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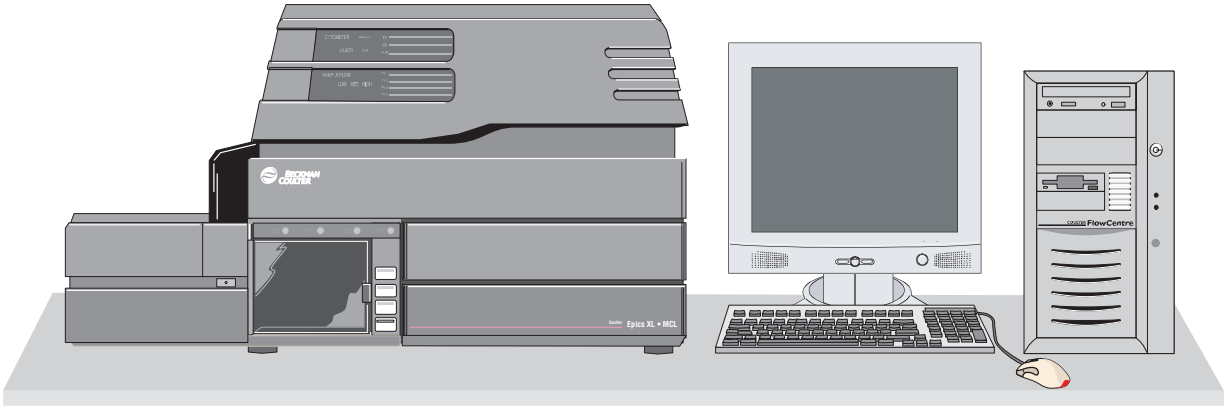
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COULTER® EPICS® XL™ Flow Cytometer
COULTER® EPICS® XL-MCL™ Flow Cytometer

Service Manual



PN 4237029F (October 2002)

Beckman Coulter, Inc.
Fullerton, CA 92835

BECKMAN COULTER™

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Initial Issue, 7/93
Software Version 1.0.

Revision B, 6/94
Software Version 1.5.
Added fluidic schematics, electronic block diagrams, and procedures, and updated parts for MCL. Pages changed or added: i, iii to vii, 1-1, 2-6 to 2-19, 4-14 to 4-35, 5-1, 5,7, 5-8, 8-1 to 8-6, 8-11 to 8-16.

Revision C, 10/94
Software Version 1.5.
Corrected text on pages 4-15, 4-21 and 4.22. Updated the PMI procedure on pages 5-7 and 5-8. Added to and corrected the parts list, pages 8-1 to 8-24. Updated Figures 2.9 and 2.10.

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Complete revision to update manual to software version 2.1 and reformat manual to new numbering system and style.

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EXPO32 version 1.0
EXPO32ADC version 1.1
Revision of Parts List and IPL based on new logos, bezels, covers, and panels. Check digits for all part numbers were deleted. Updated illustrations for title page and cytometer in Figure 8.2-6.

Revision F, 10/2002
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This document applies to the latest software listed and higher versions. When a subsequent software version affects the information in this document, the changes will be included on minor revision change pages or summarized on a Notice of Information Update form and will be released by service memo.

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WARNINGS AND PRECAUTIONS

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1.1 MANUAL DESCRIPTION

Scope

This manual provides the reference information and procedures needed for servicing and maintaining the COULTER® EPICS® XL™ Flow Cytometer and the COULTER® EPICS® XL-MCL™ Flow Cytometer.

The following references apply throughout this manual:

- The XL Flow Cytometer is referred to as the XL flow cytometer.
- The XL-MCL Flow Cytometer is referred to as the XL-MCL flow cytometer.
- When referring to either an XL flow cytometer or an XL-MCL flow cytometer or both, the more generic term “instrument” is used.
- When referring specifically to the MCL sample handler, the term “MCL option” is used.

This manual is available in both an electronic and printed format. The electronic manual is released on the Service Resource Kit CD-ROM, PN 6417471.

This manual does not contain information or procedures already covered in the customer manuals. Use this manual in conjunction with the following materials:

- COULTER® EPICS® XL and COULTER® EPICS® XL-MCL SYSTEM II™ manuals and documents:
  - Getting Started, PN 4237238
  - Operator’s Guide, PN 4237297
  - Operating Summary, PN 4237299
  - Reference, PN 4237298
  - Data Management, PN 4237237
  - Special Procedures and Troubleshooting, PN 4237296
  - Master Index, PN 4237295
- COULTER® FlowCentre™ Multimedia Workstation, PN 4237415.

With the exception of the Operating Summary and the Master Index, the Service Resource Kit CD-ROM, PN 6417471, contains the PDF version of each customer manual as well as the electronic version of this service manual.

Notification of Updates

Any service memo that affects the information in this manual will include either change pages or a Notice of Information Update form for this manual. The Notice of Information Update form will summarize the changes and list the specific headings, figures, and tables affected.

Intended Audience

To use this manual effectively, you need the following:

- Beckman Coulter authorized service training on the XL flow cytometer and the XL-MCL flow cytometer.

- A thorough understanding of:
  - Basic electronic and pneumatic principles and devices.
  - Cytometry terms and concepts.
  - Reagent systems.
  - Quality control.
  - Troubleshooting concepts.
- The ability to:
  - Use basic mechanical tools and understand related terminology.
  - Use a digital voltmeter (DVM) and an oscilloscope.
  - Read pneumatic/hydraulic schematics and understand related terminology.
  - Read electronic schematics and understand related terminology.

Organization

The material in this manual is organized into eight chapters and six appendices. To make it easier to access the information:

- In the electronic manual, each page (screen) has:
  - A Contents button linked to a master table of contents
  - An Index button linked to an alphabetic index
  - An Illustrations button linked to a master list of illustrations
  - A Tables button linked to a master list of tables.
- In the printed manual, there is a master table of contents at the beginning of the manual, a chapter-specific table of contents at the beginning of each chapter, and an alphabetic index at the end of the manual.

This manual contains:

Chapter 1, INTRODUCTION - A brief description of this manual and essential safety information.

Chapter 2, INSTRUMENT DESCRIPTION - An introduction to the instrument, a description of: how it functions, its major components, and Beckman Coulter networking.

Chapter 3, INSTALLATION PROCEDURES - PART A: A list of preinstallation requirements and all necessary instrument installation procedures. PART B: Installation procedures for all available upgrades and options.

Chapter 4, SERVICE AND REPAIR PROCEDURES - The procedures for servicing/repairing the instrument as well as various instructions, such as custom programming of the bar-code scanner EEPROM.

Chapter 5, MAINTENANCE PROCEDURES - The System Verification and Preventative Maintenance Inspection procedures.

Chapter 6, SCHEMATICS - The schematic diagrams.

Chapter 7, TROUBLESHOOTING - Level-sense indicator information and an in-depth error message table.

Chapter 8, PARTS LISTS - The master parts list followed by the illustrated parts.

Appendix A, QUICK REFERENCE INFORMATION - Quick reference information including: tolerances and limits, circuit board layouts with applicable jumper and switch settings, protocol parameters, Prefinal Service Software tests, a list of MCL option commands, Cytometer component locations and functions, Power Supply component locations and functions, as well as a description of the AMI ATLAS PCI motherboard.

Appendix B, HARDWARE/SOFTWARE CONFIGURATIONS AND REQUIREMENTS - Configuration and requirements information for the INTEL® Pentium® 199 Processor, the AMI WIN BIOS software and the Artisoft® LANtastic® network operating system.

Appendix C, FIELD WORKSHEETS - A copy of the Field Engineer Worksheet and the Network Configuration Worksheet are included for your use.

Appendix D, EXAMPLES OF SETUP FILES - Setup file examples for the: client flow cytometer, the file server and the FlowCentre Multimedia Workstation.

Appendix E, NETWORK PROTOCOL SPECIFICATIONS - Specifications for the 802.3 standard.

Appendix F, BAR-CODE SPECIFICATIONS - Specifications for: bar-code labels, bar-code scanners, and the bar-code printer.

ABBREVIATIONS - A list of abbreviations, acronyms and reference designators used in this manual.

GLOSSARY - A collection of specialized terms, with their meanings, either used in this manual or related to the information in this manual.

Numbering Format

Each chapter of this manual is further divided into topics that are numbered sequentially, beginning at one. The numbering format for the topic heading, which is called the primary heading, is chapter number, decimal point, topic number. For example, the primary heading number for the second topic covered in Chapter 2 is 2.2.

The page, figure and table numbers are tied directly to the primary heading number. For example, Heading 2.2 begins on page 2.2-1, the first figure under Heading 2.2 is Figure 2.2-1 and the first table under Heading 2.2 is Table 2.2-1.

Note: Primary headings always begin on the top of a right-hand page.

Special Headings

Throughout this manual WARNING, CAUTION, IMPORTANT, ATTENTION, and Note headings are used to indicate potentially hazardous situations and important or helpful information.

WARNING

A WARNING indicates a situation or procedure that, if ignored, can cause serious personal injury. The word WARNING is in bold-faced text in the printed manual and is red in the electronic manual.

CAUTION

A CAUTION indicates a situation or procedure that, if ignored, can cause damage to the instrument. The word CAUTION is in bold-faced text in the printed manual and is red in the electronic manual.

IMPORTANT

An IMPORTANT indicates a situation or procedure that, if ignored, can result in erroneous test results. The word IMPORTANT is in bold-faced text in the printed manual and is red in the electronic manual.

ATTENTION

An ATTENTION contains information that is critical for the successful completion of a procedure and/or operation of the instrument. The word ATTENTION is in bold-faced text in the printed manual and is red in the electronic manual.

Note

A Note contains information that is important to remember or helpful in performing a procedure.

Conventions

This manual uses the following conventions:

1. *Italics* indicate screen messages.
2. **Bold, initial capped, Helvetica-condensed font** indicates a menu item.
3. `Courier font` either indicates text you have to type using the keyboard or lines of program text that appear on the monitor screen.
4. ▭ indicates a key (such as Enter).
5. ▭+▭+▭ indicates that the keys shown (such as Ctrl+Alt+Delete) are linked (by the + symbols) for a specific function and must be pressed (and held) in this sequence:
   a. Press down **and hold** the first key listed then press down **and hold** the second key listed then press down **and hold** the third key listed.
   b. Release all three keys **simultaneously**.
6. ▭▭▭ (without the + symbols) indicates to press and release each key **separately**.
7. Select menu item ▸▸ sub-menu item (such as **Setup Screen ▸▸ Protocols**) indicates the software options you have to select, as well as the order in which you should select them.

1.2 SAFETY PRECAUTIONS

This section covers safety precautions that you must take whenever you work on an XL or XL-MCL flow cytometer. Additionally, when performing a procedure, always follow any safety precautions included in that procedure, as they supplement the precautions listed in this section.

Special

This group of warnings concerns conditions that can affect both your immediate personal safety and the future safety of the instrument's operators.

WARNING Risk of personal or operator injury. Covers and interlocks are installed on Beckman Coulter instruments to prevent injury from operating components. If you must remove covers or disable interlocks to service an instrument:

1. Be alert and use extreme care when working around exposed components to avoid personal injury.
2. At the end of the service call, **always** reinstall all instrument covers and ensure interlocks are enabled to prevent operator injury.

WARNING Risk of personal or operator injury. Broken or cut components with sharp edges could puncture your gloves and skin, causing possible injury or biohazardous contamination. Handle fragile components carefully to avoid breakage. Replace any broken or cut components with sharp edges, even if they are still functioning. Use mechanical means, such as hemostats, to handle a broken component, whenever feasible. Dispose of broken components in accordance with the local regulations and acceptable laboratory practice.

WARNING Risk of personal or operator injury. Instrument doors, covers, and panels that are mishandled can fail, leading to personal injury. Handle the doors, covers, and panels with care and always follow the written instructions for opening and closing or removing and reinstalling them.

WARNING Risk of personal injury, operator injury, or damage to instrument components. When performing a service call, always follow all applicable service manual or service memo instructions. When questions arise, consult with Technical Support for guidance.

Electronic

WARNING Risk of personal injury or damage to electronic components. While performing maintenance or service on the instrument, rings and other metal jewelry could contact exposed electronic components, causing personal injury from electric shock, or become caught in the instrument, damaging the components. Remove rings and other metal jewelry before doing maintenance or service on the instrument.

CAUTION Risk of damage to electronic components. If the power is ON while removing or replacing printed circuit cards and electronic components, the component could be damaged. To prevent damage to electronic components, always be sure power is OFF before removing or replacing printed circuit cards and electronic components.

CAUTION Risk of damage to electronic components. Electrostatic discharge (ESD) can damage disk drives, add-in circuit cards, and other electronic components. If there is a possibility of ESD damage with a procedure, then do that procedure at an ESD workstation, or wear an antistatic wrist strap attached to a metal part of the chassis connected to an earth ground.

Biological

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while servicing the Cytometer with the doors open, you may become injured or contaminated. To prevent possible injury or biological contamination, you must wear appropriate safety glasses, a lab coat, and gloves when servicing the Cytometer with the doors open.

WARNING Risk of contamination. Biohazardous contamination can occur from contact with the waste container and its associated tubing if not handled with care. Wear personal protective equipment. Avoid skin contact. Clean up spills immediately. Dispose of the contents of the waste container in accordance with the local regulations and acceptable laboratory practice.

Use universal precautions when working with pathogenic materials. Means must be available to decontaminate the instrument and to dispose of biohazardous waste.

Laser

Laser Beam

WARNING Risk of personal injury. The laser beam can cause eye damage if viewed either directly or indirectly from reflective surfaces (such as a mirror or shiny metal surface). Avoid direct exposure to the laser beam. Do not view directly or with optical instruments except for special service instruments as directed in service manual.

Because the system contains a laser, it should be isolated from non-laser instruments. Keep a copy of ANSI (American National Standards Institute) standard 136.1, SAFE USE OF LASERS, near the instrument for ready reference. Copies are available from:

American National Standards Institute
1430 Broadway
New York, N.Y. 10018

The laser is a unique light source that shows characteristics different from conventional light sources. The safe use of the laser depends upon familiarity with the instrument and with the properties of coherent, intense beams of light.

Eye, skin, as well as instrument damage can be caused by the laser beam. The laser has enough power to ignite substances placed in the beam path even at a distance. Indirect contact with the laser beam by reflective surfaces such as jewelry (called - specular reflection) might also cause damage.

For these reasons, always follow these precautions when working near an exposed laser:

- Never look directly into the laser light source or at scattered laser light from any reflective surface. Never look down into the beam's source.
- As a precaution against accidental exposure to the output beam or its reflection, personnel performing service or maintenance procedures on the system should wear proper laser safety glasses.
- Do not use lasers in the presence of flammables or explosives; these include volatile substances such as alcohol, solvents and ether.
- Avoid direct exposure and indirect reflection of the laser beam to your skin.
- Assure that any spectators are not potentially exposed to a hazardous condition.
- Do not leave the laser unattended where an unauthorized person may attempt to use it.

Radiation Hazards

WARNING Risk of radiation exposure. To reduce the risk of exposure to radiation, do not use controls or adjustments or perform any procedures other than those specified in this manual.

In its design and manufacture, Beckman Coulter has complied with requirements governing the use/application of lasers according to regulatory documents issued by the U.S. Department of Health and Human Services and the National Center for Devices and Radiological Health (CDRH).

In compliance with these regulatory documents, every measure has been taken to ensure the health and safety of users, laboratory personnel and service personnel from the possible dangers of laser use. The laser is classified as Class I when it is inside the system with the protective housing in place. The laser warning label (Figure 1.2-1) referring to a CLASS IIIb LASER PRODUCT refers to the outside of the instrument. CDRH-approved labels are placed near or on those covers that when removed might expose laser radiation. Figures 1.2-1 through 1.2-7 show the Laser Warning and Certification labels.

Figure 1.2-1 Laser Warning Labels - Cytometer, Top and Side

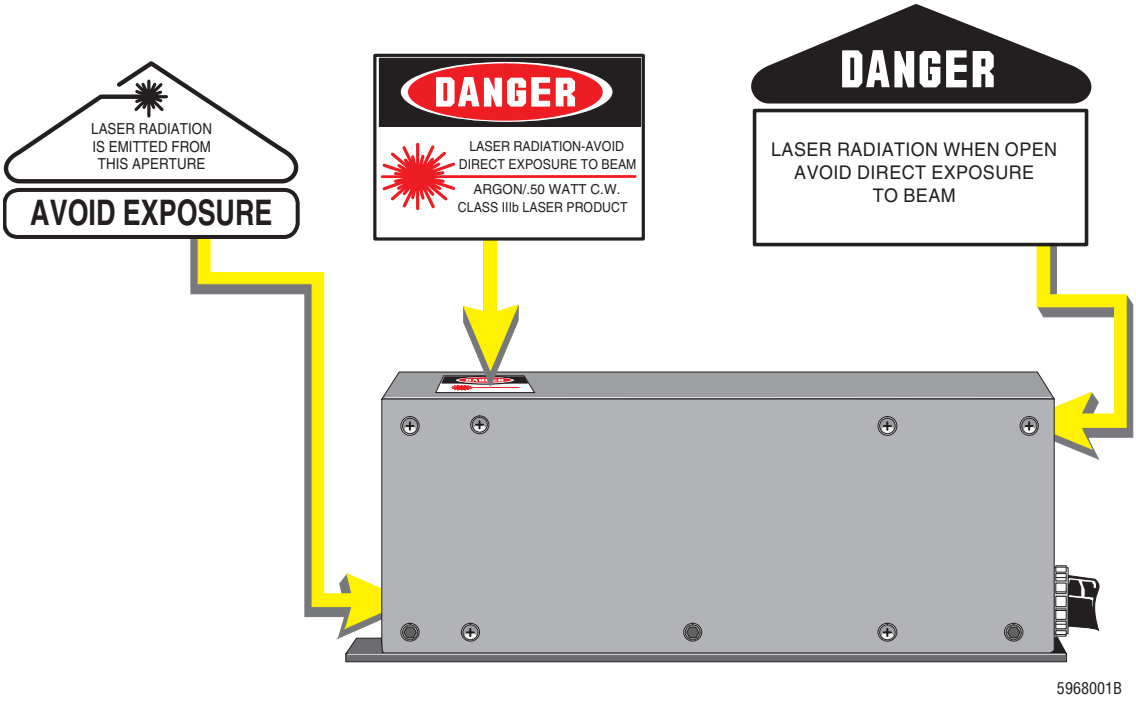


Figure 1.2-2 Laser Warning Labels - Cytometer, Sensing Compartment Cover

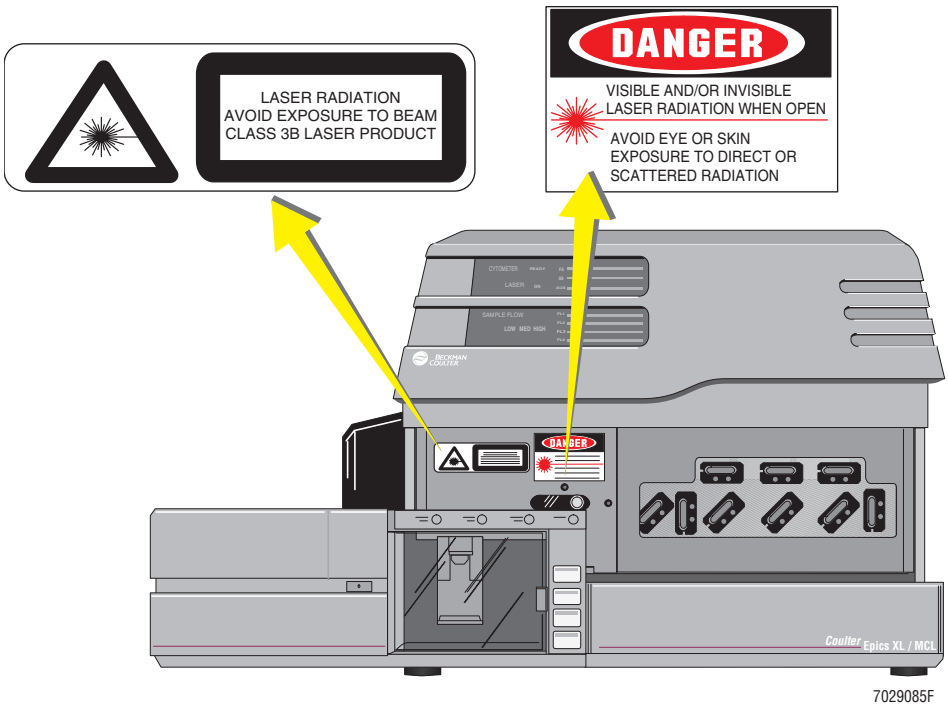
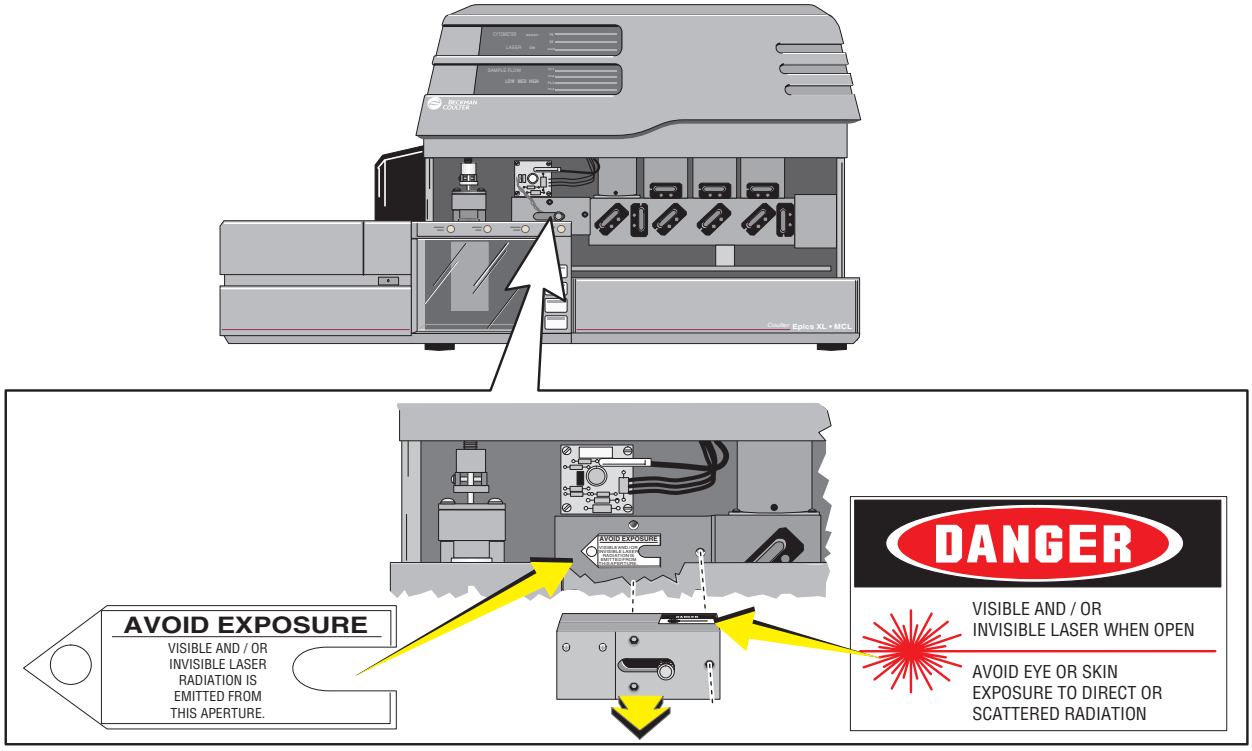
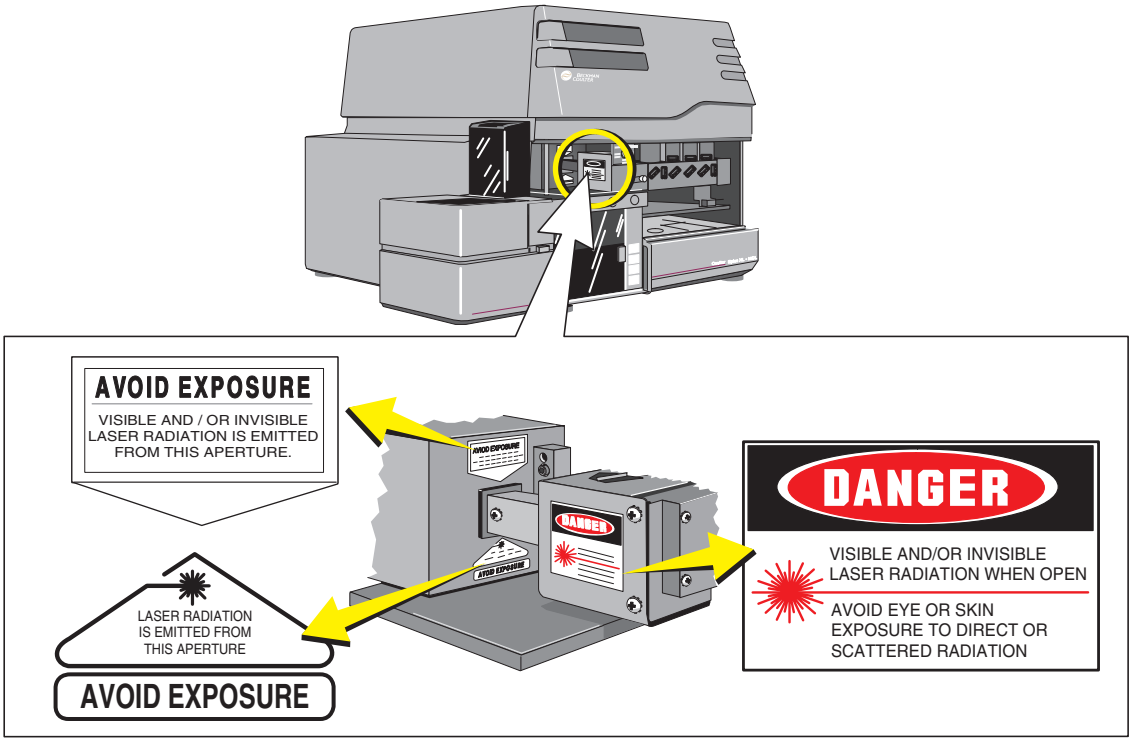


Figure 1.2-3 Laser Warning Labels - Cytometer, Optical Area, Front View



7029086F

Figure 1.2-4 Laser Warning Labels - Cytometer, Optical Area, Side View



7029087F

Figure 1.2-5 Laser Certification Label - Cytometer, Back

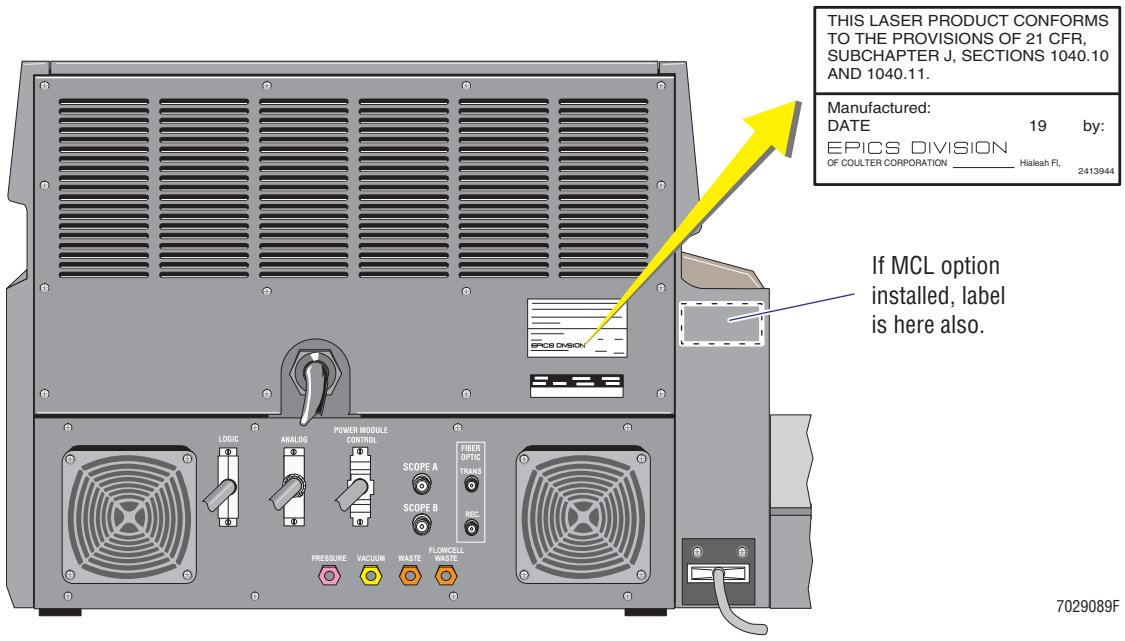


Figure 1.2-6 Laser Warning Labels - MCL Option, Probe Housing

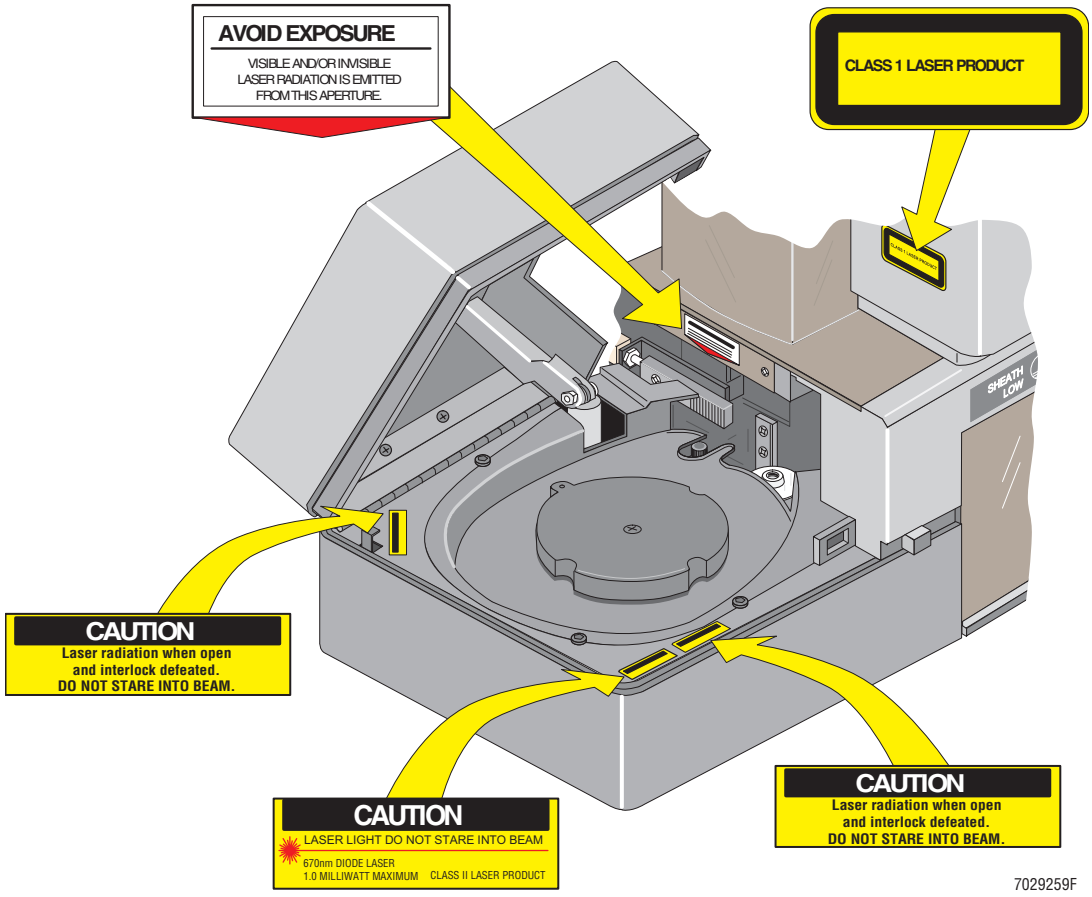
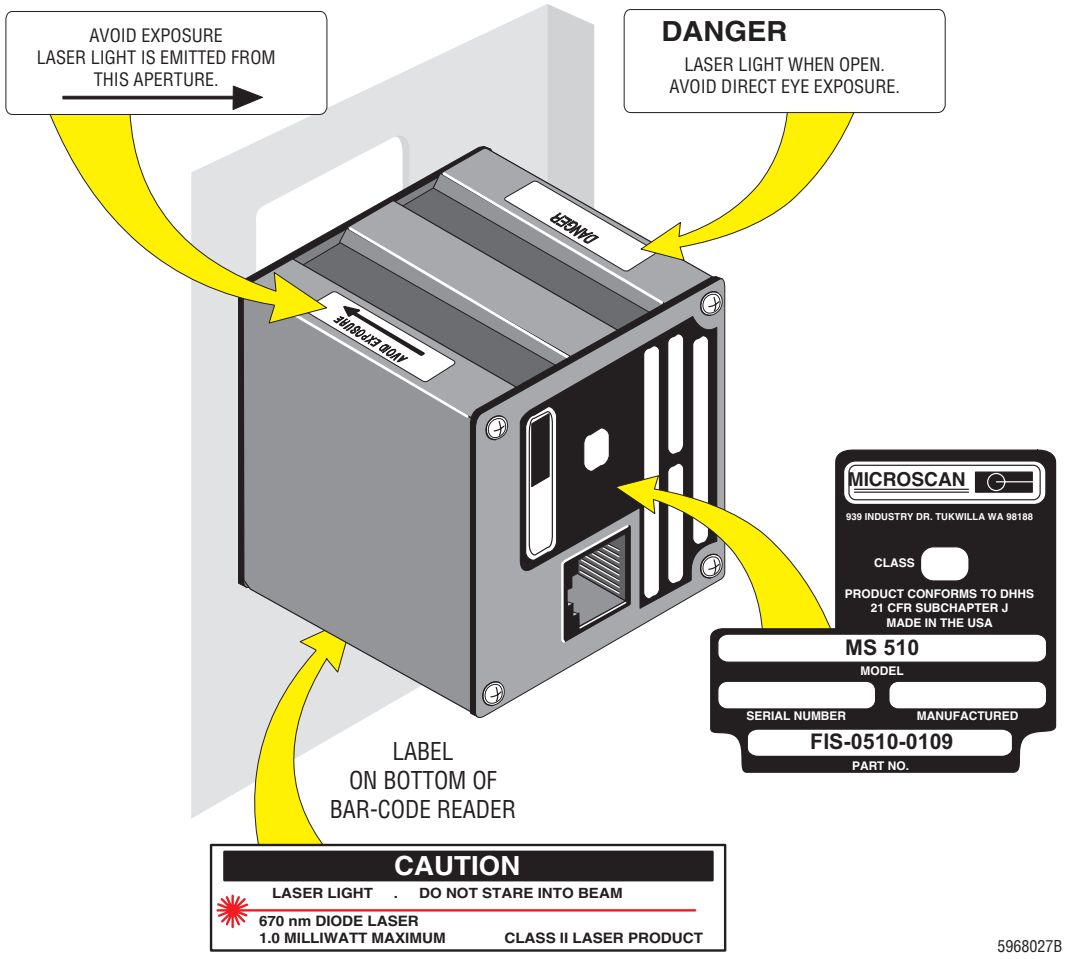


Figure 1.2-7 Laser Warning Labels - Bar-Code Scanner Option



Troubleshooting

Bring the following warning to the customer's attention before advising that customer to do any service, maintenance, or troubleshooting procedures on the Cytometer.

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while doing service, maintenance, and troubleshooting procedures, residual fluids in the Cytometer could injure or contaminate you. Beckman Coulter recommends that you wear barrier protection, such as appropriate safety glasses, a lab coat, and gloves throughout the performance of service, maintenance, and troubleshooting procedures to avoid contact with cleaners and residual fluids in the Cytometer.

Also, make sure customers are aware of the warning and information labels shown in Figures 1.2-1 through 1.2-7.

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2.1 SYSTEM OVERVIEW

Function

The instrument is a flow cytometer analyzer that reports three- and four-color surface marker analysis and one-color DNA analysis.

Sheath Flow

Set to 4.0 psi (controlled by mechanical regulator).

Sample Flow

User selectable to the following approximations when calibrated (controlled electronically):

LOW = 3.72 psi
MED = 3.92 psi
HIGH = 4.12 psi.

Segmenting Valve/Positions Flow

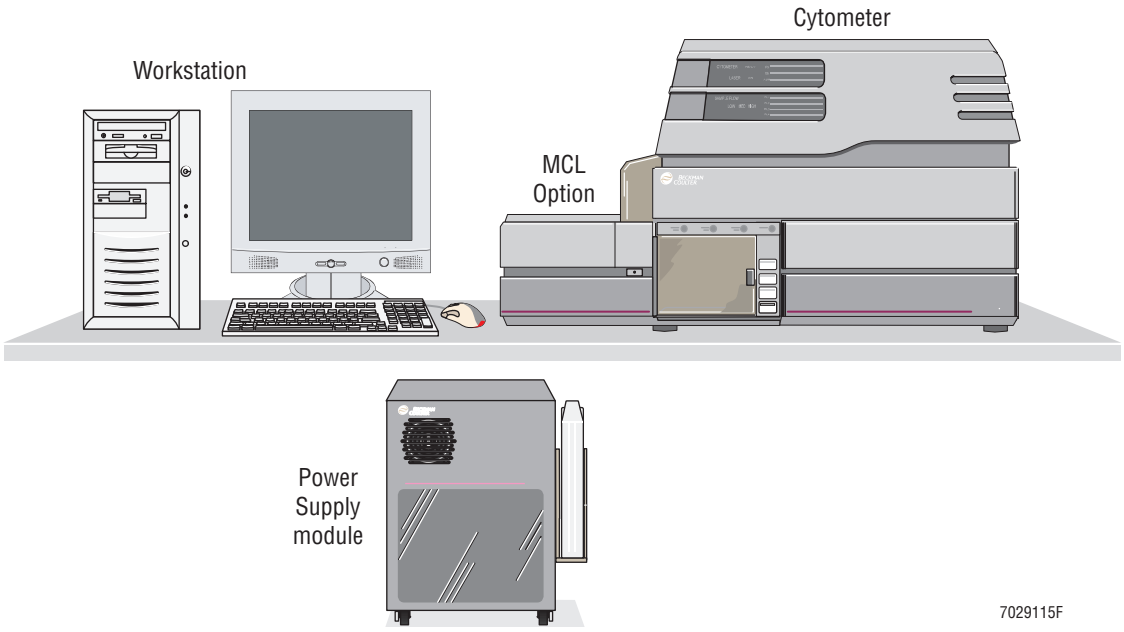
Stop on volume - 20 µL port fills when selected and the sample is pushed to the flow cell by the sheath.

Components

The instrument consists of the following main components (Figure 2.1-1):

- Cytometer (shown with the MCL option)
- Workstation
- Power Supply module.

Figure 2.1-1 XL Cytometer with MCL Option, Workstation, and Power Supply Module



Cytometer (All Signal Processing Electronics)

The instrument's Cytometer contains the:

- Fluids and pneumatic components
- Laser, flow cell, and optics to analyze cells.

Additionally, the XL-MCL flow cytometers contain the MCL option (Figure 2.1-1).

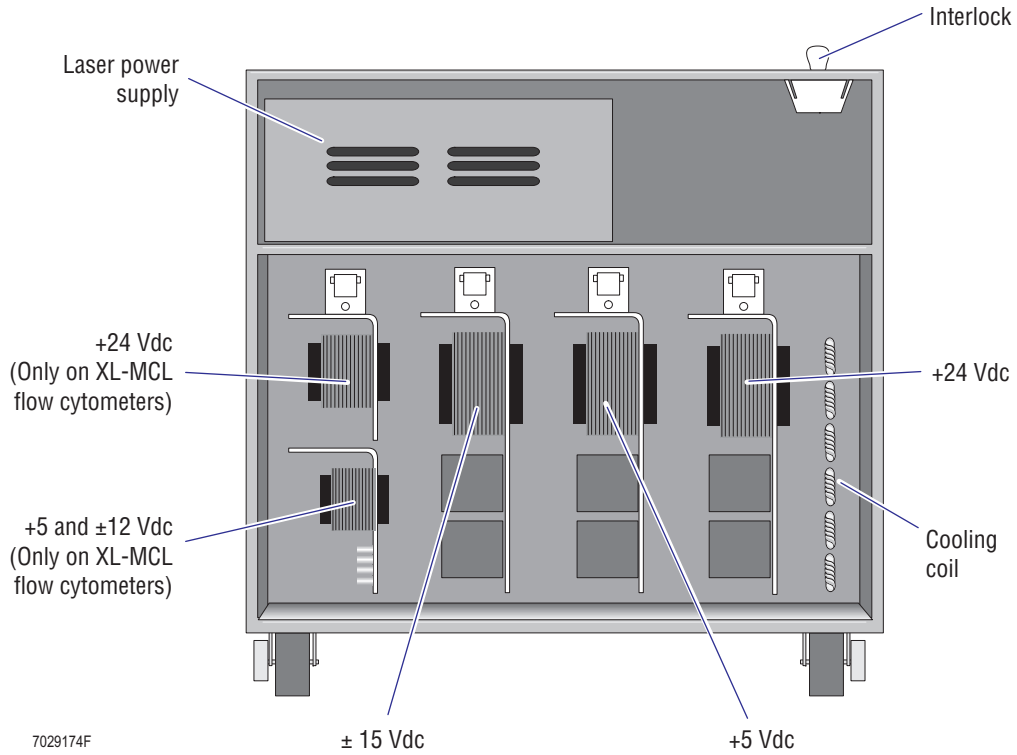
Power Supply Module

The instrument's Power Supply module contains all the power supplies (Figure 2.1-2) and the pneumatic compressor and meets ETL specification 517268 which also covers UL specifications. The power supplies include:

- +5 V
- ±15 V
- +24 V
- Argon laser power supply.

Additionally, the XL-MCL flow cytometer's Power Supply module contains all the power supplies required by an MCL option (Figure 2.1-2).

Figure 2.1-2 Power Supplies in Power Supply Module

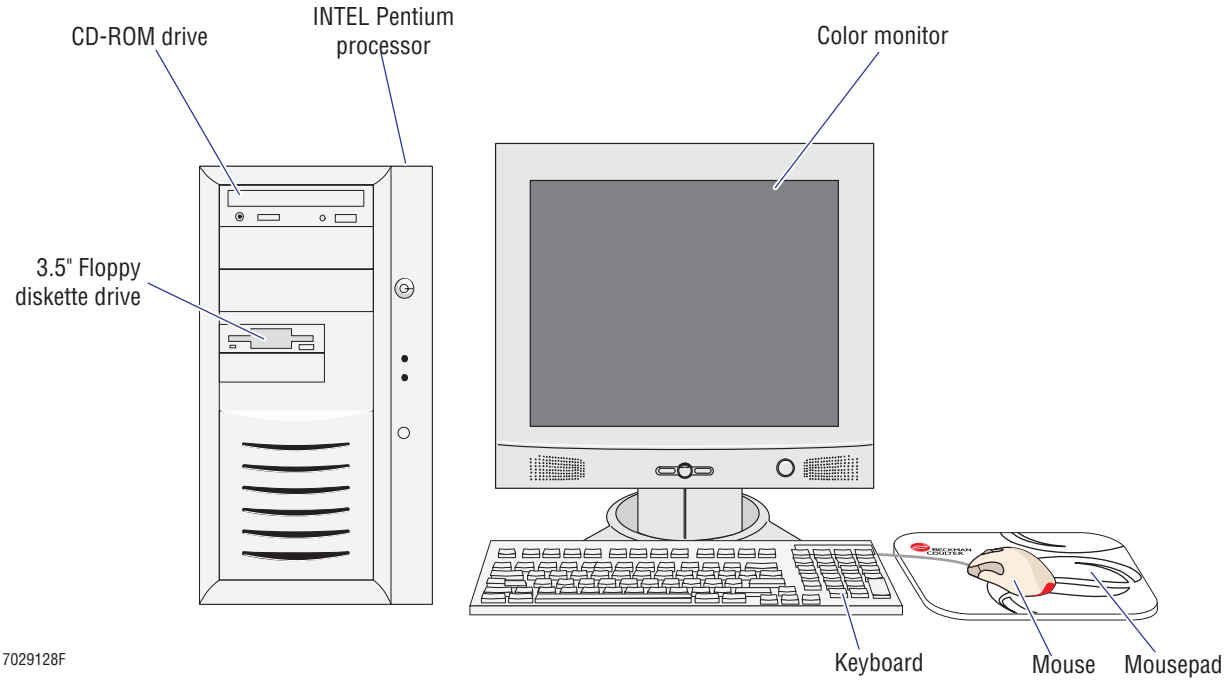


Computer Workstation

The Computer Workstation is composed of (Figure 2.1-3):

- An INTEL Pentium processor (including the Opto Transprocessor EXMEM II card),
- A 3.5 in. floppy diskette drive,
- A CD-ROM drive,
- A mouse (including a mouse pad),
- A keyboard (small or large), and
- A color monitor.

Figure 2.1-3 Computer Workstation - Components



MCL Option - Theory of Operation

The MCL option (Figure 2.1-1) allows the XL-MCL flow cytometer to automatically process up to 32 sample tubes. The MCL option can be ordered as an upgrade to an existing XL flow cytometer or an MCL option can initially be ordered and installed on an XL flow cytometer by the manufacturing department before shipment to the customer.

The major components of the XL-MCL flow cytometer are:

- The MCL option assembly containing the controller, bar-code scanner and controller, pneumatic valves, and sensor
- A blue, flat-ribbon, parallel interface cable
- A sample station
- A linear power supply (+5, ±12 and +24 Vdc)
- The MCL Interface card.

Upon power up, the COULTER® EPICS® XL/XL-MCL SYSTEM Software VER 2.1 (hereafter referred to as SYSTEM II software) detects the presence of the MCL Interface card to enable the operational code needed to support the XL-MCL flow cytometer. Commands are then sent out through the parallel interface cable to the MCL Controller card that is mounted to the XL-MCL flow cytometer's frame.

The carousel is rotated by a stepper motor operated by a 24 Vdc power supply. The stepper motor is geared through the use of a belt to ensure that extremely accurate angular positioning is achieved. A 32-position encoded disk is used with optical sensors to verify that the carousel is rotated to the desired position. An additional gear and belt assembly are used on the vortex assembly to gently mix the sample in the test tubes to resuspend the sample.

The carousel in/out movement, the lifting and lowering of the vortex motor and the lowering and raising of the sample pickup probe are all achieved by air cylinders controlled by solenoid valves. The solenoids distribute 30 psi.

A bar-code scanner is used to ensure positive sample identification. An air cylinder is used to push a mechanical finger that rotates the test tubes for bar-code reading when the test tube has a label placed on it.

After the SYSTEM II software has been loaded on power up, the software sends out a value to the MCL Interface card to determine if the card is installed. If the card is detected, another command is sent out to check if the interface cable from the backplane to the MCL CPU card is connected. If connected, the MCL option performs a series of self tests to ensure that the sensors and pneumatic hardware are operational. The system sends a command to lift the vortexer (LV sensor and LV solenoid), lower the sample probe (PROBE sensor and PROBE solenoid), move the carousel base out (CAR sensor and CAROUSEL solenoid), and rotate the carousel to find the home position (checks the tube position sensor, TB, and home sensor, HM). Any failure encountered is displayed on the monitor in the form of an error message. An interlock sensor is used to ensure that the cover to the carousel area is closed. If this sensor is not satisfied, the MCL option will not operate. Refer to the MCL Interconnect schematic and the MCL CPU card schematic for sensor locations. For the part numbers and location of these schematic files, see Heading 6.1, ENGINEERING SCHEMATICS.

The MCL option can be started two ways; selecting AUTO on the sample station keypad, or using the mouse, selecting RUN on the monitor. When enabled, the software checks the status of the door interlock (SW1). If satisfied, the carousel rotates to the load position via the stepper motor. The CAROUSEL solenoid valve fires, moving the carousel in and placing it under the sample head. The bar-code scanner fires to read the carousel label, then the stepper motor rotates a step to the test tube position one label.

The bar-code scanner reads test tube position one and compares it with the encoder wheel position to ensure that the proper position and test tube is in place. The valve ROTATOR is enabled to move the finger out and back in to rotate the test tube. The bar-code scanner fires to read the bar-code label installed on the test tube. The finger is activated three times to rotate the test tube and the bar-code scanner fires three times to try and read the label on the test tube.

If no label is read, a NO READ appears on the histogram report alerting the user that no label was present or that it was not read correctly. Next the test tube lifter solenoid (LV) fires to raise the test tube. An additional sensor (HEAD SENSOR) is then checked to see if a test tube has been lifted. If a test tube is detected, the vortex motor is enabled for two seconds to mix the sample. The sample probe is lowered into the test tube and sample pressure to the test tube is turned on. The sample pressure sensor (SN7), located in the upper electronics drawer, is checked to ensure that there is no pressure leak.

If the pressure drops because of a bad seal in the sample head, the test tube is lowered and raised an additional two times before the unit fails the test tube and the monitor displays *MCL Tube Load Error*. If the pressure does not leak out, the segmenting valve rotates aligning the MCL option's port to the flow cell, sample flows and analyses of the sample takes place.

After the sample has reached a stop or the user induces a stop, the test tube is lowered and the carousel rotates to the next sample tube. If two consecutive empty test tube wells are detected, the carousel is aborted, the carousel rotates home and the XL-MCL flow cytometer displays the Carousel report.

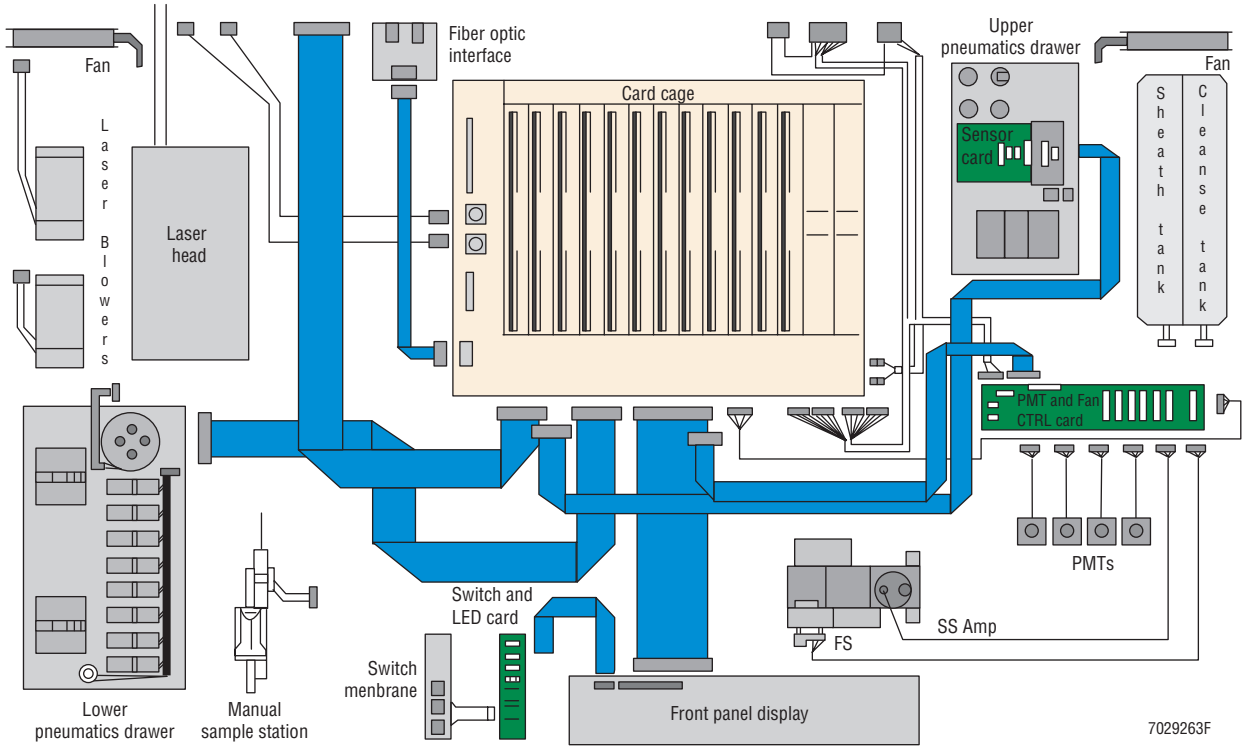
2.2 CYTOMETER

The Cytometer contains all the necessary optics, fluidics, and electronics required to analyze samples; the laser head, optical housing assembly, flow cell, sheath container, and cleaning agent container. All the pinch valves, fixed regulators, plumbing, ductwork, and the Data Acquisition card cage are housed in the Cytometer to control sample input, sense, amplify, discriminate, and digitize signals.

- All covers can be removed without affecting unit operation, as long as the interlock is disabled (bypassed). At the end of the service call, all instrument covers must be reinstalled to ensure proper operation of the interlocks.
- A parallel interface cable is used to connect the Cytometer to the Power Supply module.
- A fiber optic cable is used to connect the Cytometer to the Workstation.
- Power is supplied by the interconnect power harness from the Power Supply module.

To eliminate internal signal cables, the instrument has a multi-layered system backplane, referred to as the Analyzer backplane. The only signals that travel through BNC signal cables are those from the Photo Multiplier Tube (PMT), Forward Scatter (FS), and side scatter sensor. All other signals pass through one of the Analyzer backplane's eight layers (planes). Refer to Figure 2.2-1.

Figure 2.2-1 Cytometer Overview

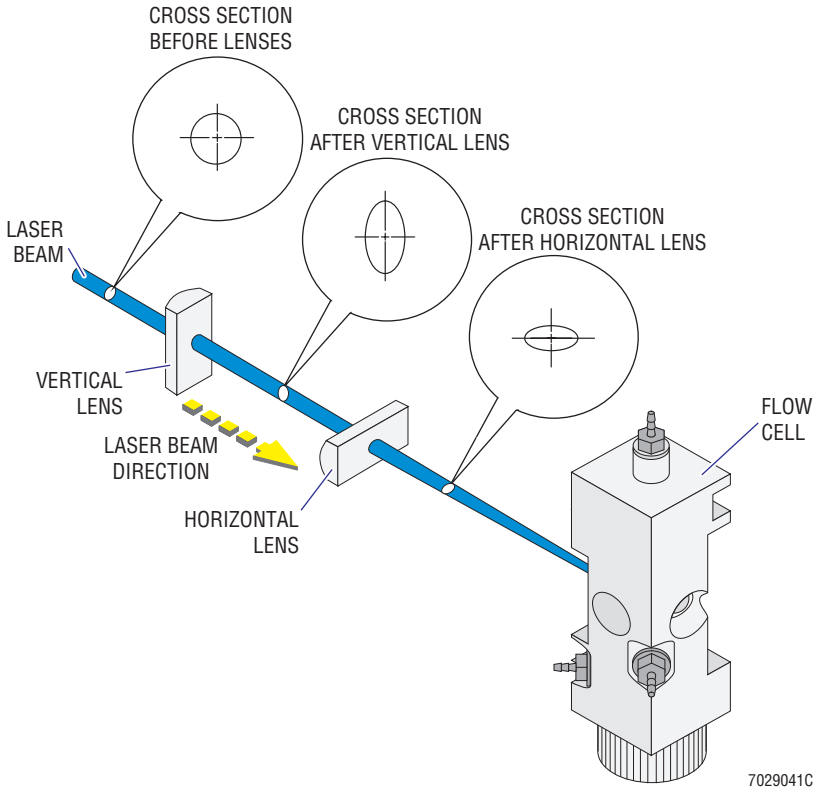


Optics

The instrument's optics system requires no customer alignment. The system produces DNA quality Coefficient of Variation (CV) and detects <1000 molecules of fluorescein. Minimal alignment is performed by Field Engineers using a special alignment tool. Access is gained by lifting the front panel and securing it in place.

The beam-shaping optics (Figure 2.2-2) are made up of two lenses, an 80-mm cylindrical lens that controls the X-axis dimension of the laser beam and a 10-mm cylindrical lens that controls the Y-axis dimension. The lenses are mounted on stages for alignment purposes.

Figure 2.2-2 Beam-Shaping Optics



Laser

The instrument incorporates a Uniphase Corporation Argon Ion Gas Laser. The system idles the laser to prolong the life of the laser. The laser is cooled by forced air from two 24 Vdc fans in a blower assembly mounted on the Cytometer frame. Cool air from this blower assembly is forced into the left side of the laser and the hot exhaust air is released out the back of the Cytometer through an insulated duct mounted on the top of the laser head.

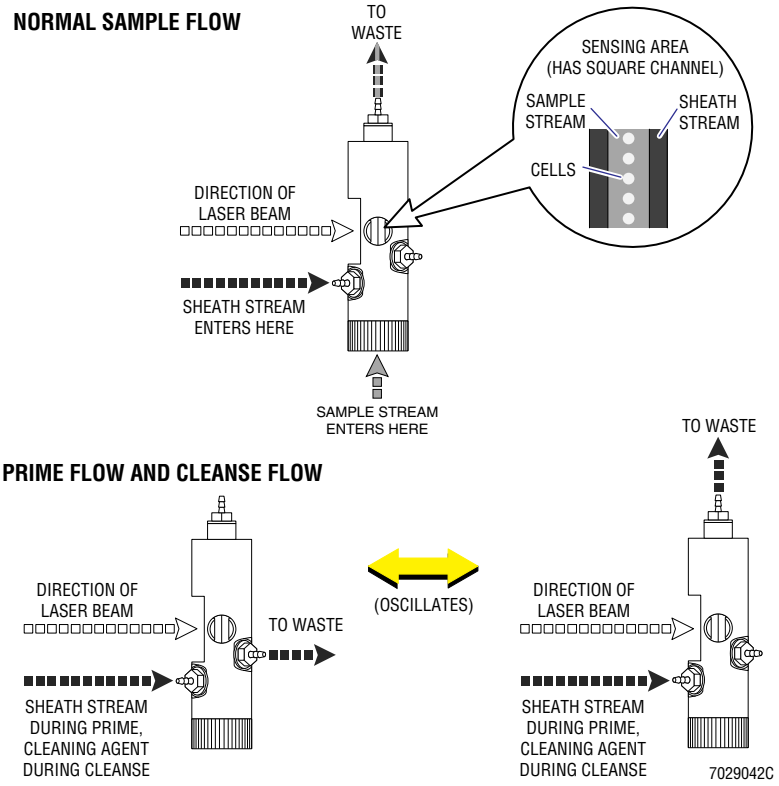
Flow Cell

The flow cell is mounted directly between the beam-shaping assembly and the FS detector in the path used by the 488 nm Argon laser beam.

If the cells were to move through the laser beam in different ways during sample flow, sample analysis could be distorted. A process called hydrodynamic focusing occurs inside the flow cell to ensure that cells move through the laser beam one at a time, along the same path.

The flow cell (Figure 2.2-3) sensing area consists of a 250-µ square quartz channel with an integral lens mounted with a vertical (upward) flow path. A stream of sheath fluid, pressurized at a constant 4 psi, enters the channel at the lower end and flows upward (Figure 2.2-3). While the sheath stream is flowing through the channel, sample pressure is applied to push a stream of sample from the bottom of the flow cell upward, injecting the sample into the middle of the sheath stream (Figure 2.2-3). The pressure of the sheath stream focuses the sample stream so that cells flow through the sensing area (the center of the 250-µ square quartz channel) single file (one at a time).

Figure 2.2-3 Flow Cell



Pushing the sample from the bottom of the flow cell upward through the sensing area aids in the removal of air bubbles that can get trapped in the flow cell. Air bubbles and particles passing through the sensing area are sent to the waste port located at the top of the flow cell (Figure 2.2-3). An additional waste port is located lower on the side (Figure 2.2-3).

The flow cell senses in a 250-µ square quartz channel (Figure 2.2-3) and uses a lens to enhance the collection efficiency.

Pinhole Assembly

The collection lenses used in the pinhole assembly are a set of anti-reflection coated, multi-element lenses. The collection lenses, PMTs, filter holders, and 90-degree diode (90 DIODE) are located in the optical-housing assembly.

Forward Scatter (FS) Detector

The forward scatter detector (also referred to as the FS detector or FS sensor) is a solid-state diode and is equipped with a slide-into-place ND 1 filter.

Laser Intersection

The Cytometer uses an air-cooled 488 nm Argon laser (set to 20 mW) to excite the sample in the core stream in the flow cell area. This 488 nm Argon laser is mounted in a pre-targeted position that sits directly in front of an 80 mm beam-shaping lens and a 10 mm lens. As these lenses correctly shape and steer the Argon laser beam through the flow cell chamber, sample particles inside the aperture are excited and scattered light is emitted. As the laser beam exits the flow cell, its path ends at the forward scatter mask assembly beam dump.

Signal Processing

As cells in the sample stream go through the sensing area of the flow cell, the laser beam illuminates them. The cells scatter the laser light and emit fluorescent light from fluorescent dyes attached to them.

The amount of laser light scattered at narrow angles to the axis of the laser beam is called forward scatter (FS). The amount of FS is proportional to the size of the cell that scattered the laser light. The amount of laser light scattered at about a 90° angle to the axis of the laser beam is called side scatter (SS). The amount of SS is proportional to the granularity of the cell that scattered the laser light.

In addition to the SS, the cells emit fluorescent light (FL) at all angles to the axis of the laser beam. Because the amount of fluorescent light (FL) emitted is directly proportional to the amount of fluorescing dye attached to the cell, the FL parameter can be used to indirectly measure the characteristics of the cells emitting the light, depending on the reagents used. FL is commonly used to identify molecules such as cell surface antigens.

Fluorescent light (FL) occurs due to the excitation produced by laser light in response to the reaction of dyes on the sample. This light, combined in the fluorescent pick up lens, consists of different wavelengths that are passed or bounced off filters to bring the light into the Photo Multiplier Tubes (PMT). The light entering a PMT is amplified by the PMT and turned into a voltage pulse. This pulse is then sent to the amplifier signal conditioner where it is further amplified and converted to an integral signal. The amplified pulses are then digitized and selected signals are converted to light, and sent across the fiber optic cable to the computer Workstation for processing.

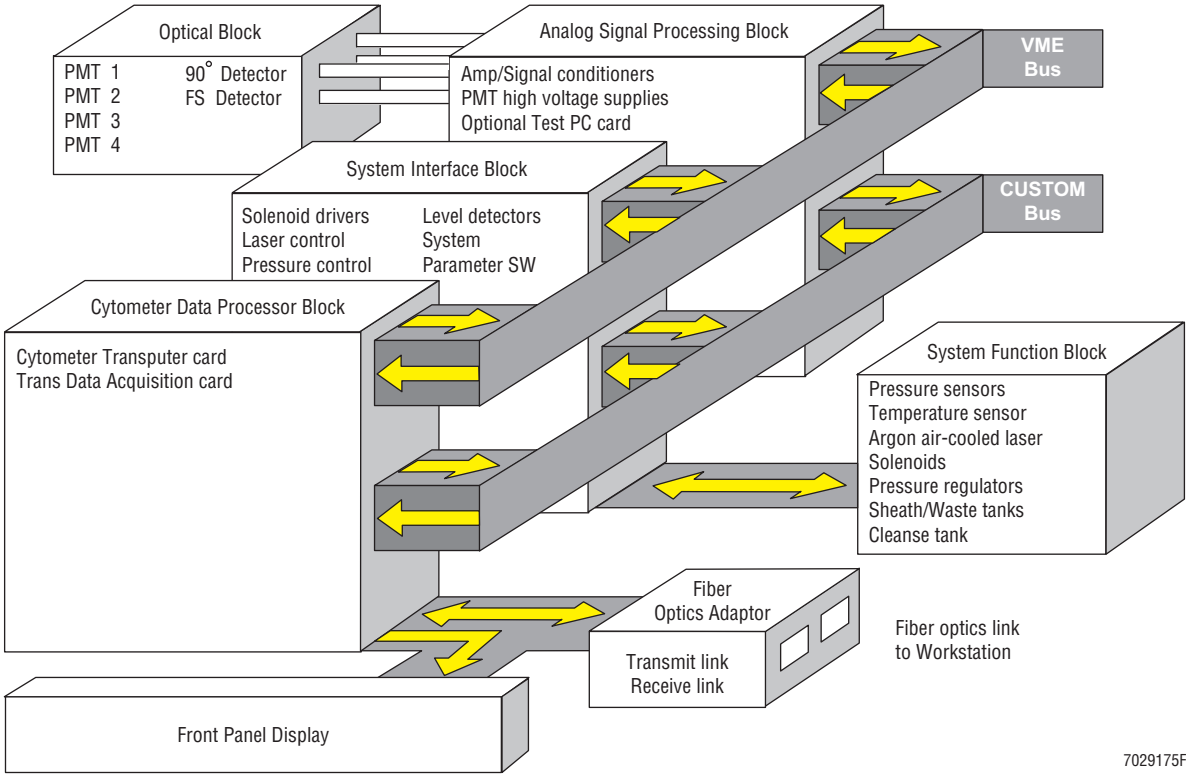
Data Acquisition Card Cage

The Data Acquisition card cage is hinge mounted and can be held open (supported) in the upright position for troubleshooting while the system is running. The Data Acquisition card cage houses the Analyzer backplane (system backplane) with 12 slots for custom electronic cards and 4 slots for the high voltage (HV) power supplies used by the PMTs. All external devices (front panel display, front panel switch, pressure sensors and regulator controls, fluidics control valves and level sensors, laser interlocks and power supply, the Workstation, and power supplies) connect to the Analyzer backplane (Figure 2.2-4).

Located in the Cytometer's upper half, the Analyzer backplane uses a modified version of the VME standard. The card connectors are two-keyed, 96-pin, DIN connectors (to ensure that the cards are not installed backwards) and provide an airtight seal for improved reliability. All connectors on the Analyzer backplane are keyed and are of a different size. Cards connected to the Analyzer backplane include the:

- Amplifier / Signal Conditioner card, commonly referred to as the Amp or Amplifier card
- Trans Data Acquisition card
- System Interface card
- Cytometer (Cyto) Transputer card
- MCL Interface card (if MCL option is installed).

Figure 2.2-4 Cytometer System Block Diagram



The Analyzer backplane is a multi-layered card with each layer (plane) having a specific function as shown in Table 2.2-1.

Table 2.2-1 Analyzer Backplane's Function

Plane	Function
1 (bottom)	Chassis GND, 24 V GND, 24 Vdc / solenoid signals
2	Signal (VME, low level dc and control) / +5 V copper
3	Digital GND, -15 Vdc
4	Signals (digital, analog, custom bus, digital GND)
5	Analog and digital GND
6	VME bus (handles all instrument status signals) / Digital GND copper
7	+5 Vdc, +15 Vdc
8 (top)	VME custom signal bus, Bertan Power / Digital GND copper

Amplifier (Amp)/Signal Conditioner Card

The instrument contains seven identical Amp/Signal Conditioner cards, six if it is a three-color system. These cards accept peak signals from the preamplifiers (PMT, FS sensor, and D90). After passing through a 5-µs delay line, the amplified signals are peak sensed and held in either a peak or an active integrating mode, and the result is captured for digitization. To handle the wide dynamic range of signals required for the four-decade log transformation, the signals pass through two paths that vary in gain by a factor of 32. The output of the high-gain channel is presented to the system for digitization until the output of that channel exceeds 9.0 V, then the low gain result is presented. The digitization system is informed of which result is being presented. Refer to Figures 2.2-5 and 2.2-6.

Figure 2.2-5 Amplifier Block Diagram

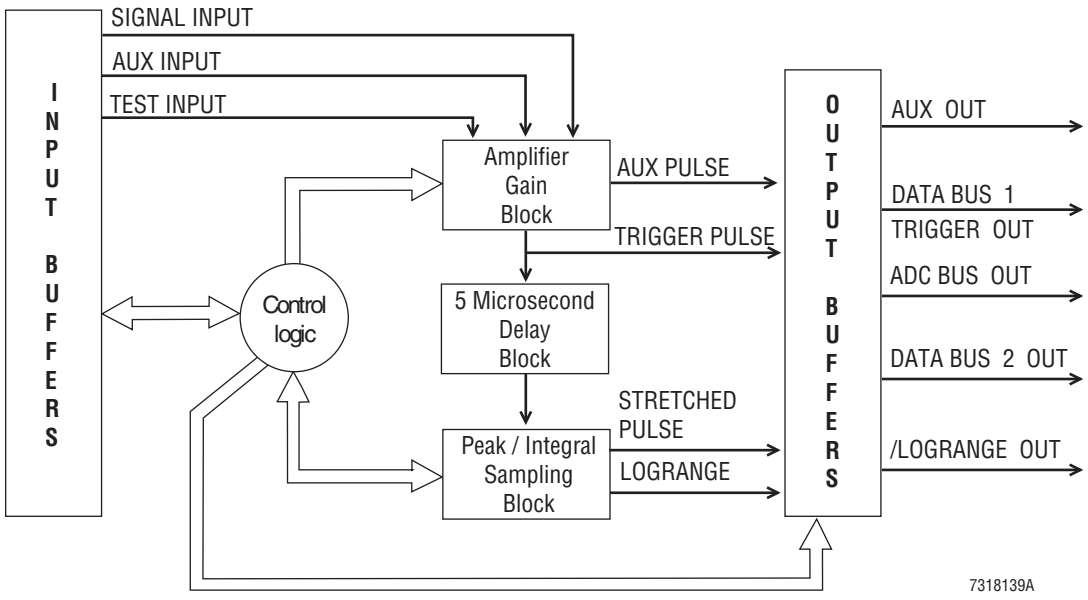
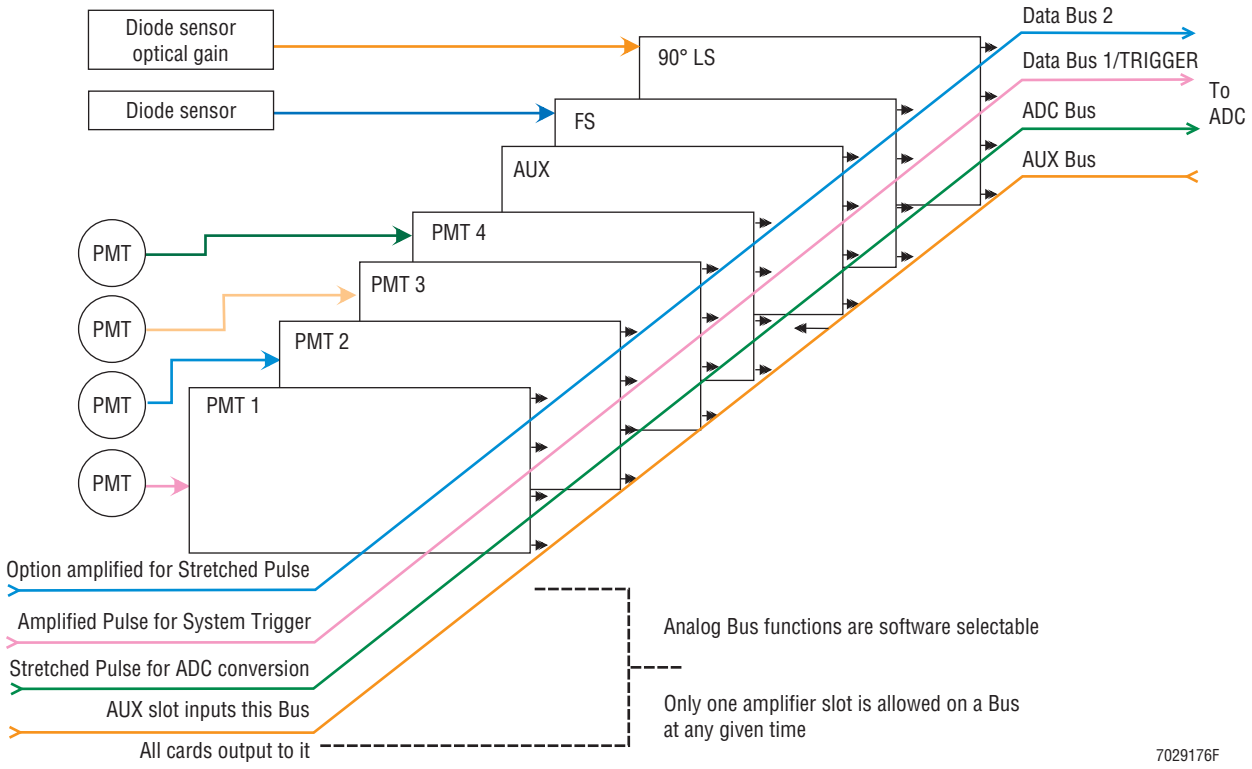


Figure 2.2-6 Amplifier Analog Bus Interface



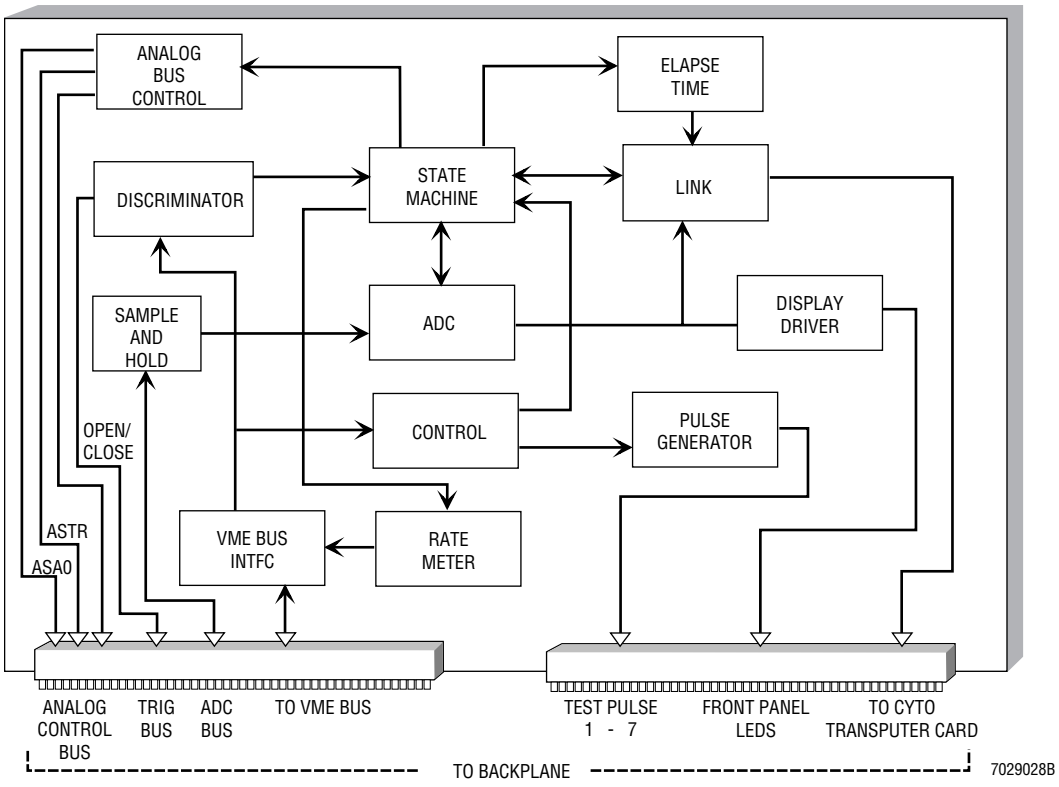
Also resident on the Amp/Signal Conditioner card are the control digital-to-analog converters (DACs) for the PMT HV power supplies. Each of the first four Amp/Signal Conditioner card slots on the Analyzer backplane is wired to one of the PMT HV power supplies. The card address for each card is obtained from the Analyzer backplane. No address jumpers are incorporated on the card.

Software addressing through the multi-layer Analyzer backplane determines which signal each card processes. Troubleshooting is as simple as swapping the card under question with a card that is known to be good.

Trans Data Acquisition Card

The Trans Data Acquisition card provides event detection through a single-trigger discriminator driven by any one of the Amp/Signal Conditioner cards. The trigger level is set by a DAC. When an event is detected, a state machine on the Trans Data Acquisition card sequences the peak sense and hold circuits on the Amp/Signal Conditioner cards. The desired signals are captured and stored for digitization. At the end of the event capture sequence a second state machine is requested to leave its background task of digitizing and transmitting of the analog operating parameters. The captured signal is digitized with 15-bits of resolution and then passed on to the Cyto Transputer card and the front panel bar-graph displays. At the end of the digitization sequence a digital elapsed time stamp is transmitted for each event. A count rate meter function records the rate of the triggered events processed, on a second-by-second basis (Figure 2.2-7).

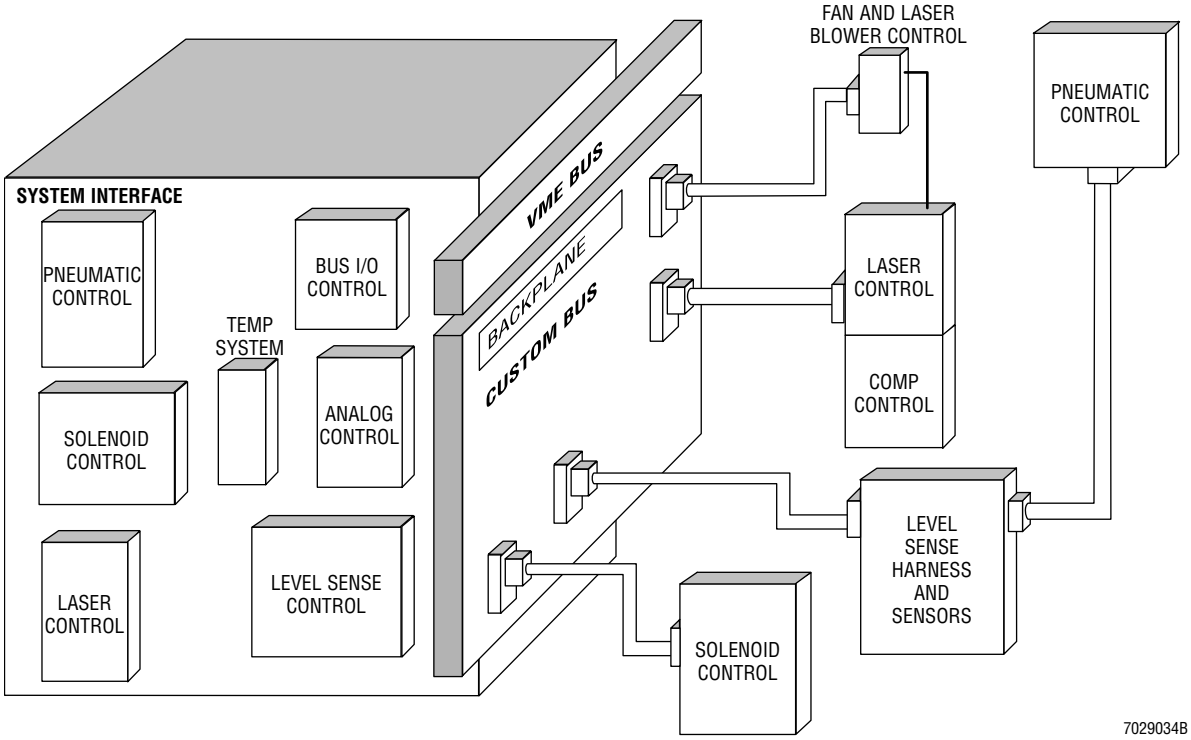
Figure 2.2-7 Trans Data Acquisition Card Block Diagram



System Interface Card

The System Interface card provides the system interface required to control all pneumatics, fluidics, and laser systems using both digital and analog signal control (Figure 2.2-8).

Figure 2.2-8 System Interface Card Block Diagram



The solenoid valves controlling the fluidics are controlled by active outputs on the Analyzer backplane corresponding to control lines loaded by the system's data bus.

The System Interface card monitors the solid-state pressure sensors for precise sample and sheath pressures. Because the sampling system is pressure driven, it requires precise control of the pressure differential applied to the sample in reference to the sheath pressure. The precision of the instrument is directly proportional to the stability of this differential. The system uses set point and pressure feedback systems to ensure precise digital control of differential pressure and continuous regulation of the set point.

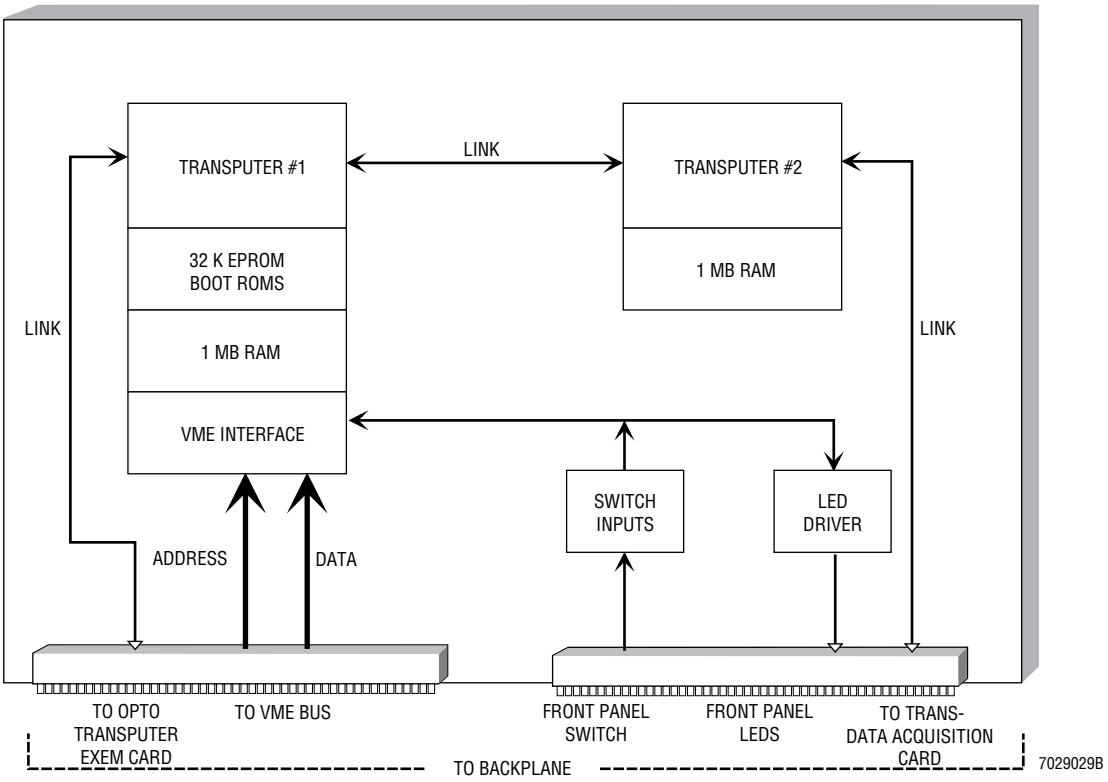
The laser is controlled by this card using a digital-to-analog converter to set a reference voltage. This digitally-controlled voltage is applied to the Laser Power supply and provides output light power. A similar circuit provides tube current.

This card also monitors Sheath, Cleaner, and Waste Level sensors, laser interlocks, and fluid sensors provided for areas not intended to contain fluid.

Cyto Transputer Card

The Cytometer (Cyto) Transputer card provides the instrument with a dedicated control and data processing system composed of two programmed 400 series INMOS transputers. The card receives signals from the Cytometer push-button switches and from the PC Transprocessor. It performs all control and adjustment operations of the Cytometer, monitors the operation of the sensor in real time, and reports all error conditions to the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card (Figure 2.2-9).

Figure 2.2-9 Cyto Transputer Card Block Diagram



The data processor system performs the following functions:

- Accepts the list data stream from the ADC on the Trans Data Acquisition card via a high speed serial link.
- Normalizes the results to 32-bit integer data.
- Performs subtractive cross normalization to correct for dye-spectra overlap (if conditions are set by the operator).
- Performs logarithmic conversions using a look-up table.
- Outputs both linear and logarithmic list mode data at 10-bit resolution in the ELITE Listmode Data Format.

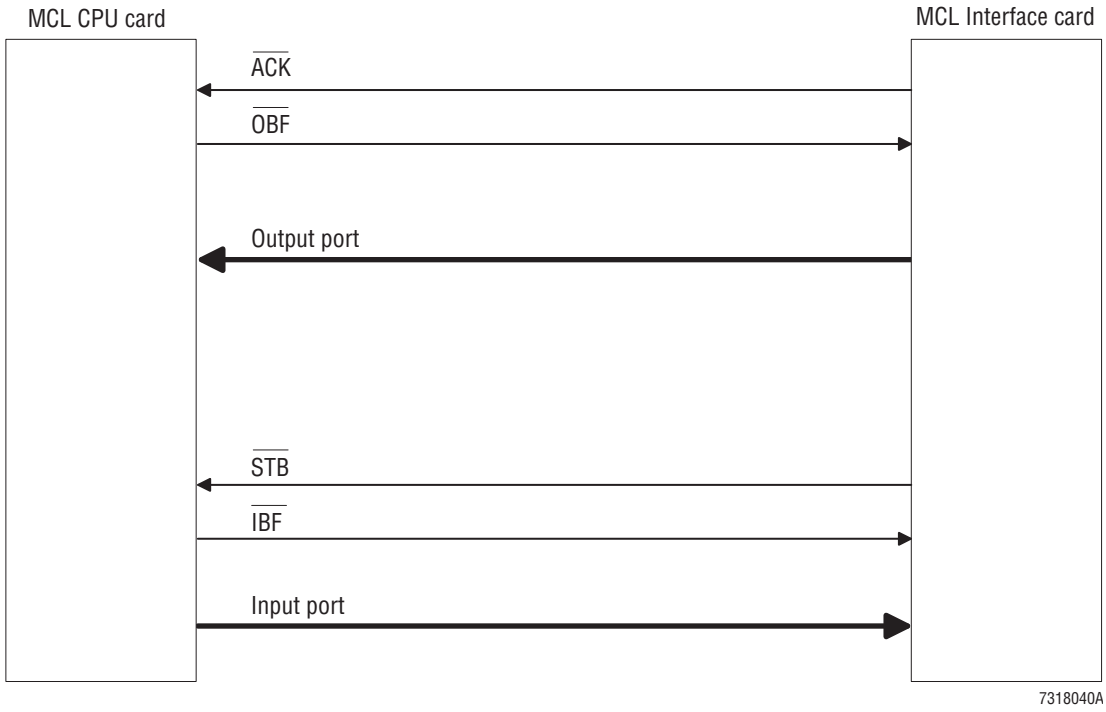
Communication with the Opto Transprocessor EXMEM card is via a high speed, serial, optical-fiber link.

MCL Interface Card

Note: The MCL Interface card is present only when the MCL option is installed.

In an XL-MCL flow cytometer, the MCL Interface card provides parallel interface to the MCL CPU card (Figure 2.2-10). The MCL Interface card is located in the Data Acquisition card cage and the MCL CPU card is mounted to the MCL frame.

Figure 2.2-10 MCL Interface Card Block Diagram of Operation



Data is sent from the MCL Interface card and sent out to the MCL CPU card through a 50-pin blue-ribbon cable that is connected from the Analyzer backplane to the MCL CPU card on the MCL frame.

Communication is provided by two unidirectional 8-bit parallel ports, a data input and output port. Commands are sent to the MCL CPU by presenting eight bits of data to the Input port and pulsing the Strobe line (indicated by an LED mounted to the card). The IBF (Input Buffer) activates another LED on the card to indicate the data is latched in. To read the data sent back from the MCL CPU, the OBF (Output Buffer) is activated to await a message back from the MCL CPU. The MCL CPU reads the data which clears the IBF. The MCL CPU card then sends an ACK (ACKNOWLEDGE signal) back to the MCL Interface card to inform MCL Interface card that it has received and successfully performed the command operation.

If the MCL CPU does not execute the command operation properly, a NACK signal (NOT ACKNOWLEDGE signal) is sent back to the MCL Interface and an error message is generated and displayed on the Workstation.

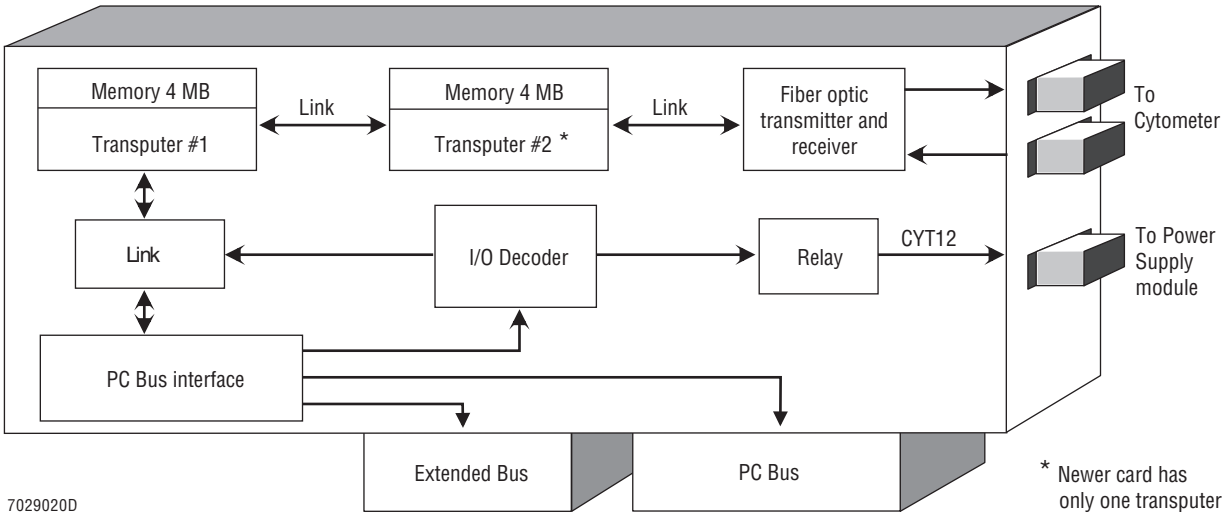
Optical Transprocessor Extended Memory Cards

The Optical (Opto) Transprocessor Extended Memory (EXMEM or EXEM) card (located in the Workstation tower computer) provides the communication interface from the Cytometer to the Computer Workstation. Two versions of this circuit card exist - the original circuit card referred to as the Opto Transprocessor EXMEM card and the new circuit card referred to as the Opto Transprocessor EXMEM II card.

Opto Transprocessor EXMEM Card

The original circuit card, the Opto Transprocessor EXMEM card, incorporates a 12 V relay to control power to the Cytometer. This card contains two 4-MB memory blocks for each of the two transputers. The fiber optics bidirectional transmitter and receiver also reside on this card (Figure 2.2-11).

Figure 2.2-11 Opto Transprocessor EXMEM Card Block Diagram



Opto Transprocessor EXMEM II Card

The newer Optical Transprocessor Extended Memory card (referred to as the Opto Transprocessor EXMEM II card) has only one transputer and the CYT12 is replaced by a fiber optic receiver.

Transputers

The instrument incorporates the use of transputers located on the Cytometer Transputer card, the Opto Transprocessor EXMEM card, and the Opto Transprocessor EXMEM II card. Transputers offer scalable or linear solutions to application problems previously requiring additional hardware development. The instrument's transputers perform several functions previously implemented in hardware including: color compensation, log amplification, ratio, and Listmode data framing.

Categorized as Multiple Instruction Multiple Data (MIMD) computers, these hardware devices are single-chip, 32-bit microcomputers that have their own local memory and communications links. Because a transputer is a parallel microprocessor it is able to perform different tasks on separate data simultaneously.

Structurally, a transputer is a monolithic device containing an integer processor, fast memory, and multiple serial communications links allowing point-to-point connections with additional transputers. Communication between links runs simultaneously to maximize the performance of processor computation. Information passes bidirectionally on two wires between one pair of transputers in a computing network. This is an advantage over conventional microprocessors requiring 32-parallel lines in each direction for every pair connection by reducing the need for additional hardware layout.

Fiber Optic Interface Card

The Fiber Optic Interface card is mounted on the back of the Cytometer rear panel. This circuit card receives digital data from the Cyto Transputer card via the Analyzer backplane and a ribbon cable. The Fiber Optic Interface card converts the digital data to light data then transmits the light data to the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card (whichever is applicable) inside the Workstation computer. Once the light data is received, the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card (whichever is applicable) sends back an acknowledgment in light data to the Cytometer's Fiber Optic Interface RECEIVE line which is converted back to digital data before being sent back to the Cyto Transputer card via the ribbon cable and Analyzer backplane. This process continues throughout the operation of the Cytometer.

Sensor Card

The Sensor card, located in the upper pneumatics drawer, monitors the sheath and sample pressure via two transducers that are mounted to the circuit card. Connected to the analyzer backplane via ribbon cables and discrete wires, this card communicates through these wires to the System Interface card connected to the analyzer backplane.

Solenoid Power Distribution Card

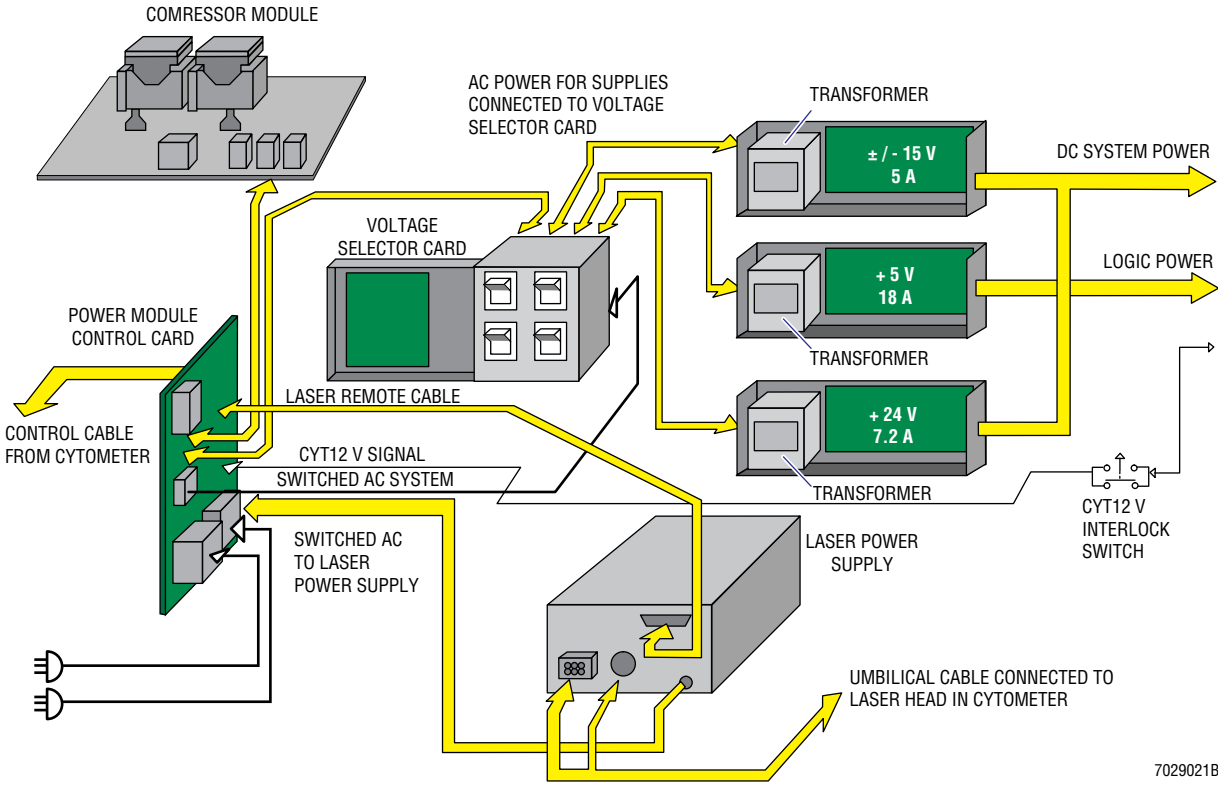
The Solenoid Power Distribution card (also referred to as the Solenoid Control card) is positioned above the other lower pneumatics drawer components. This circuit card provides the wiring interface for control of the solenoid valves from the analyzer backplane's System Interface card. For each solenoid located inside the lower pneumatics drawer, a set of discrete wires with a connector is soldered to the Solenoid Power Distribution card. When a connector is properly attached to its designated solenoid, a pathway is completed between the System Interface card and the solenoid via the Solenoid Power Distribution card. During a cycle, the System Interface card transmits a signal via the Solenoid Power Distribution card to energize each solenoid needed to complete a required task.

2.3 POWER SUPPLY MODULE

Description

The Power Supply module supplies pressure, vacuum, laser power, and all dc voltages required to the Cytometer (Figures 2.3-1 and Figure 2.3-2). The power provided by the Power Supply module is distributed via the interface harness. The Power Supply module can be installed under the Cytometer or next to it on a bench.

Figure 2.3-1 Power Supply Module - Block Diagram



Components

The Power Supply module's components are shown in Figures 2.3-3 through 2.3-6 including the following main components:

- Laser Power supply (Figures 2.3-5 and 2.3-6)
- Linear Power supplies (Figure 2.3-6)
- Voltage selection module (Figure 2.3-5)
- Compressor (Figure 2.3-5)
- Power Module Control card (Figure 2.3-4).

Removing the top cover of the Power Supply module triggers an interlock that interrupts unit operation until the interlock is disabled (bypassed). Circuit breakers are located on the back of the Power Supply module (Figure 2.3-4).

Figure 2.3-2 Power Supply Module - Power Module Control Card Flow Diagram

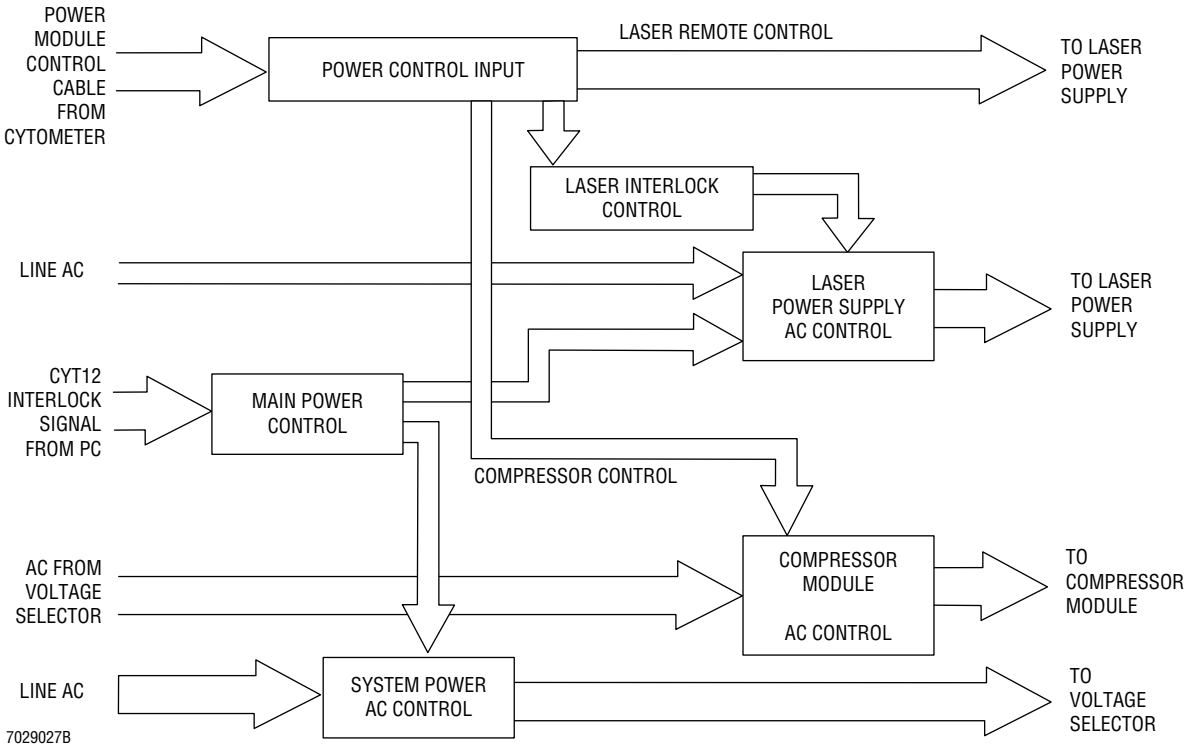


Figure 2.3-3 Power Supply Module - Front

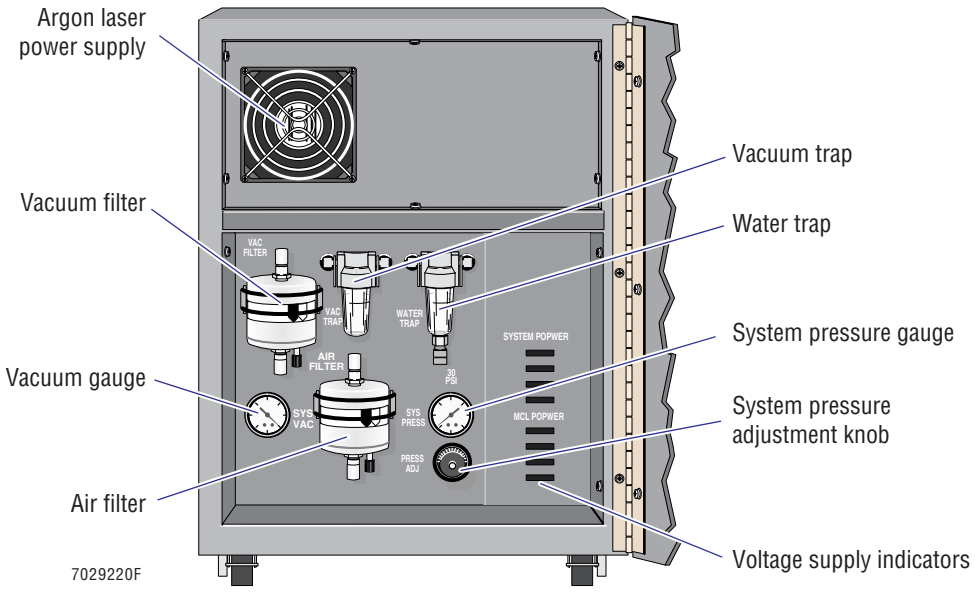


Figure 2.3-4 Power Supply Module - Rear

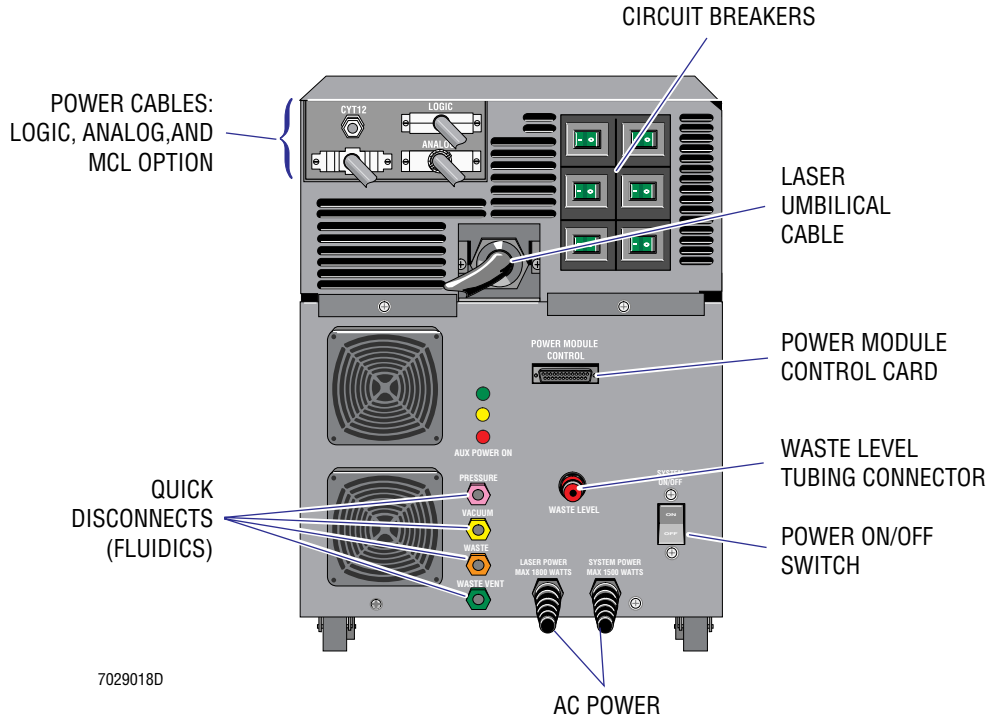
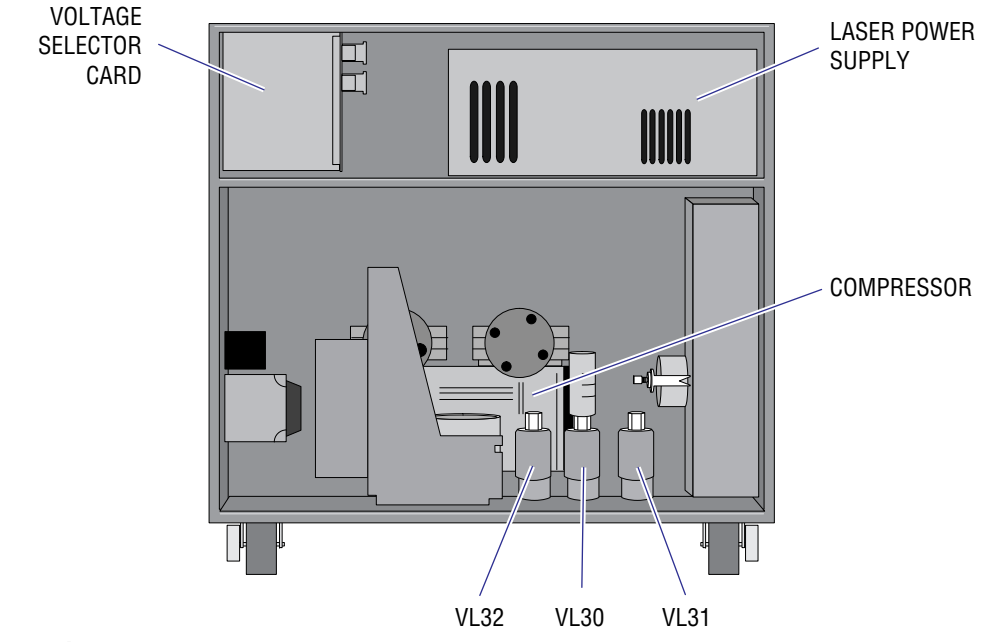


Figure 2.3-5 Power Supply Module - Left-Side View with Cover Removed

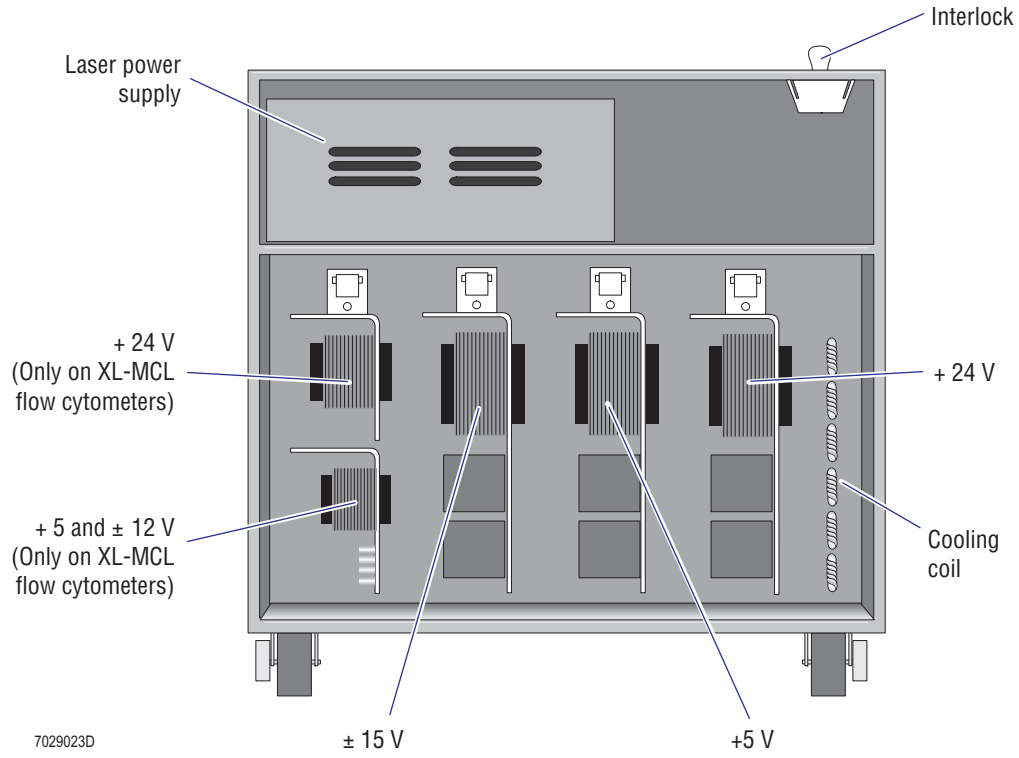


Linear Power Supply

The Linear Power supply consists of five separate power supplies (Figure 2.3-6):

- XL flow cytometers -
  - +5 Vdc
  - ±15 Vdc
  - +24 Vdc
- XL-MCL flow cytometers -
  - +5 and ±12 Vdc
  - +24 Vdc.

Figure 2.3-6 Linear Power Supply



2.4 WORKSTATION

The Workstation analyzes and reports the status of the Cytometer. The Workstation computer contains a Beckman Coulter-manufactured Opto Transprocessor EXMEM card or Opto Transprocessor EXMEM II card. The Fiber Optics Interface card attached to the rear panel of the Cytometer converts the digital data received from the Cyto Transputer card to optical data then sends that optical data to the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card inside the Workstation computer where the optical data is converted back to digital data. Based on the protocol selected by operator, this raw data input is gated and histograms are produced for analysis. These histograms are displayed on the Workstation screen and may be stored and retrieved as the operator desires.

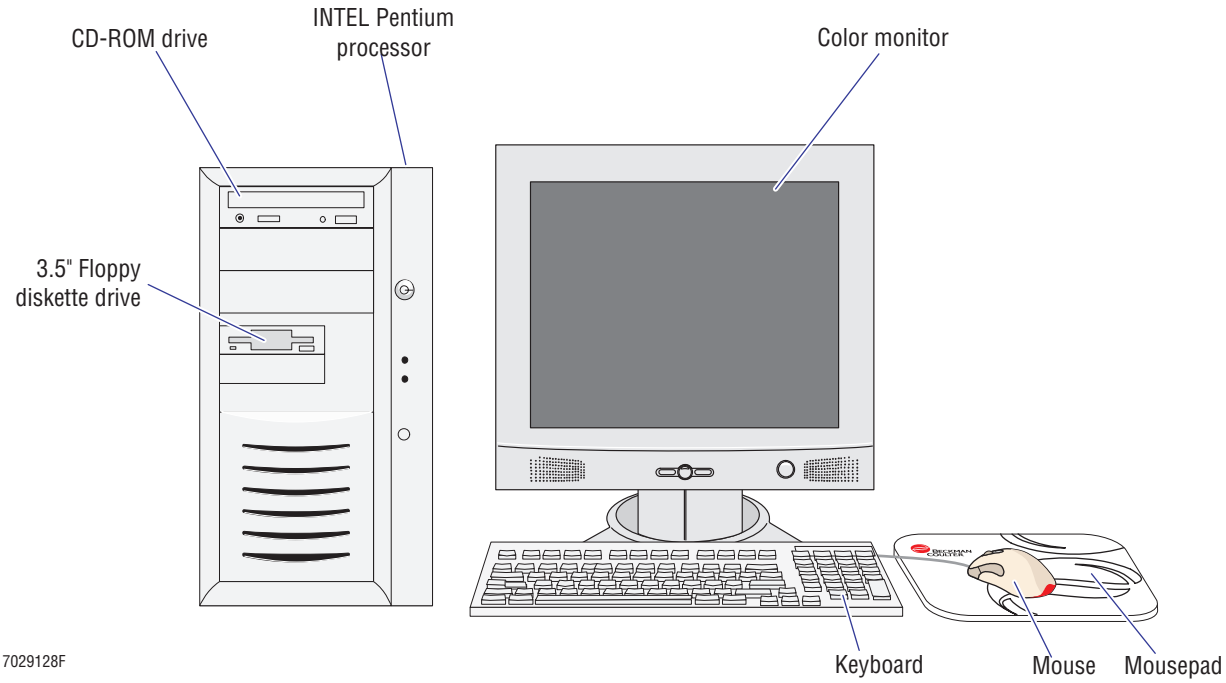
Components

Standard Configuration

The standard Workstation consists of (Figure 2.4-1):

- An INTEL Pentium processor (including the Opto Transprocessor EXMEM card or Opto Transprocessor EXMEM II card),
- A CD-ROM drive,
- A 3.5 in. floppy diskette drive,
- A mouse (including a mouse pad),
- A keyboard (small or large), and
- A color monitor.

Figure 2.4-1 Workstation - Components



Options

Options currently available:

- MCL option
- Media storage:
  - Iomega™ ZIP™ drive
  - CD-RW drive
- 4-Color PMT
- Multimedia Workstation
- Serial/Parallel Adapter Interface card
- Artisoft LANtastic Client/Server Software V8.0
- Sybase® SQL Anywhere™ PC database server software
- EXPO32™ ADC software
- EXPO32™ Analysis software
- Bar-Code EEPROM
- Printers:
  - Hewlett Packard® HP® LaserJet® 2200D printer (black print only)
  - Hewlett Packard® HP® InkJet 2280 Color Printer
- Bar-code hand-held scanner

2.5 NETWORKING

Purpose

This section provides a basic understanding of networks and specifically, Beckman Coulter's implementation of the instrument's networking hardware and software components.

Introduction

A network is an electronically connected group of computers and peripheral devices. When connected together they form a local area network (LAN). A LAN covers a limited geographical area allowing users to share resources or devices that do not reside locally on the user's computer. Each computer connected is given a network name called the "node name." The connection is made through media (cables and wiring) carrying the signal from the sending computer to the receiving computer. These signals can be either analog or digital. The distance the connection spans is dependent on the media used. Once connected, computer workstations connected to the file server have access to the file server's hard drives and printers and they appear to be local at their computer workstation.

If the signal used is baseband then the data is transmitted digitally. If it is broadband, then the signal transmission is analog. Baseband is the most common signal used and is the least expensive of the two but broadband signaling networks are not uncommon.The XL network supports baseband.

Encoding techniques are employed so that the computer can interpret the signal. Signal encoding is a set of rules for representing values for an input signal in another form. There are many different signal encoding schemes, each providing their own set of rules. In the transmission of digital signals over a network, binary values (0s and 1s) are used as a change in voltage or current levels to represent data. The XL network uses the Ethernet Manchester Encoding Scheme.

Media can be bounded or unbounded. Bounded media are cables or wires conducting electricity or light. Examples of bounded media are twisted pair (T.P.), coaxial (thick or thin), and fiber optic cables. Unbounded media transmits and receives electromagnetic signals without an electrical or optical conductor. Examples of bounded media are: microwave, infrared, and laser links. In order to connect the media, the Network Interface card (NIC) that is chosen must support the medium type. The Beckman Coulter network supports T.P., coaxial (thin), and AUI (thick).

Cabling consists of various kinds and designations. Some types of cabling medium are 10BASE-T, 10BASE2, 10BASE5, and 10BROAD 36. The designations are IEEE's (Institute for Electric and Electrical Engineering) 802.3 specifications for megabits-per-second signaling rate, the type of signaling technique, and the maximum cable-segment distance in meters in multiples of 100. The cable media types all have unique characteristics for distance, EMI and RF susceptibility. 10BASE-T and 10BASE2 are the most common forms of cable used today.

Topologies

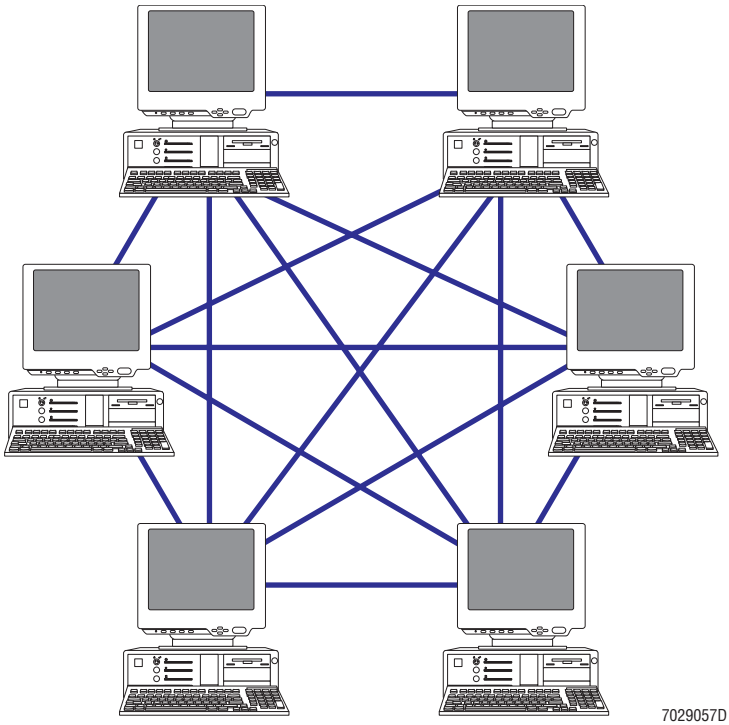
To connect the media, a layout of the connections must be planned. The layout is referred to as the physical network topology. There are four commonly used topologies:

- Mesh
- Star
- Linear Bus, and
- Ring.

Mesh

A mesh topology has point-to-point connections (Figure 2.5-1). This means that every node on the network must be physically connected together requiring an interface connection for every other device. The major drawback is that the cabling scheme is jumbled and troubleshooting can be time consuming.

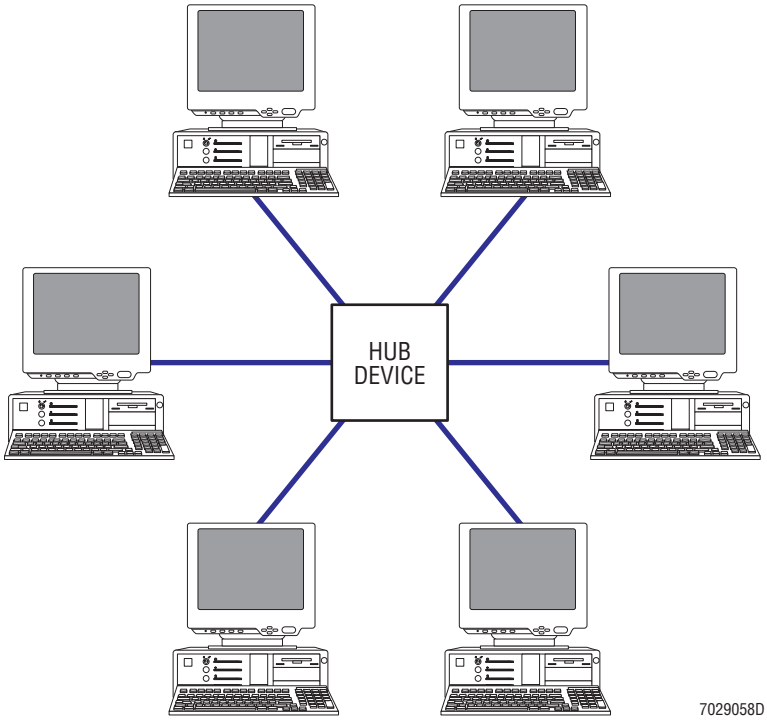
Figure 2.5-1 Mesh Topology



Star

In a star topology, each device is connected point-to-point via a central point or hub (Figure 2.5-2). This topology is easy to troubleshoot because all transferring information must go through a central point. The drawback to a star connection is the extra cost of the hub device. This topology is supported by the XL network. The customer must provide the hub device.

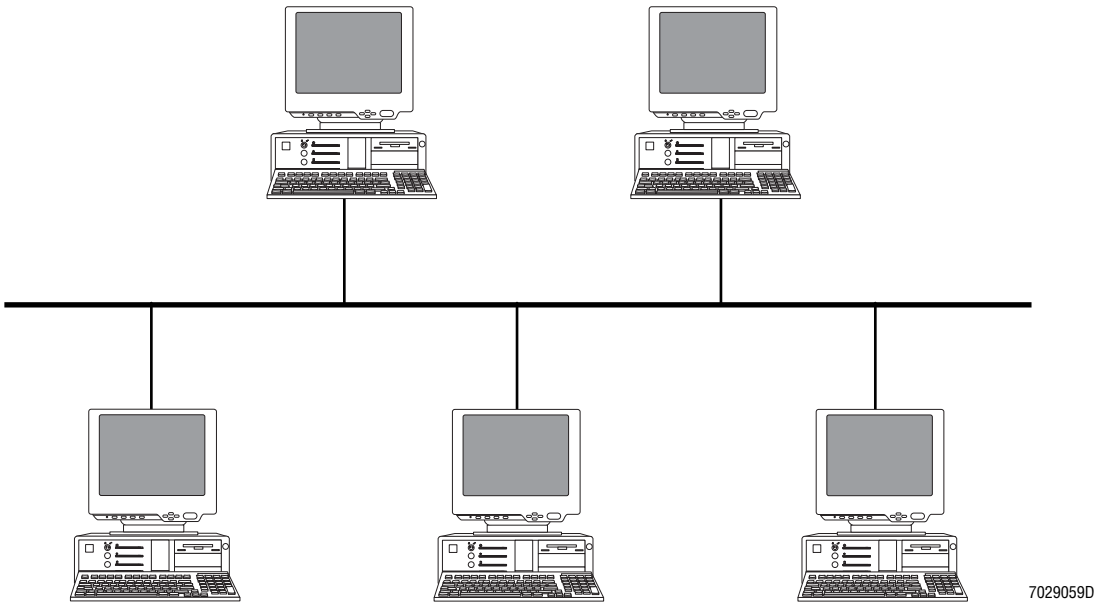
Figure 2.5-2 Star Topology



Linear Bus

In a bus topology, or linear bus, all the nodes on a network attach directly and the bus terminates at both ends (Figure 2.5-3). Data flows in both directions from the sending computer. This topology is supported by the XL network.

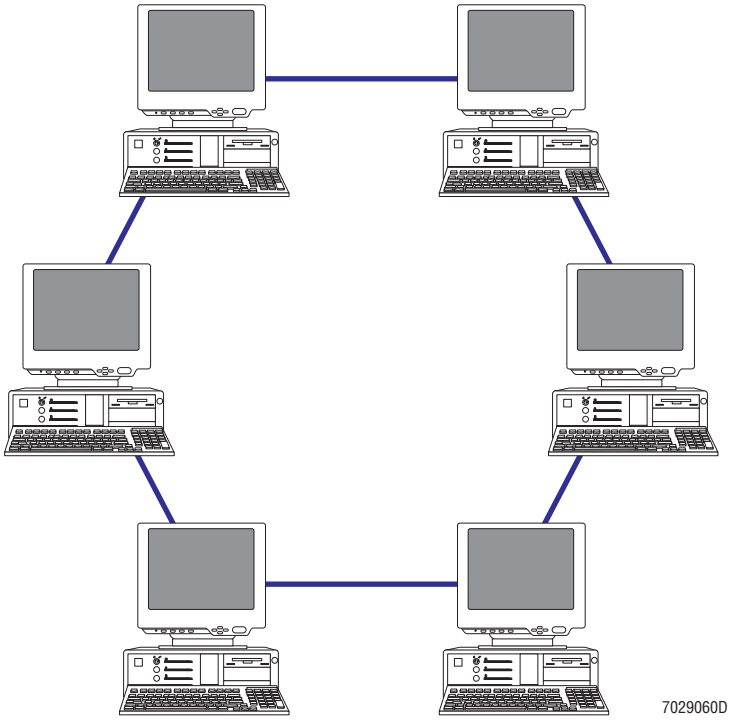
Figure 2.5-3 Linear Bus Topology



Ring

A ring topology is as the name implies, a closed loop, point-to-point connection (Figure 2.5-4). Repeaters are used between network nodes to duplicate the signal and minimize signal loss. Fiber optics use the ring topology as well as IBM's Token Ring.

Figure 2.5-4 Ring Topology



Bridges, Repeaters, Routers

Bridges, repeaters and routers are used in LANs and WANs (wide area networks). Each device has a unique function in the network environment and operates at different layers of the network model.

Bridges are electrical devices used to divide busy areas of the network from not so busy areas of the network. Bridges can be intelligent devices in that they can read the transmitted data's receiving node addresses and send them to that node. To connect from the instrument to the laboratory information systems (LIS) network, the file server or a computer workstation attached to the instrument's network acts as a bridge to the LIS network. To achieve this, a second NIC must be installed in the server and the NIC.

Repeaters are electrical devices that amplify the transmitted signal. These devices are usually used to amplify the signal when the topology exceeds the segment-length specifications. In the Token-Ring network, each NIC acts like a repeater, increasing the signal then passing it to the next node if transmitted data is not for that node.

Routers are used to connect different networking topologies together. Routers are intelligent devices that use software and hardware to determine the network address and different network protocols used for sending the packets across the media. The router reassembles the packet for the right protocol used by the destination node. Routers are used for LANs and WANs.

Specifications

To make interoperability compatible, standards have been developed to help the development of networks. Xerox's Ethernet is the basis of networking standards for interconnectivity. In 1980, the IEEE undertook the task of defining LAN standards. IEEE formed a subcommittee to develop the 802.X specifications and determined that one standard would not satisfy all networking parties. The result has been specifications for different requirements required by users. Beckman Coulter follows the 802.3 network standard.

The 802.3 specification (Table E.1-1) uses the contention access method to transmit data across the network. With contention access, the workstation goes out and checks the network for any activity. If no activity is seen, the workstation begins to transmit to the receiving computer, however, if activity is on the network, the workstation halts and waits to try again. This technique is called carrier sense multiple access (CSMA). If no collisions occur, the transmission is successful and the sending computer gives up control of the network. If a collision occurs, the workstation is notified to retransmit the data. This technique is referred to as collision detection (CD) and is often used with CSMA.

Collisions occur because two workstations try to send data at the same time. Since network transmissions are sent in both directions from a workstation, a workstation farther down the network may check the network activity and not see it and then try to transmit. The result is two different data packets trying to move across the network and these packets colliding. Collisions can be minimized with proper network setup and management.

Dedicated vs. Non-Dedicated Server

A dedicated server is a computer system set up as a device to handle network activities such as file storage and printer requests. A non-dedicated server does everything a dedicated server does but can also be used as a workstation. The problem encountered with a non-dedicated server is that the user will be using a word processor application and a print request may be asked of the server. The non-dedicated server must halt the word processing application to perform the print request activity. This halting can give the user a feeling that the workstation may have locked up and the operator may try to reboot the system to correct the problem. Also, security is jeopardized when a non-dedicated server is used as a workstation.

LANtastic™ Network Operating System

Beckman Coulter has chosen LANtastic as its NOS and defined a complete networking system for the purpose of system validation, data integrity, and ease of service support. The complete networking system consists of a Network Node Interface, the NOS software, a file server computer and the cables to connect the two. When installed, the instrument is configured as a client to the Pentium file servers. This means that the instrument does not share any of its devices, such as a hard drive or a printer. The client will share the printer and/or drives supported on the file server.

The Beckman Coulter network, when assembled, provides the user with a complete network to transfer data for archival purposes. Beckman Coulter recommends that the server be set up as a dedicated file server.

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PART A: INSTRUMENT INSTALLATION

3.1 PRE-SITE INSPECTION

Prior to installing an XL or XL-MCL flow cytometer, a pre-site inspection is required to verify the following conditions:

- Space and Accessibility
- Power Requirements
- Environment
- Unloading and Moving the Instrument
- Installation Assistance
- Inspection Report

Space and Accessibility

A bench or table **must be** available for installation.

The XL and XL-MCL flow cytometers use a 15 mW Argon air-cooled laser system manufactured by Cyonics. Evaluate the installation site to ensure sufficient air flow for cooling. All intake fans must be at least 30.5 cm (12 in.) from any wall or other obstruction that could interfere with air flow. Additionally, the instrument must be positioned with sufficient space for servicing.

Table 3.1-1 contains specifications for determining the flow cytometer's footprint and the necessary operating clearances.

Table 3.1-1 Required Operating Clearance

Specifications	XL Flow Cytometer	XL-MCL Flow Cytometer
Height	54.6 cm (21.5 in.)	54.6 cm (21.5 in.)
Additional clearance above for servicing and lifting the Data Acquisition card cage above the sensor	45.7 cm (18 in.) minimum	45.7 cm (18 in.) minimum
Total clearance needed	100.3 cm (39.5 in.)	100.3 cm (39.5 in.)
Width	61.0 cm (24 in.)	86.6 cm (34.1 in.)
Additional clearance on right for servicing	30.5 cm (12 in.)	30.5 cm (12 in.)
Additional clearance on left for servicing	30.5 cm (12 in.)	30.5 cm (12 in.)
Total clearance needed	122.0 cm (48 in.)	147.6 cm (58.1 in.)
Depth	61.0 cm (24 in.)	61.0 cm (24 in.)
Additional clearance behind instrument for sufficient cooling and room for servicing	30.5 cm (12 in.)	30.5 cm (12 in.)
Total clearance needed	91.5 cm (36 in.)	91.5 cm (36 in.)

Power Requirements

The XL or XL-MCL Cytometer and Power Supply module are contained in two separate enclosures with two separate power cables - one for system power and the other for the laser. Each power cord is intended to be plugged into a different 20 ampere supply from the other.

The electrical ratings of the XL or XL-MCL system are:

- 100 Vac system: 48 to 62 Hz, 16.00 amps, 1600 watts
- 120 Vac system: 48 to 62 Hz, 8.00 amps, 1840 watts
- 230/240 Vac system: 48 to 62 Hz, 8.00 amps, 1920 watts

Power requirements vary for each country. It is important that the correct electrical input is available prior to installation.

WARNING Risk of personal injury. Ensure that there is a main power disconnect switch in the same room as the lasers to avoid personal injury.

1. Verify sufficient power outlets are available. See Table 3.1-2.
   - Two dedicated lines (with isolated grounds) are needed:
     - One for the Power Supply module
     - One for the air-cooled Argon laser
   - Three non-dedicated lines are needed for the Workstation components:
     - One for the tower computer
     - One for the monitor
     - One for the printer
2. Verify that there is an appropriate power outlet for any accessories, including printers.

Table 3.1-2 Power Requirements

Country	Dedicated Lines with Isolated Grounds	Non-Dedicated Lines
USA	Two dedicated lines at 115 Vac, 50/60 Hz at 20 A **Note:** All 115 V receptacles **must be** tested for electrical wiring faults using the procedure under Heading 4.18, THREE-WIRE CIRCUIT ANALYZER TEST.	Three non-dedicated lines at 115 Vac, 50/60 Hz at 20 A
Europe and other applicable countries	Two dedicated lines at 220 Vac, 50/60 Hz at 20 A **or** Two dedicated lines at 240 Vac, 50/60 Hz at 20 A	Three non-dedicated lines at 220 Vac, 50/60 Hz at 20 A
Japan	Two dedicated lines at 100 Vac, 50/60 Hz at 20 A	Three non-dedicated lines at 100 Vac, 50/60 Hz at 20 A

Optional Computer Peripherals

Additional power connections may be needed for any optional purchased computer peripherals, such as monitors and printers. The type of connection is dependent on the local power available. The user may need to use a separate printer stand to free up the work space.

Environment

The room where the XL or XL-MCL flow cytometer is to be installed must meet the specifications in Table 3.1-3

Table 3.1-3 Environmental Requirements

Description	Specification
Humidity	0 - 90%, non-condensing
Heat dissipation into room	1,920 W (6,553 BTU per hour) generated by the Cytometer 300 W (1,024 BTU per hour) generated by the tower computer 60 W (205 BTU per hour) generated by the 17-inch flat screen monitor 185 W (630 BTU per hour) generated by the 22-inch CRT monitor
Ambient temperature	18° - 29°C (64° - 85°F)
Stability/rate of change	Temperature fluctuations within the ambient temperature range can affect performance. For optimal performance, Beckman Coulter recommends the room temperature not fluctuate more than 2.8°C (5°F) per hour.
Noise	65 dba

Unloading and Moving the Instrument

The instrument arrives at the customer site with the Power Supply and Cytometer packed on individual palletized cartons. The remainder of the instrument arrives in cartons that are not palletized.

WARNING Risk of personal injury. Do not attempt to unload the Power Supply or the Cytometer without using a pallet jack. Failure to use a pallet jack can result in serious personal injury.

Make sure the shipping department is aware that a pallet jack is required to unload the XL or XL-MCL flow cytometer and associated cartons from the delivery truck. Find out where these cartons will be stored prior to installation.

If the cartons are to be stored somewhere other than the installation site,

- Inspect this area to make sure the conditions are acceptable.
- Establish who will be responsible for ensuring these cartons are at the installation site at the appropriate time.

Locate the person who will most likely accept the shipment. Clearly explain what you need done prior to your arrival. Ask this person to inspect all cartons for damage. Explain that a claim must be filed with the carrier if damage is detected.

Installation Assistance

Inform the customer that during the installation you will need an able-bodied assistant to help you lift and position the Cytometer on the bench or table top. Ask them to make sure someone is available to help as needed.

Inspection Report

Review the findings with your contact person. If deficiencies are present, make sure the customer understands what actions are necessary to meet the specifications for the system their laboratory has ordered. Establish a time frame for completion. Notify your manager if the installation must be rescheduled.

3.2 PREINSTALLATION CHECKS

Before installing the instrument, verify the following conditions:

- Pre-Site Inspection Compliance
- Education Center Training
- Condition of Cartons Received
- Optional Computer Peripherals
- Supplies

Pre-Site Inspection Compliance

Prior to installing the XL or XL-MCL flow cytometer, verify the site complies with the space, accessibility, power, and environmental requirements detailed in the pre-site inspection. Verify any deficiency noted during the pre-site inspection is resolved **before** starting the installation.

Education Center Training

Verify that at least one person from the customer laboratory is already trained or is assigned to a class date within two weeks of installation.

Condition of Cartons Received

If the instrument and its associated cartons were stored somewhere other than the installation site, verify that **all** cartons are now at the installation site. If not, notify the appropriate person (established during the pre-site inspection) and make arrangements for the cartons to be moved to the installation site.

At the installation site:

1. Compare the cartons received against the customer's order, and notify shipping if there is a discrepancy.
2. Inspect the cartons for damage. If any damage exists, confirm that a claim was filed with the carrier.

Optional Computer Peripherals

If the customer orders the optional Printer or a second monitor, verify space is available. The customer may wish to use a separate Printer stand to free up the work space.

Supplies

Verify the necessary supplies are available, including:

- IsoFlow™ sheath fluid, PN 8547008
- Flow-Check™ fluorospheres, PN 6805359
- COULTER® CYTO-TROL™ control cells, PN 6604248
- COULTER CLENZ® cleaning agent, PN 8546929

3.3 INITIAL INSTALLATION

WARNING Risk of personal injury. Installation of an XL flow cytometer by anyone who has not successfully completed a Beckman Coulter authorized training course is prohibited. Avoid personal injury by obtaining the necessary training to complete these installation procedures.

Tools/Supplies Needed

- ❑ Standard Beckman Coulter Service Tool Kit, PN 5415102
- ❑ Static-dissipative field kit (ESD kit), PN 5415097
- ❑ Box suitable for storing shipping parts removed during installation

Unpacking

Power Supply Module

1. Locate the carton containing the Power Supply module.

WARNING Risk of personal injury as the steel strapping is cut. To prevent injury, hold the cutter with one hand and take hold of the steel strap with the other hand to ensure the steel strap does not spring back.

2. Stand to one side of the strapping surrounding the shipping carton.
3. Holding the steel strapping firmly with one hand, cut and remove each strap surrounding the cardboard carton. Discard the straps.
4. Lift the cardboard carton off the Power Supply module.
5. Remove the plastic covering.

WARNING Risk of personal injury. Do not attempt to unload the Power Supply module without assistance. Failure to obtain assistance can result in serious personal injury.

6. Request assistance to lift the Power Supply module off the shipping pallet.
7. Inspect the Power Supply module for any physical damage caused in shipping.
   a. Report any damage on the Lotus Notes database, WW: Cytometry Install.
   b. Correct as needed.

Cytometer

1. Locate the carton containing the Cytometer.
2. Position the carton close to the bench or table where the Cytometer is to be installed.

WARNING Risk of personal injury as the steel strapping is cut. To prevent injury, hold the cutter with one hand and take hold of the steel strap with the other hand to ensure the steel strap does not spring back.

3. Stand to one side of the strapping surrounding the shipping carton.
4. Holding the steel strapping firmly with one hand, cut and remove each strap surrounding cardboard carton. Discard the straps.
5. Remove the cardboard carton, foam blocks, and plastic covering.

6. Inspect the Cytometer for any physical damage caused in shipping.
   a. Report any damage on the Lotus Notes database, WW: Cytometry Install.
   b. Correct as needed.

WARNING Risk of personal injury. Do not attempt to unload the Cytometer without assistance. The Cytometer is heavy and can be difficult to lift and maneuver into position. Failure to obtain assistance can result in serious personal injury.

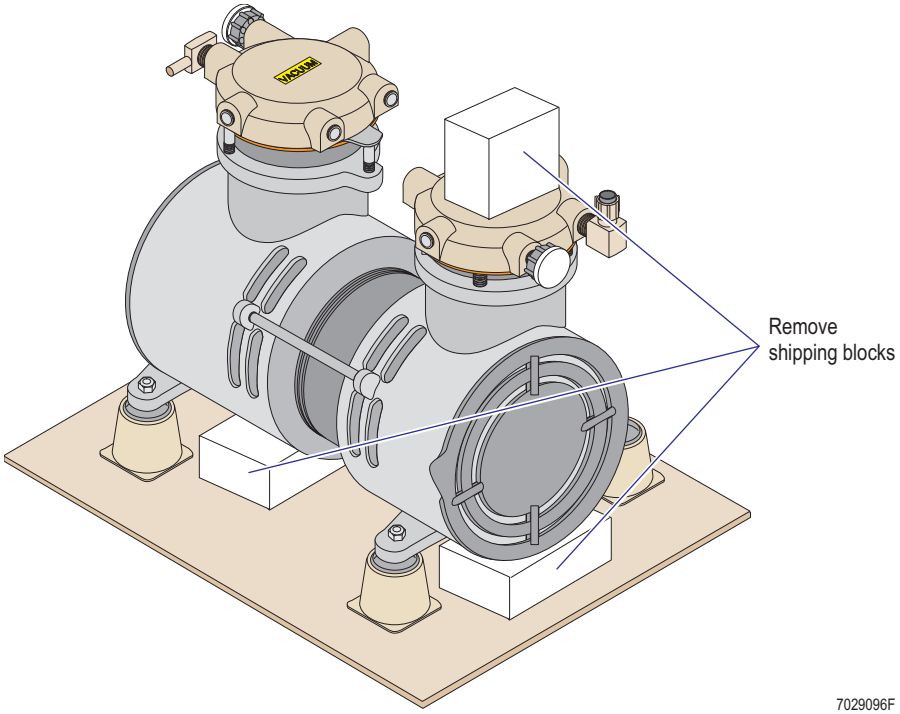
CAUTION Risk of instrument damage. The MCL option on the XL-MCL flow cytometer may be damaged if the left side of the Cytometer is grasped to move the Cytometer from the pallet to the bench or table top. Position one person in the front and the other in the back of the Cytometer to move the instrument from the pallet to the bench or table top.

7. Request assistance to place the Cytometer on the bench top or table.
   a. Position one person in front and another in the back.
   b. Do not lift the instrument from its sides, especially if the MCL option is attached.
   c. Orient the Cytometer to the far right of the designated area to allow space for installing the Workstation.

Power Supply Installation

1. Remove the two Phillips-head screws on the left side of the cover (at the bottom) and the two Phillips-head screws on the right side of the cover (at the bottom).
2. Lift the cover off of the Power Supply module.
3. Remove and discard the **three** foam blocks used to secure the compressor assembly during shipping (Figure 3.3-1). Don't forget the block wedged under the rear of the compressor.
4. Place the foam blocks inside the box designated for storing shipping parts.

Figure 3.3-1 Location of Foam Shipping Blocks Used to Protect the Compressor Assembly



5. Inspect for any loose or damaged parts.
   a. Report any loose or damaged parts/assemblies on the on the Lotus Notes database, WW: Cytometry Install.
   b. Correct as needed.

Cytometer Installation

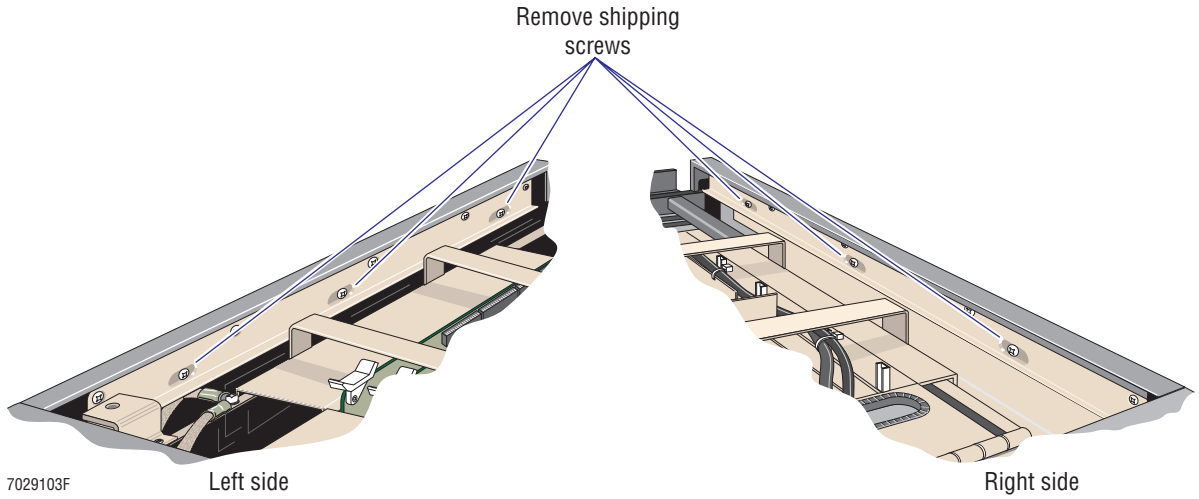
ATTENTION: Since it may be necessary to access an area of the Cytometer several times, do not reinstall a cover or panel until you are specifically instructed to do so.

Remove Covers to Provide Needed Access

1. Remove the top cover.

   At the back of the Cytometer:
   a. Remove the four Phillips-head screws securing the top cover to the Cytometer.
   b. Lift the top cover up and off of the Cytometer.
   c. Set the cover aside.
2. Remove three small shipping screws at the top of each side cover (Figure 3.3-2). Place all six screws in the box designated for storing shipping parts.

Figure 3.3-2 Location of Small Shipping Screws Used to Secure the Side Covers



3. Remove the right-side cover.
   a. Manually pull the right-side cover up and off the instrument.
   b. Set the cover aside.
4. Use instrument specific instructions to gain required access:
   - If this is an XL cytometer **without** the MCL option, go to step 5.
   - If this is an XL cytometer **with** the MCL option, go to step 10.
5. Manually pull the left-side cover up and off the Cytometer frame. Set the cover aside.
6. Remove the center front cover (filter cover) and set it aside.
7. Pull open the reagent drawer.
8. Remove the manual sample station cover assembly:
   a. Remove the four flat-head Phillips screws securing the manual sample station to the Cytometer frame.

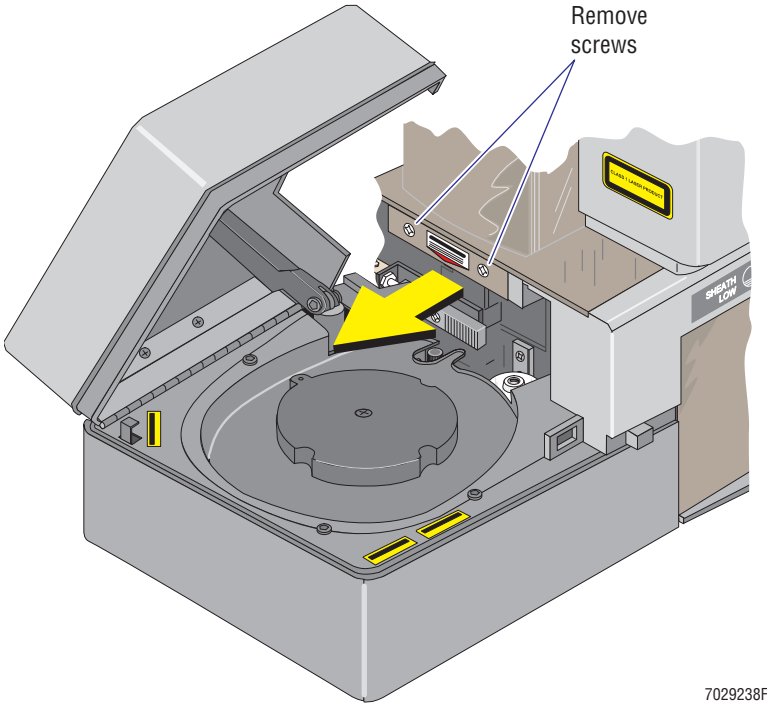
      Note: Two screws are located on the left side of the sample station and two more are located on the front to the right.
   b. Pull the cover assembly off the Cytometer frame and lay the assembly on the reagent bottles.
9. Go to step 15 to continue this installation.
10. Unlatch the MCL covers from the Cytometer:

CAUTION Risk of damage to the MCL option. The following steps are meant to unlatch, not remove, the MCL covers. If you attempt to remove the MCL covers without completing all the steps detailed in the Removing the MCL Covers procedure under Heading 4.3, COVER REMOVAL AND REINSTALLATION, you may damage MCL components. To remove the left-side cover, it is not necessary to remove the MCL covers from the Cytometer.

   a. Push the button to unlock the upper cover. The cover pops open as the air cylinder attached to the cover extends.
   b. Push the cover up to ensure it is fully open.

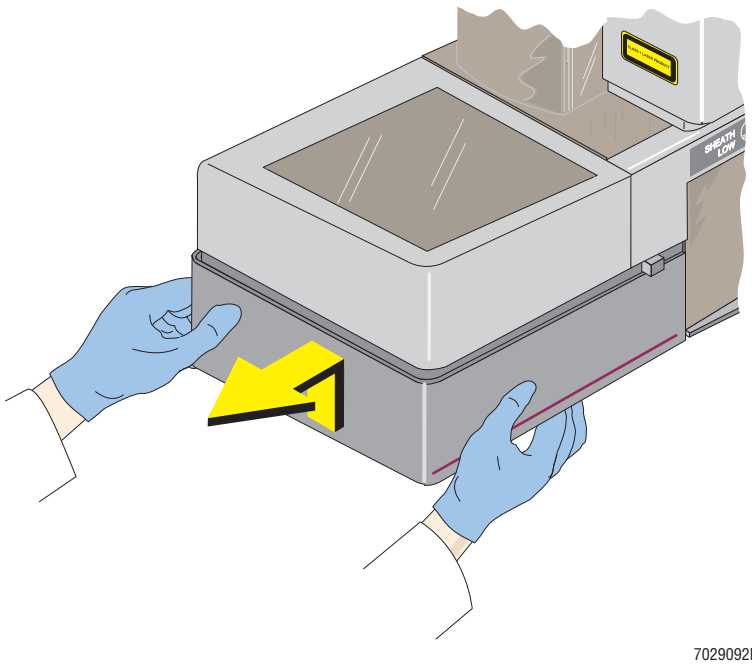
c. Remove the two screws securing the MCL probe housing (Figure 3.3-3) then carefully pull the probe housing cover off the Cytometer and set it aside.

Figure 3.3-3 Removing the MCL Probe Housing Cover



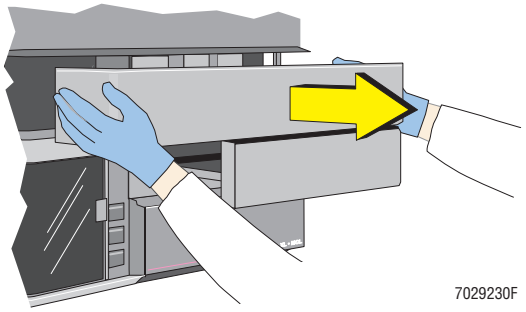
d. Close the MCL door (upper cover) and unlatch the MCL lower cover by grasping the base and gently pulling the base away from the Cytometer (Figure 3.3-4). **Do not attempt to remove the MCL option from the Cytometer.**

Figure 3.3-4 Unlatching the MCL Covers



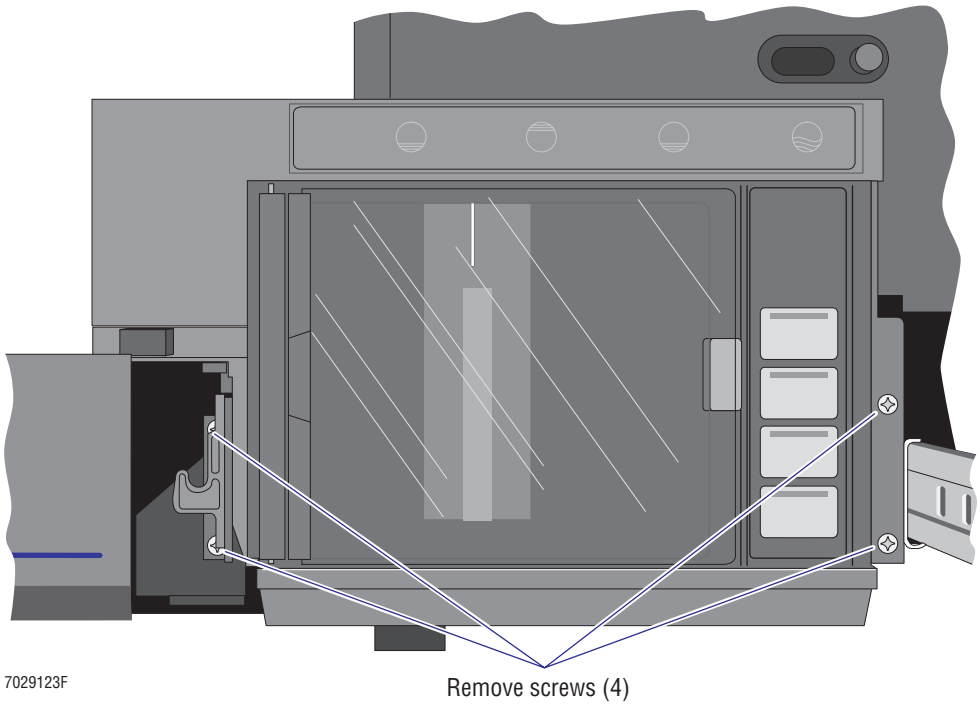
11. Remove the center front cover (filter cover) and set it aside. See Figure 3.3-5.

Figure 3.3-5 Remove the Center Front Cover (Filter Cover)



12. Pull open the reagent drawer.
13. Remove the manual sample station cover assembly:
    a. Carefully move the unlatched MCL cover away from the Cytometer frame.
    b. Locate and remove the two pan-head screws that secure the manual sample station to the Cytometer frame (Figure 3.3-6).

Figure 3.3-6 Manual Sample Station Screw Locations



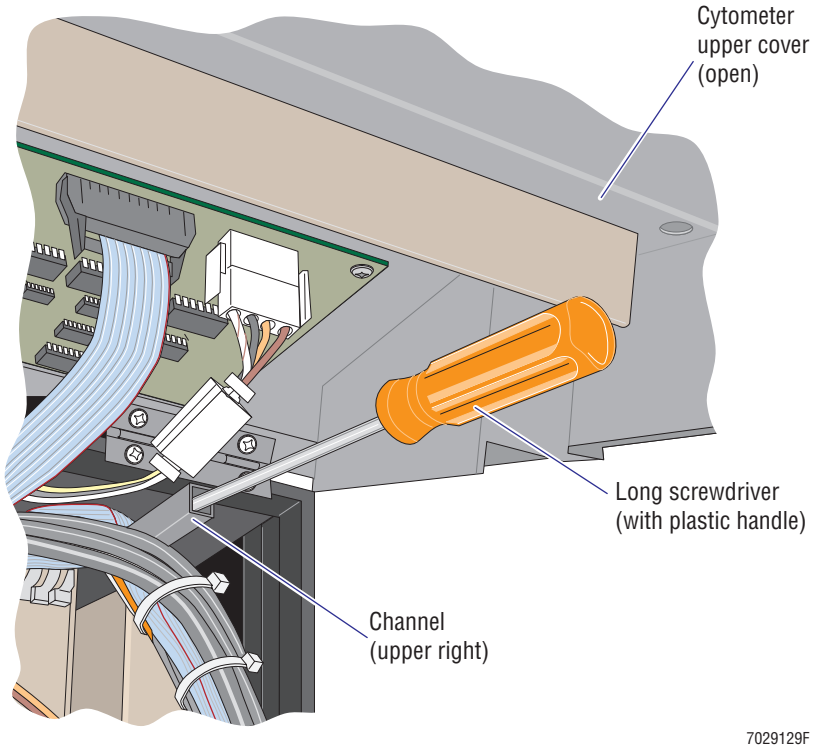
    c. Remove the two flat-head Phillips screws securing the right side of the manual sample station to the front of the Cytometer frame (Figure 3.3-6).
    d. Pull the cover assembly off the Cytometer frame and lay the assembly on the reagent bottles.

14. Manually pull the left-side cover up and off the Cytometer frame. Set the cover aside.

CAUTION Risk of damage to electrical components on the front panel display circuit card. Do not use a T-handled hex key to hold the upper cover open. If the metal in the T-handle comes in contact with the electrical components on the circuit card, the components may short out and the card becomes defective.

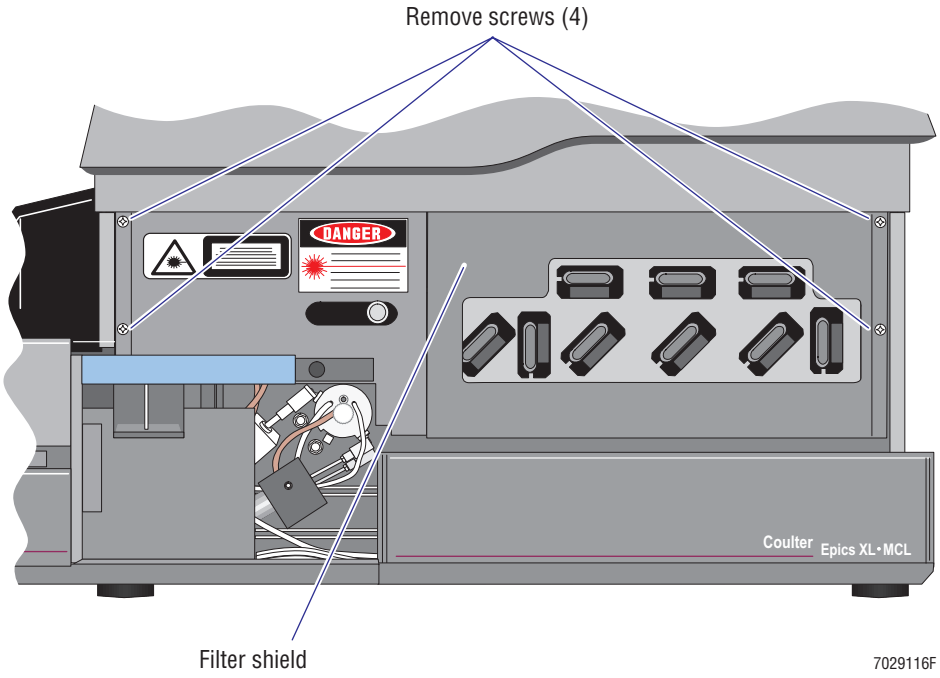
15. Lift the upper cover and place a long screwdriver (with a plastic handle) in the channel of the upper frame to it open (Figure 3.3-7).

Figure 3.3-7 Use a Long Screwdriver to Brace the Upper Cover Open



16. Remove the four screws (two on each side) securing the filter shield to the Cytometer frame (Figure 3.3-8). Set the filter shield aside.

Figure 3.3-8 Filter Shield Screw Locations

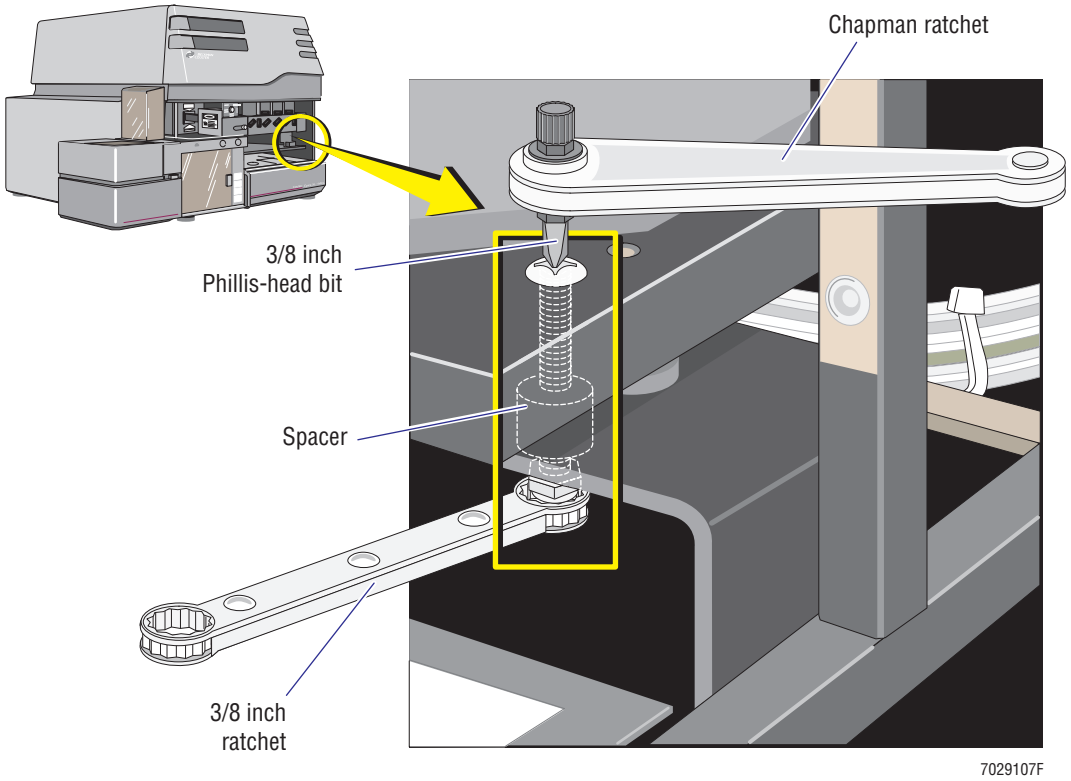


Remove the Optical Bench Shipping Tie-Down in the Front

Remove the optical bench shipping tie-down (screw and hex nut) located at the front right corner of the optical bench:

1. Slide the reagent drawer open as needed.
2. Use your Chapman's ratchet set to remove the shipping tie-down (screw and hex nut) located at the front right corner. Refer to Figure 3.3-9 as needed.
   a. Use the 3/8-inch ratchet to hold the hex nut in place (Figure 3.3-9).
   b. Use the 3/8-inch Phillips-head bit in the ratchet screwdriver to remove the shipping screw (Figure 3.3-9).

Figure 3.3-9 Remove the Optical Bench Shipping Tie-Down in the Front



3. Remove the spacer (Figure 3.3-9).
4. Place the shipping tie-down (screw, hex nut, and spacer) in the box designated for storing shipping parts.

Remove the Optical Bench Shipping Tie-Down in the Back (Behind the Laser)

1. If this is an XL with the MCL option, remove the MCL CPU card; if this is not an XL with the MCL option, go to step 2.

   Note: The MCL CPU card is the larger of the two circuit cards located on the left side of the Cytometer. It is the card near the rear of the Cytometer. Refer to Figure 3.3-10 or Figure 3.3-11 as needed.

Figure 3.3-10 MCL CPU Card Cable Locations

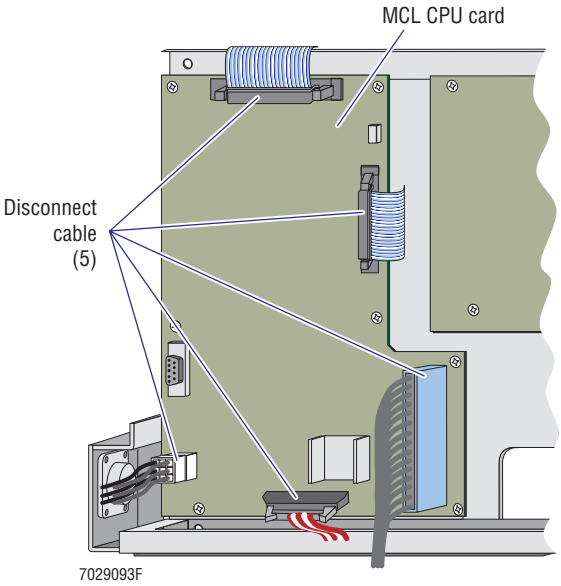
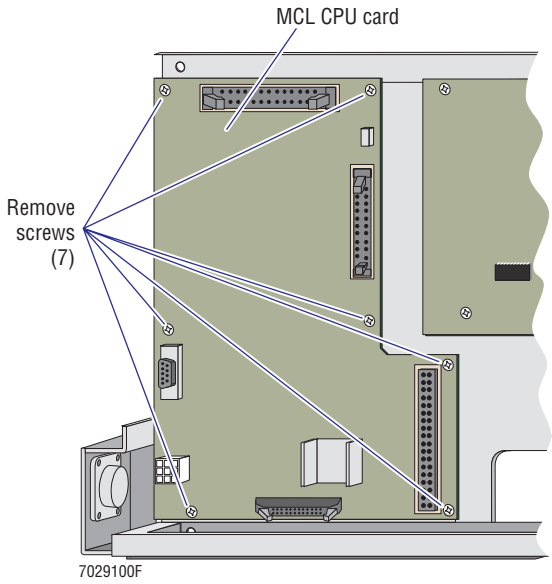


Figure 3.3-11 MCL CPU Card Screw Locations



a. Set up your static-dissipative field kit (ESD kit).

b. Disconnect the five cable connectors attached to the card (Figure 3.3-10).

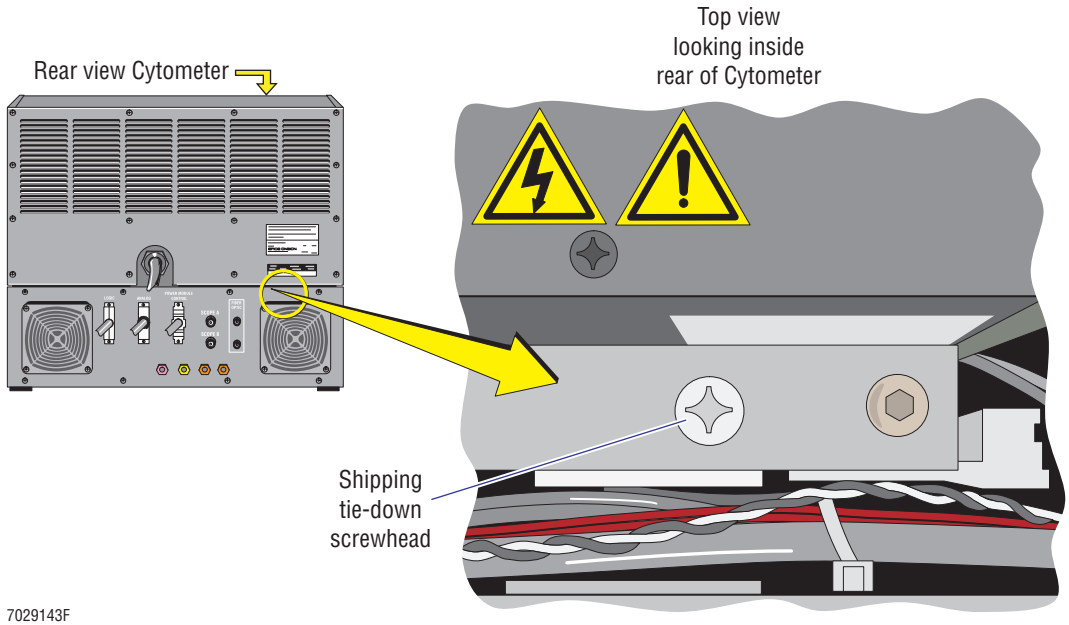
c. Remove the seven Phillips-head screws and washers that attach the card to the Cytometer frame (Figure 3.3-11).

d. Remove the card and set it aside on the static-dissipative work mat.

2. Remove the optical bench shipping tie-down (screw and hex nut) located in the left rear corner behind the laser head.

   a. Locate the shipping tie-down on the rear of the optical bench (Figure 3.3-12). It is the larger of the two screws.

Figure 3.3-12 Location of the Optical Bench Shipping Tie-Down Behind the Laser (Top View)



ATTENTION: Before beginning this task, make sure you have a long Phillips-head screwdriver (or a Phillips-head screwdriver with an extension), a 3/8-inch wrench, and a piece of electrical tape. If either the hex nut or spacer falls to the Cytometer floor, it must be retrieved.

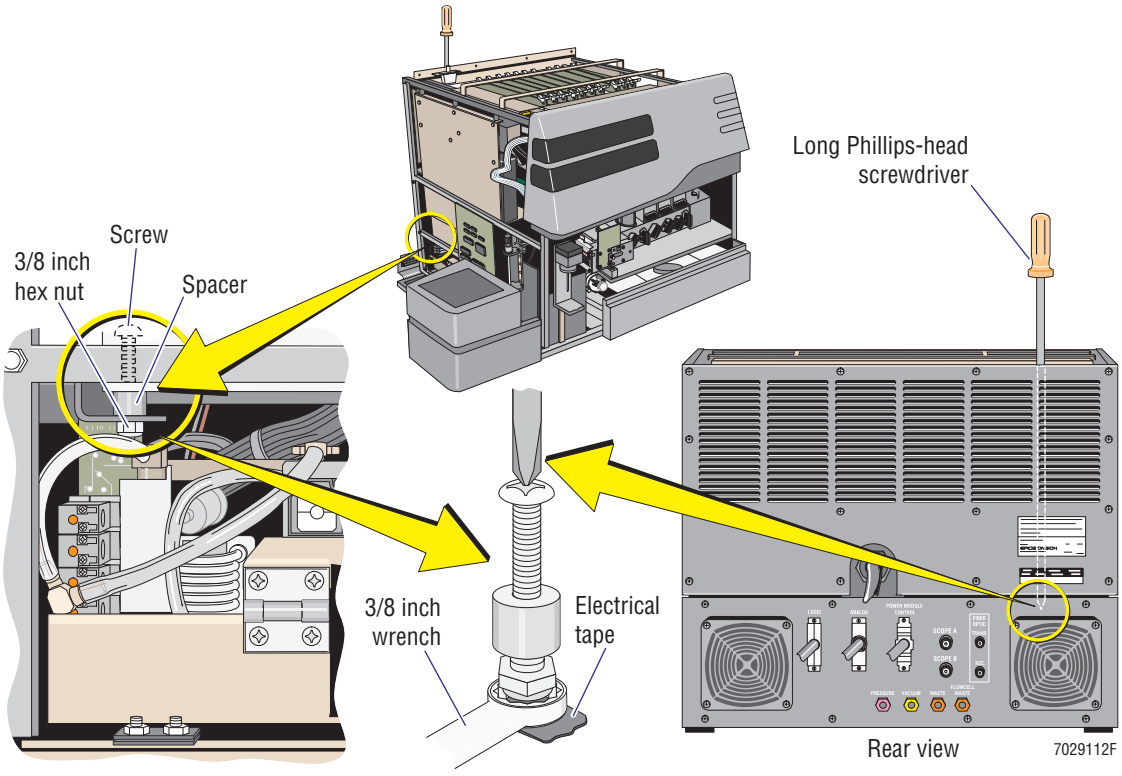
b. Use a 3/8-inch wrench and a long Phillips-head screwdriver to remove the shipping tie-down (screw and hex nut). Refer to Figure 3.3-13 as needed.

1) Place a piece of electrical tape over the opening of the 3/8-inch wrench.

2) Route the 3/8-inch wrench through the opening on the left side of the Cytometer and position the wrench to hold the hex nut in place (Figure 3.3-13).

3) Use a long Phillips-head screwdriver (or a Phillips-head screwdriver with an extension) to remove the shipping screw (Figure 3.3-13). The electrical tape should capture the hex nut inside the wrench.

Figure 3.3-13 Remove the Optical Bench Shipping Tie-Down Behind the Laser



c. Use large hemostats to carefully remove the spacer (Figure 3.3-13).

d. Retrieve the hex nut or spacer if either falls to the Cytometer floor.

3. Place the shipping tie-down (screw, hex nut, and spacer) in the box designated for storing shipping parts.

Prepare Components inside the Lower Pneumatics Drawer for Operation

1. On the left side of the Cytometer, locate the two rows of pinch-valves inside the lower pneumatics drawer.
2. Use a hemostat to remove the red shipping clip from each pinch valve. Make sure you remove all 14 shipping clips!
3. Count the removed shipping clips to confirm that all 14 red clips were removed.
4. Place the red shipping clips in the box designated for storing shipping parts.
5. Inspect for any loose or damaged parts.
   a. Report any loose or damaged parts/assemblies on the Lotus Notes database, WW: Cytometry Install.
   b. Correct as needed.

Reinstall the MCL CPU Card (if removed earlier)

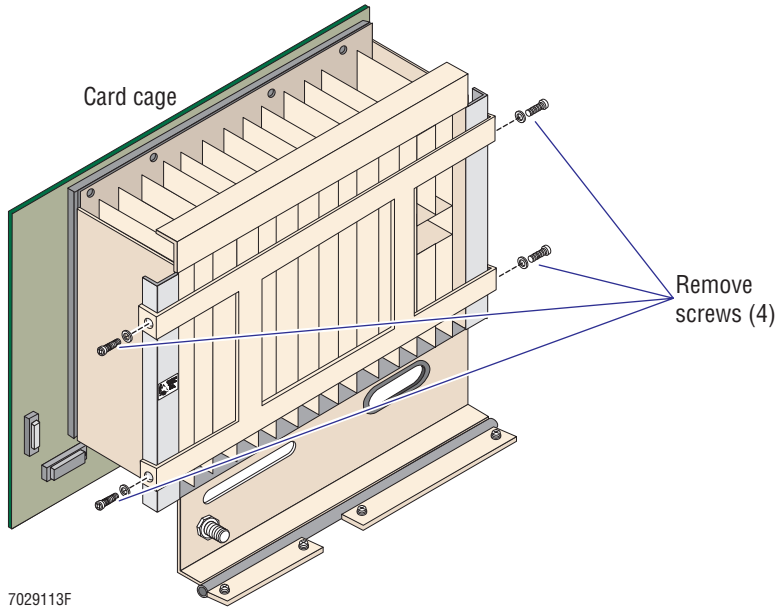
1. Position the MCL CPU card back on the Cytometer frame.
2. Loosely install the seven Phillips-head screws and washers then tighten the screws to the Cytometer frame.
3. Reconnect all five cable connectors to their respective plugs on the circuit card.

Prepare the Data Acquisition Card Cage for Operation

At the Data Acquisition card cage:

1. Remove the two shipping screws, one from each side of the card cage. Place these screws in the box designated for storing shipping parts.
2. With one hand, pull the Data Acquisition card cage forward and hold it in an upright position. With your free hand, lock the hinge on each side of the card cage to secure it in a vertical position. **Make sure both hinges are locked before releasing your grip.**
3. Remove the four screws securing the shipping brace (Figure 3.3-14).

Figure 3.3-14 Data Acquisition Card Cage - Shipping Brace and Screw Locations

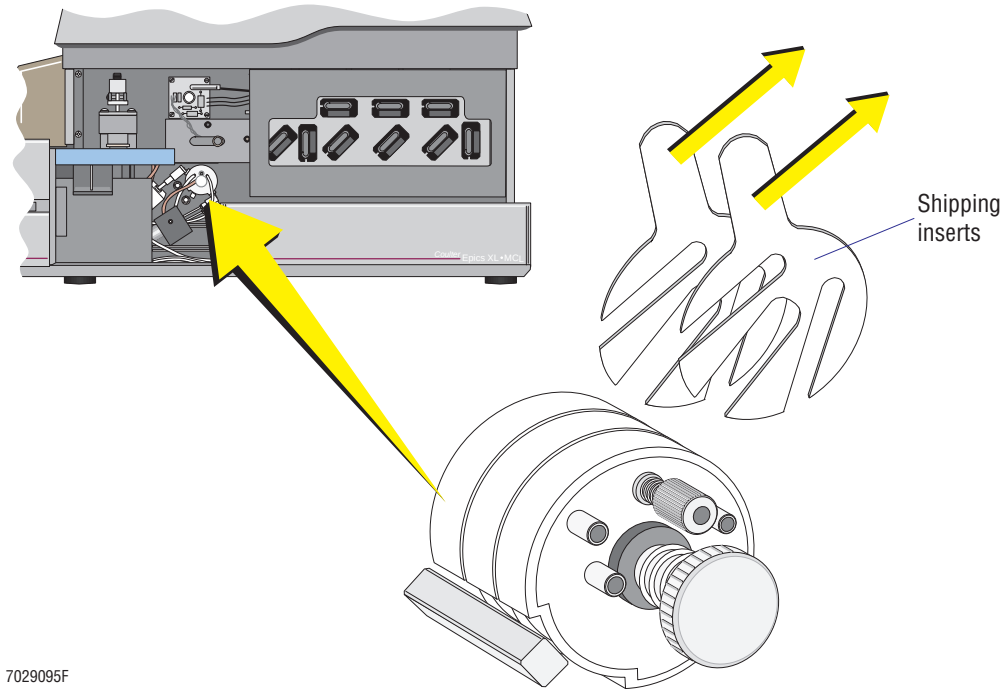


4. Remove the shipping brace (Figure 3.3-14). Place the brace and screws in the box designated for storing shipping parts.
5. Inspect for any lose cards or cables. Correct as needed.
6. Disassemble the static-dissipative field kit.

Prepare the Segmenting Valve for Operation

1. Locate the segmenting valve (behind the manual sample station removed earlier).
2. Turn the knob counterclockwise until it can be removed from its shaft (Figure 3.3-15, item 1). Set the knob aside.

Figure 3.3-15 Remove the Plastic Shipping Inserts from the Segmenting Valve



3. Gently separate the white, ceramic segmenting pads (Figure 3.3-15, item 2).
4. Remove the two plastic shipping inserts from between the segmenting pads (Figure 3.3-15, item 3).
5. Carefully remove the segmenting pads from the shaft:
   a. At the front segmenting pad:
      1) Unscrew the HPLC locking nut from the front segmenting pad. Make sure you do not lose the ferrule at the end of the PEEK tubing.
      2) Disconnect the air cylinder from the ball stud (on the segmenting pad).

         Note: To separate the air cylinder from the segmenting pad, slide the ball-stud clamp towards the air cylinder. While holding the clamp, lift the air cylinder piston off the ball stud in the segmenting pad.
      3) Slide the front segmenting pad off the shaft.

b. Disconnect the air cylinder from the middle segmenting pad and carefully slide the pad off the shaft.

c. Disconnect the air cylinder from the rear segmenting pad and carefully slide the pad off the shaft.

6. Rinse each segmenting pad with distilled water then reinstall the pad on the shaft:
   a. Rinse the rear segmenting pad with distilled water and reinstall the pad on the shaft.
   b. Rinse the middle segmenting pad with distilled water and reinstall the pad on the shaft.
   c. Rinse the front segmenting pad with distilled water and reinstall the pad on the shaft.
7. Reconnect the PEEK-tubing ferrule to the front segmenting valve.
   a. Make sure the ferrule is still on the end of the PEEK tubing.
   b. Screw the HPLC locking nut back into the front segmenting pad.

ATTENTION: Applying a light coat of Lubriplate grease to the air cylinder clamp before attaching it to the ball stud on the segmenting pad helps prevent corrosion.

8. Reattach each air cylinder clamp back on its respective ball stud.
9. Reinstall the knob in the shaft then turn the knob clockwise until it is snug. Do not overtighten the knob.
10. Wipe the outside of the segmenting valve with a lint-free tissue.
11. Ensure the work area is wiped dry.

Prepare Components inside the Upper Pneumatic Drawer for Operation

At the upper pneumatic drawer (upper right side of the Cytometer):

1. Remove the two Phillips-head screws securing the upper pneumatic drawer to the Cytometer frame.
2. Pull the hinged drawer outside of the Cytometer by grasping and pulling the right side of the drawer away from the Cytometer frame.
3. Remove the four Phillips-head screws securing the front panel (EMC shield) to the front of the hinged drawer frame. Two screws are located at the top of the frame and two screws are located at the bottom.
4. Remove the EMC shield and set it aside.
5. Remove the two red shipping clips (one from each pinch valve).
6. Place the shipping clips in the box designated for storing shipping parts.
7. Inspect the upper pneumatics assembly for loose connectors or tubing.
   a. Report any loose or damaged parts/assemblies on the Lotus Notes database, WW: Cytometry Install.
   b. Correct as needed.

Fill the Reagent Containers

IMPORTANT Risk of misleading results if you contaminate either reagent. Be careful not to contaminate the sheath fluid or cleaning reagent. Do not let your fingers, paper towels, or other objects touch the inside of the container or the inside of the cap.

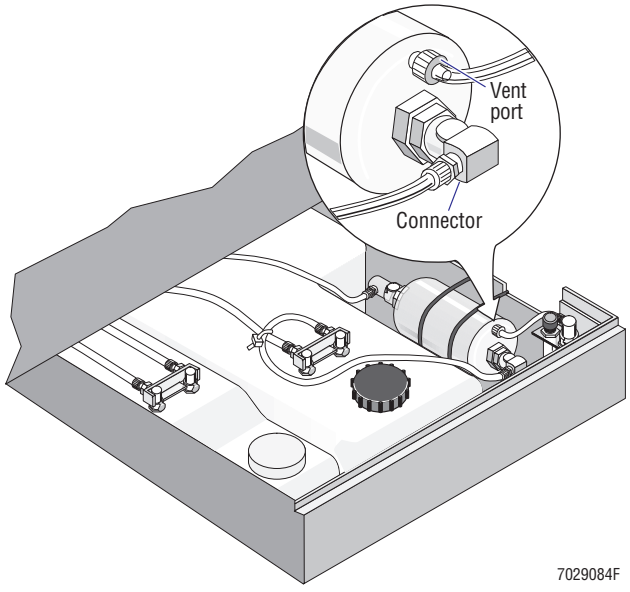
CAUTION Risk of damage to the instrument if you overfill either reagent, especially the cleaning reagent. Avoid spills. Do not tilt the container or remove it from the drawer to fill it.

Fill the Sheath Container

1. Pull open the reagent drawer.
2. Unscrew the cap on the sheath container (larger container on your right).
3. Lay the cap upside down on the container to avoid contamination.
4. Insert the funnel to help avoid spills.
5. Carefully pour sheath fluid into the container.

   Note: Fill the container just to the bottom of its neck.
6. Carefully wipe up any spills.
7. Screw the cap clockwise until the bottle is sealed.
8. Locate the sheath filter positioned to the right of the sheath container.
   a. Make sure the vent port is above the connector and pointing toward you (Figure 3.3-16).
   b. Make sure the tubing is not kinked or twisted.

Figure 3.3-16 Sheath Filter Location and Associated Components



Fill the Cleaning Agent Container

1. Unscrew the cap on the cleaning agent container (smaller container on your left).
2. Lay the cap upside down on the container to avoid contamination.
3. Insert a funnel to help avoid spills.
4. Carefully pour two 500 mL bottles of cleaning agent into the container. **Do not overfill this container.**

   Note: Fill the container just to the crease below the neck of the container.
5. Carefully wipe up any spills.
6. Screw the cap clockwise until the container is sealed.
7. Thoroughly rinse the funnel with water then dry it with paper towels before sitting it aside.
8. Push the reagent drawer back inside the Cytometer. Do not reinstall the center front cover (filter cover).

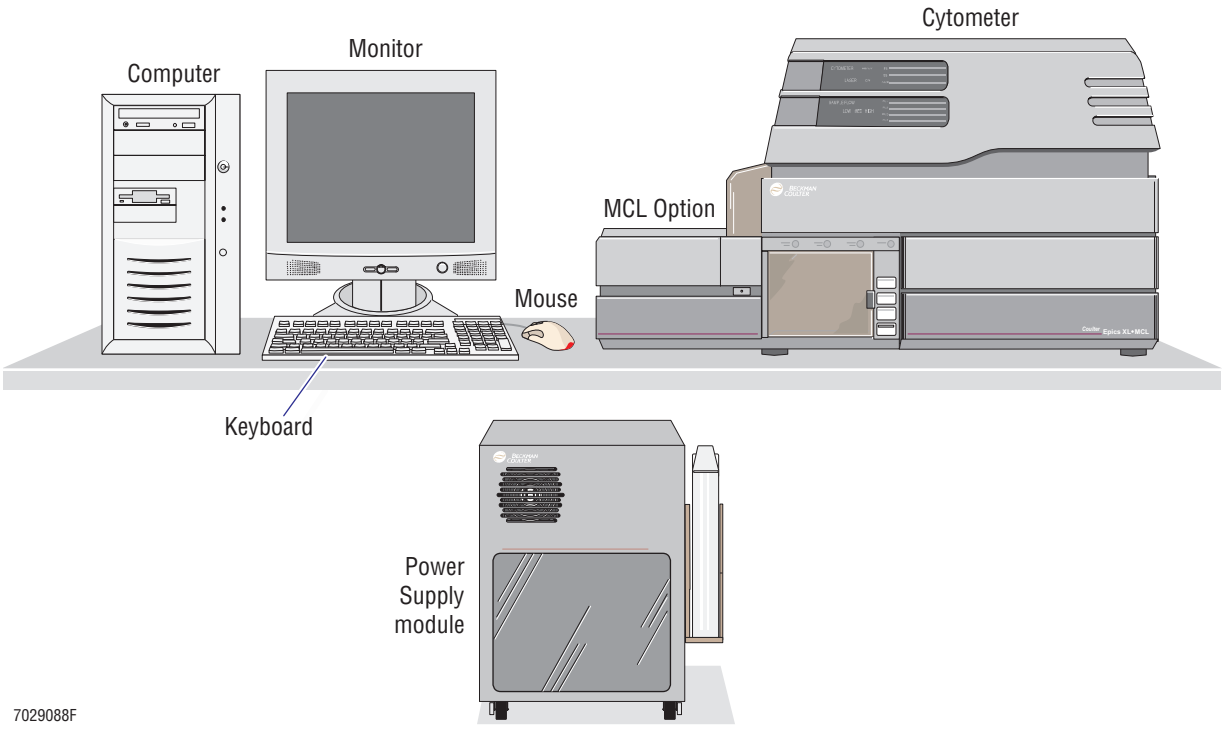
3.4 WORKSTATION INSTALLATION

"Workstation" or "Computer Workstation" is commonly used to refer to the FlowCentre Multimedia Workstation. This system consists of a tower computer, monitor, keyboard, mouse, and any optional equipment such as a Printer. The tower computer, monitor, and Printer each have their own ac power cord and power on/off switch. When a procedure calls for you to do something to the Workstation such as "turn on the Workstation," it refers to all the hardware items. When a procedure calls for you to do something to a specific part of the Workstation, it refers to that item only, such as "remove the tower computer cover."

Initial Setup

1. Unpack the FlowCentre II tower computer.
2. Consult with the customer to determine where they want to place the computer. If they have no preference, position the computer on the bench or table (Figure 3.4-1).

Figure 3.4-1 Typical Workstation Setup



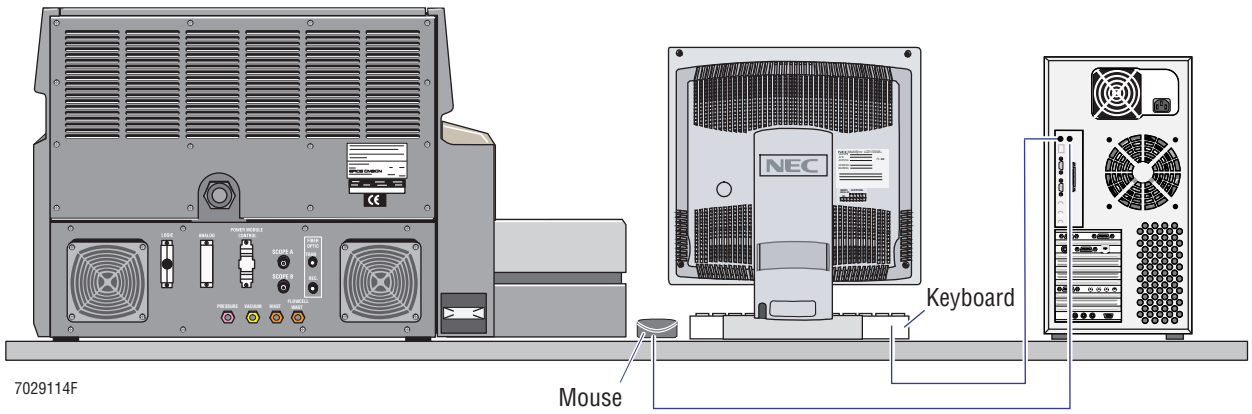
3. Unpack the monitor and place it on the bench or table (Figure 3.4-1).

   Note: The Workstation computer can accept up to two monitors. If the system has two monitors, find out where the customer wants the second monitor placed. If the monitors are different, also find out which monitor will be the primary monitor.
4. Unpack the keyboard and mouse.
5. Place the keyboard in front of the monitor then place the mouse beside it (Figure 3.4-1).

Mouse Connection

Connect the mouse cable to the mouse port on the rear of the tower computer (Figure 3.4-2).

Figure 3.4-2 Electronic Cable Connections - Mouse and Keyboard



Keyboard Connection

Connect the keyboard cable to the keyboard port on the rear of the computer tower (Figure 3.4-2).

Monitor Connections - Overview

ATTENTION: The dual-head video display adapter allows the FlowCentre Workstation to accept up to two monitors. Since this card is already installed and enabled, **do not enable** the acceleration option **DEVICE BITMAPS CACHING** under the display properties of Windows™ 98. If this option is enabled and the system is rebooted, the video display appears garbled and is no longer usable.

The FlowCentre Multimedia Tower Workstation being used with the XL or XL-MCL flow cytometer is designed to accept up to two monitors. Follow the connection instructions for the monitor(s) being installed in this laboratory.

- Monitor Connections: 17-inch Flat Panel Thin Film Transistor (TFT) Monitor
- Monitor Connections: 22-inch CRT Monitor

Monitor Connections: 17-inch Flat Panel Thin Film Transistor (TFT) Monitor

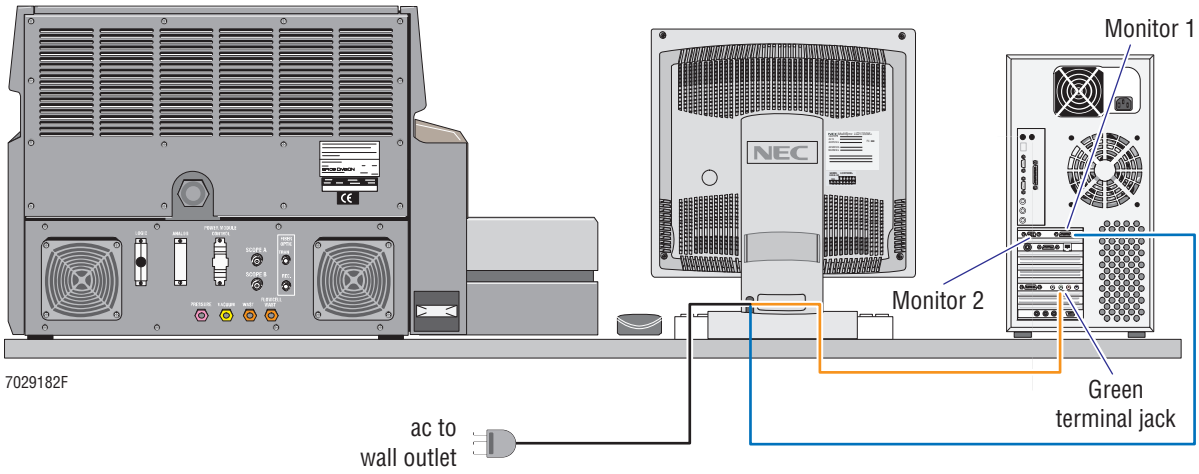
This LCD monitor has two cables and an ac power cord. Inspect these cables and the power cord to ensure the pins are straight and seated properly.

Connecting the Monitor Cables

1. Locate the cable with the terminal post (may be color-coded green).
2. Insert the terminal post in the green jack on the rear of the tower computer (Figure 3.4-3).

3. Attach the monitor plug to the appropriate jack on the rear of the tower computer (Figure 3.4-3).
   - If this is the only monitor, attach the plug to the right jack on the Dual Monitor Video card.
   - If this is the second monitor, attach the plug to the left jack on the Dual Monitor Video card.

Figure 3.4-3 Connecting the 17-inch Flat Panel TFT Monitor Cables



4. Connect the ac power cord to an appropriate ac wall outlet (Figure 3.4-3).

Monitor Connections: 22-inch CRT Monitor

This CRT monitor has two cables and an ac power cord. Inspect these cables and the power cord to ensure the pins are straight and seated properly.

Connecting the Monitor Cables

Note: Because connections for the 22-inch CRT are similar to the connections for the 17-inch flat panel monitor, Figure 3.4-3 may be used as a reference.

1. Locate the cable with the terminal post.
2. Insert the terminal post in the green jack on the rear of the tower computer.
3. Attach the monitor plug to the appropriate jack on the rear of the tower computer.
   - If this is the only monitor, attach the plug to the right jack on the Dual Monitor Video card.
   - If this is the second monitor, attach the plug to the left jack on the Dual Monitor Video card.
4. Connect the ac power cord to an appropriate ac wall outlet.

Printer Option

Connect the Printer to the PRINTER port on back of the tower computer.

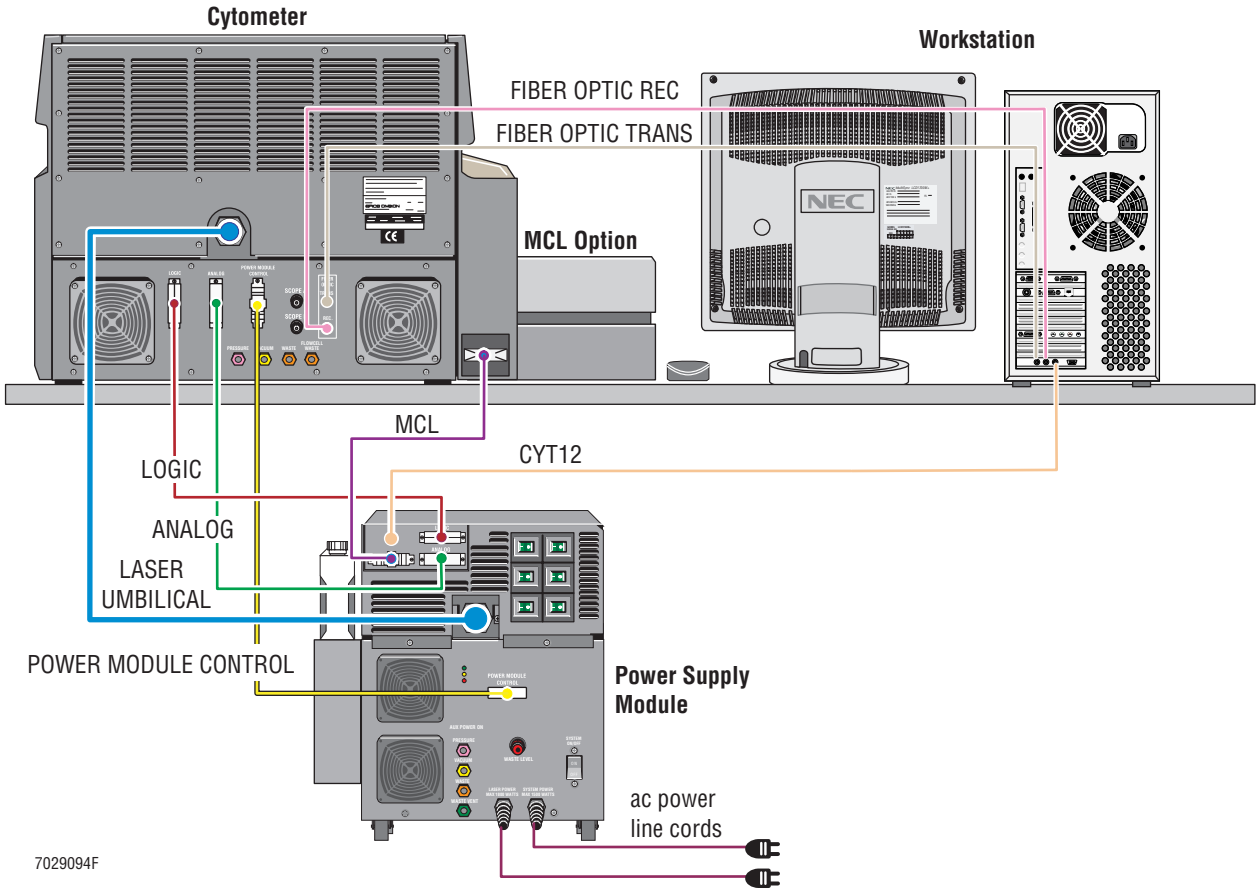
Note: For additional information, refer to the documentation supplied with the Printer.

3.5 CABLE/TUBING CONNECTIONS

Connect Cables

ATTENTION: Refer to Figure 3.5-1 as needed.

Figure 3.5-1 Instrument Connections



Laser Umbilical Cable

1. At the rear of the Power Supply:
   a. Remove the three Phillips-head screws securing the upper rear cover to the Power Supply module frame. One screw is located at the top in the middle and the other two screws are at the bottom of the cover.
   b. Remove the upper rear cover and set it aside.
   c. Locate the small cover in the center (left of circuit breaker labeled MCL 24 VOLTS).
   d. Remove the two Phillips-head screws securing the small cover to the rear cover. One screw has a hex nut to ground the cable (when installed).
   e. Remove the small cover and set it aside.
2. Cut the tie-wrap securing the laser umbilical cable to the rear of the Cytometer.

3. Route the two large connectors on the end of the laser umbilical cable through the opening in the rear of the Power Supply (Figure 3.5-1).

   Note: Remove the ac power plug for easier access to the sockets.

4. Connect the laser umbilical cable to the Laser Power Supply inside the Power Supply module.

   a. For easier and quicker connections, at the laser power supply:

      1) Remove the laser power supply key and set it aside.

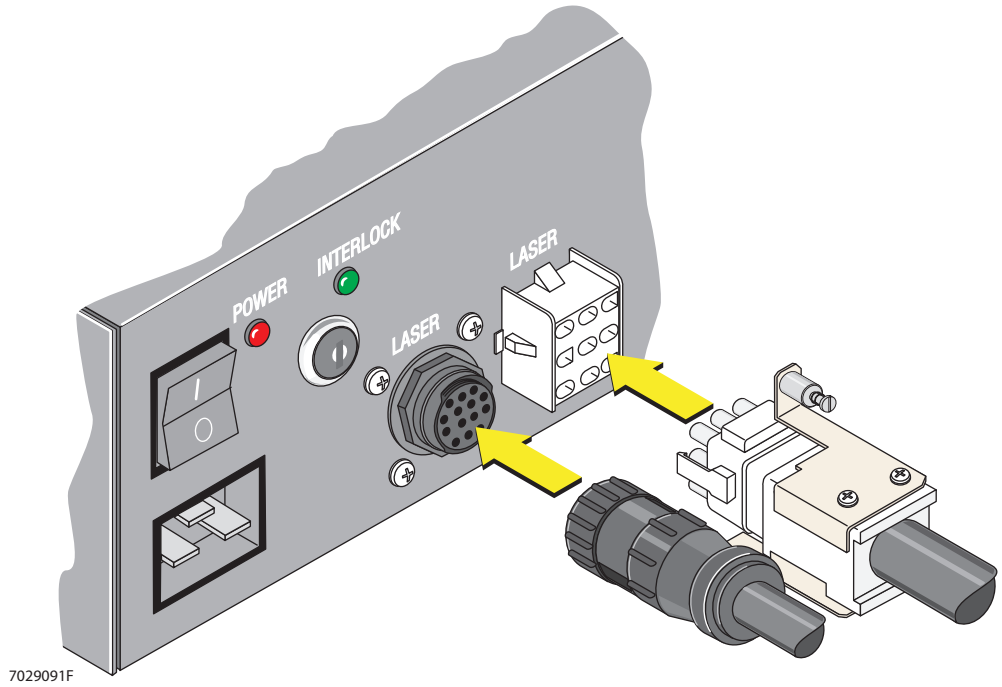
         Note: If the key is in the ON position, it must be rotated counterclockwise to the OFF position before it can be removed from the power supply.

      2) Remove the ac power plug from the laser power supply (Figure 3.5-2).

   b. Insert the black connector into the circular socket (Figure 3.5-2) and lock it in place.

      Note: The black connector is keyed to fit the circular socket. Make sure the connector is properly inserted in the socket before attempting to lock it in place.

Figure 3.5-2 Connect the Laser Umbilical Cable to the Laser Power Supply



   c. Insert the white connector into the rectangular socket (Figure 3.5-2) then tighten the two screws to lock it in place.

   d. Thread the locking nut through the opening.

   e. Position the small cover (removed earlier) back in position.

   f. Reinstall the two Phillips-head screws removed earlier.

   g. Route the strain relief collar over the cables and attach it to the locking nut. The laser umbilical cable connectors inside the power supply should remain secure when the Power Supply module is moved.

5. Use the hex nut to secure the ground wire from the laser umbilical cable to one of the screws securing the small cover to the rear cover.
6. Reconnect the ac power plug.
7. Reinstall the laser power supply key then rotate the key clockwise to the — position. (The power supply will not be activated until ac is applied later.)

Logic Cable

1. Locate the logic cable. One connector attached to this cable is male and the other female.
2. At the Cytometer, attach the male connector to the plug labeled LOGIC and tighten the two screws to secure it to the Cytometer frame (Figure 3.5-1).
3. At the Power Supply module, connect the female connector to the plug labeled LOGIC and tighten the two screws to secure it (Figure 3.5-1).

Analog Cable

1. Locate the analog cable. One connector attached to this cable is male and the other female.
2. At the Cytometer, attach the female connector to the plug labeled ANALOG and tighten the two screws to secure it to the Cytometer frame (Figure 3.5-1).
3. At the Power Supply module, connect the male connector to the plug labeled ANALOG and tighten the two screws to secure it (Figure 3.5-1).

Power Module Control Cable

1. Locate the power module control cable. One connector attached to this cable is male and the other female.
2. At the Cytometer, attach the female D-connector to the plug labeled POWER MODULE CONTROL and alternately tighten the two thumbscrews until the connector is secured to the Cytometer frame (Figure 3.5-1).
3. At the Power Supply module, connect the male D-connector to the plug labeled POWER MODULE CONTROL and alternately tighten the two thumbscrews until the connector is secure to the frame (Figure 3.5-1).

Make Appropriate MCL Connections

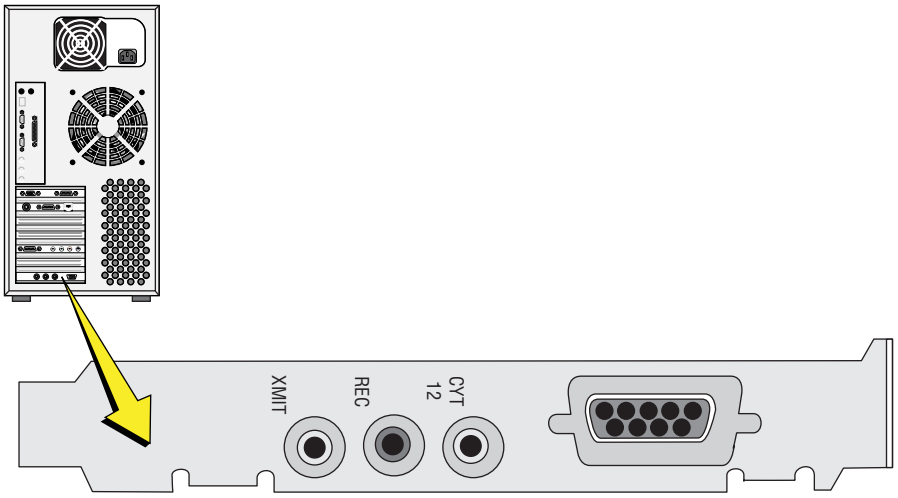
- If this is an XL cytometer **without** the MCL option, go to step 1.
- If this is an XL cytometer **with** the MCL option, go to step 4.

1. Locate the MCL dummy plug.
2. At the Power Supply module, attach the dummy plug to the connector labeled MCL (Figure 3.5-1).
3. Go to the next heading, Fiber Optic Interface Cables.
4. Locate the MCL cable. One connector attached to this cable is male and the other female.
5. At the Cytometer, attach the female connector to the plug labeled MCL and tighten the two screws to secure it to the Cytometer frame (Figure 3.5-1).
6. At the Power Supply module, attach the male connector to the to the plug labeled MCL and tighten the two screws to secure it (Figure 3.5-1).

Fiber Optic Interface Cables

1. Locate the orange fiber optic interface cable.
   - This cable is actually two cables joined together so it has two terminal posts (with a locking nut) at each end.
   - One cable is labeled RX and the other is labeled TX.
   - The terminal posts on one end of the cable will be inserted into jacks on the Cytometer and the terminal posts on the other end of the cable will be inserted into jacks on the Opto Transprocessor EXMEM II card in the tower computer.
2. Remove the red plastic caps protecting the four terminal posts. Place these caps with the other parts used for shipping.
3. At the rear of the Cytometer (Figure 3.5-1):
   a. Unscrew and remove the black caps protecting the FIBER OPTIC REC and FIBER OPTICS TRANS jacks. Place these caps with the other parts used for shipping.
   b. Insert the terminal post labeled RX into the jack labeled FIBER OPTIC REC and tighten the locking nut.
   c. Insert the terminal post labeled TX into the jack labeled FIBER OPTIC TRANS and tighten the locking nut.
4. At the rear of the tower computer (Figure 3.5-1):
   a. Locate the edge of the Opto Transprocessor EXMEM II card in the bottom slot.
   b. Unscrew and remove the black caps protecting the three jacks. Place these caps with the other parts used for shipping.
   c. Insert the terminal post labeled TX into the outer left jack labeled XMIT (Figure 3.5-3) and tighten the locking nut.

Figure 3.5-3 Opto Transprocessor EXMEM II Card Edge Locations



7029132F

   d. Insert the terminal post labeled RX into the inner (middle) jack labeled REC (Figure 3.5-3) and tighten the locking nut.

CYT12 Cable

1. Locate the orange fiber optic interface cable with a single terminal post (with a locking nut) at each end.
2. Remove the red plastic cap protecting each terminal post. Place these caps with the other parts used for shipping.
3. At the rear of the Power Supply:
   a. Locate the CYT12 jack in the upper left corner.
   b. Unscrew and remove the black cap protecting the CYT12 jack. Place the cap with the other parts used for shipping.
   c. Insert the terminal post labeled TX into the jack labeled CYT12 and tighten the locking nut. Refer to Figure 3.5-1 as needed.
4. At the rear of the tower computer (Figure 3.5-1):
   a. Locate edge of the Opto Transprocessor EXMEM II card inside the bottom slot.
   b. Insert the terminal post labeled RX into the right jack labeled CYT 12 (Figure 3.5-3) and tighten the locking nut.

Power Cords

1. Verify all six Power Supply circuit breakers in the upper corner are switched to the ON position (– position).
2. Locate the two ac power cords.
3. Connect the ac power line cords from the Power Supply module to an appropriate ac wall outlet (Figure 3.5-1).

Connect Tubings

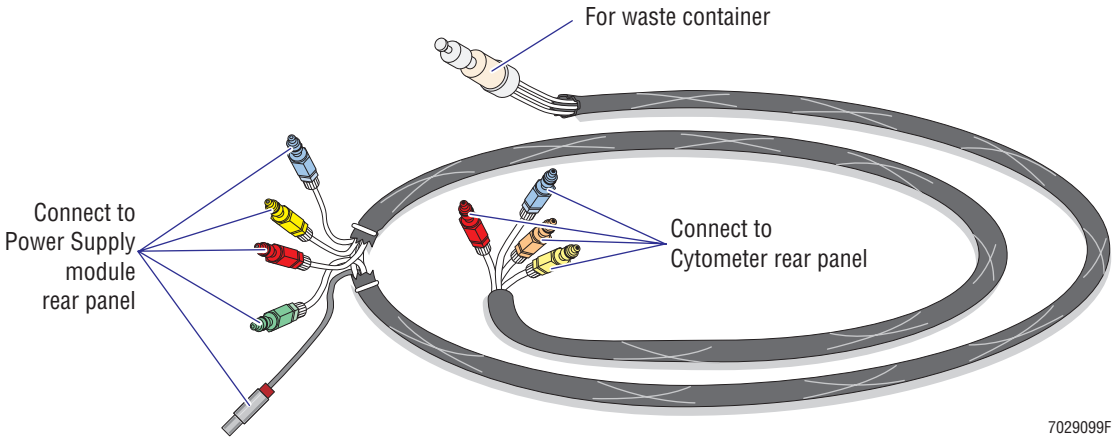
Prepare the Waste Container for Tubing Connection

1. Place the cover back on the Power Supply module but do not reinstall the four screws that secure it to the frame.
2. Locate the waste container.
3. Put about 400 mL of high-quality fragrance-free bleach (5% sodium hypochlorite - available chlorine) in the waste container to cover the bottom of the container.
4. Place the waste container in its bracket on the side of the Power Supply module.

Tubing Connections

1. Locate the bundle of shielded pneumatic/hydraulic tubings (Figure 3.5-4).

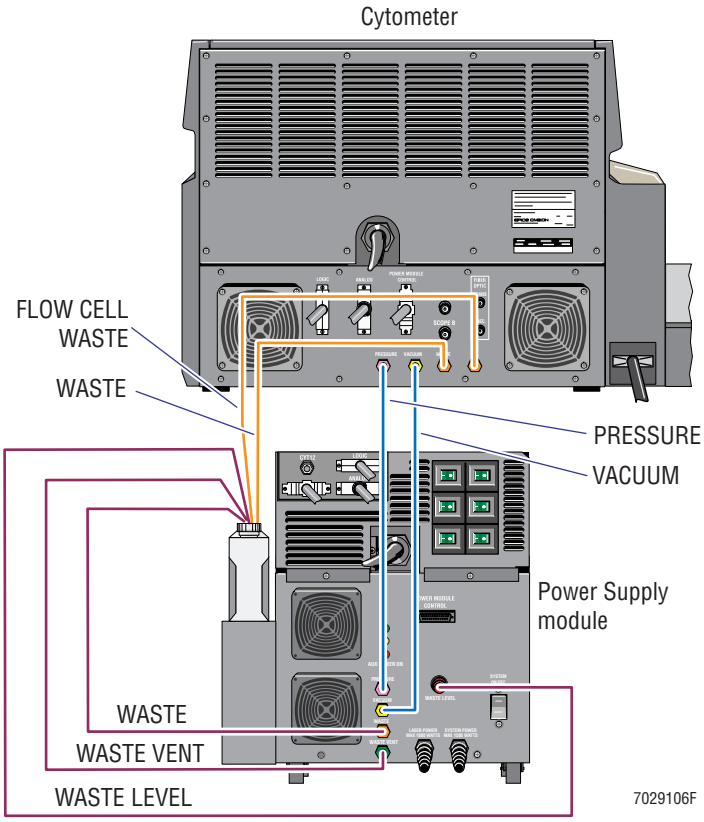
Figure 3.5-4 Bundle of Shielded Pneumatic/Hydraulic Tubings



- There are three groups of tubings:
  - The float liquid level sensor and cap are for the waste container.
  - The group with four quick-connects and sensor cable is for the Power Supply module.
  - The other group with only four quick-connects is for the Cytometer.
- Quick-connects are color-coded. Color of the male quick-connect on each tubing matches and the color of the female quick-connect on the instrument.
- Each tubing is identified by a tie-wrapped label.

2. Insert the float liquid level sensor into the waste container and screw on the cap. Refer to Figures 3.5-4 and 3.5-5 as needed.

Figure 3.5-5 Tubing Connections



3. Connect tubings to the rear of the Power Supply module. Refer to Figures 3.5-4 and 3.5-5 as needed.
   a. Connect the blue female quick-connect to the blue male quick-connect (labeled PRESSURE on the rear of the Power Supply).
   b. Connect the yellow female quick-connect to the yellow male quick-connect (labeled VACUUM on the rear of the Power Supply).
   c. Connect the orange female quick-connect to the orange male quick-connect (labeled WASTE on the rear of the Power Supply).
   d. Connect the green female quick-connect to the green male quick-connect (labeled WASTE VENT on the rear of the Power Supply).
4. Insert the waste level sense cable into the connector labeled WASTE LEVEL on the rear of the Power Supply module. Refer to Figures 3.5-4 and 3.5-5 as needed.
5. Connect tubings to the rear of the Cytometer. Refer to Figures 3.5-4 and 3.5-5 as needed.
   a. Connect the blue female quick-connect to the blue male quick-connect (labeled PRESSURE on the rear of the Cytometer).
   b. Connect the yellow female quick-connect to the yellow male quick-connect (labeled VACUUM on the rear of the Cytometer).

ATTENTION: Because there are two orange connectors in this tubing bundle, you must use the tubing labels to ensure proper connection.

c. Connect the orange female quick-connect on the tubing labeled WASTE to the orange male quick-connect labeled WASTE on the rear of the Cytometer.

d. Connect the orange female quick-connect on the tubing labeled FLCell Waste to the orange male quick-connect labeled FLOWCELL WASTE on the rear of the Cytometer.

3.6 SOFTWARE INSTALLATION

Tools/Supplies Needed

- ❑ COULTER EPICS XL / XL-MCL SYSTEM II software, Version 3.0, PN 6706441

SYSTEM II Software Installation

1. Ensure the Workstation and two Power Supply module ac power line cords are connected to appropriate wall outlets.
2. At the rear of the Power Supply module, press the SYSTEM ON/OFF rocker switch to ON, position **I**.
3. At the Workstation:
   a. Press the power ON/OFF switch until the computer turns on. The operating system automatically boots.
   b. Power on the monitor.
4. When the Microsoft Windows 98 Startup Menu appears, select **8. Previous version of MS-DOS**.
5. At the MS-DOS prompt (C:\>), type `XL_INST` then press Enter to configure the computer for an XL flow cytometer.
6. Reboot the computer system by simultaneously pressing the Ctrl, Alt, and Delete keys.
7. When the Microsoft Windows 98 Startup Menu appears, select **8. Previous version of MS-DOS** which should select SYSTEM II software as the operating system.
8. Verify the computer boots to the XL SYSTEM II software.
9. Approximately 10 seconds after the XL logo appears on the monitor, the following messages are displayed:
   a. *Resetting cytometer*
   b. *Loading Cyto. Hardware*

   Note: Once the software is loaded, it turns on the Cytometer. This process should take less than 30 seconds.
10. At the Cytometer, verify that the LASER ON indicator lights green.
11. At the monitor, verify the message *STARTUP IN PROCESS* appears (lower right display area).
12. At the Cytometer, verify the CYTOMETER READY indicator lights green.

    Note: The Cytometer can take up to 30 minutes to warm up before the READY indicator turns green.
13. Go to Heading 3.7 and complete the operational checks.

3.7 OPERATIONAL CHECKS

Tools/Supplies Needed

- ❑ One, empty, 12 x 75-mm test tube, PN 2523749
- ❑ Flow-Check fluorospheres, PN 6605359
- ❑ Oscilloscope
- ❑ Digital Voltmeter (DVM)

Preliminary Operational Checks

1. Verify all cooling fans are operating. Refer to Heading A.5 for component locations in the Cytometer and refer to Heading A.6 for component locations in the Power Supply module, as needed.

   Exterior Fan Locations

   - Two on the Cytometer (lower rear panel)
   - Two on the Power Supply module (lower left side)
   - One on the Workstation computer (back)

   Interior Fan Locations

   - Two in the laser blower assembly (mounted on the Cytometer frame, left side).
2. At the Power Supply module:
   a. Verify the system pressure gauge (SYS PRESS) reads 30 psi. Adjust the regulator if necessary.
   b. Verify the system vacuum gauge (SYS VAC) registers a minimum of 17 in. Hg.
3. At the Cytometer:
   a. Verify the CYTOMETER READY indicator lights green.

      Note: The Cytometer may take up to 30 minutes to warm up before the READY indicator turns green.
   b. Verify vacuum is present at the manual sample station head.

Purge Air Bubbles from the Sheath Filter

1. At the Cytometer control panel, press the PRIME button.
2. Verify the reagent drawer is closed.

3. Press and hold the purge (vent) button (Figure 3.7-1) until the bubbles in the vent tubing are gone (Figure 3.7-2).

Figure 3.7-1 Purge (Vent) Button Location

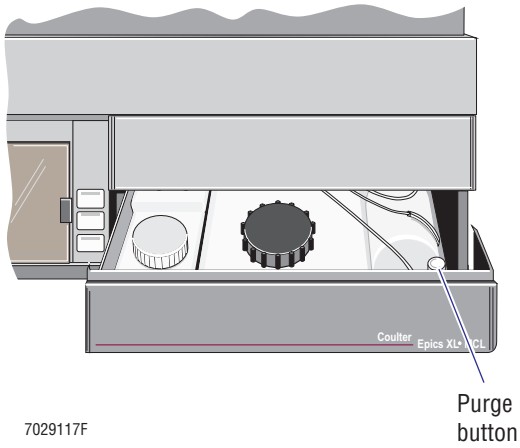
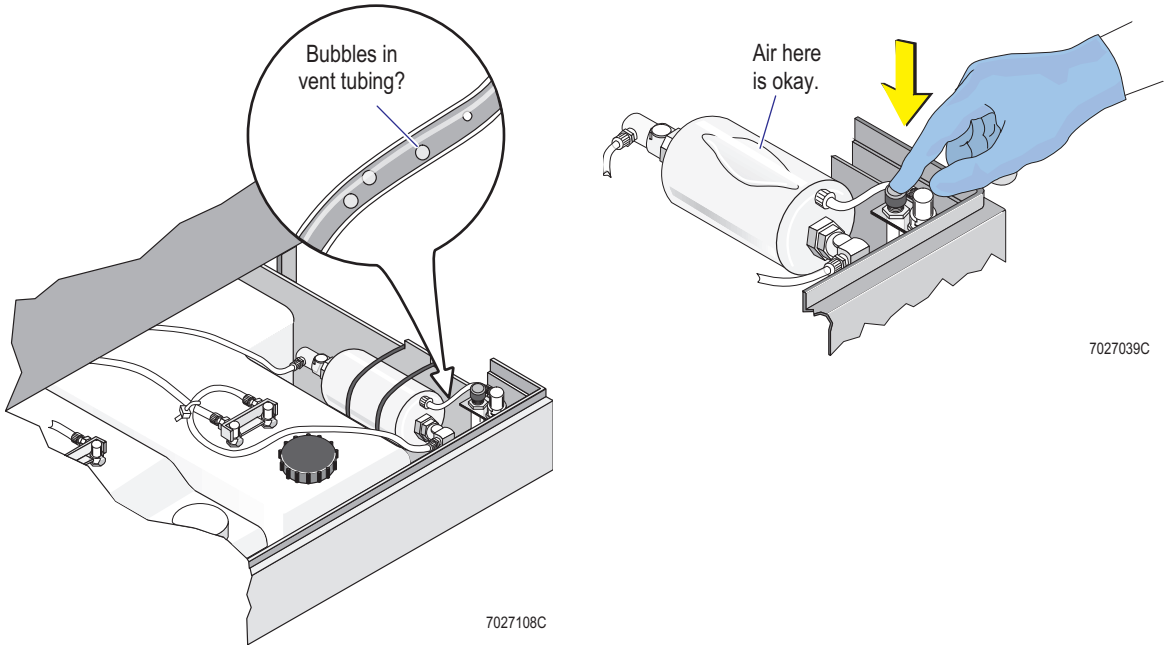


Figure 3.7-2 Purging Bubbles from the Sheath Filter



4. Press the PRIME button three more times.

Initial System Verification

Power Supply Verification

Go to Heading 4.20, POWER SUPPLY VOLTAGE VERIFICATION AND ADJUSTMENT to verify all power supply voltages (including MCL) and make needed adjustments.

Trans Data Acquisition Card Offset Verification

Go to Heading 4.14, TRANS DATA ACQUISITION CARD REPLACEMENT AND/OR CALIBRATION and complete the procedure as written. This procedure also verifies the offset of each Amp/Signal Conditioner card.

Functional Verification

1. Connect the BNC signal cables from the Scope A and B connectors on the oscilloscope to the connectors labeled SCOPE A and SCOPE B on the rear of the Cytometer.
2. Create a CHANNEL 500 protocol. For parameter and setting information, refer to Table A.3-1 as needed.
3. Fill a test tube with approximately 1 mL fluorospheres.
4. Insert the test tube into the sample station and press F9.
5. With the T-handle Allen wrench, adjust the Z-axis to the center of the flow-cell channel.
6. Set the scope according to Table 3.7-1.

Table 3.7-1 Oscilloscope Settings

Item on Scope	Setting
Channel 1	2 Volts per division
Channel 2	2 Volts per division
Time	2 microseconds per division
Trigger	Channel 1

7. At the Cytometer, wait until the indicator to turn green and the bar graphs are illuminated.
8. After approximately 10 seconds, check the events per second.
   a. At the monitor, set the Flow Rate to LOW.
   b. At the monitor, set the Flow Rate to MEDIUM. The events per second should be three times higher than it was at the LOW setting.
   c. At the monitor, set the Flow Rate to HIGH. The events per second should be six times higher than it was at the LOW setting.
9. Confirm signals are present to ensure tubing is not clogged or pinched. If such an obstruction is present, correct as needed.

10. Use instrument specific instructions to proceed:
    - If this is an XL cytometer **without** the MCL option, go to Heading 4.6, OPTICAL ALIGNMENT and complete the procedure as written to obtain the best CVs.
    - If this is an XL cytometer **with** the MCL option, go to step 11 to verify the MCL is functioning properly.
11. Verify MCL operation as follows:
    a. Fill two test tubes with approximately 1 mL fluorospheres.
    b. Insert the test tubes in the MCL carousel.
    c. At the Cytometer, press the AUTO button.
    d. Confirm signals are present to ensure tubing is not clogged or pinched. If such an obstruction is present, correct as needed.
12. Go to Heading 4.6, OPTICAL ALIGNMENT and complete the procedure as written to obtain the best CVs.

Reinstall Covers and Panels

ATTENTION: Carefully reinstall these covers while the power is turned on.

Lower the Data Acquisition Card Cage

1. Stand in front of the Cytometer and grasp the top of the Data Acquisition card cage.
2. With a secure hold on the card cage, unlock the card cage hinges with your other hand.
3. Gently lower the card cage into the center cavity of the Cytometer.

Upper Pneumatic Drawer

At the upper pneumatic drawer (upper right side of the Cytometer):

1. Position the EMC shield over the pneumatic components.
2. Reinstall the four Phillips-head screws that secure the front panel (EMC shield) to the front of the hinged drawer frame. Reinstall two screws at the top of the frame and two screws at the bottom.
3. Swing the drawer back inside the Cytometer.
4. Reinstall the two Phillips-head screws that secure the upper pneumatic drawer to the Cytometer frame.

Front Covers

1. Position the black filter shield back on the Cytometer and reinstall the four Phillips-head screws removed earlier.
2. Open the reagent drawer.
3. Reinstall the manual sample station cover assembly.
    a. Position the manual sample station cover assembly back in place.
    b. Loosely install the two pan-head, Phillips screws on the left.

    Note: If this is an XL cytometer **without** the MCL option, these are flat-head, Phillips screws.

c. Loosely install the two flat-head, Phillips screws on the right.

d. Tighten all four screws to secure the cover assembly to the Cytometer frame.

4. Close the reagent drawer.
5. Remove the tool bracing the upper cover open and gently lower the cover.
6. Reinstall the center front cover (covering the filters).

Right-Side Cover

1. Position the cover over the right side of the Cytometer.
2. Manually push the side-cover down and in place.

Left-Side Cover

1. Reinstall the left-side cover (using applicable instructions).
   - If this is an XL cytometer **without** the MCL option, position the left-side cover over the left side of the Cytometer frame and push the cover into place.
   - If this is an XL cytometer **with** the MCL option, go to step 2.
2. Reinstall the left-side cover before latching the MCL option back on the Cytometer frame.
   a. Position the side cover over the left side of the Cytometer.
   b. Manually push the side-cover down and in place.
   c. Push the button to unlock the cover. Ensure it is fully open.
   d. Remove the MCL carousel from the indexing base, if present.
   e. Position the MCL probe housing back on the Cytometer and reinstall the two Phillips-head screws to secure it to the Cytometer frame.
   f. Gently push the lower base back on the Cytometer until it latches into place.
   g. Lower the cover.
   h. Open then close the cover several times to ensure proper operation.
   i. Position the MCL carousel back on the indexing base.

Top Cover

Note: If the interlock is triggered, you must restart the system.

Carefully position the top cover back on the Cytometer. **Do not reinstall** the four Phillips-head screws (and washers) that secure the top cover to the Cytometer frame. The top cover must be removed later.

Power Supply Cover

Note: If the interlock is triggered, you must restart the system.

If you have not already done so, carefully position the three-sided cover back on the Power Supply module. **Do not reinstall** the four Phillips-head screws (and washers) that secure the cover to the Power Supply module frame. The three-sided cover must be removed later.

Clean Up

CAUTION Risk of damage to the instrument. The instrument will be damaged if it is operated without removing all 16 red shipping clips (14 in the lower pneumatic drawer and 2 in the upper pneumatic drawer) **and** the two plastic shipping insert from the segmenting valve. Two red tags are attached to the manual sample station door to remind you that these items must be removed before operating the instrument:

- NOTICE! REMOVE RED CLIPS FROM PNEUMATIC DRAWER BEFORE OPERATING UNIT
- NOTICE! REMOVE PAD SEPARATORS FROM SEGMENTING VALVE BEFORE OPERATING UNIT.

1. If you have not already done so, remove the two red tags attached to the manual sample station door. Place the tags in the box designated for storing shipping parts.
2. Carefully peel the protective films from the:
   - Power Supply front door,
   - Upper display on the front of the Cytometer,
   - Manual sample station door, and
   - Top of the MCL cover, if applicable.
3. Ask the customer to store the box containing the various shipping parts removed from the instrument.

Complete the System Verification Procedure (SVP)

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP). Under Heading Static Tests, begin at Heading Acquisition, CV Analysis and Carryover Check and complete the procedure as written.

PART B: UPGRADES AND OPTIONS INSTALLATION

3.8 MCL OPTION UPGRADE

Purpose

Use these procedures to install an MCL option. After completing these procedures, the XL-MCL flow cytometer's model code **must be changed** from 2714 to 2988.

Tools/Supplies Needed

- ❑ MCL Upgrade kit in black, PN 6912669
- ❑ MCL Upgrade kit in grey, PN 6915506
- ❑ Sample/MCL Intro Line kit, PN 6912941
- ❑ Flow-Check fluorospheres, PN 6605359
- ❑ Three, empty, 12 x 75-mL test tubes, PN 2523749
- ❑ Permanent marker
- ❑ Hard copy of Figure A.2-10, MCL CPU Card - Component Locations, optional

Preparation

1. Check the contents of the MCL Upgrade Kit against the packing list to ensure that all parts are present **before** continuing with this upgrade.
2. Power down the entire system. (This includes unplugging both ac power line cords from the wall outlet.)
   a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using SYSTEM II Software heading.
   b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using EXPO32 ADC Software heading.
3. Remove all covers required to access and remove the filter shield. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
4. Lift the Data Acquisition card cage and lock it in its vertical position. Refer to Heading 4.3 if you need detailed instructions.

Cytometer Upgrade

1. Install the new manual sample station assembly for the MCL option.
   a. Unplug the old manual sample station cover assembly. Set it aside for return and reuse.
   b. Connect the new manual sample station assembly and lay the assembly on top of the reagent containers. Make sure the flat ribbon cable is positioned so that it does not become damaged.
2. Remove the lower pneumatics drawer. Refer to Heading 4.3 if you need detailed instructions.
3. Install the MCL tubing harness to the bulk head connector of the lower pneumatic-assembly.

   Note: The MCL tubing-harness is keyed to go in only one way.

4. Carefully dress the new tubing harness to the existing tubing so that it does not get pinched when the lower pneumatics drawer is reinstalled.
5. Unpack the MCL main frame assembly and inspect it for damaged or missing parts.
6. Set S1 on the MCL CPU card as shown on Table 3.8-1. For the location of this switch, refer to Figure A.2-10 as needed.

Table 3.8-1 MCL CPU Card - S1 Settings

S1 Position	Setting
1	ON
2	ON
3	ON
4	OFF

7. Connect the tubing from the MCL harness as follows:
   a. The system pressure line to the large fitting on the MCL solenoid manifold.
   b. The orange-striped tubing to the left-side fitting on the MCL sample head.
   c. The purple-striped tubing to the right-side fitting on the MCL sample head.
8. Adjust the mounting clips on the back of the MCL main frame assembly to properly fit over the lower Cytometer frame and install the MCL option.
9. Install the MCL Interface card into the proper location in the Data Acquisition card cage. For the MCL Interface card location, refer to Figure A.5-3 as needed.
10. Install the MCL interface cable:
    a. Connect the MCL interface cable to the MCL INTERFACE connector on the left-side edge of the Analyzer backplane. For the location of this connector, refer to Figure A.2-2 as needed.
    b. Carefully route the MCL interface cable down the Data Acquisition card cage, around the laser-blower assembly, and connect it to the PARALLEL CONTROL PORT connector at the top of the MCL CPU card. For the location of this connector, refer to Figure A.2-10 as needed.
11. Under Heading 4.9, start at the Removal heading and follow the instructions for removing the old PEEK tubing (all sample lines), replacing the old tubing and installing the new MCL sample line.

Power Supply Module Upgrade

1. Remove the three-sided cover from the Power Supply module and set it aside. Refer to Heading 4.3 if you need detailed instructions.

WARNING Risk of personal injury. Be very careful when operating the instrument when the safety interlock switch in the Power Supply module is defeated, as you may be exposed to electric shock. After servicing the instrument, make sure three-sided cover is properly reinstalled to reactivate the safety interlock switch that was bypassed while servicing the instrument.

2. Defeat the Power Supply interlock by pulling up on the plunger.

3. Install the MCL power supply and secure it with four screws.
4. Connect the ac interconnect cable (internal in the Power Supply module) to the MCL power supply.
5. Remove the MCL loop plug from the rear of the Power Supply module and connect the MCL external power cable. Connect the other end of the cable to the connection on the rear of the MCL option.
6. Power up the entire system. (This includes plugging the two ac power line cords back into the wall outlet.)
   a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Up Using SYSTEM II Software heading.
   b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Up Using EXPO32 ADC Software heading.

Power Supply Voltage Verification and Adjustment

Go to Heading 4.20, POWER SUPPLY VOLTAGE VERIFICATION AND ADJUSTMENT to adjust the MCL power supply voltages as needed and verify all other power supply voltage readings match the voltage recorded on the sticker attached to the side of the Data Acquisition card cage.

MCL Alignment

Go to Heading 4.12, MCL OPTION FIELD ADJUSTMENT and complete the procedure as written.

Operational Verification

1. Press the PRIME button and observe the segmenting valve. Make sure the segmenting valve pads are rotating smoothly and there is no leakage at the segmenting valve, flow cell, or sample probe(s).
2. Add fluorospheres to three empty test tubes.
3. Insert the three test tubes in the first three positions in the carousel and start the run.
4. Ensure proper sample flow.

Reinstall Covers

1. With the exception of the left-side cover and Cytometer top cover, reinstall all covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

   Note: When installing the new manual sample station cover assembly, the two flat Phillips-head screws must be installed on the right so the reagent drawer can close properly.
2. Install the new left-side cover. Refer to Heading 4.3 if you need detailed instructions.
3. Install the new MCL probe housing cover using two Phillips-head screws. Refer to Heading 4.3 if you need detailed instructions.
4. Install the new MCL covers. Refer to Heading 4.3 if you need detailed instructions.
5. Open and close the MCL door several times. Listen for an audible snap as it closes. The MCL door must be closed with the interlock switch depressed for proper operation.

6. Reinstall the Cytometer top cover. Refer to Heading 4.3 if you need detailed instructions.

System Verification

1. Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).
2. With the permanent marker, write the XL-MCL flow cytometer's serial number in the blank box on the new serial name plate and install the name plate on the back of the Cytometer.

   Note: The model code changes from XL flow cytometer (2714) to XL-MCL flow cytometer (2988).
3. Return the following XL flow cytometer parts for reuse as spares:
   - Cytometer left-side cover, PN 6856727 (black) or PN 6807085 (grey)
   - Manual sample station cover assembly, PN 7000360 (black) or PN 7000679 (grey).

3.9 4-COLOR PMT UPGRADE

Purpose

Use this procedure to upgrade an instrument from three colors to four colors.

Tools/Supplies Needed

- ❑ 4-Color PMT Upgrade kit, PN 6912932
- ❑ Flow-Check fluorospheres, PN 6605359
- ❑ One, empty, 12 x 75-mL test tube, PN 2523749

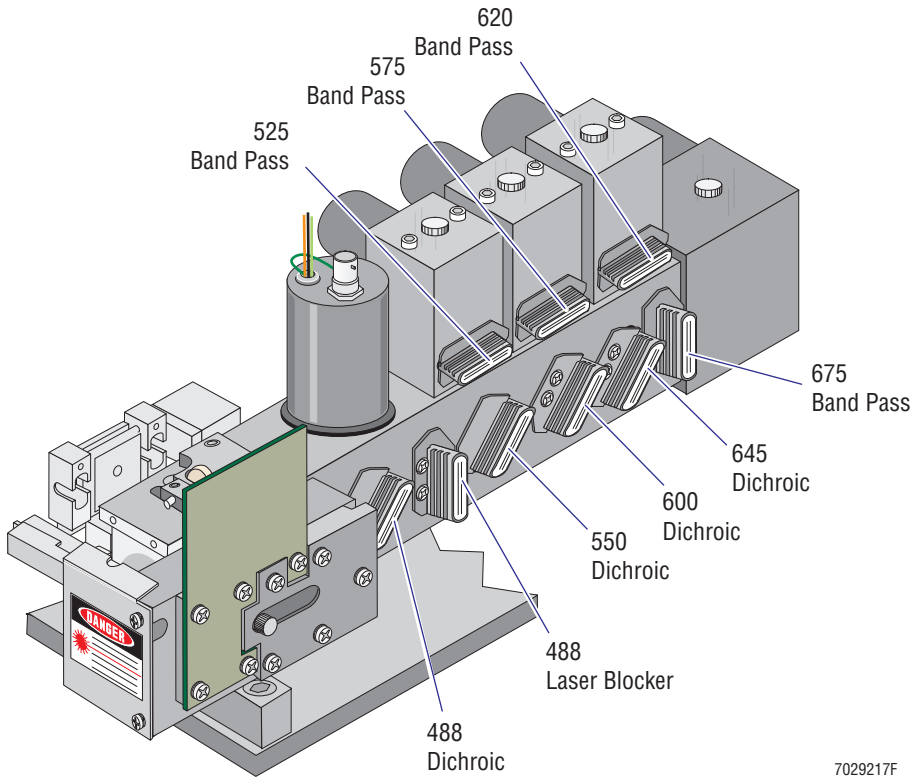
Preparation

1. Check the contents of the 4-Color PMT Upgrade kit against the packing list to ensure that all of the parts are present.
2. Power down the entire system. (This includes unplugging both ac power line cords from the wall outlet.)
   a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using SYSTEM II Software heading.
   b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using EXPO32 ADC Software heading.
3. Remove all covers required to access and remove the filter shield. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
4. Lift the Data Acquisition card cage and lock it in its vertical position. Refer to Heading 4.3 if you need detailed instructions.

Hardware Installation

ATTENTION: When this procedure is complete, the FL3 PMT currently in the instrument becomes PMT 4 and the new PMT becomes the PMT 3. The filters are then moved to obtain the filter configuration shown in Figure 3.9-1.

Figure 3.9-1 PMT Filter Locations



1. Remove the blank cover from the optical-housing block between PMT 2 and PMT 3.
2. Remove the tape that is covering the PMT 3 filter slot.
3. Install the new PMT holder between PMT 2 and PMT 3 and secure it with screws.
4. Place the new PMT into the PMT holder installed in the previous step and tighten the thumbscrew.
5. At the Data Acquisition card cage:
   a. Install the new Bertran high voltage (HV) supply into the HV PMT 4 slot. For HV PMT 4 slot location, refer to Figure A.5-3 as needed.
   b. Insert the new Amp/Signal Conditioner card into the PMT 4 card slot. For PMT 4 card slot location, refer to Figure A.5-3 as needed.
6. Remove the HV and signal cables from the old PMT 3 and install them on the new PMT.
7. Route the PMT 4 Bertran HV cable so that it connects to the old PMT 3 (now PMT 4).

   Note: A right-angle HV connector is supplied with the kit in case it is needed.
8. Connect one end of the signal cable to the Amp/Signal Conditioner card for PMT 4 and connect the other end to PMT 4.
9. Connect the ±15 Vdc connector for PMT 3 to the spare connector located on the PMT Distribution and Laser Fan Control card.
10. Assemble the new filter assemblies.

    Note: The filter holders **must be assembled**; use the ball plunger and setscrew.
11. Place the correct filter identification labels on the filters.

12. Insert the filters into their correct position (Figure 3.9-1).
13. Install the filter lock-down clips and secure the filter assembly to the optical-housing assembly using screws.
14. Attach the new four-color front cover to the optical-housing assembly using screws.
15. Power up the entire system. (This includes plugging the two ac power line cords back into the wall outlet.)
    a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Up Using SYSTEM II Software heading.
    b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Up Using EXPO32 ADC Software heading.

Amp/Signal Conditioner Card Calibration

Go to Heading 4.14 locate the If Calibrating Without Replacing the Trans Data Acquisition Card heading. Complete the procedure as written. After verifying calibration of the Trans Data Acquisition card, the procedure will direct you to the instructions for calibrating the new Amp/Signal Conditioner card under Heading 4.15.

PMT Operational Alignment

1. Reboot the Cytometer.
2. Dispense approximately 1-mL of the fluorospheres into a test tube.
3. Select the CHANNEL 500 protocol. If necessary, create a CHANNEL 500 protocol using the parameter and setting information in Table A.3-1.
4. Adjust FL PMT 3 for maximum pulse amplitude.
5. Adjust FL PMT 4 for maximum pulse amplitude.

Reinstall Covers

1. Position the new four-color filter shield over the sensing area and secure it to the Cytometer frame using four Phillips-head screws.
2. Reinstall all covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

System Verification

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

3.10 FlowCentre™ II MULTIMEDIA WORKSTATION UPGRADE

Purpose

The purpose of this section is to provide you with procedures to install the FlowCentre II Multimedia Workstation. After completing the hardware installation, you **must** install the SYSTEM II software and any optional software before verifying operation.

Tools/Supplies Needed

- ❑ FlowCentre II Multimedia Workstation, PN 2016874

  Note: PS/2 scroll point mouse pointing device, PN 2016876, and a Windows 98 compatible keyboard, PN 2016881, are included with this tower computer.
- ❑ Beckman Coulter Service Tool Kit, PN 5415102

Preparation

1. Unpack the FlowCentre II tower computer, keyboard, and mouse.
2. Inspect for any physical damage caused in shipping.
   a. Report any damage on the Lotus Notes database, WW: Cytometry Install.
   b. Correct as needed.
3. Power off the Cytometer and FlowCentre desktop computer. Refer to Stage 2: Power Off the Workstation (system using SYSTEM II software) under Heading 4.1, as needed.

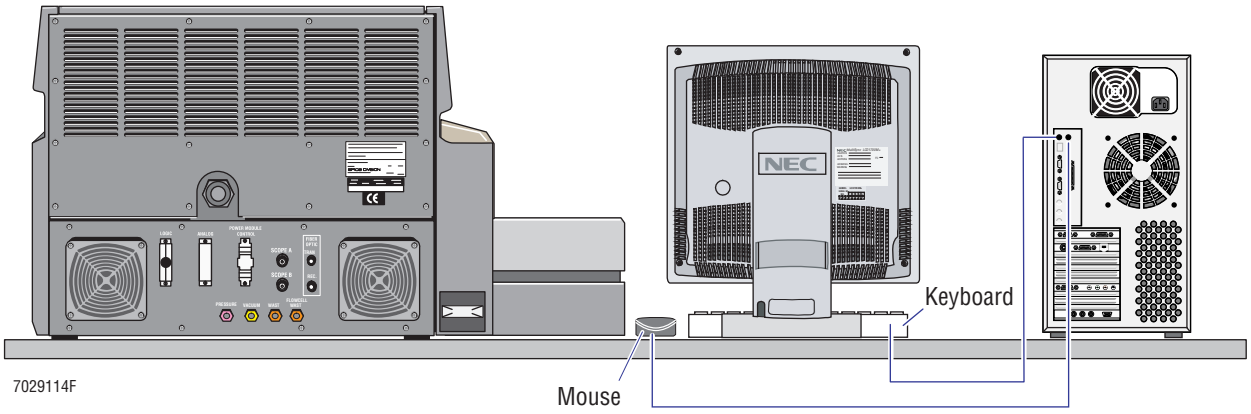
Opto Transprocessor EXMEM or EXMEM II Card Retrieval and Installation

1. Remove the cover from the customer's current desktop computer and remove the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card.
2. Remove the cover from the new FlowCentre II tower computer.
3. Insert the Opto Transprocessor EXMEM card removed from the desktop computer into the available ISA slot in the new tower computer.
4. Place the cover on the new FlowCentre II tower computer.

Mouse Connection

Connect the mouse cable to the mouse port on the rear of the tower computer (Figure 3.10-1).

Figure 3.10-1 Electronic Cable Connections - Mouse and Keyboard



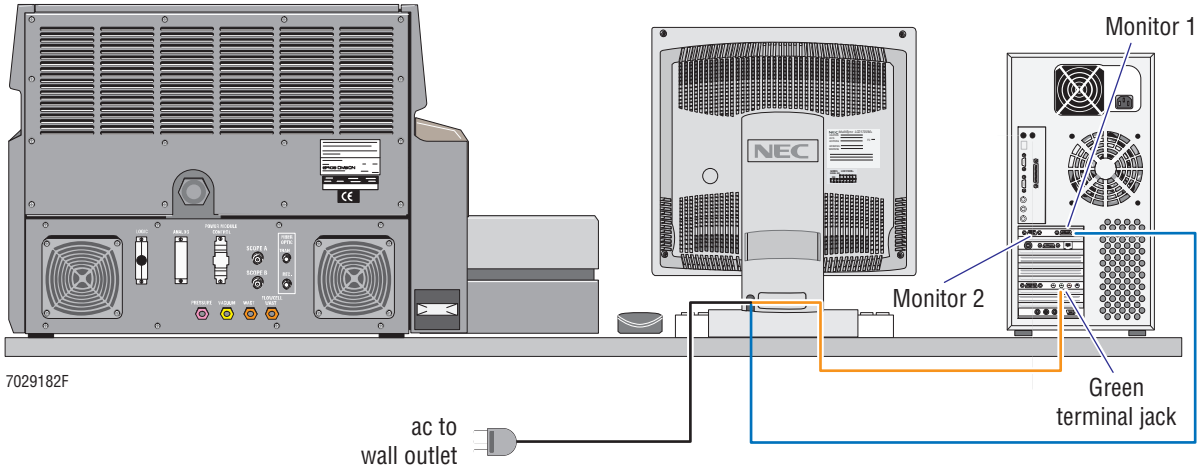
Keyboard Connection

Connect the keyboard cable to the keyboard port on the rear of the computer tower (Figure 3.10-1).

Monitor Connection (New or Existing)

1. Inspect the cables and the power cord to ensure the pins are straight and seated properly.
2. Locate the cable with the terminal post (may be color-coded green).
3. Insert the terminal post in the sound jack (green jack) on the rear of the tower computer (Figure 3.10-2).
4. Attach the monitor plug to the right jack on the Dual Monitor Video card (Figure 3.10-2).

Figure 3.10-2 Connecting Monitor Cables



5. If there is a second monitor, repeat steps 1 through 4 but this time attach the monitor plug to the left jack on the Dual Monitor Video card (Figure 3.10-2).
6. Connect the ac power cord to an appropriate ac wall outlet (Figure 3.10-2).

Cable Connections

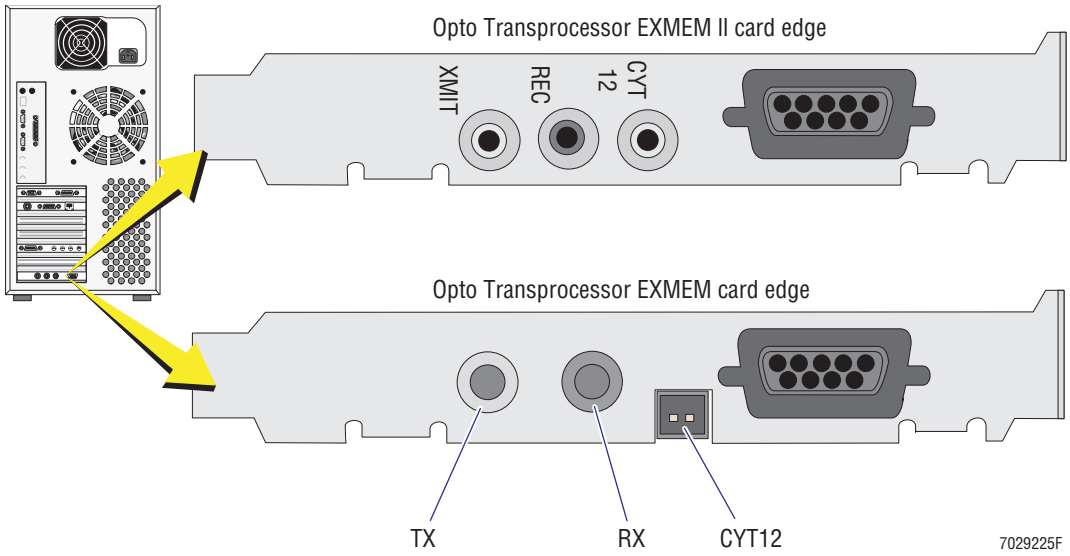
Fiber Optic Interface Cables

ATTENTION: The orange fiber optic interface cable is actually two cables joined together so it has two terminal posts (with a locking nut) at each end. One terminal post is labeled RX and the other terminal post is labeled TX. The terminal posts on one end of the cable are already inserted into jacks on the Cytometer and the terminal posts (labeled RX and TX) on the other end of the cable will be inserted into the jacks on the Opto Transprocessor EXMEM or EXMEM II card in the tower computer. Proper connection of this cable is important for operation.

- A transmit terminal post (TX) must be inserted into a transmit port; a receive terminal post (RX) must be inserted into a receive port so one end of each cable is labeled TX and the other end is labeled RX.
- Information being transmitted by the Cytometer via the FIBER OPTICS TRANS port (light grey jack with a TX terminal post attached) must enter the receive port of the computer (either a dark grey jack or jack labeled REC with the RX terminal post attached) and the information being transmitted from the computer (either a light grey jack or jack labeled XMIT with the TX terminal post attached) must enter the Cytometer via the FIBER OPTIC REC port (dark grey jack with the RX terminal post attached). If these connections are not correct, signals are not transmitted and received as required for proper operation.
- If the RX and/or TX labels are missing, you can distinguish the one cable from the other by the presence or absence of score marks on the outside covering.

1. At the rear of the Cytometer, locate the orange fiber optic interface cable attached to the FIBER OPTIC REC (dark grey jack) and FIBER OPTICS TRANS (light grey jack).
2. At the rear of the tower computer, locate the edge of the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card in the bottom slot.
   - The card edge of the Opto Transprocessor EXMEM II card is labeled. Go to step 3.
   - The card edge of the Opto Transprocessor EXMEM card is not labeled but the jacks are color coded. The jack for transmitting signals is light grey and the jack for receiving signals is dark grey. Use Figure 3.10-3 as a reference. Go to step 4.
3. Connect the Opto Transprocessor EXMEM II card:
   a. Insert the terminal post labeled TX into the outer left jack labeled XMIT (Figure 3.10-3) and tighten the locking nut.

Figure 3.10-3 Opto Transprocessor EXMEM and EXMEM II Card Edge Locations



b. Insert the terminal post labeled RX into the inner (middle) jack labeled REC (Figure 3.10-3) and tighten the locking nut.

4. Connect the Opto Transprocessor EXMEM card:
   a. Connect the terminal labeled TX to the light grey jack (Figure 3.10-3) and tighten the locking nut. This is the outer left jack.
   b. Connect the terminal labeled RX to the dark grey jack (Figure 3.10-3) and tighten the locking nut. This the inner (middle) jack.

CYT12 Cable

1. At the rear of the Power Supply, locate the CYT12 jack in the upper left corner.
2. At the rear of the tower computer:
   - If this is an Opto Transprocessor EXMEM II card, insert the terminal post labeled RX into the right jack labeled CYT 12 (Figure 3.10-3) and tighten the locking nut.
   - If this is an Opto Transprocessor EXMEM card, insert the small black connector (P109) into the CYT12 socket. See Figure 3.10-3.

Power Cord

1. Connect the female end of the ac power cord to the rear of the tower computer.
2. Connect the plug to an appropriate ac wall outlet.

SYSTEM II Software Installation

1. Power on the Workstation computer and monitor.
2. When the Microsoft Windows 98 Startup Menu appears, select **8. Previous version of MS-DOS**.
3. At the MS-DOS prompt (C:\>), type `XL_INST` then press Enter to configure the computer for an XL flow cytometer.

4. Reboot the computer system by simultaneously pressing the Ctrl, Alt, and Delete keys.
5. When the Microsoft Windows 98 Startup Menu appears, select **8. Previous version of MS-DOS** which should select SYSTEM II software as the operating system.
6. Verify the computer boots to the XL SYSTEM II software.
7. Approximately 10 seconds after the XL logo appears on the monitor, the following messages are displayed:
   a. *Resetting cytometer*
   b. *Loading Cyto. Hardware*

   Note: Once the software is loaded, it turns on the Cytometer. This process should take less than 30 seconds.
8. At the Cytometer, verify that the LASER indicator reads ON.
9. At the monitor, verify the message *STARTUP IN PROCESS* appears (lower right display area).
10. At the Cytometer, verify the READY indicator turns green.

    Note: The Cytometer can take up to 30 minutes to warm up before the READY indicator turns green.

EXPO32™ Software Option Installation

If the customer has purchased one or more EXPO32 software options, go to Heading 3.19, EXPO32™ SOFTWARE OPTIONS and complete the instructions as written.

System Verification

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

3.11 BAR-CODE PRINTER OPTION

Purpose

The purpose of this procedure is to guide you in successfully installing and connecting the bar-code Printer to the CPU. If you encounter any problems, please refer to the OEM-supplied manual for additional help.

This options allows the XL-MCL flow cytometer to print CODE 128 Bar-code labels through the System II software. Beckman Coulter has chosen Zebra Technologies Corporation STRIPE® S-500 Bar Code Printer for the XL-MCL flow cytometer. The bar-code Printer is connected to the CPU by a l-null modem cable. Bar-code data is serially transmitted at 9600 baud.

Tools/Supplies Needed

- ❑ Bar-code Printer kit, PN 6913342
- ❑ Bar-code label media replacement kit for STRIPE bar-code Printer, PN 6914992
- ❑ Scissors
- ❑ Cotton swabs
- ❑ Alcohol

Printer Setup

Note: For additional information not found in this procedure, refer to the STRIPE® Zebra Operators Guide located under the media cover in a plastic sleeve.

1. Inspect the Bar-code Printer kit for damage and verify that all parts are included **before** attempting installation.
2. Unpack and remove all shipping hold downs from the bar-code Printer. Refer to the installation notes sent with the Printer for location and removal.
3. Locate the DIP switches on the back, right side of the Printer (Figure 3.11-1).
4. Connect the serial interface cable (25-pin, D-pin connector) to the connector below the DIP switches (Figure 3.11-1).
5. Set the eight DIP switches as shown in Figure 3.11-1 and Table 3.11-1.
6. Carefully lift the side cover of the bar-code Printer and gain access to the label and ribbon area.
7. Locate the label roll (media supply) and insert the roll on the media supply hanger with the label media facing up (Figure 3.11-2).

Figure 3.11-1 Bar-Code Printer - DIP Switches

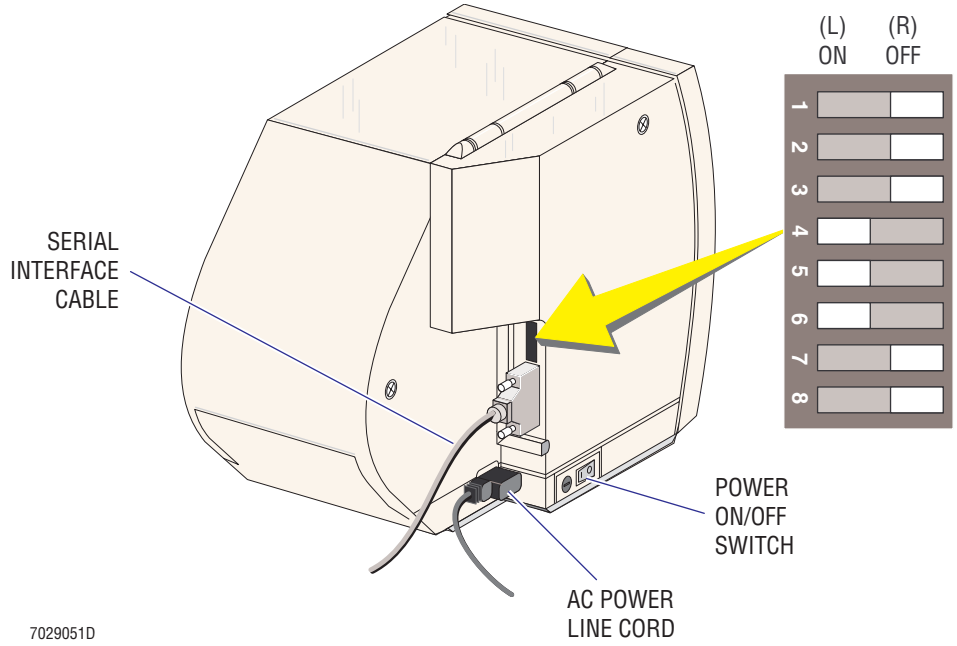
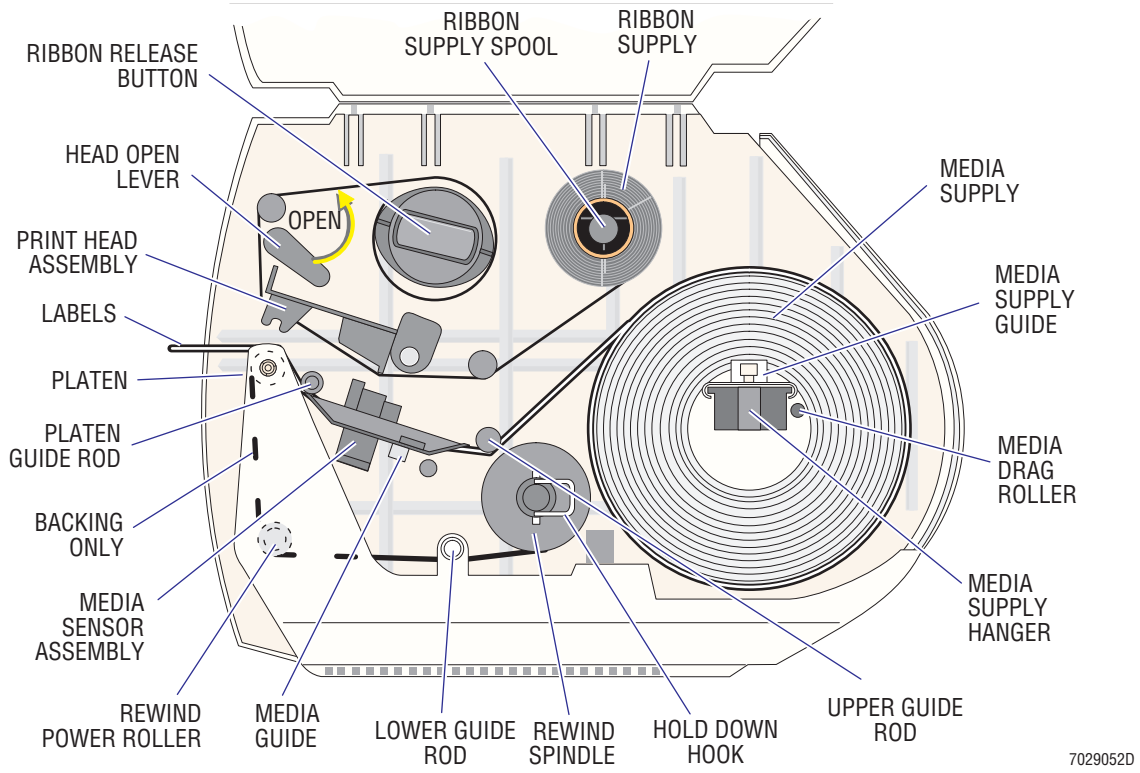


Table 3.11-1 Bar-Code Printer DIP Switch Settings

Switch	Setting	Position	Function
1	OFF	Right	Not used
2	OFF	Right	Sets BAUD rate to 9600
3	OFF	Right	Not used
4	ON	Left	Sets Data Bit length to 8
5	ON	Left	Sets Parity to Disabled
6	ON	Left	Not used
7	OFF	Right	Sets X ON/OFF Flow Control
8	OFF	Right	Sets no error detection

8. Ensure the label roll (media supply) is pushed all the way in and adjust the media supply guide to hold the label roll (media supply) in place (Figure 3.11-2).
9. To mark where the separation (space) between labels is located, adjust the media sensor (Figure 3.11-2) by sliding the sensor to the center of the label.
10. Locate the printer ribbon and install it on the ribbon supply spool (Figure 3.11-2).
11. Connect the ac power line cord to the bar-code Printer and push the power on/off switch to the on (**I**) position.
12. The Printer goes through an internal self check and when the self check is complete, a few bar-code labels are spooled out of the bar-code Printer. When the Printer is ready the POWER and PAUSE LEDs light and the PRINTHEAD LED flashes.

Figure 3.11-2 Bar-Code Printer - Media Threading and Adjustment Components



Media Calibration

Calibrate the media after completing the Printer Setup procedure and anytime a different label roll (media supply) or ribbon is installed.

1. Push the head open lever to the Open position (Figure 3.11-2).
2. Push the Printer's power on/off switch to the on (**I**) position (Figure 3.11-1). The Printer goes through an internal self check and when the self check is complete, a few bar-code labels are spooled out of the bar-code Printer. When the Printer is ready the POWER and PAUSE LEDs light and the PRINTHEAD LED flashes.
3. Push the head open lever to the Closed position (Figure 3.11-2).
4. Press the MODE button three times.
5. Ensure that the CALIBRATE LED lights.
6. Press the FEED button. The calibration process begins.

   Note: Approximately 16 blank labels feed out of the Printer. The Printer is aligning the spaces between the labels to ensure correct printing position.
7. When the calibration process is completed, all three MODE LEDs flash to indicate the new configuration settings.
8. Press the PAUSE button to place the Printer in normal operating mode.
9. Push the Printer's power on/off switch to the off (**O**) position (Figure 3.11-1).

XL-MCL Flow Cytometer Connection

1. Connect the null modem cable to the COM3 port on the back of the CPU.
2. If the Serial/Parallel Adapter Interface card **is not installed**, install it now as directed under Heading 3.13, SERIAL/PARALLEL ADAPTER INTERFACE CARD OPTION.
3. Connect the other end of the null modem cable to the bar-code Printer's serial port.
4. Push the Printer's power on/off switch to the on (**I**) position (Figure 3.11-1). The Printer goes through an internal self check and when the self check is complete, a few bar-code labels are spooled out of the bar-code Printer. When the Printer is ready the POWER and PAUSE LEDs light and the PRINTHEAD LED flashes.

Printer Testing (through SYSTEM II Software)

1. Exit to MS-DOS.
2. Edit the XL_GRAPH.CNG file to include the following statement:

   `C=3,H,128`

   where C is the bar-code Printer, 3 is the communications port, H is for horizontal printing and 128 is the code type.
3. Reboot the Computer Workstation.
4. At the Cytometer, on the Acquisition Run screen, select **SETUP SCREEN**.
5. Select **WORKLIST**.
6. Select **TUBE ID**, enter any eight digits in the ID information box and press Enter.
7. From the bottom of the screen, select **PRINT BAR CODE** ensuring that it turns green.
8. Select **TUBE ID** and ensure that a label is printed and fed out of the Printer.

   Note: If the label is correctly centered and the tear-off position and print quality are correct, this ends the procedure. If not, proceed to the next heading, Label Tear-Off Position Adjustment.

Label Tear-Off Position Adjustment

The label tear-off position adjustment procedure has to be performed only at installation as long as the customer uses bar-code labels and ribbons purchased from Beckman Coulter. If the customer purchases bar-code labels and ribbons from someone other than Beckman Coulter, the following procedure **must be performed**.

1. Press the MODE button twice and ensure that the POSITION LED lights.

   Note: The PAUSE LED lights and remains lit.
2. Taking note of the position of the label, use the FEED button to move the label away from the Printer or the CANCEL button to move the label in towards the Printer.
3. When the desired label tear-off position is reached, press the MODE button twice. The MODE LEDs turn off then all three MODE LEDs light to indicate that the new position settings are saved.

   Note: Adjustment settings are automatically saved in the Printer when the power is turned off (**O**).
4. Press the FEED button and ensure that the label stops at the correct tear-off position. If positioning is not correct, repeat steps1 through 3 under this heading.

Printer Thermal Head Adjustment

Adjusting the Printer's thermal head is an internal control. There is no observable action when adjusting. While this procedure generates bar-code labels, you adjust the lightness/darkness of the print quality pressing the PAUSE button to halt printing and then making an adjustment and repeating this sequence until the desired print quality is reached.

1. From the title bar, select **SPECIMEN ID**, enter any 16 digits in the ID information box and press Enter.
2. Select **PATIENT NAME**, enter `JOHN DOE`, and press Enter.
3. From the bottom of the screen, select **ASSIGN BAR CODE** ensuring that it turns green.
4. Select **TUBE ID** and ensure that characters are entered into the Tube ID field.
5. From the bottom of the screen, select **PRINT BAR CODE** ensuring that it turns green.
6. Print a bar-code label by selecting **TUBE ID**.
7. Press the MODE button once ensuring that the DARKEN LED lights.
8. Press the FEED button to increase the print darkness or the CANCEL button to decrease the print darkness.
9. Press the PAUSE button to pause the printing.
10. Check the print quality. If necessary, repeat steps 5 through 9 until the desired print quality is reached.

Top-of-Label Position Adjustment

Adjusting the position of the top-of-label is an internal control. There is no observable action when adjusting and label printing is the only way to verify adjustment.

1. Press the MODE button twice and ensure that the POSITION LED lights.

   Note: The PAUSE LED lights and remains lit.
2. Press and hold the MODE button for several seconds until the POSITION LED turns off and both the DARKEN and CALIBRATE LEDs light.
3. Press the FEED button to move the label format away from the top edge of the label or press the CANCEL button to move the label format closer to the top edge of the label.
4. Print a label and verify the adjustment.
5. Repeat steps 3 and 4 until the desired positioning is reached.
6. Press the MODE button twice to save the new settings.

   Note: Adjustment settings are automatically saved in the Printer when the power is turned off (**O**).

Ribbon Replacement

Beckman Coulter recommends that the customer order the same type of label roll (media supply) previously used. The bar-code label media replacement kit contains labels and enough ribbon to print the labels.

1. With scissors, cut the used ribbon and remove the empty ribbon tube from the ribbon supply holder (Figure 3.11-2).

2. Push in the ribbon release button (Figure 3.11-2) allowing the bars on the used ribbon holder to be unlocked.
3. Remove the used ribbon from the ribbon supply spool (Figure 3.11-2) and discard the used ribbon.
4. With a cotton swab and alcohol, clean the printer head (Figure 3.11-2).

   Note: The Printer head should be cleaned each time a new ribbon is installed.

3.12 BAR-CODE HAND-HELD SCANNER OPTION

Purpose

The purpose of this procedure is to guide you in successfully installing and connecting the bar-code hand-held scanner. The hand-held scanner allows XL-MCL flow cytometers to bar-code scan patient samples. The hand-held scanner is pre-programmed to Beckman Coulter's specifications by the OEM.

The default configuration is shown in Table 3.12-1 and the programmable symbologies are provided in Table F.3-3. If you encounter any problems, please refer to the OEM-supplied manual for additional help.

Table 3.12-1 Default Configuration - Bar-Code Hand-Held Scanner

	Bar-Code Symbology				
Item	**CODE 39®**	**CODABAR**	**INTERLEAVED 2 OF 5**	**CODE 93**	**CODE 128**
Code type	Enabled	Enabled	Enabled		Enabled
Fixed length	Disabled	Disabled	N/A	N/A	Disabled
Code length #1	7	10	14	12	16
Code length #2	N/A	N/A	0	N/A	N/A
Check digit	Enabled	Enabled	Enabled	N/A	N/A
C/D output	Disabled	Disabled	Disabled	N/A	N/A
C/D aim	N/A	Enabled	N/A	N/A	N/A
Intercharacter gap	Disabled	Disabled	N/A	N/A	N/A
S/S match	N/A	Disabled	N/A	N/A	N/A
S/S output	N/A	Disabled	N/A	N/A	N/A
EAN	N/A	N/A	N/A	N/A	N/A
Narrow margins	Enabled	Enabled	Enabled	Enabled	Enabled

Tools/Supplies Needed

- ❑ Bar-code scanner kit, PN 6913337
- ❑ Flow-Check fluorospheres, PN 6605359
- ❑ One, empty, 12 x 75-mL test tube, PN 2523749

Installation

1. Inspect the Bar-code scanner kit for damage and verify that all parts are included before attempting installation.
2. Turn off the power to the Cytometer.
3. Remove the keyboard connector from the back of the Computer Workstation.
4. Connect the keyboard connector to the keyboard port on the hand-held scanner cable.
5. Connect the hand-held scanner connector to the keyboard connector on the back of the Computer Workstation.

Verification

1. Turn on the power to the Cytometer.
2. After the Computer Workstation boots up into the SYSTEM II software, point the hand-held scanner at a specific area of the XL-MCL flow cytometer and pull the trigger. Ensure that a laser beam image is displayed at the same area of the XL-MCL flow cytometer.
3. Place a bar-code label on a test tube and insert some fluorospheres into the test tube.
4. Run the fluorospheres and after ten seconds select **Stop**.
5. When the XL-MCL flow cytometer prompts you to *Enter Sample ID*, aim the hand-held scanner at the bar-code label and pull the trigger. Ensure that the label is read.

3.13 SERIAL/PARALLEL ADAPTER INTERFACE CARD OPTION

Purpose

The purpose of this procedure is to successfully guide you in installing the Serial/Parallel Adapter Interface card.

Tools/Supplies Needed

- ❑ Serial/Parallel Adapter Interface card, PN 2016678

Removal

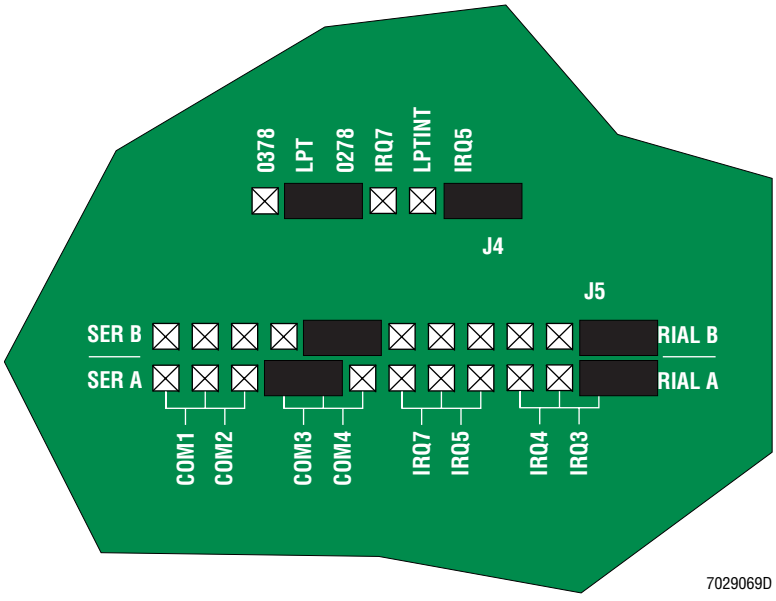
Note: Because of OEM-vendor changes, differences in Computer Workstations and customer-purchased peripheral upgrades, additional installation information may be required. This information can be obtained from the OEM-supplied manuals. Also, please refer to the OEM-supplied instruction manuals if you encounter difficulties.

1. Turn off the Computer Workstation and unplug the ac power line cords from the wall outlets.
2. Remove the CPU cover.
3. Remove the two, card-connector cover plates from the back of the CPU.

Installation

1. On the Serial/Parallel Adapter Interface card, ensure that the jumpers are set according to Figure 3.13-1. These settings are the default jumper settings from the OEM manufacturer.

Figure 3.13-1 Serial/Parallel Adapter Interface Card - Default Jumper Settings



2. Insert and secure the Serial/Parallel Adapter Interface card and additional serial port into the CPU.
3. Replace the two, card-connector cover plates and the CPU cover.

4. Plug the ac power line cords into appropriate wall outlets and turn the Computer Workstation on.
5. Check to see if any system card conflict messages display on the monitor:
   - If no system card conflict messages display on the monitor go to the next step (6).
   - If system card conflict messages display on the monitor:
     - Repeat steps 1 through 5.
     - Refer to the OEM manual.
     - Check the CMOS settings and ensure that they match Table 3.13-1.

Table 3.13-1 CMOS Settings

Item	Setting
LPT1	378
LPT2	278
COM1	3F8
COM2	2F8
COM3	3E8
COM4	2E8

6. At the MS-DOS prompt, type `MSD` and press Enter.

Verification

Verify that the COM port status shows 4 COM ports and that there are 2 LPT ports.

3.14 NETWORK SETUP USING MICROSOFT WINDOWS 95 OR 98

ATTENTION: This procedure is used to connect two or more computers together in Windows 95 or 98 and is designed for customers who are using **only** EXPO 32 software and **do not** intend to use the MS-DOS 6.22 and/or MS-DOS mode with their Workstations.

Purpose

The purpose of this procedure is to provide you with the information that will allow you to successfully install and communicate over a Windows 95 or 98 Network Neighborhood using the FlowCentre I or FlowCentre II.

Tools/Supplies Needed

- ❑ Network Interconnect Cable kit, PN 6912485
- ❑ Two BNC male terminators, PN 2906841
- ❑ Two coaxial BNC T-connectors (jack-plug-jack), PN 2121537

Note: These supplies connect only two computers. If more than two computers are to be in this network, you must order an additional cable kit (PN 6912485) and coaxial BNC T-connector (PN 2121537) for each additional computer. For example, if four computers are to be in this network, you need to order three cable kits (PN 6912485) and two BNC male terminators (PN 2906841), and four coaxial BNC T-connectors (PN 2121537).

Software Installation

Configure each adapter to use the 10-BASE-2 connector. The configuration program (3c90xcfg.exe) is located in the C:\ETHERNET subdirectory. To access the program:

1. Boot to MSDOS 6.22 or MSDOS, whichever is applicable.
   a. Press Ctrl+Alt+Delete simultaneously.
   b. When the highlighted **8. Previous version of MS-DOS** menu item appears, press Enter.
   c. When the Main screen appears, press F2.
   d. Press the Y key when the *EXIT TO DOS? y/n* message appears.
2. At the C:\XL prompt, type `cd C:\ethernet` to access the ethernet subdirectory.
3. Type `3c90xcfg` then press Enter. The **Install Configure NIC** option automatically appears.
4. Press F4 or Enter to display the NIC Configuration box.
5. Press Tab as many times as necessary to access the NIC Configuration box.
6. Press ↓ as many times as necessary to highlight the **Media Type** option then press Enter.
7. Press ↓ as many times as necessary to highlight **On-board Coax (BNC)** then press Enter.
8. Select **OK** to return to the NIC Configuration box.
9. Select **OK ▸▸ Quit ▸▸ Exit** to exit the program and save the changes.
10. Boot to Windows 95 or 98, whichever is applicable.
    a. Press Ctrl+Alt+Delete simultaneously.
    b. When the menu appears, select **1. Normal** then press Enter and wait for the Windows Desktop to appear.
11. Select **Start ▸▸ Settings ▸▸ Control Panel ▸▸ Network** icon.

12. Verify the **TCP/IP Protocol** is present.
    - If present, go to step 14.
    - If not present, go to step 13 to add the protocol.
13. At the **Configuration** tab, select the **Add** button ▸▸ **Protocol** ▸▸ **Add** button ▸▸ **Microsoft** ▸▸ **TCP/IP** ▸▸ **OK**.
14. Highlight **TCP/IP Protocol** then select the **Properties** button.

ATTENTION: Each computer on the network must have a unique IP Address. The nomenclature of the address always starts with 192.168. The first Workstation will be 0.01; the second Workstation is 0.02 and so on. Therefore, a third Workstation on the network would be 192.168.0.03

15. On the **IP Address** tab, select **Specify an IP address**.

    Note: Periods are displayed by the software. The Spacebar must be used to move from the field that contains the single digit to the last field. For example, to enter the IP Address, type `1921680`Spacebar`01`

    The address for the first computer is:

    IP Address: **192.168.0.01**

    Subnet Mask: **255.255.0.0**
16. When the entries are completed, select **OK** to exit the IP Address box.
17. Select **OK** again. The message *Restart your computer before the new settings will take effect. Do you want to restart your computer now?* appears.
18. Select **Yes**.
19. Repeat steps 1 through 18 for each computer designated to be on the network.

Cable Connections

1. Install a T-connector on the Network Interface card on the rear of each computer.
2. Connect the 50 ft network interconnect cable to each T-connector.

   Note: If more than two Workstations are in the network, connect each Workstation in series, from one T-connector to another until all Workstations are connected.
3. Place a terminator on the T-connector on the first and last Workstation on the Bus.

Set Up Hard Drives and Printers

The next step is to decide which computers will share their printers and hard drives. A Server always shares its hard drive and printers, where a Client does not. Once the decision is made as to which computer will share its hard drive and/or printers, the File and Printer Sharing Service for Microsoft Networks located under the **Services** tab must be added.

1. Select **Start** ▸▸ **Settings** ▸▸ **Control Panel** ▸▸ **Network** icon ▸▸ **Services** tab ▸▸ **Add** button ▸▸ **File and Printer Sharing Service for Microsoft Networks** ▸▸ **OK**.
2. Reboot the computer when prompted. At least one computer on the network must have this option.
3. Select **Start** ▸▸ **Settings** ▸▸ **Control Panel** ▸▸ **Network** icon ▸▸ **Services** tab ▸▸ **File and Printer Sharing**.

4. Verify both options on this screen are checked. Repeat this for each Workstation on the network.

Define the Computer Name and Workgroup

1. At the Network window, select the **Identification** tab.
2. Define the Computer Name and Workgroup.
   - The Computer Name must be a unique name and cannot be duplicated. In other words, each computer on the network should have its own unique name.
   - The Workgroup should be the same for all computers on the network.
3. Repeat this process for each Workstation on the network.

Establish Control

1. At the Network window, select the **Access Control** tab ▸▸ **Share Level Access Control**. This option allows the customer to password protect the Shared Device to the network.
2. Select the **Config** tab.
3. Verify the Primary Network Logon is Microsoft Networks.
4. Select **OK** to exit the network properties.

ATTENTION: Reboot computers sharing hard drives and/or printers first, then reboot each client.

5. Reboot each computer on the network by rebooting the computers sharing hard drives and/or printers first, then rebooting each client.

   Note: When logging into the network, it is necessary to supply a User Name and Password when going into Windows 95 or 98. It is recommended that the Computer Name be used as the User Name when logging in.
6. Attempt to locate drives on the network by selecting **Network Neighborhood** icon. The Workgroup should appear. Under the Workgroup, each computer which is sharing its hard drives and/or printers should be visible.
7. Click on it and locate the computer on the network that was set up to share its hard drives and/or printers. Click on the computer and the hard drive that was shared should be visible at this time.

   Note: If the customer chose to password protect the drive letter, enter the password if prompted. Click on the drive letter to verify the drive can be read.

Map a Network Shared Drive, if desired

1. If the customer wants to map a Network Shared drive, select **Network Neighborhood**.
2. Locate the drive letter on the computer desired.
3. Highlight the drive letter and right click with the mouse.
4. Select **Map Network Drive**.

   Note: If the option **Reconnect at Logon** is also selected, the computer will automatically connect at Logon to the Shared Network Drive. The drive letter can be any letter higher than the last available drive letter used.

3.15 LANtastic® CLIENT/SERVER SOFTWARE OPTION, VERSION 8.0

Purpose

This procedure provides instructions for installing LANtastic Client/Server software, version 8.0. These instructions install the current version of LANtastic Client/Server software for either a single-user or a 2 to 10-user license.

Tools/Supplies Needed

- ❑ LANtastic® Client/Server software V8.0, single-user license, PN 6417324
- ❑ LANtastic® Client/Server software V8.0, 2 to 10 user license, PN 6417325

Preparation

1. Verify compliance with the system requirements stated under Heading B.4, LANtastic® NETWORK OPERATING SYSTEM MINIMUM REQUIREMENTS.
2. Back up all important customer information as designated by the customer.
3. Ensure that all software is present to re-install if re-imaging is required.
4. Read this procedure completely before starting to prevent failures to the process.

Hardware Installation

1. Locate the hardware that came with the software networking kit.
2. Install the T-connectors on the network card.
3. Install the BNC cable on the Client Computer Network card T-connector and the other end to the cable on the Server Network card T-connector.
4. Install a Terminator on the other end of the T-connect on both the Client and Server Network card T-connector. If more then one Client computer is to be installed, skip the Terminator on the Client computer/computers between the Server and the last Client computer.

CD-ROM Usage in DOS

- If the computer allows you to use a CD-ROM in DOS, go to the Software Installation, Client Setup heading.
- If the computer does not allow you to use the CD-ROM in DOS, you have two choices.
  - Convert the software from CD to 3.5-inch floppy diskettes. To do this, follow the procedure in the OEM Vender manual then go to the Software Installation, Client Setup heading.
  - Use the CD-ROM in DOS. To do this, go to Heading 4.22, UNIVERSAL CD-ROM DRIVER SETUP and install a driver that works with all types of CD-ROM drives then return to this procedure and starting at Heading Software Installation, Client Setup complete the LANtastic installation as written.

Software Installation, Client Setup

ATTENTION: These instructions are written to be used in conjunction with the OEM vender's installation process. At times, you are instructed to reference the OEM vender's procedure but not step by step.

1. Select **File ▸▸ Save** to save the changes.
2. Select **File ▸▸ Save As** and rename the file from autoexec.bat to autoexec.XXX where the XXX is your initials. This is being done to have a backup of this file in case a problem occurs later.
3. At the DOS prompt (C:\), type `edit` Spacebar `config.sys`.
4. Select **File ▸▸ Save As** and rename the file from config.sys to config.XXX where XXX is you initials. This is done to have a backup of this file in case a problem occurs later.
5. At the DOS prompt (C:\), type `memmaker`.
6. Follow the instructions displayed on the screen. When ask about expanded memory, choose no. Remember, you must choose the option for DOS when running this. You must pay attention so the computer does not go into Windows when re-booting while running memmaker.

   Note: Running memmaker creates enough memory to install the LANtastic software. The driver statement added later can and should be REM'd out of the config.sys file. (REM in programming language is short for remarks or comments. When applicable, `REM` is typed at the beginning of a line and anything after it is considered a comment, a note, or a non-executable code.)
7. After memmaker has finished, at the C:\ prompt, type `mem`.
8. Verify the memory is at least 496.

   If the memory is less than 496:

   a. Review the config.sys and autoexec.bat files for add ons. There must be something added because our computers should be above 495.

   b. As you locate the add on, type `REM` in front of the add on.

   c. When the review is complete, re-boot the computer.

   d. Recheck the memory to ensure the memory is at least 496.

      Note: Contact Technical Support for advice if memory values are not meet. Some Tower Computers may not allow enough memory to load the software. You will have to REM out the MOUSE statement if this occurs. Place a (REM) in front of the mouse line in the autoexec.bat file.
9. If the memory is at least 496, re-boot the computer into Windows.

   Note: If Norton Anti-Virus is installed, you need to disable the software for loading new software. You may enable this when you are done.
10. Insert the LANtastic CD-ROM into the CD-ROM drive. It will self-start the Install process.

11. Follow the instructions displayed on the screen to install the Client version of the software. Use the following information to answer the software installation questions when they appear.
    - When the software requests a selection, select the defaults.
    - Do not share drive and printers. When the **Share Drives and Printers** option appears, select **No** (delete the check mark from the box).
    - When the software requests the Client's computer name, type either the serial number of the instrument or type computer1. This is up to you and the customer. You must remember this name. You may select to write the name on the computer somewhere so everyone can see the name.
    - Select drive C: and accept the default name of Lantasti for the directory.
    - When the software states the computer needs to re-boot, allow this to happen then go back into Windows to complete the installation.
12. When the installation in Windows is complete, re-boot the computer again and go into DOS.
13. Insert the LANtastic CD-ROM into the CD-ROM drive.
14. At the (C:\) prompt:
    a. Type `D:\` then press Enter. (Drive D: is not seen in DOS on the tower computer.)

       Note: If this is a FlowCentre desktop computer, E should be the CD-ROM drive in DOS. Type `E:\` then press Enter.

    b. Type `install`. The software automatically begins the installation. Follow the instructions displayed on the screen. Use the following information to answer the software installation questions when they appear.
       - Select the C: as the default drive and leave all the default directories for install alone.
       - When appropriate, use the ↓ key to highlight the **DO NOT SHARE DRIVERS AND PRINTERS** option to install the DOS version of LANtastic Client software.
       - When the software requests the Client's computer name, type what you did in the step above for the Windows installation. You may select to write the name on the computer somewhere so everyone can see the name.
       - When requested, select **OK** for 3com Ethernet xl and fast etherlink.
       - When shown, leave ALL Client to Novell Network at NO.
       - Do not select any options like: **TCP/IP Protocols**, **Modem Sharing**, or **Client for Novell**.
       - For the network adaptor, select **NDIS SUPPORT for NON-ARTISOFT ADAPTER** and change the path as C:\ETHERNET for the Network Interface card driver. When requested, select NO to set up for permanent connection.
15. Re-boot the computer and return to the DOS prompt C:\. You will receive errors messages but this is okay for now.
16. At the C:\ prompt, type `edit` Spacebar `autoexec.bat` and press Enter.
17. REM out all XL software statements referring to the networking SQL for the XL software under the statement, ***Database Environment***. Leave Set_DOS16M=3m alone.

18. Make sure the following lines appear below the REM'd out lines with a blank line between.

    ```
    PATH_C:\SQLANY50\DOS;%PATH%
    SET_SQLPATH=C:\SQLANY50\DOS
    SET_SQLANY50=C:\SQLANY50
    SET_SQLSTART=C:\SQLANY50\DOS\DBCLIENT_ - x_ netDG_ / q_ / d_
    XL2.DB
    SET_SQLCONNECT=DBA,SQL,,
    ```

19. Type any missing lines below the REM'd out lines. Make sure there is a blank line between the lines.

    Note: The underscore (_) indicates a space. If you are typing the line, press Spacebar when you come to the underscore (_) in the line.

20. If you are working with a FlowCentre II tower computer, place a REM statement in front of the Call C:\Lantasti\Startnet.bat line so that it looks like this:

    REM Call C:\Lantasti\Startnet.bat

21. Save the changes to the autoexec.bat file.
22. Make sure the following lines appear in the config.sys file:

    ```
    ENSURE THAT FILES ARE SET TO 60 AND THE BUFFERS ARE SET TO 63
    DEVICE=C:\LANTASTI\PROTMAN.DOS_ /I:C:\LANTASTI
    DEVICE=C:\LANTASTI\EL90X.DOS
    LASTDRIVE=Z
    ```

23. Type any missing lines.

    Note: The underscore (_) indicates a space. If you are typing the line, press Spacebar when you come to the underscore (_) in the line.

24. Save the changes made to the config.sys file.
25. At the C:\ prompt, type `CD:\Lantasti` and press Enter.
26. At C:\Lantasti, type `edit` Spacebar `startnet.bat` Spacebar `file`
27. Make sure the following lines appear under the line, `LOADHIGH_ AILANBIO_@STARTNET.CFG` with a blank line in between:

    ```
    REDIR_COMPUTER1_@STARTNET.CFG
    NET_USE_W:_\\SERVER1\C-DRIVE
    ```

    Note: SERVER1 is a generic name for the server. Replace SERVER1 with the name you are using for the server.

28. Type any missing lines below the `LOADHIGH_ AILANBIO_@STARTNET.CFG` line. Make sure there is a blank line between the lines.

    Note: The underscore (_) indicates a space. If you are typing the line, press Spacebar when you come to the underscore (_) in the line.

29. Save the changes made to the startnet.bat file.
30. Re-boot the computer.

This concludes the LANtastic installation process for the Client. You will receive a REDIR ERROR at boot up until you REM out the CD-ROM driver in the config.sys file.

Software Installation, Server Setup

ATTENTION: During this installation, no DOS version of the software is installed. Because you set the client computers to not share drivers and printers, you will not be able to see the Client computer from the Server.

1. Boot the Server computer into Windows.
2. Insert the LANtastic CD into the CD-ROM drive. It will auto start into the install process.
3. Click on the **LANtastic** icon on the upper right hand side to start the installation.
4. Follow the steps requested by the software and when required, type the Server Name (SERVER1) you choose when setting the Client computers software.

   Note: SERVER1 is a generic name for the server. Replace SERVER1 with the name you are using for the server.
5. When prompted, ensure the check box is checked for sharing drives and printers since this is the server you are setting up. Also, accept all the default directories shown.
6. Once complete, re-boot the computer but pay attention because you need to ensure that you go back into Windows to allow the software to finish the installation.
7. Once in Windows again, double click on the **LANtastic** icon to start LANtastic. When the **Share Drives and Printers** options appears, select **Yes** to start making the proper boxes/sections.
8. Click on the **Manage Server** tab and select **Share Drives**. If needed, select the server as main server.
9. Select the **Use Network** tab and select **Assign Drives**. You should see the server's drives.
10. If the customer purchased Sybase Client/Server SQL software, go to Heading 3.18, Sybase® CLIENT/SERVER SQL SOFTWARE OPTION to complete this installation.

Software and Hardware Validation

1. Boot the Server computer into Windows. Allow it to finish booting up.
   a. Simultaneously press Ctrl Alt Delete to reboot the Server computer.
   b. When the Microsoft Windows Startup Menu appears, highlight **1. Normal** and press Enter.
   c. Wait for the Windows desktop to appear.
2. Double click on the **LANtastic** icon to engage the Lantastic software.
3. Boot up the Client computer and select the SYSTEM II operating system.
   a. Simultaneously press Ctrl Alt Delete to reboot the computer.
   b. When the Microsoft Windows Startup Menu appears, **8. Previous version of MS-DOS** is already highlighted. Wait or press Enter to accelerate the process.
4. Access the Protocol select screen and verify that the W: drive is present.
5. Select the W: drive (this is the Server's XL software).
6. Select a Protocol.

   Note: You will have to re-build the directory to see any files there.

7. Select a Listmode file by changing directories and select W: drive (this is the Server). Again, you may have to re-build the directory.
8. Select any Listmode file or files and then batch play. Ensure that the output option is set to save Listmode and that the patient report and database is enabled.

3.16 LANtastic® CLIENT/SERVER SOFTWARE OPTION, VERSION 7.0

Purpose

These procedures allow you to reinstall LANtastic Client/Server software V7.0.

Tools/Supplies Needed

ATTENTION: Needed software must be obtained from the customer. If it is not available, the current version (Version 8.0) must be ordered and installed. See Heading 8.1, MASTER PARTS LISTS for the appropriate part number and Heading B.4 for the operating system minimum requirements for version 8.0.

- ❑ Obtain from the customer LANtastic® Client/Server software V6.0 and 7.0, single-user license or LANtastic® Client/Server software V6.0 and 7.0, 2 to 10 user license, as applicable

LANtastic Client/Server Version for Windows™ 95 Installation

1. Boot the FlowCentre Multimedia Workstation.
2. At the Microsoft Windows 95 Startup Menu, select **1. Normal**.
3. Make note of the CD-ROM drive letter (usually e:) and have the FlowCentre Multimedia Workstation Windows 95 Backup Disk (supplied by customer) available.
4. Insert LANtastic Client/Server software floppy diskette 1 of 7 into floppy diskette drive *a:*.
5. From the Windows 95 desktop, select **Start ▸▸ Settings ▸▸ Control Panel ▸▸ Add/Remove Programs ▸▸ Install ▸▸ Next**.
6. When the *a:\setup* program is displayed, select **Finish**.
7. Follow the on-screen instructions and enter the following information for each question/option:
   a. For the computer's name, type the unit's serial number or other name (check with the customer).
   b. Enter the Serial Number and Verification Key of the software (located on the registration card in the software kit).
   c. Accept the default directory for software installation (**c:\lantasti**).
   d. If installing a **client** version, select **DO NOT SHARE MY COMPUTER'S DRIVES/PRINTERS**.
   e. If installing a **server** version, select **SHARE MY COMPUTER'S DRIVES/PRINTERS**.
   f. **Do not** select the option **TCP/IP PROTOCOL** to install the Internet gateway.
   g. Select **DO NOT SHARE MODEM** (box unchecked).
   h. If installing a **client** version, select **INSTALL SERVICES**.
8. The Installation Utility asks for the Windows 95 Backup Disk (FlowCentre Multimedia Workstation Windows 95 Backup Disk) during installation. Place the Windows 95 Backup Disk into the CD-ROM drive, entering the drive letter of the CD-ROM drive and WIN95 (e.g., `e:\win95`).
9. Reboot the Workstation.
10. At the Microsoft Windows 95 Startup Menu, select **3. Safe Mode**.

11. From the Windows 95 desktop, select **Start ▸▸ Settings ▸▸ Control Panel ▸▸ System ▸▸ Device Manager.**
12. From the Device Manager box, select **Ports (COM & LPT)**.
13. Remove each communications port labeled **Modemshare (COM3-COM9)**.
14. Select **Start ▸▸ Shut Down ▸▸ Restart the computer**.
15. At the Microsoft Windows 95 Startup Menu, select **1. Normal**.

    Note: The reboot process is normally considerably longer when installing the LANtastic server version.
16. Verify that the **LANtastic** icon is on the Windows 95 desktop.
17. If the **LANtastic client** version of the software was installed and there is another FlowCentre Multimedia Workstation, perform steps 1 through 16 on the other Workstation, configuring the Workstation as a server.
18. If the **LANtastic server** version of the software was installed and there is another FlowCentre Multimedia Workstation, perform steps 1 through 16 on other the other Workstation, configuring the Workstation as a client.
19. Install the **MS-DOS client** version of the LANtastic software as directed under the next heading, LANtastic Client Version for MS-DOS Installation.

LANtastic Client Version for MS-DOS Installation

1. Ensure that the previous procedure, LANtastic Client/Server Version for Windows™ 95 Installation has been performed before proceeding.
2. Reboot the Workstation.
3. At the Microsoft Windows 95 Startup Menu, select **8. Previous version of MS-DOS**.
4. Exit the SYSTEM II software by pressing F2 and Y.
5. Type `cd:\lantasti\install` and press Enter.
6. To begin the installation process, type `install` and press Enter.
7. Accept the Serial Number and Verification Key displayed on the screen.
8. Installation selections:
   a. Select **DO NOT SHARE MY COMPUTER'S DRIVES/PRINTERS**.
   b. Do not select the option **TCP/IP PROTOCOL** to install the Internet gateway.
   c. Select **NO** for:
      - **Modem Sharing**
      - **Client for Novell 3.11**
      - **Client for Novell 4.0**
      - **Client for Microsoft Networks**.
   d. At **Network Adapter**, select **NDIS SUPPORT for NON-ARTISOFT ADAPTER**.
   e. At **Network Interface Card** drivers, type `c:\ethernet`.
   f. At **Set Up Permanent Connections**, select **NO**.
9. Allow the installation program to edit the **config.sys** and **autoexec.bat** files.
10. Exit to MS-DOS.

11. Change to the *c:\lantasti* directory, type `edit startnet.bat`
12. After the line `redir....@startnet.cfg`, enter the server computer name (name entered in step 7a under heading LANtastic Client/Server Version for Windows™ 95 Installation). The new line should read:

    ```
    net use w:\\lantastic_server_name_goes_here\c-drive
    ```

13. Exit saving changes to the **startnet.bat** file.
14. Edit the **config.sys** file from the *c:* prompt using the MS-DOS Edit program:
    a. Ensure that in the *files=xx* statement, xx ≥ 50.
    b. Ensure that the statement *lastdrive=z* is present.
15. Install both client and server versions of the Sybase® SQL Anywhere™ PC database server software as directed under Heading 3.18, Sybase® CLIENT/SERVER SQL SOFTWARE OPTION.
16. Connect the BNC T-connectors from the kits onto the NIC on each Workstation.
17. Connect the BNCs from each T-connector, serially connecting as many Workstations as will be on the network.
18. Place a terminator on the BNC T-connector at each end of the network (2 terminators must be installed).
19. Reboot the Workstation to allow the LANtastic drivers to take effect.
20. When the Microsoft Windows Startup Menu appears, highlight **1. Normal** and press Enter.
21. Wait for the Windows desktop to appear.

Sybase Client/Server SQL Software Option

If the customer has the Sybase Client/Server SQL software, go to Heading 3.18 and complete this installation as written.

3.17 LANtastic® CLIENT/SERVER SOFTWARE OPTION, VERSION 6.0

Purpose

These procedures allow you to reinstall LANtastic Client/Server software V6.0.

Tools/Supplies Needed

ATTENTION: Needed software must be obtained from the customer. If it is not available, the current version (Version 8.0) must be ordered and installed. See Heading 8.1, MASTER PARTS LISTS for the appropriate part number and Heading B.4 for the operating system minimum requirements for version 8.0.

- ❑ Obtain from the customer LANtastic® Client/Server software V6.0 and 7.0, single-user license or LANtastic® Client/Server software V6.0 and 7.0, 2 to 10 user license, as applicable

Installation

1. Insert the LANtastic Client/Server software diskette 1 of 4 in the floppy diskette drive.
2. At the *b:* prompt, type `INSTALL` and press Enter.
3. The LANtastic software installation program checks the Computer Workstation to ensure that Windows is present. If Windows is not present it loads the MS-DOS version. Carefully read each screen as it comes up before pressing Enter.

   Note: When setting up the instrument, use only Client/Server software floppy diskettes 1 and 2.
4. Follow the on-screen instructions and enter the following information for each question/option:
   a. For the computer's name, type the unit's serial number or other name (check with the customer).
   b. Accept the default directory for software installation (**c:\lantasti**).
   c. If installing a **client** version, select **DO NOT SHARE MY COMPUTER'S DRIVES/PRINTERS**.
   d. If installing a **server** version, select **SHARE MY COMPUTER'S DRIVES/PRINTERS**.
   e. **Do not** select any resources when prompted to select additional resources.
5. Ensure that all information is correct before selecting **OK** to continue with the installation. If information is incorrect, select **GO back** (to step 4) and re-enter the information,
6. Select **NDIS SUPPORT FOR NETWORK ADAPTERS** and press Enter.
7. Insert the 3COM device driver floppy diskette that came with the NIC and press Enter.
8. Remove the 3COM floppy diskette and reinsert the LANtastic Client/Server software floppy diskette 1 of 4 back into the floppy diskette drive when prompted to do so.
9. Select **DO NOT** set up any drive or Printer connections at this time and press Enter.

10. Ensure all network information is correct before continuing. Press Enter.

    Note: This is the last time you can go back and change information without having to reload the LANtastic Client/Server software.

11. The LANtastic Client/Server software makes the required changes to the **config.sys** and **autoexec.bat** files. The old **config.sys** and **autoexec.bat** files are renamed and saved if you encounter problems.
12. Follow the instructions on the screen for installing the remainder of the LANtastic Client/Server software.

    Note: The software takes about 10 minutes to install.

13. The LANtastic software reboots the computer but does not place the LANtastic call in the correct place in the **autoexec.bat** file. After the SYSTEM II software boots, press F2 and exit to MS-DOS.

Config.sys and startnet.bat File Editing

If you are familiar with the MS-DOS line editor, you can use it to edit these files. If not, use the LED editor provided with the LANtastic software and follow the steps below. LED is a line editor written by Artisoft to allow for quick editing of frequently used files. Examples of all the setup files are shown in Appendix D, EXAMPLES OF SETUP FILES.

1. At the *MS-DOS* prompt, type `LED` and press Enter. At the Technical Support message press Enter. The program defaults to the c: drive and displays the default files in the files box menu.
2. Using ↑ and ↓, highlight **config.sys** and press Enter.
3. View the contents of the **config.sys** file and look for a **FILES** statement. This should be set to a minimum of **50**. If lower, place the cursor on the **FILES** line and press Enter.
4. Change **FILES** to equal **50**, and press Enter, then press F2 to save.
5. Add a new line to the **config.sys** file that states `Lastdrive=z`, press F2 to save.
6. Press Esc to exit out of the LED editor.

LANtastic File Server Software Connection

1. Connect the BNC coaxial cable to the T-connector.
2. A terminating resistor is required to be connected to the ends of the last node on the network. Example: If only one Cytometer is to be connected to the Workstation file server, the Cytometer and the Workstation file server must be terminated.
3. At the Workstation file server, exit to MS-DOS.
4. Change directory to be in the *LANTASTI* directory.
5. At the *MS-DOS* prompt, type `LED`.
6. Press Enter at the Technical Support message.
7. Highlight the **STARTNET.BAT** file and press Enter.
8. Scroll down to place the cursor under the *REDIR* statement.

9. Press Enter and note that the line has changed colors and type:

   `NET USE <drive>:\\<server name>\DRIVE LETTER,` and press Enter.

   EXAMPLE: NET USE F: \\NETWORK\D-DRIVE

   This command tells the Computer Workstation to connect to the file server network's D-drive as the Computer Workstation's F-drive.

10. Press F2 to save, then press Esc to exit.
11. At the *MS-DOS* prompt, type `LANCHECK` and press Enter. A LANtastic program runs that tests the cable and the NIC and checks who else is on the network also running LANCHECK.
12. At the Computer Workstation file server, type `LANCHECK` and press Enter. The same screen that appeared in the previous step should appear and two nodes should appear. The Computer Workstation should also show the addition of a file server. If not, refer to the Troubleshooting section of the OEM-supplied manual.
13. If LANCHECK sees both or all nodes on the network that are running LANCHECK, press Esc to get back to MS-DOS.

    Note: LANCHECK only sees other nodes on the wire that are also running LANCHECK simultaneously.

14. Edit the **autoexec.bat** file and move:

    CALL C:\LANTASTI\STARTNET.BAT

    insert it after the *C:* and before *CD\XL* call.

15. Save the file.
16. Reboot the instrument into SYSTEM II software.
17. Configure the SYSTEM II software for network support:
    a. Select the Acquisition tool bar and select **Utilities**.
    b. Locate the Network Node ID box and set the **Node ID** to assign a unique node for the instrument. The node ID can be between 1 and 9 or A through Z. This node ID will be added to the first digit in the run number. If multiple instruments are installed, ensure that no node ID is duplicated to avoid file over-writing on the network file server.
    c. Exit to MS-DOS and at the *XL* prompt, type `EDIT XL_GRAPH.CNG` and press Enter.
    d. Move to the last line (*rem n=NETSHOW*) and remove the rem statement.

       Note: When this command is active, the monitor displays all the network drives the instrument has access to when in the Change Directory area of the SYSTEM II software.

18. Save the file and exit.
19. Type `XL2` and press Enter.

Sybase Client/Server SQL Software Option

If the customer has the Sybase Client/Server SQL software, go to Heading 3.18 and complete this installation as written.

3.18 Sybase® CLIENT/SERVER SQL SOFTWARE OPTION

Purpose

This procedure provides instructions for installing Sybase Client/Server SQL software for use in conjunction with LANtastic Client/Server software. Install LANtastic software before preforming this procedure.

Tools/Supplies Needed

- ❑ Sybase® SQL Anywhere™ PC database server software, 4-user license, PN 6417323

Preparation

1. Make sure the LANtastic Client/Server software is installed before installing the Sybase Client/Server SQL software. If you have not already done so, install the LANtastic Client/Server software that correlates with the version needed:
   - Heading 3.15, LANtastic® CLIENT/SERVER SOFTWARE OPTION, VERSION 8.0
   - Heading 3.16, LANtastic® CLIENT/SERVER SOFTWARE OPTION, VERSION 7.0
   - Heading 3.17, LANtastic® CLIENT/SERVER SOFTWARE OPTION, VERSION 6.0
2. Verify compliance with the system requirements stated under Heading B.5, Sybase® SQL ANYWHERE™ MINIMUM REQUIREMENTS.

Software Installation, Client Setup

ATTENTION: If you used the CD-ROM drive for installing the LANtastic software, you must use the CD-ROM drive to install the Sybase Client/Server SQL software.

1. Insert the Sybase CD-ROM into the CD-ROM drive.
2. At the C:\ prompt, type `D:\` and press Enter. If this is a FlowCentre desktop computer, type `E:\`
3. At the D:\ (or E:\) prompt, type `setup`.
4. Enter the registration number when requested. The registration number is the 12-digit code printed on the registration card.
5. Select install client version of the software but do not select to install any options.
6. Select the default directory.
7. When prompted to modify the autoexec.bat file and the config.sys file, select No.
8. Select **Let you make the modifications later**. We have already modified both files for our needs. The software will default back to the install section. Select cancel at that time.
9. Re-boot the computer and return to DOS.
10. At the C:\ prompt, type `CD\XL` and then XL2.
11. Access the Utilities screen and select **Show Database Errors** to engage the XL database engine.
12. Save the changes.
13. Exit the XL software.
14. Type `C:\` and press Enter to display the C:\ prompt.

15. Type `edit` Spacebar `config.sys`
16. Type `REM` in front of the CD-ROM drive statement line.
17. Save the changes.
18. Type `edit` Spacebar `autoexec.bat` Spacebar `file`
19. Remove the REM statement you placed in the CD\XL and XL2 lines.
20. Remove the REM statement in front of the `Call Lantasti` statement.
21. If you added the REM statement in front of the mouse line, remove that REM too.
22. Re-boot the computer and select DOS at the menu to go into XL software. You will still receive errors from the database and server not found errors until the server installation procedure is complete.

ATTENTION: This concludes the Sybase installation process for the Client. You will receive errors at boot up until this procedure is completed.

Software Installation, Server Setup

1. Install the Sybase CD into the CD-ROM drive. It should start automatically.
2. Follow the instructions displayed on the screen. Use the following information to answer the software installation questions when they appear.
   - Ensure that **Install Server for Windows** and **Share Drives and Printers** are selected.
   - Accept the default directories for installing the software.
   - Click on **Install Anywhere Options** and un-check all except for the help files.
3. When requested, allow the software to make the changes to the autoexec.bat and the config.sys files.
4. When the software ID disk is requested, insert the 3.5 in. floppy diskette into the A: drive.
5. When the software install is complete, it will default back to the install section. Click on cancel at this time.
6. Re-boot the computer to allow the software to finish the install.
7. At the Windows desktop,
   a. Right click the mouse in a blank section of the screen.
   b. Click on **New ▸▸ Shortcut ▸▸ Browse**.
   c. Locate the icon dbsrv50 in the C:\sqlany50\win32 directory and double click.
8. Find the new icon on the desktop and right click on the new icon.
   a. Click on **Properties ▸▸ Shortcut ▸▸** find **Target**.
   b. Add the following after the statement C:\sqlany50\win32\dbsrv50.exe:
      `-c_500k_-x_netDG_-n_XL2.DB_c:\sqlany50\XL2.DB`
   c. Click **Apply** and then Close.
9. Open Windows Explorer and go to the XL directory.
10. At the XL directory:
    a. Go to the sub directory DBF.
    b. Right mouse click on the XL2.DB and copy it to the directory C:\SQLANY50.

11. Close Windows Explorer.
12. Double click on the **Sybase** icon to start the database.
13. Ensure the database starts and is in the Ready state.
14. Re-boot the Client computer and ensure no errors appear when booting up.

Software and Hardware Validation

1. Boot the Server computer into Windows. Allow it to finish booting up.
2. Double click on the **LANtastic** icon to engage the Lantastic software.
3. Double click on the **Sybase** icon to engage the database. You will see that the database opens a box that states the database is NOW ACCEPTING REQUESTS.
4. Boot up the Client computer and select SYSTEM II as the operating system. Make sure the Starting Database dialog box appears during the SYSTEM II boot-up.
   a. Simultaneously press Ctrl Alt Delete to reboot the computer.
   b. When the Microsoft Windows Startup Menu appears, **8. Previous version of MS-DOS** is already highlighted. Wait or press Enter to accelerate the process.
   c. Verify the Starting Database dialog box appears during the SYSTEM II boot-up.

3.19 EXPO32™ SOFTWARE OPTIONS

Purpose

EXPO32 is a Windows based software package that contains enhancements that make acquisition and data management easier. This software is distributed via CD-ROM and requires Windows 98 Second Edition. The appropriate service ROMLOCK is also required.

Tools/Supplies Needed

- ❑ EXPO32™ ADC Cytometer software (including ROMLOCK connector), PN 6418337

  Note: This software allows the analysis of acquired Listmode data in FCS format including Advanced Digital Compensation (ADC). The hardware included in this package allows for identification of the Cytometer upgraded to the ADC capability.

Preparation

For EXPO32 ADC Installation Option

If the EXPO32 ADC software option was purchased by the customer, place the ROMLOCK connector on the parallel port on the rear of the computer tower.

Note: If a ZIP drive is being installed, install the ZIP drive first then connect the ZIP drive cable to the parallel port and install the ROMLOCK connector on the parallel pass-through connector on the ZIP drive.

For Printer Installation

If the customer purchased a printer, connect the parallel printer cable to the parallel port on the rear of the computer tower.

Note: If a ZIP drive is being installed, install the ZIP drive first then connect the printer cable to the pass-through connector on the ZIP drive.

Software Installation

1. Simultaneously press Ctrl Alt Delete to reboot the computer.
2. When the Microsoft Windows Startup Menu appears, highlight **1. Normal** and press Enter.
3. Wait for the Windows Desktop to appear.
4. Place the software CD-ROM in the CD-ROM drive. The program automatically starts.
5. Follow the instructions on the Workstation screen.
6. When the installation is complete, drag the appropriate EXPO software icon to the Windows desktop screen.

Verification

1. Double click on the EXPO software icon to verify that the EXPO software initializes within Windows 98.
2. When the Startup box appears, select **Admin** ▸▸ **Next>**.
3. Select a protocol or click on the **Finish** button.
4. At the Cytometer, verify the LASER ON indicator lights green.

5. At the Workstation, verify the message *Startup in process* appears on the status line (lower display area).

   Note: During system startup, a sequence of messages (*Startup in process* → *Verification* → *Run Initialization* → *Awaiting Sample* appear as the instrument goes through various checks. Error messages appear to the right, if applicable.

6. At the Cytometer, verify the CYTOMETER READY indicator lights green.

   Note: The Cytometer can take up to 30 minutes to warm up before the READY indicator turns green.

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4.1 GUIDELINES FOR SERVICING THE INSTRUMENT

General Guidelines

Safety Precautions

- Review and heed the general safety warnings and cautions listed under Heading 1.2, SAFETY PRECAUTIONS.
- Make sure all covers are reinstalled to ensure proper operation of interlocks when you leave the account.

Instrument Access

Ensure there is adequate space to work and to access the instrument components safely.

Laser Safety

WARNING Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

WARNING The laser beam can cause eye damage if viewed either directly or indirectly from reflective surfaces (such as a mirror or shiny metal surface). Avoid direct exposure to beam. Do not view directly or with optical instruments except for special service instruments as directed in service manual.

Before servicing the Cytometer with the filter shield removed, make sure you are thoroughly familiar with all the laser safety information provided under Heading 1.2, SAFETY PRECAUTIONS.

Electronic Precautions

WARNING Risk of personal injury. Be very careful when operating the instrument when a safety interlock switch is defeated, as you may be exposed to electric shock. After servicing the instrument, make sure covers are properly reinstalled to reactivate any safety interlock switch that was bypassed while servicing the instrument.

To protect the operator from personal injury, this instrument is equipped with two safety interlock switches that turn off the power. One of these switches is attached to the Cytometer frame and turns off power to the laser when the Cytometer top cover is removed. The second switch is attached to the Power Supply module frame and turns off power to the Cytometer and Power Supply module when the three-sided cover is removed. If the MCL option is installed, there is a third interlock switch that halts operation of the MCL carousel when the MCL door is open.

You can defeat any of these interlock switches by pulling the switch up. Always be very careful if you bypass a safety interlock and operate the instrument with the covers off. The interlock switch is reset when the cover is reinstalled.

WARNING Risk of personal injury or damage to electronic components. While performing service or maintenance on the instrument, rings and other metal jewelry could contact exposed electronic components, causing personal injury from electric shock, or become caught in the instrument, damaging the components. Remove rings and other metal jewelry before doing service or maintenance on the instrument.

CAUTION Risk of damage to electronic components.

- If you remove or replace a printed circuit card or electronic component while the power is ON, the component may be damaged. To prevent damage to delicate electronic components, turn OFF the power before removing or replacing printed circuit cards and/or components.
- Electrostatic discharge (ESD) can damage disk drives, add-in circuit cards, and other electronic components. If there is a possibility of ESD damage with a procedure, then perform that procedure at an ESD workstation, or wear an antistatic wrist strap attached to a metal part of the chassis connected to an earth ground.

Before disconnecting or reconnecting any electronic component, turn the instrument off and disconnect the power cord. Based on the customer's software preference, refer to the Power Down / Power Up Using SYSTEM II™ Software heading or the Power Down / Power Up Using EXPO32™ ADC Software heading in this section.

Procedures

WARNING Risk of personal injury or contamination. If you do not properly shield yourself before servicing the instrument with the doors open, you may be injured or contaminated. To prevent possible injury or biological contamination, you must wear gloves, a lab coat, and eye protection when servicing the instrument with the doors open and/or when working with pathogenic materials.

Adjustment, alignment, replacement, and calibration procedures that need to be done on the XL or XL-MCL are in this section. Read each procedure entirely **before** beginning the service or repair.

The following service considerations apply to all XL and XL-MCL flow cytometers:

- All covers can be removed without affecting unit operation, as long as the interlock is disabled.
- A fiber optic cable is used to interface the Cytometer to the Workstation.
- Power is supplied to the Cytometer via an interconnect power harness from the Power Supply module.
- In addition to the above considerations, the following service considerations apply only to XL-MCL flow cytometers:
  - The MCL door switch **must be defeated before** you run the MCL TERMINAL program.
  - When removing covers, the MCL option **must be unlatched before** the left-side cover can be removed.

Tools and Supplies

You can do most procedures using the standard Beckman Coulter Service Tool Kit and test equipment (oscilloscope, DVM, and an external digital pressure gauge). Any special tools, supplies, or equipment required are identified under the Tools/Supplies Needed heading at the beginning of the procedure.

Instrument Performance Verification

- When a service or repair procedure requires some type of instrument performance verification upon completion, a **Verification** heading is provided with the necessary steps that **must be** completed.
- When you have finished servicing the XL or XL-MCL flow cytometer, always verify total instrument performance by doing the System Verification Procedure (SVP) as directed under Heading 5.1.

Power Down / Power Up Using SYSTEM II™ Software

ATTENTION: If the preferred operating system for the instrument you are servicing is EXPO 32 ADC, see the Power Down / Power Up Using EXPO32™ ADC Software heading that follows.

Powering down an XL or XL-MCL system occurs in three stages. In this process, power to the Cytometer is always turned off first, before turning off power to the Workstation. For most procedures, turning off the Cytometer or turning off the Cytometer and Workstation is sufficient. Performing procedures where personal contact with electronic components is probable requires a complete power down.

WARNING Risk of personal injury. Contacting exposed electronic components while the instrument is attached to power can cause personal injury from electric shock. Power down completely before removing covers to access electronic components.

Power Down Using SYSTEM II Software

- To power off only the Cytometer, do Stage 1 only.
- To power off the Cytometer and Workstation, do Stage 1 then 2 only.
- To perform a system power down, do all three stages in order. Doing all three stages of the Power Down procedure ensures all power is removed from the instrument, preventing personal injury from electronic shock.

Stage 1: Power Off the Cytometer (system using SYSTEM II software)

At the Workstation:

1. Press F2. The message *EXIT TO DOS? y/n* should appear.

   Note: If the message does not appear, access the Menu bar. At the Menu bar, select **Applications ▸▸ Exit** and the *EXIT TO DOS? y/n* message should appear.
2. Type `Y`.
3. When the C:\XL> prompt, type `XLOFF` and press Enter to turn off only the Cytometer.

Stage 2: Power Off the Workstation (system using SYSTEM II software)

At the Workstation computer, press and hold the power ON/OFF switch until the computer shuts off.

WARNING Risk of personal injury. When servicing components located inside the Power Supply module, a Stage 3: System Power Down must always be performed **before** removing any cover.

Stage 3: System Power Down (system using SYSTEM II software)

Unplug both ac power line cords from the wall outlet. To locate the SYSTEM POWER cables, refer to Figure A.6-5 as needed.

Power Up Using SYSTEM II Software

- To restore power to only the Cytometer, go to the Restoring Power to the Cytometer Only (system using SYSTEM II software) heading.
- To restore power to the Workstation (which also turns on the Cytometer automatically), go to Stage 2: Restoring Power to the Workstation (system using SYSTEM II software) and complete as instructed.
- To restore system power, go to Stage 1: Restoring Power to the System (system using SYSTEM II software) and complete as instructed then go to Stage 2.

Stage 1: Restoring Power to the System (system using SYSTEM II software)

If unplugged earlier, plug the two ac power cords back into the wall outlet.

Stage 2: Restoring Power to the Workstation (system using SYSTEM II software)

Note: Once the software is loaded, it automatically turns on the Cytometer.

If the Workstation computer was powered off earlier:

1. Firmly press the power ON/OFF switch until the computer turns on. The operating system automatically boots.
2. When the Microsoft Windows Startup Menu appears, **8. Previous version of MS-DOS** is already highlighted. Wait or press Enter to accelerate the process.
3. After the SYSTEM II™ software screen appears, the following messages are displayed:
   a. *Rebuilding protocol directory*
   b. *Resetting cytometer*
   c. *Loading cytom. hardware*

   Note: Once the software is loaded, it turns on the Cytometer. This process should take less than 30 seconds.
4. If the Operator ID box appears, type in an operator number and press Enter. The Acquisition Run screen appears.

   Note: If the Listmode Analysis screen appears and the Cytometer does not turn on, check for a communication problem.

5. At the Cytometer, verify the LASER ON indicator lights green.

   Note: If the Cytometer turns on and then turns off immediately, check the alarm. (At the Menu bar, select **Applications ▸▸ Utilities**. At the Utilities Configuration screen, inside the START UP box, make sure the Cytometer is set up for current operation.)

6. At the Acquisition Run screen, verify the message *STARTUP IN PROCESS* appears (lower right display area).

   Note: During system startup, a sequence of messages (*STARTUP IN PROCESS* → *SYSTEM VERIFICATION* → *RUN INITIALIZATION* → *PLEASE WAIT. . PROCESSING* → *INSERT SAMPLE TUBE* appear as the instrument goes through various checks. *INSERT SAMPLE TUBE* only appears if a startup protocol or panel is either selected or previously specified on the Utilities Configuration screen. Error messages appear in red below this message line.

7. At the Cytometer, verify the CYTOMETER READY indicator lights green.

   Note: The Cytometer can take up to 30 minutes to warm up before the READY indicator turns green.

Restoring Power to the Cytometer Only (system using SYSTEM II software)

1. At the C:\XL> prompt, type `XL2` and press Enter.

   If another prompt, such as C:\PREFINAL>, is displayed:

   1) Type `CD\XL` then press Enter.
   2) At the C:\XL> prompt, type `XL2` and press Enter.

2. After the SYSTEM II™ software screen appears, the following messages are displayed:

   a. *Rebuilding protocol directory*

   b. *Resetting cytometer*

   c. *Loading cytom. hardware*

   Note: Once the software is loaded, it turns on the Cytometer. This process should take less than 30 seconds.

3. If the Operator ID box appears, type in an operator number and press Enter. The Acquisition Run screen appears.

   Note: If the Listmode Analysis screen appears and the Cytometer does not turn on, check for a communication problem.

4. At the Cytometer, verify the LASER ON indicator lights green.

   Note: If the Cytometer turns on and then turns off immediately, check the alarm. (At the Menu bar, select **Applications ▸▸ Utilities**. At the Utilities Configuration screen, inside the START UP box, make sure the Cytometer is set up for current operation.)

5. At the Acquisition Run screen, verify the message *STARTUP IN PROCESS* appears (lower right display area).

   Note: During system startup, a sequence of messages (*STARTUP IN PROCESS* → *SYSTEM VERIFICATION* → *RUN INITIALIZATION* → *PLEASE WAIT. . PROCESSING* → *INSERT SAMPLE TUBE* appear as the instrument goes through various checks. *INSERT SAMPLE TUBE* only appears if a startup protocol or panel is either selected or previously specified on the Utilities Configuration screen. Error messages appear in red below this message line.

6. At the Cytometer, verify the CYTOMETER READY indicator lights green.

   Note: The Cytometer can take up to 30 minutes to warm up before the READY indicator turns green.

Power Down / Power Up Using EXPO32™ ADC Software

ATTENTION: If the preferred operating system for the instrument you are servicing is SYSTEM II, see the Power Down / Power Up Using SYSTEM II™ Software heading.

Powering down an XL or XL-MCL system occurs in three stages. In this process, power to the Cytometer is always turned off first, before turning off power to the Workstation. For most procedures, turning off the Cytometer or turning off the Cytometer and Workstation is sufficient. Performing procedures where personal contact with electronic components is probable requires a complete power down.

WARNING Risk of personal injury. Contacting exposed electronic components while the instrument is attached to power can cause personal injury from electric shock. Power down completely before removing covers to access electronic components.

Power Down Using EXPO32 ADC Software

- To power off only the Cytometer, do Stage 1 only.
- To power off the Cytometer and Workstation, do Stage 1 then 2 only.
- To perform a system power down, do all three stages in order. Doing all three stages of the Power Down procedure ensures all power is removed from the instrument, preventing personal injury from electronic shock.

Stage 1: Power Off the Cytometer (system using EXPO32 ADC software)

At the Workstation:

1. Close the EXPO32 ADC software to return to the Windows Desktop.
2. When the message *Before continuing, do you want to save the current protocol?* appears, select **Yes** or **No**, as applicable.
3. Double click on the **XL Off** icon to power off the Cytometer.

Stage 2: Power Off the Workstation (system using EXPO32 ADC software)

1. In the lower left corner, click on the **Start** button then select **Shut Down…**
2. At the Shut Down Windows box, select **Shutdown** ▸▸ **OK**.
3. Wait for the *It's now safe to turn off your computer* message to appear.
4. At the Workstation computer, press and hold the power ON/OFF switch until the computer shuts off.

WARNING Risk of personal injury. When servicing components located inside the Power Supply module, a Stage 3: System Power Down must always be performed **before** removing any cover.

Stage 3: System Power Down (system using EXPO32 ADC software)

Unplug both ac power line cords from the wall outlet. To locate the SYSTEM POWER cables, refer to Figure A.6-5 as needed.

Power Up Using EXPO32 ADC Software

- To restore power to only the Cytometer, go to the Restoring Power to the Cytometer Only (system using EXPO32 ADC software) heading.
- To restore power to the Workstation (which also turns on the Cytometer automatically), go to Stage 2: Restoring Power to the Workstation (system using EXPO32 ADC software) and complete as instructed.
- To restore system power, go to Stage 1: Restoring Power to the System (system using EXPO32 ADC software) and complete as instructed then go to Stage 2.

Stage 1: Restoring Power to the System (system using EXPO32 ADC software)

If unplugged earlier, plug the two ac power cords back into the wall outlet.

Stage 2: Restoring Power to the Workstation (system using EXPO32 ADC software)

If the Workstation computer was powered off earlier:

1. Firmly press the power ON/OFF switch until the computer turns on. The operating system automatically boots.
2. When the Microsoft Windows Startup Menu appears, highlight **1. Normal** and press Enter.
3. When the Windows Desktop appears, double click on the **EXPO32ADC XL 4 Color** icon (**EXPO32ADC XL 3 Color** icon if this is a 3 color system).
4. When the Startup box appears, select **Admin** ▸▸ **Next>**.
5. Select a protocol or click on the **Finish** button.
6. At the Cytometer, verify the LASER ON indicator lights green.
7. At the Workstation, verify the message *Startup in process* appears on the status line (lower display area).

   Note: During system startup, a sequence of messages (*Startup in process* → *Verification* → *Run Initialization* → *Awaiting Sample* appear as the instrument goes through various checks. Error messages appear to the right, if applicable.
8. At the Cytometer, verify the CYTOMETER READY indicator lights green.

   Note: The Cytometer can take up to 30 minutes to warm up before the READY indicator turns green.

Restoring Power to the Cytometer Only (system using EXPO32 ADC software)

1. At the Windows Desktop, double click on the **EXPO32ADC XL 4 Color** icon (**EXPO32ADC XL 3 Color** icon if this is a 3 color system).
2. When the Startup box appears, select **Admin ▸▸ Next>**.
3. Select a protocol or click on the **Finish** button.
4. At the Cytometer, verify the LASER ON indicator lights green.
5. At the Workstation, verify the message *Startup in process* appears on the status line (lower display area).

   Note: During system startup, a sequence of messages (*Startup in process* → *Verification* → *Run Initialization* → *Awaiting Sample* appear as the instrument goes through various checks. Error messages appear to the right, if applicable.
6. At the Cytometer, verify the CYTOMETER READY indicator lights green.

   Note: The Cytometer can take up to 30 minutes to warm up before the READY indicator turns green.

4.2 PREFINAL SERVICE SOFTWARE INSTALLATION AND OPERATION

Purpose

Use this procedure to install and operate the Prefinal Service software. This software is not intended to be a Pass/Fail for system performance. The SVP must be run after using the Prefinal Service software.

Tools/Supplies Needed

- ❑ COULTER® EPICS® XL/XL-MCL Prefinal Software diskette, PN 7231244

Preparation

Instructions are provided for SYSTEM II and EXPO32 ADC software. Go to the If Using SYSTEM II™ Software heading or the If Using EXPO32™ ADC Software heading, as applicable.

If Using SYSTEM II™ Software

1. Make sure the Workstation computer is turned on.

   If the Workstation computer is off, power on the Workstation computer and Cytometer, refer to Stage 2: Restoring Power to the Workstation (system using SYSTEM II software) under Heading 4.1, as needed.

2. Press F2. The message *EXIT TO DOS? y/n* should appear.

   Note: If the message does not appear, access the Menu bar. At the Menu bar, select **Applications ▸▸ Exit** and the *EXIT TO DOS? y/n* message should appear.

3. Type `Y`.
4. At the C:\XL> prompt, type `XLOFF` and press Enter to turn off only the Cytometer.
5. At the C:\XL> prompt, type `CD` Spacebar `\` then press Enter.
6. At the C:\> prompt, type DIR and press Enter.
7. Look for the Prefinal directory.
   - If the Prefinal directory is not listed, go to the Installation heading.
   - If the Prefinal directory is already installed,
     1) At the C:\> prompt, type `CD` Spacebar `PREFINAL` then press Enter.
     2) When the C:\PREFINAL> prompt appears, type `PREFINAL` then press Enter.

        Note: A warning box with the message *This software can NOT be used for final system verification. This software to be used for system diagnostics ONLY. Final Test Procedure or Service V.I.P. must be used to verify final system performance.* overlays the Prefinal Test screen. This warning box disappears automatically in 15 seconds. If you do not wish to wait, press Esc, Backspace, or Enter to close the box.

     3) Go to the Operation heading.

If Using EXPO32™ ADC Software

1. Make sure the Workstation computer is turned on.

   If the Workstation computer is off, power on the Workstation computer and Cytometer, refer to Stage 2: Restoring Power to the Workstation (system using EXPO32 ADC software) under Heading 4.1, as needed.
2. Close the EXPO32 ADC software (click on the X in the upper right corner).
3. When the message *Before continuing, do you want to save the current protocol?* appears, select **Yes** or **No**, as applicable.
4. At the Windows Desktop, double click on the **XL Off** icon to power off the Cytometer.
5. Select Windows **Start** button ▸▸ **Programs** ▸▸ **MS-DOS Prompt**.
6. At the C:\Windows> prompt, type `CD` Spacebar `\` then press Enter.
7. At the C:\> prompt, type DIR and press Enter.
8. Look for the Prefinal directory.
   - If the Prefinal directory is not listed, go to the Installation heading.
   - If the Prefinal directory is already installed,
     1) At the C:\> prompt, type `CD` Spacebar `PREFINAL` then press Enter.
     2) When the C:\PREFINAL> prompt appears, type `PREFINAL` then press Enter.

        Note: A warning box with the message *This software can NOT be used for final system verification. This software to be used for system diagnostics ONLY. Final Test Procedure or Service V.I.P. must be used to verify final system performance.* overlays the Prefinal Test screen. This warning box disappears automatically in 15 seconds. If you do not wish to wait, press Esc, Backspace, or Enter to close the box.
     3) Go to the Operation heading.

Installation

1. At the C:\> prompt, type `MD` Spacebar `PREFINAL` then press Enter.
2. At the C:\> prompt, type `CD` Spacebar `PREFINAL` then press Enter.
3. When the C:\PREFINAL> prompt appears, insert the Prefinal Software diskette into the 3.5 in. floppy diskette drive on the Workstation computer.
4. At the C:\PREFINAL> prompt, type `COPY` Spacebar `A:*.*` then press Enter.
5. Wait while all the files are copied into the PREFINAL subdirectory.
6. When the C:\PREFINAL> prompt reappears, type `PREFINAL` then press Enter.

   Note: A warning box with the message *This software can NOT be used for final system verification. This software to be used for system diagnostics ONLY. Final Test Procedure or Service V.I.P. must be used to verify final system performance.* overlays the Prefinal Test screen. This warning box disappears automatically in 15 seconds. If you do not wish to wait, press Esc, Backspace, or Enter to close the box.
7. Remove the Prefinal Software diskette from the drive.

Operation

1. At the Prefinal Test menu, use ↑ and ↓ to scroll through the menu to the desired option or test. Press Enter to access the desired option or test.
   - Table A.4-1 briefly describes the tests available from the Prefinal Test menu.
   - See Heading 7.2 for a detailed description of each test.
   - A Help screen is provided for each test. To access the Help screen for a specific test, select the test then press F4.
   - On an XL-MCL flow cytometer, the MCL door switch **must be defeated** before you run the MCL TERMINAL program. Place a wire jumper between pins 3 and 4 on the door interlock connector to defeat the door switch.
   - Keyboard command codes are shown in Table A.4-2 for all tests requiring manual control of the MCL option.
2. When all testing is complete, see the bottom of the screen for appropriate exit instructions.

Wrap Up

Instructions are provided for SYSTEM II and EXPO32 ADC software. Go to the If SYSTEM II is the Customer's Preferred Operating System heading or the If EXPO32 ADC is the Customer's Preferred Operating System heading, as applicable.

If SYSTEM II is the Customer's Preferred Operating System

1. If you have not already done so, remove the Prefinal Software diskette from the drive.
2. At the C:\PREFINAL> prompt, type `CD` Spacebar `\XL` then press Enter.
3. At the C:\XL> prompt, type `XL2` then press Enter.
4. After the SYSTEM II™ software screen appears, the following messages are displayed:
   a. *Rebuilding protocol directory*
   b. *Resetting cytometer*
   c. *Loading cytom. hardware*

   Note: Once the software is loaded, it turns on the Cytometer. This process should take less than 30 seconds.
5. If the Operator ID box appears, type in an operator number and press Enter. The Acquisition Run screen appears.

   Note: If the Listmode Analysis screen appears and the Cytometer does not turn on, check for a communication problem.
6. At the Cytometer, verify the LASER ON indicator lights green.
7. At the Acquisition Run screen, verify the message *STARTUP IN PROCESS* appears (lower right display area).

   Note: During system startup, a sequence of messages (*STARTUP IN PROCESS* → *SYSTEM VERIFICATION* → *RUN INITIALIZATION* → *PLEASE WAIT. . PROCESSING* → *INSERT SAMPLE TUBE* appear as the instrument goes through various checks. *INSERT SAMPLE TUBE* only appears if a startup protocol or panel is either selected or previously specified on the Utilities Configuration screen. Error messages appear in red below this message line.

8. At the Cytometer, verify the CYTOMETER READY indicator lights green.
9. Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP)

If EXPO32 ADC is the Customer's Preferred Operating System

1. If you have not already done so, remove the Prefinal Software diskette from the drive.
2. At the keyboard, type `Exit` then press Enter to close the MS-DOS Prompt box.
3. When the Windows Desktop appears, double click on the **EXPO32ADC XL 4 Color** icon (**EXPO32ADC XL 3 Color** icon if this is a 3 color system).
4. When the Startup box appears, select **Admin** ▸▸ **Next>**.
5. Select a protocol or click on the **Finish** button.
6. At the Cytometer, verify the LASER ON indicator lights green.
7. At the Workstation, verify the message *Startup in process* appears on the status line (lower display area).

   Note: During system startup, a sequence of messages (*Startup in process* → *Verification* → *Run Initialization* → *Awaiting Sample* appear as the instrument goes through various checks. Error messages appear to the right, if applicable.
8. At the Cytometer, verify the CYTOMETER READY indicator lights green.
9. Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

4.3 COVER REMOVAL AND REINSTALLATION

Purpose

Cover removal and reinstallation is divided into physical sections depending on the area of the instrument you need to access. To expedite finding the appropriate procedure, the procedures in this section are organized into Exterior Cytometer Covers, Access Inside the Cytometer, and Power Supply Module Covers.

Overview

To expedite finding instructions on how to remove or reinstall a cover or how to properly open or close a cover, the procedures in this section are organized in physical sections that correlate with the area of the instrument you need to access.

- Figure 4.3-1 is the anchor illustration from which you can quickly locate procedures involving an exterior Cytometer cover.
- Figure 4.3-2 is the anchor illustration from which you can quickly locate procedures involving access to components inside the Cytometer.
- Figure 4.3-3 is the anchor illustration from which you can quickly locate procedures involving Power Supply module covers.

Figures 4.3-1, 4.3-2, and 4.3-3 are referred to as anchor illustrations because they serve as the reference point for accessing a specific procedure that includes illustration(s).

Locating a Procedure

1. To quickly locate a procedure, always begin at the most appropriate anchor illustration.
   - Figure 4.3-1, Exterior Cytometer Cover Procedures
   - Figure 4.3-2, Interior Cytometer Access Procedures
   - Figure 4.3-3, Power Supply Module Cover Procedures
2. Locate the cover on the anchor illustration and note the associated number.
3. Locate the associated number in the **Figure Reference** column.

WARNING Risk of personal or operator injury. Instrument doors, covers, and panels that are mishandled can fail, leading to personal injury. Handle the doors, covers, and panels with care and always follow the written instructions for opening and closing or removing and reinstalling them.

4. Go to the referenced procedure.

   Note: In the electronic version, each procedure reference is in hypertext so that when you select the reference, the procedure quickly appears. Using the hypertext links is the fastest way to access a procedure.

   - A procedure that provides instructions for opening and closing a cover begins with how to open the cover which is followed by how to close the cover.
   - A procedure that provides instructions for removing and reinstalling a cover begins with how to remove the cover which is followed by how to reinstall the cover.

Exterior Cytometer Covers

Use Figure 4.3-1 as a reference for locating the procedure for opening and closing or removing and reinstalling an external Cytometer cover.

WARNING Risk of personal or operator injury. Covers and interlocks are installed on Beckman Coulter instruments to prevent injury from operating components. If you must remove covers or disable interlocks to service an instrument:

- Be alert and use extreme care when working around exposed components to avoid personal injury.
- At the end of the service call, **always** reinstall all instrument covers and ensure interlocks are enabled to prevent operator injury.

Figure 4.3-1 Exterior Cytometer Cover Procedures

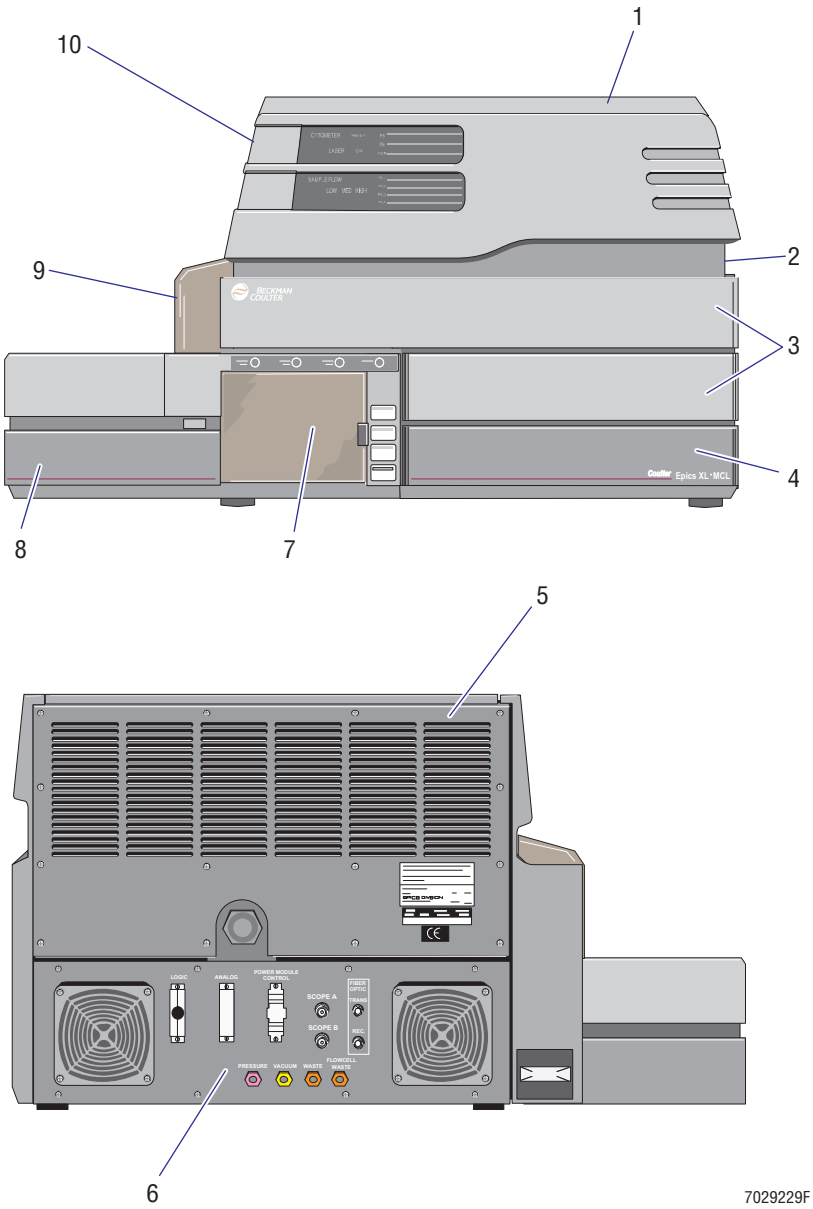


Figure Reference

1 How to Remove and Reinstall the Cytometer Top Cover — Procedure 1

2 How to Remove and Reinstall the Cytometer Right-Side Cover — Procedure 2

3 How to Remove and Reinstall the Center Front Cover (Filter Cover) — Procedure 3

4 How to Properly Open and Close the Cytometer Reagent Drawer — Procedure 4

5 How to Remove and Reinstall the Cytometer Upper Rear Cover — Procedure 5

6 How to Remove and Reinstall the Cytometer Lower Rear Cover — Procedure 6

7 How to Remove and Reinstall the Manual Sample Station, Cytometer with MCL Option — Procedure 7

How to Remove and Reinstall the Manual Sample Station, Cytometer without MCL Option — Procedure 8

8 How to Open and Close the MCL Door — Procedure 9

How to Unlatch and Relatch the MCL Covers — Procedure 10

How to Remove and Reinstall MCL Covers — Procedure 11

9 How to Remove and Reinstall the MCL Probe Housing — Procedure 12

10 How to Remove and Reinstall the Cytometer Left-Side Cover (Cytometer with MCL Option Installed) — Procedure 13

How to Remove and Reinstall the Cytometer Left-Side Cover (Cytometer without MCL Option) — Procedure 14

Access Inside the Cytometer

Use Figure 4.3-2 as a reference for locating the procedure needed to access components inside the Cytometer.

WARNING Risk of personal or operator injury. Covers and interlocks are installed on Beckman Coulter instruments to prevent injury from operating components. If you must remove covers or disable interlocks to service an instrument:

- Be alert and use extreme care when working around exposed components to avoid personal injury.
- At the end of the service call, **always** reinstall all instrument covers and ensure interlocks are enabled to prevent operator injury.

Figure 4.3-2 Interior Cytometer Access Procedures

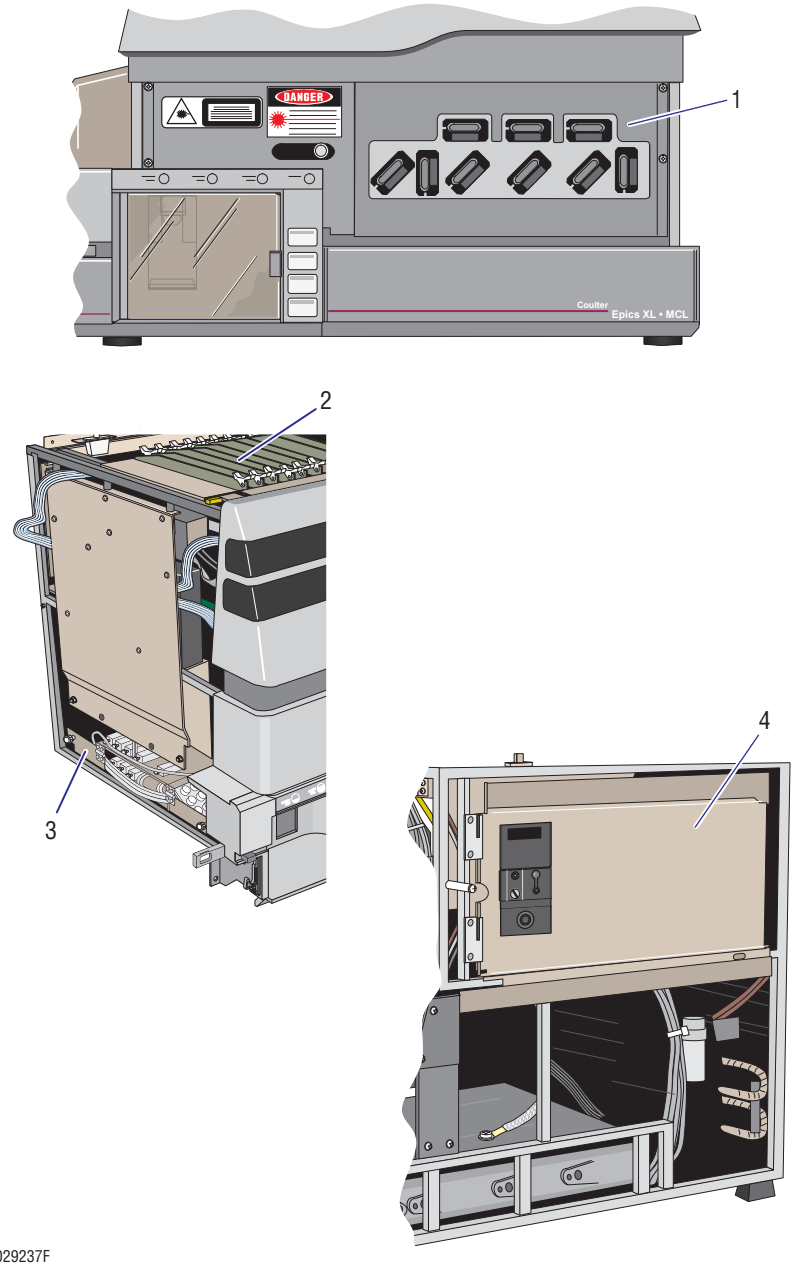


Figure Reference

1. How to Remove and Reinstall the Filter Shield — Procedure 15
2. How to Remove and Reinstall the Data Acquisition Card Cage — Procedure 16
3. How to Remove and Reinstall the Lower Pneumatics Drawer — Procedure 17
4. How to Remove and Reinstall the Upper Pneumatics Drawer EMC Shield — Procedure 18

Power Supply Module Covers

Use Figure 4.3-3 as a reference for locating a procedure involving a Power Supply module cover.

WARNING Risk of personal or operator injury. Covers and interlocks are installed on Beckman Coulter instruments to prevent injury from operating components. If you must remove covers or disable interlocks to service an instrument:

- Be alert and use extreme care when working around exposed components to avoid personal injury.
- At the end of the service call, **always** reinstall all instrument covers and ensure interlocks are enabled to prevent operator injury.

Figure 4.3-3 Power Supply Module Cover Procedures

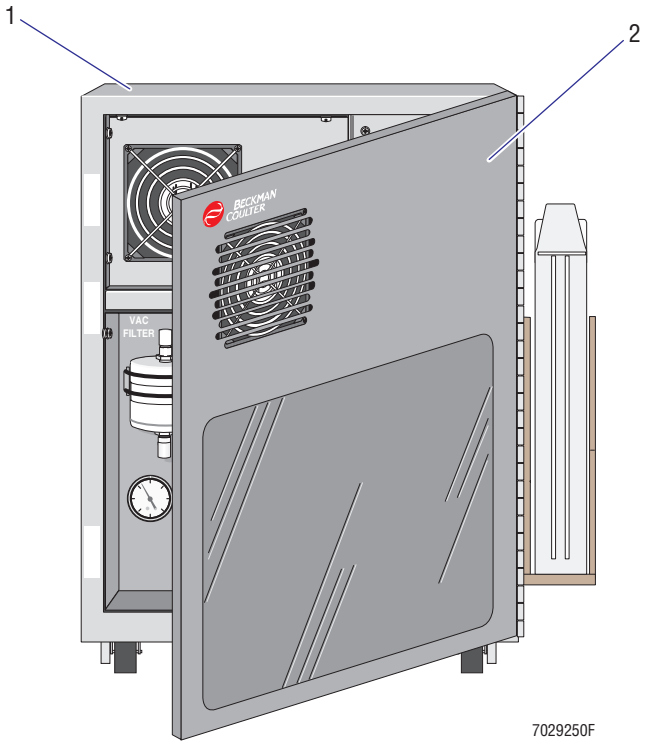


Figure Reference

1 How to Remove and Reinstall the Power Supply Module Three-Side Cover — Procedure 19

2 How to Open and Close the Power Supply Module Front Door — Procedure 20

Procedure 1

How to Remove and Reinstall the Cytometer Top Cover

The Cytometer interlock switch and Data Acquisition card cage are accessible when the Cytometer top cover is removed. The rear section of the optical collection area is also accessible when the Cytometer top cover is removed and the Data Acquisition card cage is removed from the center cavity. See Figures A.5-3 and A.5-4 for components that are accessible with the top cover removed and Tables A.5-3 and A.5-4 for a description of component functions.

The top cover can be removed without affecting instrument operation, as long as the interlock is disabled (bypassed). The top cover must be removed before either the left-side or right-side covers can be removed.

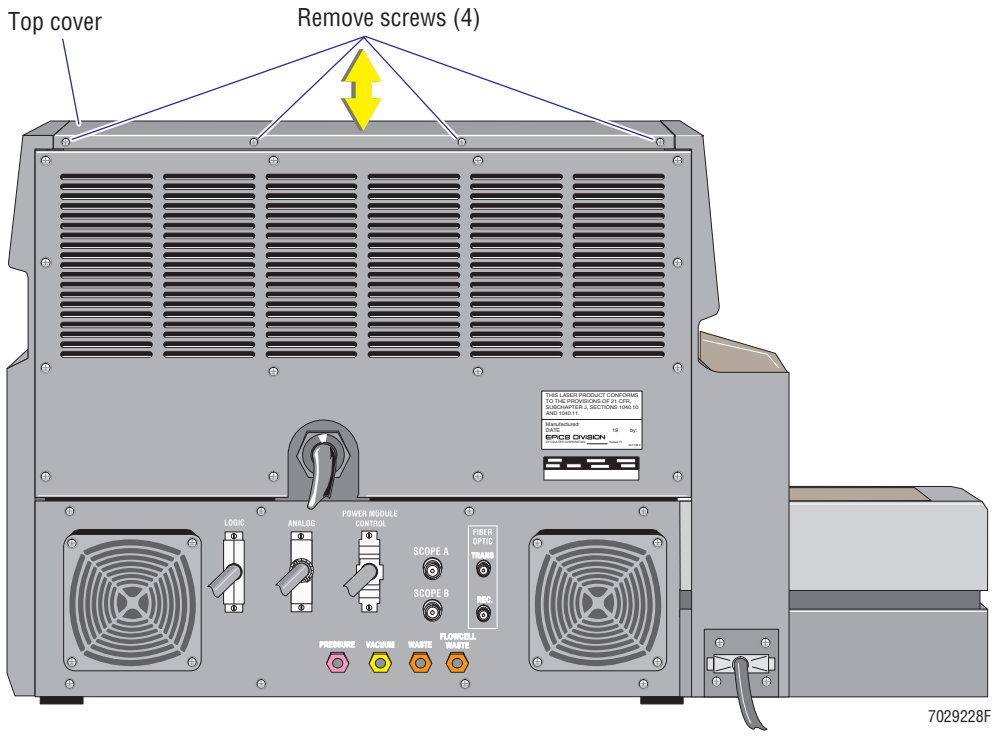
Tools/Supplies Needed

- ❑ Phillips-head screwdriver

Removing the Cytometer Top Cover

1. At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer (Figure 4.3-4).

Figure 4.3-4 Cytometer Top Cover Removal or Installation



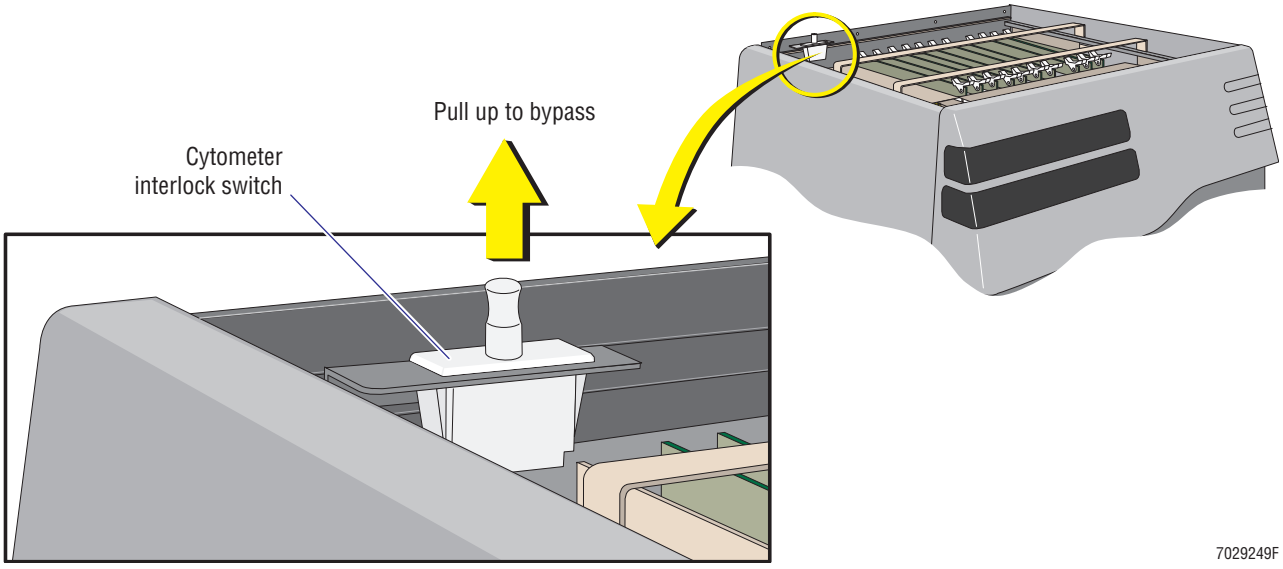
2. Lift the top cover up and off the Cytometer (Figure 4.3-4).
3. Set the cover aside in a safe place where it will not be damaged.

Note: If the laser is on when the top cover is removed, an interlock turns off power to the laser head. To bypass this interlock, see the Cytometer Interlock Switch heading that follows.

Cytometer Interlock Switch

The Cytometer interlock switch (Figure 4.3-5) is a safety interlock to ensure the Cytometer top cover is in place when the Argon laser is on. If the laser is on and the top cover is removed, this interlock turns off the power to the Argon laser head.

Figure 4.3-5 Interlock Switch Location, Cytometer



WARNING Risk of personal injury. Be very careful when operating the instrument when the safety interlock switch in the Cytometer is defeated, as you may be exposed to the laser beam and/or electric shock. After servicing the instrument, make sure the top cover is properly reinstalled to reactivate the safety interlock switch if bypassed while servicing the instrument.

WARNING Risk of eye injury. If the safety interlock is bypassed, the Argon laser powers on and the potential for injury exists. Reflections of the laser beam off a shiny object such as a screwdriver, or direct viewing of the laser beam can severely damage your eyes. When performing replacement or adjustment procedures:

- Wear laser safety glasses as required by the wavelength being used.
- Pay attention to the warning labels.
- Do NOT wear jewelry that might reflect the laser beam.
- Do NOT directly observe the intersection of the laser beam and the targets.

To override (bypass) this safety interlock, pull the switch up and power is restored to the Argon laser head even though the cover is removed.

Always be very careful if you bypass this safety interlock and operate the instrument with the covers off. The interlock switch is reset when the cover is reinstalled.

Reinstalling the Cytometer Top Cover

1. Place the top cover on the Cytometer.
2. Make sure the top cover is properly seated. The interlock switch is automatically reset.
3. At the rear of the Cytometer, secure the top cover to the Cytometer frame by tightening the four Phillips-head screws (Figure 4.3-4).

Procedure 2

How to Remove and Reinstall the Cytometer Right-Side Cover

Removing the Cytometer right-side cover provides access to the upper pneumatics drawer and the water trap filter, VL33, manifold, and cooling coil mounted on the back of the rear panel. See Figure A.5-5 for the components that are accessible with the right-side cover removed and Table A.5-5 for a description of component functions. The top cover must be removed before the right-side cover can be removed.

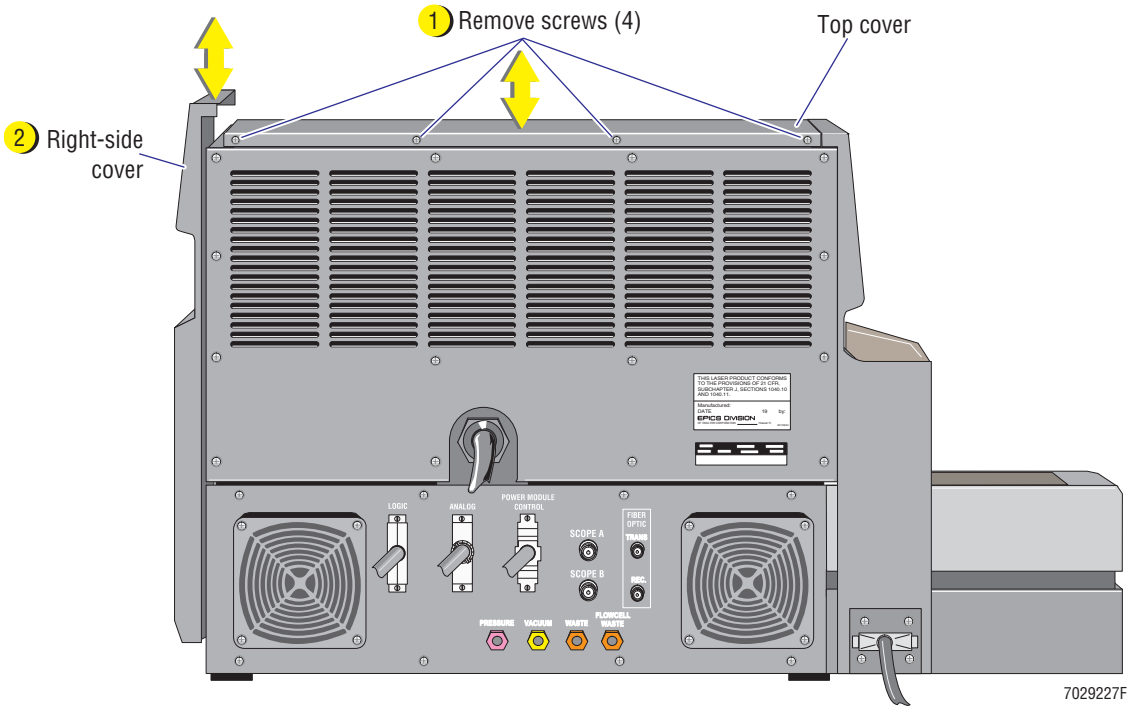
Tools/Supplies Needed

- ❑ Phillips-head screwdriver

Removing the Cytometer Right-Side Cover

1. Remove the Cytometer top cover (Figure 4.3-6, item 1).
   a. At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer
   b. Lift the top cover up and off the Cytometer.
   c. Set it aside in a safe place where it will not be damaged.
2. Pull the right-side cover up and off the Cytometer frame (Figure 4.3-6, item 2).

Figure 4.3-6 Cytometer Right-Side Cover Removal or Installation



3. Set the cover aside in a safe place where it will not be damaged.

Reinstalling the Cytometer Right-Side Cover

1. Position the right-side cover on the Cytometer frame.
2. Push the cover down on the Cytometer frame (Figure 4.3-6, item 2).
3. Make sure the upper and lower fasteners on the inside of the cover are properly positioned inside the Cytometer frame.
4. Reinstall the Cytometer top cover (Figure 4.3-6, item 1).
    a. Place the top cover on the Cytometer.
    b. Make sure the top cover is properly seated.
    c. At the rear of the Cytometer, secure the top cover to the Cytometer frame by tightening the four Phillips-head screws.

Procedure 3

How to Remove and Reinstall the Center Front Cover (Filter Cover)

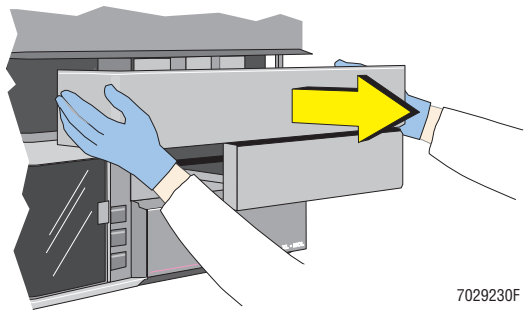
Removing the center front cover (as referred to as the filter cover) allows access to the filter shield, the individual light filters, and the ND1 filter positioning knob. See Figure A.5-6 for the components that are accessible with the center front cover removed and Table A.5-6 for a description of component functions.

Tools/Supplies Needed

- ❑ None

Removing the Center Front Cover (Filter Cover)

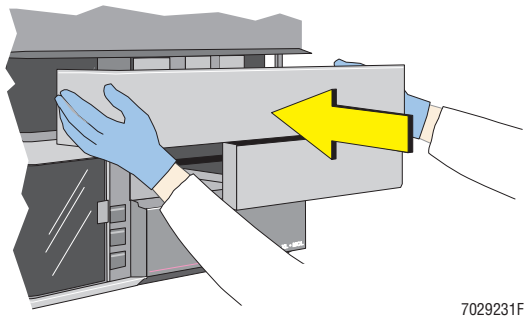
Figure 4.3-7 Removing the Center Front Cover



1. Grasp the curved outer edges of the center front cover (filter cover) and pull the cover forward (Figure 4.3-7).
2. Set the cover aside in a safe place where it will not be damaged.

Reinstalling the Center Front Cover (Filter Cover)

Figure 4.3-8 Reinstalling the Center Front Cover



1. Position the latch on each end of the center front cover (filter cover) near its corresponding catch on the Cytometer frame (Figure 4.3-8).
2. Push the center front cover back on the instrument. The latches snap into place to secure the cover to the Cytometer frame.

   Note: The center front cover fits over the lower edge of the front display panel door.

Procedure 4

How to Properly Open and Close the Cytometer Reagent Drawer

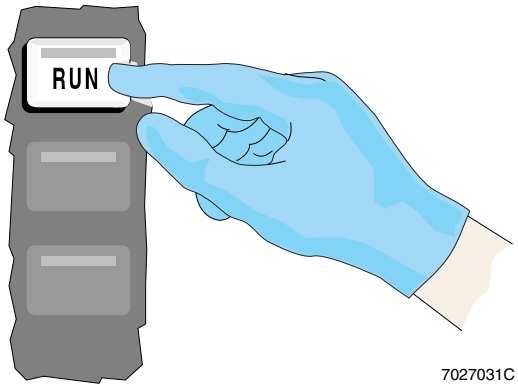
Opening the reagent drawer allows access to reagent containers, sheath liquid filter, and the purge mechanism. See Figure A.5-8 for the components that are accessible with the reagent drawer open and Table A.5-8 for a description of component functions.

Tools/Supplies Needed

- ❑ None

Opening the Reagent Drawer

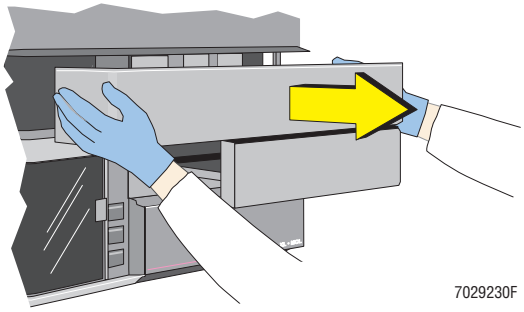
Figure 4.3-9 Placing the Cytometer in the Idle Mode



1. Verify the Cytometer is in the Idle mode.

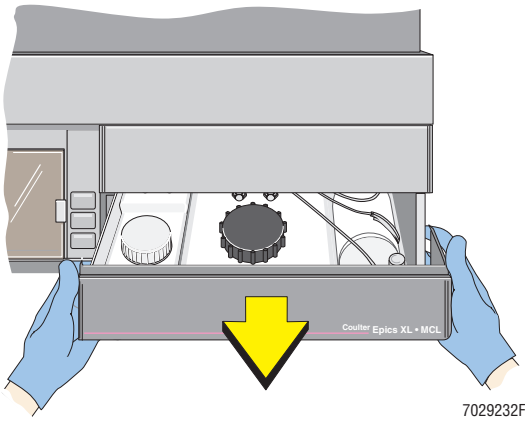
   Note: The Cytometer is in the Idle mode when a level sense indicator is glowing (not flashing) red or the indicator in the Cytometer RUN button is flashing green.
2. If the Cytometer is not in the Idle mode, press the RUN button (Figure 4.3-9).
3. Wait about 10 seconds for the Cytometer to depressurize.

Figure 4.3-10 Removing the Center Front Cover (Optional)



4. Optional step to enhance access to components inside the reagent drawer:
   a. Remove the center front cover (filter cover) by grasping the curved outer edges of the cover and pulling the cover forward (Figure 4.3-10).
   b. Set the cover aside in a safe place where it will not be damaged.

Figure 4.3-11 Opening the Reagent Drawer

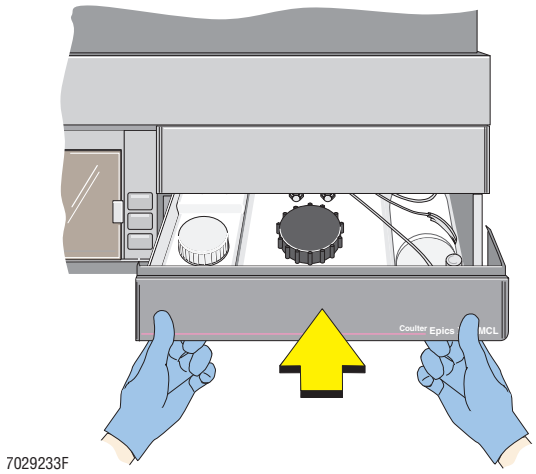


5. Grasp the reagent drawer and pull the drawer forward until it stops (Figure 4.3-11). The reagent drawer sits inside self-locking tracks and will stop when it locks.

   Note: If you need to pull the reagent drawer out further, push and hold the locking tabs under the tracks and pull the drawer forward.

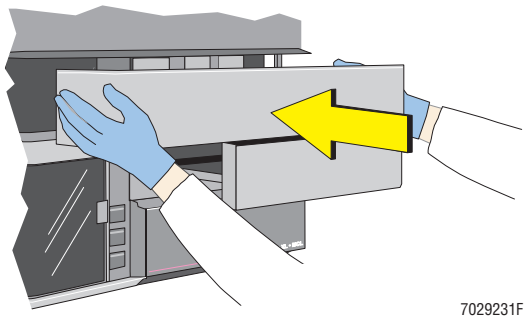
Closing the Reagent Drawer

Figure 4.3-12 Closing the Reagent Drawer



1. Slide the reagent drawer back inside the Cytometer (Figure 4.3-12). Make sure the reagent tubing does not become crimped as you push the drawer closed.

Figure 4.3-13 Reinstalling Center Front Cover, if applicable



2. If the center front cover was removed earlier:
   a. Position the latch on each end of the center front cover (filter cover) near its corresponding catch on the Cytometer frame (Figure 4.3-13).
   b. Push the center front cover back on the instrument. The latches snap into place to secure the cover to the Cytometer frame.

      Note: The center front cover fits over the lower edge of the front display panel door.

Procedure 5

How to Remove and Reinstall the Cytometer Upper Rear Cover

The upper rear cover is only removed when the Argon laser head is replaced. Otherwise, components inside the Cytometer cavity are accessed with the top cover removed and the Data Acquisition card cage lifted and locked in its vertical position and/or with the right-side cover removed.

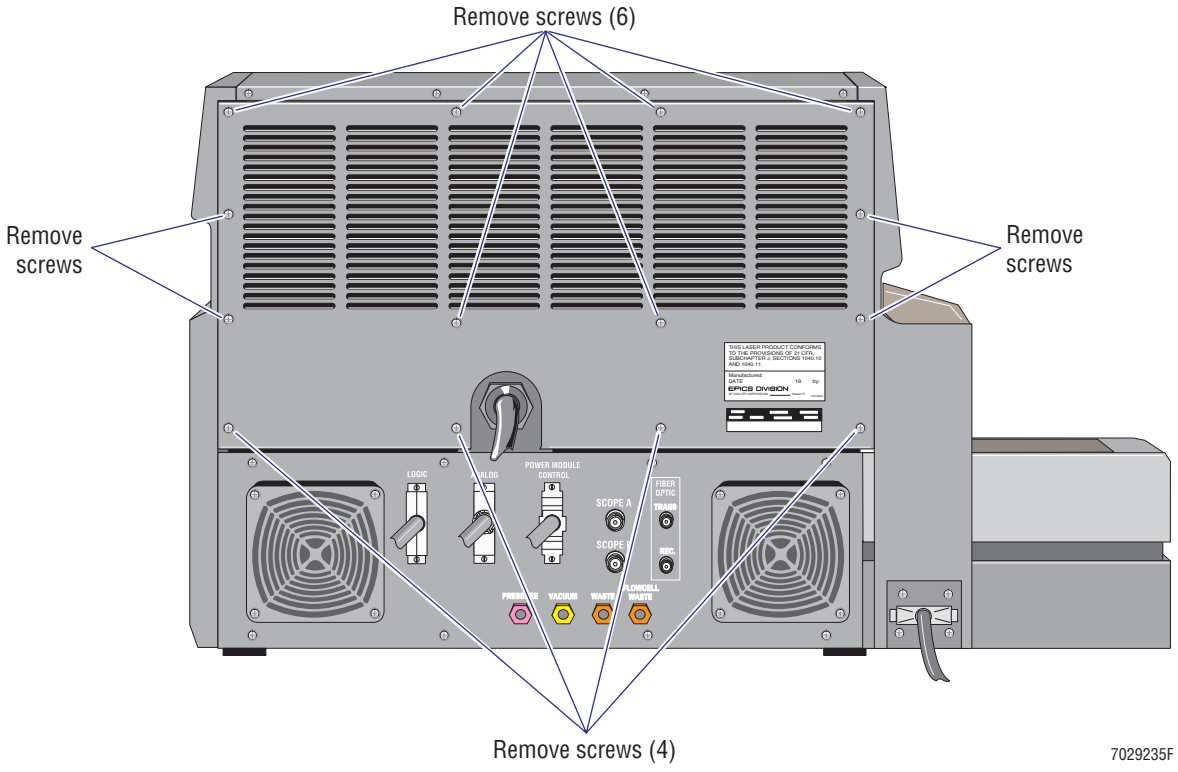
Tools/Supplies Needed

- ❑ Phillips-head screwdriver

Removing the Cytometer Upper Rear Cover

1. Remove the Cytometer top cover.
   a. At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer (Figure 4.3-4).
   b. Lift the top cover up and off the Cytometer.
   c. Set it aside in a safe place where it will not be damaged.
2. Remove the flexible duct from the exhaust vent. Lay the flexible duct on the optical bench.
3. Remove the 14 Phillips-head screws securing the upper rear cover to the Cytometer frame. See Figure 4.3-14 for screw locations.

Figure 4.3-14 Cytometer Upper Rear Cover Screw Locations



4. Remove the rear cover from the Cytometer frame and set it aside in a safe place where it will not be damaged.

Reinstalling the Cytometer Upper Rear Cover

1. Position the upper rear cover on the Cytometer frame. Make sure the labels are on the exterior.
2. Loosely reinstall the 14 Phillips-head screws to secure the cover to the Cytometer frame. See Figure 4.3-14 for screw locations.
3. Tighten all 14 screws.
4. Reinstall the flexible duct removed earlier back on the exhaust vent.
5. Reinstall the Cytometer top cover.
    a. Place the top cover on the Cytometer.
    b. Make sure the top cover is properly seated.
    c. At the rear of the Cytometer, secure the top cover to the Cytometer frame by tightening the four Phillips-head screws.

Procedure 6

How to Remove and Reinstall the Cytometer Lower Rear Cover

The Cytometer lower rear cover rarely needs to be removed. When access to this lower rear area is required, it is generally easier to gain that access by removing either the left-side or right-side cover. If it does become necessary to remove the lower rear cover from the Cytometer frame, disconnect only those tubings and cables that are required to provide the needed access. See Figure A.5-9 for components attached to the lower rear cover and Table A.5-9 for a description of component functions.

Tools/Supplies Needed

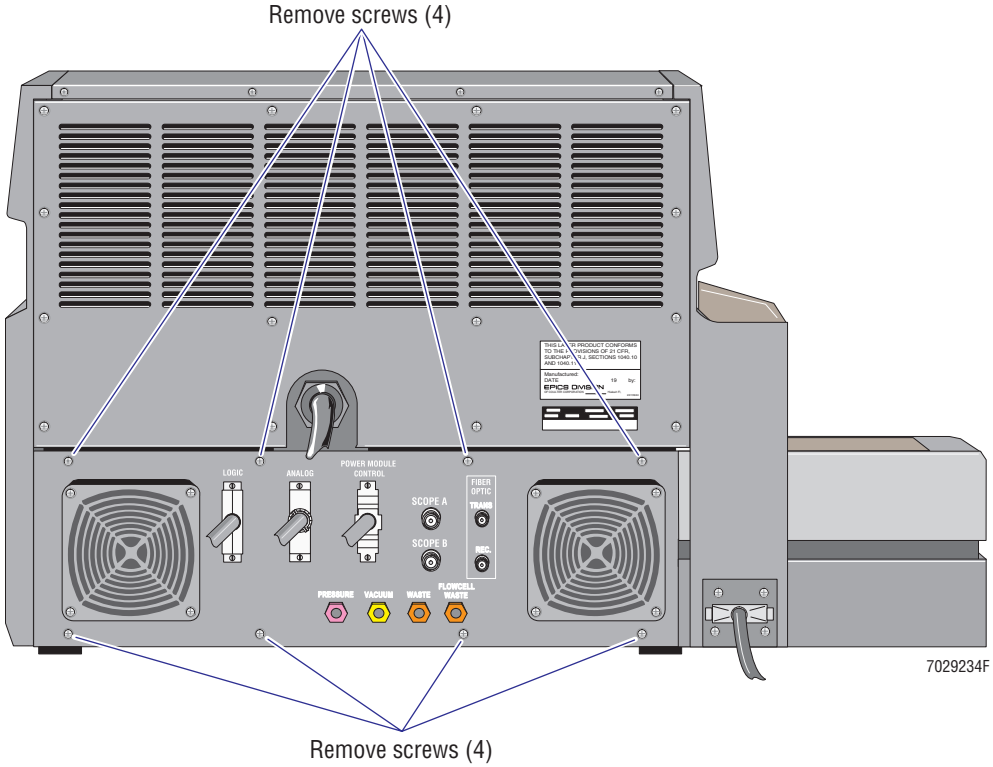
- ❑ Phillips-head screwdriver

Removing the Cytometer Lower Rear Cover

1. Remove the eight Phillips-head screws securing the lower rear cover to the Cytometer frame (Figure 4.3-15).

   Note: The screws to be removed are located near the outer edge of the cover. Four screws are located across the top and another four screws across the bottom.

Figure 4.3-15 Cytometer Lower Rear Cover Screw Locations



ATTENTION: Many tubings and cables are attached to the inside of this lower rear cover. To prevent disconnection or component breaks, you must be careful to pull the cover slowly away from the Cytometer frame.

2. Gently pull the cover away from the Cytometer frame. Any tubings or cables that restrict access must be removed. Make sure you are certain where to reconnect each tubing or cable you disconnect. If later, the reconnection location may be unclear, write the reconnection location on a piece of paper and wrap the label around the disconnected tubing or cable to ensure proper reconnection.

Reinstalling the Cytometer Lower Rear Cover

1. On the lower rear cover's inner panel:
   a. Reconnect any tubing or cable you disconnected.
   b. Check all other tubings and connectors to make sure they are secure.
2. Gently push the cover into position on the Cytometer frame. Make sure that no tubing or cable gets pinched between the cover and the Cytometer frame.
3. Reinstall the eight Phillips-head screws to secure the lower rear cover to the Cytometer frame. See Figure 4.3-15, as needed.
4. On the lower rear cover's outer panel:
   a. Reconnect any tubings or cables you disconnected.
   b. Check all other tubings and connectors to make sure they are secure.

Procedure 7

How to Remove and Reinstall the Manual Sample Station, Cytometer with MCL Option

The manual sample station must be removed to access the segmenting valve. To access the lower pneumatics drawer, the manual sample station must be removed to access one of the Phillips-head screws that secure the MCL to the Cytometer main frame. See Figure A.5-10 for manual sample station components and Table A.5-10 for a description of component functions.

Tools/Supplies Needed

- ❑ Phillips-head screwdriver

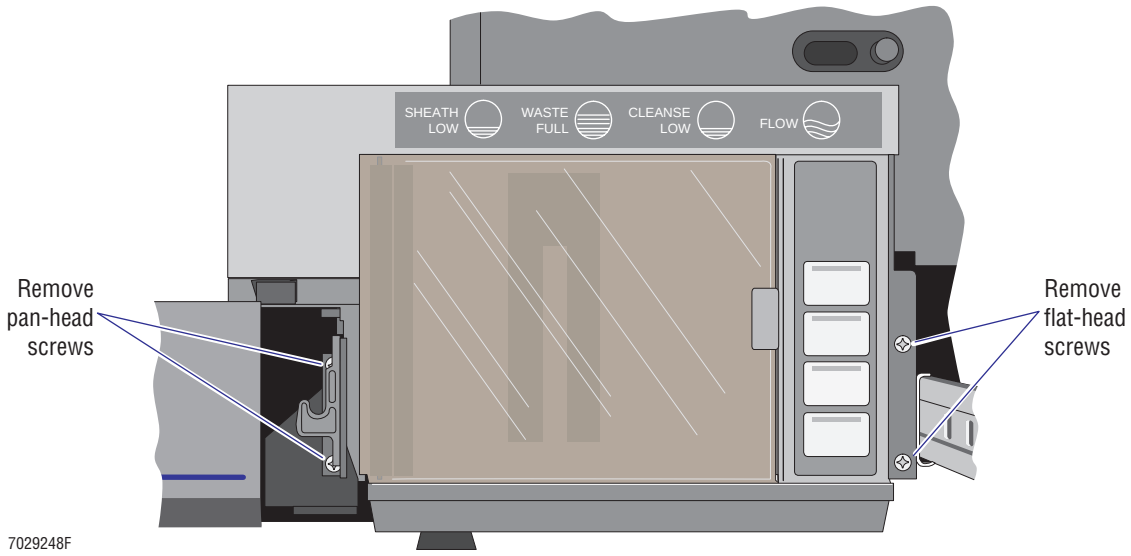
Removing the Manual Sample Station on a Cytometer with the MCL Option Installed

1. Remove the center front cover (filter cover).
   a. Grasp the curved outer edges of the center front cover (filter cover) and pull the cover forward (Figure 4.3-7).
   b. Set the cover aside in a safe place where it will not be damaged.
2. Remove the MCL probe housing.
   a. Push the button to unlock the MCL door (Figure 4.3-25). The door pops open as the air cylinder attached to the door extends.
   b. Push the door up to ensure it is fully open.
   c. Remove the two Phillips-head screws securing the housing to the Cytometer frame (Figure 4.3-26).
   d. Slide the housing cover forward and remove it from the instrument.
   e. Set the housing cover aside in a safe place where it will not be damaged.
   f. Lower the MCL door. Listen for an audible snap as it closes.
3. Unlatch the MCL by grasping the MCL lower cover and firmly pulling the MCL base away from the Cytometer frame (Figure 4.3-20). **Do not attempt to remove the MCL from the Cytometer.**
4. Slide the reagent drawer open.
   a. Verify the Cytometer is in the Idle mode.
      1) If the Cytometer is not in the Idle mode, press the RUN button (Figure 4.3-9).
      2) Wait about 10 seconds for the Cytometer to depressurize.
   b. Grasp the reagent drawer and pull the drawer forward until it stops (Figure 4.3-11). The reagent drawer sits inside self-locking tracks and will stop when it locks.
   c. Push and hold the locking tabs under the tracks and pull the drawer out further. The top of the reagent containers will provide a place to rest the manual sample station cover assembly when it is removed.

5. Remove the manual sample station cover assembly:

   a. Locate and remove the two pan-head screws that secure the left side of the manual sample station to the Cytometer frame (Figure 4.3-16). You may need to move the MCL further away from the Cytometer frame.

Figure 4.3-16 Manual Sample Station Screw Locations



   b. Remove the two flat-head Phillips screws securing the right side of the manual sample station to the front of the Cytometer frame (Figure 4.3-16).

   c. Pull the manual sample station cover assembly off the Cytometer frame and lay the assembly on top of the reagent containers. Make sure the flat ribbon cable is positioned so that it does not become damaged.

   d. If you need to access the segmenting valve, remove the two Phillips-head screws that secure the sample and waste connect panel. To locate the sample and waste connect panel, refer to Figure A.5-10 as needed.

Reinstalling the Manual Sample Station on a Cytometer with the MCL Option Installed

1. If you removed the sample and waste connect panel, reinstall the panel using the two Phillips-head screws removed earlier.
2. Reinstall the manual sample station cover assembly:
   a. Position the manual sample station cover assembly back on the Cytometer frame. Make sure the flat ribbon cable is not crimped.
   b. On the **right side** of the manual sample station, loosely reinstall the two **flat** Phillips-head screws (Figure 4.3-16).
   c. On the **left side** of the manual sample station, loosely reinstall the two **pan** Phillips-head screws (Figure 4.3-16).
   d. Tighten the four screws to secure the manual sample station to the Cytometer frame.
3. Slide the reagent drawer back inside the Cytometer. Make sure the reagent tubing does not become crimped as you push the drawer closed.
4. Relatch the MCL lower cover to the Cytometer frame.
   a. Align the MCL lower cover with the latch attached to left-side of the Cytometer frame.
   b. Push the MCL base back on the Cytometer frame. Make sure it is securely attached.
   c. Open and close the MCL door several times. Listen for an audible snap as it closes. The MCL door must be closed with the interlock switch depressed for proper operation.
5. Reinstall the MCL probe housing using the two screws removed earlier.
   a. Open the MCL door then push the door up to ensure it is fully open.
   b. Make sure the back edge of the MCL probe housing cover is aligned to slide under the edge of the left-side cover then slide the beveled edge of the housing cover under the notched opening at the top of the push-button panel for the MCL door.
   c. Slide the housing cover back in position. Make sure that the tubing surrounding the MCL sample probe does not become crimped between the housing cover and the Cytometer frame.
   d. Reinstall the two Phillips-head screws removed earlier.
   e. Lower the MCL door.
6. Reinstall the center front cover (filter cover).

   Note: The center front cover fits over the lower edge of the front display panel door.
   a. Position the latch on each end of the center front cover (filter cover) near its corresponding catch on the Cytometer frame.
   b. Push the center front cover back on the instrument. The latches snap into place to secure the cover to the Cytometer frame.

Procedure 8

How to Remove and Reinstall the Manual Sample Station, Cytometer without MCL Option

The manual sample station must be removed to access the segmenting valve. See Figure A.5-11 for manual sample station components and Table A.5-11 for a description of component functions.

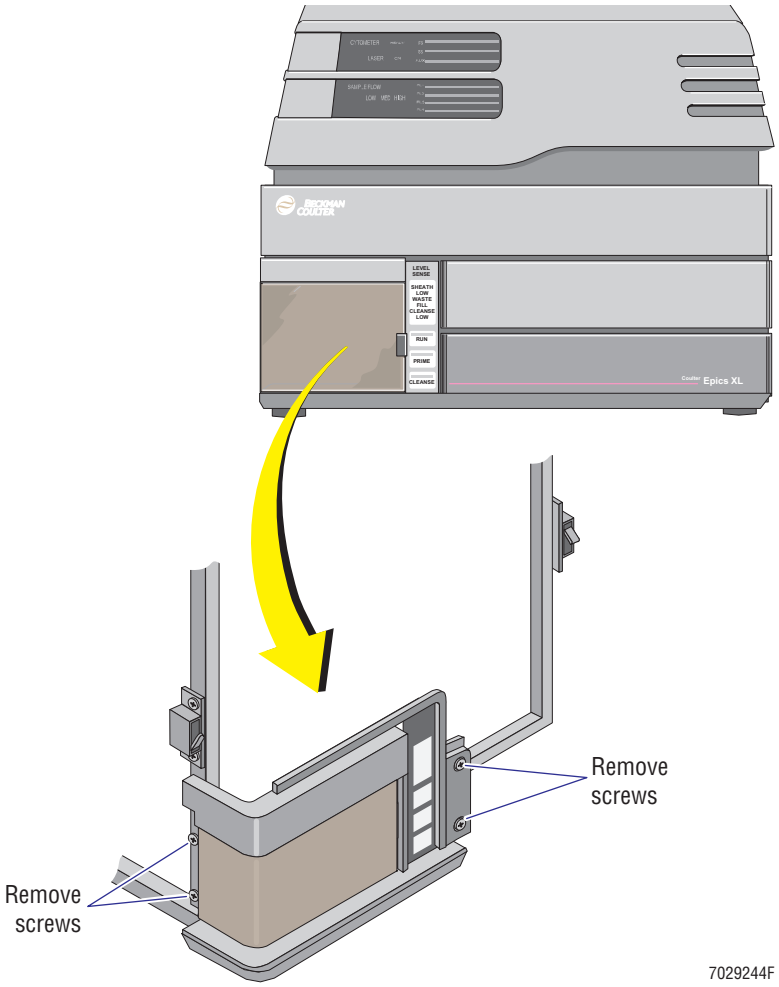
Tools/Supplies Needed

- ❑ Phillips-head screwdriver

Removing the Manual Sample Station on a Cytometer without the MCL Option

1. Remove the left-side cover.
   a. Remove the Cytometer top cover.
      1) At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer (Figure 4.3-29, item 1).
      2) Lift the top cover up and off the Cytometer.
      3) Set it aside in a safe place where it will not be damaged.
   b. Pull the left-side cover up and off the Cytometer frame (Figure 4.3-29, item 2).
   c. Set the cover aside in a safe place where it will not be damaged.
2. Remove the center front cover (filter cover).
   a. Grasp the curved outer edges of the center front cover (filter cover) and pull the cover forward (Figure 4.3-7).
   b. Set the cover aside in a safe place where it will not be damaged.
3. Slide the reagent drawer open.
   a. Verify the Cytometer is in the Idle mode.
      1) If the Cytometer is not in the Idle mode, press the RUN button (Figure 4.3-9).
      2) Wait about 10 seconds for the Cytometer to depressurize.
   b. Grasp the reagent drawer and pull the drawer forward until it stops (Figure 4.3-11). The reagent drawer sits inside self-locking tracks and will stop when it locks.
   c. Push and hold the locking tabs under the tracks and pull the drawer out further. The top of the reagent containers will provide a place to rest the manual sample station cover assembly when it is removed.
4. Remove the manual sample station cover assembly:
   a. Locate and remove the four Phillips-head screws that secure the manual sample station to the Cytometer frame (Figure 4.3-17).

Figure 4.3-17 Manual Sample Station Screw Locations



b. Pull the manual sample station cover assembly off the Cytometer frame and lay the assembly on top of the reagent containers. Make sure the flat ribbon cable is positioned so that it does not become damaged.

c. If you need to access the segmenting valve, remove the two Phillips-head screws that secure the sample and waste connect panel. To locate the sample and waste connect panel, refer to Figure A.5-11 as needed.

Reinstalling the Manual Sample Station on a Cytometer without the MCL Option

1. If you removed the sample and waste connect panel, reinstall the panel using the two Phillips-head screws removed earlier.
2. Reinstall the manual sample station cover assembly:
   a. Position the manual sample station cover assembly back on the Cytometer frame. Make sure the flat ribbon cable is not crimped.
   b. Loosely reinstall the four Phillips-head screws that secure the manual sample station to the Cytometer frame (Figure 4.3-17).
   c. Tighten the four screws.
3. Position the left-side cover on the Cytometer frame.
4. Push the cover down on the Cytometer frame.
5. Make sure the upper and lower fasteners on the inside of the cover are properly positioned inside the Cytometer frame.
6. Reinstall the Cytometer top cover.
   a. Place the top cover on the Cytometer.
   b. Make sure the top cover is properly seated.
   c. At the rear of the Cytometer, secure the top cover to the Cytometer frame by tightening the four Phillips-head screws.
7. Slide the reagent drawer back inside the Cytometer. Make sure the reagent tubing does not become crimped as you push the drawer closed.
8. Reinstall the center front cover (filter cover).

   Note: The center front cover fits over the lower edge of the front display panel door.
   a. Position the latch on each end of the center front cover (filter cover) near its corresponding catch on the Cytometer frame.
   b. Push the center front cover back on the instrument. The latches snap into place to secure the cover to the Cytometer frame.

Procedure 9

How to Open and Close the MCL Door

The MCL door (upper cover) is opened routinely to either place a carousel on the carousel hub (also referred to as the indexing hub) or remove a carousel. The MCL door must be closed during operation. If the door is open, operation is halted until the MCL door is closed. See Figure A.5-13 for MCL carousel components and Table A.5-13 for a description of component functions.

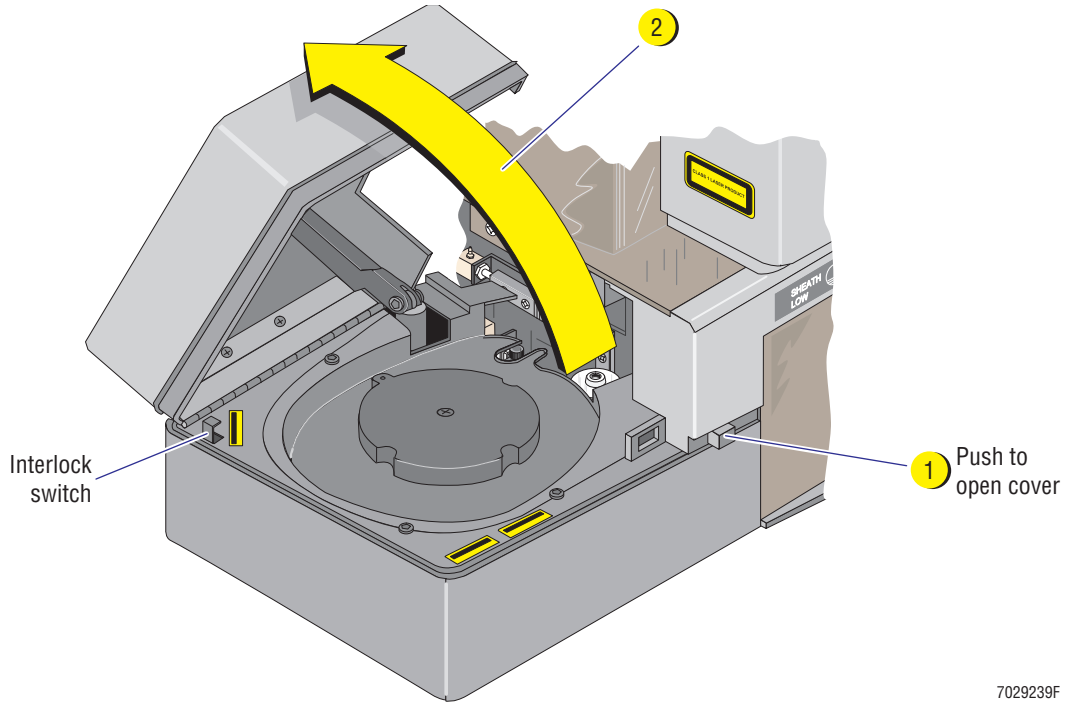
Tools/Supplies Needed

- ❑ None

Opening the MCL Door

1. Push the button to unlock the MCL door (Figure 4.3-18, item 1). The door pops open as the air cylinder attached to the door extends.

Figure 4.3-18 Opening the MCL Door



2. Push the cover up to ensure it is fully open (Figure 4.3-18, item 2).

MCL Interlock Switch

An interlock switch (Figure 4.3-18) is located on the base to ensure the MCL door is closed during operation. If the door is open, an *MCL Door Open Error* or *MCL Door Open Warning* message appears on the Workstation screen. Operation is halted until the MCL door is closed.

WARNING Risk of personal injury. Be very careful when operating the instrument when the MCL interlock switch is defeated, as you may be exposed to moving components. After servicing the instrument, make sure the MCL door is properly closed to reactivate the safety interlock switch if it was bypassed while servicing the instrument.

To override (bypass) this safety interlock, pull the switch up and operation resumes even through the door is open.

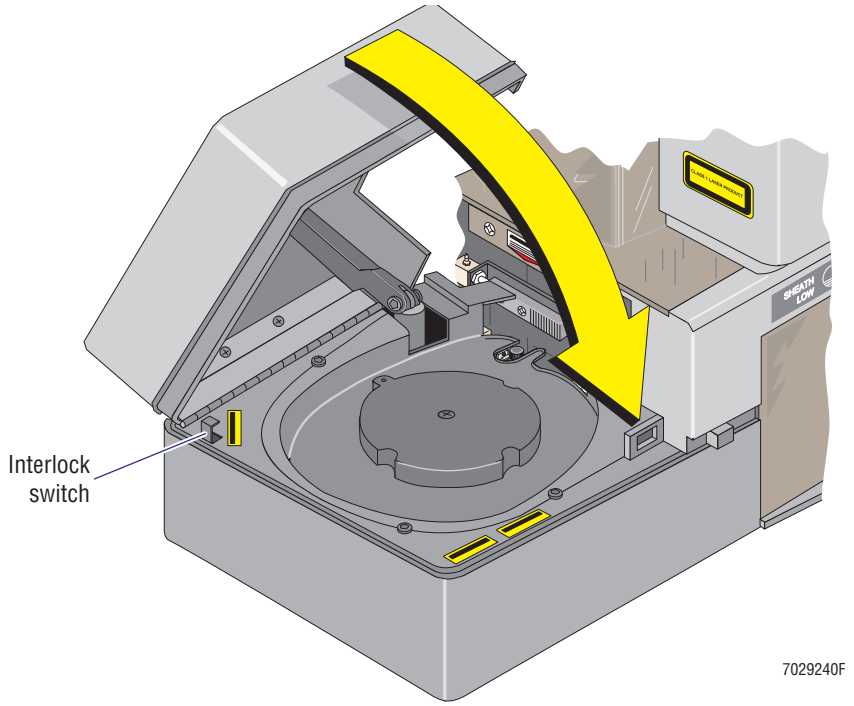
Always be very careful if you bypass this safety interlock and operate the instrument with the door open. The interlock switch is reset when the door is closed.

Closing the MCL Door

1. Close the MCL by lowering the MCL door (Figure 4.3-19). Listen for an audible snap as it closes. The MCL door must be closed with the interlock switch depressed for proper operation.

   Note: When the MCL door closes, it must close completely to make solid contact with the interlock switch (Figure 4.3-19). If the door does not depress the interlock switch completely, an *MCL Door Open Error* or *MCL Door Open Warning* message appears on the Workstation screen. Operation is halted until the MCL door is closed completely.

Figure 4.3-19 Closing the MCL Door



Procedure 10

How to Unlatch and Relatch the MCL Covers

The MCL must be unlatched, but not removed, before removing the left-side cover or manual sample station. See Figure A.5-13 for MCL carousel components and Table A.5-13 for a description of component functions.

Tools/Supplies Needed

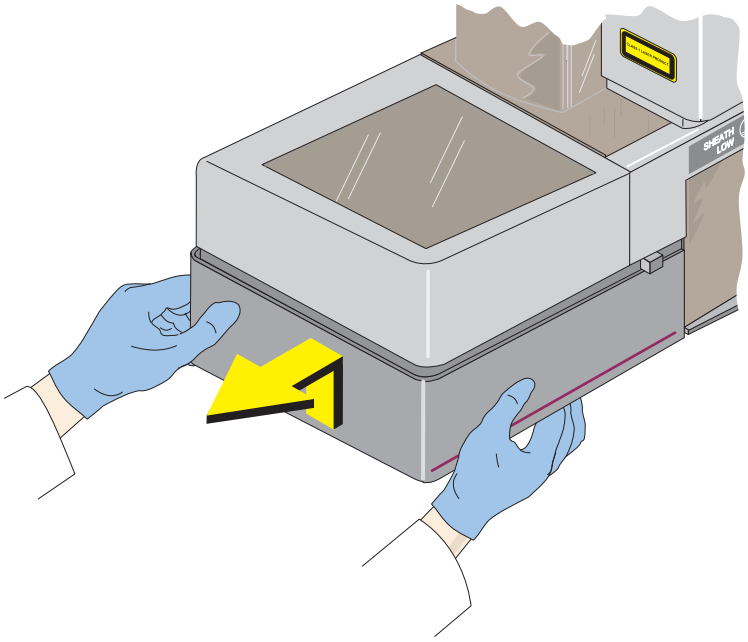
- ❑ None

Unlatching the MCL Covers

CAUTION Risk of damage to the MCL option. The following instructions are meant to unlatch the MCL covers, not remove the MCL. If you attempt to remove the MCL without completing all the steps detailed in the Heading Removing the MCL Covers in Procedure 11, you may damage the MCL components.

Grasp the MCL lower cover and firmly pulling the MCL base away from the Cytometer frame (Figure 4.3-20). **Do not attempt to remove the MCL from the Cytometer.**

Figure 4.3-20 Unlatching the MCL Covers



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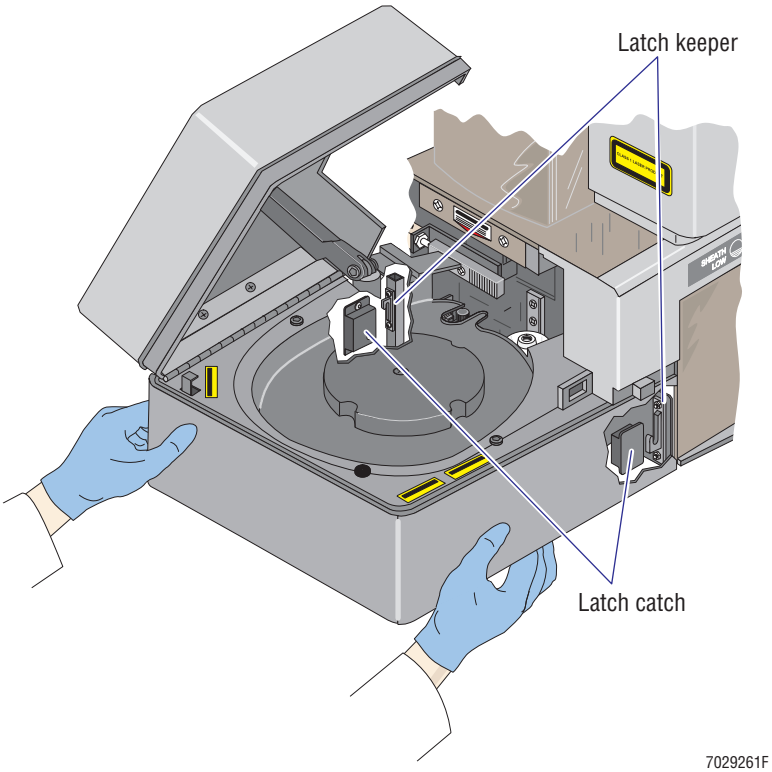
Relatching the MCL Covers

Note: The MCL base may be relatched with the door opened or closed. If the MCL door is open, the rear latch catch and keeper can be viewed through the opening for the gas cylinder.

1. Align the latch catches on the MCL lower cover with the latch keepers attached to left-side of the Cytometer frame (Figure 4.3-21).

   Note: If the MCL door is open, the rear latch catch and keeper can be viewed through the opening for the gas cylinder.

Figure 4.3-21 Relatching the MCL Covers, Latch Catch and Latch Keeper Locations



2. Push the MCL base back on the Cytometer frame. Make sure it is securely attached.
3. Open and close the MCL door several times to ensure proper operation. Listen for an audible snap as the door closes.

   Note: When the MCL door closes, it must close completely to make solid contact with the interlock switch (Figure 4.3-19). If the door does not depress the interlock switch completely, an *MCL Door Open Error* or *MCL Door Open Warning* message appears on the Workstation screen. Operation is halted until the MCL door is closed completely.

Procedure 11

How to Remove and Reinstall MCL Covers

For most procedures, the MCL can simply be unlatched from the Cytometer frame. The MCL covers must be removed to access the MCL carousel base assembly or the lower pneumatics drawer. See Figure A.5-13 for MCL carousel components and Table A.5-13 for a description of component functions.

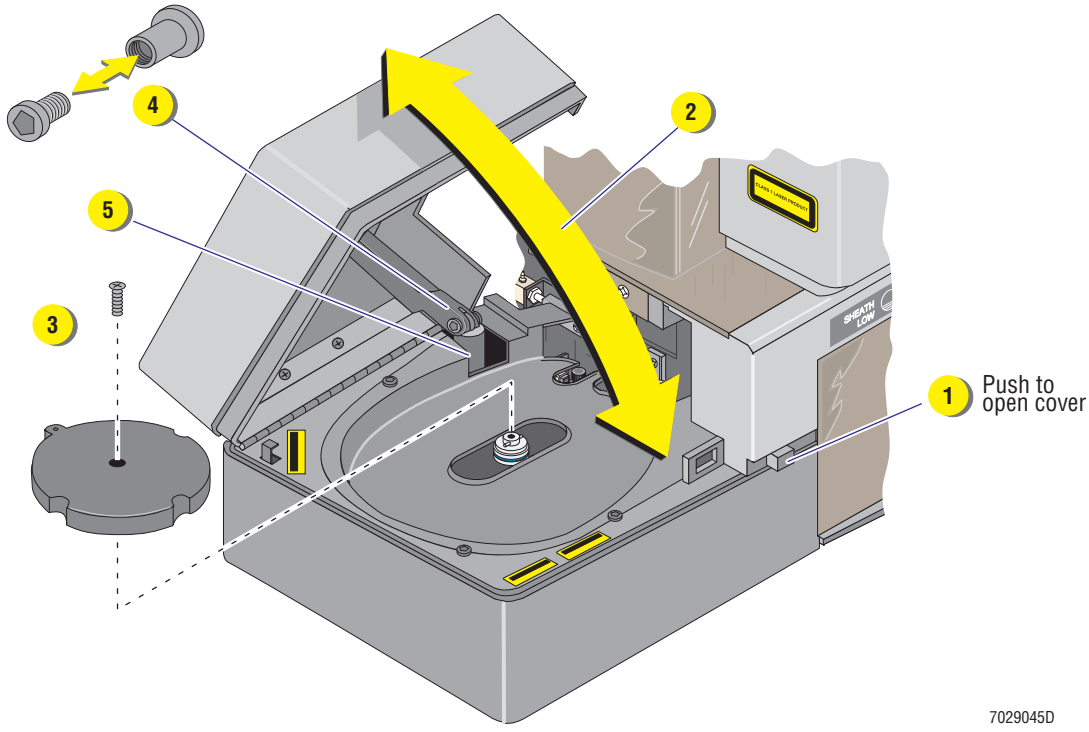
Tools/Supplies Needed

- ❑ Phillips-head screwdriver
- ❑ 2 mm Allen wrench

Removing the MCL Covers

1. Push the button to unlock the MCL door (Figure 4.3-22, item 1). The door pops open as the air cylinder attached to the door extends.

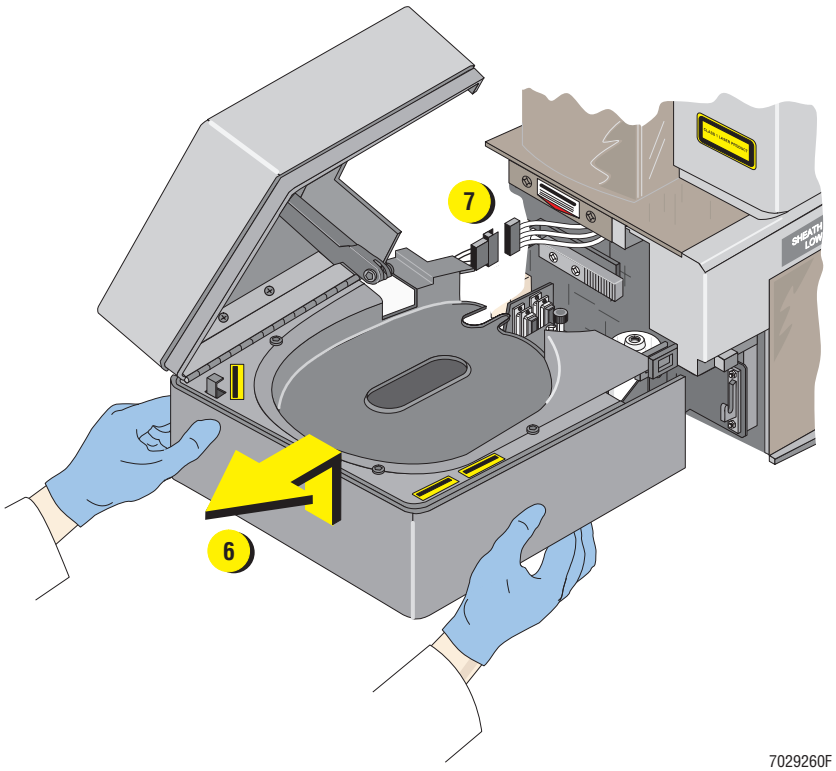
Figure 4.3-22 Removing the MCL Covers



2. Push the MCL door up to ensure it is fully open (Figure 4.3-22, item 2).
3. If present, remove the carousel and set it aside.
4. Remove the Phillips-head screw from the center of the carousel hub and lift the hub off the MCL base (Figure 4.3-22, item 3).
5. Remove the Allen screw from the door hinge (Figure 4.3-22, item 4) using the 2 mm Allen wrench.

6. Push down on the air cylinder and move it out of the way of the cover (Figure 4.3-22, item 5).
7. Grasp the lower base of the MCL. Place your right hand on the front of the base near the Cytometer and your left hand at the rear corner.
8. Firmly pull the lower base away from the Cytometer frame (Figure 4.3-23, item 6).

Figure 4.3-23 Removing the MCL Covers Continued



9. Disconnect P17 from J17 (Figure 4.3-23, item 7).
10. Set the MCL covers aside in a safe place where it will not be damaged.

Reinstalling the MCL Covers

1. Position the MCL covers over the MCL carousel base assembly.
2. Connect P17 to J17 (Figure 4.3-23, item 7).
3. Firmly push the lower base back on latch attached to the Cytometer frame (Figure 4.3-23, item 6).
4. Put the air cylinder back in place (Figure 4.3-22, item 5).
5. Reinstall the Allen screw in the door hinge and tighten (Figure 4.3-22, item 4).
6. Reinstall the carousel hub on the MCL base and secure it with the Phillips-head screw removed earlier Figure 4.3-22, item 3).
7. Place the carousel back on the carousel hub, if desired.
8. Lower the MCL door (Figure 4.3-22, item 2). Listen for an audible snap as it closes.
9. Open and close the MCL door several times to ensure proper operation.

   Note: When the MCL door closes, it must close completely to make solid contact with the interlock switch (Figure 4.3-19). If the door does not depress the interlock switch completely, an *MCL Door Open Error* or *MCL Door Open Warning* message appears on the Workstation screen. Operation is halted until the MCL door is closed completely.

Procedure 12

How to Remove and Reinstall the MCL Probe Housing

The MCL probe housing cover must be removed before the left-side cover or manual sample station can be removed. See Figure A.5-13 for MCL carousel components (including the MCL probe housing) and Table A.5-13 for a description of component functions.

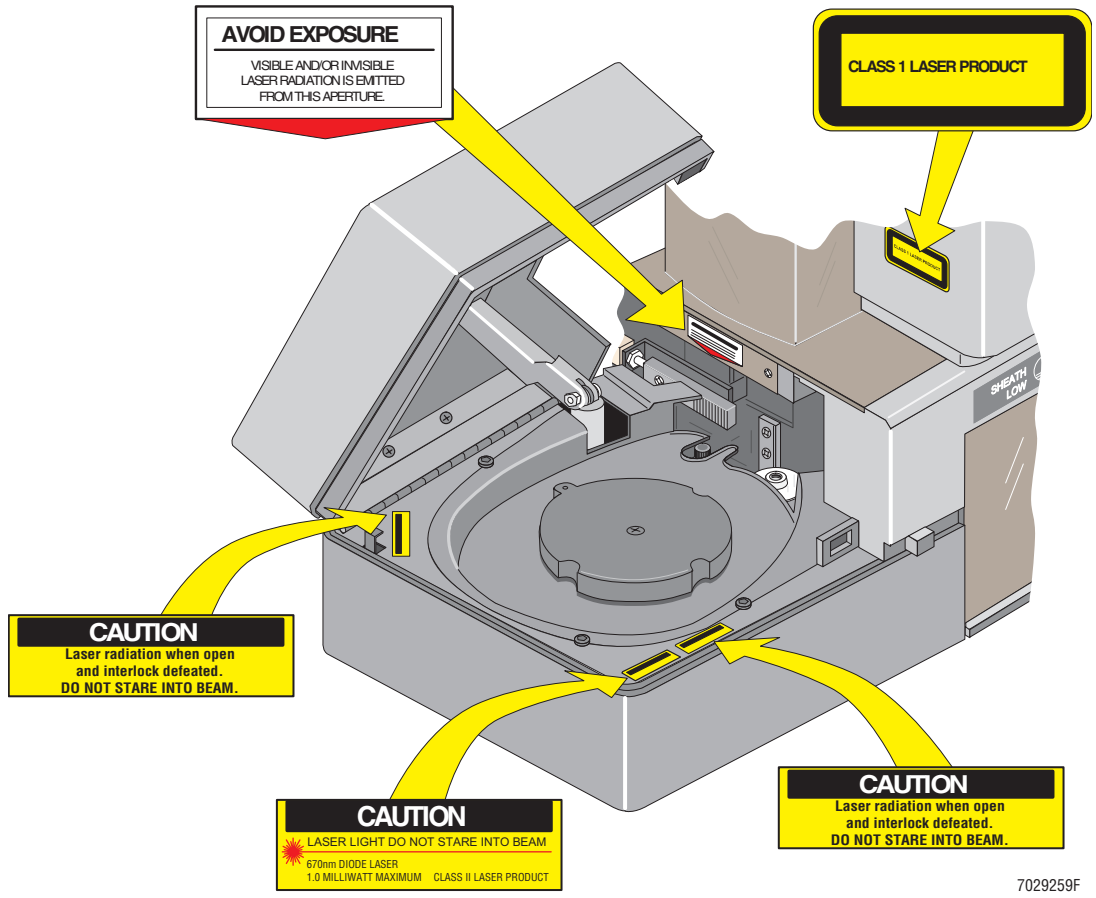
Tools/Supplies Needed

- ❑ Phillips-head screwdriver

WARNING Risk of eye injury. The following procedure requires the removal of covers protecting you from laser light. Reflections of the laser beam off a shiny object such as a screwdriver, or direct viewing of the laser beam, can severely damage your eyes. When performing replacement or adjustment procedures:

- Wear laser safety glasses as required by the wavelength being used.
- Pay attention to the warning labels.
- Do NOT wear jewelry that might reflect the laser beam.
- Review and heed the laser warning labels shown in Figure 4.3-24.

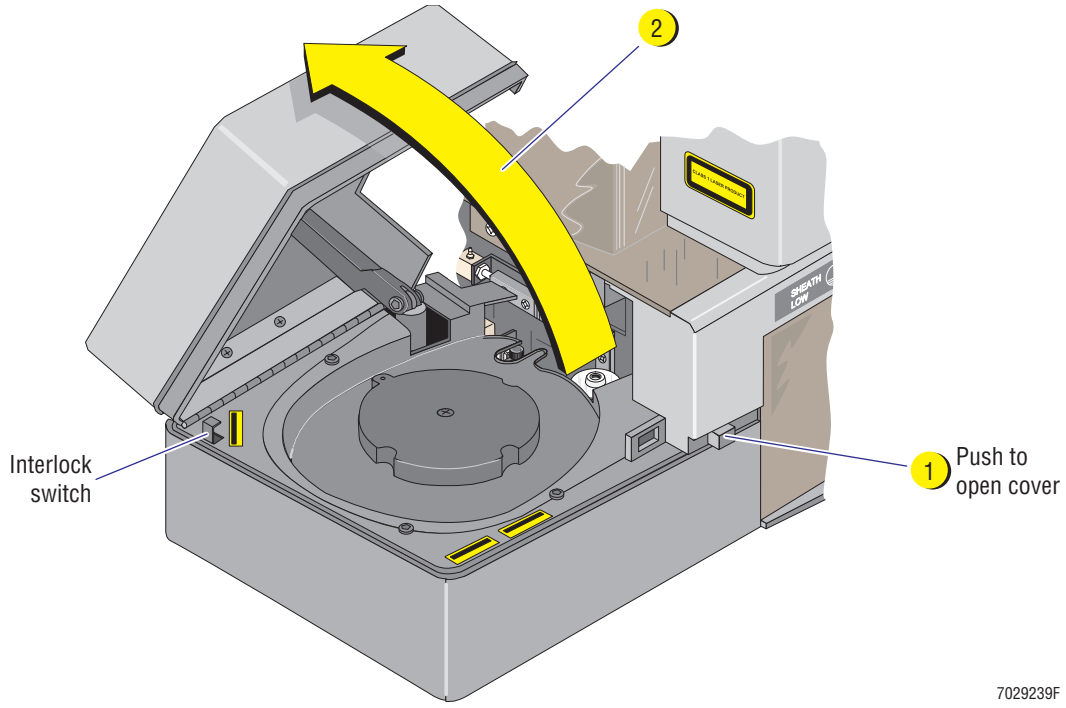
Figure 4.3-24 Laser Warning Labels - MCL Option and Probe Housing



Removing the MCL Probe Housing Cover

1. Push the button to unlock the MCL door (Figure 4.3-25, item 1). The door pops open as the air cylinder attached to the door extends.

Figure 4.3-25 Opening the MCL Door

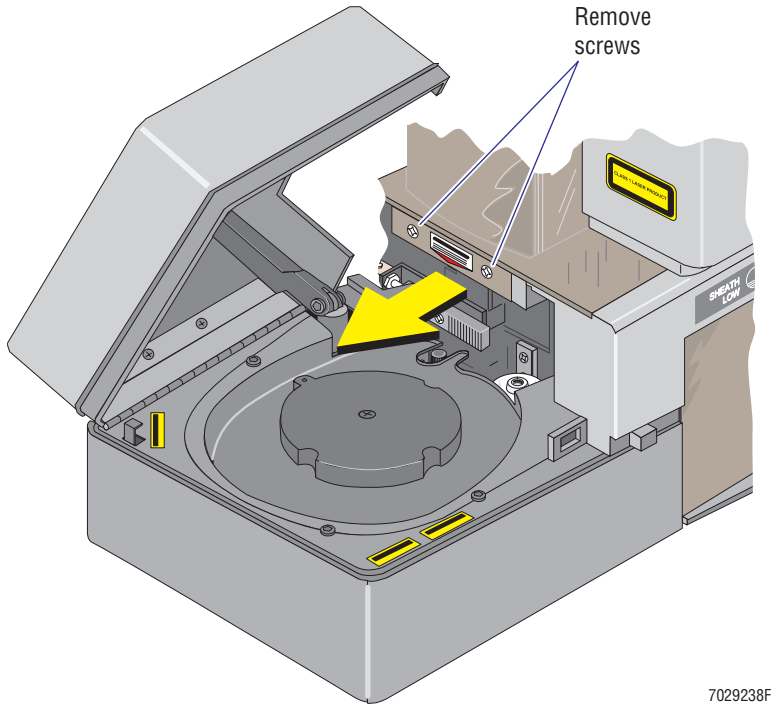


2. Push the door up to ensure it is fully open (Figure 4.3-25, item 2).

3. Remove the two Phillips-head screws that secure the MCL probe housing cover to the left-side cover (Figure 4.3-26).

WARNING Risk of personal injury. Removing the MCL probe housing cover exposes you to the bar-code reader laser beam. Review and heed the laser safety information under Heading 1.2, SAFETY PRECAUTIONS and the laser warning labels shown in Figure 4.3-24.

Figure 4.3-26 Removing the MCL Probe Housing Cover



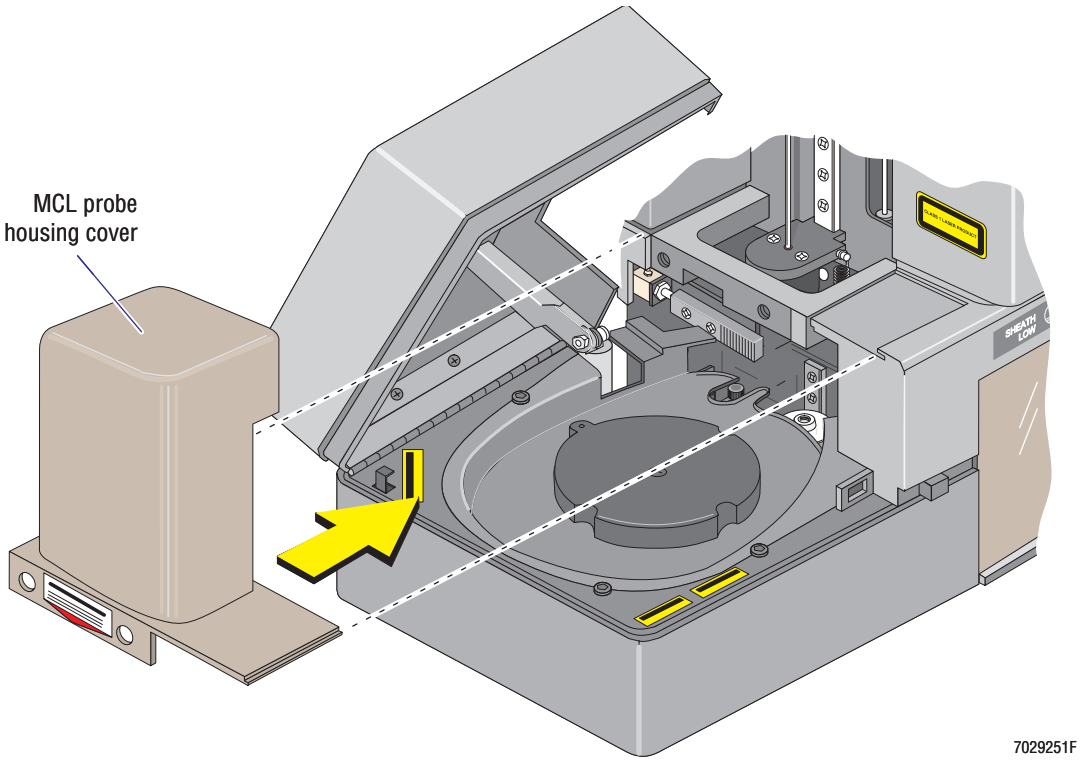
4. Slide the housing cover forward and remove it from the instrument.
5. Set the housing cover aside in a safe place where it will not be damaged.
6. Lower the MCL door. Listen for an audible snap as it closes.

Reinstalling the MCL Probe Housing Cover

1. If the MCL door is blocking the area, push the button to unlock the MCL door then push the door up to ensure it is fully open. Refer to Figure 4.3-25 as needed.
2. Make sure the back edge of the MCL probe housing cover is aligned to slide under the edge of the left-side cover then slide the beveled edge of the housing cover under the notched opening at the top of the push-button panel. See Figure 4.3-27.

WARNING Risk of personal injury. Replacing the MCL probe housing cover exposes you to the bar-code reader laser beam. Review and heed the laser safety information under Heading 1.2, SAFETY PRECAUTIONS and the laser warning labels shown in Figure 4.3-24.

Figure 4.3-27 Reinstalling the MCL Probe Housing Cover



3. Slide the housing cover back in position. Make sure that the tubing surrounding the MCL sample probe does not become crimped between the housing cover and the Cytometer frame.
4. Reinstall the two Phillips-head screws removed earlier.
5. Lower the MCL door.

Procedure 13

How to Remove and Reinstall the Cytometer Left-Side Cover (Cytometer with MCL Option Installed)

Removing the Cytometer left-side cover provides access to the MCL components attached to the MCL main frame. Removing the MCL main frame provides access to the lower pneumatics drawer. The top cover must be removed before the left-side cover can be removed.

- See Figure A.5-14 for MCL components that are accessible with covers removed and Table A.5-14 for a description of component functions.
- See Figure A.5-15 for lower pneumatics drawer components and Table A.5-15 for a description of component functions.

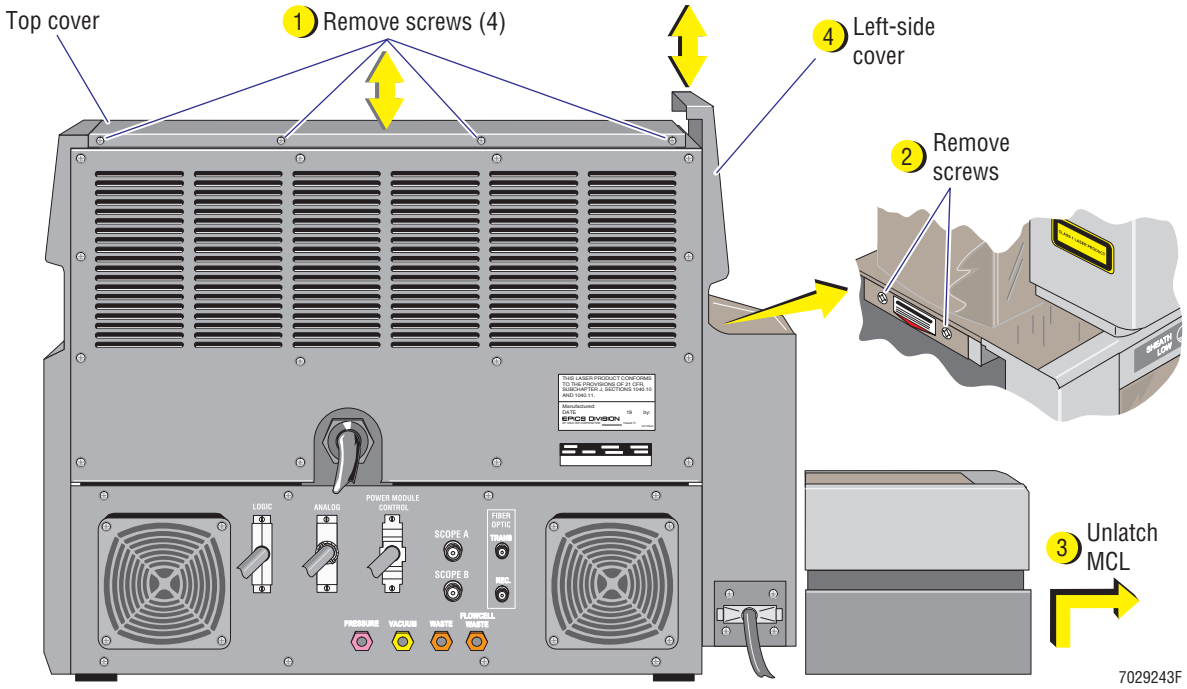
Tools/Supplies Needed

❑ Phillips-head screwdriver

Removing the Cytometer Left-Side Cover (Cytometer with MCL Option Installed)

1. Remove the Cytometer top cover (Figure 4.3-28, item 1).
   a. At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer.
   b. Lift the top cover up and off the Cytometer.
   c. Set it aside in a safe place where it will not be damaged.

Figure 4.3-28 Left-Side Cover Removal or Installation (Cytometer with MCL Option Installed)



2. Remove the MCL probe housing (Figure 4.3-28, item 2).
   a. Push the button to unlock the MCL door. The door pops open as the air cylinder attached to the door extends.
   b. Push the door up to ensure it is fully open.
   c. Remove the two Phillips-head screws securing the housing to the Cytometer frame.
   d. Slide the housing cover forward and remove it from the instrument.
   e. Set the housing cover aside in a safe place where it will not be damaged.
   f. Lower the MCL door. Listen for an audible snap as it closes.
3. Unlatch the MCL by grasping the MCL lower cover and firmly pulling the MCL base away from the Cytometer frame (Figure 4.3-28, item 3). **Do not attempt to remove the MCL from the Cytometer.**
4. Pull the left-side cover up and off the Cytometer frame (Figure 4.3-28, item 4).
5. Set the cover aside in a safe place where it will not be damaged.

Reinstalling the Cytometer Left-Side Cover (Cytometer with MCL Option Installed)

1. Position the left-side cover on the Cytometer frame.
2. Push the cover down on the Cytometer frame (Figure 4.3-28, item 4).
3. Make sure the upper and lower fasteners on the inside of the cover are properly positioned inside the Cytometer frame.
4. Relatch the MCL lower cover to the Cytometer frame (Figure 4.3-28, item 3).
   a. Align the MCL lower cover with the latches attached to the Cytometer frame.
   b. Push the MCL base back on the Cytometer frame. Make sure it is securely attached.
   c. Open and close the MCL door several times. Listen for an audible snap as it closes. The door must be closed with the interlock switch depressed for proper operation.
5. Reinstall the MCL probe housing using the two screws removed earlier (Figure 4.3-28, item 2).
   a. Open the MCL door then push the door up to ensure it is fully open.
   b. Make sure the back edge of the MCL probe housing cover is aligned to slide under the edge of the left-side cover then slide the beveled edge of the housing cover under the notched opening at the top of the push-button panel for the MCL door. Refer to Figure 4.3-27 as needed.
   c. Slide the housing cover back in position. Make sure that the tubing surrounding the MCL sample probe does not become crimped between the housing cover and the Cytometer frame.
   d. Reinstall the two Phillips-head screws removed earlier.
   e. Lower the MCL door.
6. Reinstall the Cytometer top cover (Figure 4.3-28, item 1).
   a. Place the top cover on the Cytometer.
   b. Make sure the top cover is properly seated.
   c. At the rear of the Cytometer, secure the top cover to the Cytometer frame by tightening the four Phillips-head screws.

Procedure 14

How to Remove and Reinstall the Cytometer Left-Side Cover (Cytometer without MCL Option)

Removing the Cytometer left-side cover provides access to the lower pneumatics drawer. See Figure A.5-15 for lower pneumatics drawer components and Table A.5-15 for a description of component functions. The top cover must be removed before the left-side cover can be removed.

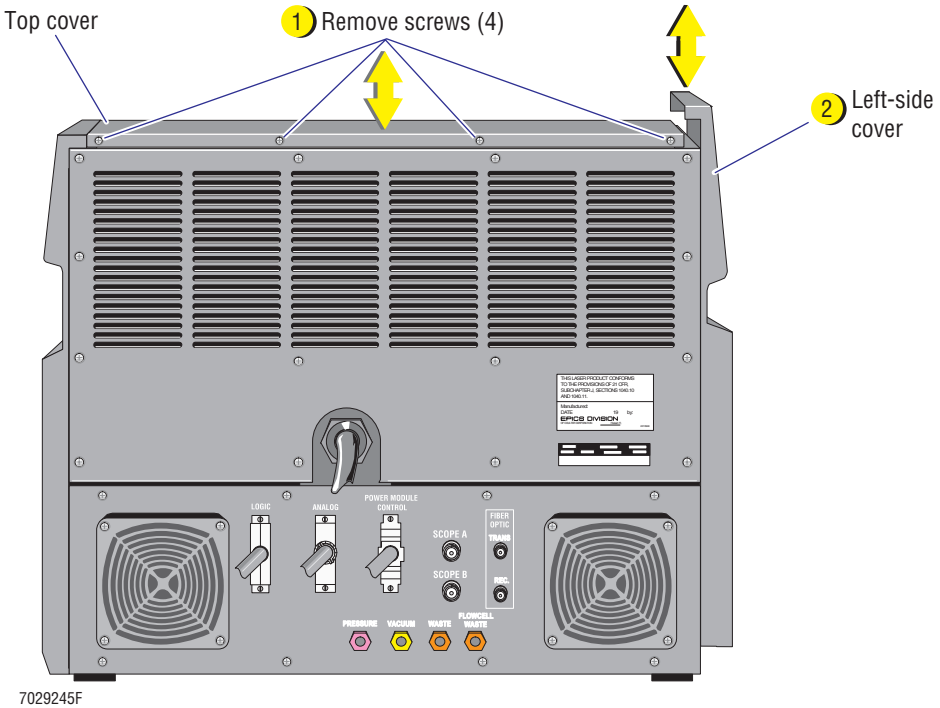
Tools/Supplies Needed

- ❑ Phillips-head screwdriver

Removing the Cytometer Left-Side Cover (Cytometer without MCL Option)

1. Remove the Cytometer top cover (Figure 4.3-29, item 1).
   a. At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer.
   b. Lift the top cover up and off the Cytometer.
   c. Set it aside in a safe place where it will not be damaged.

Figure 4.3-29 Left-Side Cover Removal or Installation (Cytometer without MCL Option)



2. Pull the left-side cover up and off the Cytometer frame (Figure 4.3-29, item 2).
3. Set the cover aside in a safe place where it will not be damaged.

Reinstalling the Cytometer Left-Side Cover (Cytometer without MCL Option)

1. Position the left-side cover on the Cytometer frame.
2. Push the cover down on the Cytometer frame (Figure 4.3-29, item 2).
3. Make sure the upper and lower fasteners on the inside of the cover are properly positioned inside the Cytometer frame.
4. Reinstall the Cytometer top cover (Figure 4.3-29, item 1).
   a. Place the top cover on the Cytometer.
   b. Make sure the top cover is properly seated.
   c. At the rear of the Cytometer, secure the top cover to the Cytometer frame by tightening the four Phillips-head screws.

Procedure 15

How to Remove and Reinstall the Filter Shield

The filter shield covers the sensing area that houses the flow cell, beam-shaping hardware, FS detector, and side scatter diode. The filter shield must be removed to replace these components or when aligning the optics or laser. See Figure A.5-7 for components accessed with the filter shield removed and Table A.5-7 for a description of component functions.

Tools/Supplies Needed

- ❑ Phillips-head screwdriver
- ❑ Long screwdriver with a plastic handle

Removing the Filter Shield

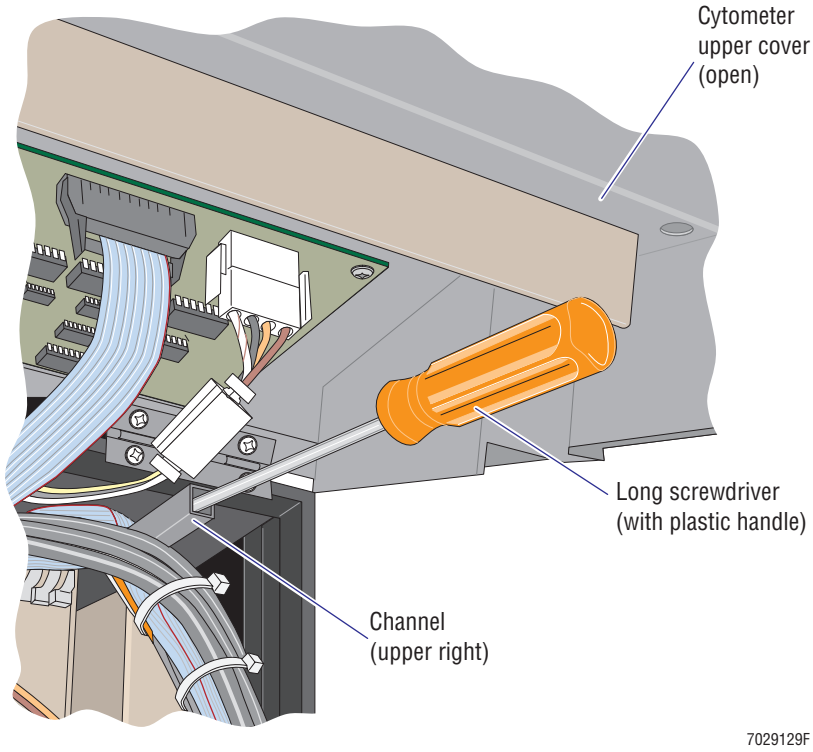
1. Remove the center front cover (filter cover).
   a. Grasp the curved outer edges of the center front cover (filter cover) and pull the cover forward (Figure 4.3-7).
   b. Set the cover aside in a safe place where it will not be damaged.
2. Slide the reagent drawer open.
   a. Verify the Cytometer is in the Idle mode.
      1) If the Cytometer is not in the Idle mode, press the RUN button (Figure 4.3-9).
      2) Wait about 10 seconds for the Cytometer to depressurize.
   b. Grasp the reagent drawer and pull the drawer forward until it stops (Figure 4.3-11).
3. Remove the Cytometer top cover.
   a. At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer (Figure 4.3-6, item 1).
   b. Lift the top cover up and off the Cytometer.
   c. Set it aside in a safe place where it will not be damaged.
4. Remove the right-side cover.
   a. Pull the right-side cover up and off the Cytometer frame (Figure 4.3-6, item 2).
   b. Set the cover aside in a safe place where it will not be damaged.
5. Use instrument specific instructions to gain required access:
   - If this is an XL cytometer **without** the MCL option, go to step 6.
   - If this is an XL cytometer **with** the MCL option, go to step 9.
6. Remove the left-side cover.
   a. Pull the left-side cover up and off the Cytometer frame (Figure 4.3-29, item 2).
   b. Set the cover aside in a safe place where it will not be damaged.

7. Remove the manual sample station cover assembly.
    a. Pull the reagent drawer out further. The reagent drawer sits inside self-locking tracks. Push and hold the locking tabs under the tracks and pull the drawer forward. The top of the reagent containers will provide a place to rest the manual sample station cover assembly when it is removed.
    b. Locate and remove the four Phillips-head screws that secure the manual sample station to the Cytometer frame. See Figure 4.3-17 as needed.
    c. Pull the manual sample station cover assembly off the Cytometer frame and lay the assembly on top of the reagent containers. Make sure the flat ribbon cable is positioned so that it does not become damaged.
8. Go to step 11.
9. Remove the left-side cover as follows:
    a. Remove the MCL probe housing.
        1) Push the button to unlock the MCL door. The door pops open as the air cylinder attached to the door extends.
        2) Push the door up to ensure it is fully open.
        3) Remove the two Phillips-head screws securing the probe housing cover to the Cytometer frame. See Figure 4.3-26 as needed.
        4) Slide the housing cover forward and remove it from the instrument.
        5) Set the housing cover aside in a safe place where it will not be damaged.
        6) Lower the MCL door. Listen for an audible snap as it closes.
    b. Unlatch the MCL by grasping the MCL lower cover and firmly pulling the MCL base away from the Cytometer frame. See Figure 4.3-20 as needed. **Do not attempt to remove the MCL from the Cytometer.**
    c. Pull the left-side cover up and off the Cytometer frame and set the cover aside.
10. Remove the manual sample station cover assembly.
    a. Pull the reagent drawer out further. The reagent drawer sits inside self-locking tracks. Push and hold the locking tabs under the tracks and pull the drawer forward. The top of the reagent containers will provide a place to rest the manual sample station cover assembly when it is removed.
    b. Locate and remove the two pan-head screws that secure the left side of the manual sample station to the Cytometer frame. You may need to move the MCL further away from the Cytometer frame. See Figure 4.3-16 as needed.
    c. Remove the two flat-head Phillips screws securing the right side of the manual sample station to the front of the Cytometer frame. See Figure 4.3-16 as needed.
    d. Pull the manual sample station cover assembly off the Cytometer frame and lay the assembly on top of the reagent containers. Make sure the flat ribbon cable is positioned so that it does not become damaged.

CAUTION Risk of damage to electrical components on the front panel display circuit card. Do not use a T-handled hex key to hold the upper cover open. If the metal in the T-handle comes in contact with the electrical components on the circuit card, the components may short out and the card becomes defective.

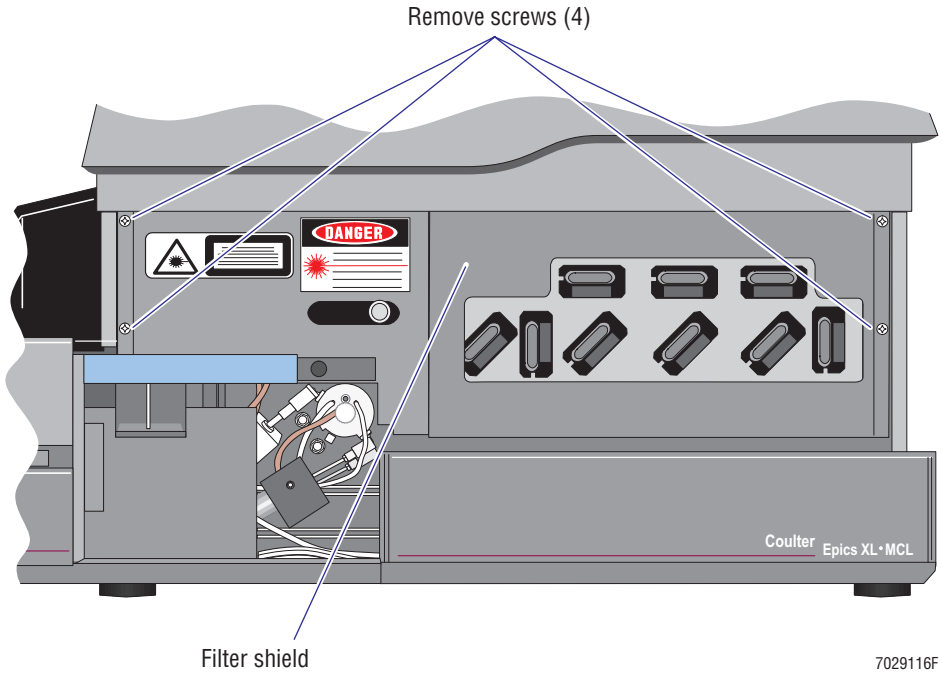
11. Lift the front panel display cover and place a long screwdriver (with a plastic handle) in the upper frame channel to brace the cover open (Figure 4.3-30).

Figure 4.3-30 Use a Long Screwdriver to Brace the Upper Cover Open



12. Remove the four Phillips-head screws (two on each side) securing the filter shield to the Cytometer frame (Figure 4.3-31).

Figure 4.3-31 Filter Shield Screw Locations



13. Set the filter shield aside in a safe place where it will not be damaged.

Reinstalling the Filter Shield

1. Position the filter shield over the sensing area and secure it to the Cytometer frame using the four Phillips-head screws removed earlier (Figure 4.3-31).
2. Lift the upper display panel and remove the long screwdriver from the channel (Figure 4.3-30). Carefully lower the upper display panel.
3. Reinstall the manual sample station cover assembly:
   a. Position the manual sample station cover assembly back on the Cytometer frame. Make sure the flat ribbon cable is not crimped.
   b. Loosely reinstall the four Phillips-head screws that secure the manual sample station to the Cytometer frame. If this is an XL cytometer with the MCL option installed,
      1) On the **right side** of the manual sample station, loosely reinstall the two **flat** Phillips-head screws. See Figure 4.3-16 as needed.
      2) On the **left side** of the manual sample station, loosely reinstall the two **pan** Phillips-head screws. See Figure 4.3-16 as needed.
   c. Tighten the four screws.
4. Slide the reagent drawer back inside the Cytometer. Make sure the reagent tubing does not become crimped as you push the drawer closed.
5. Position the right-side cover on the Cytometer frame.
6. Push the cover down on the Cytometer frame.
7. Make sure the upper and lower fasteners on the inside of the cover are properly positioned inside the Cytometer frame.
8. Position the left-side cover on the Cytometer frame.
9. Push the cover down on the Cytometer frame.
10. Make sure the upper and lower fasteners on the inside of the cover are properly positioned inside the Cytometer frame.
11. Use instrument specific instructions to proceed:
    - If this is an XL cytometer **with** the MCL option, go to step 12.
    - If this is an XL cytometer **without** the MCL option, go to step 14.
12. Relatch the MCL lower cover to the Cytometer frame.
    a. Align the MCL lower cover with the latch attached to left-side of the Cytometer frame.
    b. Push the MCL base back on the Cytometer frame. Make sure it is securely attached.
    c. Open and close the MCL door several times. Listen for an audible snap as it closes. The MCL door must be closed with the interlock switch depressed for proper operation.

13. Reinstall the MCL probe housing using the two screws removed earlier.
    a. Open the MCL door then push the door up to ensure it is fully open.
    b. Make sure the back edge of the MCL probe housing cover is aligned to slide under the edge of the left-side cover then slide the beveled edge of the housing cover under the notched opening at the top of the push-button panel for the MCL door. See Figure 4.3-27 as needed.
    c. Slide the housing cover back in position. Make sure that the tubing surrounding the MCL sample probe does not become crimped between the housing cover and the Cytometer frame.
    d. Reinstall the two Phillips-head screws removed earlier.
    e. Lower the MCL door.
14. Reinstall the center front cover (filter cover).

    Note: The center front cover fits over the lower edge of the front display panel door.
    a. Position the latch on each end of the center front cover (filter cover) near its corresponding catch on the Cytometer frame.
    b. Push the center front cover back on the instrument. The latches snap into place to secure the cover to the Cytometer frame.
15. Reinstall the Cytometer top cover.
    a. Place the top cover on the Cytometer.
    b. Make sure the top cover is properly seated.
    c. At the rear of the Cytometer, secure the top cover to the Cytometer frame by tightening the four Phillips-head screws.

Procedure 16

How to Remove and Reinstall the Data Acquisition Card Cage

The Data Acquisition card cage is accessible when the Cytometer top cover is removed. However, most procedures require the card cage be lifted out of the Cytometer and locked in its vertical position. See Figure A.5-3 for the circuit cards and power supplies in the Data Acquisition card cage and Table A.5-3 for a description of component functions.

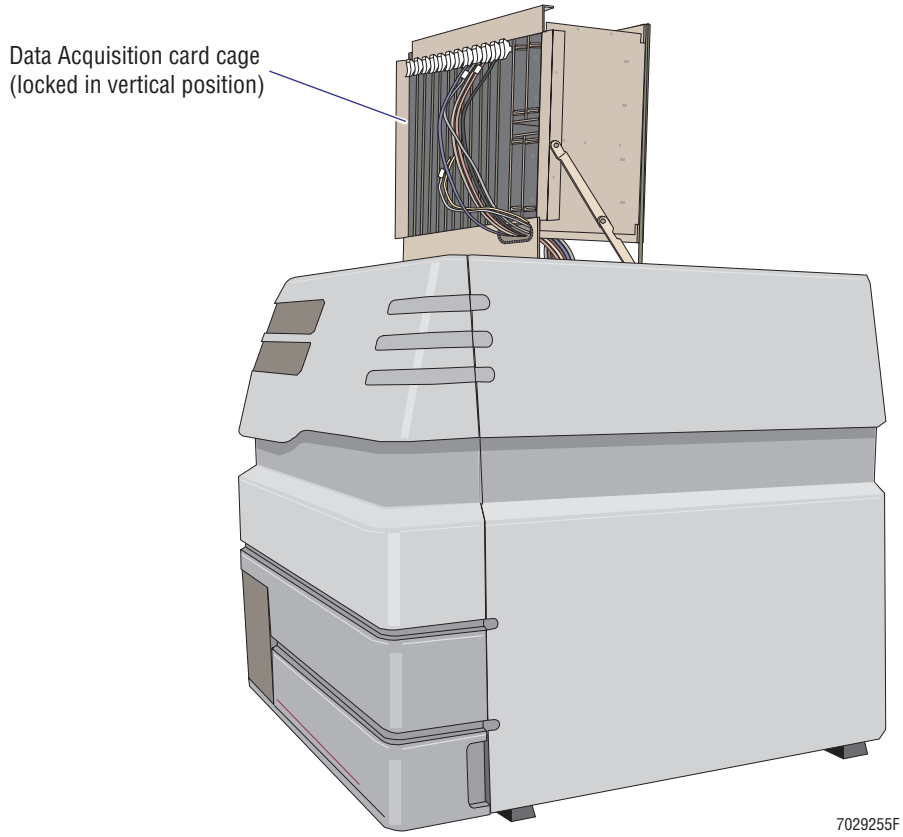
Tools/Supplies Needed

- ❑ Phillips-head screwdriver

Removing the Data Acquisition Card Cage from the Cytometer Center Cavity

1. Power off the Cytometer.
   - Refer to Stage 1: Power Off the Cytometer (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Stage 1: Power Off the Cytometer (system using EXPO32 ADC software) under Heading 4.1, as needed.
2. Remove the Cytometer top cover.
   a. At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer (Figure 4.3-4).
   b. Lift the top cover up and off the Cytometer.
   c. Set it aside in a safe place where it will not be damaged.
3. Lift the Data Acquisition card cage and lock it in its vertical position (Figure 4.3-32).
   a. With one hand, pull the Data Acquisition card cage forward and hold it in an upright position.
   b. With your free hand, lock the hinge on each side of the card cage to secure the card cage in this vertical position.
   c. **Make sure both hinges are locked before releasing your grip.**

Figure 4.3-32 Data Acquisition Card Cage Locked in its Vertical Position



Note: Once the card cage is locked in the vertical position, power may be restored to the Cytometer as needed.

Reinstalling the Data Acquisition Card Cage Back in the Cytometer Center Cavity

1. Power off the Cytometer, if applicable.
   - Refer to Stage 1: Power Off the Cytometer (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Stage 1: Power Off the Cytometer (system using EXPO32 ADC software) under Heading 4.1, as needed.
2. Lower the card cage back into the center cavity of the Cytometer:
   a. Stand in front of the Cytometer and grasp the top of the Data Acquisition card cage.
   b. With a secure hold on the card cage, unlock the card cage hinges with your other hand.
   c. Gently lower the card cage into the center cavity of the Cytometer.
3. Reinstall the Cytometer top cover.
   a. Place the top cover on the Cytometer.
   b. Make sure the top cover is properly seated.
   c. At the rear of the Cytometer, secure the top cover to the Cytometer frame by tightening the four Phillips-head screws.
4. Power on the Cytometer.
   - Refer to Restoring Power to the Cytometer Only (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Restoring Power to the Cytometer Only (system using EXPO32 ADC software) under Heading 4.1, as needed.

Procedure 17

How to Remove and Reinstall the Lower Pneumatics Drawer

The lower pneumatics drawer contains the waste chamber, the Solenoid Power Distribution card as well as most of the solenoids and pinch valves used in the Cytometer. The lower pneumatics drawer is located in the left-side the Cytometer underneath the optical bench and can be easily accessed on an XL flow cytometer that does not have the MCL option installed. However, on an XL flow cytometer that does have the MCL option installed, the manual sample station and the MCL option must be removed to access these components. See Figure A.5-15 for components in the lower pneumatics drawer and Table A.5-15 for a description of component functions.

Tools/Supplies Needed

- ❑ Phillips-head screwdriver
- ❑ Long Phillips-head screwdriver, only if the MCL option is installed

ATTENTION: Use instrument specific instructions to remove the lower pneumatics drawer.

- If the MCL option is installed, go to Heading Removing the Lower Pneumatics Drawer on a Cytometer with the MCL Option Installed.
- If the MCL option is not installed, go to Heading Removing the Lower Pneumatics Drawer on a Cytometer without the MCL Option.

Removing the Lower Pneumatics Drawer on a Cytometer with the MCL Option Installed

1. Remove the center front cover (filter cover).
   a. Grasp the curved outer edges of the center front cover (filter cover) and pull the cover forward (Figure 4.3-7).
   b. Set the cover aside in a safe place where it will not be damaged.
2. Remove the MCL probe housing and MCL covers from the instrument as follows:
   a. Push the button to unlock the MCL door. The door pops open as the air cylinder attached to the door extends (Figure 4.3-22, item 1).
   b. Push the MCL door up to ensure it is fully open (Figure 4.3-22, item 2).
   c. If present, remove the carousel and set it aside.
   d. Remove the two Phillips-head screws securing the MCL probe housing to the Cytometer frame (Figure 4.3-26).
   e. Slide the probe housing cover forward and remove it from the instrument.
   f. Set the probe housing cover aside in a safe place where it will not be damaged.
   g. Remove the Phillips-head screw from the center of the carousel hub and lift the hub off the MCL base (Figure 4.3-22, item 3).
   h. Remove the Allen screw from the door hinge (Figure 4.3-22, item 4).
   i. Push down on the air cylinder and move it out of the way of the cover (Figure 4.3-22, item 5).
   j. Grasp the lower base of the MCL. Place your right hand on the front of the base near the Cytometer and your left hand at the rear corner.

k. Firmly pull the lower base away from the Cytometer frame (Figure 4.3-23, item 6).

l. Disconnect P17 from J17 (Figure 4.3-23, item 7).

m. Set the MCL covers aside in a safe place where it will not be damaged.

3. Slide the reagent drawer open.

   a. Verify the Cytometer is in the Idle mode.

      1) If the Cytometer is not in the Idle mode, press the RUN button (Figure 4.3-9).

      2) Wait about 10 seconds for the Cytometer to depressurize.

   b. Grasp the reagent drawer and pull the drawer forward until it stops (Figure 4.3-11). The reagent drawer sits inside self-locking tracks and will stop when it locks.

   c. Push and hold the locking tabs under the tracks and pull the drawer out further. The top of the reagent containers will provide a place to rest the manual sample station cover assembly when it is removed.

4. Remove the manual sample station cover assembly:

   a. Locate and remove the two pan-head screws that secure the left side of the manual sample station to the Cytometer frame (Figure 4.3-16).

   b. Remove the two flat-head Phillips screws securing the right side of the manual sample station to the front of the Cytometer frame (Figure 4.3-16).

   c. Pull the manual sample station cover assembly off the Cytometer frame and lay the assembly on top of the reagent containers. Make sure the flat ribbon cable is positioned so that it does not become damaged.

5. Remove the Cytometer top cover.

   a. At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer (Figure 4.3-4).

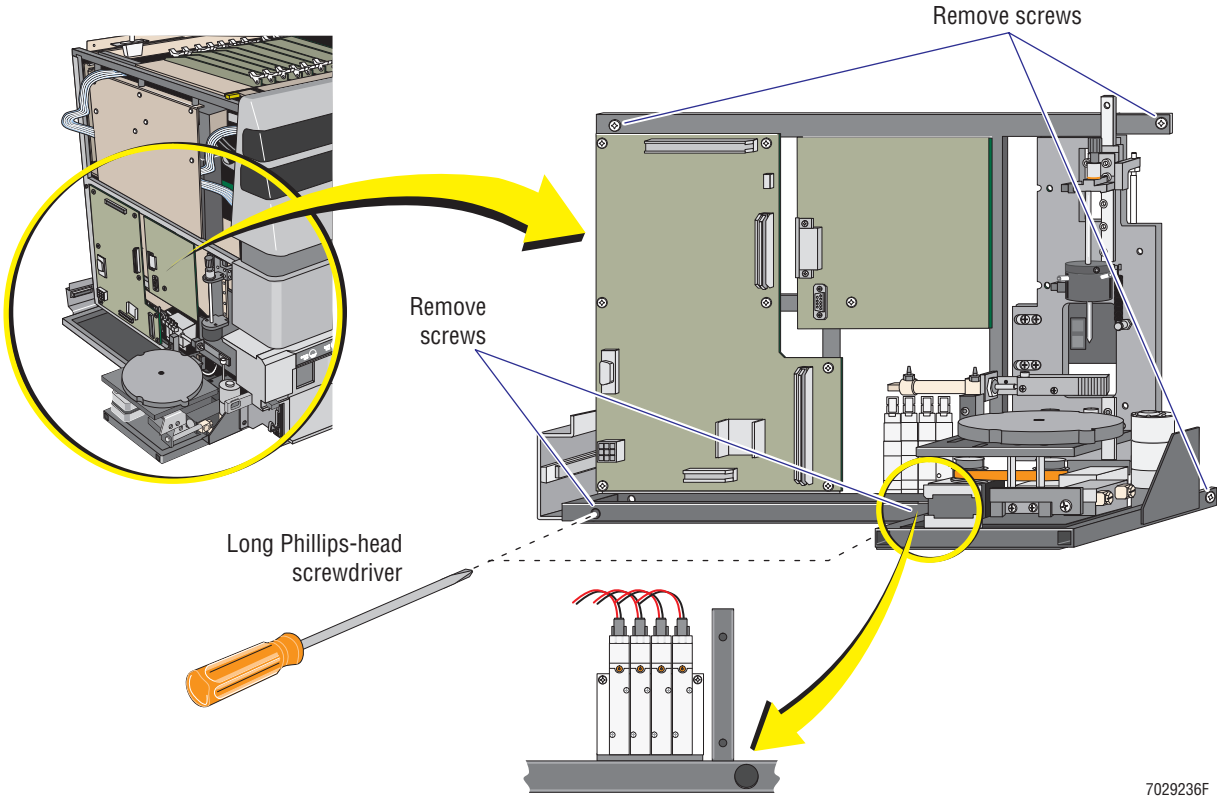
   b. Lift the top cover up and off the Cytometer.

   c. Set it aside in a safe place where it will not be damaged.

6. Remove the left-side cover by pulling the cover up and off the Cytometer frame. Set the cover aside.

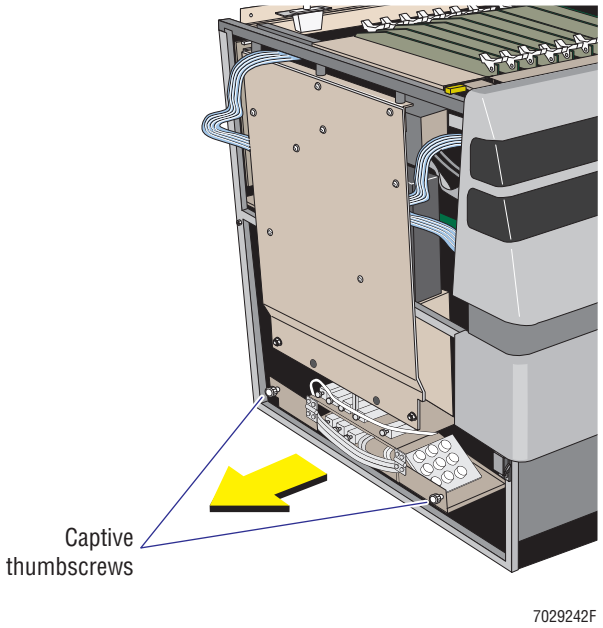
7. Remove the five Phillips-head screws that secure the MCL option to the Cytometer frame (Figure 4.3-33). The lower left screw and the screw to the right of the MCL solenoid assembly require a long Phillips-head screwdriver.

Figure 4.3-33 Removing the MCL from the Cytometer Frame



8. Locate the lower pneumatics drawer (Figure 4.3-34).

Figure 4.3-34 Removing the Lower Pneumatics Drawer (Cytometer with the MCL Option Installed)

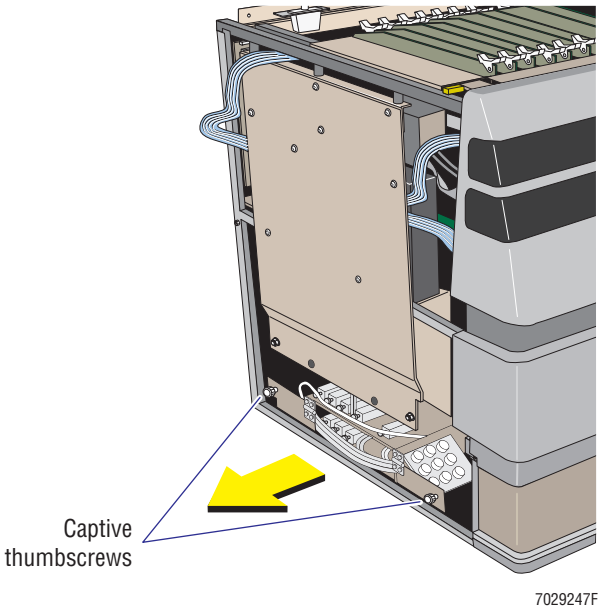


9. Loosen the captive thumbscrews (Figure 4.3-34).
10. Pull the lower pneumatics drawer out of the Cytometer.

Removing the Lower Pneumatics Drawer on a Cytometer without the MCL Option

1. Remove the Cytometer top cover.
   a. At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer (Figure 4.3-29, item 1).
   b. Lift the top cover up and off the Cytometer.
   c. Set it aside in a safe place where it will not be damaged.
2. Pull the left-side cover up and off the Cytometer frame (Figure 4.3-29, item 2). Set the cover aside.
3. Locate the lower pneumatics drawer (Figure 4.3-35).

Figure 4.3-35 Removing the Lower Pneumatics Drawer (Cytometer without MCL Option)



4. Loosen the captive thumbscrews.
5. Pull the lower pneumatics drawer out of the Cytometer.

Reinstalling the Lower Pneumatics Drawer

1. Push the lower pneumatics drawer back inside the Cytometer.
2. Tighten the captive thumbscrews to reattach the lower pneumatics drawer to the Cytometer frame.
3. Use instrument specific instructions to proceed:
   - If this is an XL cytometer **with** the MCL option, go to step 4.
   - If this is an XL cytometer **without** the MCL option, position the left-side cover on the Cytometer frame and push the cover down. Make sure the upper and lower fasteners on the inside of the cover are properly positioned inside the Cytometer frame. Reinstallation is complete.
4. Reposition the MCL main frame next the Cytometer main frame.
5. Reinstall the five Phillips-head screws removed earlier (Figure 4.3-33).
6. Reinstall the manual sample station cover assembly:
   a. Position the manual sample station cover assembly back on the Cytometer frame. Make sure the flat ribbon cable is not crimped.
   b. On the **right side** of the manual sample station, loosely reinstall the two **flat** Phillips-head screws (Figure 4.3-16).
   c. On the **left side** of the manual sample station, loosely reinstall the two **pan** Phillips-head screws (Figure 4.3-16).
   d. Tighten the four screws to secure the manual sample station to the Cytometer frame.
7. Slide the reagent drawer back inside the Cytometer. Make sure the reagent tubing does not become crimped as you push the drawer closed.
8. Position the left-side cover on the Cytometer frame.
9. Push the cover down on the Cytometer frame (Figure 4.3-28, item 4).
10. Make sure the upper and lower fasteners on the inside of the cover are properly positioned inside the Cytometer frame.
11. Reinstall the MCL probe housing using the two screws removed earlier.
    a. Make sure the back edge of the MCL probe housing cover is aligned to slide under the edge of the left-side cover then slide the beveled edge of the housing cover under the notched opening at the top of the push-button panel for the MCL door.
    b. Slide the housing cover back in position. Make sure that the tubing surrounding the MCL sample probe does not become crimped between the housing cover and the Cytometer frame.
    c. Reinstall the two Phillips-head screws removed earlier.
12. Position the MCL covers over the MCL carousel base assembly.
13. Connect P17 to J17 (Figure 4.3-23, item 7).
14. Firmly push the lower base back on latch attached to the Cytometer frame (Figure 4.3-23, item 6).
15. Put the air cylinder back in place (Figure 4.3-22, item 5).
16. Reinstall the Allen screw in the door hinge and tighten (Figure 4.3-22, item 4).

17. Reinstall the carousel hub on the MCL base and secure it with the Phillips-head screw removed earlier Figure 4.3-22, item 3).
18. Place the carousel back on the carousel hub, if desired.
19. Lower the MCL door (Figure 4.3-22, item 2). Listen for an audible snap as it closes.
20. Open and close the MCL door several times to ensure proper operation.

    Note: When the MCL door closes, it must close completely to make solid contact with the interlock switch (Figure 4.3-19). If the door does not depress the interlock switch completely, an *MCL Door Open Error* or *MCL Door Open Warning* message appears on the Workstation screen. Operation is halted until the MCL door is closed completely.
21. Reinstall the center front cover (filter cover).

    Note: The center front cover fits over the lower edge of the front display panel door.

    a. Position the latch on each end of the center front cover (filter cover) near its corresponding catch on the Cytometer frame.

    b. Push the center front cover back on the instrument. The latches snap into place to secure the cover to the Cytometer frame.

Procedure 18

How to Remove and Reinstall the Upper Pneumatics Drawer EMC Shield

The upper pneumatics drawer contains many components including the Sensor card, the sheath pressure regulator, sample pressure regulator, vacuum regulator, sensors, and pinch valves needed for providing and maintaining proper sheath flow and sample flow. See Figure A.5-5 for components in the upper pneumatics drawer and Table A.5-5 for a description of component functions.

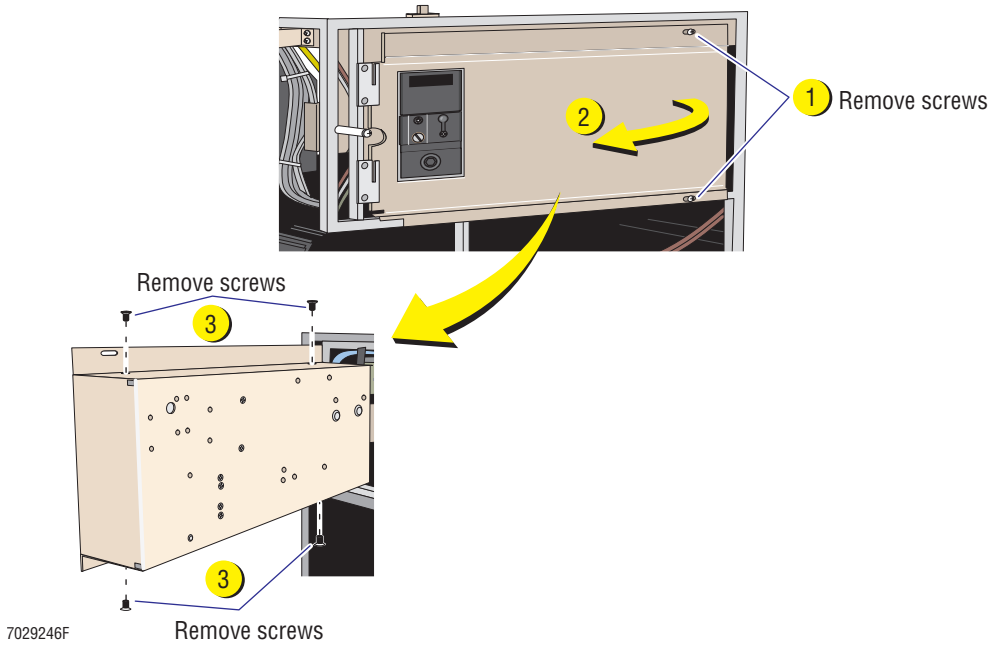
Tools/Supplies Needed

- ❑ Phillips-head screwdriver

Removing the Upper Pneumatics Drawer EMC Shield

1. Remove the right-side cover.
   a. Remove the Cytometer top cover (Figure 4.3-6, item 1).
      1) At the rear of the Cytometer, remove the four Phillips-head screws securing the top cover to the Cytometer
      2) Lift the top cover up and off the Cytometer and set it aside.
   b. Pull the right-side cover up and off the Cytometer frame and set it aside (Figure 4.3-6, item 2).
2. Remove the two Phillip-head screws that secure the upper pneumatics drawer assembly to the Cytometer frame (Figure 4.3-36, item 1).

Figure 4.3-36 Removing the EMC Shield from the Upper Pneumatics Drawer



3. Grasp the right edge of the drawer and pull the drawer away from the Cytometer (Figure 4.3-36, item 2).

4. Remove the four Phillips-head screws that secure the EMC shield to the upper pneumatics drawer cabinet. There are two screws securing the top and two screws securing the bottom. See Figure 4.3-36, item 3.
5. Pull the EMC shield off the drawer.
6. Set the shield aside in a safe place where it will not be damaged.

Reinstalling the Upper Pneumatics Drawer EMC Shield

1. Position the EMC shield back on the upper pneumatics drawer.
2. Reinstall the four Phillips-head screws that secure the EMC shield to the upper pneumatics drawer cabinet (two screws secure the top and two screws secure the bottom).
3. Push the drawer back inside the Cytometer.
4. Reinstall the two Phillip-head screws that secure the upper pneumatics drawer assembly to the Cytometer frame.
5. Position the right-side cover on the Cytometer frame.
6. Push the cover down on the Cytometer frame.
7. Make sure the upper and lower fasteners on the inside of the cover are properly positioned inside the Cytometer frame.
8. Reinstall the Cytometer top cover.
    a. Place the top cover on the Cytometer.
    b. Make sure the top cover is properly seated.
    c. At the rear of the Cytometer, secure the top cover to the Cytometer frame by tightening the four Phillips-head screws.

Procedure 19

How to Remove and Reinstall the Power Supply Module Three-Side Cover

The Power Supply module provides and monitors the main electronic and pneumatic power (vacuum and pressure) to the Cytometer.

- See Figure A.6-3 for the main components located in the left side and Table A.6-3 for description of component functions
- See Figure A.6-4 for the main components located in the right side and Table A.6-4 for description of component functions

Tools/Supplies Needed

- ❑ Phillips-head screwdriver

Removing the Power Supply Module's Three-Sided Cover

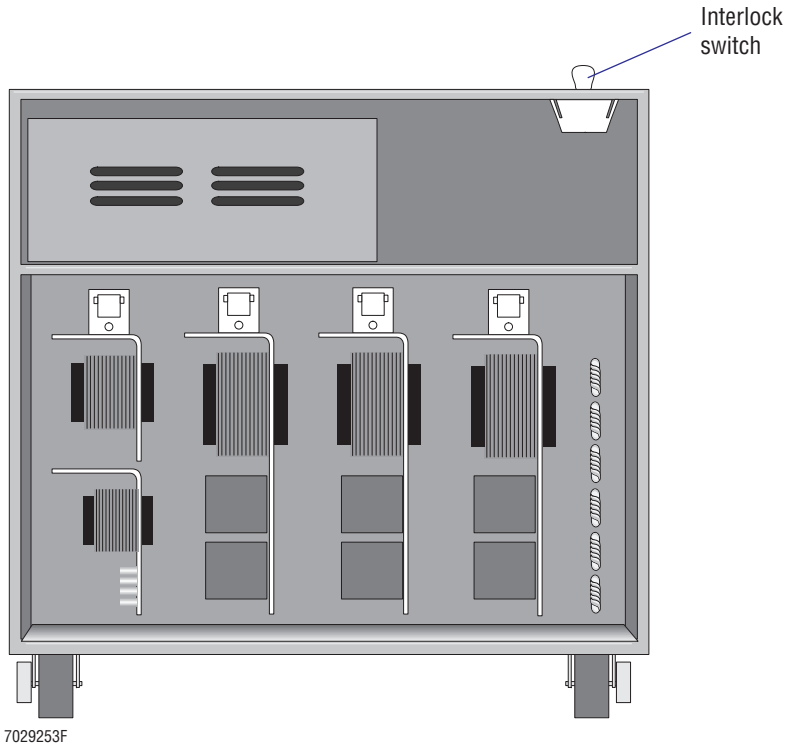
1. Power down the entire system. (This includes unplugging both ac power line cords from the wall outlet.)
   a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using SYSTEM II Software heading.
   b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using EXPO32 ADC Software heading.
2. At the left-side of the Power Supply module, remove the two Phillips-head screws located at the bottom of the cover.
3. At the right-side of the Power Supply module, remove the two Phillips-head screws located at the bottom of the cover.
4. Standing at the front (or rear) of the Power Supply module, grasp the left-side and right-side of the three-sided cover.
5. Lift the cover straight up and off the Power Supply module.
6. Set the cover aside in a safe place where it will not be damaged.

Note: When the three-sided cover is removed, an interlock turns off power to the Power Supply module and the Cytometer. To bypass this interlock, see the Interlock Switch for the Power Supply Module heading that follows.

Interlock Switch for the Power Supply Module

The Power Supply module interlock switch (Figure 4.3-37) is a safety interlock to ensure the three-sided cover is in place when the power is on. If the power is on and the cover is removed, this interlock turns off the power to the Power Supply module and the Cytometer.

Figure 4.3-37 Interlock Switch Location, Power Supply Module



WARNING Risk of personal injury. Be very careful when operating the instrument when the safety interlock switch in the Power Supply module is defeated, as you may be exposed to electric shock. After servicing the instrument, make sure the three-sided cover is properly reinstalled to reactivate the safety interlock switch if it was bypassed while servicing the instrument.

To override (bypass) this safety interlock, pull the switch up and power is restored to the Power Supply module and the Cytometer even though the cover is removed.

Always be very careful if you bypass this safety interlock and operate the instrument with the covers off. The interlock switch is reset when the cover is reinstalled.

Reinstalling the Power Supply Module's Three-Sided Cover

1. Position the three-sided cover over the Power Supply module.
2. Lower the cover onto the Power Supply module. Make sure it is properly seated.
3. Reinstall the four Phillips-head screws, two in the lower left-side panel and two in the lower right-side panel.
4. Power up the entire system. (This includes plugging the two ac power line cords back into the wall outlet.)
   a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Up Using SYSTEM II Software heading.
   b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Up Using EXPO32 ADC Software heading.

Procedure 20

How to Open and Close the Power Supply Module Front Door

The Power Supply module provides and monitors the main electronic and pneumatic power (vacuum and pressure) to the Cytometer. See Figure A.6-2 for the components located behind the front door and Table A.6-2 for description of component functions.

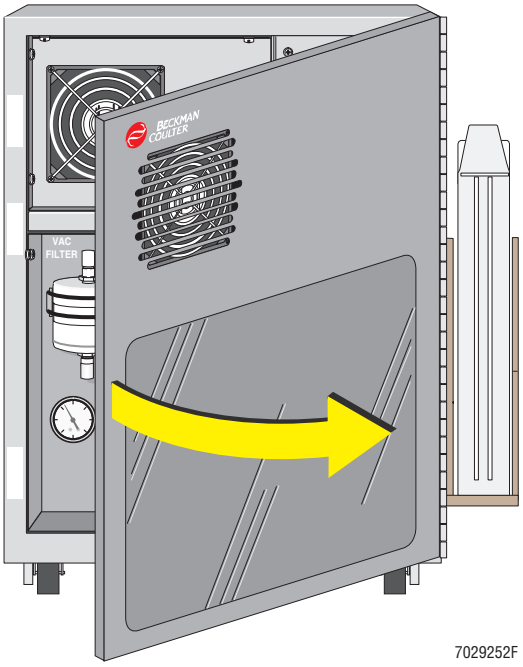
Tools/Supplies Needed

- ❑ None

Open the Front Door

Grasp the left edge of the front door and pull it away from the Power Supply towards the right (Figure 4.3-38). The front door opens fully for ease of access to front panel components.

Figure 4.3-38 Opening the Power Supply Module Front Door



Close the Front Door

Grasp the left edge of the front door and push it towards the left-side of the Power Supply module. When the door makes contact with the Power Supply module frame, two magnets latch the door to keep it in its closed position.

4.4 ARGON LASER HEAD OR POWER SUPPLY REPLACEMENT

Purpose

Replace the Argon laser head and/or Argon laser power supply if the instrument generates:

- High CVs
- *Laser Current Error* or *Laser Current Warning* message
- *Laser Power Error* or *Laser Power Warning* message

Tools/Supplied Needed

- ❑ Standard Beckman Coulter tool kit, PN 5415102
- ❑ 5/32 in., T-handle, Allen wrench
- ❑ Argon air-cooled laser head, PN 7000358
- ❑ Argon air-cooled laser switching power supply, as applicable
  - for 100 Vac system, PN 7000431
  - for 115 Vac system, PN 7000721
  - for 220 or 240 Vac system, PN 7000432

Preparation

1. Power down the entire system. (This includes unplugging both ac power line cords from the wall outlet.)
   a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using SYSTEM II Software heading.
   b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using EXPO32 ADC Software heading.

Laser Power Supply

Removal

1. Remove the three-sided cover from the Power Supply module and set it aside. Refer to Heading 4.3 if you need detailed instructions.
2. At the rear of the Power Supply module, remove the three Phillips-head screws securing the vent plate (top plate) to the back of the Power Supply module and remove the vent plate.
3. At the rear of the Power Supply module, remove the two Phillips-head screws and the plate anchoring the laser umbilical cord to the back of the Power Supply module.
4. Remove the MATE-N-LOK® connector and unscrew the black circular connector from the laser power supply.
5. At the rear of the Power Supply module, remove the two Phillips-head screws securing the lower plate to the Power Supply module and remove the lower plate.
6. Disconnect the Argon laser power supply cable from the ac input at the laser power supply.

7. Remove the four Phillips-head mounting screws securing the Argon laser power supply to the Power Supply module.
8. Remove the defective Argon laser power supply from the Power Supply module.

Installation

1. Position the replacement Argon laser power supply in the Power Supply module.
2. Secure the laser power supply to the Power Supply module using four Phillips-head mounting screws.
3. At the rear of the Power Supply module, secure the lower plate to the Power Supply module using two Phillips-head screws.
4. Connect the laser power supply cable to the ac input at the laser power supply.
5. Screw the black circular connector onto the laser power supply and replace the MATE-N-LOK connector.
6. At the rear of the Power Supply module, secure the plate anchoring the laser umbilical cord to the back of the laser power supply using two Phillips-head screws.
7. At the rear of the Power Supply module, secure the vent plate (top plate) to the back of the Power Supply module using three Phillips-head screws.
8. Place the cover on the Power Supply module and secure it with two Phillips-head screws on the bottom of each side.

Laser Head

Removal

1. Remove the Cytometer top cover and set it aside. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
2. At the back of the Cytometer, remove the upper rear cover and set it aside. Refer to Heading 4.3 if you need detailed instructions.
3. Remove the two flat-head screws and plate securing the laser umbilical cord to the rear of the Cytometer.
4. Lift the Data Acquisition card cage and lock it in its vertical position. Refer to Heading 4.3 if you need detailed instructions.
5. Lift the plenum off the laser head and move it to the right side of the Cytometer.
6. Remove the two Phillips-head screws securing the laser beam shield and set the laser beam shield aside.
7. Remove the four countersunk Allen-head screws securing the laser head to the optical bench. The long 5/32 in. Allen wrench with a T-handle is the best tool for this task.
8. Carefully remove the laser head through the top of the Cytometer while feeding the laser umbilical cord with the laser head.

Installation

1. Carefully route the replacement laser head (and attached laser umbilical cord) through the top of the Cytometer and position the laser head on the optical bench.
2. Secure the laser head to the optical bench using four countersunk Allen-head screws.
3. Secure the laser beam shield using two Phillips-head screws.
4. Place the plenum over the laser head and put it into position.
5. Lower the Data Acquisition card cage back in the center cavity of the Cytometer. Refer to Heading 4.3 if you need detailed instructions.
6. Secure the laser umbilical cord to the rear of the Cytometer using two flat-head screws and a plate.
7. At the back of the Cytometer, reinstall the upper rear cover. Refer to Heading 4.3 if you need detailed instructions.
8. Reinstall the Cytometer top cover. Refer to Heading 4.3 if you need detailed instructions.

Wrap Up

1. Power up the system. (This includes plugging both ac power line cords back into the wall outlet.)
   a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Up Using SYSTEM II Software heading.
   b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Up Using EXPO32 ADC Software heading
2. Align the optics as directed under Heading 4.6, OPTICAL ALIGNMENT.

4.5 FLOW CELL AND BEAMSHAPER REPLACEMENT AND/OR ALIGNMENT

Purpose

Use this procedure after replacing the:

- Flow cell
- Beamshaper
- Laser
- Lens holders.

This procedure is performed with the unit on and all covers removed. If replacing the laser, first follow the procedures as directed under Heading 4.4, ARGON LASER HEAD OR POWER SUPPLY REPLACEMENT, then perform this procedure.

Tools/Supplies Needed

- ❑ Optical Alignment kit, PN 6914939
- ❑ 7/64 in., T-handle, Allen wrench
- ❑ 3/32 in., L-handle, Allen wrench
- ❑ 1/8 in., L-handle, Allen wrench
- ❑ Mylar® flexible film

WARNING Risk of personal injury due to exposure to laser beam. Do not proceed until you review, understand, and adhere to the safety precautions for lasers under Heading 1.2.

WARNING Risk of eye injury. The following procedure requires the removal of the covers protecting you from laser light. Reflections of the laser beam off a shiny object such as a screwdriver, or direct viewing of the laser beam, can severely damage your eyes. When performing replacement or adjustment procedures:

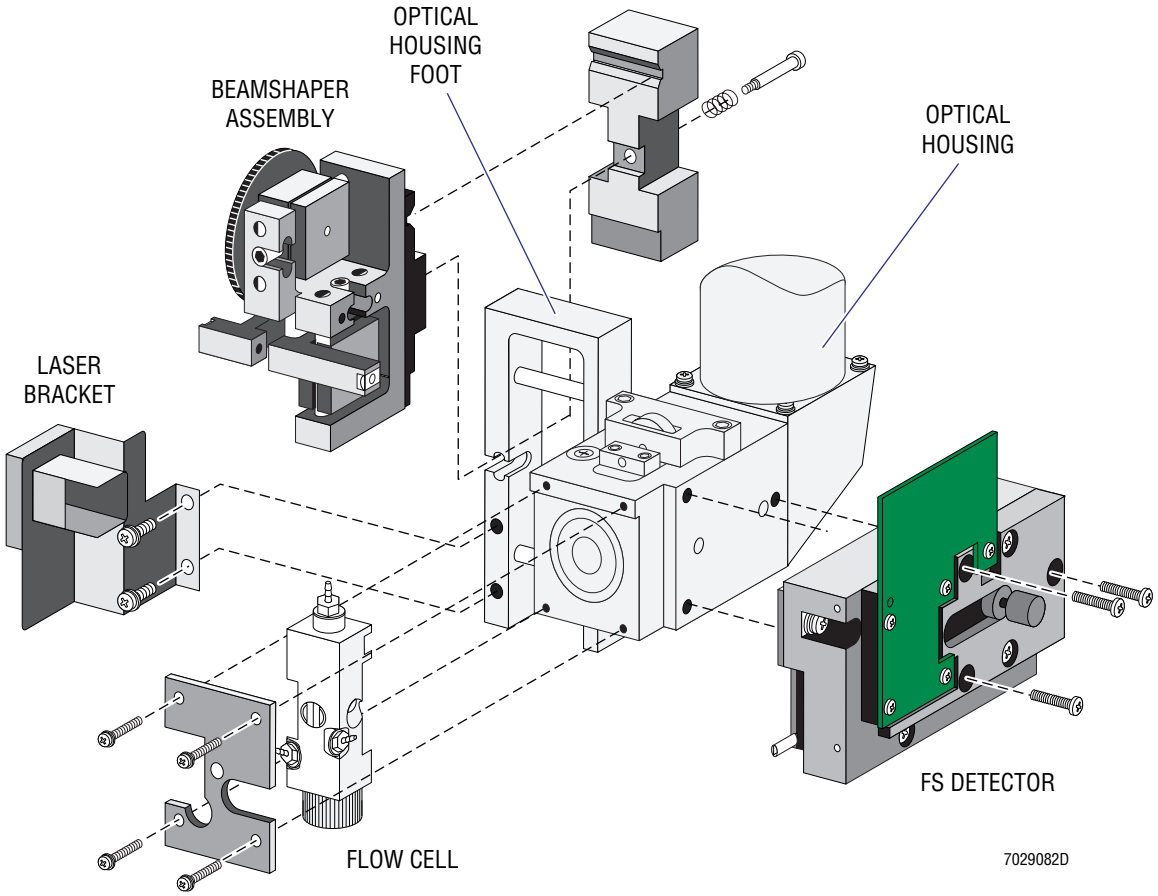
- Wear laser safety glasses as required by the wavelength being used.
- Pay attention to the warning labels.
- Do NOT wear jewelry that might reflect the laser beam.

ATTENTION: If the flow cell is being replaced that is the only assembly that needs to be removed. If the beam shaping assembly is being replaced, you must first remove the flow cell.

Preparation

1. Ensure that the Cytometer is on.
2. Remove all covers required to access the left-side compartment. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
3. Remove the flow cell (Figure 4.5-1).
   a. Remove the four screws securing the flow cell plate to the optical housing.
   b. Remove the plate and set it aside.
   c. If the beamshaper assembly is being replaced, go to Heading Beamshaper Assembly Removal, Replacement, and Alignment in this procedure.
   d. If the flow cell is being replaced, go to Heading Flow Cell Replacement that follows.

Figure 4.5-1 Flow Cell and Beamshaper Replacement Components



Flow Cell Replacement

1. Remove the tubing attached to the flow cell. Label the tubing for correct reattachment later.
2. Discard the old flow cell.
3. Install the replacement flow cell.
4. Reattach the tubing.
5. Reinstall the plate using the four screws removed earlier.

WARNING Risk of personal injury. Be very careful when operating the instrument when the safety interlock switch in the Cytometer is defeated, as you may be exposed to the laser beam and/or electric shock. After servicing the instrument, make sure the top cover is properly reinstalled to reactivate the safety interlock switch if bypassed while servicing the instrument.

6. Defeat the Cytometer interlock switch. For the location of the Cytometer interlock switch, refer to Figure 4.3-5 as needed.

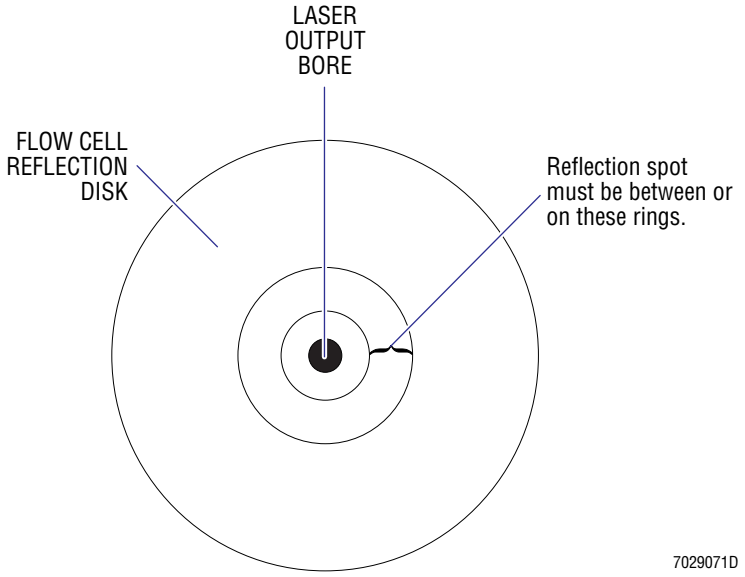
   Note: Pulling up on the Cytometer interlock switch allows the Argon laser to be energized.

WARNING The laser beam can cause eye damage if the laser beam's path is viewed directly on the same viewing plane. Avoid direct exposure to beam. Do not view directly or with optical instruments except for special service instruments as directed in this service manual.

7. Place the flow cell reflection disk over the laser output bore and carefully move the disk until the laser light is coming through the hole and a reflection spot is on the disk. The reflection spot must be within or on the two rings inscribed on the disk (Figure 4.5-2).

   Note: If the reflection spot is not within or on the inscribed rings, the quartz is **not** within the 2.0 degree rotation specifications for the flow cell and you **must** replace the flow cell.

Figure 4.5-2 Correct Laser Reflection Positioning



8. Go to Heading 4.6, OPTICAL ALIGNMENT and perform the entire procedure as written.
9. Go to Heading 4.7, SAMPLE AND SHEATH SENSOR CALIBRATION and perform the entire procedure as written.

Beamshaper Assembly Removal, Replacement, and Alignment

Note: The flow cell must be removed before starting this replacement.

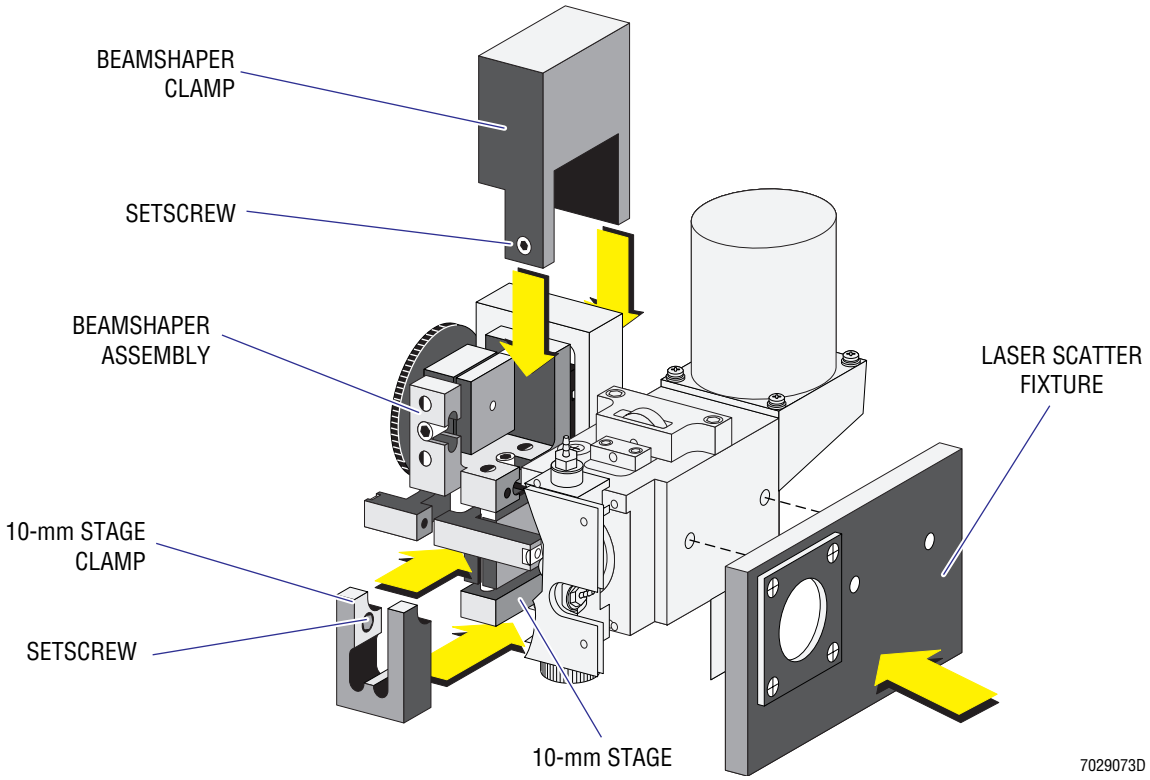
WARNING The laser beam can cause eye damage if the laser beam's path is viewed directly on the same viewing plane. Avoid direct exposure to beam. Do not view directly or with optical instruments except for special service instruments as directed in this service manual.

1. Remove the laser bracket from the optical housing assembly by removing the two Phillips-head screws (Figure 4.5-1).
2. Unscrew the beamshaper assembly and remove it from the optical housing assembly (Figure 4.5-1).
3. If the beamshaper is being replaced set aside the old beamshaper to be sent back for repair.
4. Reinstall the flow cell.

Install Alignment Tools

1. Install the 10-mm stage clamp to the 10-mm stage and secure it by tightening the 1/8 in. Allen setscrew (Figure 4.5-3).

Figure 4.5-3 Beamshaper Components

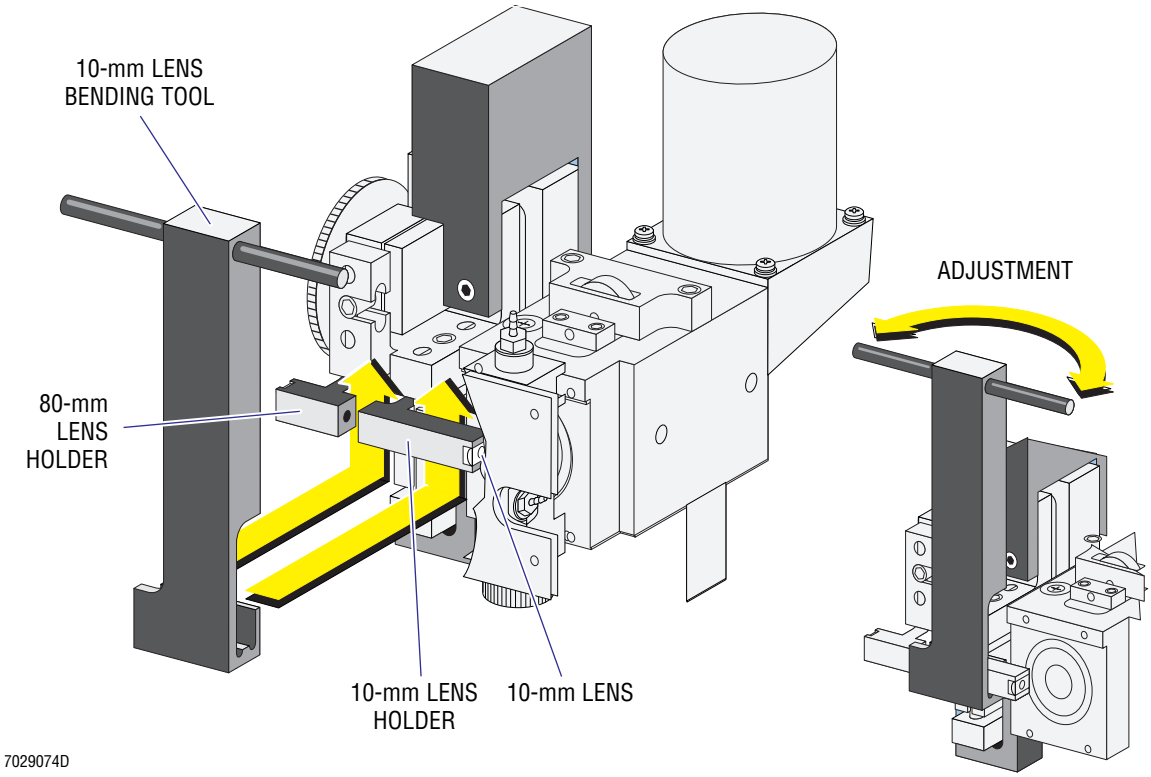


2. Install the beamshaper assembly onto the optical housing foot and secure it to the foot (Figure 4.5-1).
3. Install the beamshaper clamp over the optical housing assembly and secure it by tightening the setscrew (Figure 4.5-3).
4. Remove the FS detector (Figure 4.5-1) from the optical housing and install the laser scatter fixture (Figure 4.5-3).

Alignment

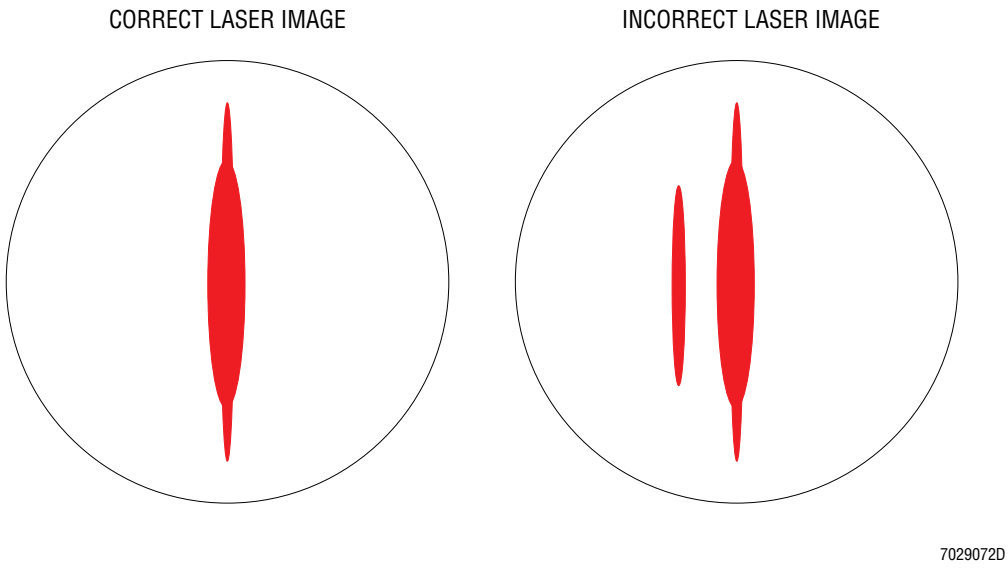
1. Insert the 10-mm lens bending tool into the 10-mm lens and tilt the bending tool forward so the tool remains in place and the laser beam is not clipped. Slip the bending tool in-between the 80-mm and 10-mm lens holders (Figure 4.5-4).

Figure 4.5-4 Flow Cell and Beamshaper Alignment



2. Carefully turn the bending tool to get the correct laser image to appear on the Mylar flexible film (Figure 4.5-5).

Figure 4.5-5 Correct/Incorrect Laser Image



3. Remove both the 10-mm stage and beamshaper clamps from the stage and beamshaper assembly and the laser scatter fixture from the optical housing (Figure 4.5-3).
4. Reinstall the FS detector.
5. Go to Heading 4.6, OPTICAL ALIGNMENT and perform the entire procedure as written.

Reinstall Covers

Reinstall all covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions

System Verification

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

4.6 OPTICAL ALIGNMENT

Purpose

Perform this procedure whenever a Preventative Maintenance Inspection (PMI) procedure is performed or any of the following are replaced:

- The laser
- The flow cell
- The FS detector.

Tools/Supplies Needed

- ❑ One, empty, 12 x 75-mm test tube, PN 2523749
- ❑ Flow-Check fluorospheres, PN 6605359
- ❑ 7/64 in., T-handle, Allen wrench
- ❑ 7/64 in., L-handle, Allen wrench
- ❑ Storage scope or oscilloscope

Preparation

1. Turn the Cytometer on.
2. Remove all covers required to access the left-side compartment. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

Laser Beam Steering

1. Press RUN when the READY light blinks green.
2. Connect the BNC signal cables from the Scope A and B connectors to connectors on the rear panel of the Cytometer labeled SCOPE A and SCOPE B.
3. Create a CHANNEL 500 protocol. For parameter and setting information, refer to Table A.3-1 as needed.
4. Fill a test tube with approximately 1-mL fluorospheres.
5. Insert the test tube into the sample station and press F9.
6. With the T-handle Allen wrench, adjust the Z-axis to the center of the flow-cell channel.
7. Set the scope according to Table 4.6-1.

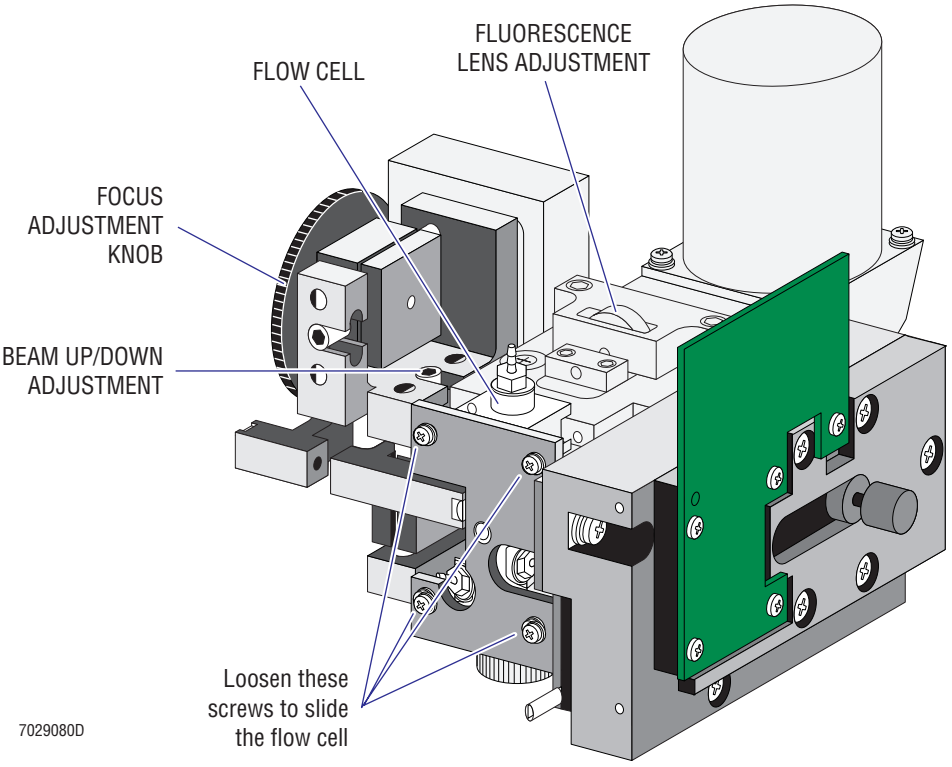
Table 4.6-1 Oscilloscope Settings

Item on Scope	Setting
Channel 1	2 v/div.
Channel 2	2 v/div.
Time	2 µS/div.
Trigger	Channel 1

8. While viewing the scope, align the Z-axis until the FS pulse is displayed on Channel 1.

9. Using the focus adjustment knob (Figure 4.6-1), adjust the beam-shaping assembly until the narrowest pulse width for FS is observed.

Figure 4.6-1 Beam-Shaping Stage Components



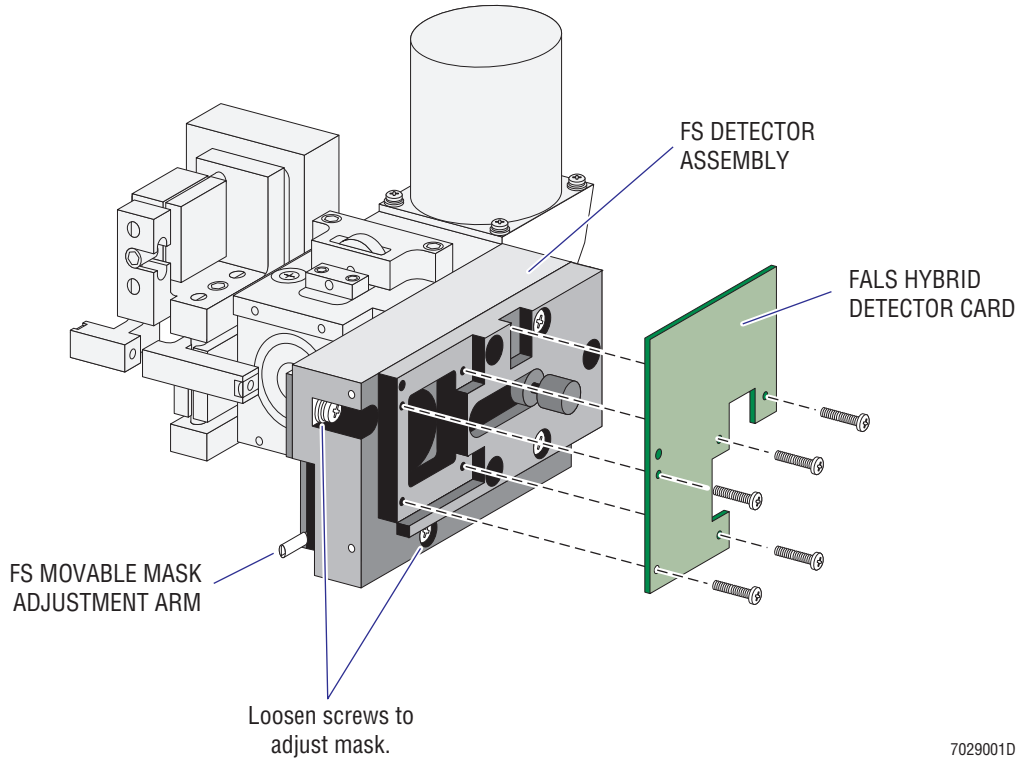
10. Repeat step 6 through 9 until the tightest pulse width for FS is observed.
11. Slide the flow cell slowly back and forth (Figure 4.6-1) until a fluorescent signal is present on the bar graph.
12. Using the L-handle Allen wrench, adjust the beam up/down until the maximum fluorescent signal is present.
13. Adjust the fluorescence lens to gain the maximum fluorescent signal (Figure 4.6-1).
14. Repeat steps 6 through 13 until no further adjustments are needed.

Forward Scatter (FS) Mask Alignment

1. Select the CHANNEL 500 protocol.
2. If not already connected, connect the scope to the BNC connector (labeled SCOPE A) on the back of the Cytometer.
3. Dispense the fluorospheres into a test tube.
4. Insert the test tube into the manual sample stage and run the sample.
5. Looking at FL3, adjust for best FL3 mean channel and CV.

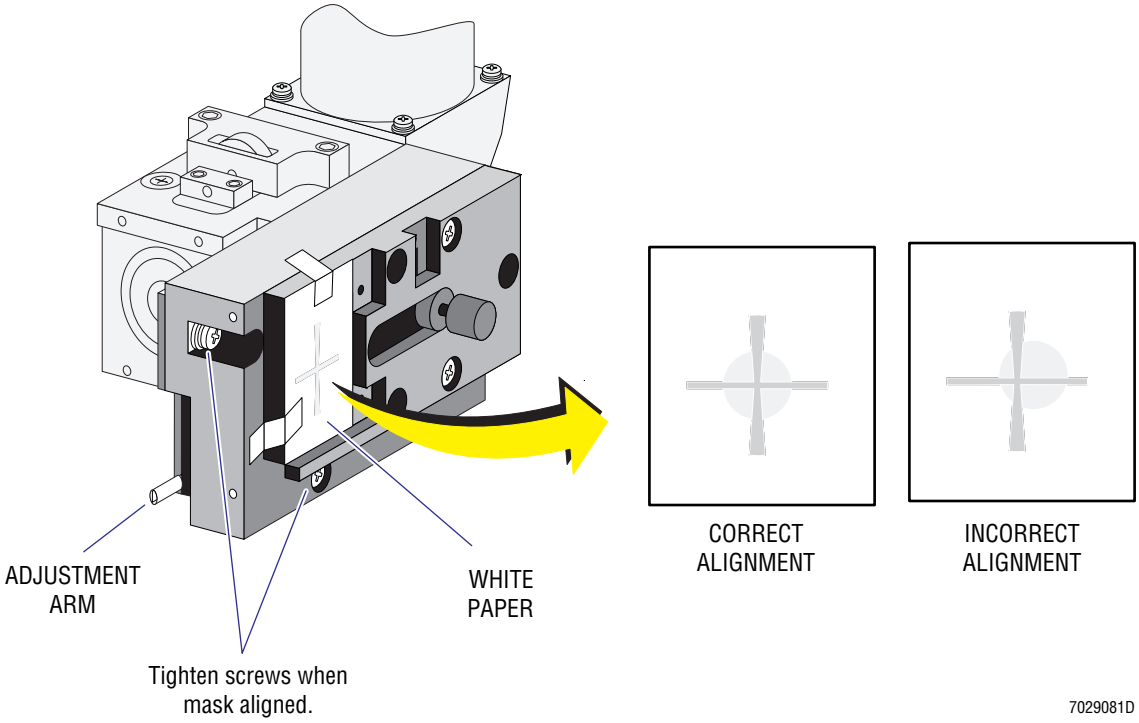
6. Remove the FALS Hybrid Detector card mounted to the FS detector assembly (Figure 4.6-2).

Figure 4.6-2 Forward Scatter (FS) Movable Mask Adjustment



7. Place a sheet of white paper over the optical lens (Figure 4.6-3).
8. Loosen the screws to adjust the mask (Figure 4.6-2).
9. Using the adjustment arm, position the mask crosshairs as shown in CORRECT ALIGNMENT in Figure 4.6-3.

Figure 4.6-3 Correct/Incorrect Scattered Light Positioning



10. When the mask is properly aligned, tighten the screws (Figure 4.6-3).

How to Proceed

1. If you did this procedure as part of the Cytometer installation, go back to Heading 3.7 and complete the procedures under the Reinstall Covers and Panels heading.
2. If you did this procedure as part of the PMI procedure, perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).
3. If you did this procedure as part of replacing the laser, flow cell, or FS detector, perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).
4. To complete this procedure, reinstall all covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

4.7 SAMPLE AND SHEATH SENSOR CALIBRATION

Purpose

Perform this procedure if erratic data rates exist or if you replace any of the following:

- System Interface card
- Sensor card
- Sample regulator (electronic regulator)
- Sheath regulator.

Tools/Supplies Needed

- ❑ One, empty, 12 x 75-mm test tube, PN 2523749
- ❑ COULTER® EPICS® Prefinal Software diskette, PN 7231244
- ❑ Digital Voltmeter (DVM)
- ❑ External digital pressure gauge, 0 to 100 psi range with 0.01 psi accuracy, with vacuum gauge capabilities or a separate vacuum gauge
- ❑ Pneumatic calibration box, PN 2907103
- ❑ T-connector and tubing
- ❑ Trimmer pot adjustment tool, PN 5402071
- ❑ Flow-Check fluorospheres, PN 6605359
- ❑ Hard copy of Figure A.2-19, System Interface Card - Component Locations, optional

Preparation

1. Remove all covers required to access and remove the EMC shield from the upper pneumatics drawer. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
2. Lift the Data Acquisition card cage and lock it in its vertical position. Refer to Heading 4.3 if you need detailed instructions.
3. Install the Prefinal Service Software as directed under Heading 4.2, PREFINAL SERVICE SOFTWARE INSTALLATION AND OPERATION.
4. At the Prefinal Test Menu:
   a. Select **VALVE CONTROL**.
   b. Turn on valves 5, 21, and 22.
   c. Turn the compressor off.

Preliminary Voltage Checks

1. At the upper pneumatics drawer, disconnect the tubing attached to the back of feed-through fitting FF42 (sample pressure) and the tubing attached to the back of feed-through fitting FF43 (sheath pressure).
2. Wait 10 seconds for the pressure to vent to atmosphere.
3. At the Data Acquisition card cage, connect the negative DVM lead to E27 on the chassis for ground.

4. At the System Interface card:
   a. Connect the positive DVM lead to TP3 and, as needed, adjust the SAMPLE ZERO potentiometer until the DVM reads 0.000 ±0.001 Vdc. For test point and potentiometer locations, refer to Figure A.2-19 as needed.
   b. Move the positive DVM lead to TP2 and, as needed, adjust the SHEATH ZERO potentiometer until the DVM reads 0.000 ±0.001 Vdc. For test point and potentiometer locations, refer to Figure A.2-19 as needed.
5. At the upper pneumatics drawer, reconnect the tubing (from the lower pinch valve) to feed-through fitting FF43.

Calibration

1. Use a T-fitting to make an in-line connection between the external pressure gauge and the sheath pressure tubing attached to the back of feed-through fitting FF42.
2. Turn the compressor on.
3. Insert an empty test tube into the manual sample station.
4. Make sure the external pressure gauge reads 4.00 psi.
   a. If the gauge reads 4.00 psi, go to step 5.
   b. If the gauge does not read 4.00 psi:
      1) Unlock the sheath pressure regulator. To locate the sheath pressure regulator, refer to Figure A.5-5 as needed.
      2) Rotate the black knob to adjust the regulator to make the external pressure gauge reads 4.00 psi.
5. At the System Interface card:
   a. Connect the positive DVM lead to TP2 (negative DVM lead to E27).
   b. While monitoring the voltage at TP2, adjust the SHEATH GAIN potentiometer (R14) as needed to make the DVM readout 2.400 Vdc. For test point and potentiometer locations, refer to Figure A.2-19 as needed.
6. Disconnect the external pressure gauge and reconnect the sheath pressure tubing to feed-through fitting FF42.
7. Move the T-fitting to make an in-line connection between the external pressure gauge and the sample pressure tubing attached to the back of feed-through fitting FF43.
8. Connect the Pneumatic Calibration Box.
   a. Locate the sample pressure regulator (electronic regulator to the left). To locate the sample pressure regulator, refer to Figure A.5-5 as needed.
   b. Disconnect the power connector (labeled P105) supplying power to the regulator.
   c. Insert the two-pin male connector from the sample pressure regulator into the two-position female connector attached to the pneumatic calibration box (labeled J2).
   d. Locate the PMT Distribution and Laser Fan Control card on the optical bench. To locate this circuit card, refer to Figure A.5-4 as needed.

e. Disconnect one of the PMT ±15 Vdc power connectors and connect the four-pin power connector from the pneumatic calibration box in its place. To locate these connectors, refer to Figure A.2-14 as needed.

Note: The four-pin connector only contains two pins.

9. Connect the negative lead of the DVM to the black wire on the electronic regulator's power connector. Connect the positive lead to the white wire.
10. Adjust the calibrator pot to a 1.000 Vdc reading on the DVM.
11. Adjust the Zero Adjustment on the electronic regulator for 3.000 psi on the external pressure gauge.
12. Adjust the calibrator pot to a 1.600 Vdc reading on the DVM.
13. Adjust the RANGE adjustment pot for 4.000 psi on the external pressure gauge.
14. Repeat steps 10 through 13 until no further adjustment is required.
15. With the external pressure gauge reading 4.000 psi, monitor TP3 on the System Interface card and adjust the SAMPLE GAIN (R35) to 2.400 Vdc.
16. Disconnect the pneumatic calibrator box and reconnect the electronic regulator and PMT power connectors.
17. On the screen, ensure that the *SET DIFFERENTIAL PRESSURE* displayed is zero and adjust the ZERO adjustment pot on the electronic regulator so that the *ACTUAL DIFFERENTIAL PRESSURE* is zero.
18. Disconnect the tubing going to the SN7 sensor. To locate this sensor, refer to Figure A.5-5 as needed.
19. Connect a syringe and an external pressure gauge to the SN7 sensor.
20. Connect a DVM and set it to check continuity by connecting the ground lead to E7 and the positive lead to wire marker 35 on the SN7 sensor.
21. Slowly increase the pressure by pushing the syringe plunger until 2.0 psi is obtained on the external pressure gauge.
22. Adjust SN7 (access through the opening in the back panel) until continuity is observed on the DVM.
23. Remove the syringe from the SN7 sensor and reconnect the tubing.
24. Disconnect the tubing from the SN6 sensor. To locate this sensor, refer to Figure A.5-5 as needed.
25. Connect a syringe and an external pressure gauge to the SN6 sensor.
26. Connect the positive lead to wire marker 33 on the SN6 sensor.
27. Slowly increase the vacuum on the SN6 sensor by pulling the syringe plunger until -1.00 psi is obtained on the external pressure gauge.
28. Adjust SN6 until continuity is observed on the DVM.
29. Disconnect the syringe and reconnect the tubing going to the SN6 sensor.
30. Connect the external vacuum gauge to the purple tubing on the sample head.
31. Using the Prefinal Test Software **Valve Control** test option,
    a. Turn VL21 and VL22 off.
    b. Turn VL5 off.

32. In the upper pneumatics drawer, adjust the vacuum regulator (RG3) to 7.00 inches. To locate the vacuum regulator, refer to Figure A.5-5 as needed.
33. Remove the external vacuum gauge.
34. If you have not already done so, remove the Prefinal Software diskette from the drive.
35. Press and hold Ctrl+Alt+Delete to reboot the instrument.
36. Select the **CHANNEL 500** protocol and run some fluorospheres. For parameter and setting information, refer to Table A.3-1 as needed.
37. Ensure that the external pressure gauge reads the following psi settings:
    - LOW = 3.72 psi
    - MED = 3.92 psi
    - HIGH = 4.12 psi.
38. Disconnect the external pressure gauge.

Operational Verification

Note: Since the fluorospheres are at a concentration of 1.0 to 1.2 million/m, the number of fluorospheres per **second** in the low flow rate setting is 135 to 200.

Verify the flow rate as follows:

1. At the Workstation, select the **CHANNEL 500** protocol.
2. Run Flow-Check fluorospheres.
    a. Fill a test tube with 1.0 mL of Flow-Check fluorospheres (meniscus curve at the 1.0 mL mark).
    b. Place the test tube into the manual sample station.
    c. Run the sample.
3. Restart after 15 seconds of acquisition. After the 10,000 event stop count is reached, note the average events/second displayed.
4. Check the average events for the run are between 135 events per second (minimum rate) and 200 events per second (maximum rate):
    a. If the average events for the run are between the minimum and maximum rates, go to step 5 and do five runs of fluorospheres.
    b. If the average events for the run is **below** the minimum (135 events per second) rate for the fluorospheres:
        1) Use the sample pressure gain adjust potentiometer (R35) on the System Interface card and adjust the sample pressure upwards. Do not go **above** 3.80 psi.
        2) Go to step 5 and do five runs of fluorospheres.
    c. If the average events for the run is **above** the maximum (200 events per second) rate for the fluorospheres,
        1) Use the sample pressure gain adjust the potentiometer (R35) on the System Interface card to adjust the sample pressure down. Do not go **below** 3.70 psi.
        2) Go to step 5 and do five runs of fluorospheres.

5. Run five test tubes containing 1.0 mL of Flow-Check fluorospheres.
   a. Fill five test tubes to the 1.0 mL mark with Flow-Check fluorospheres.
   b. Place a test tube into the manual sample station.
   c. Run the sample.
   d. Print the histograms from the run.
   e. Repeat steps a through d until all five test tubes are processed and the results are printed.
6. Record the average events for each of the five runs.
7. Find the sum by adding the average events for each of the five runs.
8. Divide the sum by five to determine the average events for the five runs.
9. Verify that the average of the sum is between the minimum and maximum rates.
   - If it is between 135 events per second and 200 events per second, go to Heading Reinstall Assemblies and Covers that follows.
   - If it is **not** between 135 events per second and 200 events per second, repeat steps 2 through 9 until the flow rate is acceptable.

Reinstall Assemblies and Covers

1. Lower the Data Acquisition card cage back in the center cavity of the Cytometer. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
2. Reinstall all covers removed during this procedure. Refer to Heading 4.3 if you need detailed instructions.

System Verification

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

4.8 CARRYOVER TEST

Purpose

This test verifies sample carryover in the sample tubing and flow cell area. Perform this test if the customer complains of sample carryover. If an XL-MCL flow cytometer is being checked, the carryover test must be performed using the manual sample station then repeated using the MCL sample station.

Tools/Supplies Needed

- ❑ Flow-Check fluorospheres, PN 6605359
- ❑ IsoFlow sheath fluid, PN 8547008
- ❑ Six, empty, 12 x 75 mm test tubes, PN 2523749

  Note: If the carryover test is being performed on an XL flow cytometer without the MCL option, only three empty 12 x 75 mm test tubes are required.

Preparation

1. Create a test protocol using the parameter and setting information in Table 4.8-1.

Table 4.8-1 Carryover Protocol

Histogram	Parameter	Signals	Gating	Analysis Region
1	Dual	FS vs. SS	RECT GATE	A
2	Single	FS	On region A	B
3	Single	FL1	On region A	C
4	Single	FL2	On region A	D
5	Single	FL3	On region A	E
6	Single	FL4	On region A	F
7	Single	SS	On region A	G

Settings:	FLOW RATE	HIGH
	COMPENSATION	All signals = 0%
	DISCRIMINATOR	FS = 100
	Stop	On Histogram 1 for 10,000 events
	Autoprint	ON

2. Save the protocol and name it CARRYOVER.
3. Dispense approximately 1 mL of clean sheath fluid in four test tubes and label each tube ISO. If you are testing an XL flow cytometer without the MCL option installed, only two tubes are needed.
4. Dispense approximately 1 mL of Flow-Check fluorospheres into two test tubes and label each tube BEADS. If you are testing an XL flow cytometer without the MCL option installed, only one tube is needed.

Procedure

Using the Manual Sample Station

1. Select the CARRYOVER protocol from the protocol screen.
2. Insert the test tube labeled BEADS in the manual sample station.
3. Run the CARRYOVER protocol.
4. At the end of the run, record the time it took to reach 10,000 events and save the printout.
5. Remove the test tube containing the fluorospheres (beads).
6. Insert one of the ISO test tubes in the manual sample station.
7. Rerun the CARRYOVER protocol with a manual stop at the time recorded in step 4.
8. At the end of the run, label the sample information as CLEAR1 and save the printout.
9. Remove the ISO test tube from the manual sample station. **Discard** the test tube immediately to ensure it is not accidently rerun.
10. Wait five minutes.
11. After the five minute wait, insert the second ISO test tube in the manual sample station.
12. Rerun the CARRYOVER protocol with a manual stop at the time recorded in step 4.
13. At the end of the run, label the sample information as CLEAR2 and save the printout.
14. Remove the ISO test tube from the manual sample station. **Discard** the test tube immediately to ensure it is not accidently rerun.
15. Ensure that the carryover for CLEAR1 and CLEAR2 are less than 1% (<100 events each).

    Note: If the carryover is greater than 1%:

    1) Clean the segmenting valve as instructed under Heading 4.11.
    2) Using the manual sample station, repeat the Carryover Test. Start at step 1 again.
16. If you are performing this carryover test on an XL-MCL flow cytometer, repeat this check using the MCL sample station.

Using the MCL Sample Station

1. Select the CARRYOVER protocol.
2. Place the test tube labeled BEADS in the MCL carousel.
3. Run the CARRYOVER protocol.
4. At the end of the run, record the time it took to reach 10,000 events and save the printout.
5. Remove the test tube containing the fluorospheres (beads).
6. Place one of the ISO test tubes in the MCL carousel.
7. Rerun the CARRYOVER protocol with a manual stop at the time recorded in step 4.
8. At the end of the run, label the sample information as CLEAR1-MCL and save the printout.
9. Remove the ISO test tube from the MCL carousel. **Discard** the test tube immediately to ensure it is not accidently rerun.

10. Wait five minutes.
11. After the five minute wait, place another ISO test tube in the MCL carousel.
12. Rerun the CARRYOVER protocol with a manual stop at the time recorded in step 4.
13. At the end of the run, label the sample information as CLEAR2-MCL and save the printout.
14. Remove the ISO test tube from the MCL carousel. **Discard** the test tube immediately to ensure it is not accidently rerun.
15. Ensure that the carryover for CLEAR1-MCL and CLEAR2-MCL are less than 1% (<100 events each).

    Note: If the carryover is greater than 1%:

    1) Go to Heading 4.11 and clean the segmenting valve as instructed.
    2) Repeat the Carryover Test, first using the manual sample station then the MCL sample station. Begin at step 1 under the Using the Manual Sample Station heading.

4.9 PEEK TUBING REPLACEMENT

Purpose

Use this procedure when any of the following conditions are present:

- Excessive carryover
- High CVs
- Mean channel drift
- No aspiration.

Tools/Supplies Needed

- ❑ Beckman Coulter Service Tool Kit, PN 5415102
- ❑ Sample/MCL Intro Line kit, PN 6912941, consisting of:
  - One 14 in. piece of blue PEEK tubing, PN 1021636
  - One 15 in. piece of blue PEEK tubing, PN 1021654
  - One 3.75 in. piece of tan PEEK tubing, PN 1022073
  - Six black ferrule nuts, PN 6232526
  - Six tan ferrules PN 6232525
- ❑ Lint-free tissue

Preparation

Remove all covers required to access the segmenting valve located behind the manual sample station cover assembly. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

Removal

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while performing service, maintenance and troubleshooting procedures, biohazardous material in the instrument could injure or contaminate you. Beckman Coulter recommends that you wear barrier protection, such as appropriate safety glasses, a lab coat and latex gloves throughout the performance of service, maintenance and troubleshooting procedures to avoid contact with biohazardous material in the instrument.

1. Turn the segmenting valve knob counterclockwise to remove the knob from the segmenting valve. To locate the segmenting valve knob, refer to Figure A.5-12 as needed.
2. At the segmenting valve front pad:
   a. Locate the black ferrule nut. Refer to Figures 4.9-1 and 4.9-2 as needed.

Figure 4.9-1 PEEK Tubing Connections

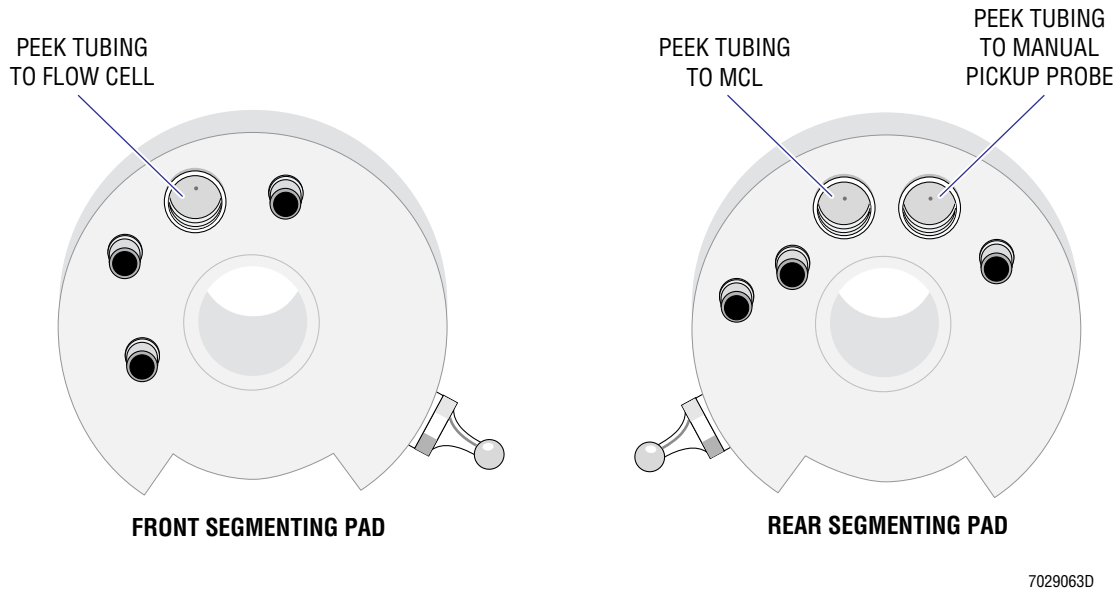
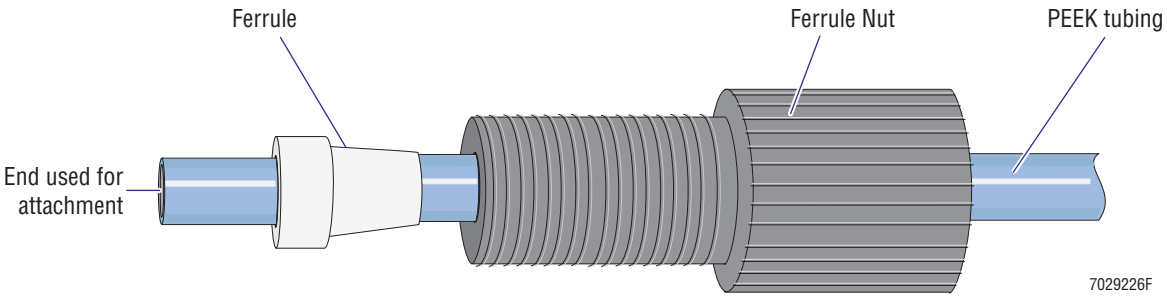


Figure 4.9-2 PEEK Tubing with Ferrule and Ferrule Nut



b. Unscrew the ferrule nut and remove the nut (and attached PEEK tubing) from the front pad.

c. Follow the PEEK tubing to the base of the flow cell to locate the ferrule nut attached to the flow cell.

d. Unscrew the ferrule nut to completely remove the PEEK tubing from the instrument.

e. Discard the tubing assembly (PEEK tubing, ferrules, and ferrule nuts) into a biohazardous container.

3. Separate the segmenting valve pads from their individual air cylinders.

   a. Separate the front pad from its air cylinder by sliding the clamp at the end of the cylinder's piston towards the air cylinder then pushing the piston away from the ball stud that's attached to the front pad.

   b. Separate the middle pad from its air cylinder by sliding the clamp at the end of the cylinder's piston towards the air cylinder then pushing the piston away from the ball stud that's attached to the middle pad.

   c. Separate the rear pad from its air cylinder by sliding the clamp at the end of the cylinder's piston towards the air cylinder then pushing the piston away from the ball stud that's attached to the rear pad.

4. Slide the segmenting valve forward on the shaft until the black ferrule nuts are accessible.

   Note: Two ferrule nuts are present.

   - If the MCL option is installed, blue PEEK tubing extends from each ferrule nut. The ferrule nut to your left is associated with the manual sample probe; the ferrule nut on your right, with the MCL sample probe.
   - If the MCL option is not installed, the ferrule nut to your left is associated with the manual sample probe but the ferrule nut on your right is solid and acts as a plug to seal the port used for the MCL option.

5. At the segmenting valve rear pad:
   a. Unscrew a ferrule nut (with attached PEEK tubing) and remove the nut (and attached PEEK tubing) from the rear pad.
   b. Follow the PEEK tubing to locate the ferrule nut attached to the probe at the manual sample station (or MCL sample station).
   c. Unscrew the ferrule nut to completely remove the PEEK tubing from the instrument.
   d. If the MCL option is installed, repeat steps a through c to remove the second tubing assembly. If the MCL option is being installed, remove and discard the plug.
   e. Before discarding the tubing assemblies you removed from the instrument, examine one of the assemblies (PEEK tubing, ferrules, and ferrule nuts). For proper installation, the ferrules and ferrule nuts must be correctly oriented. Use Figure 4.9-2 as a reference.
   f. If you have not done so, discard into a biohazardous container all tubing assemblies removed from the instrument.

Installation

1. Locate the two pieces of blue PEEK tubing. One is slightly longer than the other.
2. If the Cytometer has the MCL option installed or if you are installing the MCL option:
   a. Using the longer piece of blue PEEK tubing, thread a ferrule nut (knurled end first) followed by a ferrule (tapered end first) onto one end of the tubing. See Figure 4.9-2 for correct orientation of components.

   ATTENTION: Install the new PEEK tubing with the ferrule pushed back (Figure 4.9-2) so the PEEK tubing can be slightly compacted around the port as the ferrule is tightened by the ferrule nut.

   b. Push the ferrule away from the end of the PEEK tubing, as shown in Figure 4.9-2.
   c. At the segmenting valve rear pad, screw the ferrule nut into the threaded socket on the right (socket that's closer to the two metal fittings).
   d. At the opposite end of the PEEK tubing, thread a ferrule nut (knurled end first) followed by a ferrule (tapered end first) onto the end of the tubing.
   e. Push the ferrule away from the end of the PEEK tubing, as shown in Figure 4.9-2.
   f. At the MCL sample probe, screw the ferrule nut into the threaded socket at the top of the MCL sample probe to provide a path from the MCL sample probe to the segmenting valve.

3. Using the shorter piece of blue PEEK tubing:
   a. Thread a ferrule nut (knurled end first) followed by a ferrule (tapered end first) onto one end of the tubing. See Figure 4.9-2 for correct orientation of components.

   ATTENTION: Install the new PEEK tubing with the ferrule pushed back (Figure 4.9-2) so the PEEK tubing can be slightly compacted around the port as the ferrule is tightened by the ferrule nut.

   b. Push the ferrule away from the end of the PEEK tubing, as shown in Figure 4.9-2.
   c. At the segmenting valve rear pad, screw the ferrule nut into the threaded socket on the left (socket that's closer to the single metal fitting).
   d. At the opposite end of the PEEK tubing, thread a ferrule nut (knurled end first) followed by a ferrule (tapered end first) onto the end of the tubing.
   e. Push the ferrule away from the end of the PEEK tubing, as shown in Figure 4.9-2.
   f. At the manual sample probe, screw the ferrule nut into the threaded socket at the top of the manual sample probe to provide a pathway from the manual sample probe to the segmenting valve.
4. Carefully slide the segmenting valve to it original position on the shaft.
5. Locate the piece of tan PEEK tubing.
6. Thread a ferrule nut (knurled end first) followed by a ferrule (tapered end first) onto one end of the tubing. See Figure 4.9-2 for correct orientation of components.

ATTENTION: Install the new PEEK tubing with the ferrule pushed back (Figure 4.9-2) so the PEEK tubing can be slightly compacted around the port as the ferrule is tightened by the ferrule nut.

7. Push the ferrule away from the end of the PEEK tubing, as shown in Figure 4.9-2.
8. At the segmenting valve front pad, screw the ferrule nut into the threaded socket.
9. At the opposite end of the PEEK tubing, thread a ferrule nut (knurled end first) followed by a ferrule (tapered end first) onto the end of the tubing.
10. Push the ferrule away from the end of the PEEK tubing, as shown in Figure 4.9-2.
11. At the flow cell, screw the ferrule nut into the threaded socket at the base of the flow cell to provide a pathway from the flow cell to the segmenting valve.
12. Reattach the segmenting valve pads to their individual air cylinders. Reattach the rear, then the middle, and finally the front. In each case, slide the clamp at the end of the cylinder's piston towards the air cylinder then push the socket over the ball stud that's attached to the pad. Release the sliding clamp to secure the ball stud to the air cylinder piston.
13. Reinstall the segmenting valve knob. Finger tighten the knob by rotating it clockwise until it can no longer be turned without force. Do not overtighten the knob!
14. Wipe the outside of the segmenting valve with a lint-free tissue.

ATTENTION: If you did this procedure as part of installing the MCL Option, do not press the PRIME button at this time. Go back to Heading 3.8 and starting at the Power Supply Module Upgrade heading, complete the procedure as written.

15. Press the PRIME button and observe the segmenting valve. Make sure the segmenting valve pads are rotating smoothly and there is no leakage at the segmenting valve, flow cell, or sample probe(s).

Reinstall Covers

1. Reinstall the sample and waste connect panel using the two Phillips-head screws removed earlier.
2. Reinstall all covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

System Verification

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

4.10 SHEATH PRESSURE/SAMPLE STATION VACUUM CALIBRATION

Purpose

This procedure provides instructions for field calibration of the sheath pressure regulator and the sample station vacuum regulator. Follow this procedure if either regulator is erratic or replaced.

Tools/Supplies Needed

- ❑ External digital pressure gauge, 0 to 100 psi range with 0.01 psi accuracy, with vacuum gauge capabilities or a separate vacuum gauge
- ❑ One, empty, 12 x 75-mm test tube, PN 2523749
- ❑ IsoFlow sheath fluid, PN 8547008

Preparation

1. Turn the instrument OFF.
2. Remove all cover required to access and remove the EMC shield from the upper pneumatics drawer. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

Calibration

1. Place a test tube filled with sheath fluid on the sample station.
2. Connect the external pressure gauge at fitting FF48 (left side of bracket) on upper pneumatics drawer.
3. Turn ON the instrument.
4. Wait until the screen displays *Cytometer* in **Verification** mode.
5. Adjust the sheath pressure regulator (RG2) to read 4.0 psi ±0.1 psi. Lock down the regulator after adjustment.
6. Remove the external pressure gauge and reconnect the pressure line.
7. Connect the vacuum gauge at fitting FF42.
8. Adjust the sample station vacuum regulator (R3) to 4 in. Hg.
9. Remove the vacuum gauge and reconnect the sample station vacuum line.

Verification

Select a protocol to run to ensure system operation.

Reinstall Covers

Reinstall all covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

System Verification

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

4.11 SEGMENTING VALVE CLEANING

Purpose

Perform this procedure if performance deteriorates or if symptoms of slow sample start, carryover, or a defective segmenting pad exists.

Tools/Supplies Needed

- ❑ Beckman Coulter Service Tool Kit, PN 5415102
- ❑ Latex gloves
- ❑ Beaker of bleach (unscented, household)
- ❑ Lubriplate™ grease, PN 1604005
- ❑ Lint-free tissue

Preparation

1. Select the RUN button on the sample station. Wait 10 seconds for the sheath draw to depressurize. (The RUN button should flash green.)
2. Remove all covers required to access the segmenting valve located behind the manual sample station. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

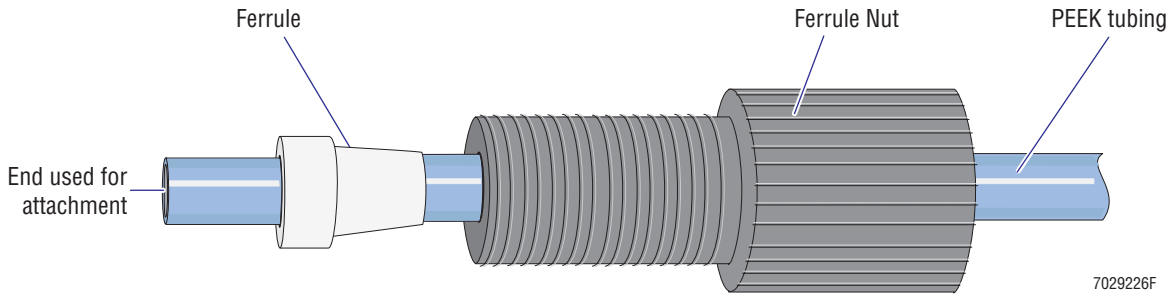
Removal

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while performing service, maintenance and troubleshooting procedures, biohazardous material in the instrument could injure or contaminate you. Beckman Coulter recommends that you wear barrier protection, such as appropriate safety glasses, a lab coat and latex gloves throughout the performance of service, maintenance and troubleshooting procedures to avoid contact with biohazardous material in the instrument.

Front Segmenting Pad

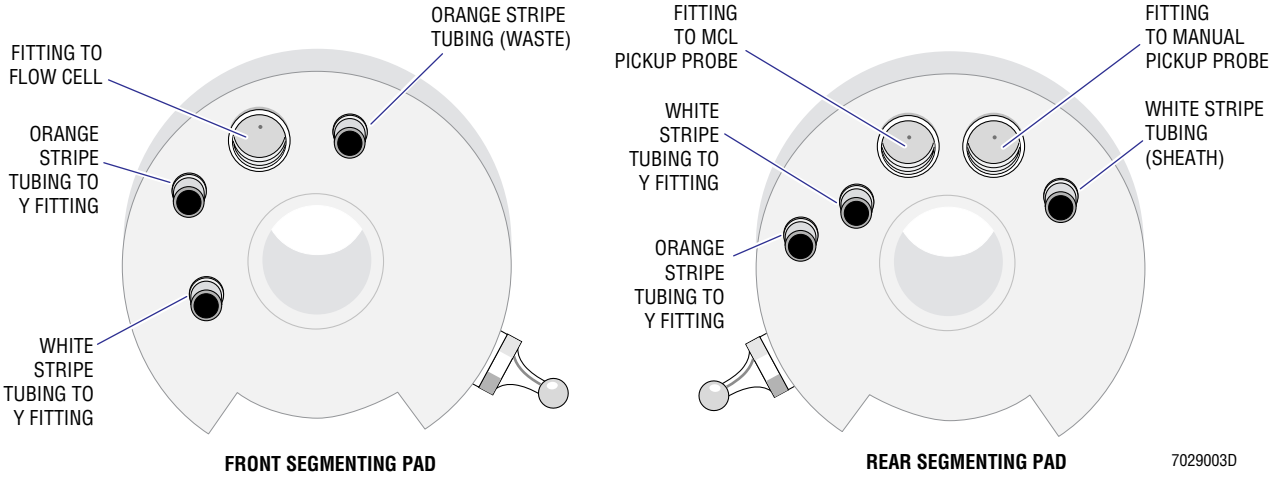
1. Turn the segmenting valve knob counterclockwise to remove the knob from the segmenting valve. To locate the segmenting valve knob, refer to Figure A.5-12 as needed.
2. Unscrew the black ferrule nut and remove the nut (with attached PEEK tubing and ferrule) from the front pad. Make sure the ferrule is not lost. Refer to Figure 4.11-1 as needed.

Figure 4.11-1 PEEK Tubing with Ferrule and Ferrule Nut



3. To facilitate installation, label the positions where the tubing is connected to the front segmenting pad (Figure 4.11-2).

Figure 4.11-2 Segmenting Valve Pad Connections



4. Separate the front pad from its air cylinder by sliding the clamp at the end of the cylinder's piston towards the air cylinder then pushing the piston away from the ball stud that's attached to the front pad.
5. Carefully slide the front segmenting pad off of the shaft.
6. Disconnect the tubing from the front segmenting pad (Figure 4.11-2):
   - Orange-striped Y-tubing
   - White-striped Y-tubing
   - Orange-striped (WASTE) tubing.
7. Submerge the front segmenting pad in bleach for five minutes.

Middle Segmenting Pad

1. Separate the middle segmenting pad from its air cylinder by sliding the clamp at the end of the cylinder's piston towards the air cylinder then pushing the piston away from the ball stud that's attached to the middle pad.
2. Carefully slide the middle pad off the shaft and place it in bleach for five minutes.

Rear Segmenting Pad

1. Separate the rear pad from its air cylinder by removing the cylinder clamp from the ball stud to the rear pad.
2. Carefully slide the rear segmenting pad off the shaft.
3. To facilitate installation, label the positions where the tubing is connected to the rear segmenting pad (Figure 4.11-2). If the MCL option is installed, label the blue PEEK tubing to ensure it is reinstalled in the correct location.
4. Unscrew the black ferrule nut and remove the nut (with attached PEEK tubing and ferrule) from the rear pad. Make sure the ferrule is not lost. Refer to Figure 4.11-1 as needed.

5. If the MCL option is installed, unscrew the second black ferrule nut and remove the nut (with attached PEEK tubing and ferrule) from the rear pad. Make sure the ferrule is not lost.
6. If the MCL option is not installed, unscrew and remove the black knurled plug and set it aside.
7. Remove the tubing (Figure 4.11-2):
   - Orange-striped Y-tubing
   - White-striped Y-tubing
   - Orange-striped (WASTE) tubing.
8. Submerge the rear segmenting pad in bleach for five minutes.

Clean the Shaft

1. Wipe the shaft with bleach to remove any debris.
2. Dry the shaft with a lint-free tissue.
3. Wipe the shaft with Lubriplate grease.
4. Wipe the shaft with a lint-free tissue to remove excess Lubriplate grease. The shaft should be only lightly coated.

Installation

Rear Segmenting Pad

1. Remove the rear segmenting pad from the bleach and rinse it with distilled water.
2. Connect the tubing to the rear segmenting pad (Figure 4.11-2):
   - Orange-striped Y-tubing
   - White-striped Y-tubing
   - Orange-striped (WASTE) tubing.
3. Locate the PEEK tubing connected to the manual sample probe.
4. Screw the ferrule nut into the threaded socket on the right (socket that's closer to the two metal fittings). See Figure 4.11-2.
5. If the MCL option is installed:
   a. Locate the PEEK tubing connected to the MCL sample probe.
   b. Screw the ferrule nut into the threaded socket on the left (socket that's closer to the single metal fitting). See Figure 4.11-2.
6. If the MCL option is not installed, reinstall the black knurled plug in the MCL location. See Figure 4.11-2.
7. Install the front pad on the shaft.

Middle Segmenting Pad

1. Remove the middle segmenting pad from the bleach and rinse it with distilled water.
2. Install the middle pad on the shaft.

Front Segmenting Pad

1. Remove the front segmenting pad from the bleach and rinse it with distilled water.
2. Connect the tubing to the front segmenting pad (Figure 4.11-2):
   - Orange-striped Y-tubing
   - White-striped Y-tubing
   - Orange-striped (WASTE) tubing.
3. Install the front pad on the shaft.
4. Locate the PEEK tubing connected to the flow cell.
5. Screw the ferrule nut into the threaded socket on the front segmenting pad. See Figure 4.11-2.

Complete the Installation

1. Reattach the segmenting valve pads to their individual air cylinders. Reattach the rear, then the middle, and finally the front. In each case, slide the clamp at the end of the cylinder's piston towards the air cylinder then push the socket over the ball stud that's attached to the pad. Release the sliding clamp to secure the ball stud to the air cylinder piston.
2. Reinstall the segmenting valve knob. Finger tighten the knob by rotating it clockwise until it can no longer be turned without force. Do not overtighten the knob!
3. Wipe the outside of the segmenting valve with a lint-free tissue.
4. Press the PRIME button and observe the segmenting valve. Make sure the segmenting valve pads are rotating smoothly and there is no leakage.

Reinstall Covers

1. Reinstall the sample and waste connect panel using the two Phillips-head screws removed earlier.
2. Reinstall all covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

Verification

Perform the carryover test as directed under Heading 4.8, CARRYOVER TEST.

4.12 MCL OPTION FIELD ADJUSTMENT

Purpose

Use this procedure to properly align and adjust the MCL option:

- After installation
- After field replacement
- Upon detecting erratic MCL option operation.

Tools/Supplies Needed

- ❑ COULTER EPICS XL/XL-MCL Prefinal Software diskette, PN 7231244
- ❑ Five, empty, 12 x 75-mm test tubes, PN 2523749

Preparation

1. Remove all covers required to access the MCL main frame assembly. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

   Note: Unlatch the MCL covers from the Cytometer frame. **Do not attempt to remove the MCL from the Cytometer.** Refer to Heading 4.3 if you need detailed instructions.
2. Place a wire jumper between pins 3 and 4 on the MCL door interlock connector to defeat the door switch.
3. Ensure that the Computer Workstation is turned on.

WARNING Risk of personal injury. Be very careful when operating the instrument when the safety interlock switch in the Cytometer is defeated, as you may be exposed to the laser beam and/or electric shock. After servicing the instrument, make sure the top cover is properly reinstalled to reactivate the safety interlock switch if bypassed while servicing the instrument.

4. Defeat the Cytometer interlock switch. Refer to Heading 4.3 if you need detailed instructions.
5. Install the Prefinal Software diskette as directed under Heading 4.2, PREFINAL SERVICE SOFTWARE INSTALLATION AND OPERATION.

MCL TERMINAL Program Setup

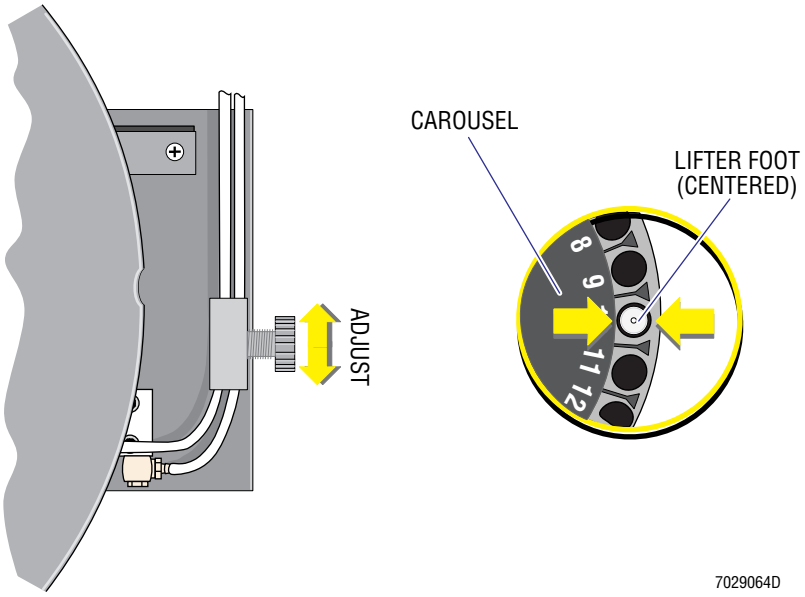
1. At the Prefinal Menu, select **MCL TERMINAL** and press Enter.
2. Place a carousel on the MCL turntable.

   Note: A carousel **must** be on the MCL option turntable before doing a master reset.
3. Press Esc, then type MR. This command does a master reset to the MCL option.
4. Wait for a spade symbol to appear on the monitor indicating the master reset is finished.
   - The spade symbol (♠) is an acknowledge return symbol that indicates a programmed command was completed successfully.
   - If the spade symbol does not appear, a sensor did not see a change of state.

Carousel Tube-Position Sensor Adjustment

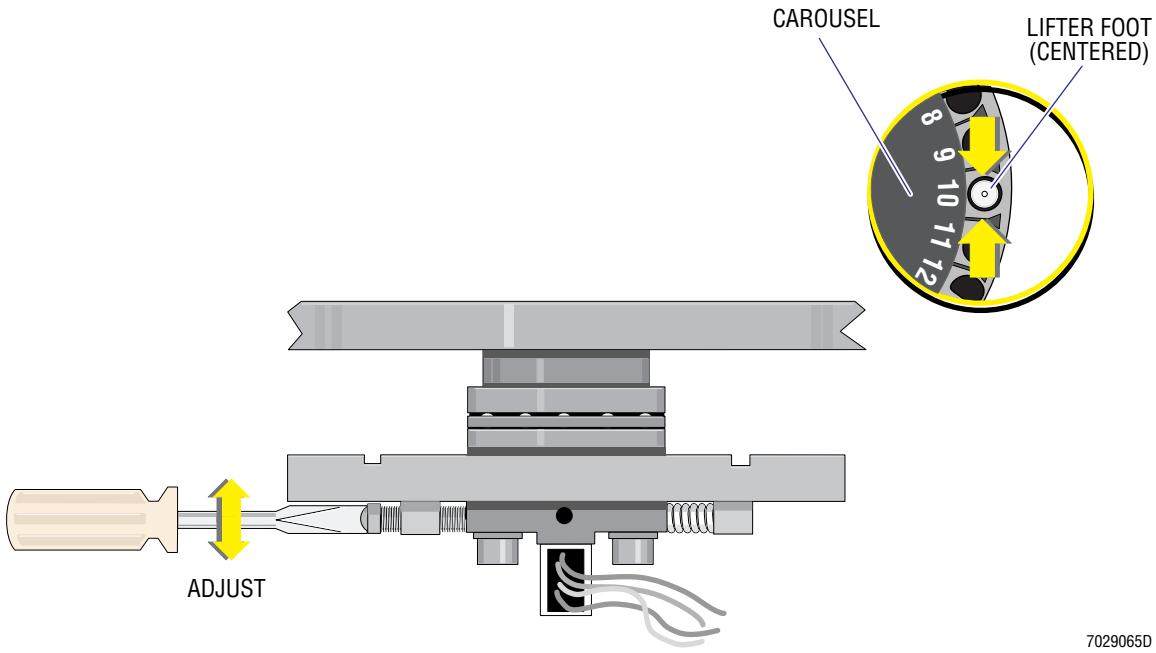
1. Insert a carousel with five test tubes installed in the first five carousel positions.
2. Press Esc, then type `CH`. The carousel rotates to the home position.
3. Press Esc, then type `CI`. The carousel moves in towards the MCL option probe.
4. Press Esc, then type `CR`. The carousel advances to position one.
5. Press Esc, then type `LU`. The lifter motor rises and stays up.
6. Ensure that the lifter foot comes up without touching the carousel. If the lifter foot clears the tube position well, go to step 8 (under this heading), otherwise adjust as follows:
   a. Press Esc, then type `LD` to lower the lifter.
   b. Press Esc, then type `CO` to move the carousel out.
   c. Manually adjust the carousel tube position using the IN/OUT screw as shown in Figure 4.12-1.

Figure 4.12-1 Carousel IN/OUT Adjustment



   d. Repeat steps 3 through 6c (under this heading) until no further adjustments are required.
7. Press Esc, then type `LM`. The vortex motor is activated.
8. Ensure that the lifter foot does not hit the carousel. If the lifter foot does hit the carousel, with a flat-head screwdriver, adjust the tube position using the carousel-tube position screw so that the lifter foot clears the carousel (is centered) (Figure 4.12-2). Repeat until no further adjustments are required.

Figure 4.12-2 Carousel Tube-Position Screw Adjustment

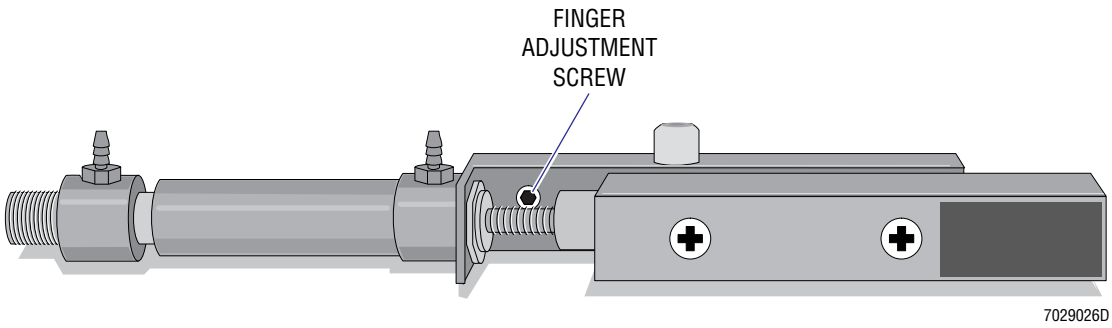


9. Press Esc, then type LD. The lifter lowers.
10. Press Esc, then type CO. The carousel moves out.
11. Press Esc, then type CL. The carousel moves back to the load position.
12. Repeat steps 7 and 8 (under this heading) until no further adjustments are necessary.

Finger Adjustment

1. Press Esc, then type XO. The finger moves in.
2. Ensure that the finger clears the tube position bar-code label and makes contact with the tube and rotates the tube. Using the finger adjustment screw, adjust the finger for proper clearance (Figure 4.12-3).

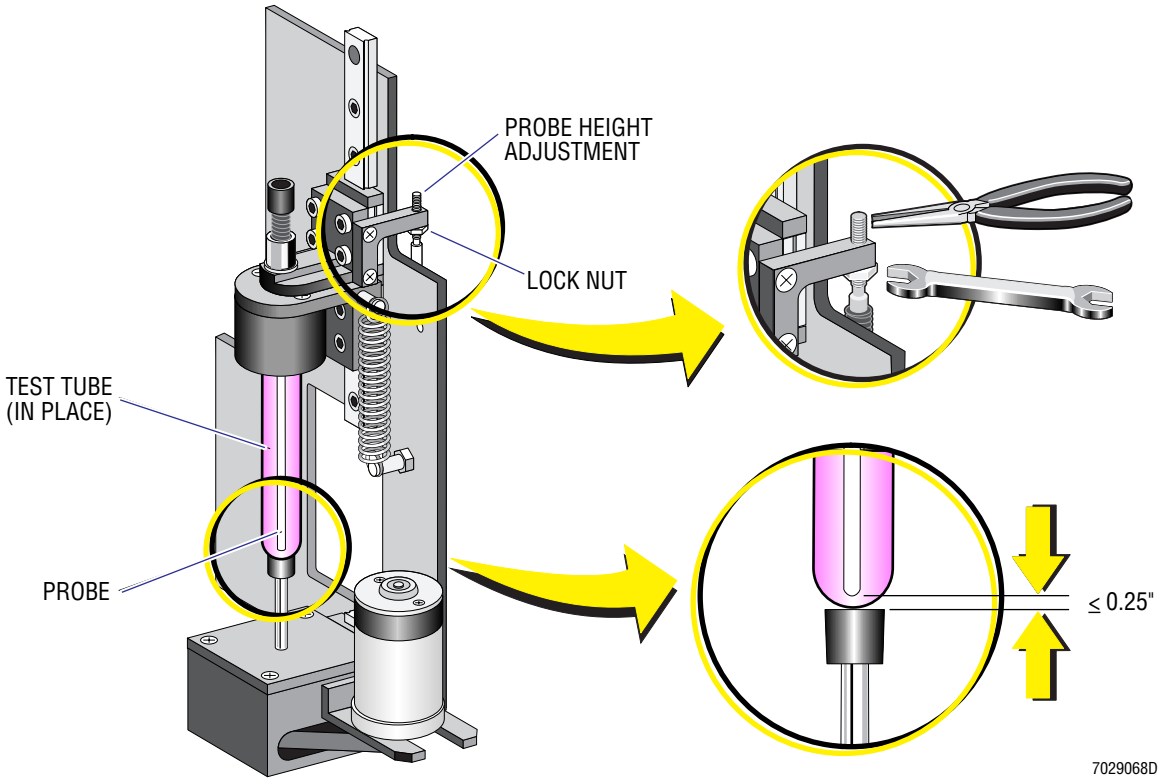
Figure 4.12-3 Finger Adjustment Screw



MCL Sample Probe Adjustment

1. Insert a carousel with one test tube in the first carousel position.
2. Press Esc, then type `CH`. The carousel rotates to the home position.
3. Press Esc, then type `CI`. The carousel moves in towards the MCL option probe.
4. Press Esc, then type `CR`. The carousel advances to position one.
5. Press Esc, then type `LU`. The lifter motor rises and stays up.
6. Press Esc, then type `PD`. The sample probe moves down into the test tube.
7. Verify the sample probe comes just to the bottom of the test tube.
8. Adjust the lock nut on the probe up/down air cylinder to reposition the sample probe if necessary (Figure 4.12-4).

Figure 4.12-4 MCL Sample Probe Adjustment



How to Proceed

1. If you did this procedure as part of the MCL Option Upgrade installation, go back to Heading 3.8 and complete the instructions under the Operational Verification heading.
2. If you this procedure to correct an MCL malfunction:
   a. Reinstall all covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
   b. Remove the wire used to defeat the MCL door interlock switch.

4.13 VORTEXER FOOT ASSEMBLY REPLACEMENT

Purpose

Perform this procedure to replace the vortex foot If the bearing is binding. To determine if the vortex foot and bearing need to be replaced, rotate the foot clockwise/counter clockwise and ensure that it spins freely without resistance.

Tools/Supplies Needed

- ❑ Vortexer foot assembly, PN 7000579
- ❑ Empty, 12 x 75-mm test tubes, PN 2523749

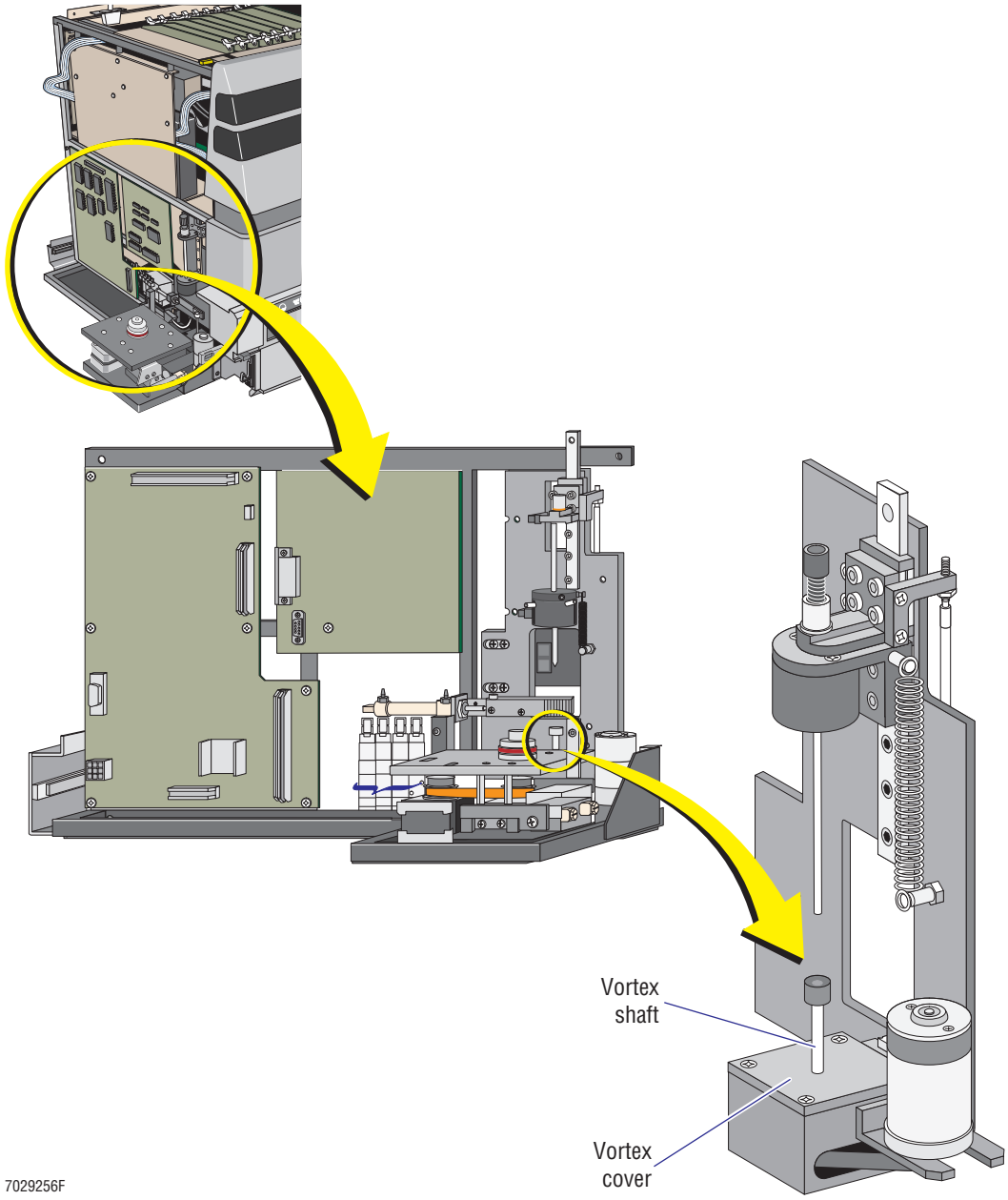
Preparation

1. Power off the Cytometer.
   - Refer to Stage 1: Power Off the Cytometer (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Stage 1: Power Off the Cytometer (system using EXPO32 ADC software) under Heading 4.1, as needed.
2. Remove the MCL covers to access the MCL carousel base assembly. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

Removal

1. Locate the vortex foot assembly directly below the MCL sample probe. See Figure 4.13-1 for the vortex cover and shaft that comprise this assembly.
2. On top of the vortex cover, mark the back end of the cover so that the mark is in the same position as it was before removal (Figure 4.13-1). The cover, if not installed correctly, can be hit by the vortexer shaft during operation.

Figure 4.13-1 Vortex Foot Assembly, Location and Components



3. Remove the four screws securing the vortex cover (Figure 4.13-1).
4. Remove the two screws securing the vortex shaft to the eccentric slide mechanism.
5. Remove the defective vortexer foot assembly.

Installation

1. Install the replacement vortexer foot assembly.
2. Install the vortex cover to the correct position orientation and secure it with four screws.

Reinstall Covers

Reinstall all covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

Verification

1. Power on the Cytometer.
   - Refer to Restoring Power to the Cytometer Only (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Restoring Power to the Cytometer Only (system using EXPO32 ADC software) under Heading 4.1, as needed.
2. Place the empty test tubes into the carousel.
3. Press RUN CYCLE and ensure that the vortexer foot spins freely both clockwise and counter clockwise.

4.14 TRANS DATA ACQUISITION CARD REPLACEMENT AND/OR CALIBRATION

Purpose

Use this procedure to adjust the ADC offset of the Trans Data Acquisition card whenever you replace the Trans Data Acquisition card. This procedure is also used to verify the Trans Data Acquisition card offset when the offset of an Amp/Signal Conditioner card is out of tolerance. Calibration of a Trans Data Acquisition card may also be referred to as offset adjustment.

Tools/Supplies Needed

- ❑ COULTER EPICS XL/XL-MCL Prefinal Software diskette, PN 7231244
- ❑ XL card extender, PN 6705582
- ❑ Hardcopy of Figure A.2-21, Trans Data Acquisition Card - Component Locations, optional

Preparation

1. Power off the Cytometer.
   - Refer to Stage 1: Power Off the Cytometer (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Stage 1: Power Off the Cytometer (system using EXPO32 ADC software) under Heading 4.1, as needed.
2. Remove the Cytometer top cover and set it aside. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

WARNING Risk of personal injury. Be very careful when operating the instrument when the safety interlock switch in the Cytometer is defeated, as you may be exposed to the laser beam and/or electric shock. After servicing the instrument, make sure the top cover is properly reinstalled to reactivate the safety interlock switch if bypassed while servicing the instrument.

3. Defeat the Cytometer interlock switch.
4. Lift the Data Acquisition card cage and lock it in its vertical position. Refer to Heading 4.3 if you need detailed instructions.

If Replacing the Trans Data Acquisition Card

1. Remove the defective Trans Data Acquisition card.
2. Install the XL card extender in the Trans Data Acquisition card position in the card cage.
3. On the replacement Trans Data Acquisition card:
   a. Verify the jumper settings using Figure A.2-21 as a reference.
   b. Remove the jumper from E1 to E2 and install it on E2 to E3. For jumper locations, refer to Figure A.2-21 as needed.
4. Install the replacement Trans Data Acquisition card on the card extender.

If Calibrating Without Replacing the Trans Data Acquisition Card

1. Remove the Trans Data Acquisition card from the Data Acquisition card cage.
2. Remove the jumper from E1 to E2 and install it on E2 to E3. For jumper locations, refer to Figure A.2-21 as needed.
3. Install the XL card extender in the Trans Data Acquisition card position in the card cage.
4. Install the Trans Data Acquisition card on the card extender.

Access the Prefinal Menu

1. Power on the Cytometer.
   - Refer to Restoring Power to the Cytometer Only (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Restoring Power to the Cytometer Only (system using EXPO32 ADC software) under Heading 4.1, as needed.
2. Install the Prefinal Software diskette as directed under Heading 4.2, PREFINAL SERVICE SOFTWARE INSTALLATION AND OPERATION.

Calibration

ATTENTION: Before making any adjustments, the instrument must be allowed to warmed up to stabilize the amplifiers on the Amp/Signal Conditioner cards.

- If the instrument was powered off more than one hour, make sure the instrument is warmed up 30 minutes **before** making any adjustments.
- If the instrument was powered off less than one hour, a 15 minute warmed up is sufficient **before** making adjustments.

1. At the Prefinal Menu, select **ADC ZERO ADJUST** and press Enter.
2. Verify the offset reading is between 0.3 mVdc and 0.9 mVdc.
   a. If the reading is acceptable, go to step 3.
   b. If the reading is out of tolerance, adjust the offset potentiometer, R8, until the reading is within the acceptable range of 0.3 mVdc and 0.9 mVdc.

      Note: Always make sure your adjustment is midrange (0.6 mVdc) or slightly above midrange rather than on the low end (0.3 mVdc). It is important that this offset be slightly positive to ensure the offset does not drift less than zero.
3. Press Esc to exit **ADC ZERO ADJUST**.
4. Press Spacebar to power off the Cytometer.
5. Verify the Cytometer power is off. (Pneumatics should be off and the front panel display should be dark.)
6. Remove the Trans Data Acquisition card from the card extender.
7. Remove the card extender from the Data Acquisition card cage.
8. Reinstall the Trans Data Acquisition card in the card cage.
9. From the Prefinal Menu, select **ADC ZERO ADJUST** and press Enter.
10. Verify that the offset reading is between 0.3 mVdc and 0.9 mVdc.
    a. If the reading is acceptable, continue the calibration by going to step 11.

b. If the reading is out of tolerance, the calibration must be repeated as follows:
   1) Press Esc to exit **ADC ZERO ADJUST**.
   2) Press Spacebar to power off the Cytometer.
   3) Verify the Cytometer power is off. (Pneumatics should be off and the front panel display should be dark.)
   4) Remove the Trans Data Acquisition card from the Data Acquisition card cage.
   5) Install the XL card extender in the Trans Data Acquisition card position in the card cage.
   6) Install the Trans Data Acquisition card on the card extender.
   7) Go to the Calibration heading and repeat the calibration as written.

11. Press Esc to exit **ADC ZERO ADJUST**.
12. Press Spacebar to power off the Cytometer.
13. Verify the Cytometer power is off. (Pneumatics should be off and the front panel display should be dark.)
14. Remove the Trans Data Acquisition card from the Data Acquisition card cage.
15. On the Trans Data Acquisition card, remove the jumper from E2 to E3 and reinstall it from E1 to E2. For jumper locations, refer to Figure A.2-21 as needed.
16. Reinstall the Trans Data Acquisition card in the Data Acquisition card cage.
17. Lower the Data Acquisition card cage into the center cavity of the Cytometer.
    a. Stand in front of the Cytometer and grasp the top of the Data Acquisition card cage.
    b. With a secure hold on the card cage, unlock the card cage hinges with your other hand.
    c. Gently lower the card cage into the center cavity of the Cytometer.
18. How to proceed:
    a. If you did this procedure as part of the Service Verification Procedure (SVP), go to step 19 to verify the offset for each Amp/Signal Conditioner card.
    b. If you did this procedure as part of an XL or XL-MCL flow cytometer installation, go to step 19 to verify the offset for each Amp/Signal Conditioner card.
    c. If you did this procedure as part of a Trans Data Acquisition card replacement or calibration, go to step 19 to verify the offset for each Amp/Signal Conditioner card.
    d. If you did this procedure as part of replacing an Amp/Signal Conditioner card, go back to Heading 4.15. Start at the Calibration heading and complete the Amp/Signal Conditioner card calibration as written.
    e. If you did this procedure as part of calibrating (without replacing) an Amp/Signal Conditioner card, go back to Heading 4.15. Under the If Calibrating Without Replacing the Amp/Signal Conditioner Card heading, start at step 2 and complete the Amp/Signal Conditioner card calibration as written.
19. At the Prefinal Menu, select the **GRAND CANYON ADJUST** and press Enter.
    a. Make sure the instrument has warmed up at least 15 minutes before proceeding.

b. **For each parameter**, verify the offset voltage reading is displayed in green.
   - Select the desired parameter using the cursor keys, ↑ or ↓.
   - All the offset voltages must be displayed in green. If you are testing a 3-color system, the PMT4 parameter fails because there is no circuit card in the card cage. Ignore this failure
   - If an offset voltage reading is red, the corresponding Amp/Signal Conditioner card is defective. Replace the Amp/Signal Conditioner card and calibrate the replacement circuit card as instructed under Heading 4.15.

20. Press Esc to exit the **GRAND CANYON ADJUST**.
21. Press F10 to exit the Prefinal software. The Cytometer should power off automatically.
22. If you have not already done so, remove the Prefinal Software diskette from the drive.
23. How to proceed:
    a. If you did this procedure as part of an XL or XL-MCL flow cytometer installation, go back to Heading 3.7 and continue the installation by going to the Functional Verification heading. Complete the installation as written.
    b. If you did this procedure for any other purpose than installation, go to the Reinstall Cover heading that follows and continue this procedure as written.

Reinstall Cover

Reinstall the Cytometer top cover and any other covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

Load the Customer's Preferred Operating System

- If SYSTEM II is the customer's preferred operating system, under Heading 4.2, refer to the If SYSTEM II is the Customer's Preferred Operating System heading, as needed.
- If EXPO32 ADC is the customer's preferred operating system, under Heading 4.2, refer to the If EXPO32 ADC is the Customer's Preferred Operating System heading, as needed.

System Verification

ATTENTION: If you did this procedure as part of the System Verification Procedure (SVP), go back to Heading 5.1 and continue the SVP at Heading Acquisition, CV Analysis and Carryover Check.

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

4.15 AMP/SIGNAL CONDITIONER CARD REPLACEMENT AND/OR CALIBRATION

Purpose

Perform this procedure when you replace any of the Linear Power supplies or an Amp/Signal Conditioner card, or when the amplifier performance is erratic. This ensures that an instrument-calibrated replacement Amp/Signal Conditioner card is properly installed in the Cytometer. Calibration of an Amp/Signal Conditioner card may also be referred to as offset adjustment.

Tools/Supplies Needed

- ❑ COULTER EPICS XL/XL-MCL Prefinal Software diskette, PN 7231244
- ❑ One, empty, 12 x 75-mm test tube, PN 2523749
- ❑ Isoflow sheath fluid, PN 8547008
- ❑ Trimmer pot adjustment tool, PN 5402071
- ❑ Hardcopy of Figure A.2-1, Amp / Signal Conditioner Card - Component Locations, optional

ATTENTION: The ADC offset for the Trans Data Acquisition card must be confirmed acceptable before starting the calibration procedure for an Amp/Signal Conditioner card.

- If you are replacing an Amp/Signal Conditioner card, the Trans Data Acquisition card offset is checked after you replace the Amp/Signal Conditioner card. Go to Heading If Replacing the Amp/Signal Conditioner Card and complete the procedure as written.
- If you are calibrating without replacing an Amp/Signal Conditioner card, the Trans Data Acquisition card offset is checked before you actually begin the calibration process. Go to Heading 4.14, TRANS DATA ACQUISITION CARD REPLACEMENT AND/OR CALIBRATION and complete the procedure as written.

If Replacing the Amp/Signal Conditioner Card

1. Power off the Cytometer.
   - Refer to Stage 1: Power Off the Cytometer (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Stage 1: Power Off the Cytometer (system using EXPO32 ADC software) under Heading 4.1, as needed.
2. Remove the Cytometer top cover and set it aside. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

WARNING Risk of personal injury. Be very careful when operating the instrument when the safety interlock switch in the Cytometer is defeated, as you may be exposed to the laser beam and/or electric shock. After servicing the instrument, make sure the top cover is properly reinstalled to reactivate the safety interlock switch if bypassed while servicing the instrument.

3. Defeat the Cytometer interlock switch.
4. Lift the Data Acquisition card cage and lock it in its vertical position. Refer to Heading 4.3 if you need detailed instructions.
5. Remove the defective Amp/Signal Conditioner card.

6. On the replacement Amp/Signal Conditioner card:
   a. Verify the jumper settings using Figure A.2-1 as a reference.
   b. Remove the jumper from E4 to E5. Save the jumper. For jumper locations, refer to Figure A.2-1 as needed.
   c. Install the replacement Amp/Signal Conditioner card in the card cage.
7. Go to Heading 4.14, TRANS DATA ACQUISITION CARD REPLACEMENT AND/OR CALIBRATION. Start at the If Calibrating Without Replacing the Trans Data Acquisition Card heading and complete the procedure as written.

If Calibrating Without Replacing the Amp/Signal Conditioner Card

ATTENTION: The ADC offset for the Trans Data Acquisition card must be confirmed acceptable before starting this procedure. Go to Heading 4.14, TRANS DATA ACQUISITION CARD REPLACEMENT AND/OR CALIBRATION and complete the procedure as written.

1. Go to Heading 4.14, TRANS DATA ACQUISITION CARD REPLACEMENT AND/OR CALIBRATION and complete the procedure as written.
2. Lift the Data Acquisition card cage and lock it in its vertical position. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
3. Remove the Amp/Signal Conditioner card from the Data Acquisition card cage.
4. Remove the jumper from E4 to E5. Save the jumper. For jumper locations, refer to Figure A.2-1 as needed.
5. Reinstall the Amp/Signal Conditioner card in the card cage.
6. Repeat steps 1 through 5 for each Amp/Signal Conditioner card requiring calibration.
7. Lower the Data Acquisition card cage into the center cavity of the Cytometer. Refer to Heading 4.3 if you need detailed instructions.

Calibration

ATTENTION: Before making any adjustments, the instrument must be allowed to warmed up to stabilize the amplifiers.

- If the instrument was powered off more than one hour, make sure the instrument is warmed up 30 minutes **before** making any adjustments.
- If the instrument was powered off less than one hour, a 15 minute warmed up is sufficient **before** making adjustments.

1. At the Prefinal Menu, select **ADC ZERO ADJUST** and press Enter.
2. Verify the offset reading is between 0.3 mVdc and 0.9 mVdc.
   a. If the reading is acceptable:
      1) Press Esc to exit **ADC ZERO ADJUST**.
      2) Go to step 3 to continue this calibration.

b. If the reading is out of tolerance:

1) Press Esc to exit **ADC ZERO ADJUST**.

2) Press Spacebar to power off the Cytometer.

3) Verify the Cytometer power is off. (Pneumatics should be off and the front panel display should be dark.)

4) Replace the circuit card as instructed under Heading If Replacing the Amp/Signal Conditioner Card then calibrate the replacement card as written.

3. At the Prefinal Menu, select the **GRAND CANYON ADJUST** and press Enter.
4. Make sure the instrument has warmed up at least 15 minutes before proceeding.
5. Select the desired parameter using the cursor keys, ↑ or ↓, as needed.
6. Verify the offset voltage reading is displayed in green. If the voltage reading is red, the circuit card is defective. Replace the Amp/Signal Conditioner card before proceeding.

IMPORTANT Risk of misleading results. If extremely high voltage readings appear or the **GRAND CANYON ADJUST** does not seem to be working properly, press Spacebar Spacebar. The first time you press the spacebar switches the test into peak mode and the second time switches the test back into the integral mode. All voltages must be read in the integral mode. For each amplifier, verify that both the 1X and 32X voltage readings are less than 9.3 Vdc

7. Verify the offset voltage reading is within the acceptable range of 00.000 to -05.000 mV.
   a. If the offset is within the acceptable range, go to step 8.
   b. If the offset is not within acceptable range:
      1) Remove the center front cover (filter cover) and set it aside.
      2) Lift up the front panel display.
      3) Locate the Amp/Signal Conditioner card being checked.
      4) Adjust R34, the offset potentiometer, as close to 00.000 mV as possible. Slightly negative within the green display range is better than positive due to a possible positive thermal drift.
8. Check the offset on the remaining Amp/Signal Conditioner cards.
   a. Select the desired parameter using the cursor keys, ↑ or ↓.
   b. Verify the offset voltage reading is displayed in green.
      1) If the offset voltage reading is green, repeat steps a and b until all the offset voltages are verified. When all the offset voltages are acceptable, go to step 9.

         Note: If you are testing a 3-color system, the PMT4 parameter fails because there is no circuit card in the card cage. Ignore this failure.

      2) If the offset voltage reading is red, the circuit card must be readjusted.
         a) Press Esc to exit **ADC ZERO ADJUST**.
         b) Press Spacebar to power off the Cytometer.
         c) Verify the Cytometer power is off. (Pneumatics should be off and the front panel display should be dark.)

d) Go to the If Calibrating Without Replacing the Amp/Signal Conditioner Card heading and perform the calibration as written.

Note: If you have already readjusted the circuit card and the offset reading is still out of tolerance, the Amp/Signal Conditioner card is defective. Replace the circuit card as instructed under the If Replacing the Amp/Signal Conditioner Card heading then calibrate the replacement card as written.

9. Press Esc to exit **GRAND CANYON ADJUST**.
10. Press Spacebar to power off the Cytometer.
11. Verify the Cytometer power is off. (Pneumatics should be off and the front panel display should be dark.)
12. For any Amp/Signal Conditioner card that was replaced:
    a. Remove the circuit card from the Data Acquisition card cage.
    b. Reinstall the jumper from E4 to E5.
    c. Reinstall the circuit card in the Data Acquisition card cage.
13. From the Prefinal Menu, select the **CANYON JUMPER TEST** and press Enter. All should pass unless you are testing a 3-color system, the PMT4 parameter fails because there is no circuit card in the card cage. Ignore this failure.

    If the test *FAILS*:
    a. Press Esc to exit **CANYON JUMPER TEST**.
    b. Press Spacebar to power off the Cytometer.
    c. Verify the Cytometer power is off. (Pneumatics should be off and the front panel display should be dark.)
    d. For each circuit card that fails:
        1) Remove each circuit card from the Data Acquisition card cage.
        2) Reinstall the jumper from E4 to E5.
        3) Reinstall the circuit card in the Data Acquisition card cage.
    e. Repeat step 13.
14. Press Esc to exit the **CANYON JUMPER TEST**.
15. Press F10 to exit the Prefinal software. The Cytometer should power off automatically.
16. If you have not already done so, remove the Prefinal Software diskette from the drive.

Verify Acceptable Histograms

1. Load the customer's preferred operating system.
    - If SYSTEM II is the customer's preferred operating system, under Heading 4.2, refer to the If SYSTEM II is the Customer's Preferred Operating System heading, as needed.
    - If EXPO32 ADC is the customer's preferred operating system, under Heading 4.2, refer to the If EXPO32 ADC is the Customer's Preferred Operating System heading, as needed.

2. Create a protocol called LIN/LOG SWITCH POINT 1 TEST according to Table 4.15-1 and the setting information below this table.

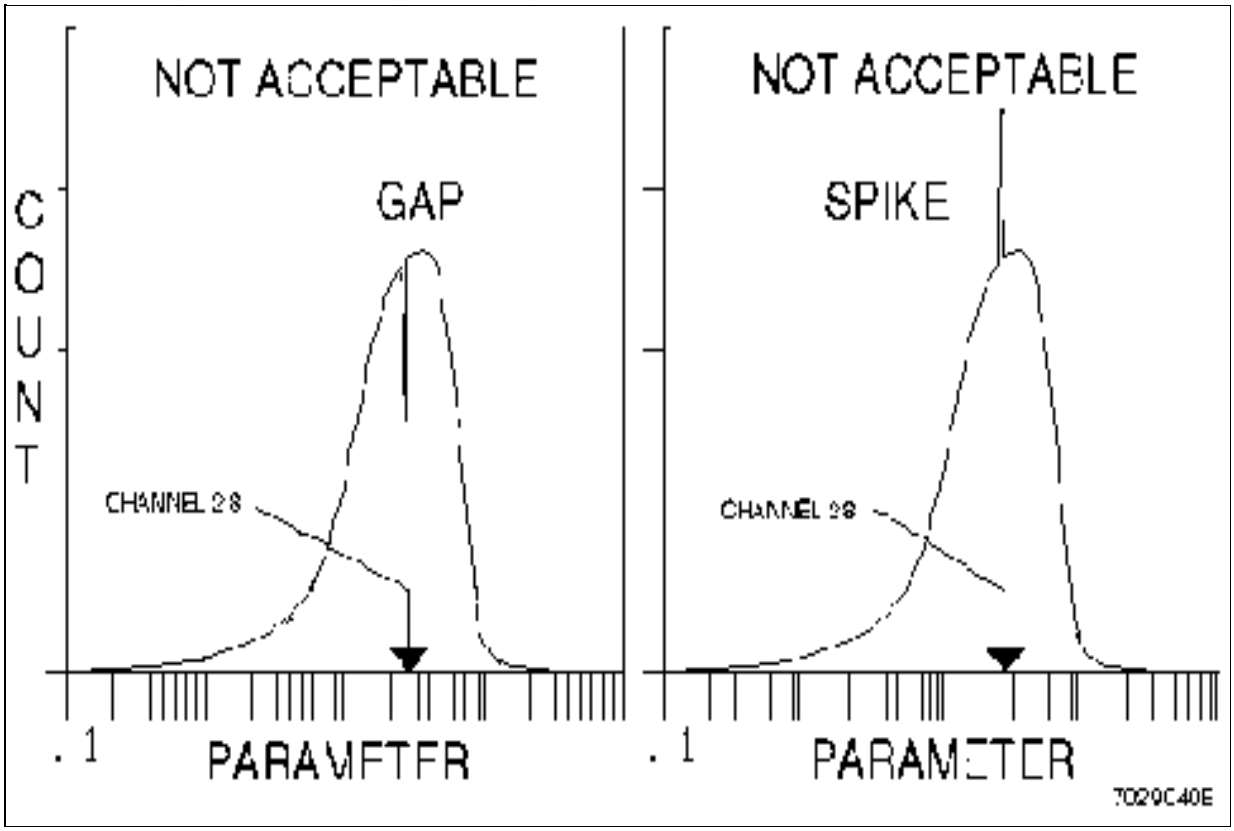
Table 4.15-1 LIN/LOG SWITCH POINT 1 TEST Protocol

Histogram	Parameter	Signals	Gain	Gating	Analysis Region
1	Dual	FS vs. SS	N/A	Rectilinear gate	A
2	Single	FSLOG	100.0	On region A	B
3	Single	SSLOG	1.0	On region A	C
4	Single	FL1LOG	1.0	On region A	D
5	Single	FL2LOG	1.0	On region A	E
6	Single	FL3LOG	1.0	On region A	F
7	Single	FL4LOG	1.0	On region A	G

Settings:	DISCRIMINATOR	FS = 35
	COMPENSATION	All signals = 0%
	STOP	On Histogram 1 for 40,000 counts
	FLOW RATE	LOW

3. Dispense sheath fluid to a clean test tube and run it. Adjust the High Voltage so that the peak channel for each histogram is at channel 28 ±5 channels.
4. Ensure there are no gaps or spikes at Channel 28 in each histogram (Figure 4.15-1).

Figure 4.15-1 Unacceptable Histograms



5. If all histograms are free of gaps or spikes at Channel 28, go to the Reinstall Cover heading that follows.
6. If one or more histograms exhibit gaps or spikes at Channel 28:
   a. Power off the Cytometer.
      - Refer to Stage 1: Power Off the Cytometer (system using SYSTEM II software) under Heading 4.1, as needed.
      - Refer to Stage 1: Power Off the Cytometer (system using EXPO32 ADC software) under Heading 4.1, as needed.
   b. Lift the Data Acquisition card cage and lock it in its vertical position.
   c. For each histogram displaying a gap or spike at Channel 28:
      1) Remove the corresponding Amp/Signal Conditioner card from the Data Acquisition card cage.
      2) Remove the jumper from E4 to E5. Save the jumper.
      3) Reinstall the Amp/Signal Conditioner card in the card cage.
   d. Lower the Data Acquisition card cage into the center cavity of the Cytometer.
7. Repeat the Calibration procedure as written until all parameters are free of gaps or spikes at Channel 28.

Reinstall Cover

Reinstall the Cytometer top cover and any other covers removed during this procedure. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

System Verification

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

4.16 PREPARING INSTRUMENT FOR SHIPMENT

Purpose

Use this procedure to prepare the instrument for shipment. This procedure should be performed **only by a Service Engineer**.

Tools/Supplies Needed

- ❑ Bleach (household, unscented)
- ❑ One, empty, 12 x 75-mm test tube, PN 2523749
- ❑ COULTER EPICS XL/XL-MCL Prefinal Software diskette, PN 7231244
- ❑ 1 gal. deionized or distilled water (found in most laboratories)

Procedure

ATTENTION: Blood can clog lines. If fluids are not cleaned from the lines after use, clogging can occur. If blood was processed in the instrument, the instrument must be cleaned with bleach before performing the rest of this procedure.

1. If blood was processed in the system:
   - Wipe the outer covers of the instrument with bleach.
   - Run a test tube of bleach through both the manual sample stage and the MCL option.
2. Ensure that an empty, 12 x 75-mm test tube is on the manual sample stage.
3. Pull out the reagent drawer and empty the sheath and the cleanse agent containers.
4. Thoroughly rinse both containers with tap water.
5. Fill both the containers with deionized water.
6. Push the reagent drawer back into the Cytometer.
7. Install the Prefinal Software diskette as directed under Heading 4.2, PREFINAL SERVICE SOFTWARE INSTALLATION AND OPERATION.
8. At the Prefinal Test Menu, select **VALVE SEQUENCE** and press Enter to drain the system.
9. When the Valve Sequence routine is complete, select **PRIME** and press Enter to flush the sheath fluid out of the sheath and waste lines.
10. When the Prime routine is complete, select **SHUTDOWN AND CLEANUP** and press Enter to sequentially activate the solenoid valves through the flushing and purging functions to push out all the sheath fluid and cleaning agent.
11. Repeat the Shutdown and Cleanup routine three times.
12. Pull out the reagent drawer and empty the deionized water from both tanks.
13. Reinstall the sheath and cleanse containers into the reagent drawer and close the drawer.
14. Run the Shutdown and Cleanup routine four more times to blow the system dry.
15. When you have completed the Valve Sequence routine, follow the exit directions at the bottom of the screen.
16. Empty and rinse out the waste tank.
17. Place a test tube on the sample stage.

18. Power down the entire system. (This includes unplugging both ac power line cords from the wall outlet.)
    a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using SYSTEM II Software heading.
    b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using EXPO32 ADC Software heading.
19. Remove all the ac power line cords and prepare the instrument for packaging.

4.17 INSTRUMENT SHUTDOWN

Purpose

Ensure that you go through this procedure once with the customer before leaving the site.

Tools/Supplies Needed

- ❑ One, empty, 12 x 75-mm test tube, PN 2523749
- ❑ IsoFlow sheath fluid, PN 8547008

Procedure

1. With the Cytometer in the Run mode and the Computer Workstation in the Acquisition Halted mode, remove the sample tube from the sample station. The sample station remains in the down position.
2. Press the CLEANSE button on the sample station and verify that the CLEANSE indicator reads ON.
3. When the cleanse cycle is complete, verify that the CLEANSE indicator reads OFF.
4. Fill a test tube approximately 1/3 full with sheath fluid and insert it into the sample station.
5. Turn off the Computer Workstation and the Power Supply module. Ensure that the Cytometer's sample station rises and that the Cytometer turns off.

4.18 THREE-WIRE CIRCUIT ANALYZER TEST

Purpose

This test allows you to determine if the standard 115 Vac receptacle (NEMA 5-15R or NEMA 5-20R) has electrical wiring faults. The 3-wire circuit analyzer is not however, a comprehensive instrument. **The analyzer has the following limitations:**

- Will not test for:
  - Ground and neutral reversed (see the following procedure, Reverse/Shorted Ground/Neutral Test)
  - Ground and neutral wired together
  - Ground fault circuit interrupt (G.F.C.I.) in circuit
- Will not normally trip G.F.C.I.
- Circuit capacitance may indicate continuity in an open circuit.

Tools/Supplies Needed

- ❑ 3-wire circuit analyzer, PN 2906883

Procedure

1. Unplug all the equipment on the branch circuit.
2. Insert the 3-wire circuit analyzer into the receptacle and take readings.
3. Compare the readings with Table 4.18-1. If you receive any readings other than Correct, refer the problem to an electrician.
4. Perform the reverse/shorted ground/neutral test as directed under the following procedure, Reverse/Shorted Ground/Neutral Test.

Table 4.18-1 Indicator Troubleshooting

Indicator	Fault	Reason for Wiring Fault
○ ● ○	Open ground	Ground contact not connected
○ ○ ●	Open neutral	Neutral contact not connected
○ ○ ○	Open hot	Hot contact not connected
● ○ ●	Hot/ground reverse	Hot and ground contact interchanged
● ● ○	Hot/neutral reverse	Hot and neutral contact interchanged
○ ● ●	Correct	Receptacle is wired correctly

Reverse/Shorted Ground/Neutral Test

ATTENTION: If the receptacle passes the THREE-WIRE CIRCUIT ANALYZER TEST, you **must perform** the reverse/shorted ground/neutral test as described in the following procedure.

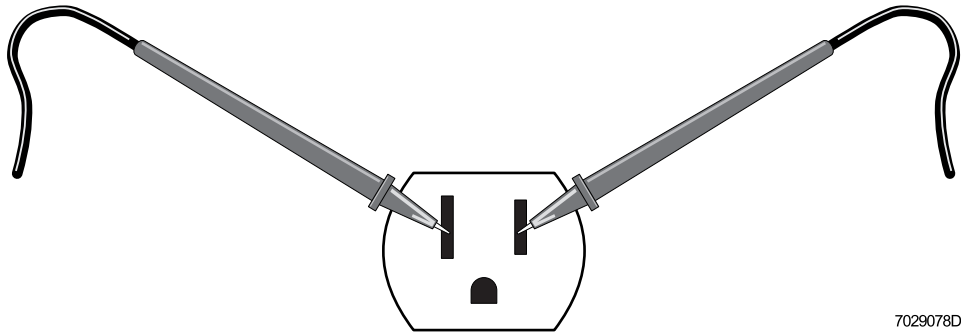
Tools/Supplies Needed

- ❑ 3-wire circuit analyzer, PN 2906883

Procedure

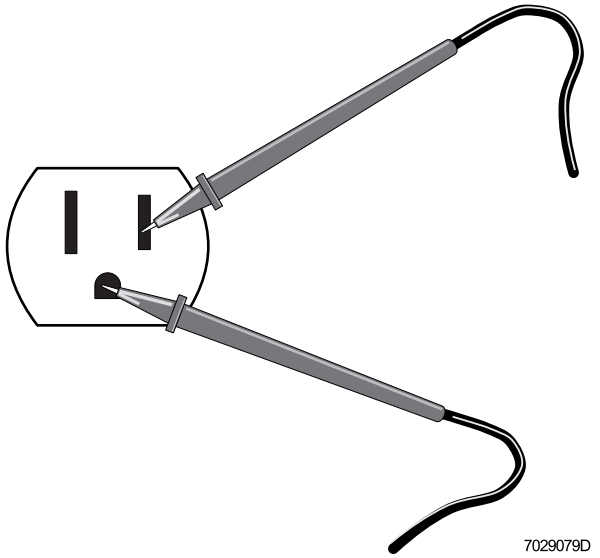
1. Place the 3-wire circuit analyzer's meter leads as shown in Figure 4.18-1. Record the reading.

Figure 4.18-1 Meter Lead Connection - 1



2. Place the meter leads as shown in Figure 4.18-2. Record the reading.

Figure 4.18-2 Meter Lead Connection - 2



3. The difference between the two readings should be 0.5 to 1.0 V with the Figure 4.18-1 reading being less than the Figure 4.18-2 reading.
4. If step 3 fails, the neutral and ground may be reversed or shorted together.
5. Refer any problems found to an electrician.

4.19 POWER SUPPLY REPLACEMENT

Purpose

Perform this procedure to replace or verify operation of the following power supplies:

- On XL flow cytometers -
  - +5 Vdc
  - ±15 Vdc
  - +24 Vdc
- On XL-MCL flow cytometers -
  - +5 Vdc
  - ±15 Vdc
  - +24 Vdc
  - MCL +24 Vdc
  - MCL +5 Vdc and ±12 Vdc

These power supplies are located in the right side compartment of the Power Supply module.

Tools/Supplies Needed

- ❑ Beckman Coulter Service Tool Kit, PN 5415102
- ❑ +5 Vdc Power Supply, PN 7000356
- ❑ ±15 Vdc Power Supply, PN 7000355
- ❑ +24 Vdc Power Supply, PN 7000357
- ❑ MCL Power Supply assembly (+5 Vdc, ±12 Vdc, and +24 Vdc), PN 7000362

Preparation

1. Power down the entire system. (This includes unplugging both ac power line cords from the wall outlet.)
   a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using SYSTEM II Software heading.
   b. If EXPO32 ADC is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using EXPO32 ADC Software heading.
2. At the Power Supply module:
   a. Remove the Power Supply module three-sided cover. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

WARNING Risk of personal injury. Be very careful when operating the instrument when the safety interlock switch in the Power Supply module is defeated, as you may be exposed to electric shock. After servicing the instrument, make sure the three-sided cover is properly reinstalled to reactivate the safety interlock switch if it was bypassed while servicing the instrument.

   b. Defeat the interlock by pulling interlock bypass switch up.

Removal

1. Locate the power supply that needs replaced. For power supply locations, refer to Figure A.6-4, as needed.
2. Remove the defective power supply.

Replacement

1. Install the replacement power supply.
2. Plug the Power Supply module's ac power line cords into the appropriate wall outlets.
3. Wait 15 minutes to allow the Power Supply module to warm up.
4. Go to Heading 4.20, POWER SUPPLY VOLTAGE VERIFICATION AND ADJUSTMENT to make the appropriate adjustments.

System Verification

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

4.20 POWER SUPPLY VOLTAGE VERIFICATION AND ADJUSTMENT

Purpose

Perform this procedure to verify (and adjust if needed) voltages at the following power supplies:

- +5 Vdc
- ±15 Vdc
- +24 Vdc
- MCL +24 Vdc
- MCL +5 Vdc and ±12 Vdc

The voltages in this procedure are measured at the Analyzer backplane but adjustments are made on the corresponding power supply in the right-side compartment of the Power Supply module. Since these power supplies are purchased from a vendor, the location of an adjustment potentiometer may differ from instrument to instrument.

Tools/Supplies Needed

- ❑ Digital Voltmeter (DVM)
- ❑ Trimmer pot adjustment tool, PN 5402071

+24 Vdc Power Supply

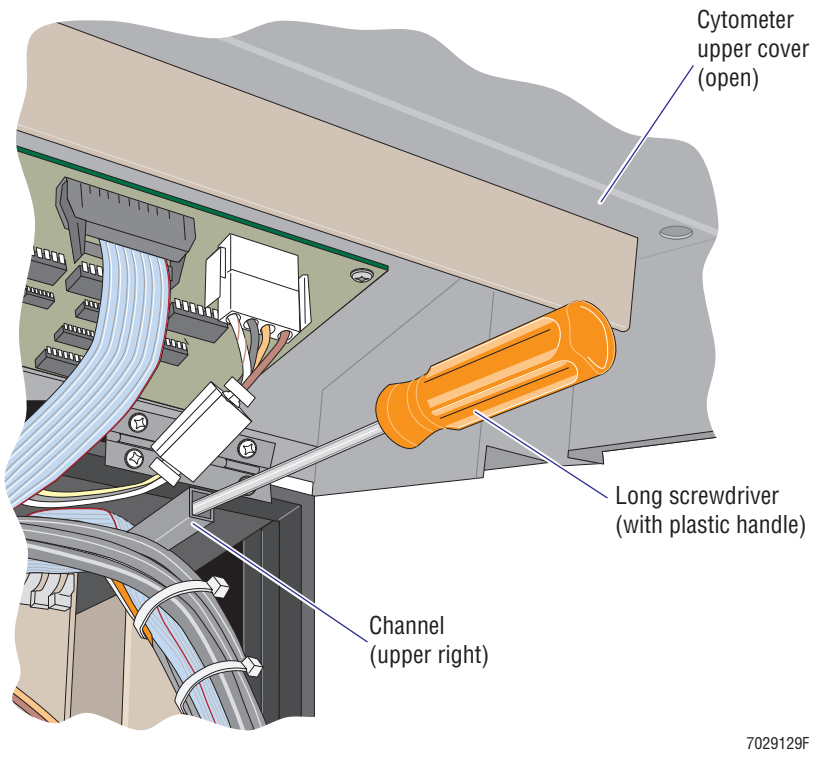
Preparation

1. Remove the Cytometer top cover and set the cover aside. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
2. Remove the Cytometer center front cover (filter cover) and set it aside. Refer to Heading 4.3 if you need detailed instructions.

CAUTION Risk of damage to electrical components on the front panel display circuit card. Do not use a T-handled hex key to hold the upper cover open. If the metal in the T-handle comes in contact with the electrical components on the circuit card, the components may short out and the card becomes defective.

3. Lift the front panel display cover and place a long screwdriver (with a plastic handle) in the upper frame channel to brace the cover open (Figure 4.20-1).

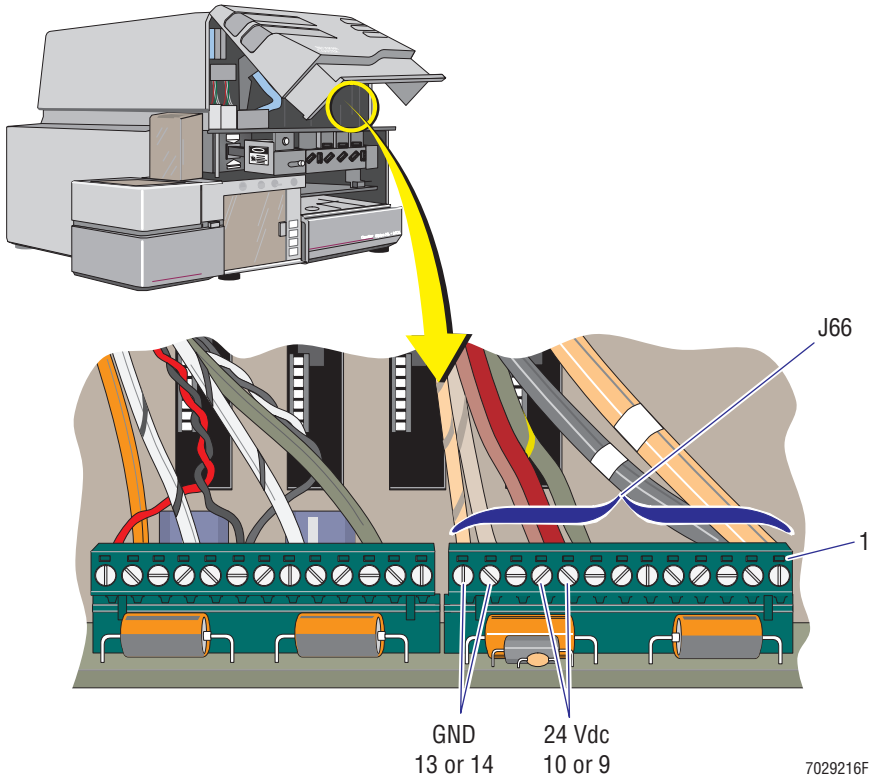
Figure 4.20-1 Use a Long Screwdriver to Brace the Upper Cover Open



Voltage Verification

1. Locate J66 attached to the lower edge of the front of the Analyzer backplane. For the location of J66, refer to Figure A.2-2.
2. Connect the negative DVM test lead to Pin 12 or 13 and the positive DVM test lead to Pin 9 or 10 (Figure 4.20-2).

Figure 4.20-2 J66 and Pin Locations for +24 Vdc Voltage Verification



3. Verify the DVM voltage reading matches the voltage reading recorded on the sticker attached to the side of the Data Acquisition card cage.
   a. If the voltage matches:
      1) Reinstall the display panel.
      2) Reinstall and close the Cytometer front door.
   b. If the voltage does not match, go to the Voltage Adjustment heading that follows.

Voltage Adjustment

ATTENTION: The +24 Vdc voltage is measured at the Analyzer backplane, but the adjustment is made on the +24 Vdc linear power supply in the right-side compartment of the Power Supply module. For the +24 Vdc linear power supply location, refer to Figure A.6-4.

1. Adjust R10 on the +24 Vdc linear power supply to obtain the voltage reading recorded on the sticker attached to the Data Acquisition card cage.
2. If you did this adjustment because the +24 Vdc linear power supply was replaced, perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

+5 Vdc Power Supply

Preparation

1. Remove the Cytometer top cover. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
2. Lift the Data Acquisition card cage and lock it in its vertical position. Refer to Heading 4.3 if you need detailed instructions.

Voltage Verification

1. At the Analyzer backplane, connect the negative DVM test lead to TP2 (DGND) and the positive DVM test lead to TP1 (yellow). For test point and/or ground locations, refer to Figure A.2-3.
2. Verify the DVM voltage reading matches the voltage reading recorded on the sticker attached to the side of the Data Acquisition card cage.
   a. If the voltage matches and other voltage readings are required, proceed to the appropriate heading.
   b. If the voltage matches and no other voltage readings are required, lower the Data Acquisition card cage.
      1) Stand in front of the Cytometer and grasp the top of the Data Acquisition card cage.
      2) With a secure hold on the card cage, unlock the card cage hinges with your other hand.
      3) Gently lower the card cage into the center cavity of the Cytometer.
   c. If the voltage does not match, go to the Voltage Adjustment heading that follows.

Voltage Adjustment

ATTENTION: The +5 Vdc voltage is measured at the Analyzer backplane, but the adjustment is made on the +5 Vdc linear power supply in the right-side compartment of the Power Supply module. For the +5 Vdc linear power supply location, refer to Figure A.6-4.

1. Adjust the R11 potentiometer on the +5 Vdc linear power supply to obtain the voltage reading recorded on the sticker attached to the Data Acquisition card cage.
2. If you did this adjustment because the +5 Vdc linear power supply was replaced, perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

±15 Vdc Power Supply

Preparation

1. Remove the Cytometer top cover. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
2. Lift the Data Acquisition card cage and lock it in its vertical position. Refer to Heading 4.3 if you need detailed instructions.

+15 Vdc Voltage Verification

1. At the Analyzer backplane, connect the negative DVM test lead to TP5 (AGND) and the positive DVM test lead to TP4 (orange). For test point and/or ground locations, refer to Figure A.2-3.
2. Verify the DVM voltage reading matches the voltage reading recorded on the sticker attached to the side of the Data Acquisition card cage.
   a. If the voltage matches, do the -15 Vdc Voltage Verification that follows.
   b. If the voltage does not match, go to the Voltage Adjustment heading.

-15 Vdc Voltage Verification

1. At the Analyzer backplane, connect the negative DVM test lead to TP5 (AGND) and the positive DVM test lead to TP3 (green). For test point and/or ground locations, refer to Figure A.2-3.
2. Verify the DVM voltage reading matches the voltage reading recorded on the sticker attached to the side of the Data Acquisition card cage.
   a. If the voltage matches and other voltage readings are required, proceed to the appropriate heading.
   b. If the voltage matches and no other voltage readings are required, lower the Data Acquisition card cage.
      1) Stand in front of the Cytometer and grasp the top of the Data Acquisition card cage.
      2) With a secure hold on the card cage, unlock the card cage hinges with your other hand.
      3) Gently lower the card cage into the center cavity of the Cytometer.
   c. If the voltage does not match, go to the Voltage Adjustment heading that follows.

Voltage Adjustment

ATTENTION: The +15 Vdc voltage is measured at the Analyzer backplane, but the adjustment is made on the ±15 Vdc linear power supply in the right-side compartment of the Power Supply module. For the ±15 Vdc linear power supply location, refer to Figure A.6-4.

1. Adjust the V.ADJ. potentiometer on the ±15 Vdc linear power supply to obtain the voltage reading recorded on the sticker attached to the Data Acquisition card cage.
   - **Never adjust the potentiometer labeled I.LIM.**
   - Two potentiometers are labeled V.ADJ. One increases the voltage and the other decreases the voltage. Since these two potentiometers are labeled identically, locate one of the potentiometers, make a small adjustment, then check the voltage to verify you are making the desired change. If not, locate the other potentiometer labeled V.ADJ. before proceeding.
2. If you did this adjustment because the ±15 Vdc linear power supply was replaced, perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

MCL Power Supply

Preparation

1. Remove the left-side cover. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.

   Note: The MCL CPU card is the large card towards the rear of the Cytometer.

Voltage Verification

1. In Table 4.20-1, locate the voltage you wish to check.

Table 4.20-1 MCL CPU Card

Voltage and Acceptable Range	Test Point	Ground
+5 Vdc ±0.005	TP1	TP2 (GND)
-12 Vdc ±0.005	TP3	TP2 (GND)
+12 Vdc ±0.005	TP4	TP2 (GND)
+24 Vdc ±0.005	TP5	TP2 (GND)

2. At the MCL CPU card:
   a. Connect the negative DVM test lead to TP2. For the test point location, refer to Figure A.2-10.
   b. Connect the positive DVM test lead to the desired test point. For a test point location, refer to Figure A.2-10 as needed.
3. Verify the DVM voltage reading is within the voltage range listed in Table 4.20-1.
   a. If the voltage is acceptable, go back to step 1 to determine the next voltage you wish to check. Make sure each voltage is within the acceptable limits listed in Table 4.20-1.
      - If all MCL voltages are within the acceptable range and other voltage readings are required, proceed to the appropriate heading.
      - If all voltages are within the acceptable range and no other voltage readings are required, reinstall the left-side cover.
      - If these voltages were verified as part of the initial installation procedure, go back to the Functional Verification heading (under Heading 3.7) to continue the operational checks.
      - If these voltages were verified as part of the MCL Option Upgrade procedure, go back to the MCL Alignment heading (under Heading 3.8) to complete the installation.
   b. If a voltage does not match, go to the Voltage Adjustment heading that follows.

Voltage Adjustment

ATTENTION: The MCL voltages are measured at the MCL CPU card, but adjustments are made on the corresponding MCL power supply in the right-side compartment of the Power Supply module. For the MCL power supply locations, refer to Figure A.6-4.

1. Locate the voltage that requires adjustment on Table 4.20-2.

Table 4.20-2 MCL Power Supply Voltage Adjustments

Voltage and Acceptable Range	Adjustment Potentiometer on an MCL Power Supply
+5 Vdc ±0.005	Use +5V ADJ on the +5 and ±12 Vdc MCL power supply
-12 Vdc ±0.005	Use -12V ADJ on the +5 and ±12 Vdc MCL power supply
+12 Vdc ±0.005	Use +12V ADJ on the +5 and ±12 Vdc MCL power supply
+24 Vdc ±0.005	Use V ADJ on the +24 Vdc MCL power supply

2. Use the designated adjustment potentiometer to bring the voltage within the acceptable range.
3. If these voltages were verified as part of the installation procedure, go back to the Functional Verification heading (under Heading 3.7) to continue the operational checks.
4. If you did this adjustment because the MCL power supply was replaced, perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

4.21 RE-IMAGING FlowCentre™ COMPUTERS

Purpose

This procedure provides the instruction for re-imaging the FlowCentre desktop computer, PN 2016753, or the FlowCentre II tower computer, PN 2016874.

Tools/Supplies Needed

- ❑ Re-Imaging CD-ROM. PN 7270464, for FlowCentre II tower computer PN 2016874
- ❑ Re-Imaging CD-ROM, PN 7270626, for FlowCentre desktop computer PN 2016753

  Note: Imaging Utility Boot Disk, PN 6417654 will also be needed if the computer is using a Cache Controller card.

A Licensed Norton Anti Virus CD-ROM is inside the box. The Customer can renew their virus software through Norton as desired.

Preparation

1. Backup any files the customer may need such as protocols, listmode files, and so forth. All information will be lost during the re-imaging process.
2. Go to the appropriate heading.
   - Re-imaging a FlowCentre II Tower Computer, PN 2016874
   - Re-imaging a FlowCentre Desktop Computer without a Cache Controller Card, PN 2016753
   - Re-imaging a FlowCentre Desktop Computer with a Cache Controller Card, PN 2016753

Re-imaging a FlowCentre II Tower Computer

For the FlowCentre II tower computer, there is only one Re-Imaging CD-ROM. It is a bootable CD-ROM. Remember that before you re-image a computer, all information WILL be lost. Back up any protocols, listmode files or anything else that the customer may need.

Re-imaging a FlowCentre Desktop Computer without a Cache Controller Card

ATTENTION: The Re-Imaging CD, PN 7270626, works with any hard drive or video card that we use on this system. The hard drives used on this system have ranged from 3.2 GB to 6.4 GB.

- When re-imaging a 3.2 GB hard drive, you will have a 2 GB partition (Drive C) for DOS and a 1.2 GB (Drive D) partition for Windows.
- When re-imaging a 6.4 GB hard drive, you will have a 2 GB partition (Drive C) for DOS and a 2 GB (Drive D) partition for Windows. You will not be able to use the full 6.4 GB of the drive because it would require that Beckman Coulter purchase a new license for using Windows 95 version in our computers. This is not going to be done.

1. Place the CD-ROM in the CD drive.
2. Press the re-boot button.

3. When the computer is running the memory test, hit the delete key to get into the C-MOS setup. You will have to type AUER for the password.
4. In CMOS, select the Advance Setup and change the following:

   1st boot = Floppy

   2nd boot = CDROM

   3rd boot = IDE=0
5. Save changes and allow the computer to re-boot. Type C to re-image the drive
6. After the computer re-images, remove the CD-ROM from the drive and re-boot the computer. At the menu, select DOS.
7. At the C:\ prompt, choose the proper instrument type, by typing, XL_inst or ALT_inst for the correct instrument.
8. Re-boot the computer and ensure it functions correctly for which instrument you have.
9. Re-boot into Windows at the menu and allow it to finish booting up.
10. Re-load any customer Windows based software, which they purchased from Beckman Coulter.
11. Re-boot into DOS and re-load any of the customers files needed.

Re-imaging a FlowCentre Desktop Computer with a Cache Controller Card

ATTENTION: The Re-Imaging CD, PN 7270626, works with any hard drive or video card that we use on this system.

- The hard drives used on this system have ranged from 3.2 GB to 6.4 GB.
  - When re-imaging a 3.2 GB hard drive, you will have a 2 GB partition (Drive C) for DOS and a 1.2 GB (Drive D) partition for Windows.
  - When re-imaging a 6.4 GB hard drive, you will have a 2 GB partition (Drive C) for DOS and a 2 GB (Drive D) partition for Windows. You will not be able to use the full 6.4 GB of the drive because it would require that Beckman Coulter purchase a new license for using Windows 95 version in our computers. This is not going to be done.
- With a Cashe Controller card present, the CD-ROM drive cannot be used as a bootable device. This means you need to use the Imaging Utility Boot Disk, the 3.5 in. bootable diskette.

1. Place the 3.5 in. disk into the floppy drive
2. Place the CD-ROM into the CD-ROM drive
3. Re-boot the computer and type image when requested to re-image the drive
4. After the computer re-images, remove the CD-ROM and the 3.5” disk from the drives and re-boot the computer. At the menu, select DOS.
5. At the C:\ prompt, choose the proper instrument type, by typing, XL_inst or ALT_inst for the correct instrument.
6. Re-boot the computer and ensure it functions correctly for which instrument you have.

7. Re-boot into Windows at the menu and allow it to finish booting up.

   Note: Also when re-imaging this type, when requested to restart the computer after new hardware is found, select NO until after it has found the secondary controller card. It will find the sound card and the primary control card but do not re-start until it finds the secondary controller.

8. Re-load any Windows based software the customer purchased from Beckman Coulter.
9. Re-boot into DOS and re-load any of the customers files needed.

4.22 UNIVERSAL CD-ROM DRIVER SETUP

Purpose

This procedure provides the instructions for installing a driver that works with all types of CD-ROM drives. This driver can be setup on any computer using Windows 95 or higher.

Tools/Supplies Needed

- ❑ Unused 3.5 in. floppy diskette, PN 2016394

Preparation

1. Obtain a clean 3.5 in. floppy diskette.
2. At the Windows Desktop screen, click on the Windows **Start** button ▸▸ **Settings** ▸▸ **Control Panel**.
3. Double click on **Add/Remove Programs**.
4. Click on the **Startup Disk** tab.
5. Click on **Create Disk**.

   Note: If you are using an unformatted 3.5 in. floppy diskette, when the message appears to inquire if you want the diskette formatted, select **Yes**.
6. When the disk is complete, return to the Windows desktop.

Driver Installation

1. Click on the **My Computer** icon to open Windows Explorer.
2. Click on **3½ Floppy (A:)** to show the files on the 3.5 in. floppy disk.
3. Drag and drop the OAKCDROM.SYS file in the root directory of (C:).
   a. Locate the OAKCDROM.SYS file.
   b. At the OAKCDROM.SYS file, click and hold the left mouse button.
   c. Drag the file to the root directory of (C:).
   d. Release the left mouse button.
   e. Click on **C:** and verify the OAKCDROM.SYS file is now located in the root directory.
4. Reboot the computer.
   a. Click on the Windows **Start** button ▸▸ **Shut Down**.
   b. Select **Restart the computer?** and click on **Yes**.
   c. When the Microsoft Windows Startup Menu appears, highlight **8. Previous version of MS-DOS** and press Enter.
5. Press F2. The message *EXIT TO DOS? y/n* should appear.

   Note: If the message does not appear, access the Menu bar. At the Menu bar, select **Applications** ▸▸ **Exit** and the *EXIT TO DOS? y/n* message should appear.
6. Type `Y`.
7. When the C:\XL> prompt, type `XLOFF` and press Enter to turn off only the Cytometer.
8. At the C:\XL> prompt, type `CD` Spacebar `\` then press Enter.

9. At the C:\> prompt (DOS prompt), type `edit` Spacebar `config.sys`
   a. Add this line:
      `DEVICE=C:\OAKCDROM.SYS/D:MSCD000`
   b. Save and close the file.
   c. At the DOS prompt (C:\), type `edit` Spacebar `autoexec.bat`.
   d. In the autoexec.bat file:
      1) Make sure the line `C:\DOS\MSCDEX.EXE/D:MSCD000` is displayed. If not, add the line, then save and close the file.
      2) Press ↓ as many times as necessary to reach the line that displays: CD\XL
      3) Type `REM` in front of the line.
      4) Press ↓ as many times as necessary to reach the line that displays: XL2.
      5) Type `REM` in front of the line.
10. Remove the floppy disk from the A: drive.
11. Reboot the computer.
    a. Click on the Windows **Start** button ▸▸ **Shut Down**.
    b. Select **Restart the computer?** and click on **Yes**.
    c. When the Microsoft Windows Startup Menu appears, highlight **8. Previous version of MS-DOS** and press Enter.
12. The CD-ROM should now be seen in DOS. If you did this setup as part of installing the LANtastic software option, go back to Heading 3.15 and continue the procedure starting at Heading Software Installation, Client Setup. Complete the procedure as written.

4.23 BAR-CODE SCANNER EEPROM CUSTOM PROGRAMMING

IMPORTANT Risk of sample misidentification if the parameters for Code 128 bar-code symbology are changed to a setting other than default. Code 128 is used to identify sample tube positions in the MCL. If the default parameter settings are altered, sample tube positions may be misread. Do not reprogram the Code 128 bar-code symbology.

Purpose

The XL-MCL has the ability to read bar-code symbologies of Code 39, Interleaved 2 of 5, Codabar, and Code 128. These configurations were chosen to optimize the maximum read rate and fit the maximum number of characters on a label so that the label does not interfere with MCL operation.

This procedure provides instructions on how to reprogram the bar-code scanner EEPROM so the MCL can read bar-code labels that do not incorporate a check digit or use bar-code labels with a different character length than the laboratory is currently using. A customer wishing to run a XL-MCL without check digits or wishing to change the recommended character lengths for bar-code labels must sign a letter from Beckman Coulter stating that the laboratory will take full responsibility for misreads, or mislabeling. Contact Technical Support for proper documentation to record this agreement.

Tools/Supplies Needed

- ❑ Bar-code communications cable, PN 6028275

  Note: If you service the TQ-Prep, you may already have this cable. This is the cable used with the TQ-Prep for service diagnostics.
- ❑ Laptop computer or instrument Workstation computer running Windows 95 or higher
- ❑ Form from Technical Support to document the customer's acceptance of responsibility

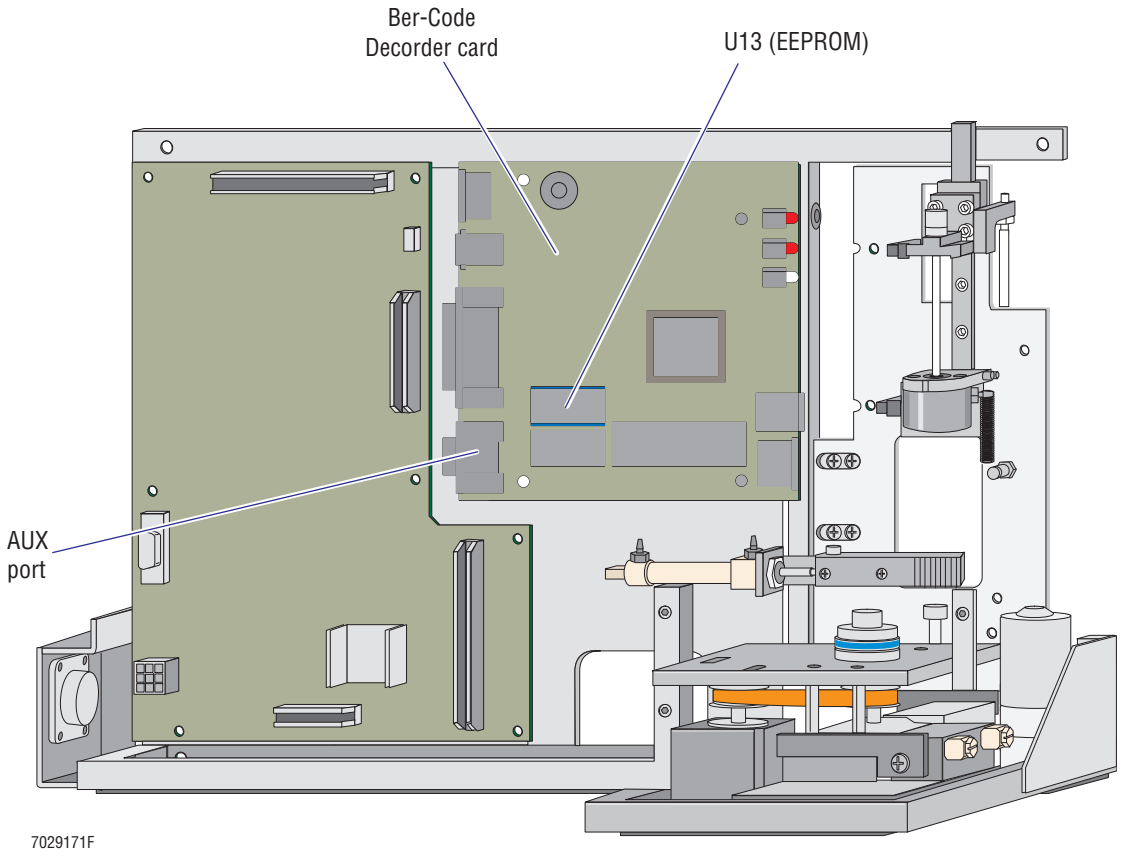
Preparation

1. Power off the Cytometer.
   - Refer to Stage 1: Power Off the Cytometer (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Stage 1: Power Off the Cytometer (system using EXPO32 ADC software) under Heading 4.1, as needed.
2. Remove the Cytometer top cover and set it aside. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
3. Remove the left-side cover and set it aside.

   Note: If the MCL option is installed, remove the MCL probe housing and unlatch the MCL covers before removing the left-side cover. Refer to Heading 4.3 if you need detailed instructions.
4. Locate the Bar-Code Decoder card. This is the smaller of the two circuit cards attached to the MCL main frame. See Figure 4.23-1.
5. Locate U13 and note the version of EEPROM being used on this system (Figure 4.23-1).
   - OEM part number 35-213064-10 indicates an original EEPROM
   - OEM part number 35-213064-11 indicates an ALL CODES EEPROM

- This information is important later in this procedure.

Figure 4.23-1 Bar-Code Decoder Card with Component Locations



6. Connect the female end of the bar-code communications cable to the AUX port on the Bar-Code Decoder card (Figure 4.23-1).
7. Connect the other end of the bar-code communications cable to the COM port on the laptop computer or the instrument's Workstation computer.
8. Power on the laptop or the instrument's Workstation computer and access the Windows desktop.
9. Turn on the Cytometer.
   - If SYSTEM II™ is your customer's preferred software, at the C:\XL> prompt, type `XLON` and press Enter to turn on the Cytometer.
   - If EXPO32™ ADC is your customer's preferred software, at the Windows Desktop, double click on the **XL On** icon to power on the Cytometer.

Computer Setup

1. From the Windows desktop, select **Start** button ▸▸ **Programs** ▸▸ **Accessories** ▸▸ **Hyperterminal** ▸▸ **HyperTerminal**.
2. At the Connection Description dialog box, type `BARCODE` and select **OK**.

   Note: If you want to store the customized configuration in your laptop computer, assign a name that differentiates this configuration from other laboratories.

3. At the Connect To dialog box:
   a. Locate **Connect using:**
   b. Click on the down arrow to open the drop-down selection.
   c. Select **COM 1 ▸▸ OK**.
4. At the **Port Settings** tab inside the COM1 Properties dialog box:
   a. Select the communication protocol required for the EEPROM version (original or ALL CODES) installed on the Bar-Code Decoder card.
      - For the proper BAUD rate, parity, data bits, stop bits and flow control settings, refer to Heading Communication Protocol under Heading F.2, MCL BAR-CODE SCANNER.
      - If OEM part number 35-213064-10 appears on U13, use the original EEPROM information.
      - If OEM part number 35-213064-11 appears on U13, use the ALL CODES EEPROM information.
   b. Select **OK** when finished.
   c. The screen should show a large area with a blinking cursor in the upper left corner.
5. Select **File ▸▸ Properties ▸▸ Settings** tab.
6. At the **Settings** tab:
   a. Locate **Emulation**.
   b. Click on the down arrow to open the drop-down selection.
   c. Select **TTY ▸▸ OK**.
7. At the keyboard, while holding down the Shift key, press < D >.

   Note: The characters must be upper case. The MicroScan Systems software is case sensitive.
8. The MicroScan Configuration Program Main Menu should be scrolling onto the computer screen which indicates communication with the Bar-Code Decoder card is established. Wait for the Main Menu to be completely transferred from the Bar-Code Decoder card to your computer before continuing.

Custom Programming Sequence

1. When the MicroScan Configuration Program Main Menu is completely transferred, MAIN ----> COMMUNICATIONS appears at the bottom of the display. This is the first of four topics listed on the Main Menu.

IMPORTANT Risk of sample misidentification if the parameters for Code 128 bar-code symbology are changed to a setting other than default. Code 128 is used to identify sample tube positions in the MCL. If the default parameter settings are altered, sample tube positions may be misread. Do not reprogram the Code 128 bar-code symbology.

2. Press Spacebar as many times as necessary to display CODE TYPES as the topic (MAIN ----> CODE TYPES) then press Enter. The current settings for the various code types are displayed.

3. Locate Table F.2-1, MCL Bar-Code Scanner - Default Configuration. Use this information as a reference. Code 128 settings must reflect the Default Configuration.
4. While monitoring the information to the right of the CODE TYPES ----> prompt, press Spacebar as many times as necessary to display the desired bar-code symbology then press Enter. *CODE TYPES ----> the selected code----> STATUS* appears.
5. The status appears as either *ENABLED* or *DISABLED*.
   - To retain the current status, press Spacebar to access the next parameter available for that the selected bar-code symbology.
   - To change the current status, press Enter Spacebar. Verify the desired status is displayed then press Enter to save the change. (If the desired status is not displayed, press Spacebar again then press Enter.)
6. Press Spacebar as many times as necessary until the next parameter requiring change is displayed.
   a. Press Enter to identify you desire to change this parameter.
   b. Either press Spacebar to toggle to the desired setting or if this requires a numerical entry, type in the numer.
   c. When the desired setting is displayed, press Enter to save the change.
7. Repeat step 6 until all the parameters for the selected code are set according to the customer's requirements.
8. When all codes are correctly set:
   a. Press Esc. *EXIT or MAIN (E, M)* appears.
   b. Press E. *Do you want to save changes for power on? (Y=yes N=no)* appears.
   c. Press Y to save all changes for power on.
   d. Verify the Bar-Code Decoder card beeps. This audible signal (one beep) indicates the changes are registered.

If You Want to Store this Custom Configuration (Optional)

If you wish to store this configuration for access at a later time:

1. Close the computer program (click on the X in the upper right corner).
2. When the message *You are currently connected. Are you sure you want to disconnect now?* appears, select **Yes**.
3. When the message *Do you want to save session?* appears, select **Yes**. The configuration is stored under **HyperTerminal**. The Windows desktop reappears.

   Note: To access from the Windows desktop, select **Start** button ▸▸ **Programs** ▸▸ **Accessories** ▸▸ **Hyperterminal** ▸▸ **HyperTerminal** then select the desired configuration.

If You Do Not Want to Store this Custom Configuration

If you do not wish to store this configuration for access at a later time:

1. Close the computer program (click on the X in the upper right corner).
2. When the message *You are currently connected. Are you sure you want to disconnect now?* appears, select **Yes**.

3. When the message *Do you want to save session?* appears, select **No**. The Windows desktop reappears.

Reinstall Covers

1. Turn off the Cytometer.
   - If SYSTEM II™ is your customer's preferred software, at the C:\XL> prompt, type `XLOFF` and press Enter to turn off the Cytometer.
   - If EXPO32™ ADC is your customer's preferred software, at the Windows Desktop, double click on the **XL Off** icon to power off the Cytometer.
2. Exit all applications and turn off computer.
3. Disconnect the bar-code communications cable from the AUX port on the Bar-Code Decoder card and from the COM port on the laptop computer or the instrument's Workstation computer. Set the cable aside.
4. Reinstall the left-side cover.

   Note: If the MCL option is installed, relatch the MCL covers back on the Cytometer frame and reinstall the MCL probe housing. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
5. Reinstall the Cytometer top cover. Refer to Heading 4.3 if you need detailed instructions.

Verification

1. Turn on the Cytometer.
   - If SYSTEM II™ is your customer's preferred software, at the C:\XL> prompt, type `XLON` and press Enter to turn on the Cytometer.
   - If EXPO32™ ADC is your customer's preferred software, at the Windows Desktop, double click on the **XL On** icon to power on the Cytometer.
2. Verify the customer's bar-code labels can be read.

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5.1 SYSTEM VERIFICATION PROCEDURE (SVP)

Purpose

Doing the System Verification Procedure (SVP) at the end of a service call ensures the instrument is working correctly before you leave. Fill in a copy of the SVP form and leave it with the customer.

Required Service Form

A copy of the Coulter Cytometry Systems Verification Form, PN 4276437, is included at the end of this chapter for your convenience. Make copies as needed.

Tools/Supplies Needed

- ❑ Flow-Check fluorospheres, PN 6605359
- ❑ IsoFlow sheath fluid, PN 8547008
- ❑ 24 empty 12 x 75-mm test tubes, PN 2523749

  Note: If the SVP is being performed on an XL flow cytometer without the MCL option, only 12 empty 12 x 75 mm test tubes are required.
- ❑ CYTO-TROL control cells, PN 6604248 (or customer samples)
- ❑ Copy of the Coulter Cytometry Systems Verification Form, PN 4276437
- ❑ Copy of the Field Engineer Worksheet under Heading C.1, WORKSHEETS

Preparation

If you have not already done so, make a copy of the Coulter Cytometry Systems Verification Form and the Field Engineer Worksheet.

ATTENTION: If you are performing this SVP as part of an XL or XL-MCL flow cytometer installation, start at Heading Acquisition, CV Analysis and Carryover Check. Cover removal and replacement is already validated and the other static tests are not necessary with a new instrument. The power up tests and verification of the Trans Data Acquisition card offsets were completed during installation.

Static Tests

1. Ensure that all covers can be removed and replaced without problems as directed under Heading 4.3, COVER REMOVAL AND REINSTALLATION.
   - At the Cytometer, **do not reinstall** the four Phillips-head screws securing the top cover to the Cytometer frame. The top cover must be removed later.
   - At the Power Supply module, **do not reinstall** the four Phillips-head screws securing the three-sided cover to the Power Supply module's frame. The three-sided cover must be removed later.
2. Clean all the fan filters:
   - Two on the Cytometer (lower rear panel)
   - Two on the Power Supply module (lower left side)
   - One on the Workstation computer (back).
3. Inspect the reagent drawer for leakage and spillage. Clean and repair as needed.

4. Inspect the segmenting valve for leakage and corrosion. Clean and repair as needed.
5. Inspect the flow cell area for leakage and saline deposit build-up. Clean and repair as needed.
6. Inspect the air/water filter separators (water traps). Clean and repair as needed:
   - One in the Cytometer
   - One in the Power Supply module.
7. Inspect the vacuum trap in the Power Supply module. Clean and repair as needed.

Power Up Tests

1. Verify all cooling fans are operating properly. Repair as needed.

   Exterior Fan Locations

   - Two on the Cytometer (lower rear panel)
   - Two on the Power Supply module (lower left side)
   - One on the Workstation computer (back)

   Interior Fan Locations

   - Two in the laser blower assembly (mounted on the Cytometer frame, left side).
2. At the Power Supply module:
   a. Verify the system pressure gauge (SYS PRESS) reads 30 psi. Adjust the regulator if necessary.
   b. Verify the system vacuum gauge (SYS VAC) registers a minimum of 17 in. Hg.
3. At the Cytometer:
   a. Verify the CYTOMETER READY indicator lights green.
   b. Verify vacuum is present at the manual sample station head.

Trans Data Acquisition Card Offset Verification

Go to Heading 4.14, TRANS DATA ACQUISITION CARD REPLACEMENT AND/OR CALIBRATION and complete the procedure as written. This procedure also verifies the offset of each Amp/Signal Conditioner card.

Acquisition, CV Analysis and Carryover Check

Using the Manual Sample Station

1. At the Workstation, select the **Acquire Fluorospheres** protocol.

   Note: If an Acquire Fluorospheres protocol needs to be set up, see Acquiring Fluorospheres under Heading A.3.
2. Dispense approximately 1 mL of Flow-Check fluorospheres into 10 test tubes and label each tube BEADS.
3. Dispense approximately 1 mL of sheath fluid into two test tubes and label each tube ISO.
4. Insert one of the test tubes labeled BEADS in the manual sample station.
5. Run the Acquire Fluorospheres protocol.
6. At the end of the run, record the results on the Field Engineer Worksheet.

7. Remove the test tube from the manual sample station. Discard the test tube.
8. Repeat steps 4 through 7 until all the test tubes labeled BEADS are processed.
9. At the end of run 10, record the time it took to reach 5,000 events.
10. Insert one of the test tubes labeled ISO in the manual sample station.
11. Rerun the Acquire Fluorospheres protocol with a manual stop at the time recorded in step 9.
12. At the end of the run, label the sample information as CLEAR1 and save the printout.
13. Remove the ISO test tube from the manual sample station. **Discard** the test tube immediately to ensure it is not accidently rerun.
14. Wait five minutes.
15. After the five minute wait, insert the second ISO test tube in the manual sample station.
16. Rerun the Acquire Fluorospheres protocol with a manual stop at the time recorded in step 9.
17. At the end of the run, label the sample information as CLEAR2 and save the printout.
18. Remove the ISO test tube from the manual sample station. **Discard** the test tube immediately to ensure it is not accidently rerun.
19. Ensure that the carryover for CLEAR1 and CLEAR2 are less than 1% (<100 events each).
    a. If the carryover is greater than 1%:
        1) Clean the segmenting valve as instructed under Heading 4.11.
        2) Using the manual sample station, repeat the CV analysis. Start at step 1 again.
    b. If the carryover is less than 1%, go to step 19 and perform the CV analysis.
20. On the Field Engineer Worksheet, verify that all CVs are acceptable.
    a. Add the HP CVs and the Mean Channels.
    b. Divide each total by 10 to get the average.
    c. Add the HP CVs and the Mean Channels.
    d. Divide each total by 10 to get the average.
    e. Evaluate the results to determine if all CVs are within the assay value on the package insert.
        - If all CVs are acceptable, go to step 21.
        - If one or more CVs are unacceptable, go to Heading 4.6, OPTICAL ALIGNMENT and complete the procedure as written.
21. How to proceed:
    a. If you are performing this CV analysis and carryover check on an XL-MCL flow cytometer, repeat this check using the MCL sample station.
    b. If you are performing this CV analysis and carryover check on an XL flow cytometer without the MCL option, go to Heading Interlock Checks that follows. Complete the checks as written.

Using the MCL Sample Station

1. At the Workstation, select the **Acquire Fluorospheres** protocol.
2. Dispense approximately 1 mL of Flow-Check fluorospheres into 10 test tubes and label each tube BEADS.
3. Dispense approximately 1 mL of sheath fluid into two test tubes and label each tube ISO.
4. Place the test tubes labeled BEADS in the MCL carousel.
5. Run the Acquire Fluorospheres protocol.
6. Watch the Workstation screen and at the end of each run, record the results on the Field Engineer Worksheet.
7. At the end of run 10, record the time it took to reach 5,000 events.
8. Remove and discard the test tubes containing the fluorospheres (beads).
9. Place one of the test tubes labeled ISO in the MCL carousel.
10. Rerun the Acquire Fluorospheres protocol with a manual stop at the time recorded in step 7.
11. At the end of the run, label the sample information as CLEAR1-MCL and save the printout.
12. Remove the ISO test tube from the MCL carousel. **Discard** the test tube immediately to ensure it is not accidently rerun.
13. Wait five minutes.
14. After the five minute wait, place the second ISO test tube in the MCL carousel.
15. Rerun the Acquire Fluorospheres protocol with a manual stop at the time recorded in step 7.
16. At the end of the run, label the sample information as CLEAR2-MCL and save the printout.
17. Remove the ISO test tube from the MCL carousel. **Discard** the test tube.
18. Ensure carryover for CLEAR1-MCL and CLEAR2-MCL are less than 1% (<100 events each).
    a. If the carryover is greater than 1%:
        1) Clean the segmenting valve as instructed under Heading 4.11.
        2) Using the MCL sample station, repeat the CV analysis. Start at step 1 again.
    b. If the carryover is less than 1%, go to step 19 and perform the CV analysis.
19. On the Field Engineer Worksheet, verify that all CVs are acceptable.
    a. Add the HP CVs and the Mean Channels.
    b. Divide each total by 10 to get the average.
    c. Add the HP CVs and the Mean Channels.
    d. Divide each total by 10 to get the average.
    e. Evaluate the results to determine if all CVs are within the assay value on the package insert.
        - If all CVs are acceptable, go to Heading Workstation Computer Test that follows. Complete the check as written.
        - If one or more CVs are unacceptable, go to Heading 4.6, OPTICAL ALIGNMENT and complete the procedure as written.

Interlock Checks

1. If the MCL option is installed, check the MCL door interlock:
   a. Place an empty test tube in the MCL carousel but leave the MCL door open.
   b. Attempt to run the Acquire Fluorospheres protocol again.
   c. If MCL operation halts immediately and an *MCL Door Open Error* or *MCL Door Open Warning* message appears on the Workstation screen, proper operation of the MCL interlock is confirmed.
2. On the front of the Power Supply module, verify the SYSTEM POWER indicators (and MCL POWER indicators if the MCL option is installed) are lighted.
3. At the Cytometer front panel display, verify the:
   a. LASER ON indicator glows green indicating the Argon laser is powered on.
   b. CYTOMETER READY indicator glows green indicating the Cytometer is ready for operation.
4. Check the Cytometer interlock:
   a. Remove the Cytometer top cover. The Argon laser should power off immediately.
   b. If the LASER ON indicator darkens, proper operation of the Cytometer interlock is confirmed.
5. Check the Power Supply module interlock:
   a. Remove the three-sided cover from the Power Supply module. Power supply components and the Cytometer should power off immediately.
   b. If the SYSTEM POWER indicators (and MCL POWER indicators if the MCL option is installed) on the front of the Power Supply module darken and the Cytometer READY indicator on the Cytometer front panel display darkens, proper operation of the Power Supply module interlock is confirmed.
6. Reinstall the three-sided cover on the Power Supply module using the four Phillips-head screws removed earlier. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
7. Reinstall the Cytometer top cover using the four Phillips-head screws removed earlier. Refer to Heading 4.3 if you need detailed instructions.
8. Verify all instrument covers are installed.
9. Power on the Cytometer.
   - Refer to Restoring Power to the Cytometer Only (system using SYSTEM II software) under Heading 4.1, as needed.
   - Refer to Restoring Power to the Cytometer Only (system using EXPO32 ADC software) under Heading 4.1, as needed.
10. At the Cytometer front panel display, verify the:
    a. LASER ON indicator lights green indicating the Argon laser is powered on.
    b. CYTOMETER READY indicator lights green indicating the Cytometer is ready for operation.

Workstation Computer Test

1. Go to the DOS directory.
2. Run SCANDISK C: and verify disk space available is adequate enough for the operator.

On-Site Close Out

1. Have the customer run one or more samples to verify operation.
2. Ensure that all the customer's concerns have been addressed.
3. Provide a completed copy of the SVP form to the customer for future reference.

5.2 PREVENTATIVE MAINTENANCE INSPECTION (PMI)

Purpose

Use this procedure to perform a PMI on the instrument.

Tools/Supplies Needed

- ❑ XL PMI kit, PN 6913241

Procedure

1. Check the contents of the XL PMI kit against the packing list to ensure that all the parts are present.
2. Turn OFF the instrument.
3. Remove covers as needed to replace, inspect, and clean designated components. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
4. Replace the:
   a. Manual sample head and pickup probe.
   b. MCL sample head and pickup probe.
   c. Discolored tubing (all).
   d. Sample introduction tubing (PEEK tubing).
   e. Fan filters.
   f. Sheath filter.
   g. Waste vent filters (both of them) in the Power Supply module.
   h. Check valves as needed.
   i. Y-fittings as needed.
5. Inspect and clean the:
   a. Optical filters (all).
   b. Beam-shaping optics.
   c. Flow cell.
   d. Pinhole lenses.
6. Turn ON the instrument.
7. Align the optics as directed under Heading 4.6, OPTICAL ALIGNMENT.
8. Reinstall all covers removed during the PMI. Refer to Heading 4.3, COVER REMOVAL AND REINSTALLATION if you need detailed instructions.
9. Exit the SYSTEM II software and enter MS-DOS.

ATTENTION: Depending on when the instrument was manufactured, it may be using MS-DOS Version 5.0, 6.0 or 6.22.

10. At the MS-DOS prompt:
    - If running under MS-DOS 5.0, type `CHKDSK/F` and press Enter.
    - If running under MS-DOS 6.0 or 6.22, type `SCANDISK` and press Enter. After this is completed, type `DEFRAG` and press Enter.
11. If any lost chains are found, mark them.
12. Delete all the lost chains; type `DEL*.CHK` and press Enter.
13. Reboot the Computer Workstation.

System Verification

Perform an SVP as directed under Heading 5.1, SYSTEM VERIFICATION PROCEDURE (SVP).

COULTER CYTOMETRY SYSTEMS VERIFICATION FORM

Institution Name _____ Date _____

FSR # _____ Model / Serial # _____ Run # _____

PROBLEM / SYMPTOM

CORRECTIVE ACTION

SMOs PERFORMED

On all types of maintenance completed, **VERIFY:**

- ☐ HPCV Precision for FS & FL Linear Parameters on Flourospheres *
- ☐ HPCV Stability on Flourospheres *
- ☐ Peak or Mean Channel Stability for All Linear Parameters*
- ☐ That All Customer Concerns Have Been Addressed (Verified by customer signature.)

*Reference the appropriate Operator's Manual for the Instrument to obtain Performance Specifications.

Additional Comments

Customer Signature _____

Print Customer's Last Name _____

CSS Signature _____

PN 4276437B R 4-97/ Rev B 7/2001

Checked Box Indicates Function Performed

PROCEDURE / VERIFICATION	ALTRA	XL	XL/MCL	Elite Analyser	ELITE	ELITE / ESP
PERFORMANCE - ON ALL CALL COMPLETIONS						
HPCV Precision on FS & FL Linear Parameters						
HPCV Stability on FS & FL Linear Parameters						
Peak or Mean Channel Stability						
Carryover						
Operation of Cleaning Adaptors						
All above performed in Manual and/or Auto Modes						
PERFORMANCE - AS REQUIRED BY TYPE OF PROBLEM						
Linearity Of Linear Parameter(s)						
Linearity Of Log Parameter(s)						
Operation Of Multi-Carousel Loader						
Ran Prefinal Service Software						
Standard Sorting Capability						
High Speed Sorting Capability						
Operation Of Autoclone						
Other						
PNEUMATICS / FLUIDICS						
Repl. Actuator / Pinch Valve / Solenoid						
Repl. Tubing - [ ] Common - [ ] Sample						
Repl. Sample Introduction Kit (Peek Tubing)						
Repl. Pressure / Vacuum Switch						
Repl. Sheath / Sample Transducer						
Repl. [ ] - Cleaned [ ] - Segmenting Valve						
Repl. Sheath Filter / Waste Filter						
Repl. Reagent / Waste // Sensor / Switch						
Repl. Air / Water Sep.- [ ] Assy. - [ ] Filter						
Repl. [ ] - Adj. [ ] - Sheath Regulator						
Repl. [ ] - Adj. [ ] - Sample Regulator						
Repl. [ ] - Adj. [ ] - Vacuum Regulator						
Repl. Sheath / Waste / Clenz / Rinse Tank						
Repl. Compressor / Vacuum Assembly						
Repl. [ ] - Repair [ ] - Sample Station						
Repl. [ ] - Cleaned [ ] - Man. Sample Head						
Repl. [ ] - Cleaned [ ] - MCL Sample Head						
Repl. Sample Tube Cap						
Repl. [ ] - Cleaned [ ] - Flow Cell [ ] - Tip [ ]						
Repl. [ ] - Repair [ ] - Lower Pneu. Drawer						
Adj. [ ] Align. [ ] MCL						
Repl. [ ] Repair [ ] MCL						
Other						
ELECTRONICS						
Cleaned [ ] - Repl. [ ] - Fan Filters						
Repl. - [ ] Fan - [ ] - Blower Assembly						
Repl. Power Supply						
Checked [ ] - Adj. [ ] - Power Supply						
Repl. Printed Circuit Board						
Calibrated Printed Circuit Board						
Performed Pneumatic Calibration Procedure						
Repl. Scatter Detector - [ ] FS - [ ] SS						
Repl. Photo Multiplier Tube Assembly						
Repl. Bar-Code Reader Head						
Cleaned Bar-Code Reader Head						
Other						

	ALTRA	XL	XL/MCL	Elite Analyser	ELITE	ELITE / ESP
COMPUTER / WORKSTATION						
CMOS Setup Verified						
Verified Config.sys / Autoexec.bat						
Checked for Viruses						
Ran - Defrag [ ] - Chkdsk [ ] - Scandisk [ ]						
Ran Diagnostic Software						
Reloaded Software						
Repl. Drive - [ ] Hard - [ ] Floppy						
Repl. Drive - [ ] Optical - [ ] Bernoulli						
Repl. Printed Circuit Board						
Repl. - Computer [ ] - Keybd [ ] - Monitor [ ]						
Repl. [ ] - Cleaned [ ] - Mouse						
Repl. Bar-Code Hand Held Scanner						
Other						
PRINTERS						
Repl. [ ] Verified [ ] Standard Printer						
Repl. [ ] Verified [ ] Color Printer						
Repl. [ ] Verified [ ] Bar Code Printer						
Repl. [ ] Verified [ ] Thermal Printer						
Other						
OPTICAL SUBSYSTEMS						
Cleaned [ ] Repl. [ ] Optical Filter						
Cleaned [ ] Repl. [ ] Beam Shaper						
Cleaned [ ] Repl. [ ] FL Pickup Assembly						
Cleaned [ ] Repl. [ ] Flow Cell / Tip						
Cleaned / Lubricated Optical Rail Assembly						
Aligned Laser Head to Targets						
Adj. Z Axis						
Performed Optical Alignment						
Aligned Photo Multiplier Tube(s)						
Other						
AUTOMATED SAMPLE HANDLING OPTIONS						
Repl. Autocloner Board						
Repl. [ ] Repair [ ] AUTO-CLONE						
Adj. [ ] Calibrated [ ] AUTO-CLONE						
Repl. [ ] Repair [ ] MQP						
Other						

LASERS
Check only if laser aligned, repaired, or replaced.
CYONICS
COHERENT - I 60 Series
COHERENT - I 70 Series
COHERENT - I 90 Series
COHERENT - I 305
COHERENT - Spectrum
COHERENT - Enterprise
COHERENT - DPSS
MELLES GRIOT - Green HeNe
UNIPHASE - Red HeNe
OMNICHROME - HeCd 74
OTHER

LASER POWER

LASER CURRENT

WAVELENGTH

6 SCHEMATICS, 6.1-1

6.1 ENGINEERING SCHEMATICS, 6.1-1

CONTENTS

6.1 ENGINEERING SCHEMATICS

The following is a list of the engineering schematics you need for troubleshooting an XL or XL-MCL flow cytometer.

Name	PN
Amplifier / Signal Conditioner card	6320739
Analyzer Backplane	6320633
CYT12 Receiver EMC	6322948
Cyto Transputer card	6320738
FALS Hybrid Detector card	6321049
Fiber Optic Interface card	6320755
Front Panel LED and Switch Input (for XL units only)	6320590
Front Panel LED and Switch Input 2 (for XL-MCL units only)	6321141
MCL CPU card	6321078
MCL Interconnect	6319791
MCL Interface card	6321034
Motor Filter EMC	6322977
Opto Transprocessor EXMEM card (non-EMC version)	6320820
Opto Transprocessor EXMEM II card (EMC version)	6322949
Pneumatic / Hydraulic Layout: XL System	6320886
PMT Distribution and Laser Fan Control card	6320591
Power Module Control card (non-EMC version)	6320636
Power Module Control II card (EMC version)	6322947
Safety Interlock Interconnect	6320912
Sensor card	6320630
SideScatter Amplifier 1	6320530
Solenoid Power Distribution card	6321192
System Interface card	6320782
Top Panel Display 2 card	6320606
Trans Data Acquisition card	6320732
Transient Absorber EMC	6323009
Voltage Selector 100 Vac	6320870
Voltage Selector 120 Vac	6320657
Voltage Selector 220 Vac	6320888
Voltage Selector 230/240 Vac	6320889
Voltage Supply Monitor card	6321107

Electronic (.pdf) files of these schematics are available on a separate CD-ROM in the Service Resource Kit (SRK) and in a Lotus Notes® database. The schematics in the SRK are the latest revisions available at the time the SRK is released. For copies of schematics released between revisions of the SRK, check the Lotus Notes database. It will always have the most current revisions.

Note: Depending on the configurations of this instrument in the field, more than one revision of a schematic can be valid.

If you want to include schematics in the printed version of this manual, make printouts of the electronic files and insert them at the end of this chapter.

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CONTENTS

7.1 LEVEL SENSE INDICATORS AND ERROR MESSAGES

Level Sense Indicators

Cleanse Low

When the CLEANSE LOW indicator is red, fill the cleanse container. You cannot start a cleanse cycle until this is done.

Sheath Low and Waste Full

Table 7.1-1 documents how to read the *SHEATH LOW* and *WASTE FULL* level-sense indicators.

Note: If a full waste container is detected while the last sample in a carousel is being analyzed, the carousel report is not printed. To print the report:

1. Select **Applications ▸▸ Acquisition.**
2. Select **Alt Save**.
3. Select **Print Carousel Report**.

Table 7.1-1 Level Sense Indicators - Sheath Low and Waste Full

Indicator Turned Red During…	Elapsed Time (minutes)	Indicator Is…	Action
Sample analysis	1 2 3 4	Flashing red	Five minutes remain to finish analyzing current sample. Either immediately or after current sample analysis is complete, refill or empty appropriate container (see Special Procedures and Troubleshooting manual).
	5	Glowing red, beeping every 10 seconds	
	6	Glowing red	Refill or empty appropriate container (see Special Procedures and Troubleshooting manual). Samples **cannot** be analyzed until this is done. Cytometer stopped data acquisition, stored data, is in Idle mode.
Prime or cleanse cycle	N/A	Glowing red	Refill or empty appropriate container (see Special Procedures and Troubleshooting manual). Samples **cannot** be analyzed until this is done.

Error Messages

Error messages appear:

- In the center of the monitor's screen. To acknowledge:
  - Press and release either mouse button, or
  - Press Enter.
- In the lower right corner of the Acquisition Run screen. To acknowledge, use the mouse to move the cursor over the message *Click here to clear messages* and press either mouse button.

About the Error Messages Table

The table of error messages (Table 7.1-2) lists the error messages in alphabetical order, with their cause and what to do about them. An additional error message table is printed automatically when you install SYSTEM II software.

Table 7.1-2 Error Messages

Message	Cause/Symptom	Action
A region must first be selected	A region operation was attempted **before** selecting a region.	Select region, repeat operation.
All regions are already assigned	Creation of >24 regions attempted.	Delete some existing regions, create new ones.
Cannot get Cytometer ready	• Laser defective or not ignited • No vacuum • Incorrect pressure	Reset circuit breakers (see Special Procedures and Troubleshooting manual).
Cannot get sample information from MCL	• Software error • Bad bar-code label	Clean carousel or use new one and/or check condition and placement of bar-code label on sample tube.
Cannot open protocol queue file	• File load error • No file • Wrong path specified	Specify correct directories on Utilities Configuration screen and/or from File menu, select **Rebuild.**
Caution: No histograms were noted	Protocol is missing histograms.	Create histograms.
Counter not available	>3 stop counts specified.	Delete an existing stop count, create new one.
Cleanse level error	Low cleaning agent.	Fill cleaning agent container.
Cleanse level warning	Cleanse sensor failed.	Replace level sensor or cleanse tank.
>>>> Cytometer communications failure during file load <<<<	Program unable to communicate with Cytometer.	• Reset circuit breakers (see Special Procedures and Troubleshooting manual). • At computer workstation, turn instrument off, then back on.
>>>> Cytometer program file not found <<<<		
Cytometer read cyto state timeout	Cytometer communication error.	At Computer Workstation, turn instrument off, then back on.
Data rate error	Data rate too high for Cytometer data handling.	Dilute sample and/or change discriminator setting.
Data rate warning	Data rate too high due to high sample concentration.	
	Discriminator **not** set.	Set discriminator.
	Instrument needs calibration.	Reset circuit breakers (see Special Procedures and Troubleshooting manual).
Data stream error	Data acquisition hardware error.	Replace Trans Data Acquisition card.
Data stream warning		

Table 7.1-2 Error Messages *(Continued)*

Message	Cause/Symptom	Action
Equation(s) exceed defined limitations	Software failure.	At Computer Workstation, turn instrument off, then back on.
ERROR: 2 parameter histograms not allowed	Two-parameter histogram selected as control or test in Immuno-4 data analysis.	Select one-parameter histogram.
ERROR: Channel resolution of histograms are different	Control and test histogram selected with different resolutions in Immuno-4 analysis.	Select other control and/or test histograms.
ERROR: Histogram Log decades are different	Control and test histograms selected with different log types in Immuno-4 analysis.	
ERROR: in accessing metafile	Metafile saved incorrectly.	Save again.
Error: Invalid path selected	Invalid path entered.	Enter another path.
ERROR: Mouse Driver Not Present	No mouse detected.	• Secure mouse connector. • At Computer Workstation, turn instrument off, then back on.
	No mouse driver installed.	Add mouse driver to **config.sys** file.
ERROR: No controls or tests have been set up for this panel	Controls or tests not selected.	In Immuno-4 application, build control queue.
ERROR: No more entries may be selected	>32 protocols selected in a panel.	Delete some protocols, add others.
ERROR: Not enough memory to calculate amorphous statistics	System needs more memory to calculate statistics for amorphous region.	At Computer Workstation, turn instrument off, then back on.
ERROR: Unable to receive cytometer's program version	Instrument **cannot** receive Cytometer changes.	
ERROR! <your file name> does not exist in this directory!	Software cannot find named file in directory.	From File menu, select **Rebuild**.
ERROR! DEFAULT is a reserved name.	"Default" entered as name.	Enter another name.
ERROR! Name must not consist entirely of spaces.	Name consisting of all blank spaces entered.	
ERROR! Requested file does not exist in this directory	Software **cannot** find file in directory.	From File menu, select **Rebuild**.
ERROR! Unable to access file <your file name>.	Software **cannot** load named file, or named file invalid.	Specify correct directories on Utilities Configuration screen and/or from File menu, select **Rebuild**.
ERROR! Unable to access file.	Software **cannot** load file.	
ERROR! Unable to get the available disk space for the specified drive	Software **cannot** calculate available disk space.	At Computer Workstation, turn instrument off, then back on.

Table 7.1-2 Error Messages *(Continued)*

Message	Cause/Symptom	Action
ERROR! -- Unable to read non-XL protocols!	Attempted to create protocols using non-XL/XL-MCL flow cytometer software.	Use valid protocol.
>>>> Error loading cytometer program file <<<<	Software unable to program Cytometer.	Reset SYSTEM II software program.
Error allocating extended memory	Software cannot allocate extended memory.	At Computer Workstation, turn instrument off, then back on.
Error in acquiring	Cytometer unable to acquire data.	
Error in rename listmode file	• File write error • Hard disk error	Select **Alt Save** and repeat save.
Error in sending all the compensation values of the signals	Computer Workstation/Cytometer communication error.	At Computer Workstation, turn instrument off, then back on.
Error in sending all the gain settings to Cytometer		
Error in sending all the pertinent time parameters to Cytometer	Computer Workstation/Cytometer communication error.	• Reset circuit breakers (see Special Procedures and Troubleshooting manual). • At Computer Workstation, turn instrument off, then back on.
Error in sending all the signals selected as parameters during acquisition		
Error in sending ratio's numerator and denominator to Cytometer	Computer Workstation/Cytometer communication error.	At Computer Workstation, turn instrument off, then back on.
Error in sending sample pressure		
Error in sending signal with the discriminator set		
Error in setting Cytometer in the awaiting sample state		
Error in writing file, Current operation aborted	• Wrong path specified • Full disk.	Specify correct directories on Utilities Configuration screen and/or use Archive on Data Management screen and free up disk space.
ERROR LOADING PROTOCOL	Software **cannot** access protocol file.	From File menu, select **Rebuild**.
ERROR writing to file [filename]! Possible full disk.	Software **cannot** write information to named file.	Specify correct directories on Utilities Configuration screen and/or use Archive on Data Management screen to free up disk space.
Error stop Cytometer	Computer Workstation/Cytometer communication error.	At Computer Workstation, turn instrument off, then back on.
Fail to close Listmode file	• Hard disk error • Full disk.	Use Archive on Data Management screen to free up disk space.
Help is not available at this time	No help screens available yet.	None.

Table 7.1-2 Error Messages *(Continued)*

Message	Cause/Symptom	Action
Host command invalid	Unknown command.	At Computer Workstation, turn instrument off, then back on.
Illegal Cytometer state	Cytometer error.	
Insufficient memory available	System needs more memory.	
Insufficient memory for listmode replay	System needs more memory to replay Listmode data.	
Insufficient space on <drive designation>: <# bytes> bytes free! <# bytes> bytes selected!	More space needed on destination disk to copy/move files.	Change file selection and/or get another diskette and/or use Archive on Data Management screen to free up disk space.
INTERNAL System ERROR: Invalid application specified	Software error.	At Computer Workstation, turn instrument off, then back on.
Invalid count value	Invalid histogram stop count entered.	Enter valid histogram stop count.
Invalid equation string!	Invalid histogram equation entered.	Enter valid histogram equation.
Invalid Name. Must be other than blank characters.	Name consisting of blank spaces entered.	Enter another name.
<your panel name>: Invalid panel selected	Invalid panel selected.	From File menu, select **Rebuild**.
Invalid region index. Call for service.	Software error.	At Computer Workstation, turn instrument off, then back on.
Laser Current Error *Laser current warning*	Laser current requirements outside expected range.	Reset circuit breakers (see Special Procedures and Troubleshooting manual).
Laser Power Error *Laser power warning*	Laser light power requirements outside expected range.	
MCL Carousel Homing Error	Carousel could **not** go to home position.	Press AUTO. If message reappears, at Computer Workstation, turn instrument off, then back on.
MCL Carousel In/out Error	Carousel could **not** move when requested to.	
MCL Carousel Label Error	Carousel bar-code label missing, dirty or bad.	Clean bar-code label. If message reappears, replace bar-code label or use another carousel.
MCL Carousel Rotate Error	MCL option door open.	Close MCL option door.
	Sample tube stuck on sample probe guide	Remove sample tube.
MCL CPU Error	MCL option/Cytometer communication error.	At Computer Workstation, turn instrument off, then back on.
MCL Door Open error *MCL Door Open Warning*	MCL option door open.	Close MCL option door.
MCL EPROM Error	EPROM failed.	Replace MCL CPU card.

Table 7.1-2 Error Messages *(Continued)*

Message	Cause/Symptom	Action
MCL Error	MCL option disconnected.	• Reset circuit breakers (see Special Procedures and Troubleshooting manual). • Check blue, flat-ribbon cable. • Check MCL CPU card.
MCL Probe Up/Down Error	Probe did **not** go down or stuck in sample tube.	Press AUTO. If message reappears, at computer workstation, turn instrument off, then back on.
MCL Receive Timeout *MCL Transmit Timeout*	MCL option /Cytometer communication error.	At Computer Workstation, turn instrument off, then back on.
MCL Tube Displaced Error	Sample tube incorrectly positioned.	Check for broken sample tube or reposition tube.
MCL Tube Jam Error	Sample tube lodged in MCL option.	Remove sample tube from sample probe guide.
MCL Tube Load Error	Bad seal between sample probe guide/sample tube.	Put sample in another sample tube.
MCL Tube Position Error	• MCL option could **not** rotate to correct tube position • Read error on bar-code label for tube position.	Clean bar-code label or use another carousel.
MCL Tube Up/down Error	Sample tube did **not** load correctly.	Put sample in another sample tube.
Must be greater than previous level [n]	Smaller scaling value than previous one entered.	Enter greater scaling value.
Must first select a histogram to redisplay	Redisplay of unspecified histogram attempted.	Select histogram first.
Must first select a histogram to rescale	Rescale of unspecified histogram attempted.	
No changes allowed while in Listmode	Attempted to change Cytometer settings while analyzing a Listmode file.	None.
No listmode results to display	Attempted to display histogram before replaying it.	Replay histogram first.
No >8 signals may be chosen as parameters.	Attempted to select >8 signals as parameters.	Deselect some signals, then select others.
No parameter selected	Attempted to acquire data before selecting parameters.	Select parameters first.
<your sample name>: not allowed for name	Entered invalid sample name.	Enter another name.

Table 7.1-2 Error Messages *(Continued)*

Message	Cause/Symptom	Action
No valid histogram files were found	• Specified wrong path • No directory files.	Specify correct directories on Utilities Configuration screen and/or from File menu, select **Rebuild**.
No valid listmode files were found		
No valid protocol files were found		
Parameters are not present	Parameters missing from protocol.	Recreate protocol.
Printer busy	Printer busy.	Check Printer for error message and/or wait and/or at Computer Workstation, turn instrument off, then back on.
Printer error	Printer out of order.	Check Printer for error message and/or at Computer Workstation, turn instrument off, then back on.
Printer not ready	Printer not on-line.	Put Printer on-line, check Printer for error message and/or at Computer Workstation, turn instrument off, then back on.
Printer out of paper	Printer paper tray empty.	Add paper.
Protocol not valid	Created invalid protocol.	Create another protocol.
Quadstat regions not allowed in this equation	Created quadstat region in one-parameter histogram.	Create quad-stat region in two-parameter histogram.
RAM memory is full	Listmode file too large.	Begin again with a smaller file or upgrade RAM.
Region already erased	Attempted erasing non-existent region.	Check cursor mode.
Region undefined. May only edit defined regions.	Attempted editing unspecified region.	Create region before editing.
Replay Not Active	You pressed F10 during Listmode data analysis, but were not acquiring data.	None.
Sample Pressure Error	Broken sample tube.	Put sample in another sample tube.
	Sample probe guide damaged.	Replace sample head (see Special Procedures and Troubleshooting manual).
Sample pressure warning	Defective sample tube **not** pressurizing.	Put sample in another sample tube.
Sample Tube Error	**Cannot** run cleanse cycle with tube on sample stage.	Remove sample tube from sample stage.
Selected Region is not in specified histogram	Selected region not part of a histogram.	Select another histogram or region.
Selected signal cannot be a CALCULATED parameter	As CALCULATED parameters, RATIO or TIME cannot be selected as numerator/denominator for RATIO parameter.	Select other signals.

Table 7.1-2 Error Messages *(Continued)*

Message	Cause/Symptom	Action
Selected signal must be a parameter	Selected signal that is not a parameter to numerator/denominator for RATIO parameter.	First select signal as parameter.
Selection, edit or erase of ratio not allowed under listmode	Attempted selecting, editing, or erasing RATIO parameter during Listmode data analysis.	None.
Selection or erase of signals not allowed under listmode	Attempted selecting or erasing parameters during Listmode data analysis.	
Sensor data stream error	Data acquisition hardware error.	Replace System Interface card and reboot.
Sensors stream warning		
Set sample pressure fail	Cytometer communication error.	At Computer Workstation, turn instrument off, then back on.
Sheath Drawer Error *Sheath drawer warning*	Reagent drawer open.	Close reagent drawer completely.
Sheath Level Error	Low sheath fluid.	Fill sheath container.
Sheath level warning	Sheath sensor failed.	Replace sheath sensor or sheath tank.
Sheath Pressure Error	Connectors on sheath container loose.	Tighten connectors.
Sheath pressure warning		
	Cap on sheath container loose	Tighten cap.
Signal is not used as a parameter	Signal **not** used /**already** used as parameter.	Check cursor mode and select another signal.
Signal is already used as a parameter		
Skipping a queued file due to error	File format invalid.	From File menu, select **Rebuild**.
Skipping queued file <your file name> due to error	Named file invalid.	
Software failure	Cytometer software error.	At Computer Workstation, turn instrument off, then back on.
State machine failure	Cytometer software failure.	
System pressure error *System pressure warning*	Low pressure.	Verify: 1. WATER TRAP on front of Power Supply module secure. 2. Blue connectors on back of Power Supply module and Cytometer secure, attached hose intact.

Table 7.1-2 Error Messages *(Continued)*

Message	Cause/Symptom	Action
System vacuum error *System vacuum warning*	• Vacuum low • VAC TRAP loose or full • Bad vacuum hose.	Verify: 1. VAC TRAP (on front of Power Supply module) secure with <0.5 in. fluid. If it has more, empty it (see Special Procedures and Troubleshooting manual). 2. Hose attached to yellow connectors on back of Power Supply module and Cytometer intact.
System vacuum error *System vacuum warning*	VAC FILTER clogged.	Replace the vacuum filter.
Temperature error	Temperature inside Cytometer too high.	1. Ensure fan filter at back of instrument is operating properly. If not, replace. 2. Replace System Interface card. 3. Ensure laser cooling fans are operating properly. If not, replace.
Temperature sensor failure	No change in temperature reading.	
Temperature warning	Temperature inside Cytometer too high.	
TERMINAL ERROR IN System! Press the Enter *key to exit program*	Hardware failure.	At Computer Workstation, turn instrument off, then back on.
There are no saved key strokes to write to disk	Attempted saving a macro, but there is nothing to save.	Create macro again.
There are presently no saved files to process	**Select item** selected from File menu, no files found.	Specify correct directories on Utilities Configuration screen and/or from File menu, select **Rebuild**.
There is no acquisition data to print	Attempted printing a histogram before acquiring data.	Acquire data first.
There is presently no panel file to process	No panel files available.	Specify correct directories on Utilities Configuration screen and/or from File menu, select **Rebuild**.
Transputer1 error *Transputer2 error*	Cytometer software error.	At Computer Workstation, turn instrument off, then back on.
Transputer link error		
Unable to autogate	• Not enough data points inside gate • Unable to identify distinct population.	Run sample again and/or redraw region.
Unable to find/open the protocol file	File deleted.	Recreate protocol and/or specify correct directories on Utilities Configuration screen and/or from File menu, select **Rebuild**.
Unable to find the listmode file	Software **cannot** access Listmode file.	From File menu, select **Rebuild**.

Table 7.1-2 Error Messages *(Continued)*

Message	Cause/Symptom	Action
Unable to find the panel info	• You pressed Esc or F2 during panel selection • Panel file cannot be found.	Select panel again and/or specify correct directories on Utilities Configuration screen.
Unable to get the specified Cytometer state	Cytometer failed.	Replace fiber optic cable.
Unable to load current panel	Panel file corrupted, **cannot** be opened.	Select another panel.
Unable to open file for processing	File load error.	Specify correct directories on Utilities Configuration screen and/or from File menu, select **Rebuild**.
Unable to open listmode work file	Specified wrong path.	Specify correct directories on Utilities Configuration screen.
	Disk full.	Use Archive on Data Management screen to free up disk space.
Unable to reset Cytometer--reboot	Cytometer not resetting using RESET button.	At Computer Workstation, turn instrument off, then back on.
Unable to save protocol file	Specified wrong path.	Specify the correct directories on Utilities Configuration screen.
	Disk full.	Use Archive on Data Management screen and free up disk space.
Unable to set Cytometer in the READY to ACQUIRE state	Cytometer failed.	Reset circuit breakers (see Special Procedures and Troubleshooting manual).
Unknown data stream error *Unknown data stream warning*	Data acquisition hardware error.	Replace Trans Data Acquisition card.
>>>> Unknown error <<<<	System unable to program Cytometer.	At Computer Workstation, turn instrument off, then back on.
Unknown region type. Call for service.	Program error.	
Vacuum chamber error	Waste in vacuum chamber.	Replace level sensor.
Vacuum chamber warning	Defective sensor.	
VDI display device driver not loaded properly.	No GSS/VDI graphics loaded.	Put software program diskette in drive a: At the a:\ prompt, type `install`.
Warning: Less than 4 megabyte of disk space available	<4 MB free on hard disk.	Use Archive on Data Management screen to free up disk space.
Warning: Less than 1 megabyte of disk space available	<1 MB free on hard disk.	
Warning: No valid histograms were noted	• A protocol without histograms created • Histograms created that do not match gates created.	Create another protocol.
Warning: No valid signals were noted	Protocol (in Listmode data analysis) does not match signal.	Create or select another Listmode file.

Table 7.1-2 Error Messages *(Continued)*

Message	Cause/Symptom	Action
Waste backpressure err	Air filter or its vent tubing clogged	Bypass clogged air filter (front of Power Supply module) or vent tubing (above filter) by disconnecting connector underneath FILTER. (Vent tubing vented to air.)
	Vent line not connected.	On back of Power Supply module, check that green connector is secure.
Waste level error	Waste container full.	Empty waste container.
Waste level warning	Waste sensor failed.	Replace waste tubing harness.
x and y channel count exceeded 65535	Count too high when calculating projection.	Rerun sample.
x channel count exceeded 65535		
y channel count exceeded 65535		
You cannot delete the next use entry	Deleting the protocol assigned next was attempted.	Reassign next, delete protocol.
You cannot deselect the next use entry	Deselecting the protocol assigned next was attempted.	Reassign next, deselect protocol.
You may not make a deleted or errored entry as next	Assigning a deleted or corrupted protocol as next was attempted.	Reassign next.

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