vial.
- A drive motor to control vertical motion of the dilution probe.
- A syringe pump to control flow of the diluent.
- Electronics to control the motor and syringe pump.
- A rinse station capable of rinsing both probes.

About This Book

This document describes the procedures for installing, using, and maintaining the ADX-500.

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 ADX-500.

WARNING

CHEMICAL INJURY HAZARD

The ADX-500 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.

Where to Go for More Information

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

- The CETAC Web site: <http://www.cetac.com/>. You can find additional manuals under "Service & Support," including
 - Updated versions of this manual
 - The *Operator's Manual* for your autosampler
 - The *CETAC ADX-500 Autodilutor Software Developer's Manual*
- The manual for your analytical instrument
- CETAC Technologies Customer Service and Support:
 - 1 (800) 369-2822
 - 1 (402) 733-2829
 - 1 (402) 733-1932 (Fax)
 - E-mail: custserv@cetac.com

Theory of Operation

The on-line dilution of the sample is controlled by the same software which controls the analytical instrument. Samples are diluted by a factor of 1:10, with sequential dilutions available as a software option.

The user can configure the software to dilute samples (1) upon over-range of the calibration curve, where the intensity is above the high standard or (2) upon saturation of the detector. The user also selects the autosampler

Chapter 1: Introduction

positions used for receiving diluted sample. The software can suspend the automatic run, when all preset dilution tubes have been used.

Upon the determination that the sample concentration is above the user defined limit, the software automatically begins the dilution process. When a sample is diluted, 1 mL of the sample is transferred from the sample tube and a total of 9 mL of the diluent is transferred from the diluent bottle and deposited into an empty tube.

The diluted sample is analyzed and the solution's concentration is calculated with a 1:10 dilution factor. In the case that the diluted sample is still above the user-defined limit, the entire dilution process is repeated, yielding another 1:10 dilution.

The ADX-500 uses a dual probe Z-drive assembly. The use of a second and independent probe for dilution eliminates the need for valves in the sample introduction path. This allows the autosampler to function normally until dilution is needed, preventing the possibility of cross contamination from the dilution probe.

Equipment Supplied

The following components are part of, or supplied with, the ADX-500:

- ADX-500 Online AutoDilution Accessory
- External desktop power supply
- Power cord (with a plug appropriate for your country)
- Serial cable (9-pin, female-female)
- Syringe pump with 5 mL syringe
- Z-drive assembly
- Spare thumbscrews (two thumbscrews are used to install the Z-drive assembly)
- Spare sample probe clamp
- Sample probe and dilution probe (pre-installed on Z-drive assembly, with attached tubing)
- Diluent bottle
- Tubing
- Sample racks and vials
- CD, including this *Operator's Manual* and the C-Term terminal emulation software

Note that the ADX-500 is always provided along with an ASX-520 autosampler. The autosampler has been preconfigured to work with the ADX-500.

Additional Equipment Required

In addition to the provided equipment, you will need:

- A host computer with a free serial port.

Intended Use

The ADX-500 is designed for usage in analytical laboratories. It is not suitable for use in biochemical, biological or medical environments.

Chemical Compatibility

ADX-500 components are made of corrosion-resistant stainless steel alloys or anodized aluminum. The enclosure is made from a high-strength aluminum alloy that is chromated and finished with an epoxy powder coating.

The ADX-500 operates reliably under a wide variety of conditions. Wetted components 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 40%)
- Predominantly aqueous solutions of strong bases (less than 10%)
- Common organic solvents such as acetone, alcohols, ethyl acetate, Methyl ethyl ketone (MEK), petroleum oils and derived fuels, tetrachloroethylene, toluene, kerosene and xylene.

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 wetted 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).

WARNING

CHEMICAL HAZARD

Do not use the ADX-500 with substances which could pose a hazard of serious injury to the operator if spilled or injected, such as biological substances or formic acid.

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2 Preparing for Installation

This chapter explains how to prepare the laboratory for the ADX-500. It also describes how to successfully unpack the instrument.

CAUTION

Make sure you have read and understood both the autosampler manual and the analytical instrument manual before you proceed with the ADX-500 installation. **Make sure that all instruments are working properly before you attempt to install the ADX-500 Online AutoDilution Accessory.**

Space Requirements

The ADX-500 does not affect the benchtop footprint beyond that of the ASX-520 autosampler. It increases height (height of Z-drive assembly) by only about 5 cm (two inches). The diluent bottle (1 liter with hole in lid) should be placed beneath or to the right of the ADX-500.

Power Requirements

The ADX-500 receives power through the connection to the external desktop power supply. Place both the ADX-500 and autosampler within 1.2 meters of a power outlet.

CAUTION

Connect the power supply to the ADX-500 first and then connect the line cord. Do not apply power to the power supply until ready to operate the ADX-500.

The power supply socket is on the back of the ADX-500 beside the power button.

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 ADX-500 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 240VAC 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 sample changer 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 sample changer should be disconnected from the power source.

Unpacking the ADX-500

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

If the ADX-500 or any of its components are shipped or removed from storage during cold weather, allow the packaged equipment to attain room temperature before opening and exposing to warm, humid air. It is usually sufficient to provide 4 to 8 hours for this purpose.

Remove the packing checklist from the shipping container, and check off items against it. Leave accessories in the packing until needed.

Note:

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

3 Installing the ADX-500 System

Always use the ADX-500 with the provided autosampler. The provided autosampler is specifically configured to work with the ADX-500.

CAUTION

Do not attempt to retrofit an existing ASX-520 autosampler to work with the ADX-500. The standard-configuration ASX-520 is not compatible with the ADX-500.

CAUTION

Using tools such as screwdrivers or pliers could result in damage to the ADX-500. Thumbscrews can be removed with tools if necessary, but do not tighten with anything other than your fingers.

WARNING

Ensure that AC power is off before proceeding with installation.

Installing the ADX-500 on the Autosampler

To set up the ADX-500 you must complete the tasks listed below:

- 1 Place the ADX-500 on top of the autosampler. Hook-and-loop fastener material holds the ADX-500 in place.
- 2 Remove the two thumb screws from the Y-axis slider block. Slide the Z-drive assembly onto the autosampler arm and secure by tightening the thumbscrews.

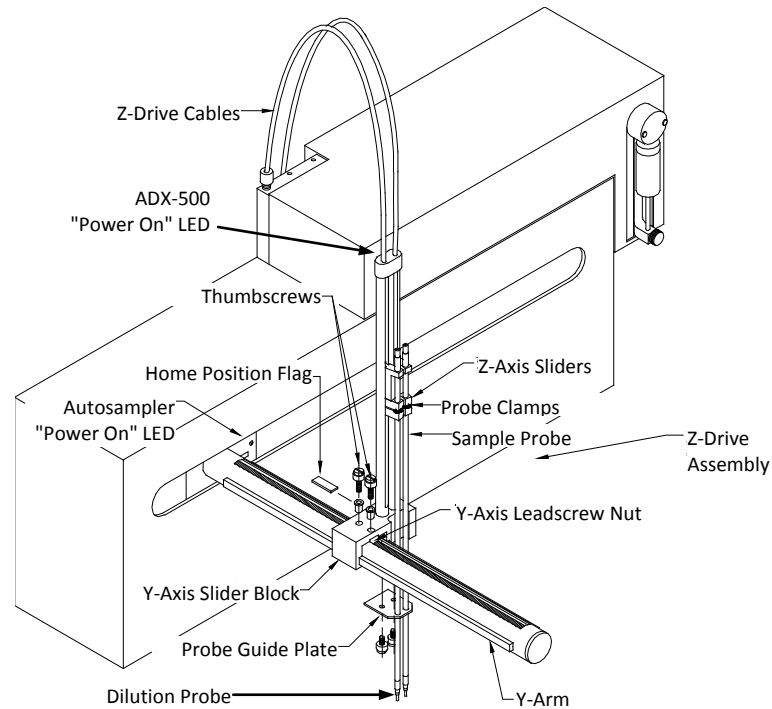


Figure 3-1. Z-drive assembly components.

Connecting the Tubing

- 1 Place the diluent bottle near the ADX-500.
- 2 Attach an approximately 2 ft. length of 1/8" ID (1/4" OD) Tygon tubing for the diluent to the ADX-500 syringe pump. The tubing should be long enough to almost reach the bottom of the bottle. See Figure 3-2, callout F.

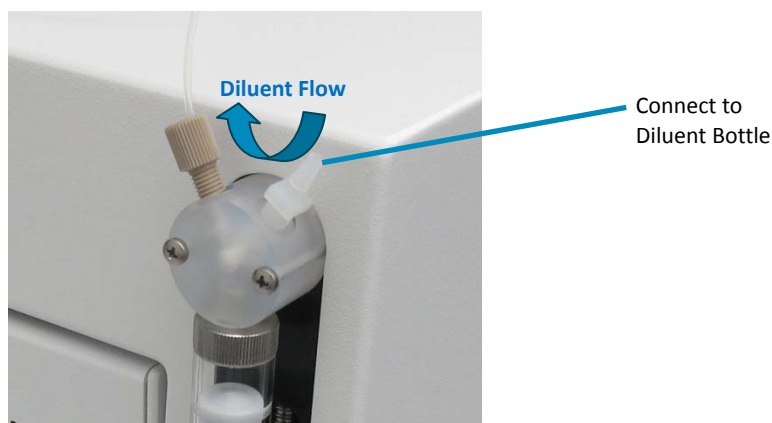


Figure 3-2. Front view of autosampler and ADX-500.

- 3** Connect the autosampler rinse station tubing as required for your application. To prevent pressure buildup in the waste bottle, be sure that the waste bottle is vented.

Connecting the Serial Cables

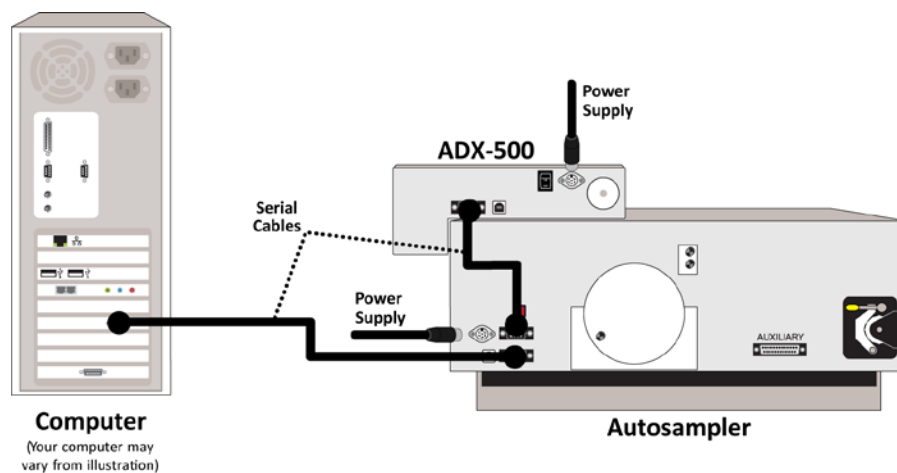


Figure 3-3. Power and data connections.

- 1** Make sure that the power switches on the autosampler and ADX-500 are turned off.
- 2** Connect a serial cable from a serial port on the host computer to COM 1 on the autosampler.
- 3** Connect a serial cable from COM 2 on the autosampler to COM 1 on the ADX-500.

Connecting to a Power Supply and Turning On the ADX-500

- 1 Check the plug on the power cord to verify that it is of the correct type for your country.
- 2 Plug the power cord into a power outlet.
- 3 Plug the power cord into the power supply.
- 4 Plug the power supply into the 24V connector on the ADX-500.
- 5 If you have not done so already, connect the autosampler to its power supply as described in the autosampler *Operator's Manual*.
- 6 Turn the power switch on the autosampler ON.
- 7 Turn the power switch on the ADX-500 ON.

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

- “Power requirements” on page 42.
- “Power Cord Set Requirements” on page 43.

WARNING

FIRE AND SHOCK HAZARD

Use only the provided desktop power supply.

WARNING

INJURY HAZARD

Do not touch the syringe while power to the ADX-500 is turned on. The syringe could move unexpectedly.

Turning Off the ADX-500

- 1 Turn the power switch on the autosampler OFF.
- 2 Turn the power switch on the ADX-500 OFF.
- 3 If performing maintenance on the autosampler or ADX-500, unplug the autosampler and ADX-500 power cords. Ensure that any hazardous liquid in the tubing is allowed to drain safely.

4 Verifying Installation

Once installation of the ADX-500 Online AutoDilution Accessory is complete, it is necessary to verify that the system has been installed correctly.

CAUTION

Attempting to use the ADX-500 before ensuring correct installation may result in damage to the autosampler and ADX-500 components.

Verifying installation of the ADX-500 consists of two parts:

- Ensuring that the communications interface between the host computer, the autosampler and the ADX-500 is working.
- Ensuring that the sample probe and syringe pump functions properly.

This chapter explains how to test the communications interface, sample probe and syringe pump before using the ADX-500.

Testing the Interface

If the communications interface between the ADX-500 and the host computer is not established correctly, the autosampler and the ADX-500 will not function.

Before you test the interface, ensure that the communication port connectors are correct and secure, and that power has been established to the autosampler, the ADX-500, and the analytical instrument.

The standard configuration for the system is to connect the ports as follows:

COM 1 of the autosampler is connected to the host computer.

COM 2 of the autosampler is connected to COM 1 of the ADX-500.

Chapter 4: Verifying Installation

NOTE:

The following procedures assume that the power switches at the rear of the autosampler and the ADX-500 are both on. Green LEDs will be lit on the front panels of both instruments.

Each device communicates at 9600-8-N-1 (9600 baud, 8 data bits, no parity, 1 stop bit) with no flow control.

To verify or change the communication settings of the COM ports of the ADX-500 and autosampler, use a terminal emulation program.

- 1 Check that the communication cables are properly attached.
- 2 Connect to the autosampler using a terminal emulator program such as C-Term.
See “Operating the ADX-500 Using a Terminal Program” on page 33.
- 3 To test communication, enter the following command

```
\VER
```

The backslash tells the autosampler to pass the command on to its COM 2 port. Press the Enter key after entering each command.

The ADX-500 should respond with ‘Cetac Technologies DIL ROM ...’. (The exact content of the response may vary.)

If the ADX-500 does not reset, see “Interface Problems” on page 28.

- 4 If you have not already done so, connect all of the ADX-500 tubing and fill the diluent bottle.

CAUTION

Before proceeding to the next step, make sure tubing to diluent bottle is connected and that there is diluent in the bottle. You may damage the pump by running it dry.

- 5 To test the syringe pump, enter the following commands:

```
STD-10
```

```
\PRIME
```

The STD-10 command tells the autosampler to move to standard position 10, which is the diluent waste tube.

The \PRIME command tells the ADX-500 pump to flush itself by twice filling with diluent and depositing it into diluent waste tube.

5 Maintaining the ADX-500

Routine maintenance of the ADX-500 Online AutoDilution Accessory should be incorporated into the regular cleaning of the measurement system. It also includes checking the ADX-500 components for leaks or other damage.

WARNING

Discharge static buildup and ground to the auto sampler base or cabinet before performing any maintenance. Do not touch or short-circuit bare contacts or ports.

Cleaning the ADX-500

You should clean the ADX-500 daily after any analysis to prevent damage and extend its life. It is especially important to clean up spills and remove contaminants from the autosampler's and ADX-500's moving parts and surfaces. It may also be necessary to chemically neutralize spills.

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.

Daily External Cleaning

Use of the ADX-500 may result in spills on components. Good maintenance requires that you clean the ADX-500 and autosampler every day they are used. To do so, complete the following steps:

- 1 Shut down both the autosampler and ADX-500.
- 2 Wipe the ADX-500, 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 on the autosampler arm. Also, never lubricate either of the two lead screws.

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

This process removes any remaining contaminants.

- 4** Dry the ADX-500, sample tray, autosampler cabinet, and autosampler arm using a dry towel.

The ADX-500 and autosampler must be thoroughly dry before you turn the power on.

Daily Rinsing or Priming the Pump

Good maintenance requires that you clean the Syringe Pump every day it is used to remove acid residue and prevent contamination.

At the end of analysis, exchange diluent solution with a rinse solution of deionized water. Depending on the instrument control software, this may be done by selecting manual “Prime” function. This rinses both the pump and dilutor probe.

CAUTION

Prime the Pump! Make sure you prime the syringe pump at the end of every work session. When doing so make sure there is an empty tube in Standard Position 10.

Maintaining the Syringe Pump

Both the syringe pump and plunger need to be replaced as needed.

Syringe Replacement or Installation

- 1 Using the manual controls in your instrument control software, lower the syringe plunger approximately 1000 steps.
- 2 Loosen the knurled nut at the base of the syringe.
- 3 If you are removing a syringe, loosen the knurled knob at the top of the syringe. Carefully slide the syringe away from the pump.
- 4 Line up the new syringe plunger with the plunger shaft and the bottom of the crossflow manifold with the guide on the front of the pump. Carefully slide the syringe back into position to avoid breaking the syringe or bending the plunger.
- 5 Screw the knurled knob at the top of the syringe finger tight.

CAUTION

Do not over tighten the knurled knobs. This can result in a broken syringe.

- 6 Replace the plunger at the base of the syringe shaft.
- 7 Tighten the knurled nut at the base of the syringe.

Plunger Replacement for Syringe Pump

- 1 Remove the plunger from the pump.
- 2 Press the new plunger tip firmly into the hole until it snaps into position.

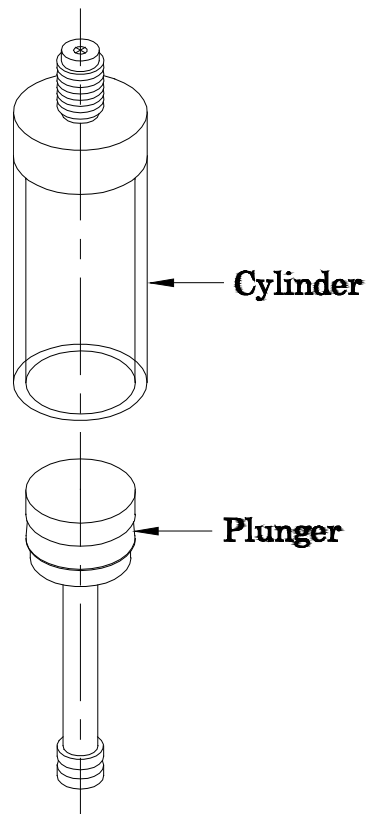


Figure 5-1. Cylinder and plunger of syringe pump.

Replacing the Z-Drive Assembly

To replace or re-install the Z-drive assembly and probes, you'll need to install the probes on the Z-drive assembly, connect the probe drive cables to the rotors, and align the "home" position of the Z-drive assembly.

- 1 Turn off power to the autosampler and ADX-500.
- 2 Install the both probes on the Z-drive. The sample probe should be placed in the left position (closest to the autosampler arm); the dilution probe should be placed in the right position.
- 3 On the back of the autosampler, turn the rotor clockwise as far as it will go.
- 4 Slide the cable onto the rotor on the back of the autosampler.



Figure 5-2. Securing block to back of autosampler.

- 5 Secure the guide block to the back of the autosampler with 2 black-capped thumbscrews. Note that it is important to install the mounting block in the correct orientation. Connect autosampler sample probe to drive wheel on the back of the autosampler. See the autosampler *Operator's Manual* for complete details about the autosampler's installation.
- 6 Gently move the Z-slider until the gap between the slider and cap is approximately 2mm.



Figure 5-3. View of gap between probe bracket and cap (standard Z-drive).

- 7 Hold the cable flat against the rotor and secure the cable by tightening thumbscrew on the rotor. The thumbscrew should be as tight as you can get it using just your fingers.



Figure 5-4. Securing cable to rotor (PEEK cable).

- 8** 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.
- 9** Pass the exposed end of the dilution probe cable over the shaft of a screwdriver until it curls approximately to the diameter of the rotor.
- 10** Remove the screw on the Z-drive rotor.

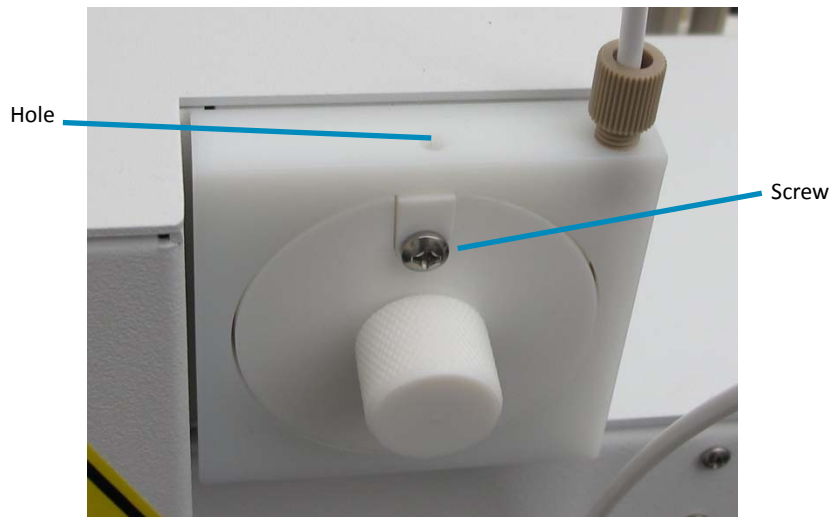


Figure 5-5 Z-drive rotor for the dilution probe.

- 11** Slide the cable into the rotor. Hold the cable sheath in a vertical position and attach the fitting to the Z-drive stator. Tighten the fitting until it bottoms in the stator. Do not over-tighten.
- 12** Rotate the Z-drive rotor until the screw is at the twelve o'clock position.
- 13** Gently move the cable into the rotor until the end of the cable is at the end of the slot in the rotor.

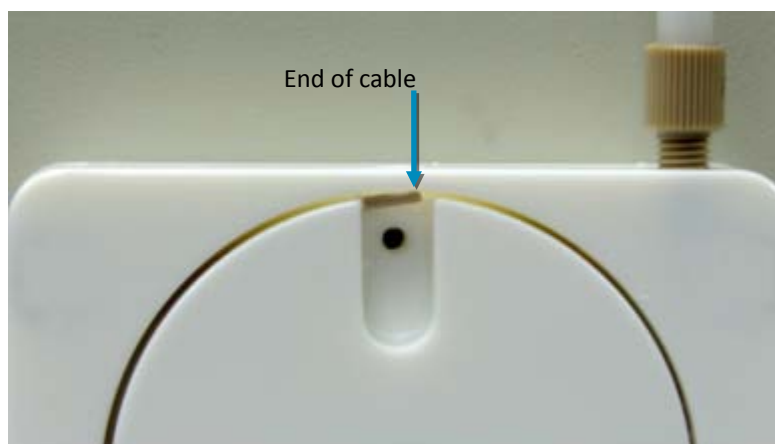


Figure 5-6 Aligning the end of the cable.

To adjust the cable to the left, gently push the slider on the Z drive down.

To adjust the cable to the right, move to the front of the autosampler and gently guide the slider and cable up a short distance. Be careful that the cable does not kink or bend sharply anywhere along its length. If the cable is not moving completely freely, stop and look for the obstruction.

The end of the cable should be visible through the hole in the top of the rotor.



Figure 5-7 End of cable viewed from above.

- 14** Start to install the screw/clamp assembly. Do not tighten it all the way.
- 15** Use an Allen wrench or other tool to hold the cable in the groove while you tighten the screw. The screw should be just tight enough to secure the clamp and lock the cable into the proper position.
- 16** Rotate the Z-drive rotor back and forth to ensure that the end of the cable does not catch on the edge of the hole.
If it catches, loosen the screw and carefully press the cable into the groove while re-tightening the thumbscrew/clamp assembly. If the rotor does not rotate freely, STOP and reinstall the cable.
- 17** Completely tighten the fitting on the Z-drive rotor.
- 18** Rotate the Z-drive rotor back and forth to ensure that the cable is not binding anywhere.
If the rotor does not rotate freely, loosen the screw and reinstall the cable.
- 19** Turn the autosampler on, wait for it to initialize and move the probe to the "home" position, then turn the autosampler off.

Chapter 5: Maintaining the ADX-500

- 20** Check that the probe is centered over the tube of the rinse station. Manually lower the probe by gently turning the rotor on the back of the autosampler. The probe should be centered in the tube of the rinse station.

If the probe is not centered, move the Z-drive assembly to a convenient position and use wire cutters to trim off a narrow strip of the black positioning flag. If you trim off too much, replace the flag (extra flags are supplied with the Z-drive assembly).

Repeat steps 19 and 20 until the probe is centered precisely over the rinse station.



Figure 5-8. View of flag adjustment.

- 21** Turn on power and use your instrument control software to move the probe to several rack positions to make sure the probe is hitting positions correctly.

6 Troubleshooting the ADX-500

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 product.

The ADX-500 is both easy to operate and reliable. However, problems with the ADX-500 may occur. When it does not function properly, isolate the problem to determine if it originates in the host computer, the analytical instrument, the RS-232 cable, or the autosampler or ADX-500.

If you determine the problem is in the ADX-500, check the power system, the communications interface, or the Z-drive assembly to find the cause of the problem and resolve it.

Power System Problems

A possible cause of ADX-500 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, both of the LED status indicator lights 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 ADX-500 is turned on.
- 2** Check that the power cord is plugged in firmly between the power input on the ADX-500 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 ADX-500, but leave it plugged into the wall.

Chapter 6: Troubleshooting the ADX-500

- If the LED is not lit, the power supply is faulty and requires replacement.
 - If the LED is lit when unplugged from the ADX-500 but turns off when plugged into the sample changer, the ADX-500 may have an internal short and requires repair.
- 4** If the external power supply LED is illuminated while plugged into the ADX-500, cycle the power switch. The Z-drive should move up and the ADX-500 should initialize. After initialization, the status LED on the front of the sample changer should light up.

Interface Problems

Operation of the ADX-500 is directed by the host computer. A malfunction of the ADX-500 can indicate a problem with the RS-232 or with the configuration of the software on the host computer.

RS-232 Cable Problems

The first step in troubleshooting interface problems is to check the RS-232 cable. To do so, complete the following steps:

- 1** Check the power switch and front LED to ensure it is on.
- 2** Check that a USB cable is not connected.
When a USB cable is connected, the RS-232 serial interface is disabled.
- 3** Check the RS-232 cables to ensure they are plugged in tightened.
 - COM 1 of the autosampler is connected to the host computer.
 - COM 2 of the autosampler is connected to COM 1 of the ADX-500.

Checking the Autosampler DIP Switches

The autosampler provided with the ADX-500 is pre-configured. If you are unable to communicate with the ADX-500, and you suspect that the autosampler DIP switches may have been changed, check the setting as follows:

- 1** Remove one of the screws which secures the small access cover plate to the back of the autosampler, then loosen the other screw.

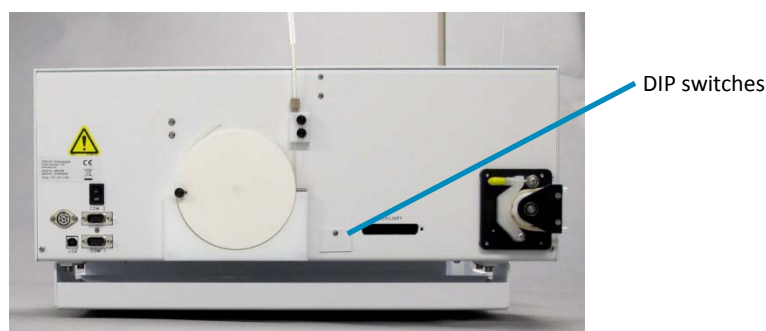


Figure 6-1 Location of DIP switches

- 2 Swing the plate so that you can see the DIP switches.
- 3 Check that switch 5 is set to ON.

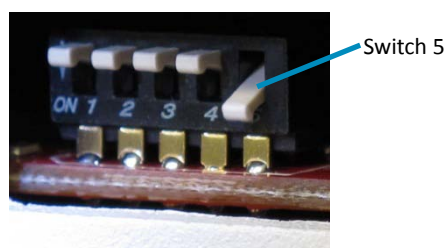


Figure 6-2 DIP switch 5 is ON

- 4 Replace the access plate.

Software Configuration Problems

If the RS-232 cable is connected properly and the ADX-500 is still not communicating with the host computer, ensure that the host software is configured correctly. To do so, complete the following steps:

- 1 Run the host software and ensure that the instrument is functioning properly.
- 2 Check the software configuration for the correct COM port selection and baud rate (9600, N, 8, 1).

If the wrong port or baud rate is selected, change the configuration. See Chapter 4 of this manual for directions.

Software Troubleshooting

Refer to this chart of ADX-500 software errors that an analyst may encounter, the most likely cause of the message, and suggested course of action.

Error Message	Probable Cause	Action
Error detecting the ADX-500.	At startup, ADX-500 is not on-line or connected properly or defective cable(s).	Check power, serial connections and cables and then restart. Check the autosampler DIP switches.
Error in priming ADX-500 pump.	Physical ADX-500 hardware or serial communications failure.	Check serial connections and cables and pump and then restart.
Error setting the dilution tube range.	Serial communications failure or pump failure (either hardware or communications).	Check serial connections and cables and pump and then restart. Set dilution tube range again.
Error setting the ADX-500's program rack type.	Serial communications failure.	Check serial connections and cables and then restart. Set rack type again.
Error setting the ADX-500 sipper speed.	Serial communications failure.	Check serial connections and cables and then restart.

Table 7-1. Typical software error messages

Returning the Product to CETAC for Service

Refer to the following information if you need to return the product to 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 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 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.

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 DE-FECTIVE 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.

Chapter 6: Troubleshooting the ADX-500

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.

7 Operating the ADX-500 Using a Terminal Program

The ADX-500 can be controlled using a serial communications protocol. You can use any terminal emulation program, including:

- **C-Term.** This program is included on the software CD or from the CETAC Web site, and runs on Windows 2000 and later. (recommended)
- **HyperTerminal.** This program was supplied with versions of the Windows operating system through Windows XP.

This chapter explains how to operate the ADX-500 using either of the two programs.

Using C-Term™

C-Term is a simple terminal program developed to validate the installation and functionality of various devices. C-Term communicates through a serial (RS-232) port on the host computer. (If the device is connected to a USB port, the device driver will create a virtual serial port. CETAC does not recommend using the ADX-500 with a USB connection. If a USB cable is used, it must be less than 3 meters long.)

C-Term is provided on the software CD or can be downloaded from the CETAC Web site.

Starting C-Term

- 1 Check that the communication port connectors are properly attached between the host computer and the device.

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

- 2 Click on the C-Term icon.

Overview of the C-Term Window

Once C-Term is loaded, the window shown in Figure 7-1 will open. The majority of C-Term's functions are available from this window.

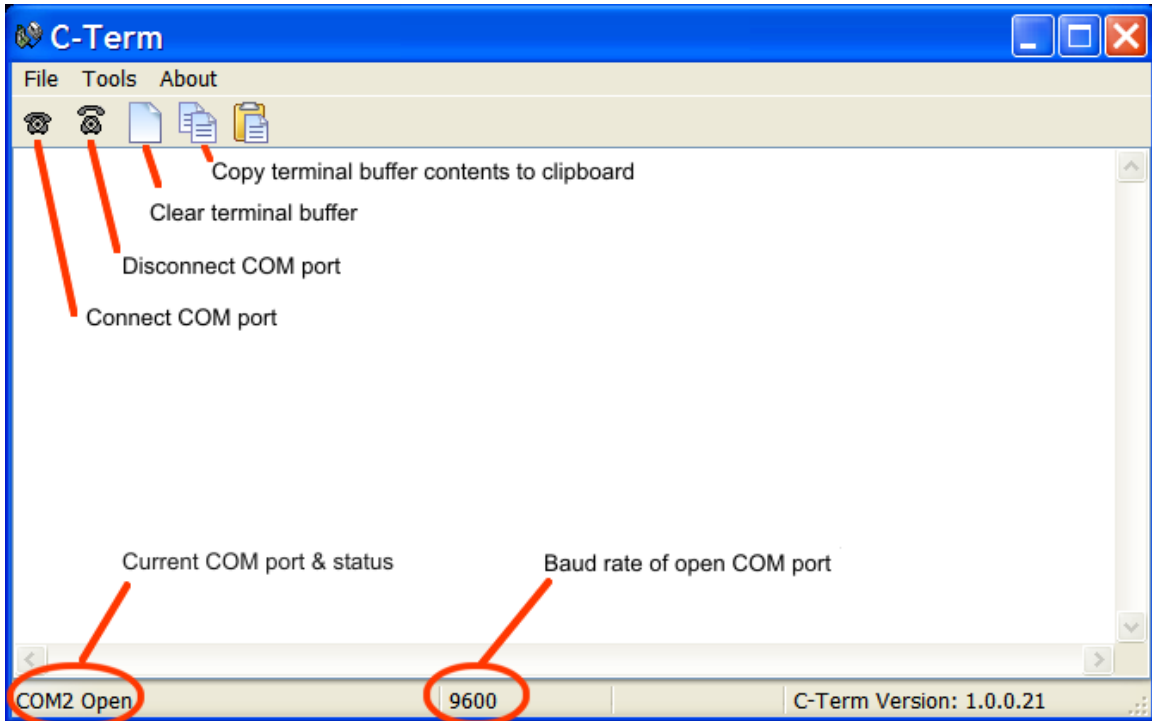


Figure 7-1 C-Term Window

By default, typed commands are sent to the device connected to the opened port. The typed commands will appear in light green in the terminal buffer. Responses from the device 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.

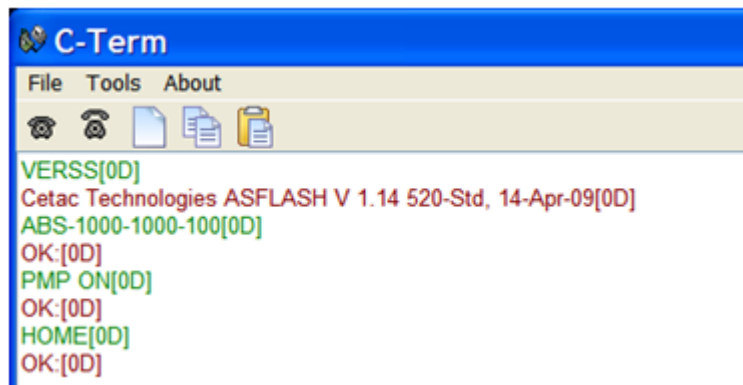


Figure 7-2 Outgoing commands shown in green and incoming responses shown in red

Configuring C-Term

By default, C-Term attempts to open COM 1 the first time it is executed. If the COM port that the device is connected to is not the default (COM 1), then it will be necessary to configure C-Term to use the desired port.

The default communications configuration is appropriate for use with the vast majority of devices.

NOTE

If COM 1 (or the currently selected COM port) is in use by another program or is otherwise unavailable, a warning dialog box will pop up when C-Term starts stating that the COM port could not be opened.

- 1 On the Tools menu, click Setup Serial Port.

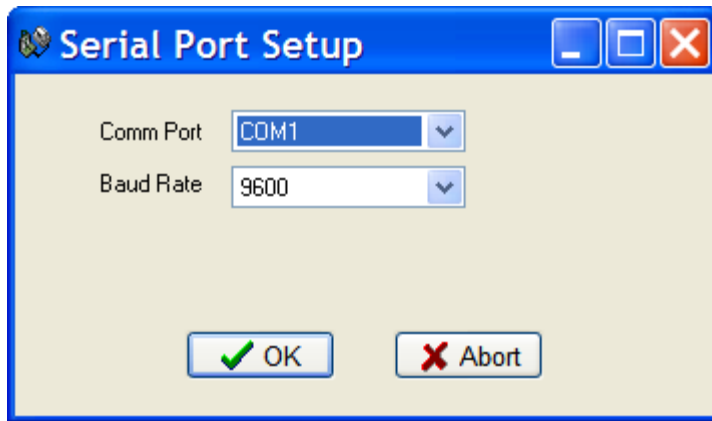


Figure 7-3 Serial Port Setup Window

- 2 Select the desired COM port and, if necessary, the Baud rate used by the connected device then click OK.

The window will close and the settings will be saved. These new settings will be applied immediately and used thereafter unless changed again.

NOTE

Most devices communicate at 9600 baud (which is the default.)

NOTE

Only installed COM ports, including USB virtual COM ports, will appear in the **Comm Port** menu.

Setting Preferences

If desired, the size of the scrollbar buffer or the color of the outgoing and incoming texts can be changed (to work around color blindness, for example).

- 1 On the Tools menu, click Preferences.

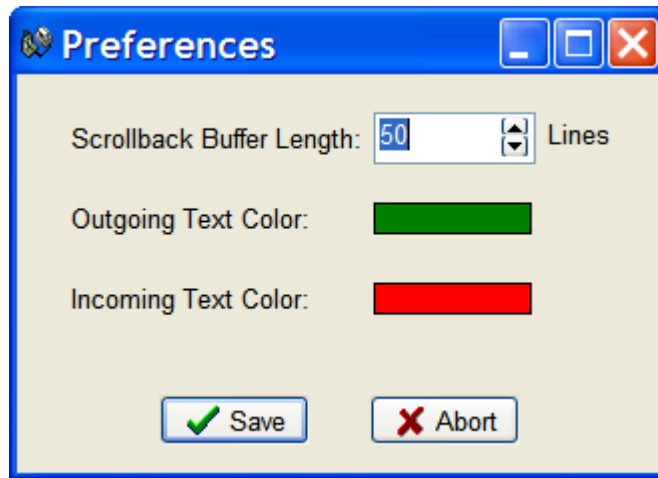


Figure 7-4 Preferences Window

To change the Scrollback Buffer Length, either type the new value in the field or use the arrows adjust the value up or down.

To change text color, click on the color bar and a color selection dialog box will appear. Select the new color and click OK.

- 2 Click Save to apply your settings and close the window.

Using HyperTerminal

- 1 Using a serial cable, connect the ADX-500 with the computer. Plug each end of the serial cable into the COM 1 port of the ADX-500 and the computer, respectively.
- 2 Turn on the computer and select the Accessories folder. Select the HyperTerminal folder and then the HyperTerminal program.
- 3 A window will appear as in Figure 7-5. Enter COM 1 in the name box. Press the OK button.

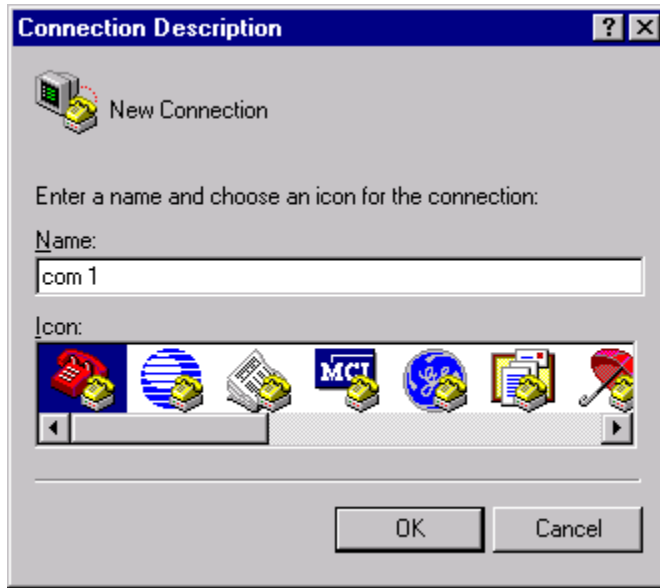


Figure 7-5 “Connection Description” Window

- 4 In the Connect To window, set Connect Using to COM 1, then click OK.



Figure 7-6 “Connect To” Window

- 5 In the Properties window, set Bits per second to 9600 and Flow control to None.

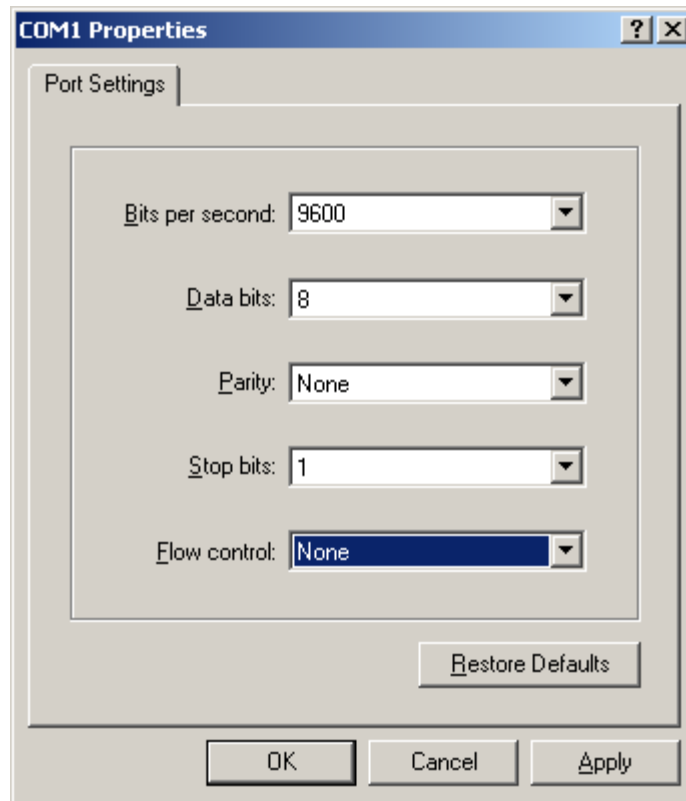


Figure 7-7 "COM 1 Properties" Window

- 6 Click OK.

The HyperTerminal window will open.

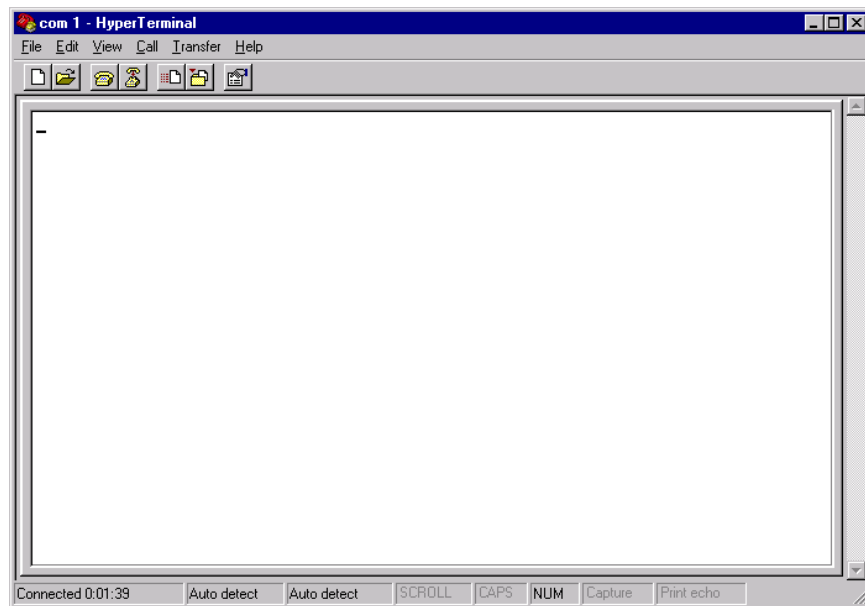


Figure 7-8 "COM 1 HyperTerminal" Window

- 7 On the File menu, click Properties.

- 8 On the Settings tab, click ASCII Setup

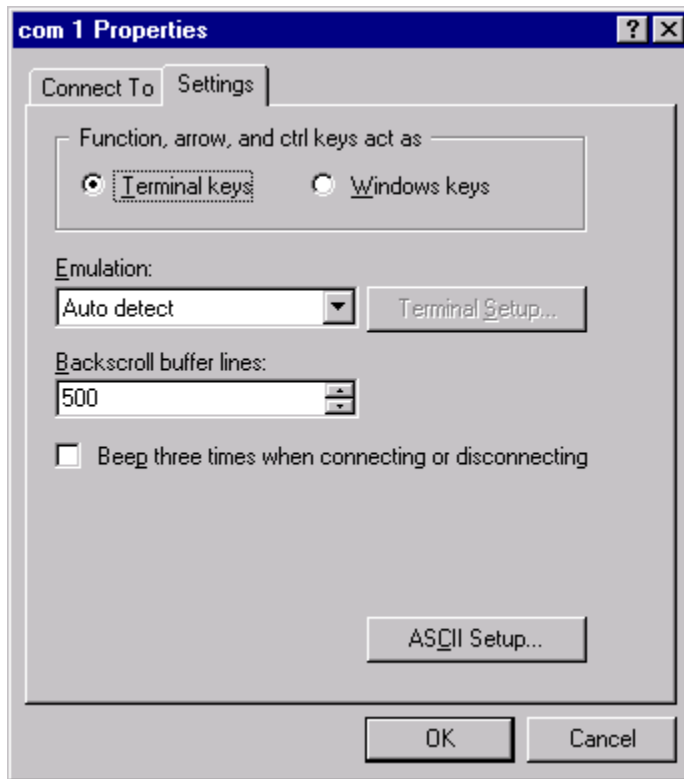


Figure 7-9 “COM 1 Properties” Window

- 9 Click ASCII Setup.
- 10 Enable “Echo typed characters locally” and “Append line feeds to incoming line ends,” then click OK.

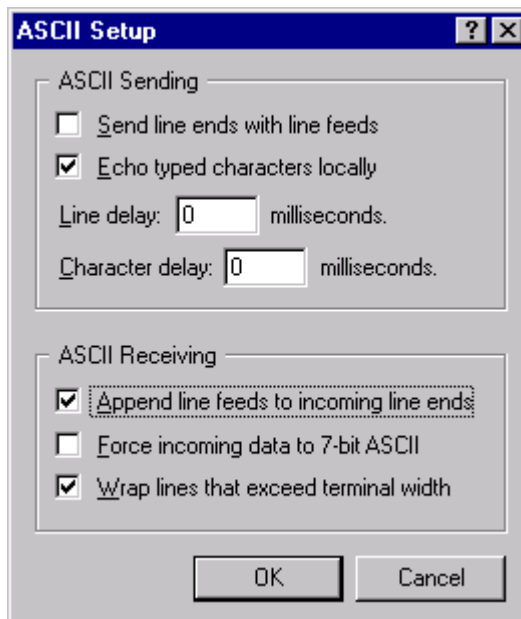


Figure 7-10 “ASCII Setup” Window

11 Turn on the ADX-500.

The HyperTerminal window should display an OK.

ADX-500 Commands

The following commands will produce various responses of the ADX-500.

Command	Description
<code>\Ver</code>	Returns firmware version. (The output of VER is intended for human interpretation during troubleshooting; changes to the firmware version may cause the output of this command to differ from unit to unit.)
<code>\Prime</code>	Prompts the pump to flush itself by twice filling with diluent and depositing it into diluent waste tube

Table 7-1. ADX-500 commands.

ADX-500 commands must be preceded by a backslash ("\") if they are being passed through the autosampler. Omit the backslash if connecting directly to the ADX-500.

You can use these commands to determine if the ADX-500 is communicating and functioning properly.

8 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

Operating Temperature	+10° C to +30° C (+50° F to +85° F)
Non-Operating Temperature	+0° C to +55° C (+32° to +131° F)
Operating Altitude	Up to 3,048 m (10,000 ft)
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 8-1: Environmental Characteristics

For indoor use only.

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

See page 9 for information on chemical compatibility.

Electrical Characteristics

Power requirements

Power Supply	<p>Input: AC Voltage, Frequency, and Current 100-240 V ~ 47-63 Hz 1.9 A Installation Category: CAT II (Line voltage in appliance and to wall outlet)</p> <p>Output: 24 V DC, 3.3 A</p>
ADX-500	<p>Input: DC Voltage and Current — — — 24 V 3.3 A Installation Category: CAT I (Mains isolated) Use only with the provided power supply.</p>

Table 8-2: Power Requirements

Input and output connectors

All terminals allow a maximum current of 500MA @ 24VDC, unless otherwise noted.

USB	USB connection to a controller PC. (Not used)
Serial	RS-232 serial connection to a controller PC.

Table 8-3: Electrical Input and Output Connectors

Safety Notices

WARNING

If the equipment is used in a manner not specified by 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 ADX-500 through the included 24v 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

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.

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 or in the presence of flammable gasses or fumes.

Mechanical Hazards

If you insert any part of your body between the moving parts of the sample changer, you could be injured. Figure 8-1 shows the location of potential hazards. Additional hazards related to the autosampler are described in the autosampler *Operator's Manual*.

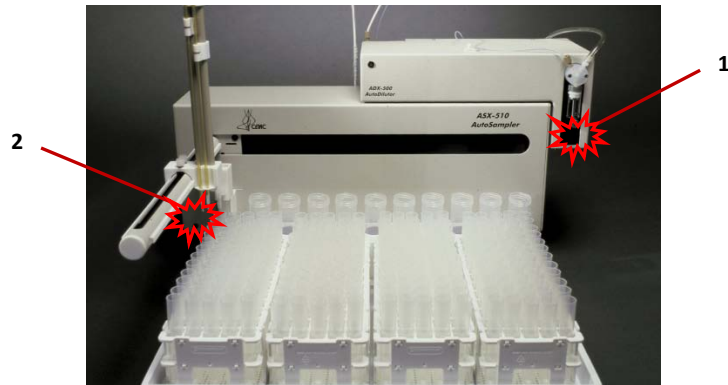


Figure 8-1 Overview of the mechanical hazards of the ADX-500 (front).

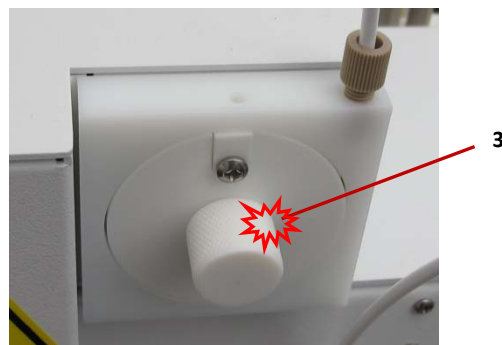


Figure 8-2 Overview of the mechanical hazards of the ADX-500 (rear).

WARNING

1 – CRUSH OR PINCH HAZARD

Keep fingers, hair, and loose clothing away from moving parts when the system is powered on.

2 – PUNCTURE HAZARD and other autosampler-related hazards: See autosampler manual.

3 – ABRASION HAZARD.

Keep away from moving parts when the system is powered on.

WARNING

INJURY HAZARD

Do not touch the syringe while power to the ADX-500 is turned on. The syringe could move unexpectedly.

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. **Syringe movement or 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 indicates an action which must be taken to prevent equipment damage or a serious loss of data. 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 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

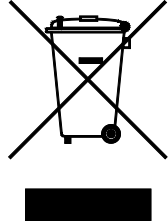
This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled "Digital Apparatus" ICES-001 of the Department of Communications.

AVIS CANADIEN

Chapter 8: Safety and Regulatory Information

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 CETAC Technologies customer service department at 1 (800) 369 2822.



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.

9 Glossary

Analytical Instrument: The instrument, typically an ICP or ICP-MS, to which the ADX-500 is connected.

Host Computer: The computer that controls operation of the analytical instrument and through which the autosampler and ADX-500 are controlled.

Hz: Hertz

ICP/ICP-MS: Inductively Coupled Plasma/Inductively Coupled Plasma-Mass Spectrometer.

ID: Inside Diameter.

LED: Light-Emitting Diode.

PEEK: Polyetheretherketone.

Peristaltic Pump: An on-board pump controlling the movement of the rinse solution to the rinse station on the autosampler.

PTFE: Polytetraflouroethylene.

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 tube that moves the analyte from the sample vial to the sample transfer tubing.

Sipper: Synonym for *Sample Probe*.

VDC: Volts Direct Current.

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

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

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

Chapter 9: Glossary

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