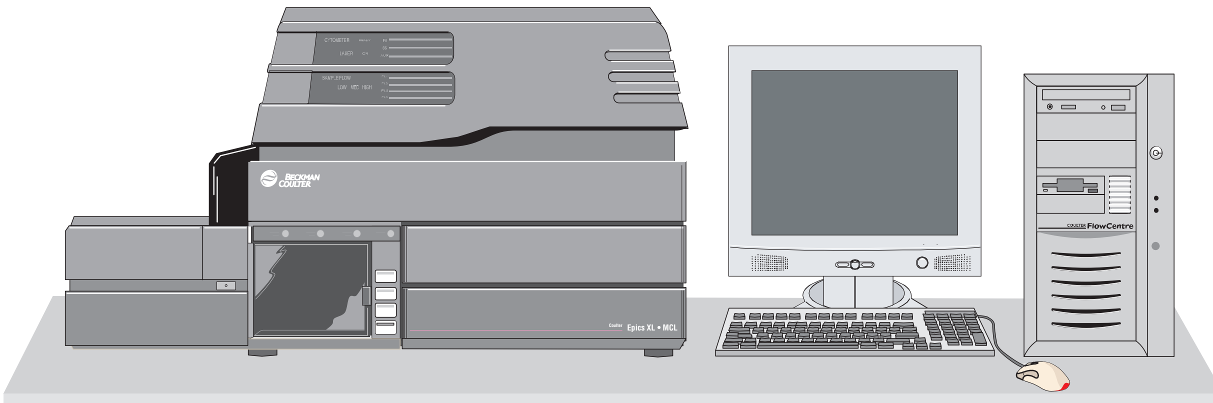
COULTER® EPICS® XL™ Flow Cytometer
COULTER® EPICS® XL-MCL™ Flow Cytometer

Service Manual



PN 4237029F (October 2002)

Beckman Coulter, Inc.
Fullerton, CA 92835

BECKMAN COULTER™

WARNINGS AND PRECAUTIONS

Beckman Coulter, Inc. makes no representation that, upon furnishing this service manual, the holder of the manual will have the necessary technical capabilities and know-how to properly troubleshoot and repair any of the equipment specified in the manual. Beckman Coulter, Inc. assumes no liability whatsoever, including consequential and incidental damages, resulting from improper operation of Beckman Coulter instruments after maintenance of Beckman Coulter instruments has been performed by persons not employed by Beckman Coulter, Inc. Furthermore, Beckman Coulter, Inc. assumes no liability whatsoever for any personal injury or property damage resulting from maintenance and/or repair of Beckman Coulter instruments performed by persons not employed by Beckman Coulter, Inc.

READ ALL PRODUCT MANUALS AND CONSULT WITH BECKMAN COULTER-TRAINED PERSONNEL BEFORE ATTEMPTING TO OPERATE INSTRUMENT.

HAZARDS AND OPERATIONAL PRECAUTIONS AND LIMITATIONS

WARNINGS, CAUTIONS, and IMPORTANTS alert you as follows:

WARNING - Can cause injury.
CAUTION - Can cause damage to the instrument.
IMPORTANT - Can cause misleading results.

Beckman Coulter, Inc. urges its customers to comply with all national health and safety standards such as the use of barrier protection. This may include, but it is not limited to, protective eyewear, gloves, and suitable laboratory attire when operating or maintaining this or any other automated laboratory analyzer.

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.

Revision D, 3/98
Released by CN 306660-0561
Software Version 2.1.
Complete revision to update manual to software version 2.1 and reformat manual to new numbering system and style.

Revision E, 9/00
Released by CN 312810-0012
Software Versions: System II version 3.0
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
Released by CN 306660-0797
Software Versions:
SYSTEM II™ version 3.0
Prefinal version F
EXPO32™ ADC version 1.1
Complete revision that includes information released by Service Memos 1664, 1722, 1776, 1982, 3045, 3061, 3066, 3067, 3095, 3131 and Technical Updates TU2000M027 and TU2000M084.

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.

REVISION STATUS

ILLUSTRATIONS

TABLES

ILLUSTRATIONS

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

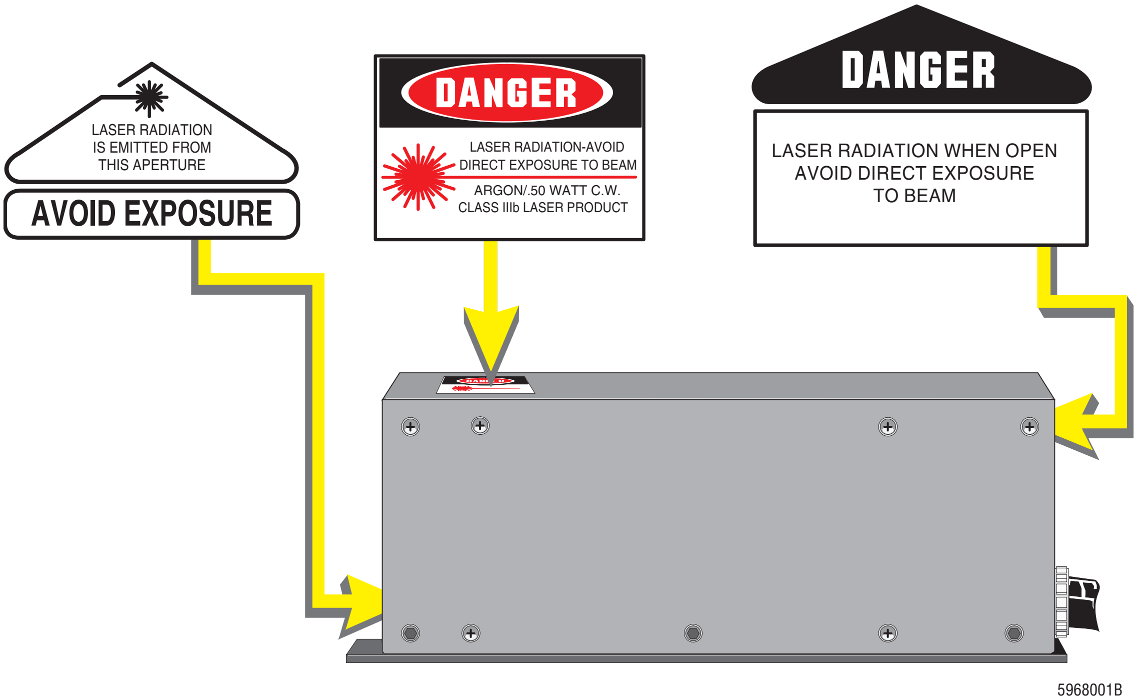


Figure 1.2-2 Laser Warning Labels - Cytometer, Sensing Compartment Cover

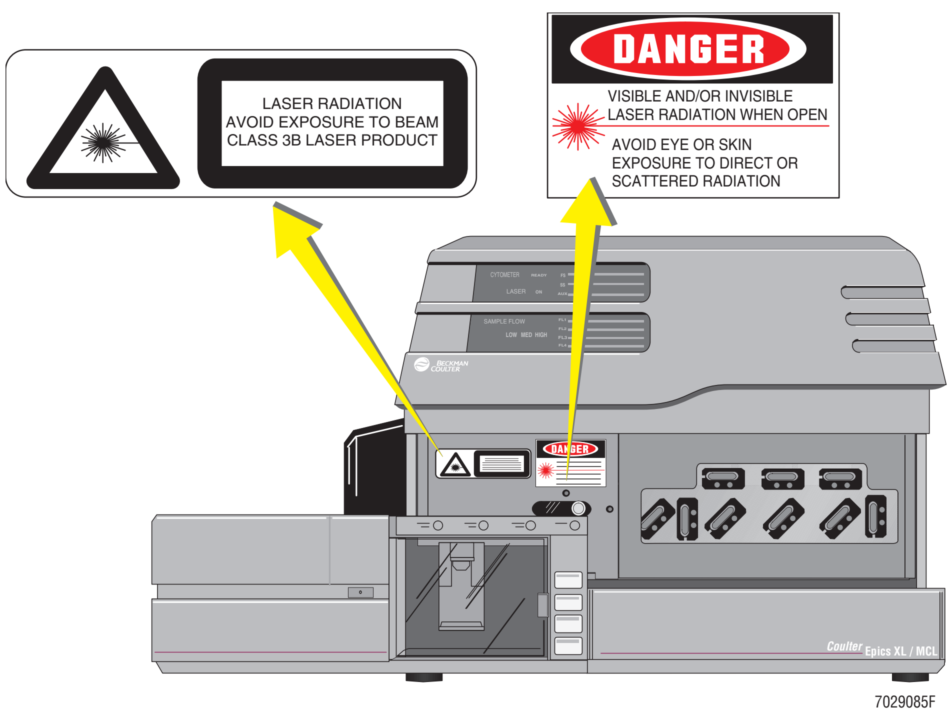
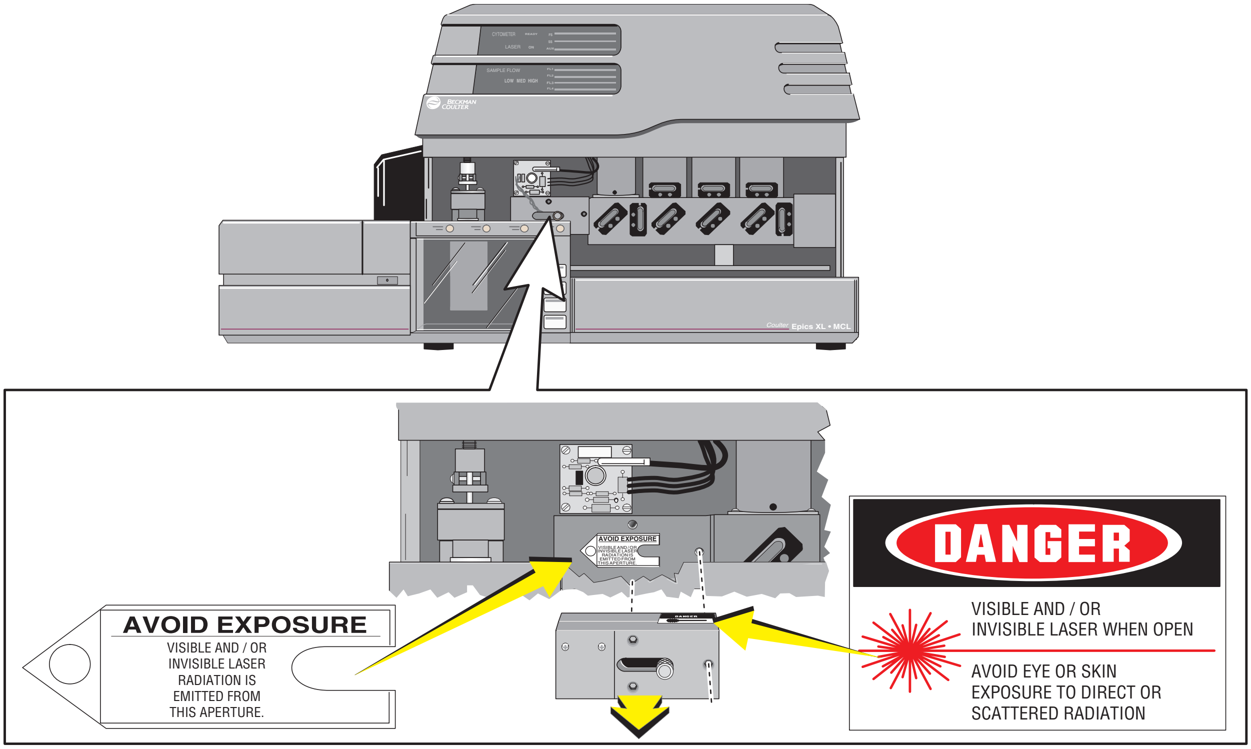
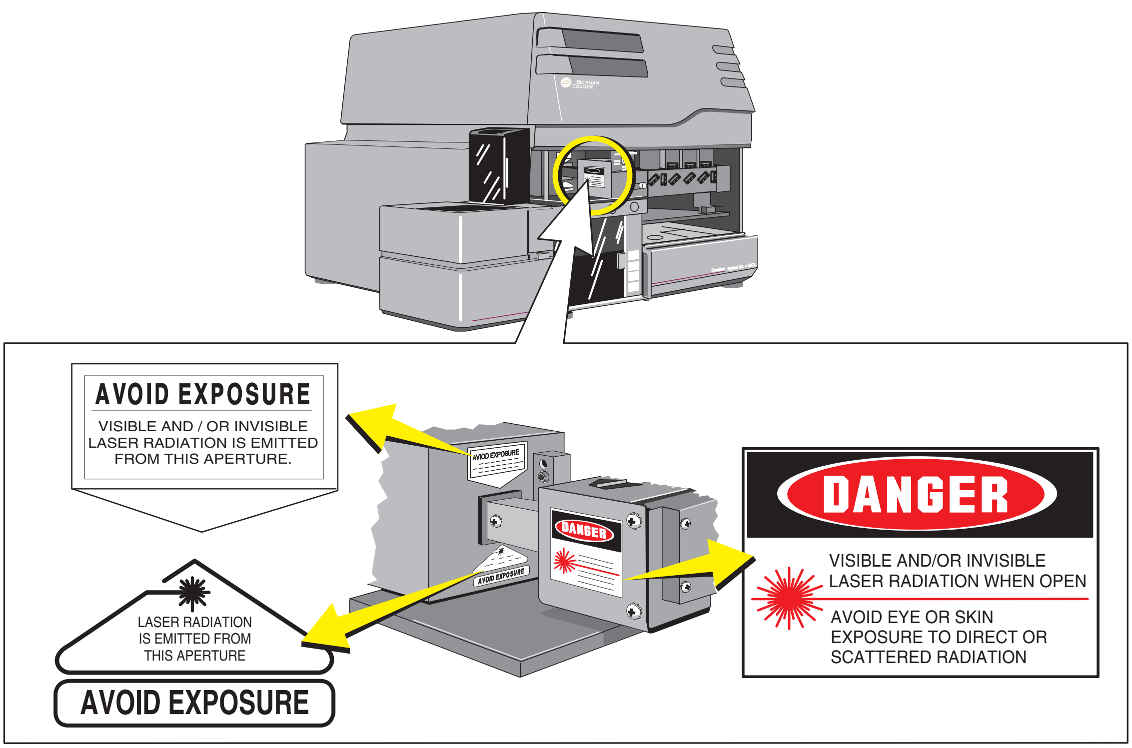


Figure 1.2-3 Laser Warning Labels - Cytometer, Optical Area, Front View



7029086F

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



7029087F

Figure 1.2-5 Laser Certification Label - Cytometer, Back

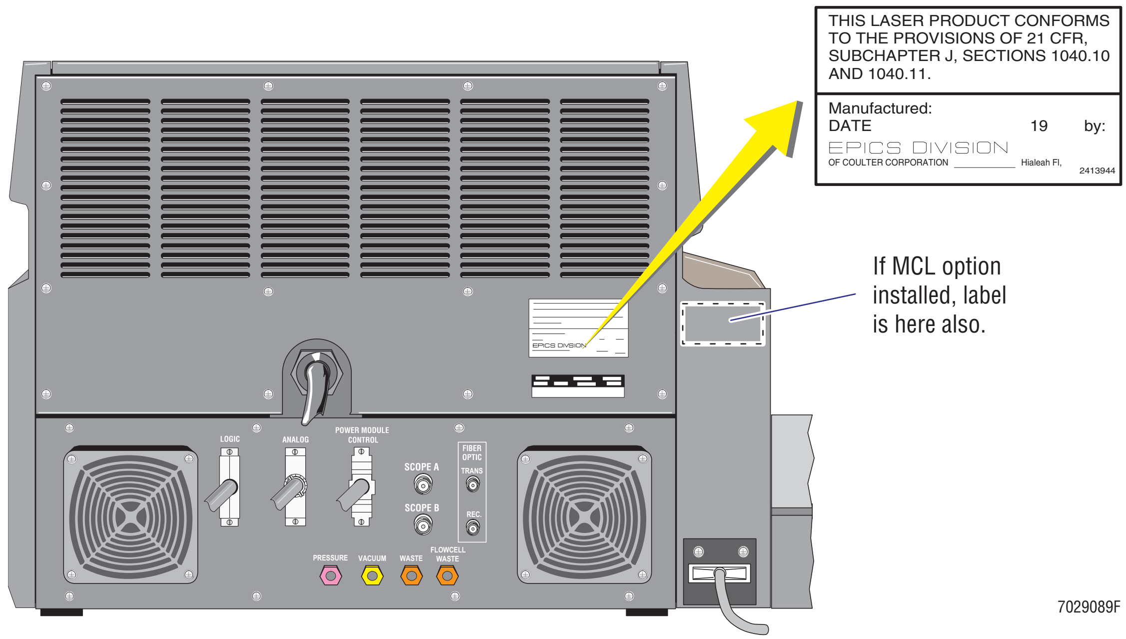


Figure 1.2-6 Laser Warning Labels - MCL Option, Probe Housing

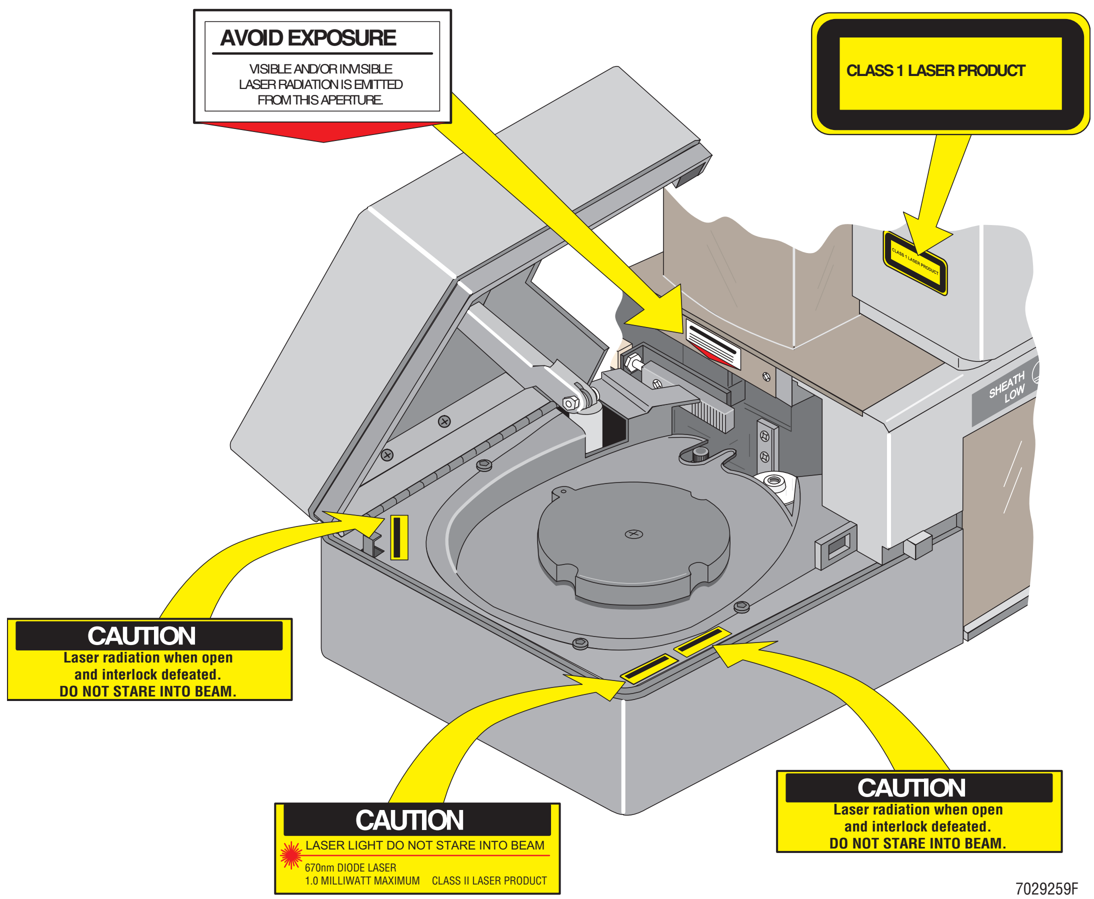
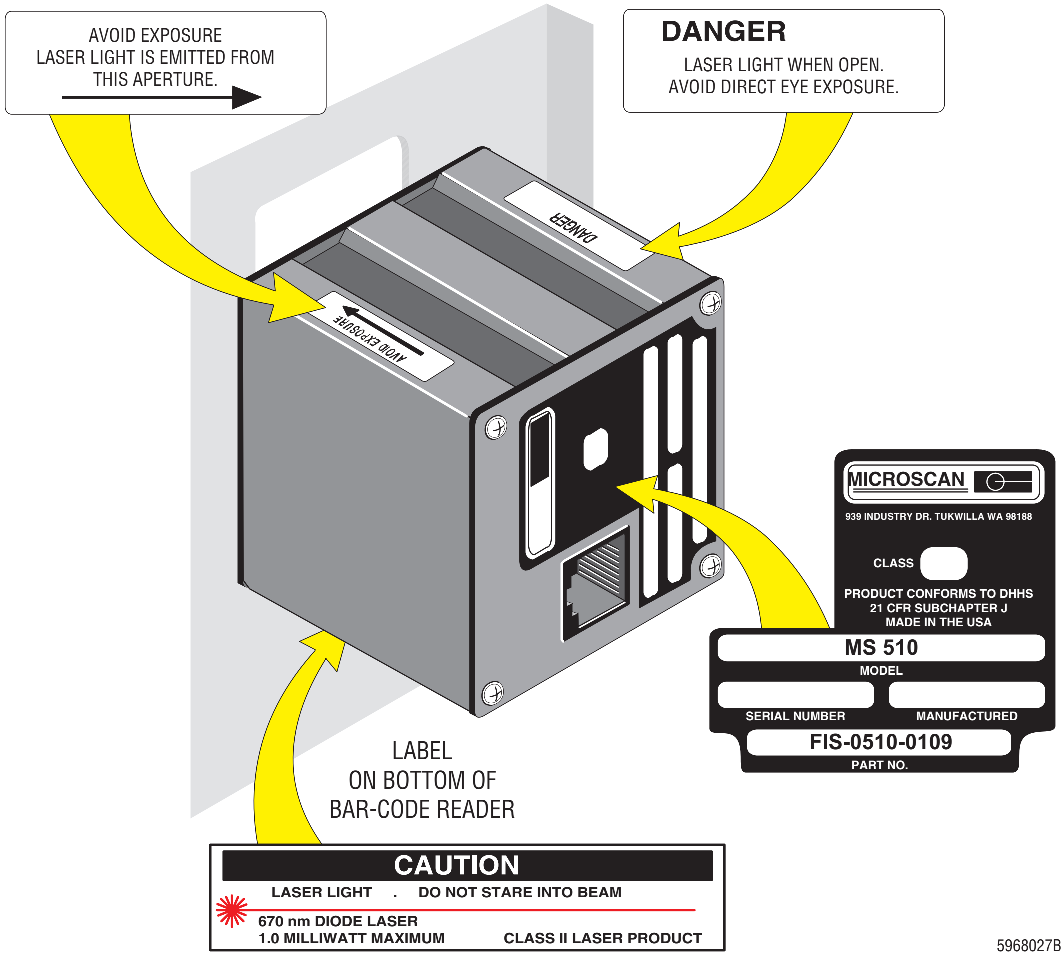


Figure 1.2-7 Laser Warning Labels - Bar-Code Scanner Option



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.

ILLUSTRATIONS

TABLES

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

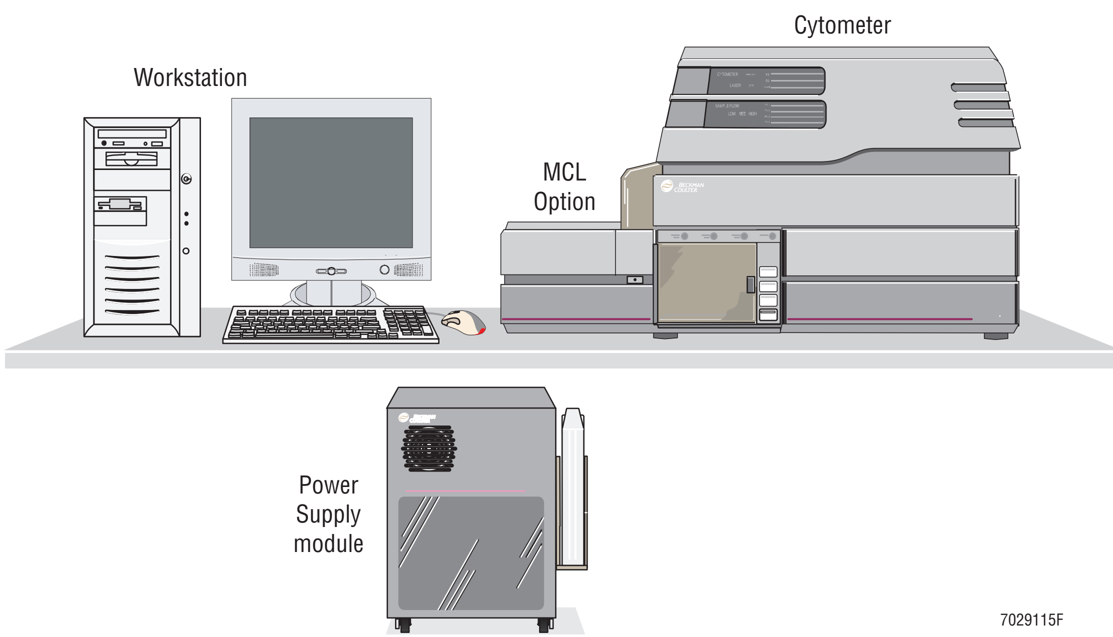
Stop on volume - 20 µL port fills when selected and the sample is pushed to the flow cell by the sheath.

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).

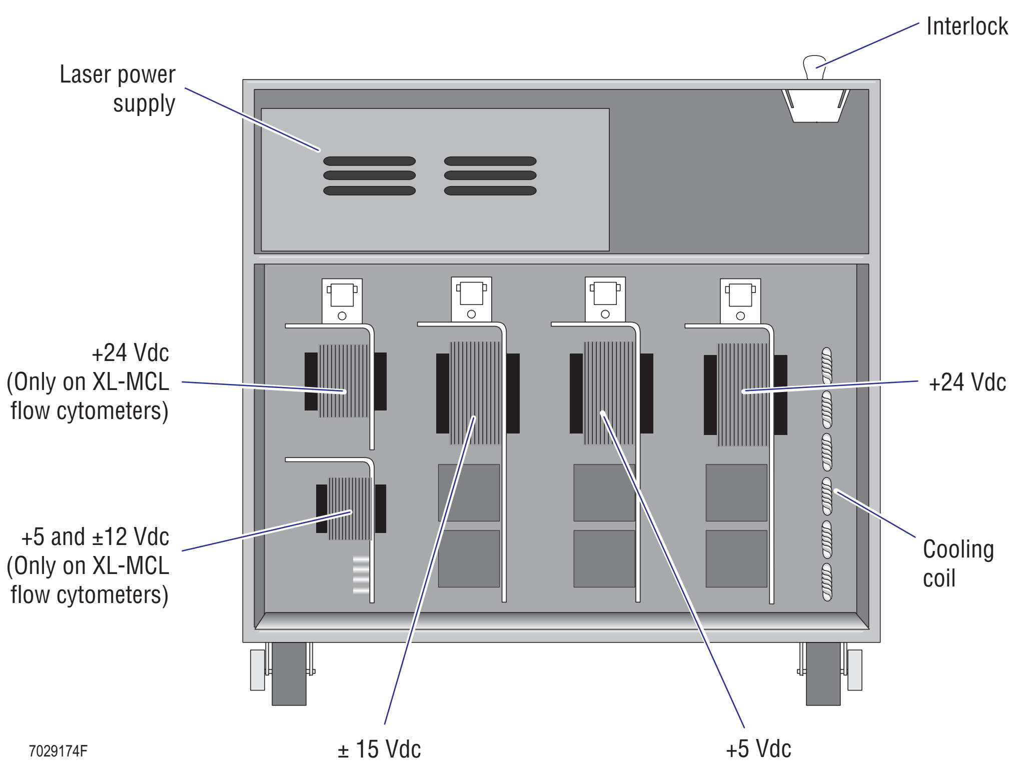
Power Supply Module

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

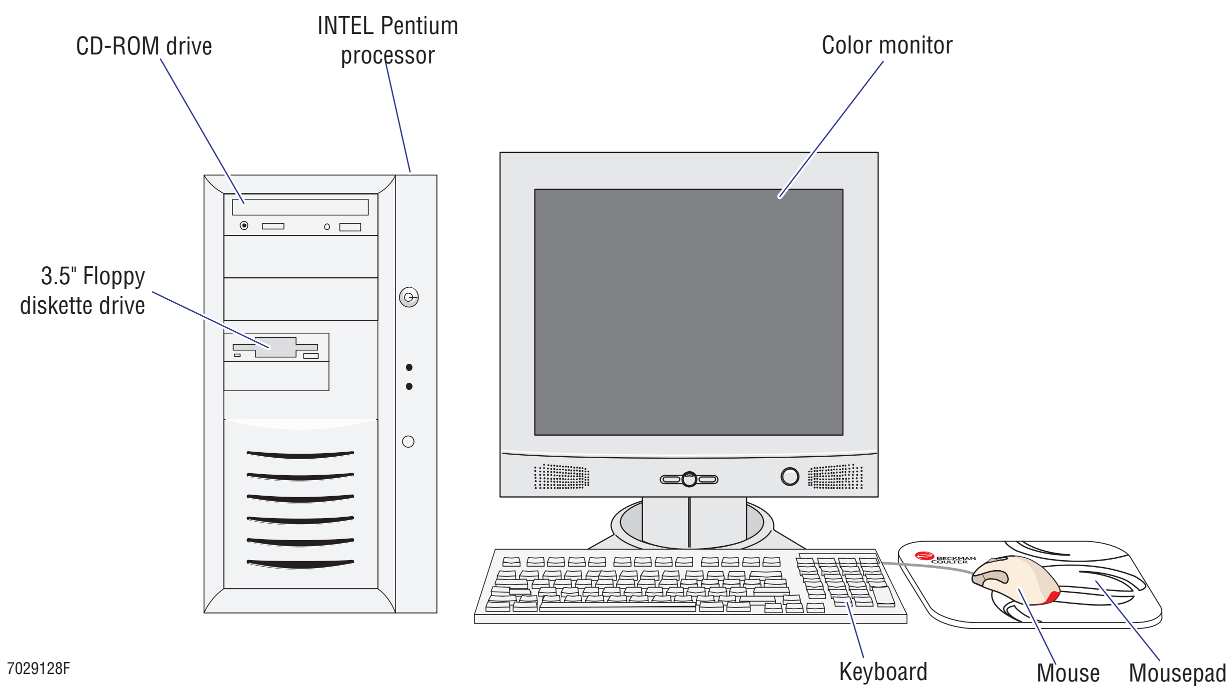


Computer Workstation

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.

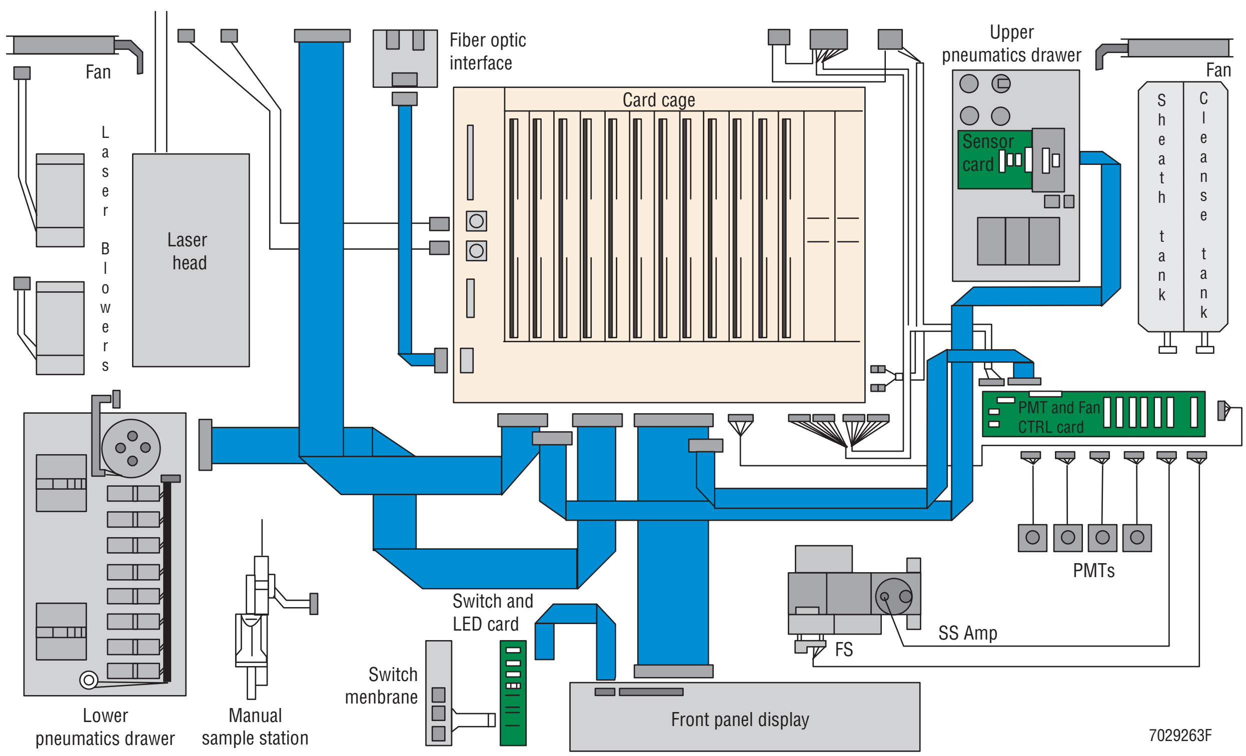
2.2 CYTOMETER

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

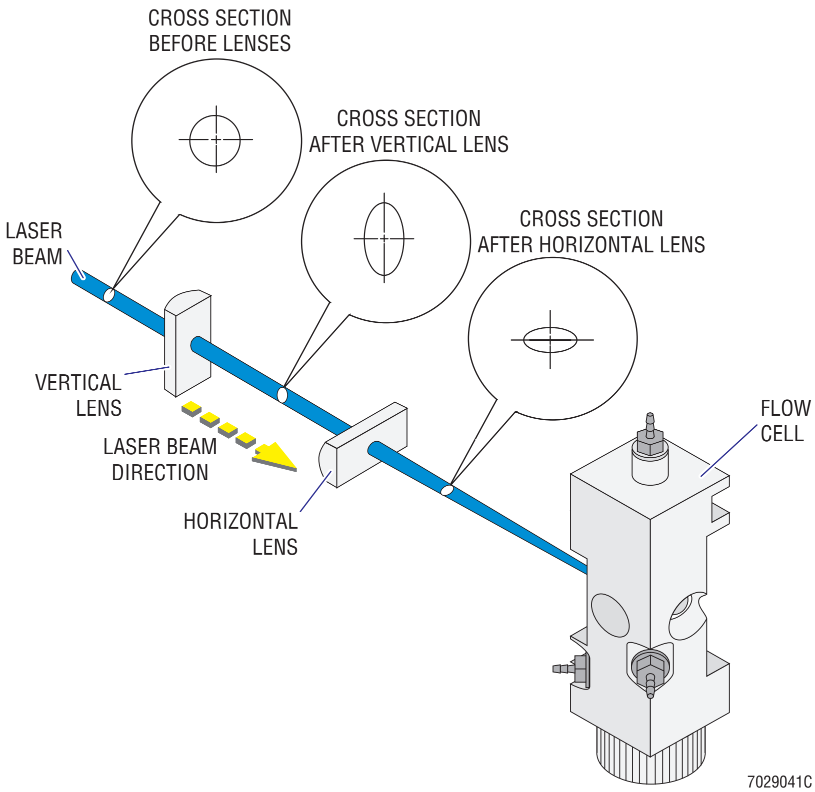


Optics

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.

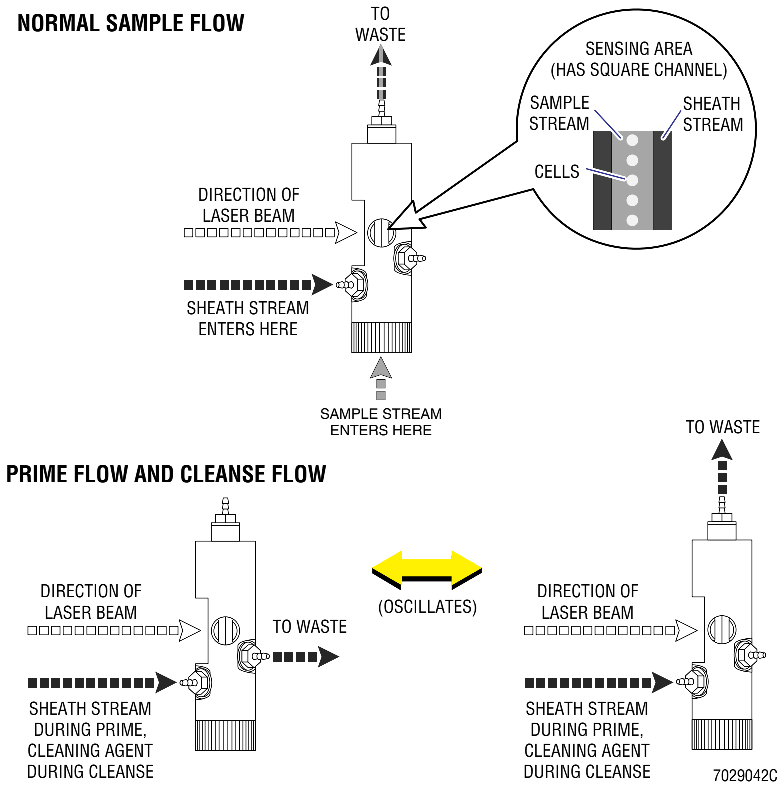
Flow Cell

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.

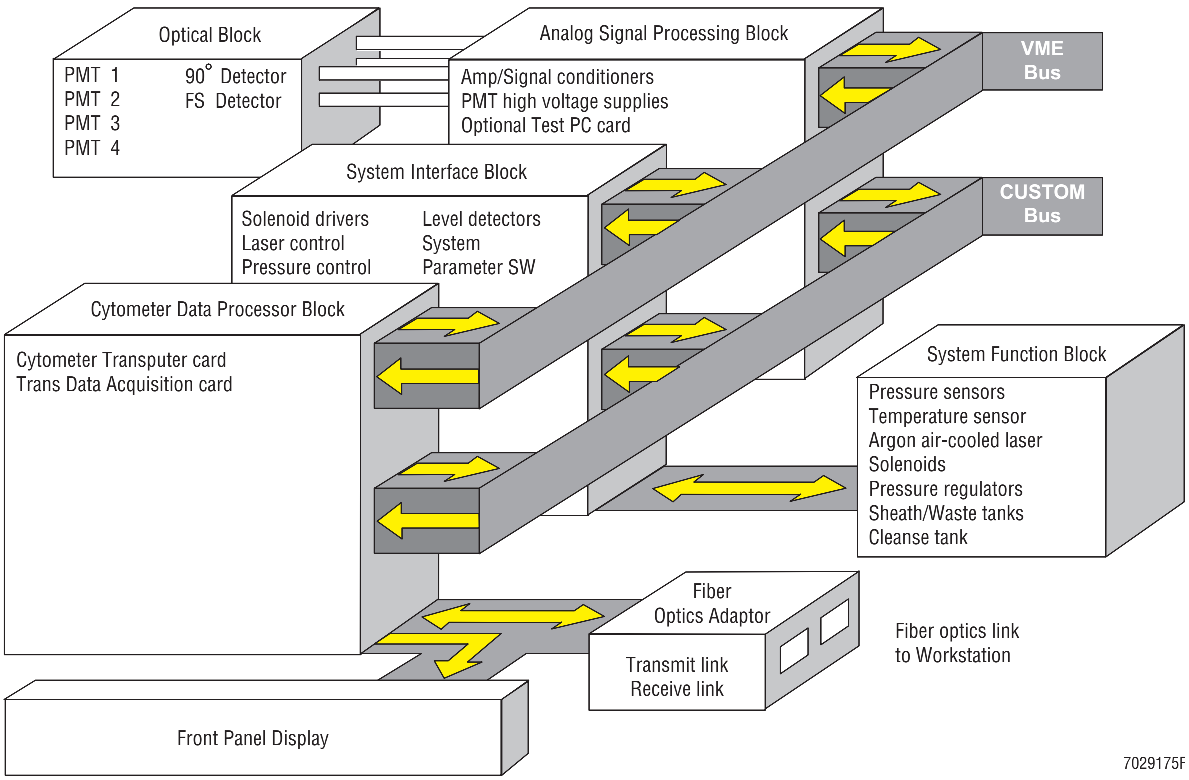
Data Acquisition Card Cage

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

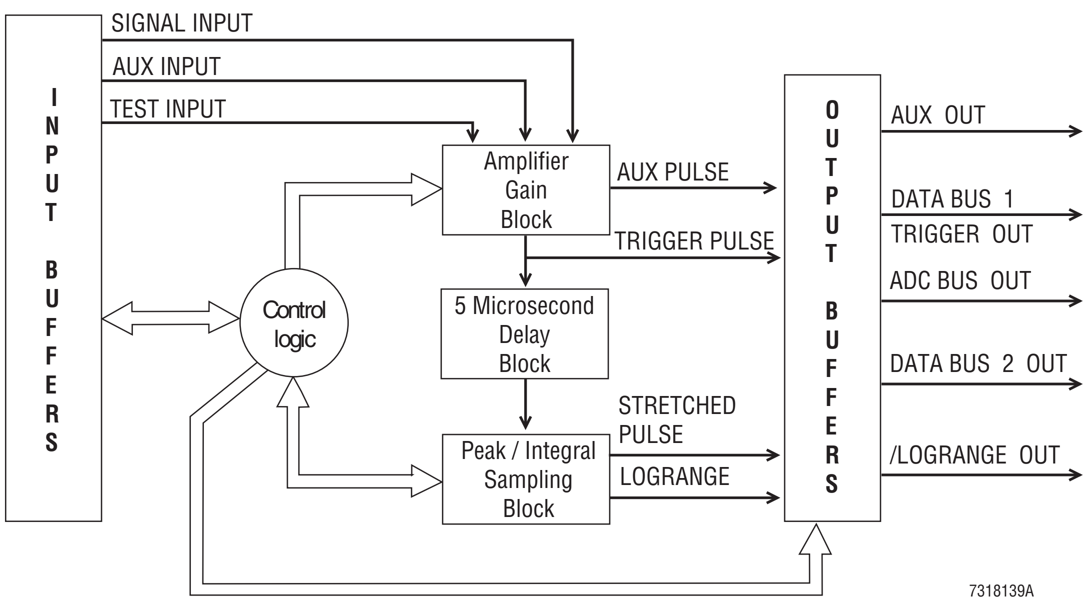
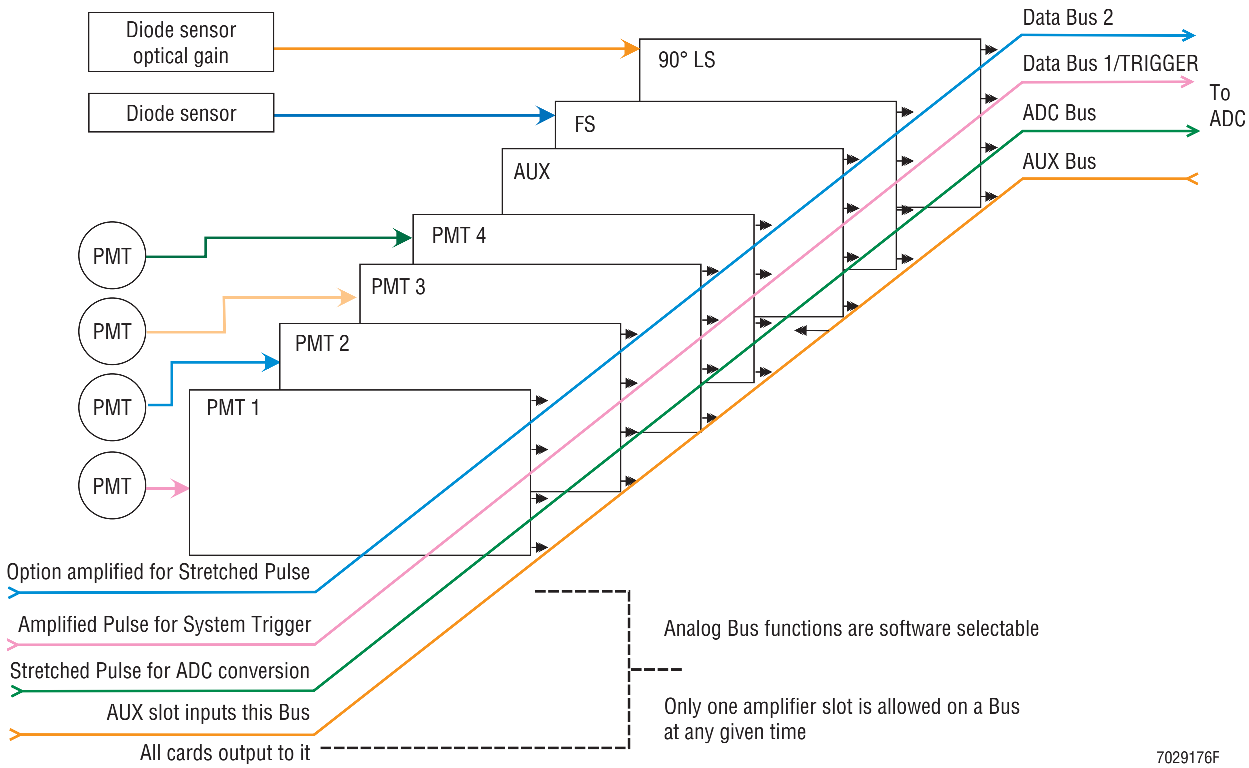


Figure 2.2-6 Amplifier Analog Bus Interface



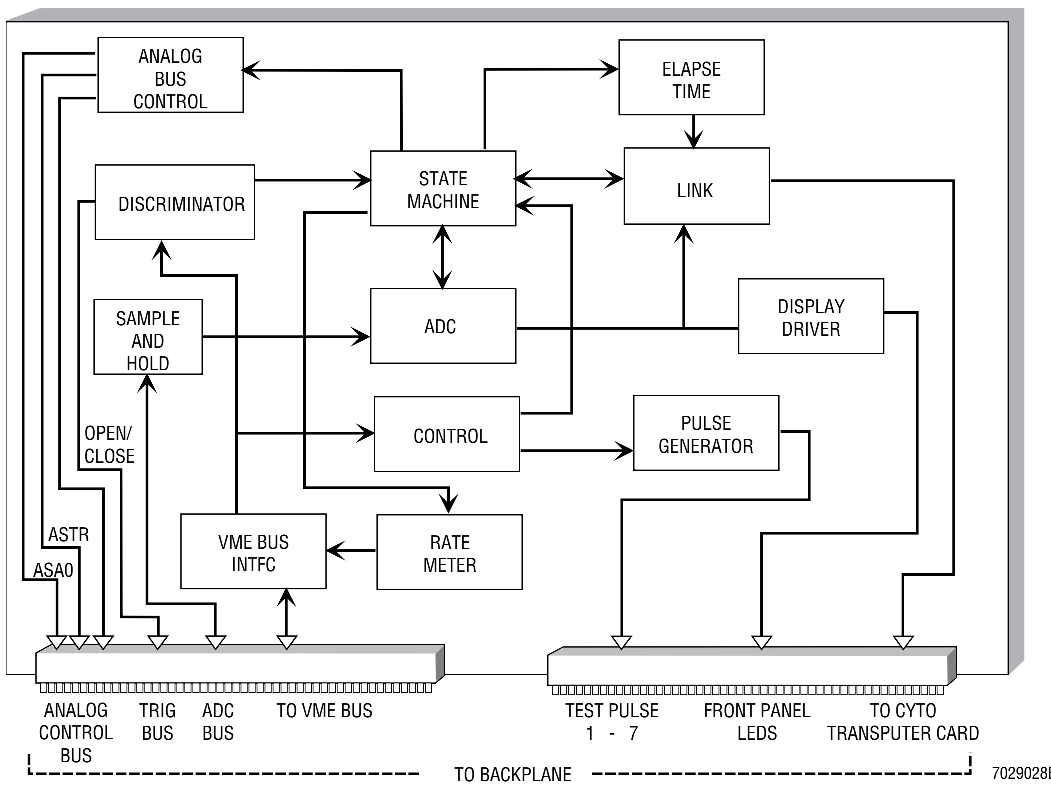
Also resident on the Amp/Signal Conditioner card are the control digital-to-analog converters (DACs) for the PMT HV power supplies. Each of the first four Amp/Signal Conditioner card slots on the Analyzer backplane is wired to one of the PMT HV power supplies. The card address for each card is obtained 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).

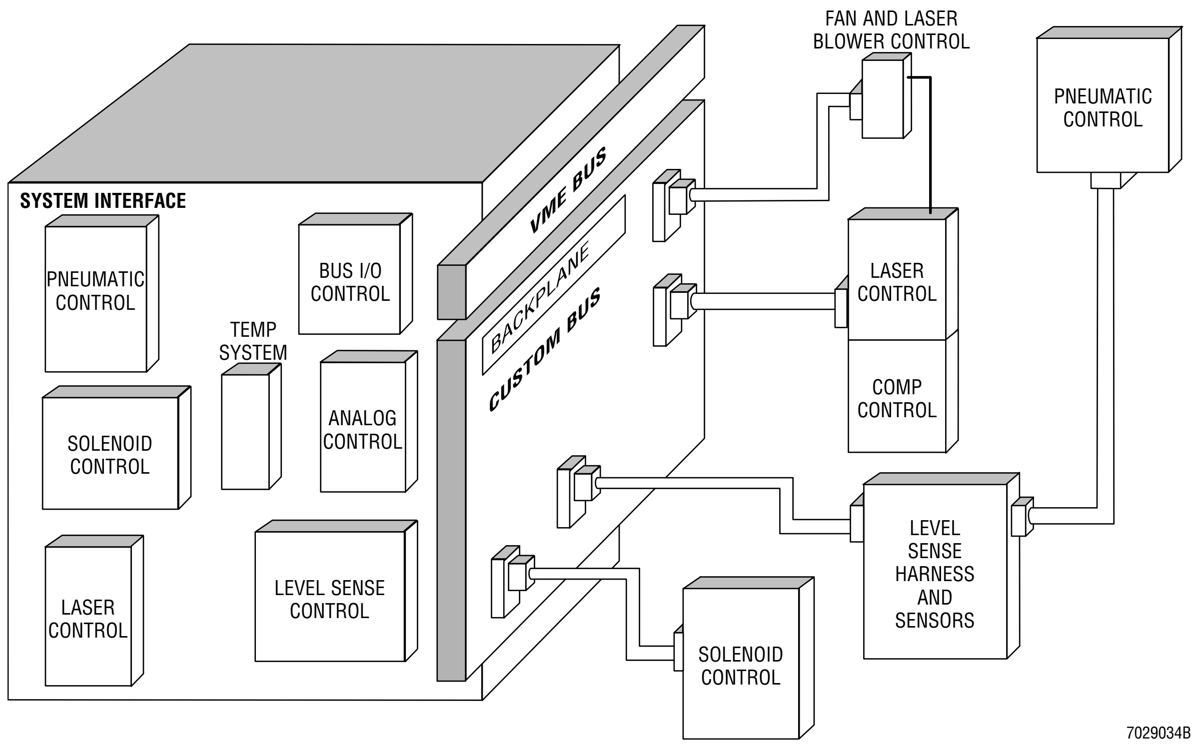
Figure 2.2-7 Trans Data Acquisition Card Block Diagram



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.

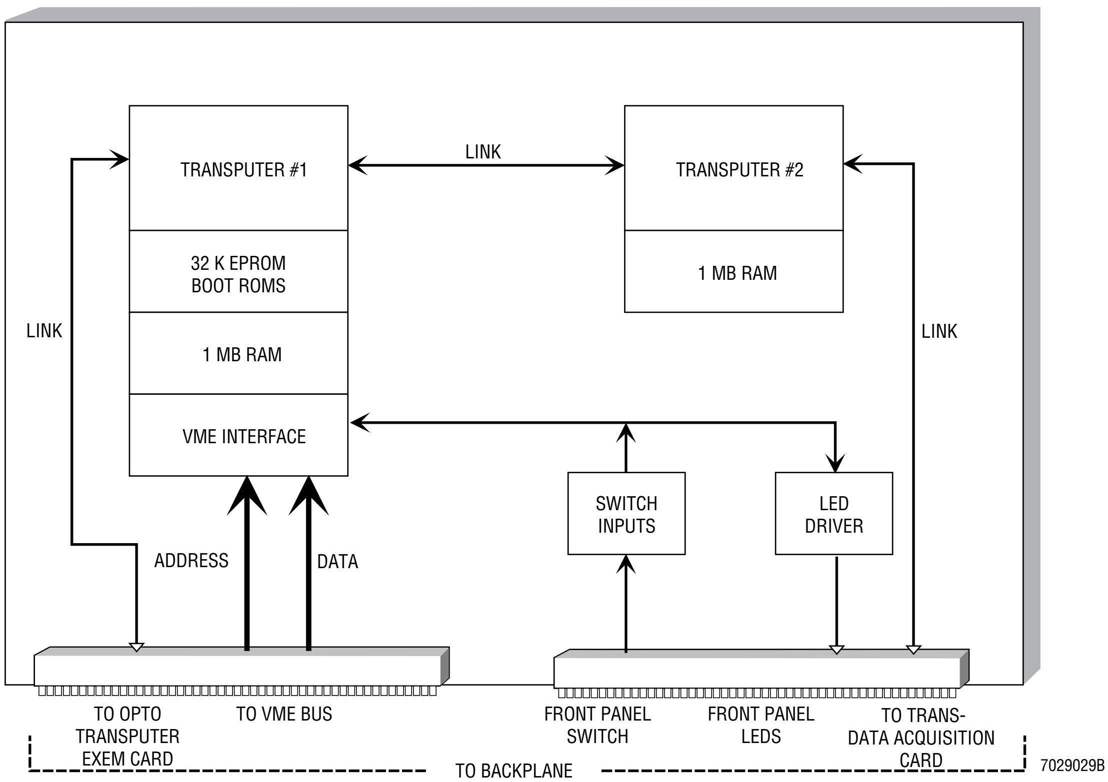
The laser is controlled by this card using a digital-to-analog converter to set a reference voltage. This digitally-controlled voltage is applied to the Laser Power supply and provides output light power. A similar circuit provides tube current.

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.

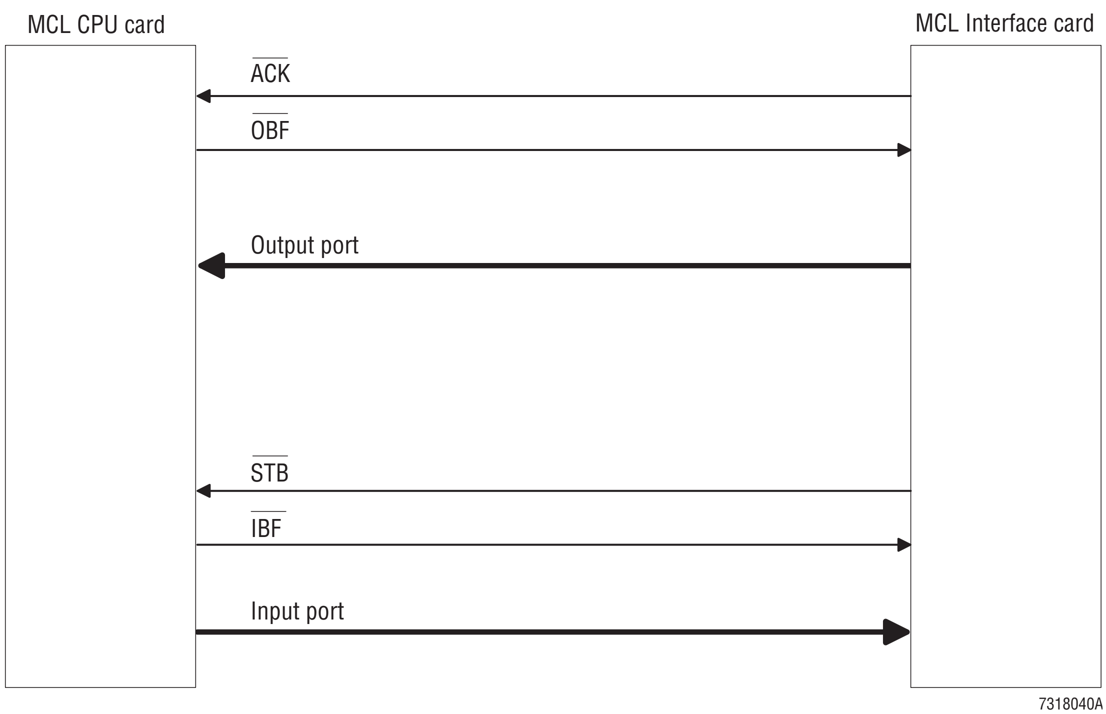
Communication with the Opto Transprocessor EXMEM card is via a high speed, serial, optical-fiber link.

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.

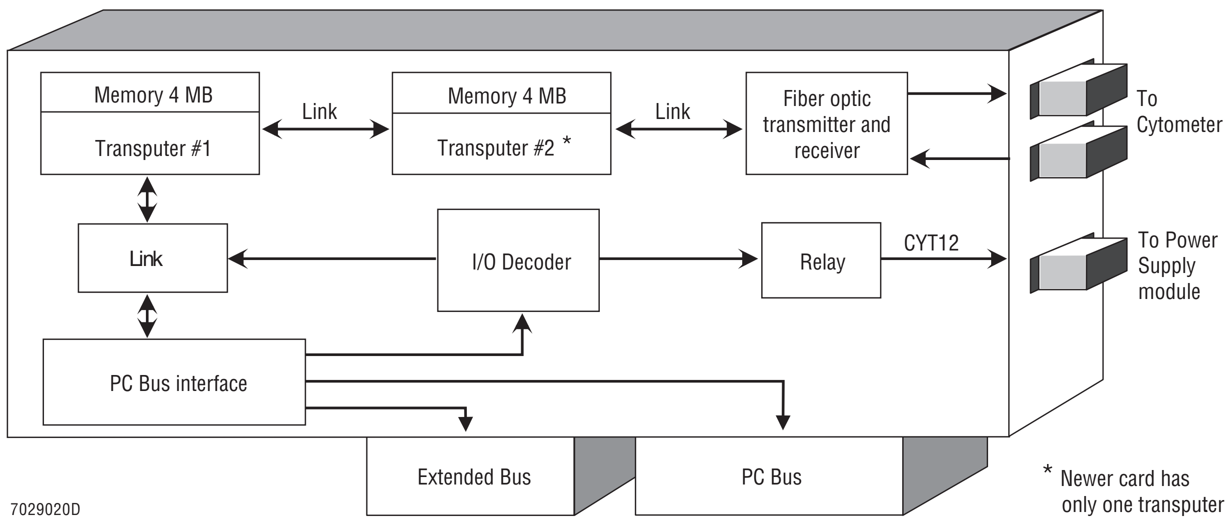
Optical Transprocessor Extended Memory Cards

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

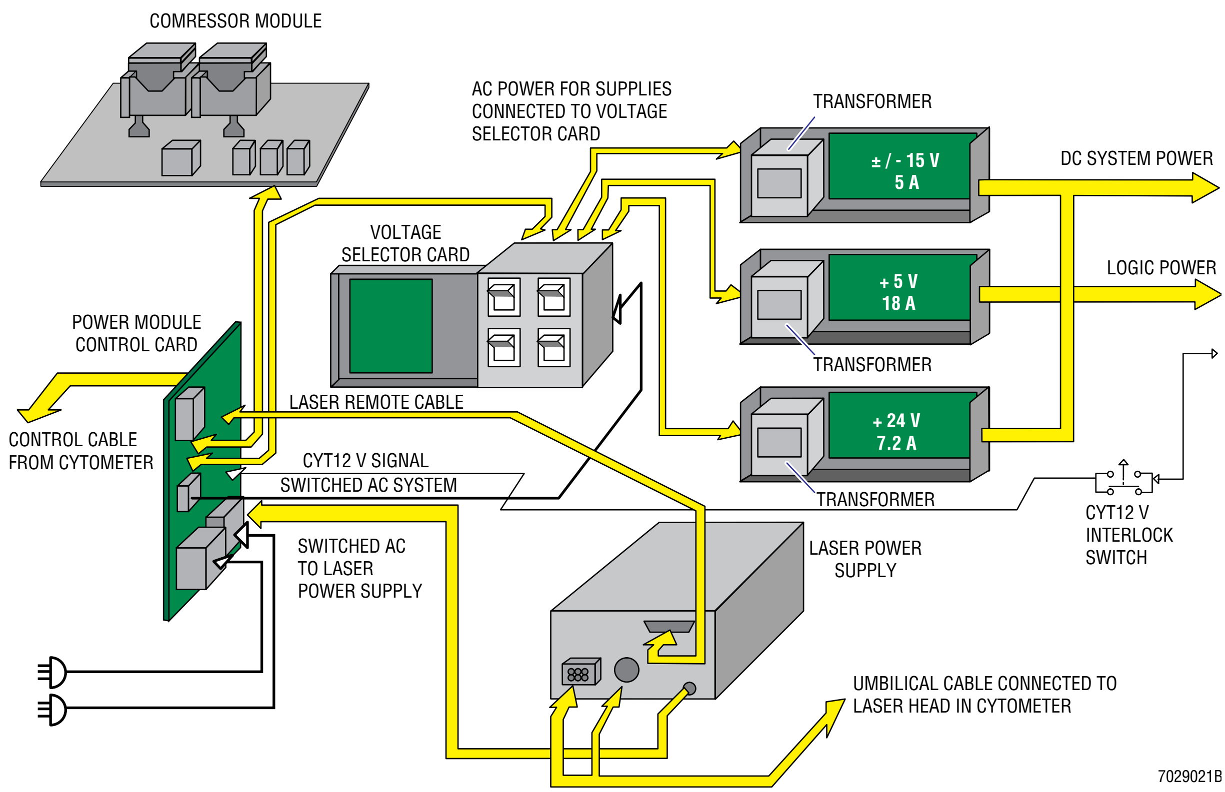
The Solenoid Power Distribution card (also referred to as the Solenoid Control card) is positioned above the other lower pneumatics drawer components. This circuit card provides the wiring interface for control of the solenoid valves from the analyzer backplane's System Interface card. For each solenoid 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

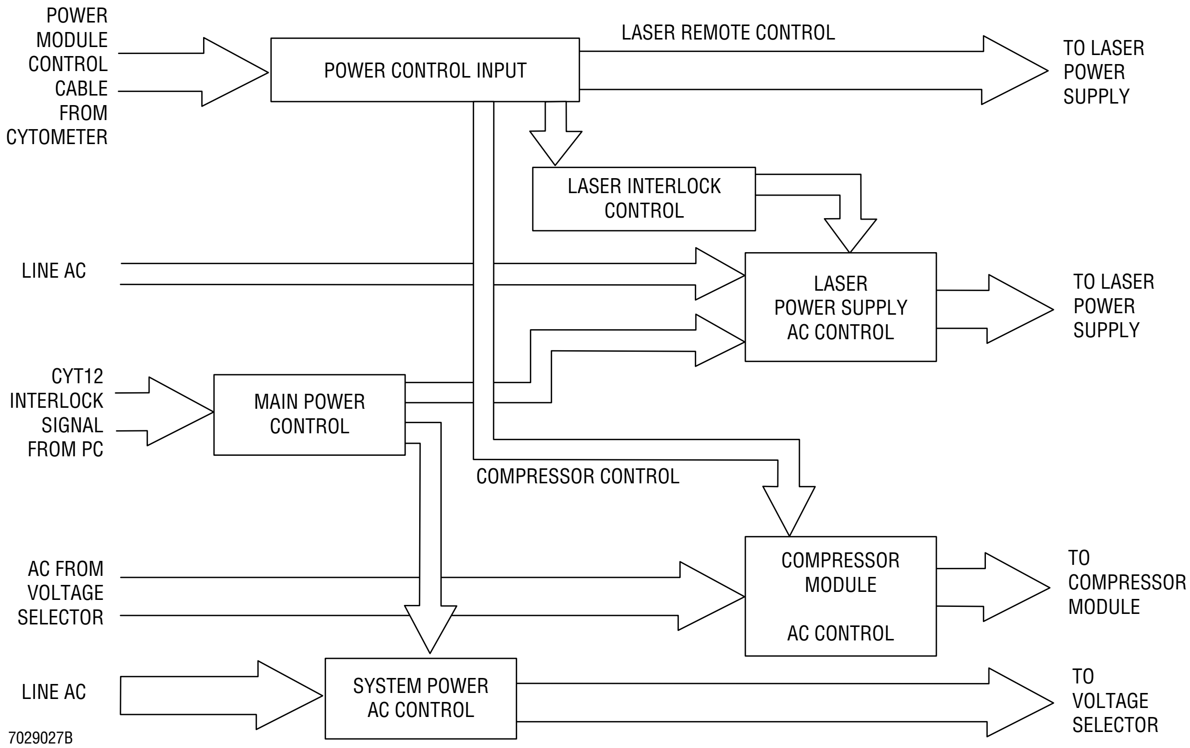


Figure 2.3-3 Power Supply Module - Front

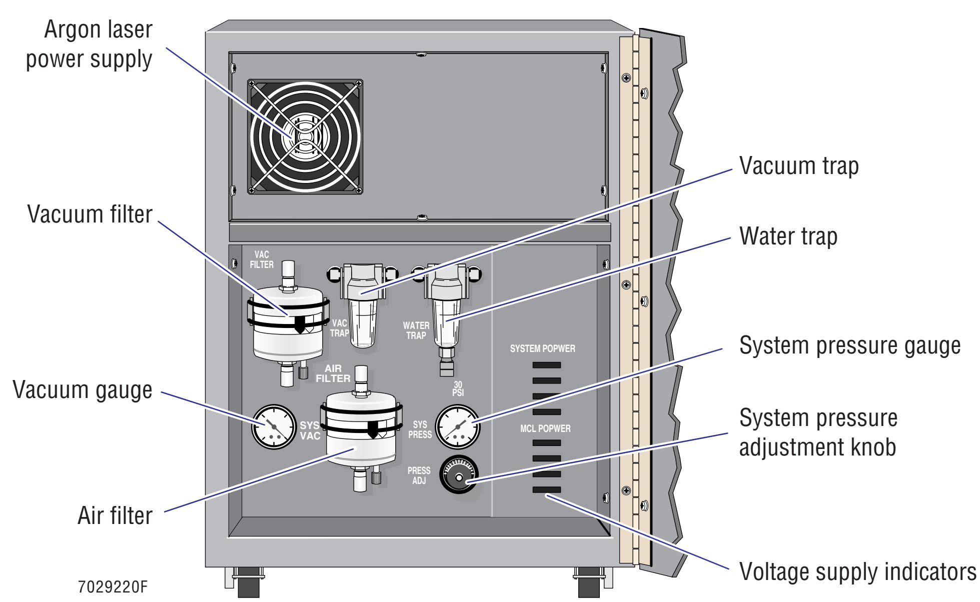


Figure 2.3-4 Power Supply Module - Rear

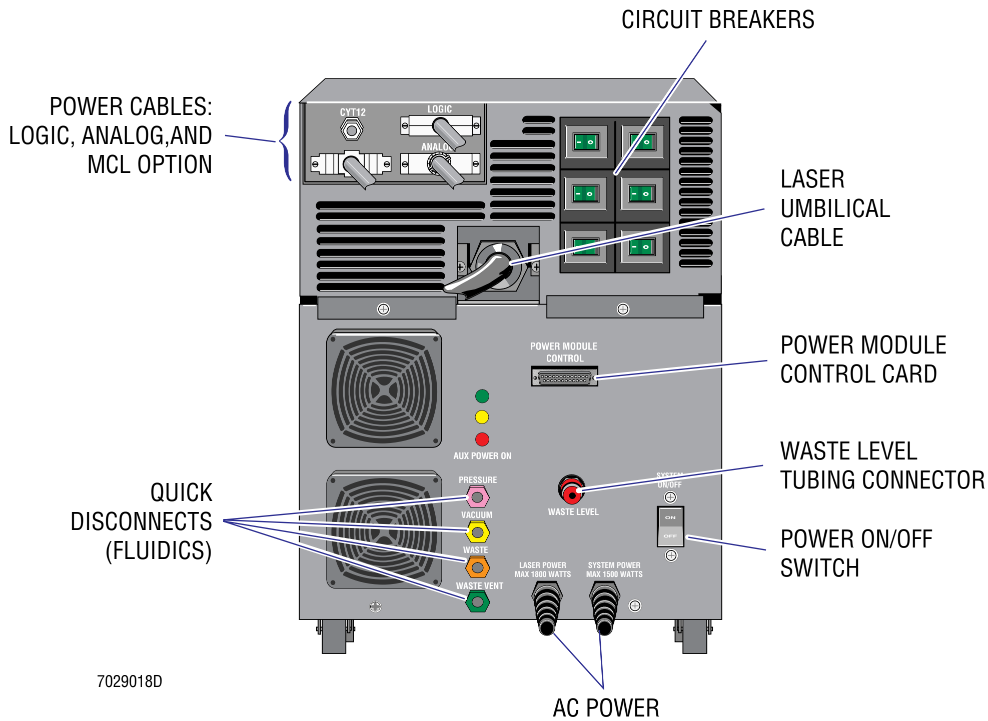
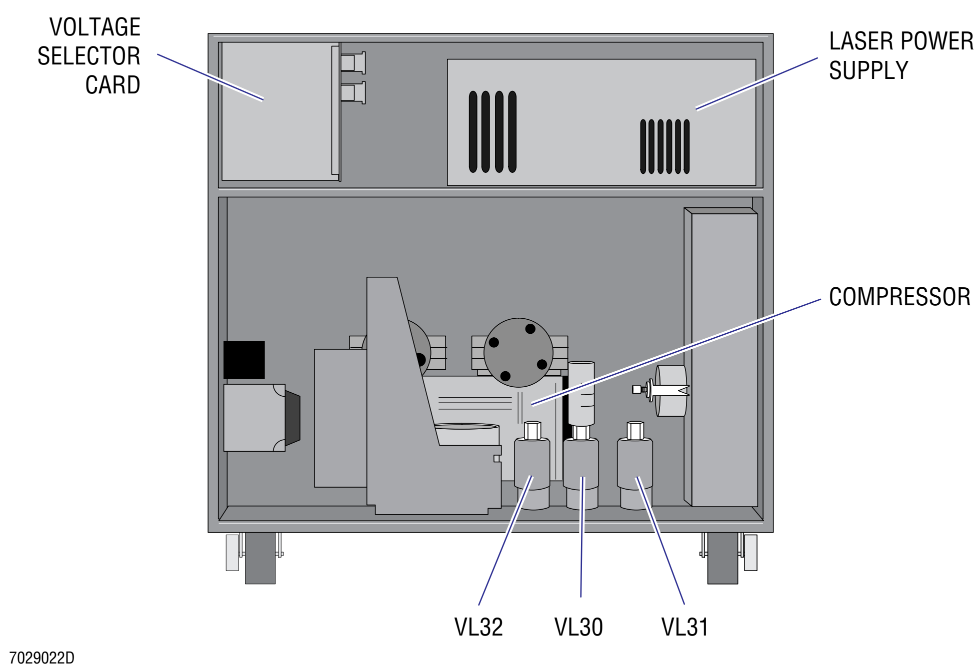


Figure 2.3-5 Power Supply Module - Left-Side View with Cover Removed

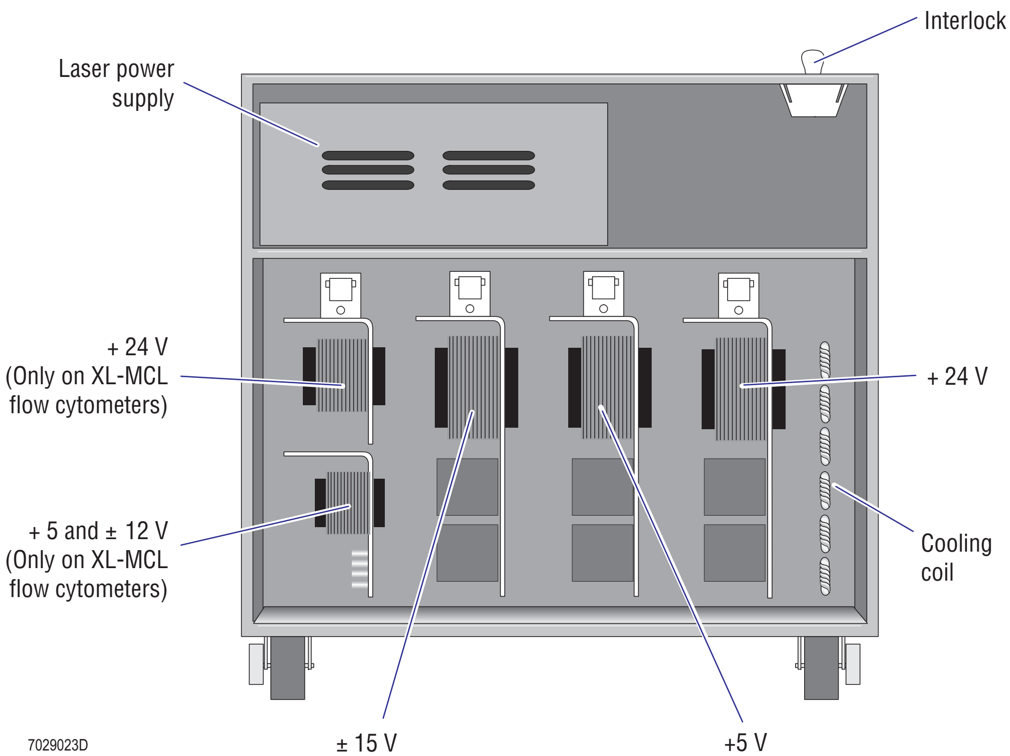


Linear Power Supply

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.

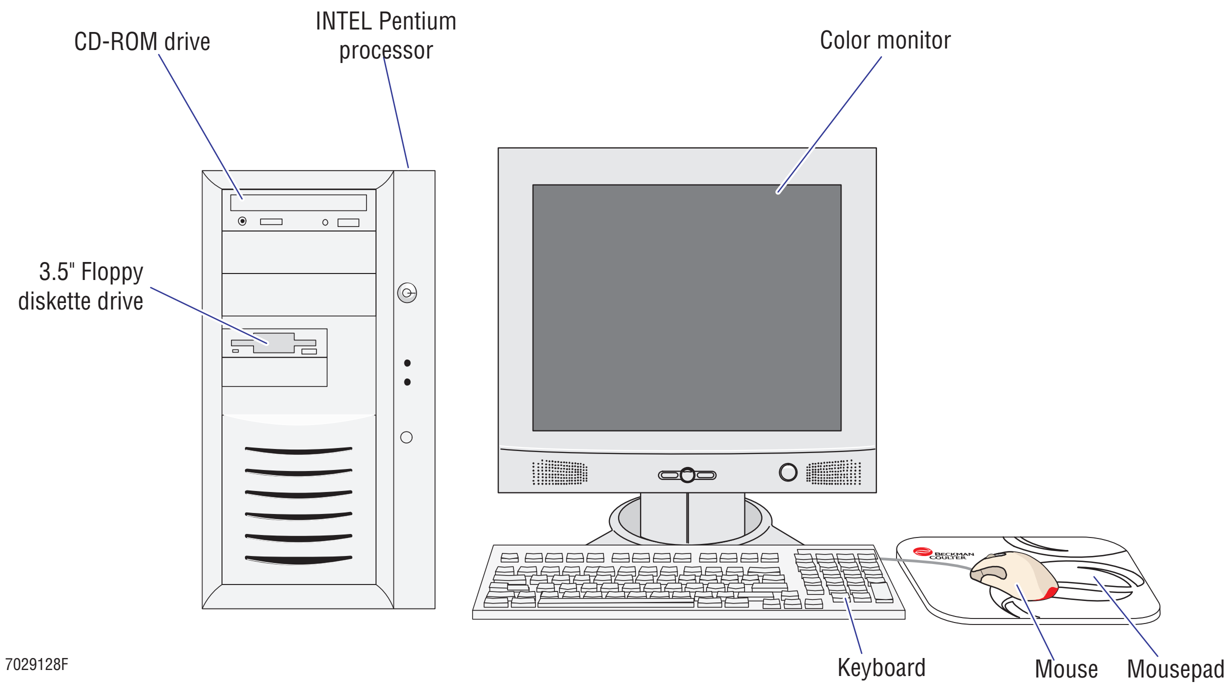
Components

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

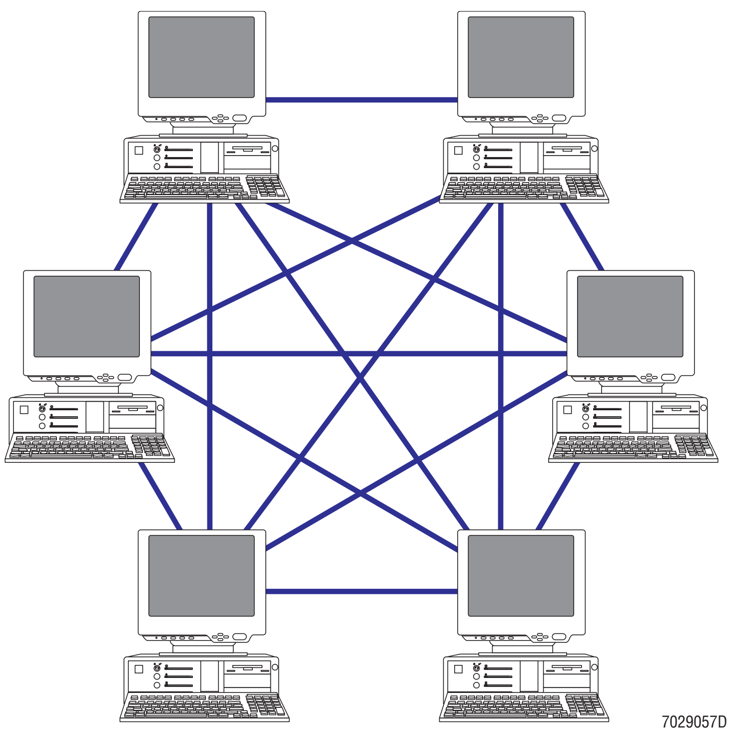
To connect the media, a layout of the connections must be planned. The layout is referred to as the physical network topology. There are four commonly used topologies:

- 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.

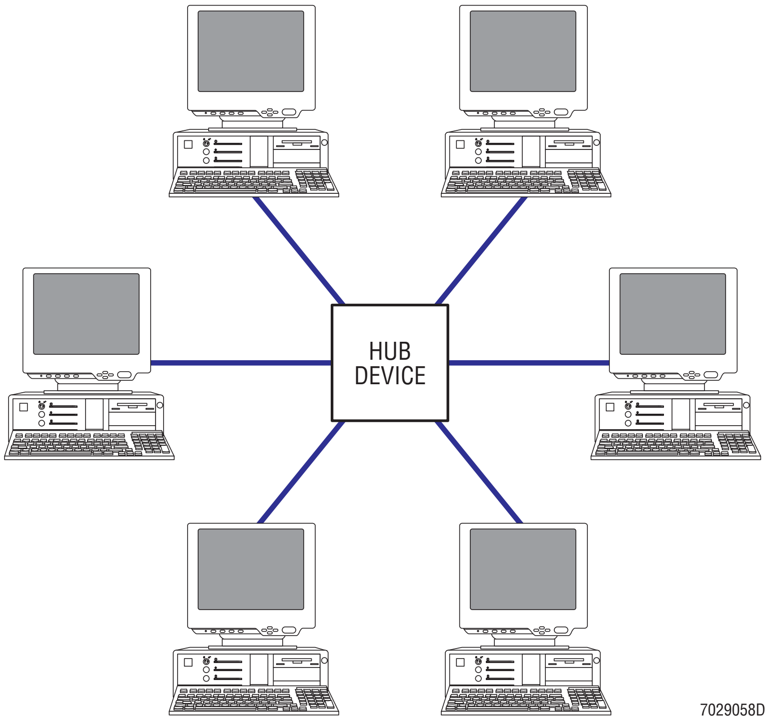
Figure 2.5-1 Mesh Topology



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.

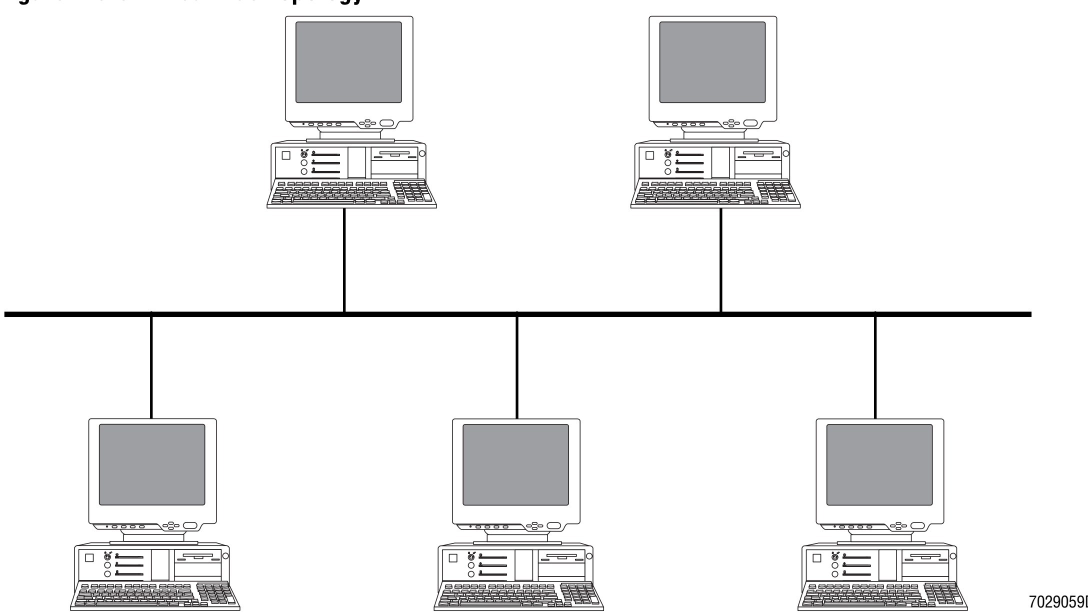
Figure 2.5-2 Star Topology



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.

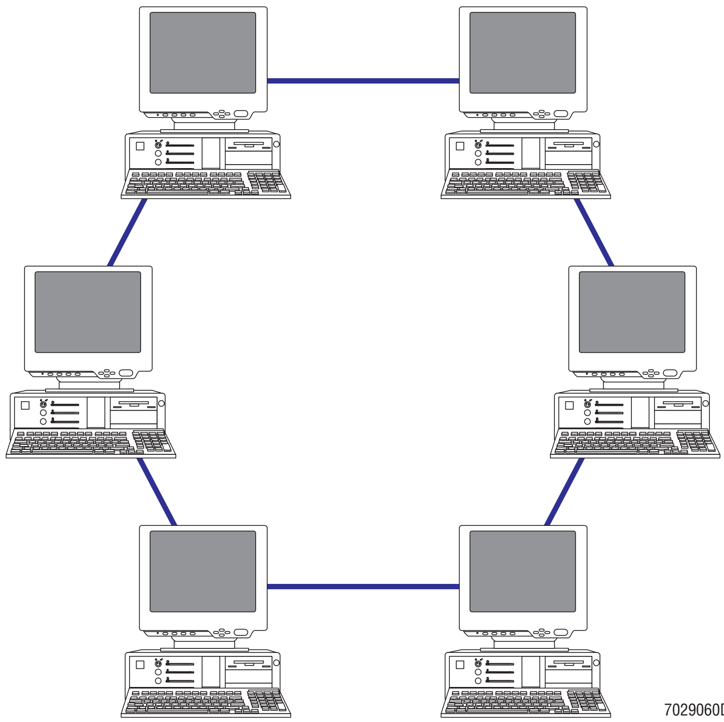
Figure 2.5-3 Linear Bus Topology



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.

ILLUSTRATIONS

TABLES

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.

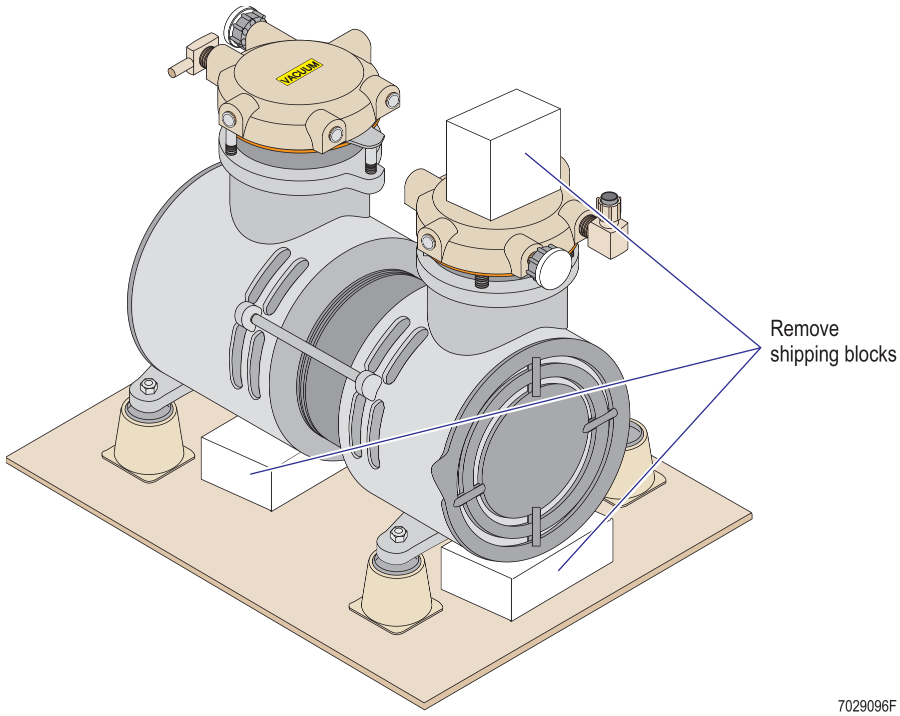
CAUTION Risk of instrument damage. The MCL option on the XL-MCL flow cytometer may be damaged if the left side of the Cytometer is grasped to move the Cytometer from the pallet to the bench or table top. Position one person in the front and the other in the back of the Cytometer to move the instrument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

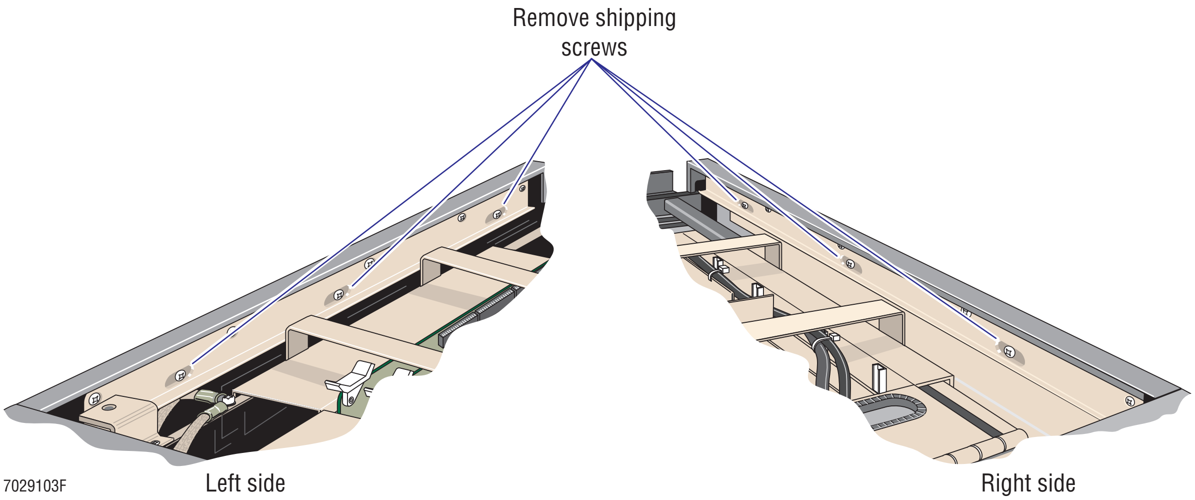
Remove Covers to Provide Needed Access

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.

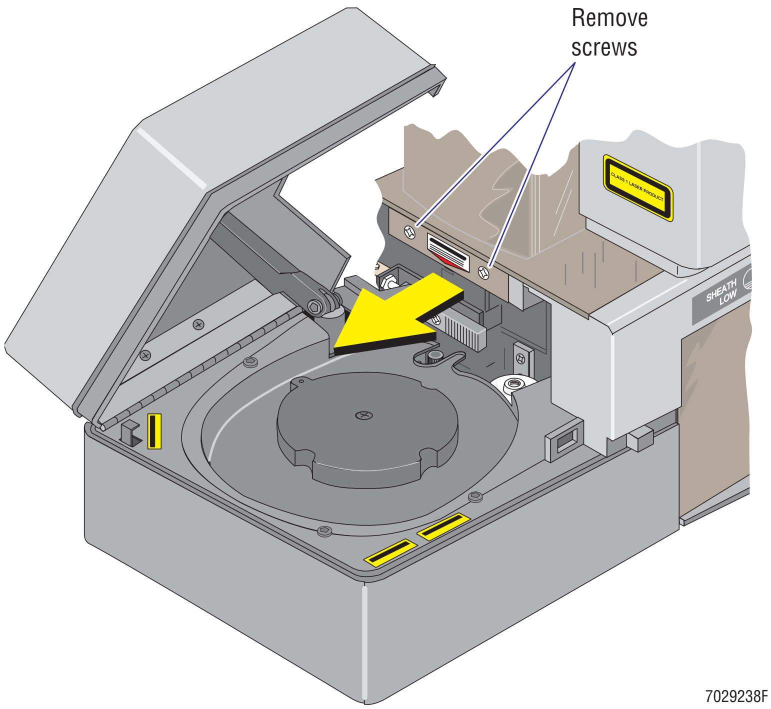
      Note: Two screws are located on the left side of the sample station and two more are located on the front to the right.
   b. Pull the cover assembly off the Cytometer frame and lay the assembly on the reagent bottles.
9. Go to step 15 to continue this installation.
10. Unlatch the MCL covers from the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

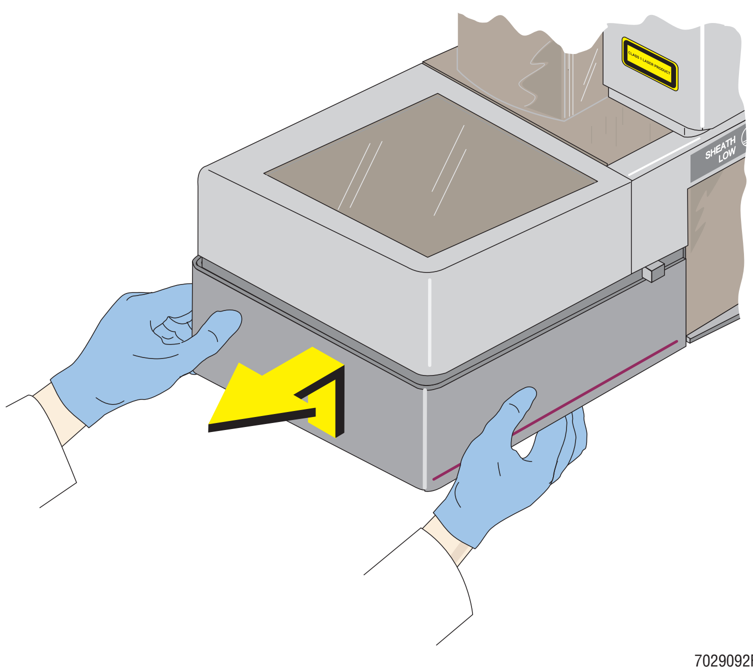
c. Remove the two screws securing the MCL probe housing (Figure 3.3-3) then carefully pull the probe housing cover off the Cytometer and set it aside.

Figure 3.3-3 Removing the MCL Probe Housing Cover



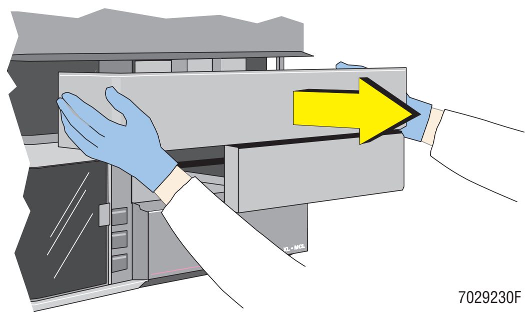
d. Close the MCL door (upper cover) and unlatch the MCL lower cover by grasping the base and gently pulling the base away from the Cytometer (Figure 3.3-4). **Do not attempt to remove the MCL option from the Cytometer.**

Figure 3.3-4 Unlatching the MCL Covers



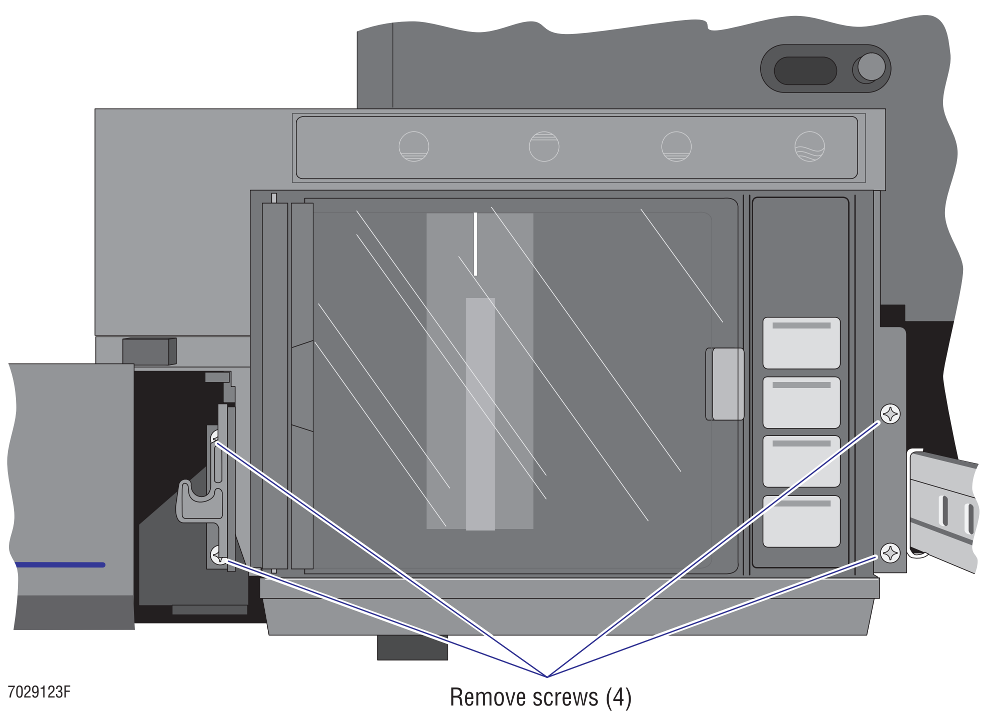
11. Remove the center front cover (filter cover) and set it aside. See Figure 3.3-5.

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



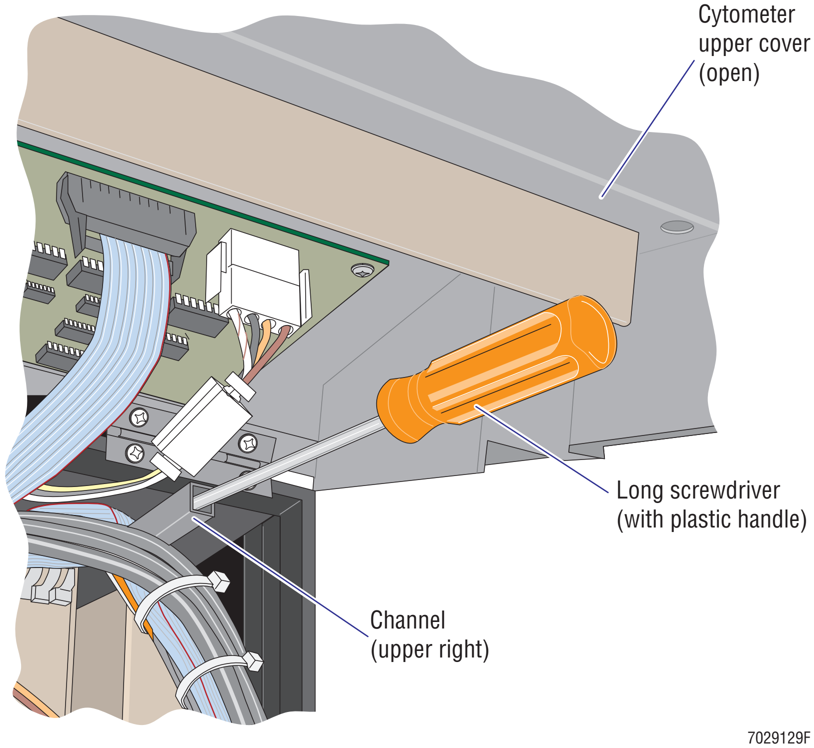
    c. Remove the two flat-head Phillips screws securing the right side of the manual sample station to the front of the Cytometer frame (Figure 3.3-6).
    d. Pull the cover assembly off the Cytometer frame and lay the assembly on the reagent bottles.

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.

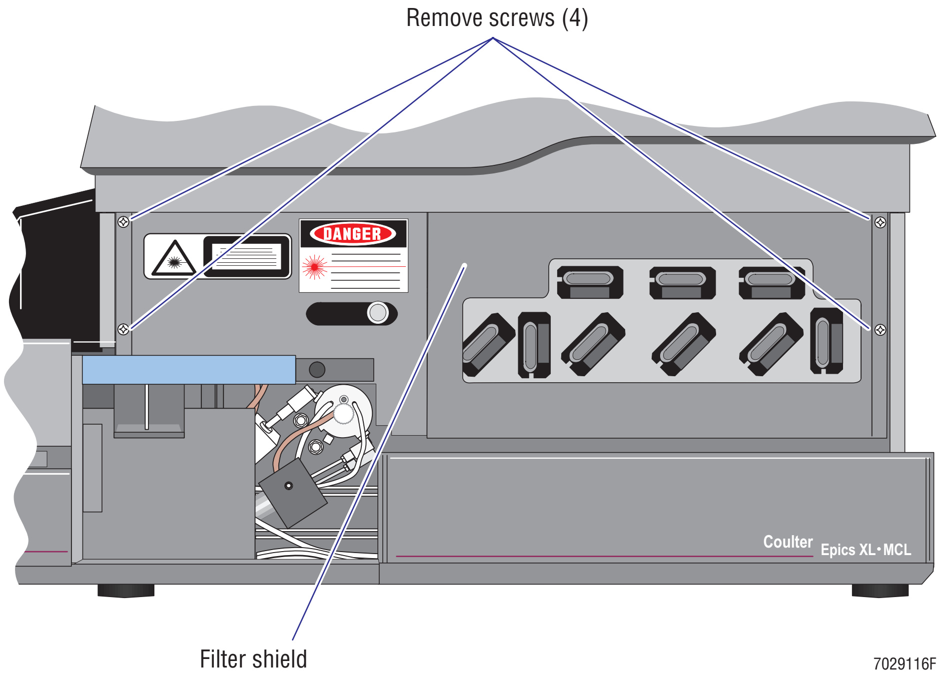
15. Lift the upper cover and place a long screwdriver (with a plastic handle) in the channel of the upper frame to it open (Figure 3.3-7).

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

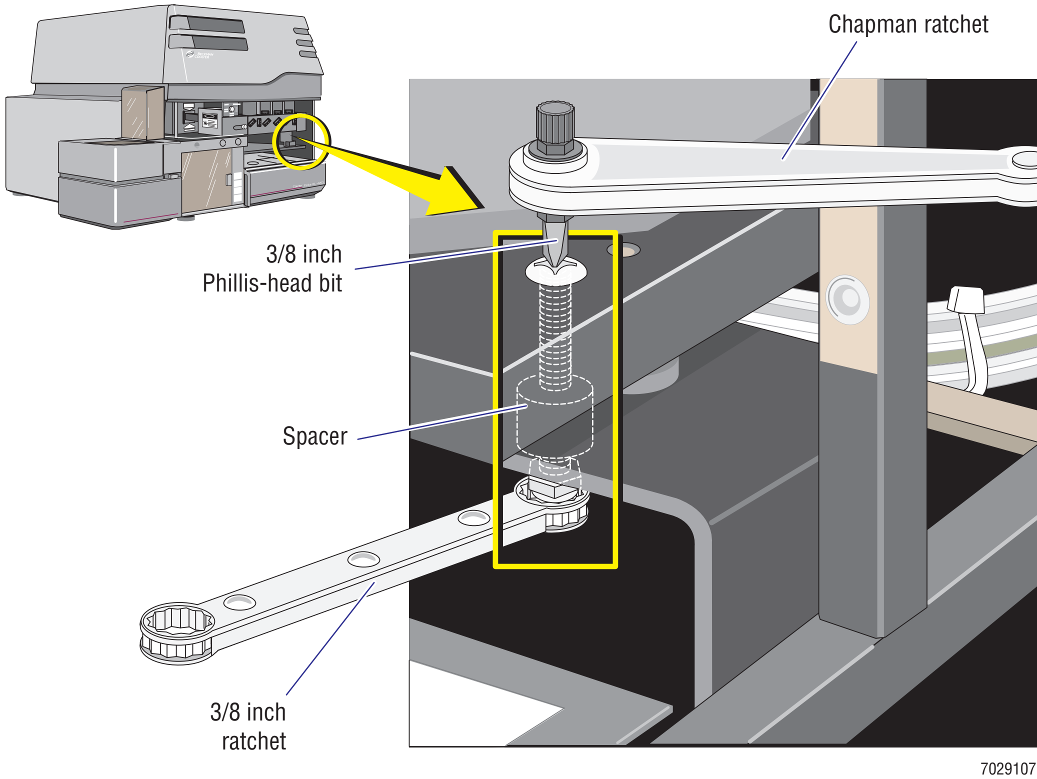


Remove the Optical Bench Shipping Tie-Down in the Front

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

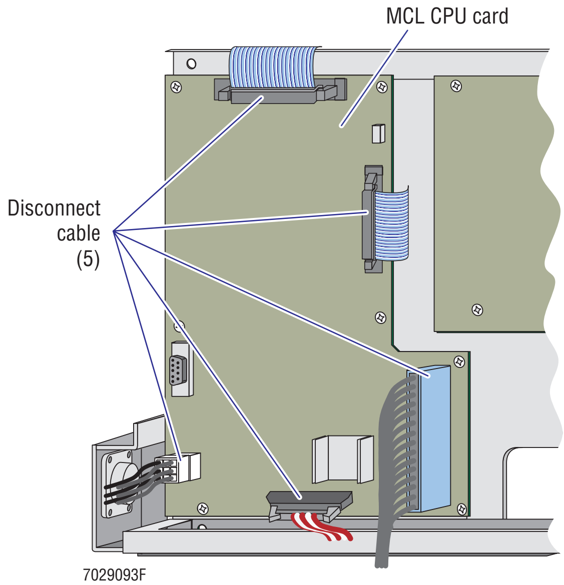
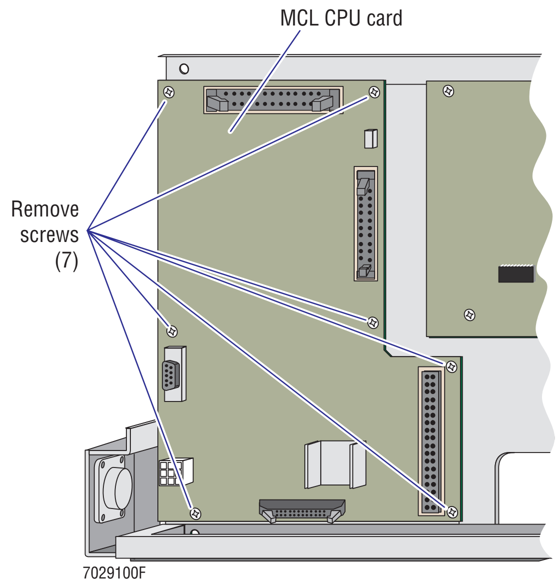


Figure 3.3-11 MCL CPU Card Screw Locations



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

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

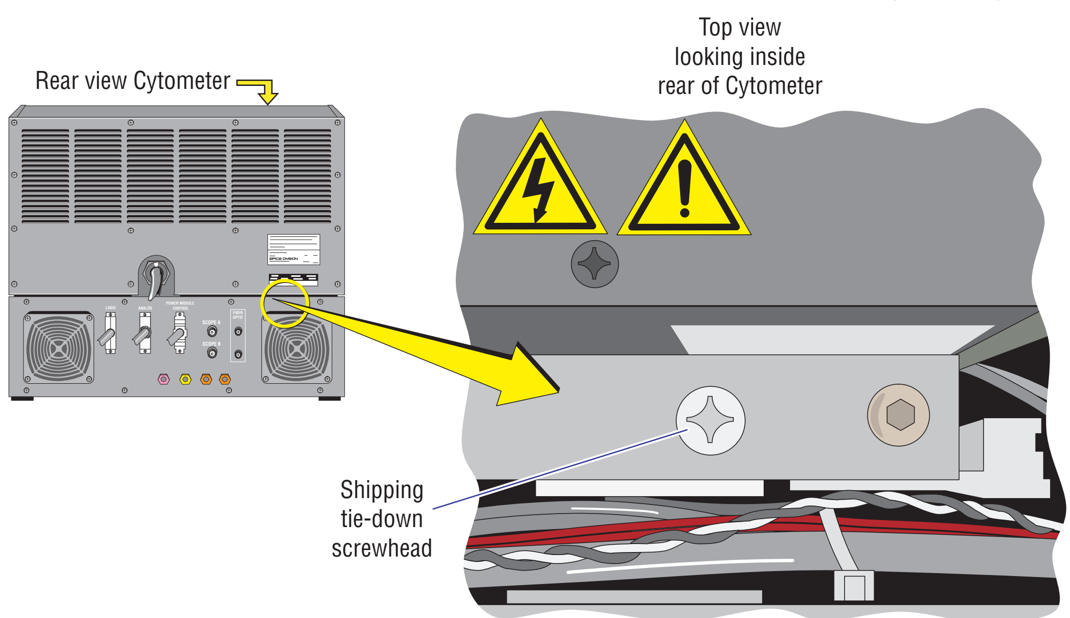
c. Remove the seven Phillips-head screws and washers that attach the card to the Cytometer frame (Figure 3.3-11).

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.

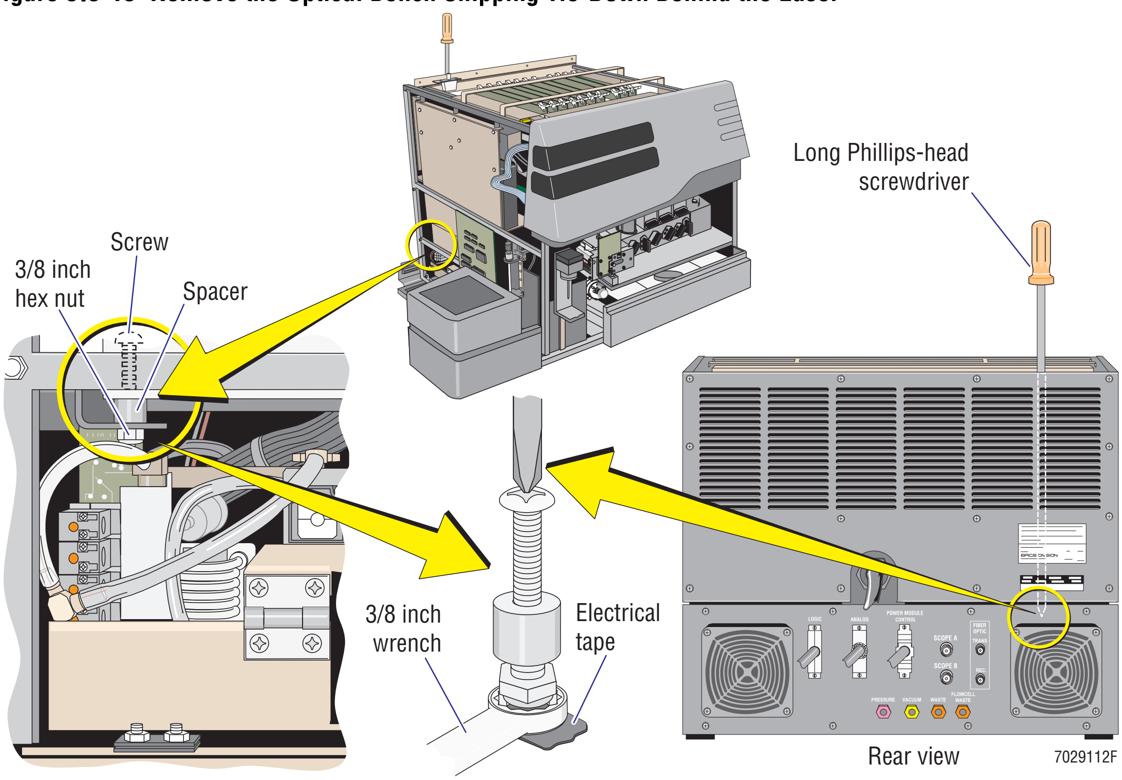
b. Use a 3/8-inch wrench and a long Phillips-head screwdriver to remove the shipping tie-down (screw and hex nut). Refer to Figure 3.3-13 as needed.

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)

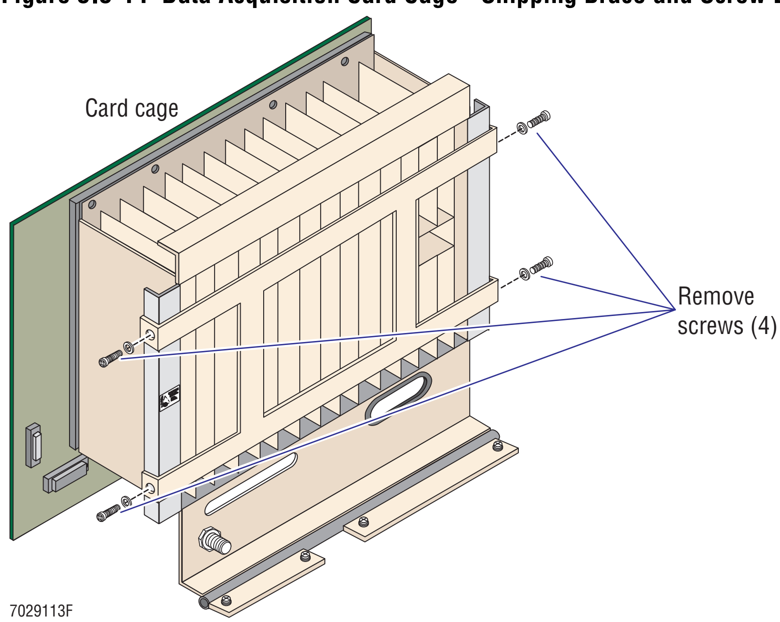
1. Position the MCL CPU card back on the Cytometer frame.
2. Loosely install the seven Phillips-head screws and washers then tighten the screws to the Cytometer frame.
3. Reconnect all five cable connectors to their respective plugs on the circuit card.

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

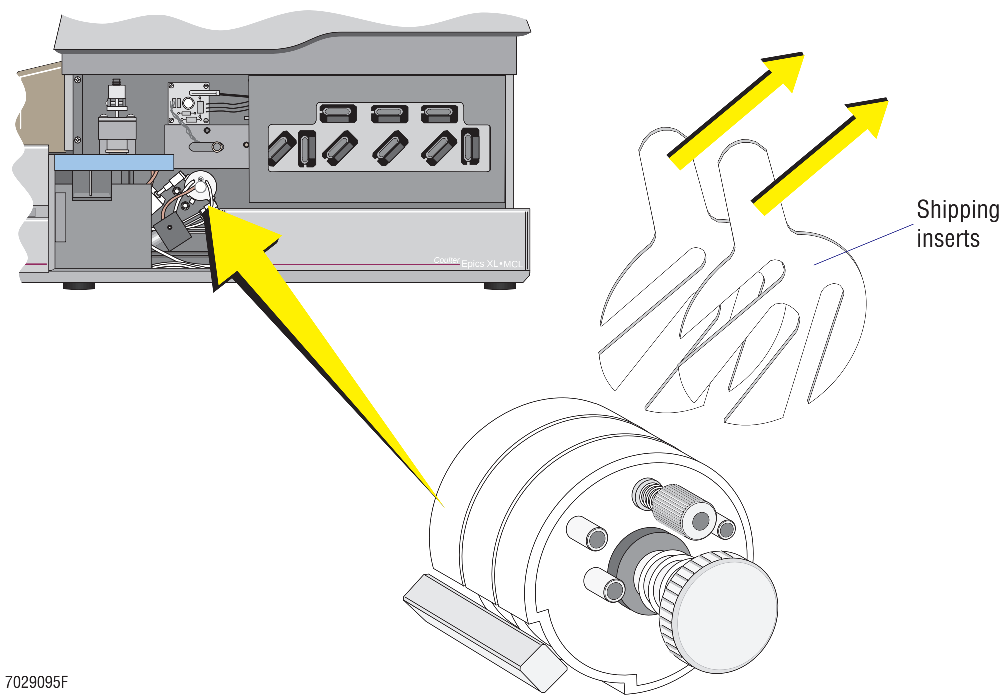


4. Remove the shipping brace (Figure 3.3-14). Place the brace and screws in the box designated for storing shipping parts.
5. Inspect for any lose cards or cables. Correct as needed.
6. Disassemble the static-dissipative field kit.

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.

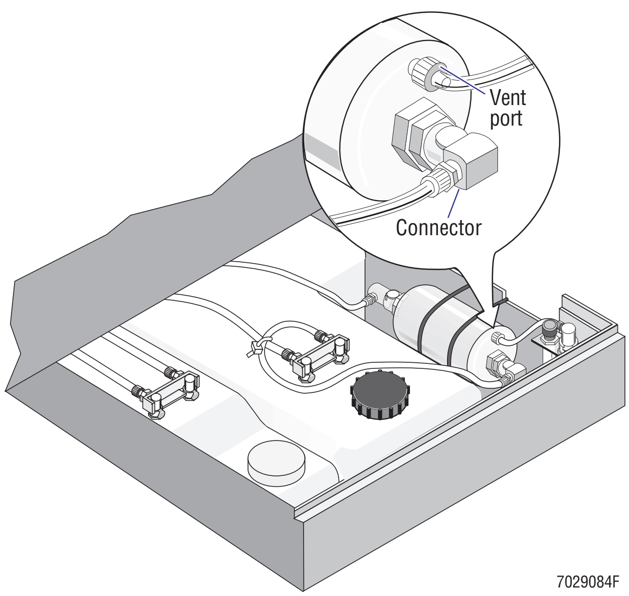
CAUTION Risk of damage to the instrument if you overfill either reagent, especially the cleaning reagent. Avoid spills. Do not tilt the container or remove it from the drawer to fill it.

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).

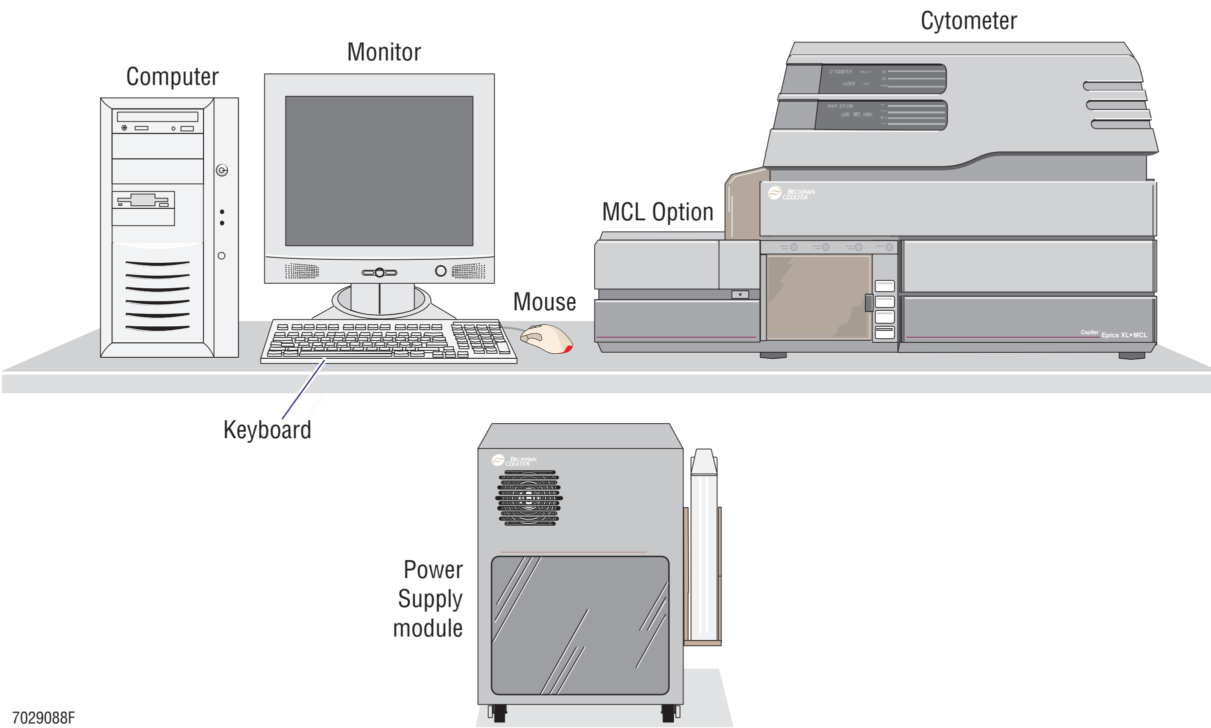
3.4 WORKSTATION INSTALLATION

"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



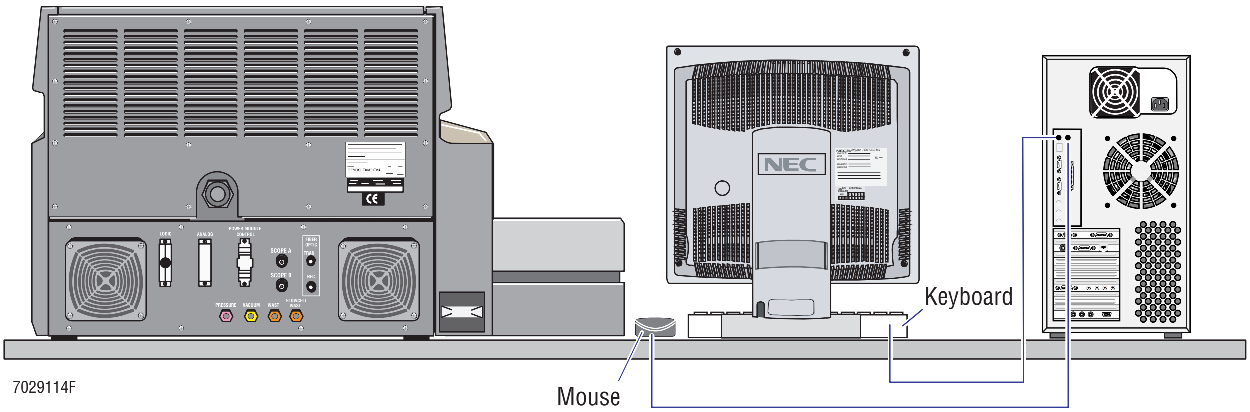
3. Unpack the monitor and place it on the bench or table (Figure 3.4-1).

   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

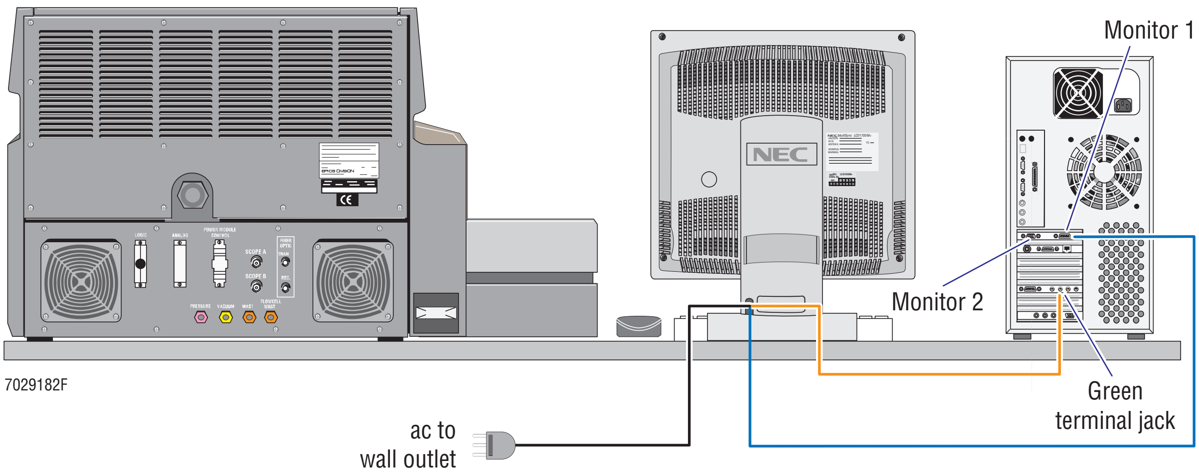
This LCD monitor has two cables and an ac power cord. Inspect these cables and the power cord to ensure the pins are straight and seated properly.

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.

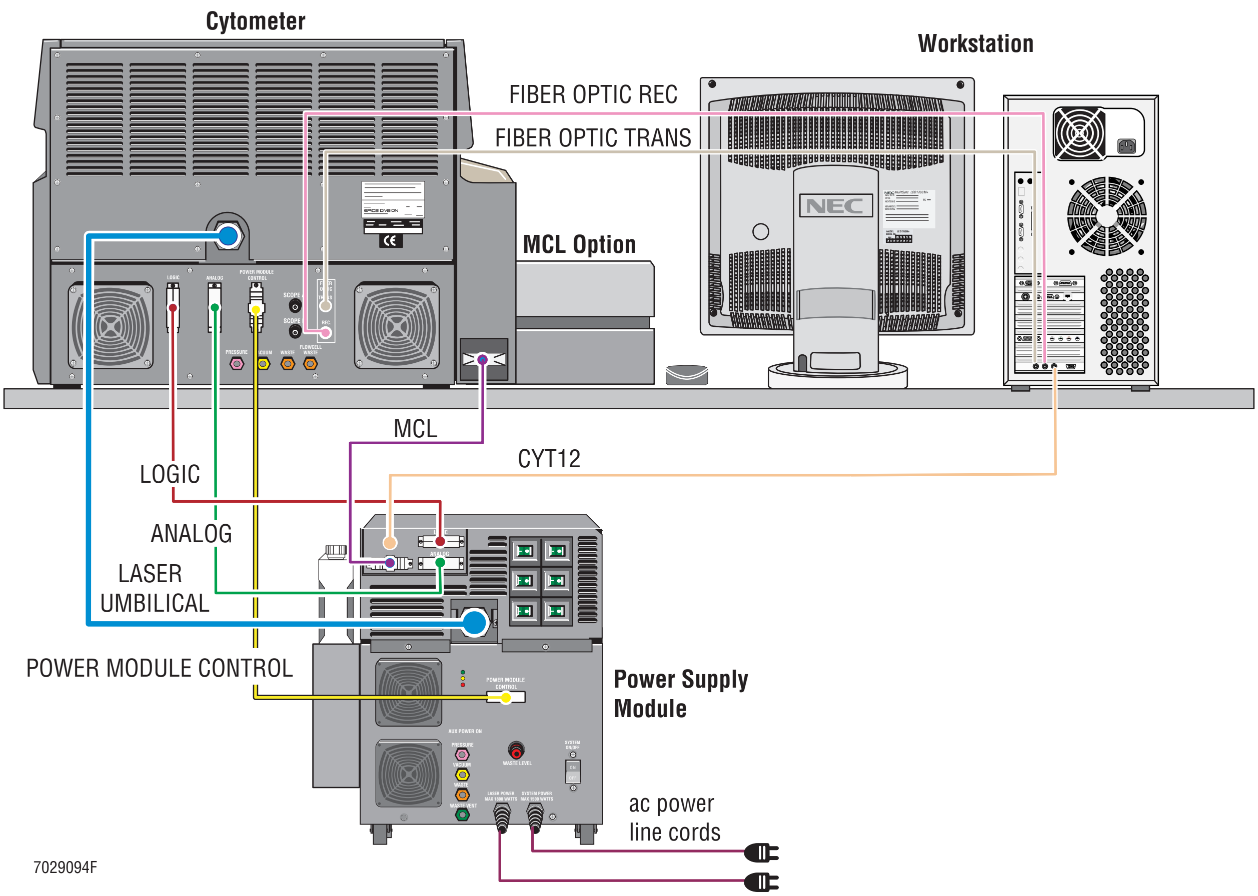
Note: For additional information, refer to the documentation supplied with the Printer.

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.

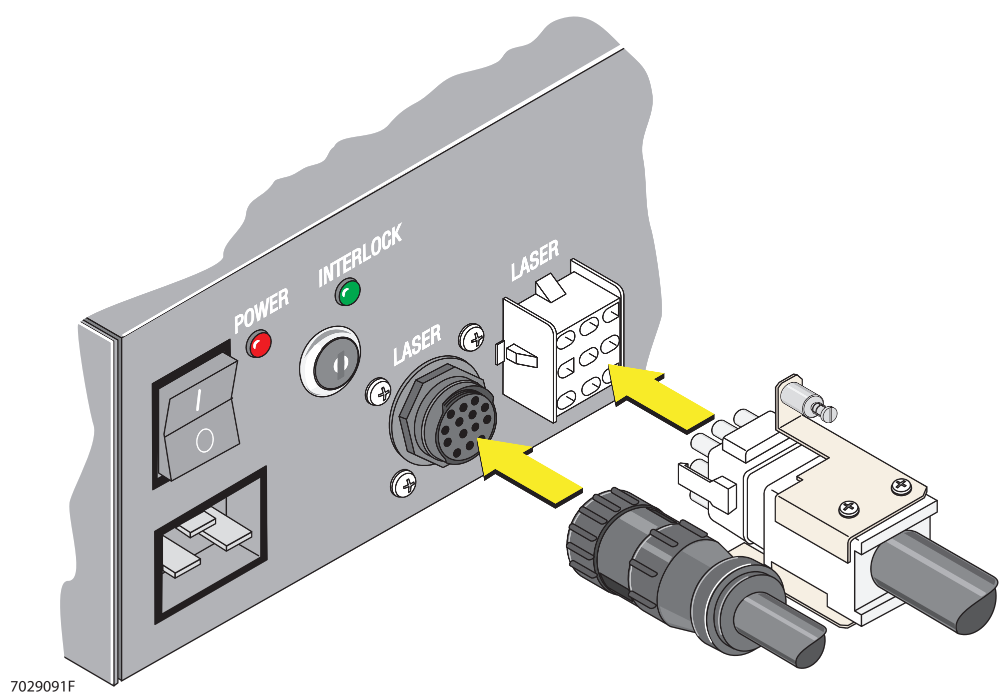
         Note: If the key is in the ON position, it must be rotated counterclockwise to the OFF position before it can be removed from the power supply.

      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

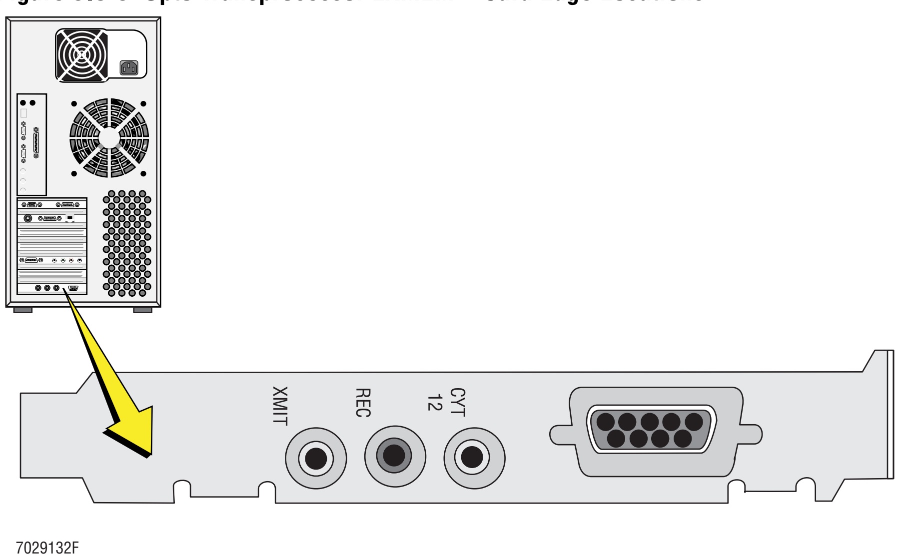
- If this is an XL cytometer **without** the MCL option, go to step 1.
- If this is an XL cytometer **with** the MCL option, go to step 4.

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



   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

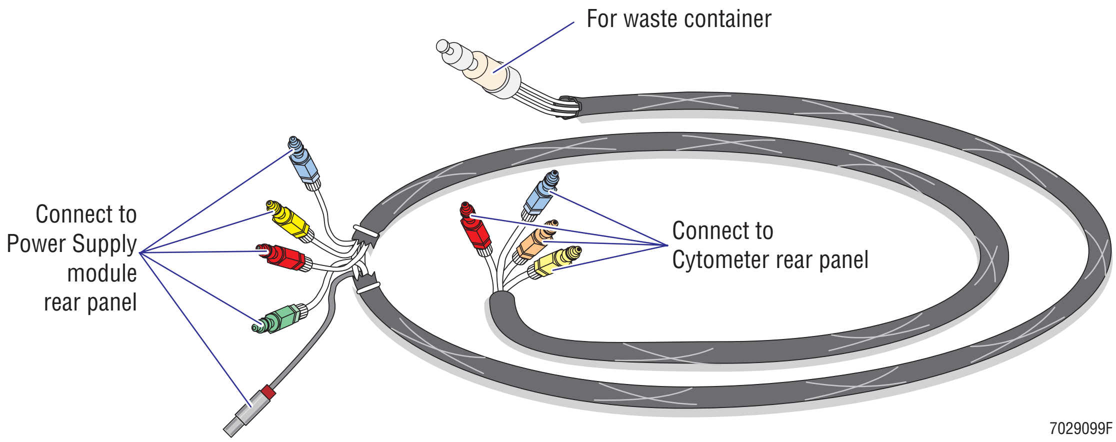
Prepare the Waste Container for Tubing Connection

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).

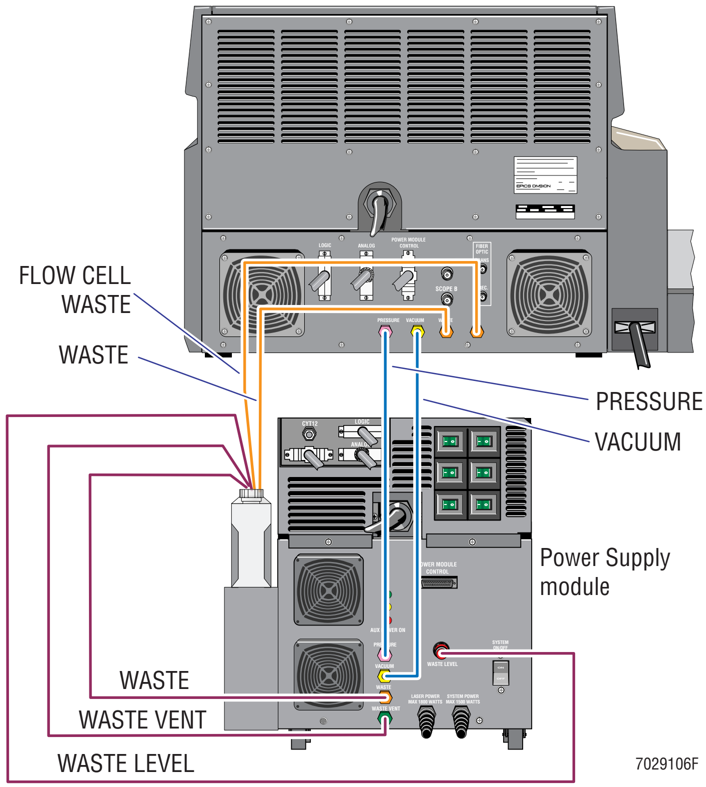
Figure 3.5-4 Bundle of Shielded Pneumatic/Hydraulic Tubings



- 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

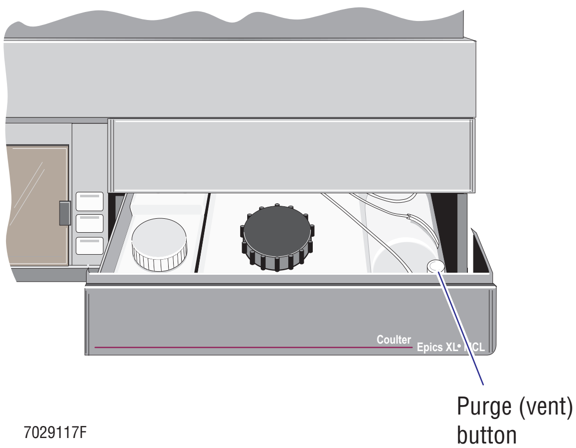
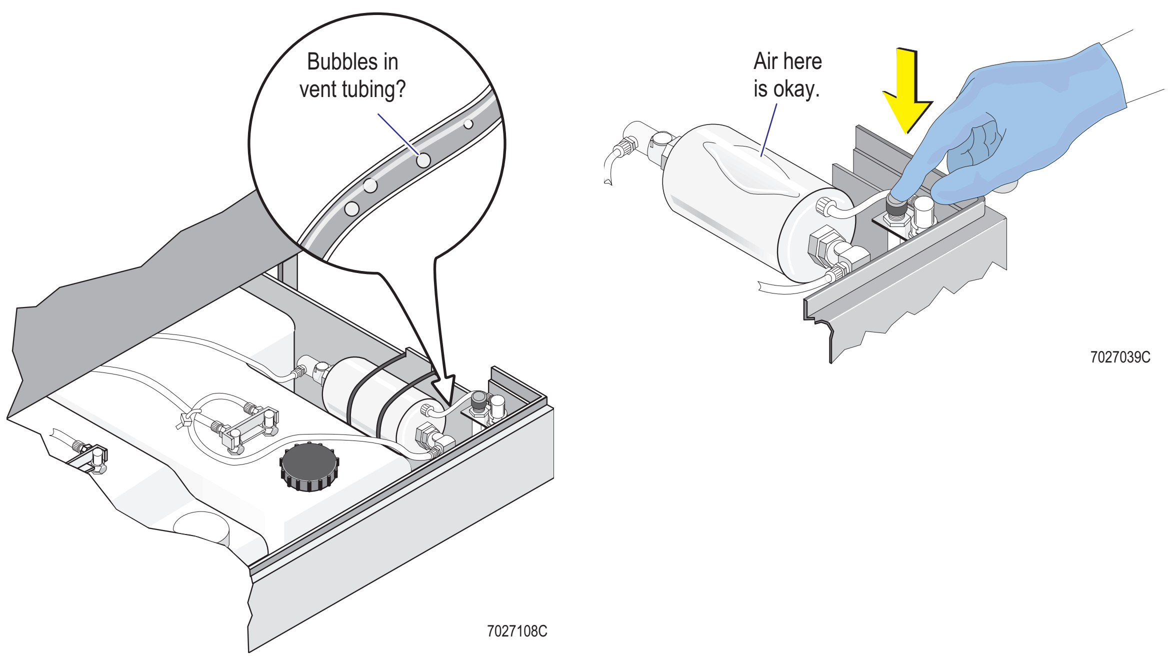


Figure 3.7-2 Purging Bubbles from the Sheath Filter



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

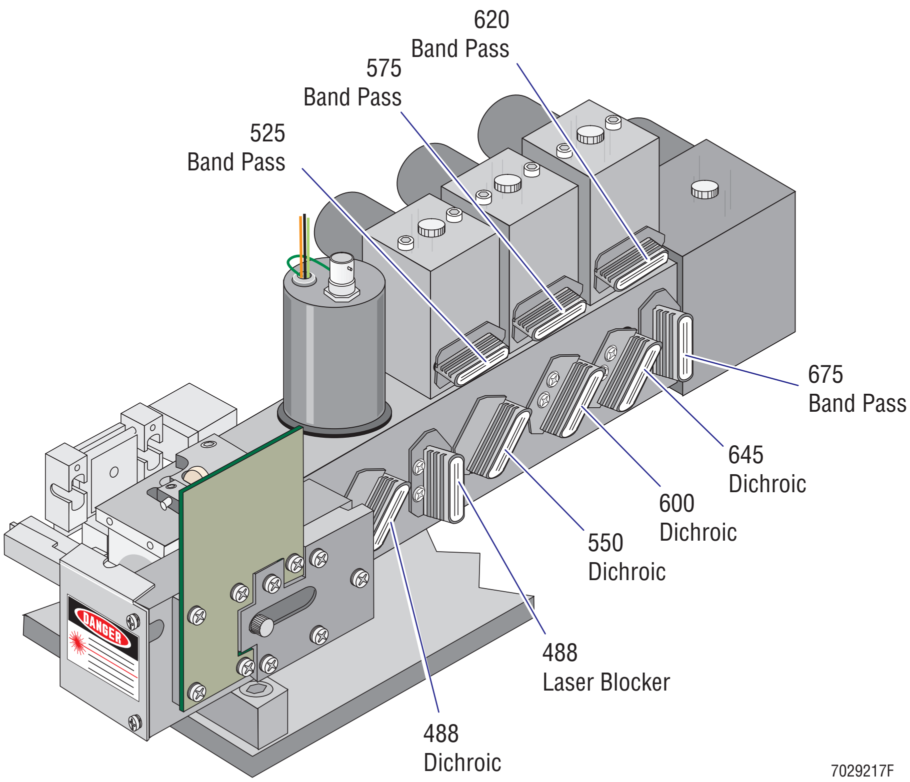
Preparation

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.

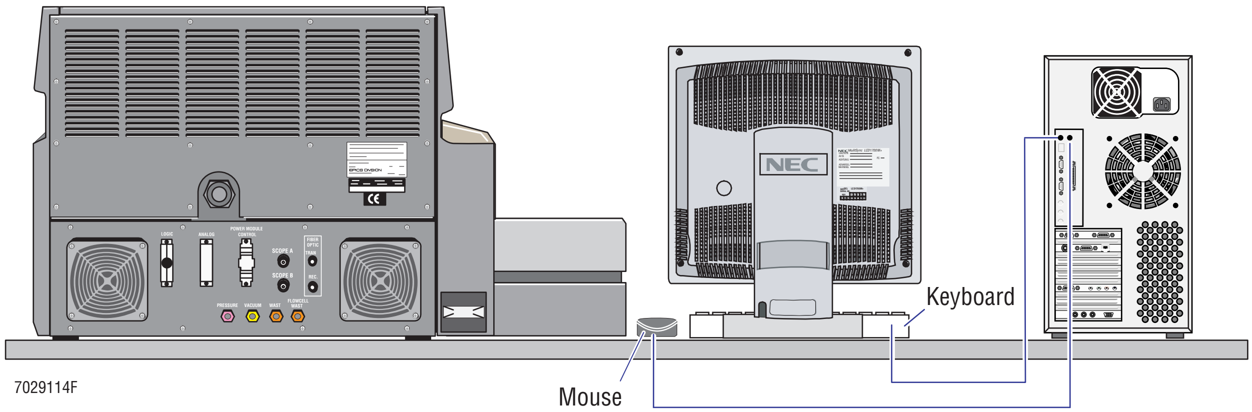
Opto Transprocessor EXMEM or EXMEM II Card Retrieval and Installation

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



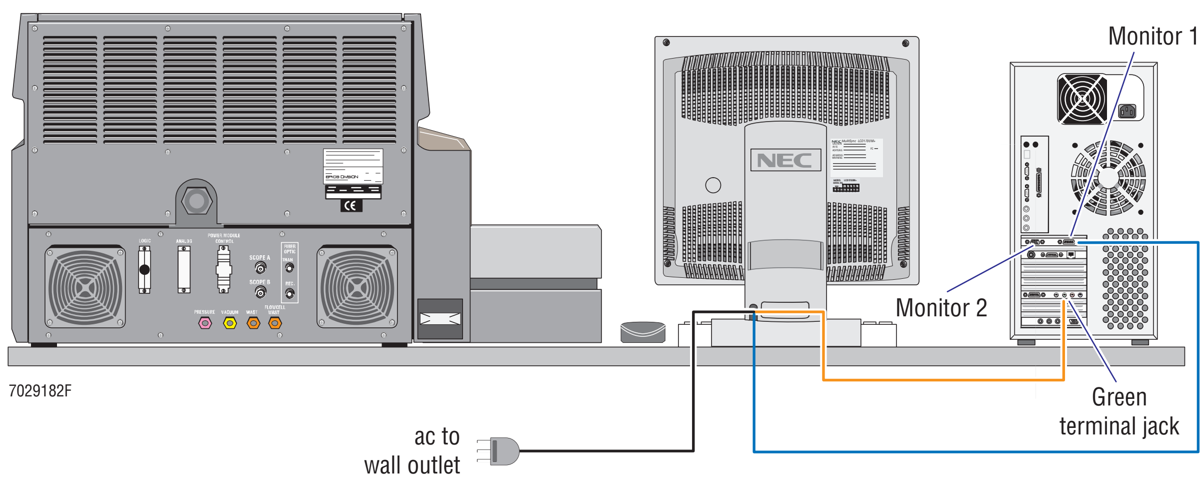
Keyboard Connection

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

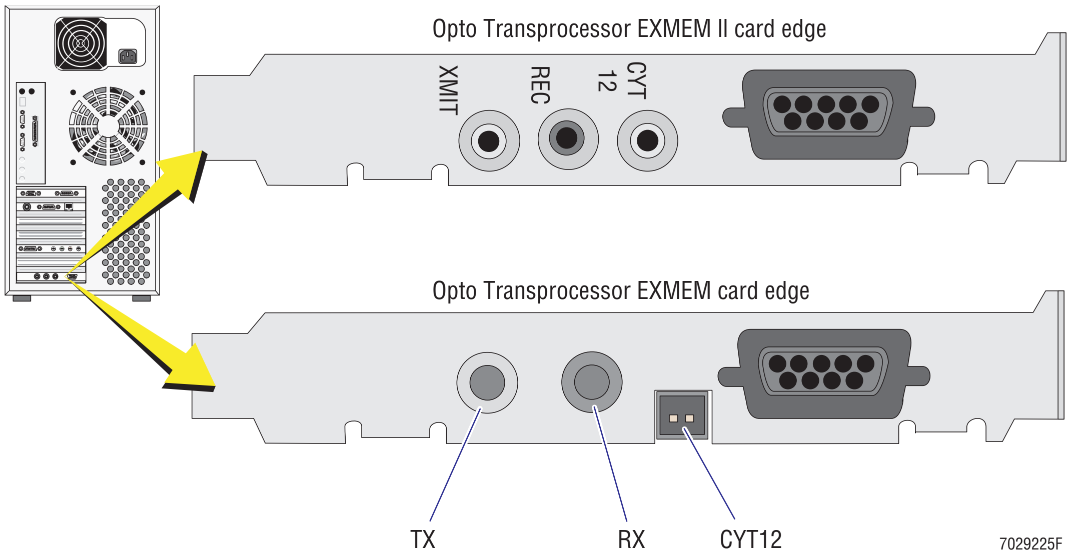
Fiber Optic Interface Cables

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

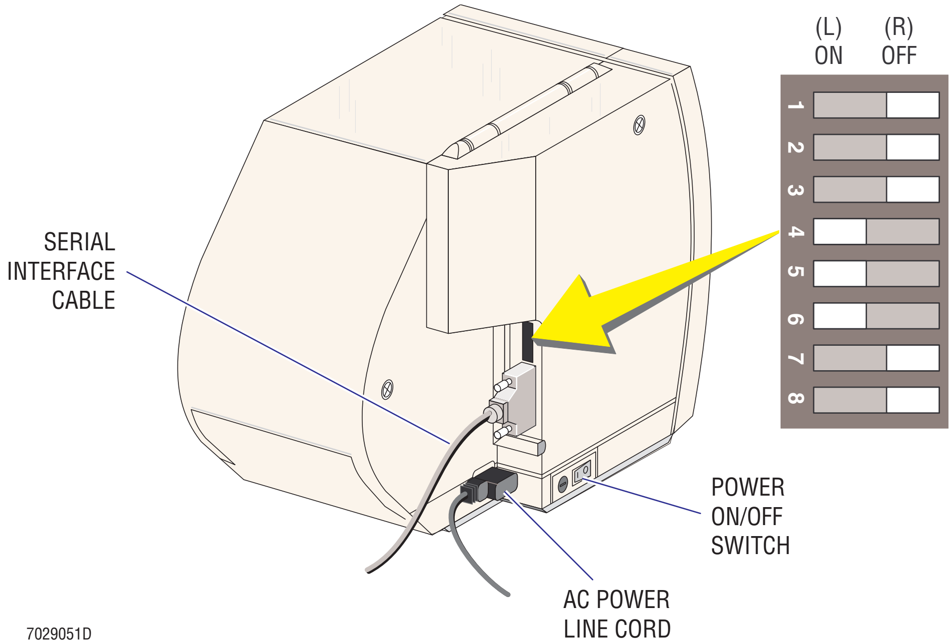
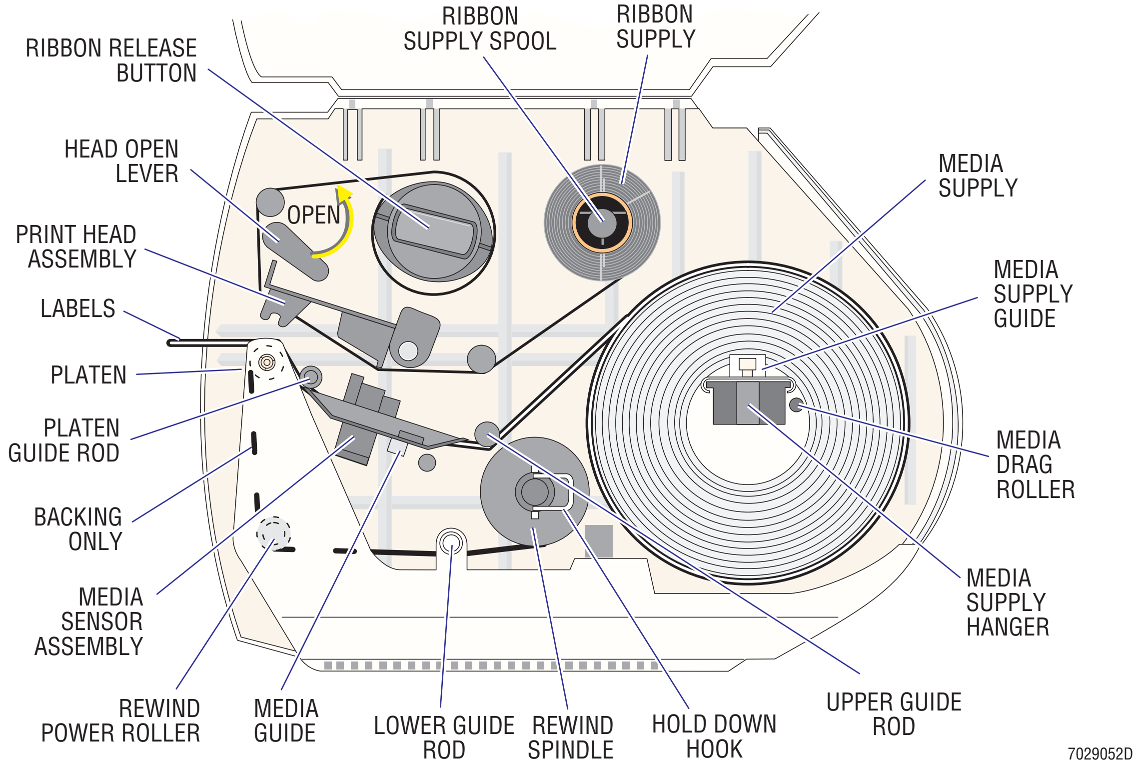


Table 3.11-1 Bar-Code Printer DIP Switch Settings

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

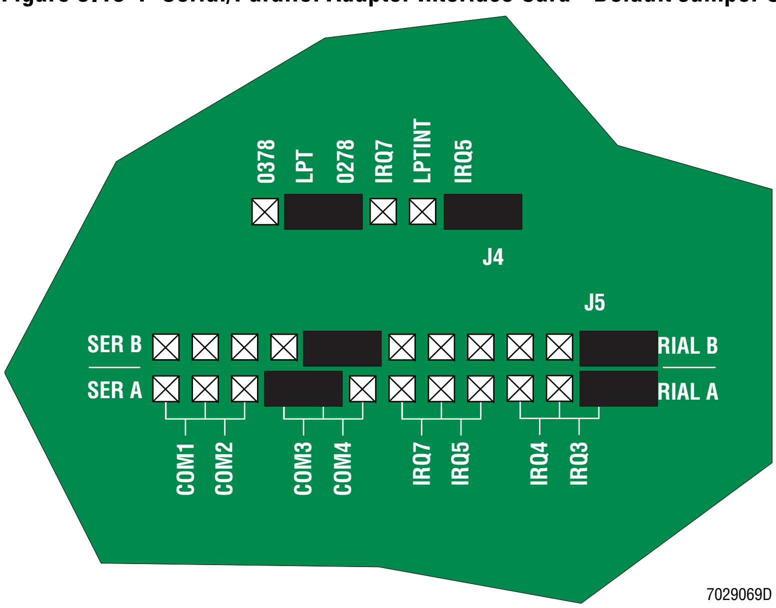
Note: Because of OEM-vendor changes, differences in Computer Workstations and customer-purchased peripheral upgrades, additional installation information may be required. This information can be obtained from the OEM-supplied manuals. Also, please refer to the OEM-supplied instruction manuals if you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

ILLUSTRATIONS

TABLES

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

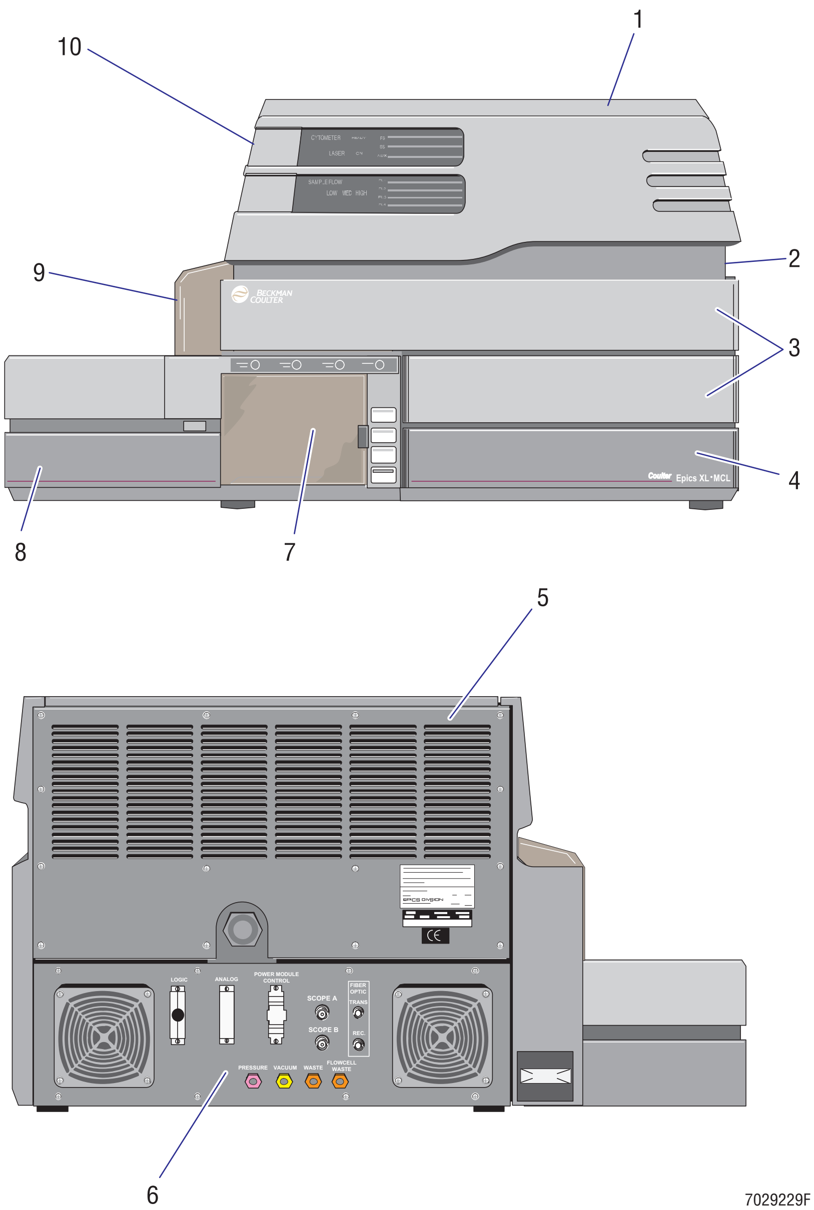


Figure Reference

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

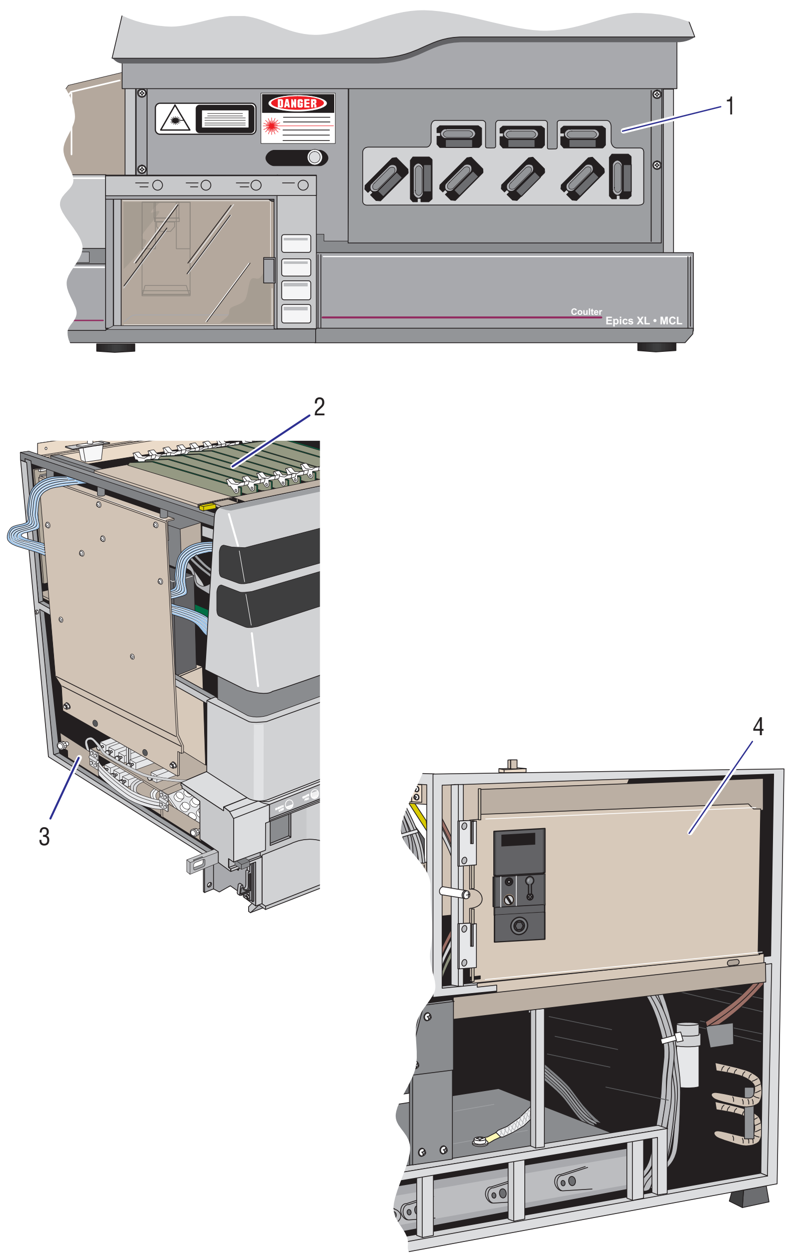
Access Inside the Cytometer

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



7029237F

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

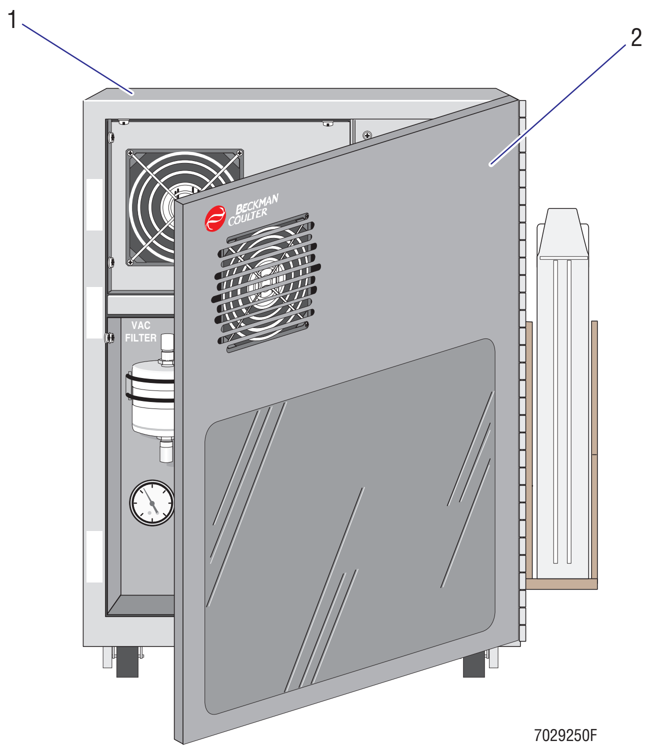


Figure Reference

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.

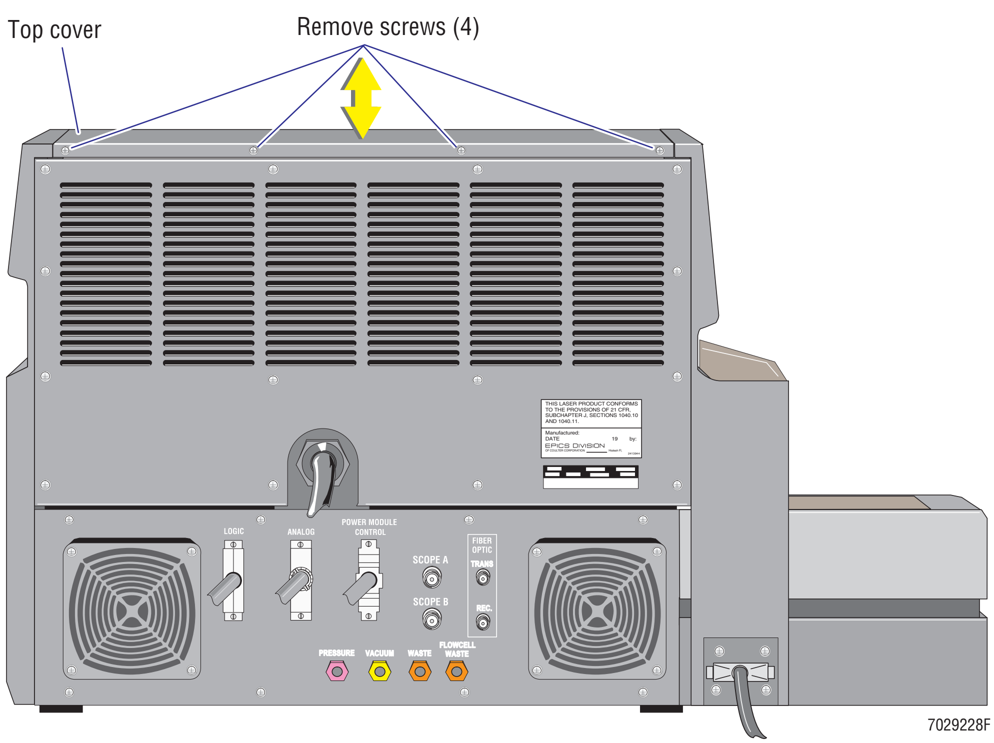
Tools/Supplies Needed

- ❑ 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



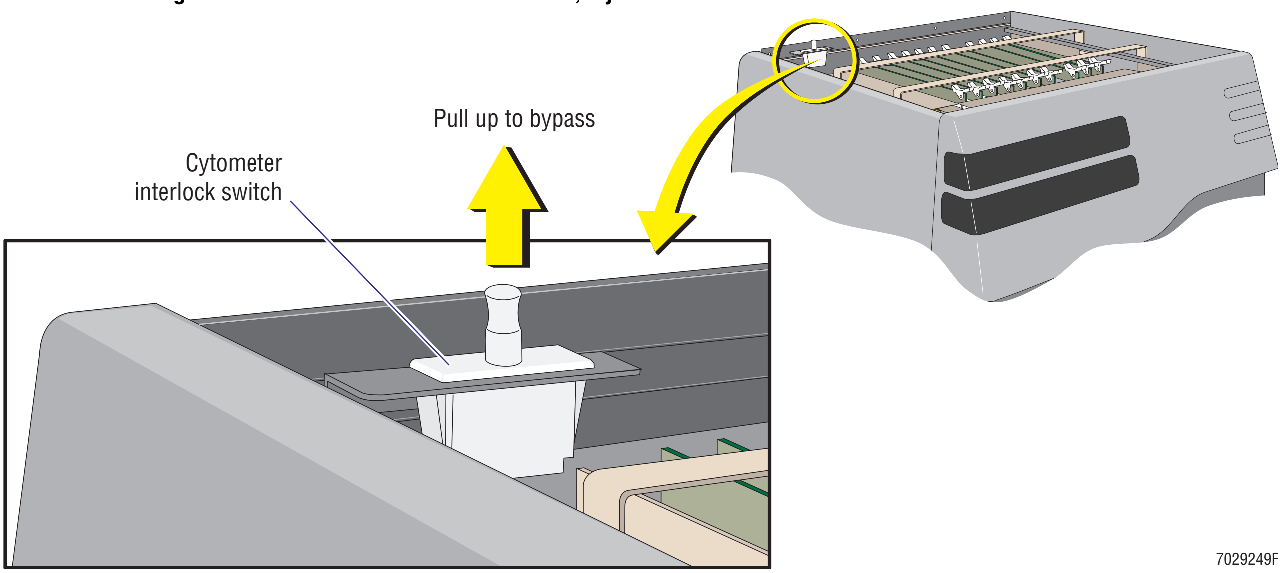
2. Lift the top cover up and off the Cytometer (Figure 4.3-4).
3. Set the cover aside in a safe place where it will not be damaged.

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.

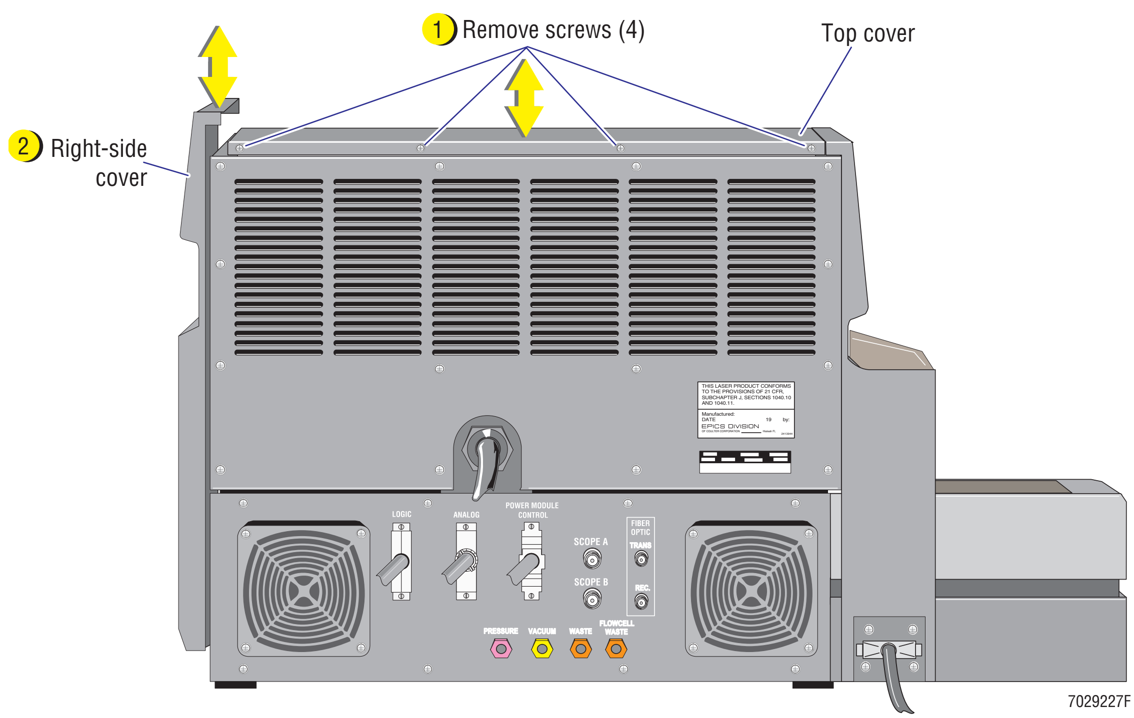
Tools/Supplies Needed

- ❑ 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)

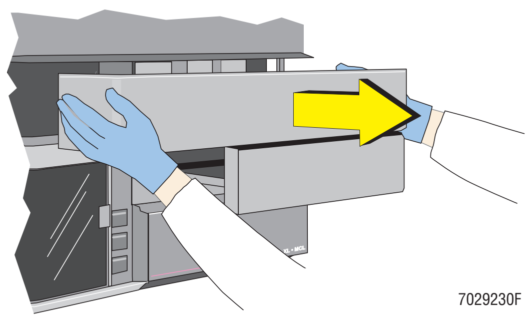
Removing the center front cover (as referred to as the filter cover) allows access to the filter shield, the individual light filters, and the ND1 filter positioning knob. See Figure A.5-6 for the components that are accessible with the center front cover removed and Table A.5-6 for a description of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

Tools/Supplies Needed

- ❑ None

Removing the Center Front Cover (Filter Cover)

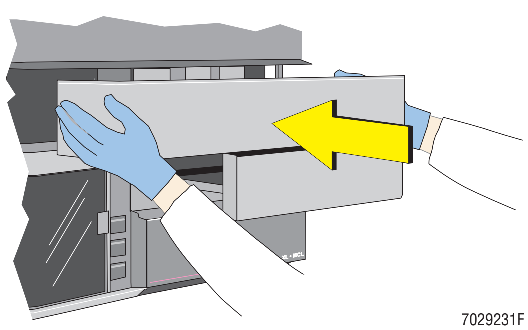
Figure 4.3-7 Removing the Center Front Cover



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

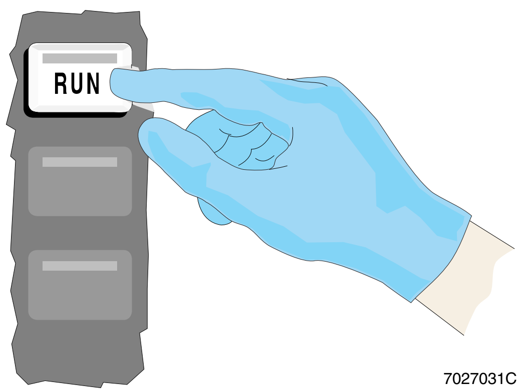
Opening the reagent drawer allows access to reagent containers, sheath liquid filter, and the purge mechanism. See Figure A.5-8 for the components that are accessible with the reagent drawer open and Table A.5-8 for a description of component functions.

Tools/Supplies Needed

- ❑ None

Opening the Reagent Drawer

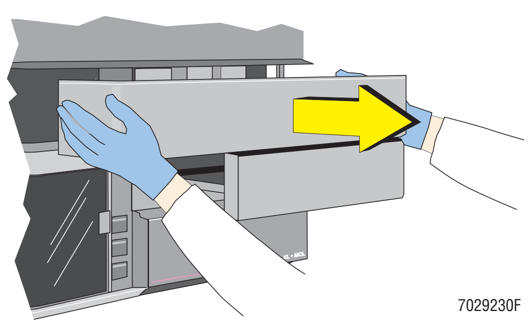
Figure 4.3-9 Placing the Cytometer in the Idle Mode



1. Verify the Cytometer is in the Idle mode.

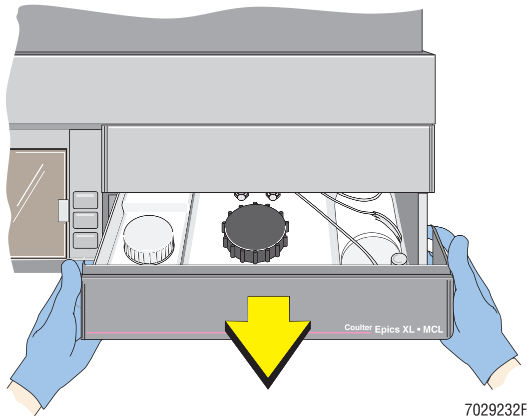
   Note: The Cytometer is in the Idle mode when a level sense indicator is glowing (not flashing) red or the indicator in the Cytometer RUN button is flashing green.
2. If the Cytometer is not in the Idle mode, press the RUN button (Figure 4.3-9).
3. Wait about 10 seconds for the Cytometer to depressurize.

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

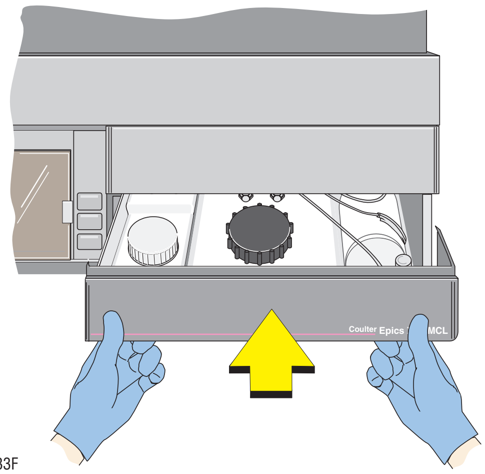


5. Grasp the reagent drawer and pull the drawer forward until it stops (Figure 4.3-11). The reagent drawer sits inside self-locking tracks and will stop when it locks.

   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

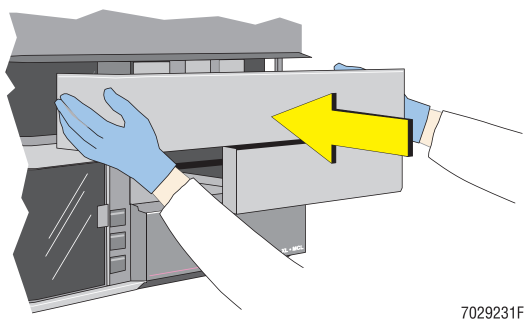
Figure 4.3-12 Closing the Reagent Drawer



7029233F

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



7029231F

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.

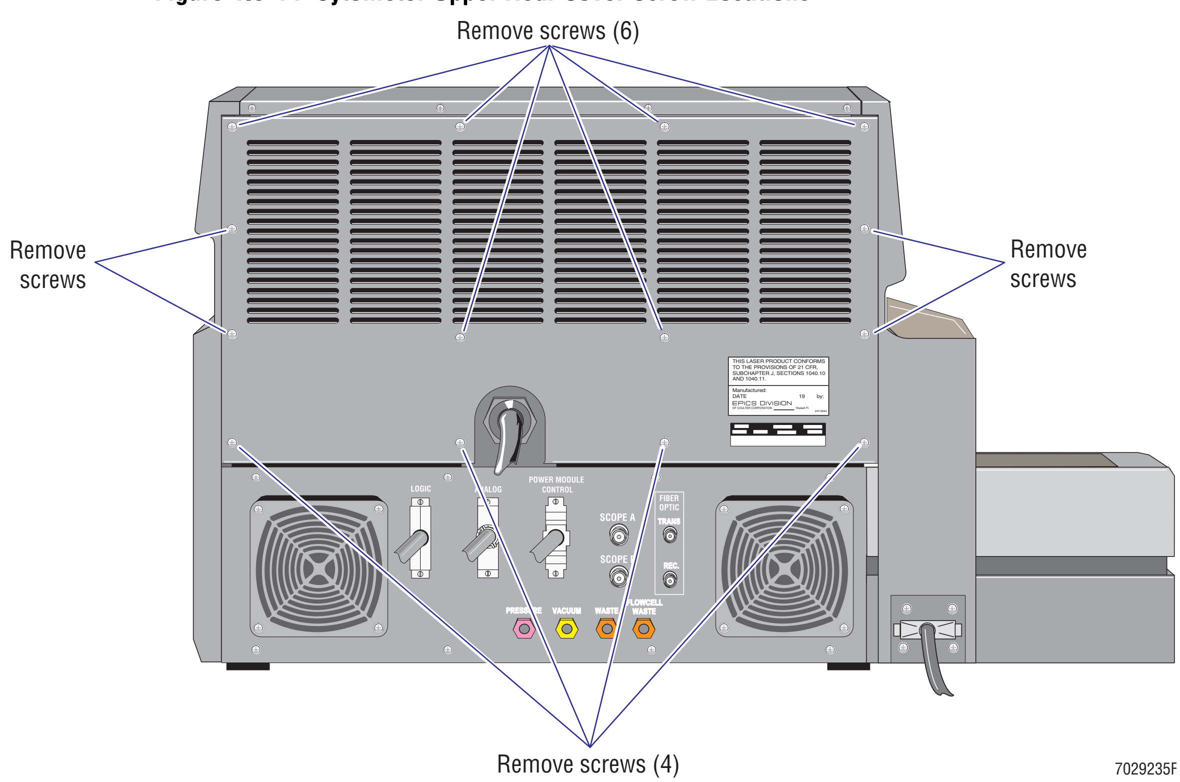
Tools/Supplies Needed

- ❑ 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

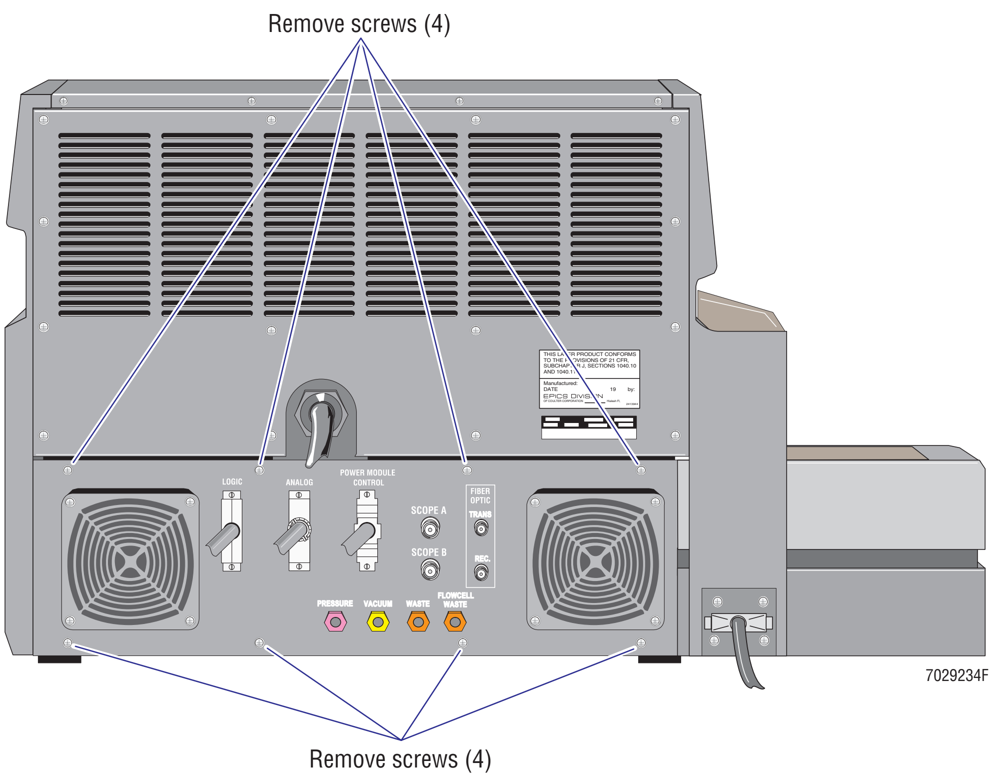
- ❑ Phillips-head screwdriver

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

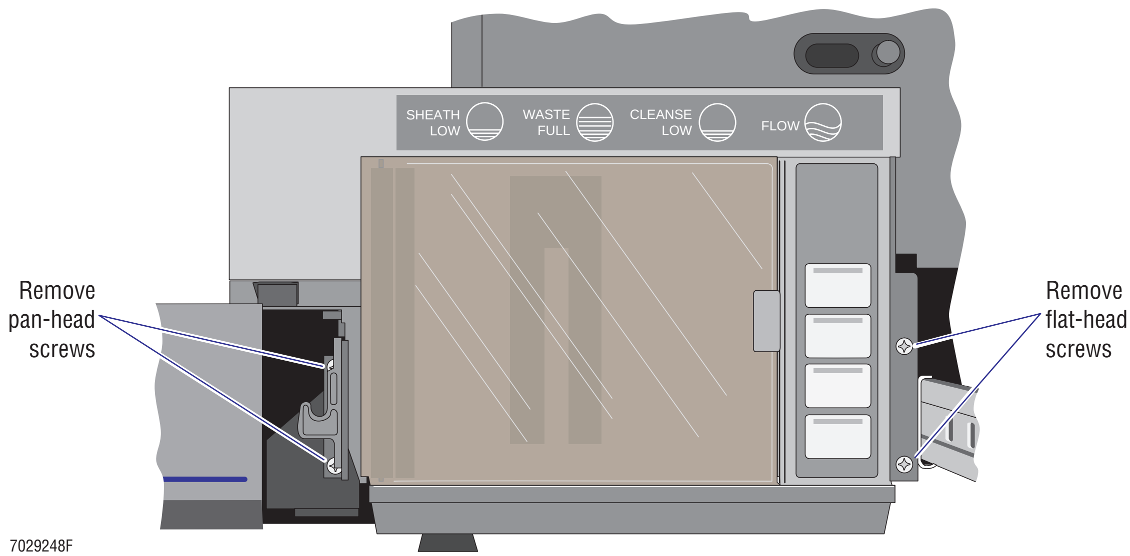
- ❑ Phillips-head screwdriver

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.

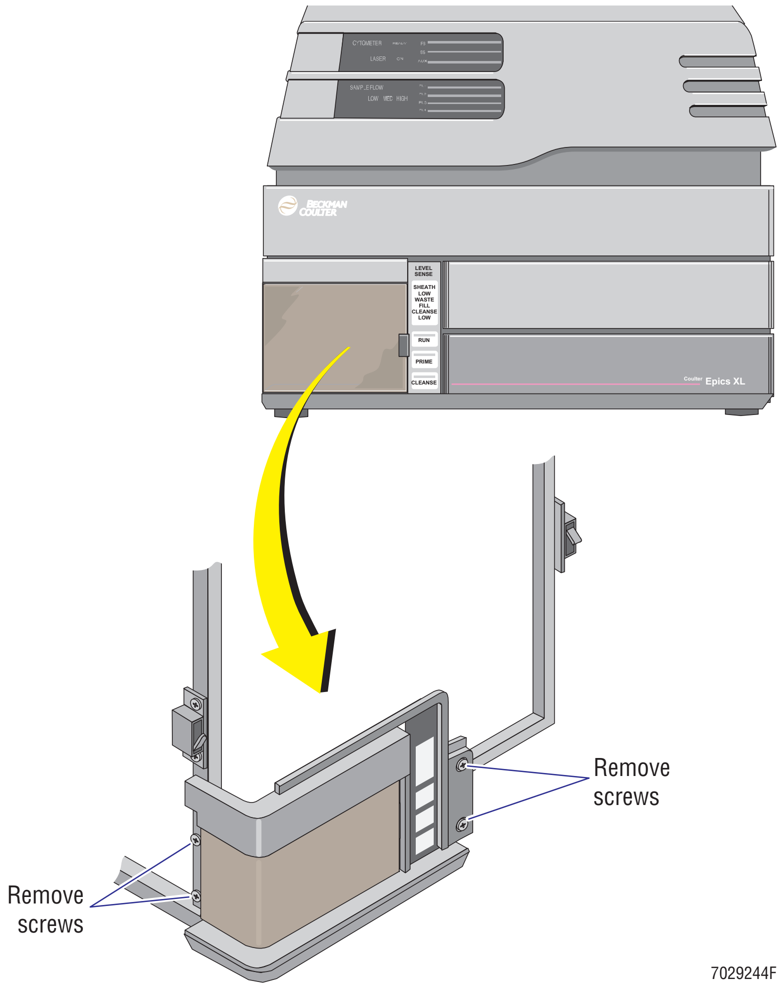
Tools/Supplies Needed

❑ 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.

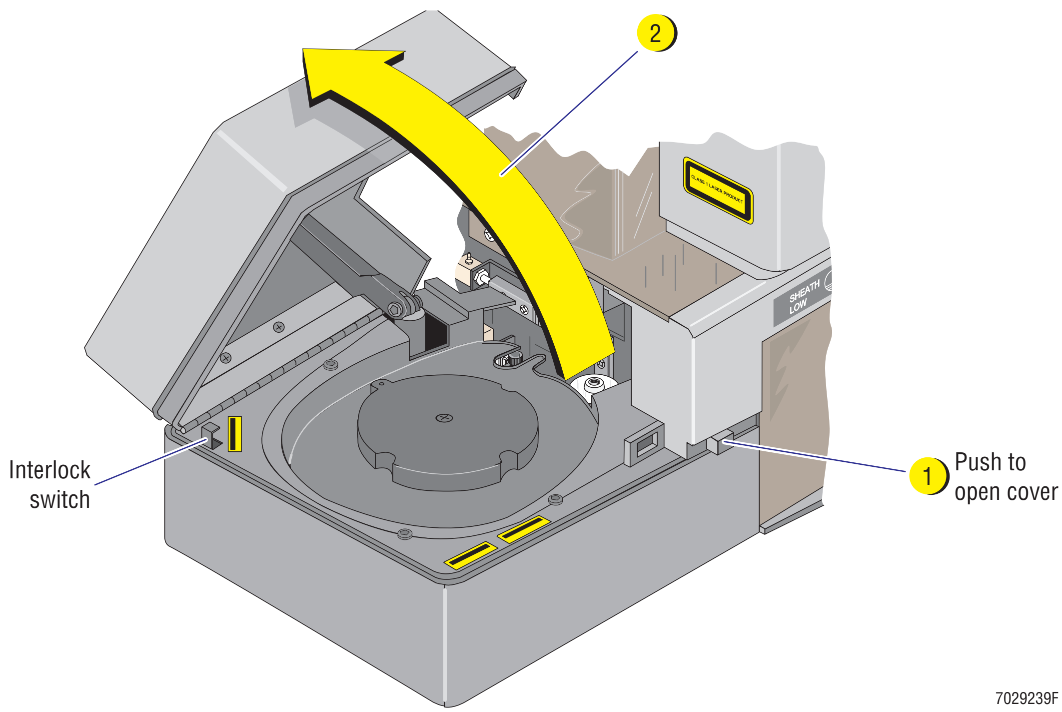
Tools/Supplies Needed

- ❑ 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.

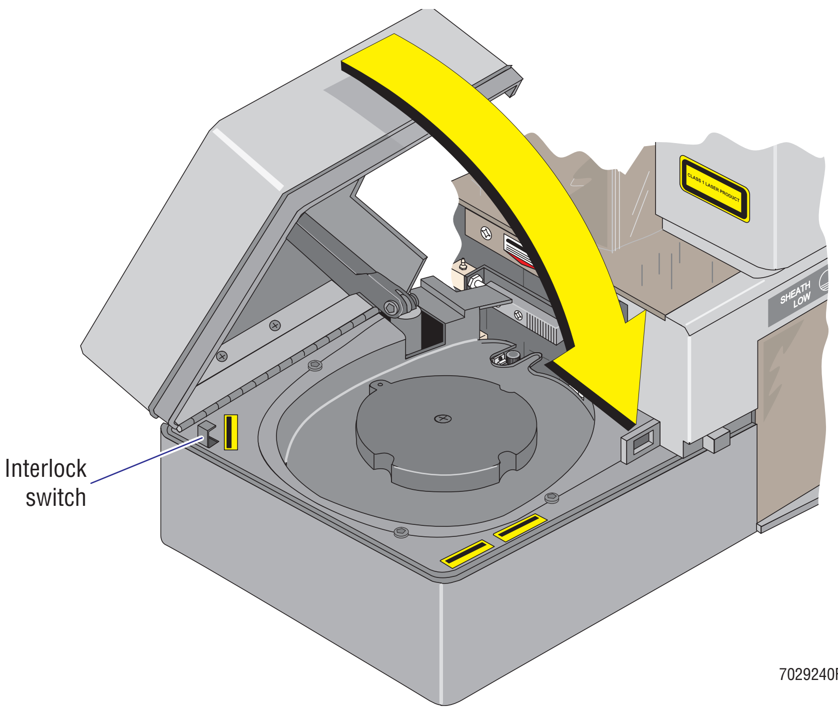
Always be very careful if you bypass this safety interlock and operate the instrument with the door open. The interlock switch is reset when the door is closed.

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

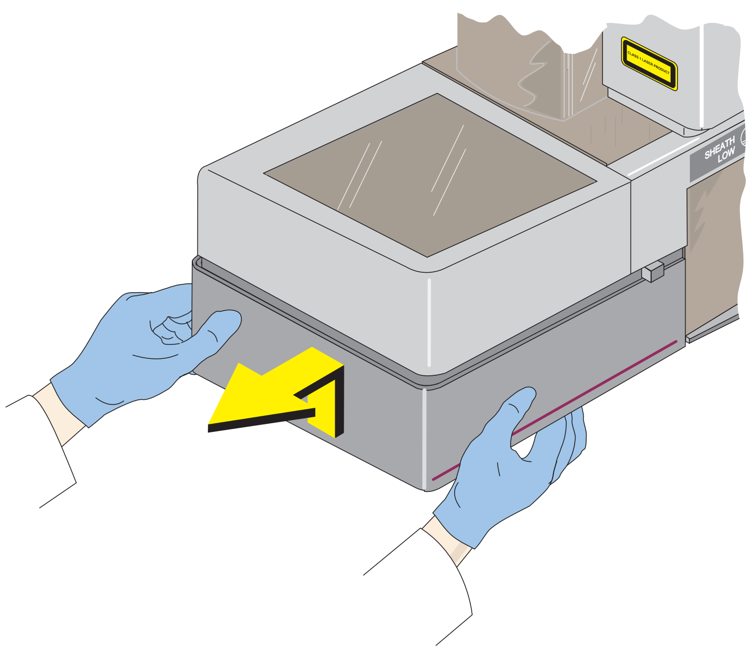
- ❑ None

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



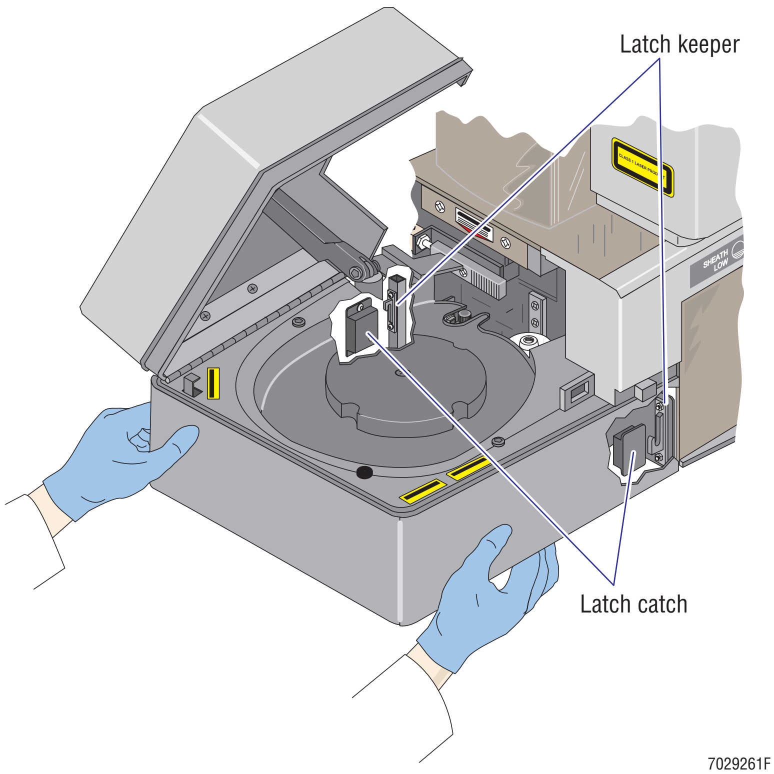
Relatching the MCL Covers

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.

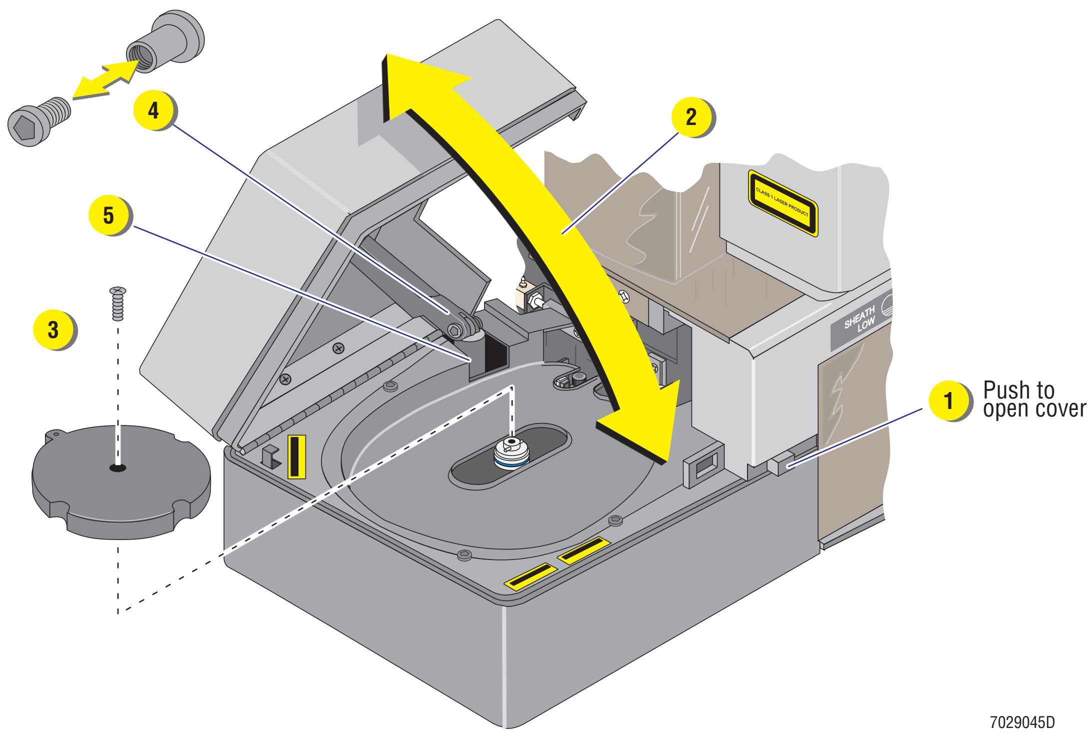
Tools/Supplies Needed

- ❑ 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.

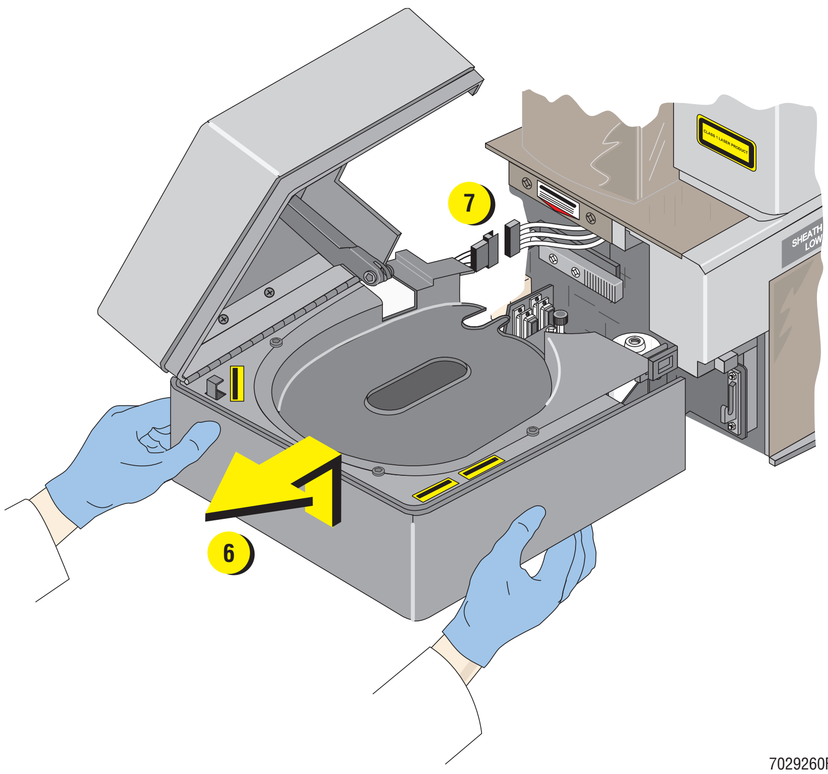
Figure 4.3-22 Removing the MCL Covers



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.

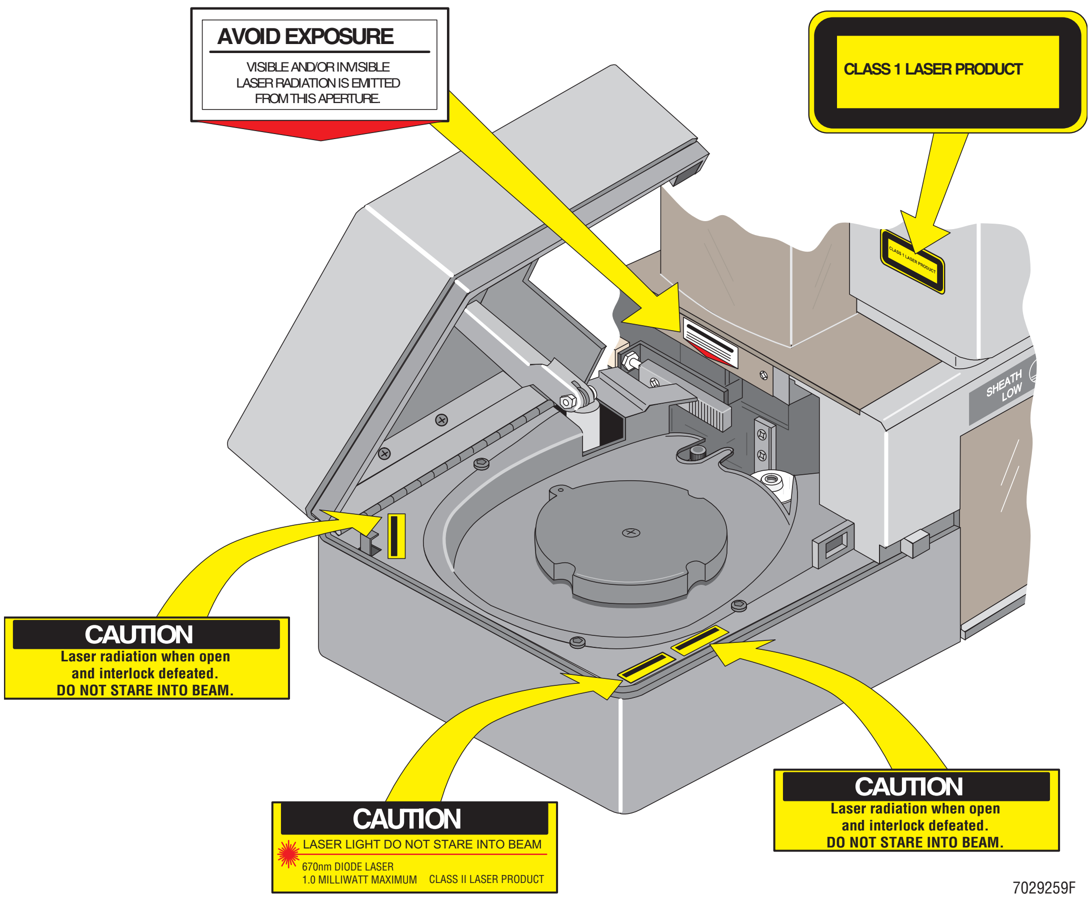
Tools/Supplies Needed

- ❑ 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.

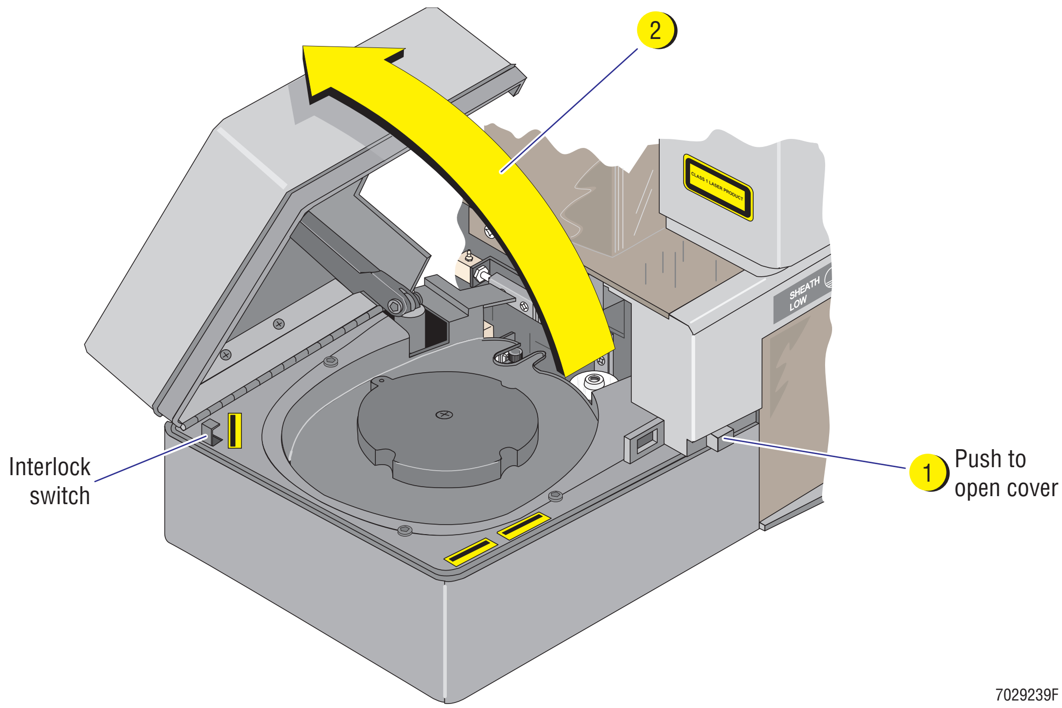
Figure 4.3-24 Laser Warning Labels - MCL Option and Probe Housing



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

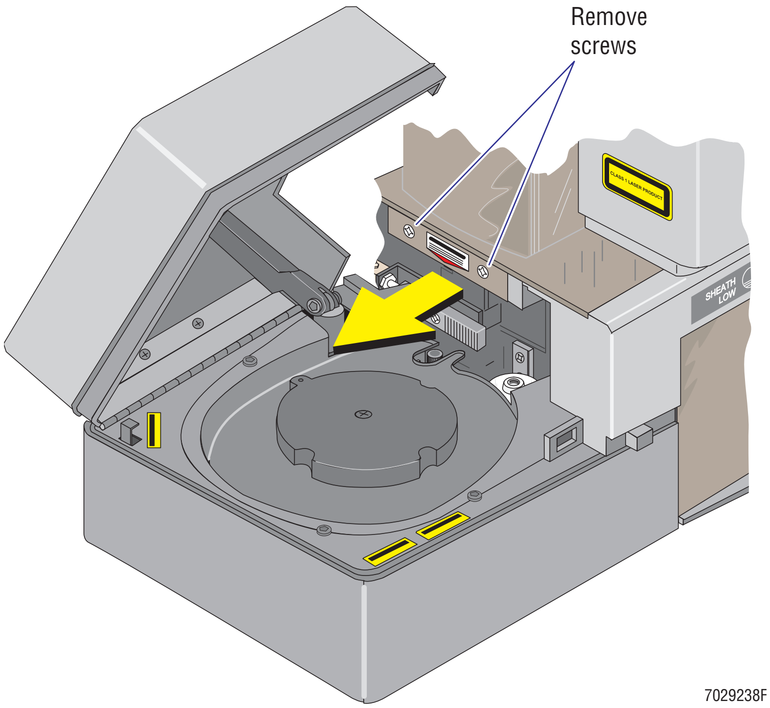


2. Push the door up to ensure it is fully open (Figure 4.3-25, item 2).

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



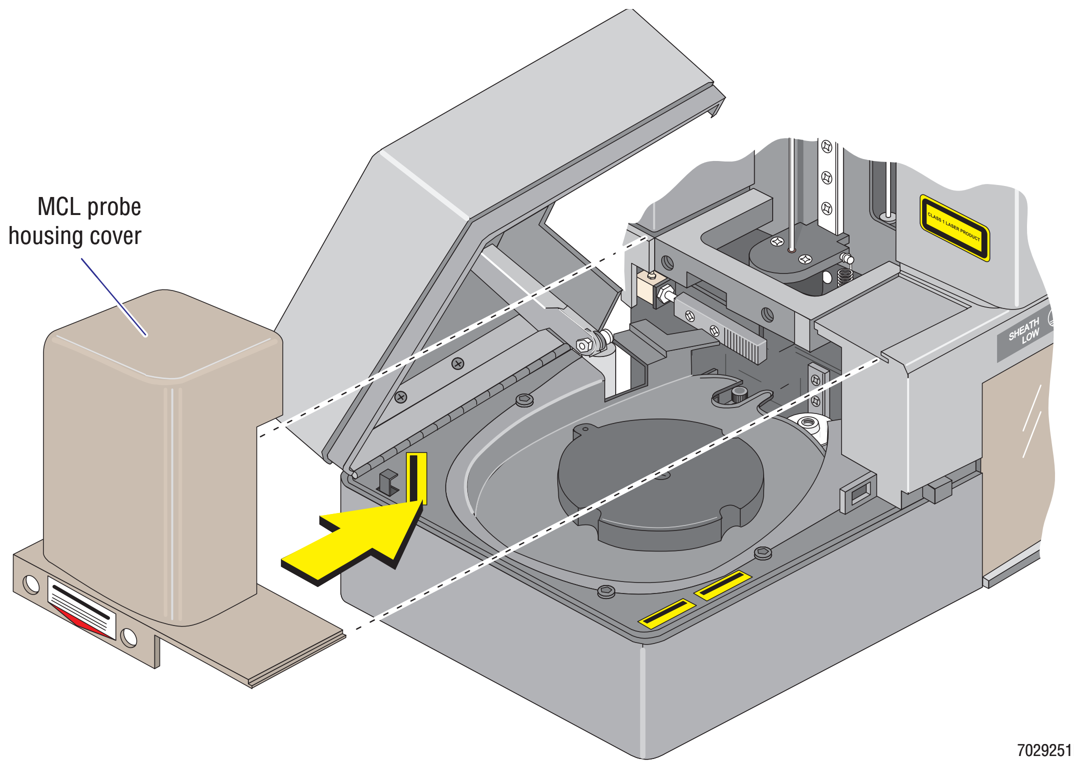
4. Slide the housing cover forward and remove it from the instrument.
5. Set the housing cover aside in a safe place where it will not be damaged.
6. Lower the MCL door. Listen for an audible snap as it closes.

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.

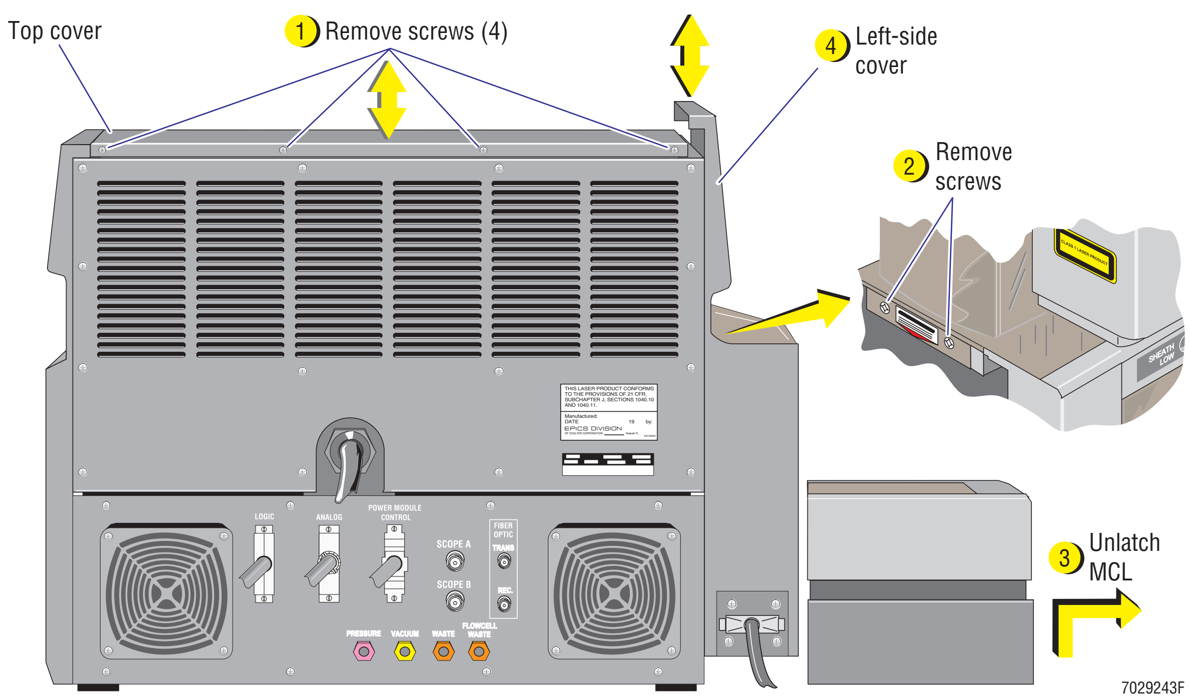
Tools/Supplies Needed

❑ 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.

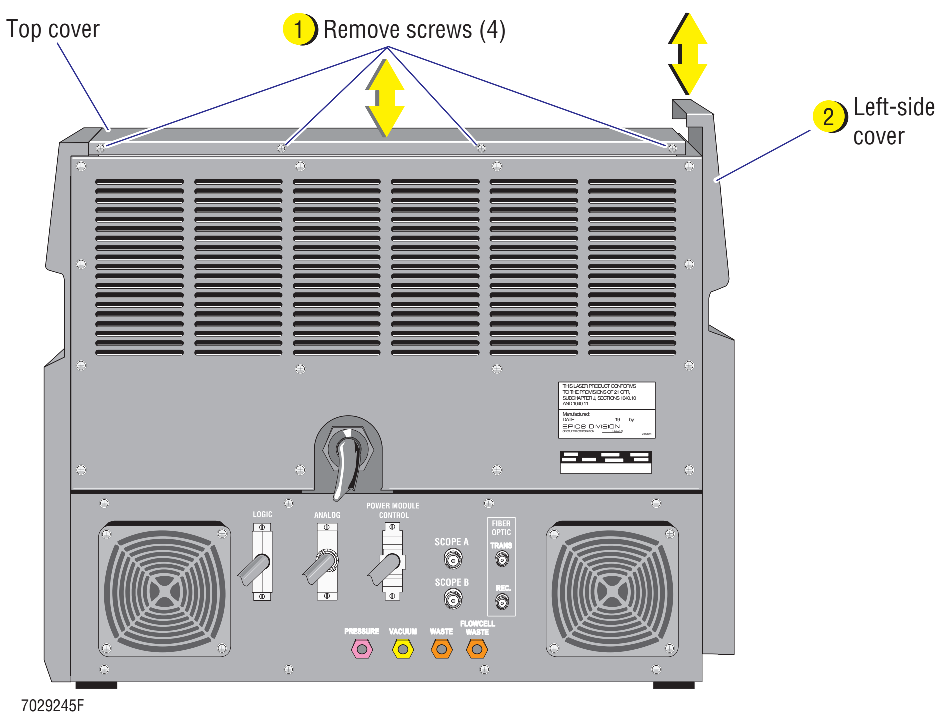
Tools/Supplies Needed

- ❑ 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

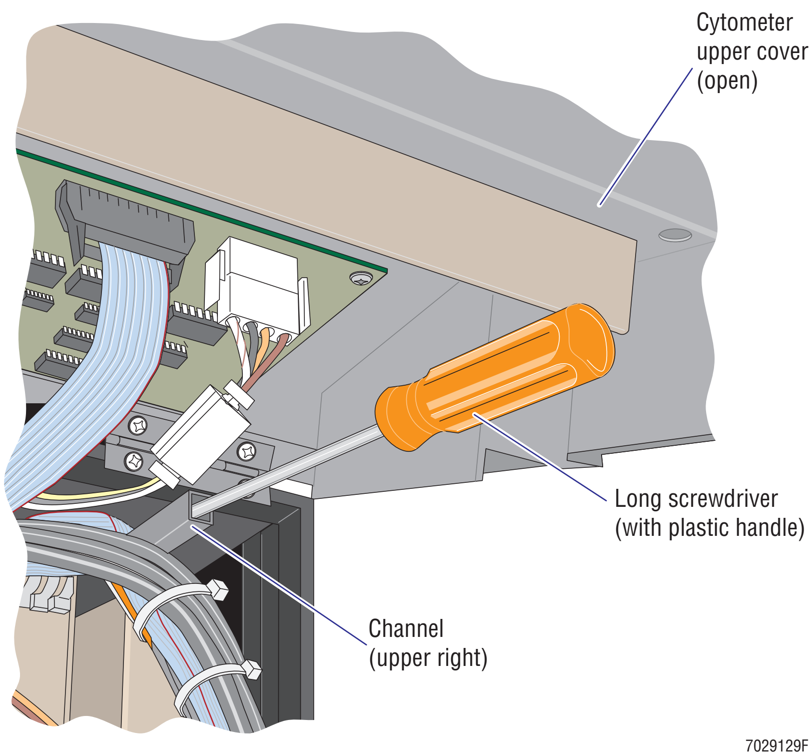
1. Remove the center front cover (filter cover).
   a. Grasp the curved outer edges of the center front cover (filter cover) and pull the cover forward (Figure 4.3-7).
   b. Set the cover aside in a safe place where it will not be damaged.
2. Slide the reagent drawer open.
   a. Verify the Cytometer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

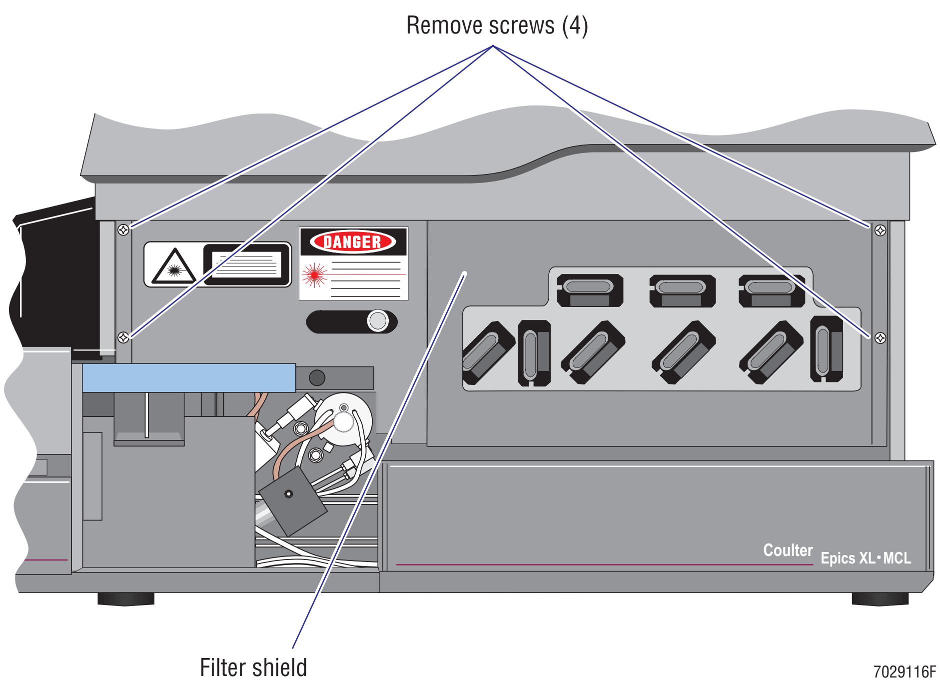
11. Lift the front panel display cover and place a long screwdriver (with a plastic handle) in the upper frame channel to brace the cover open (Figure 4.3-30).

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.

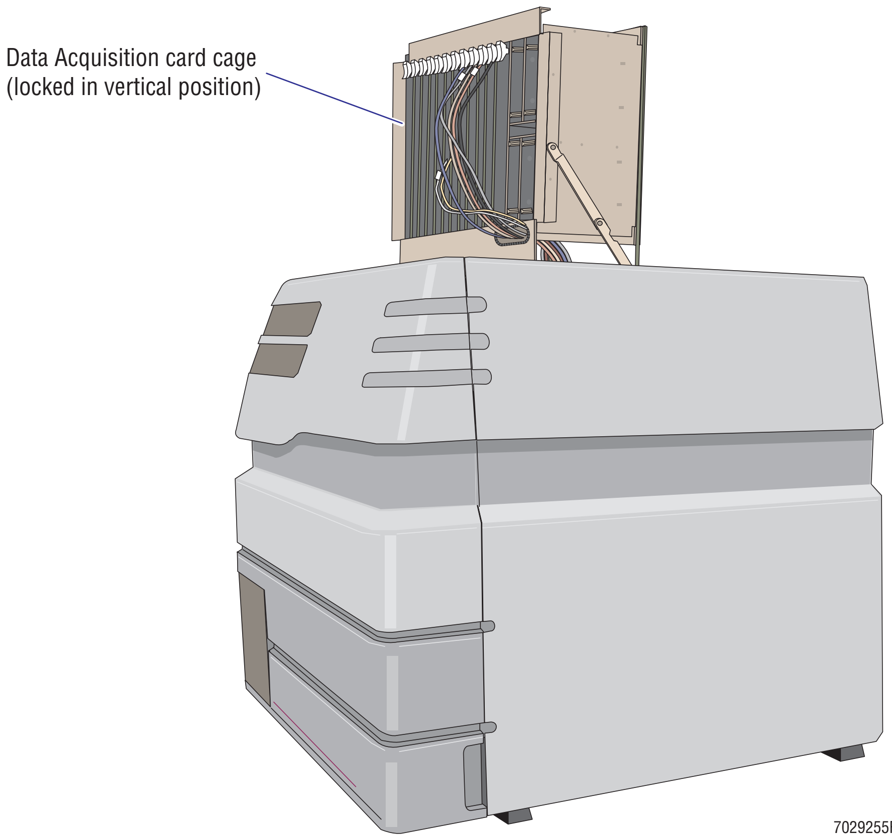
Tools/Supplies Needed

❑ 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.

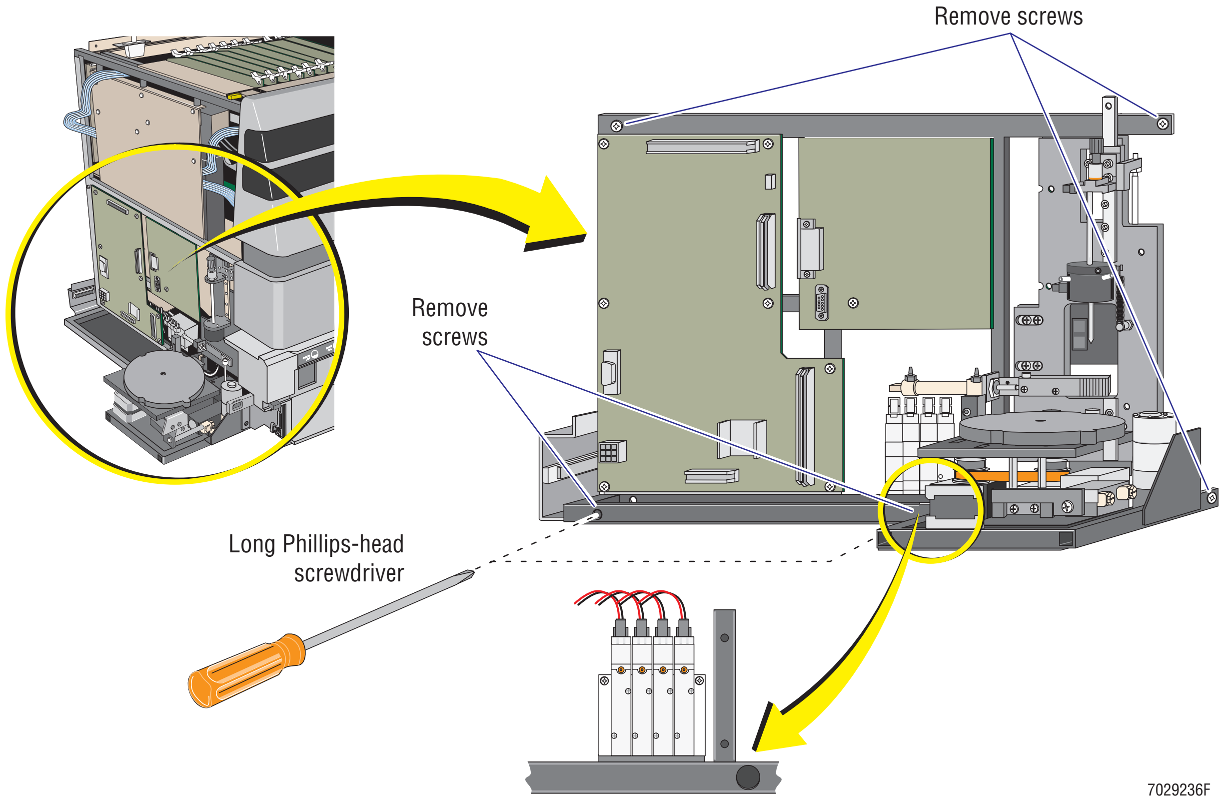
Removing the Lower Pneumatics Drawer on a Cytometer with the MCL Option Installed

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.

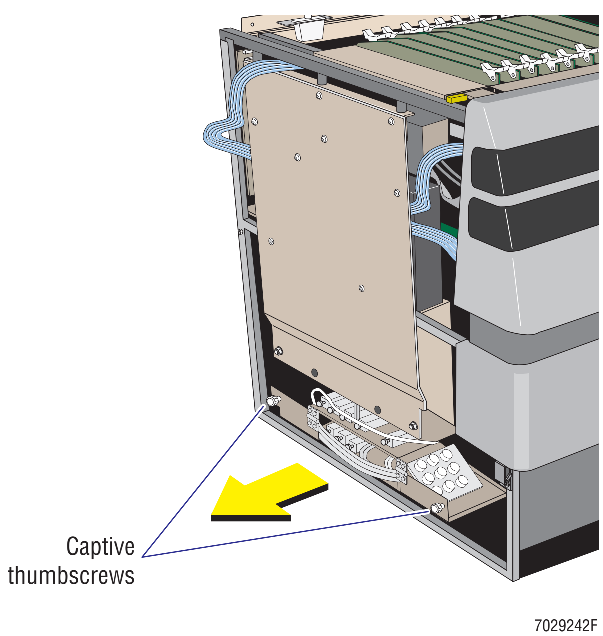
3. Slide the reagent drawer open.
   a. Verify the Cytometer is in the Idle mode.
      1) If the Cytometer is not in the Idle mode, press the RUN button (Figure 4.3-9).
      2) Wait about 10 seconds for the Cytometer to depressurize.
   b. Grasp the reagent drawer and pull the drawer forward until 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)

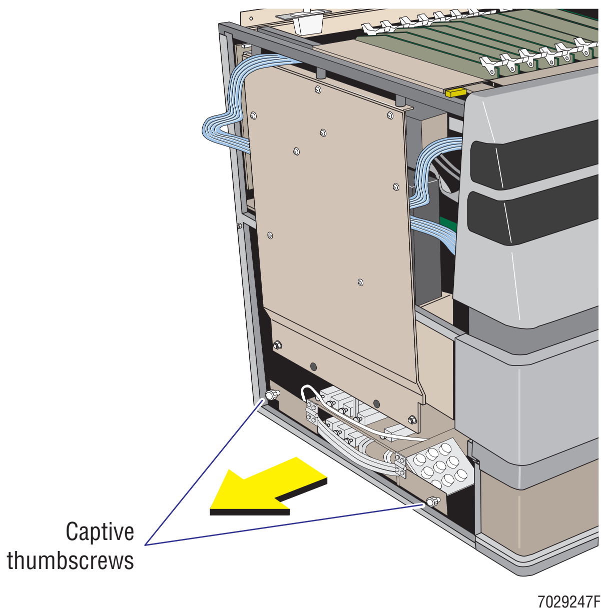


9. Loosen the captive thumbscrews (Figure 4.3-34).
10. Pull the lower pneumatics drawer out of the Cytometer.

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.

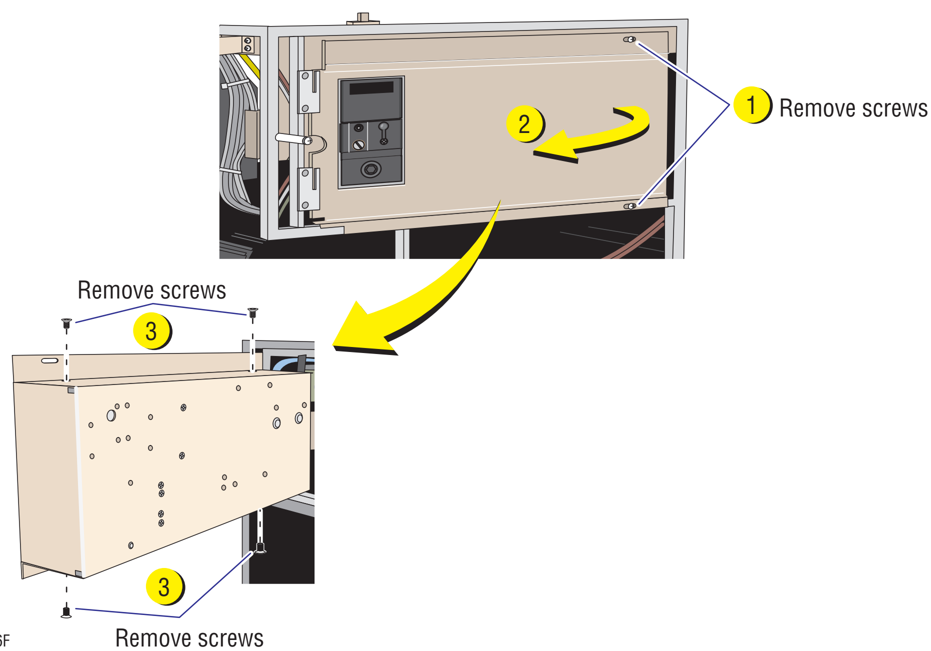
Tools/Supplies Needed

- ❑ 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

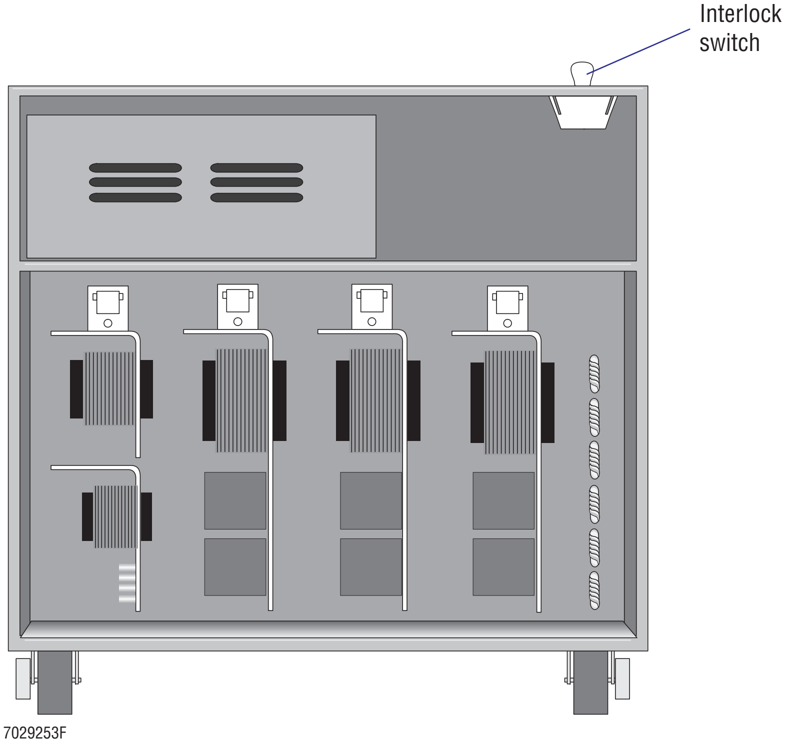
1. Power down the entire system. (This includes unplugging both ac power line cords from the wall outlet.)
   a. If SYSTEM II is the preferred operating system, under Heading 4.1, complete the three stages detailed under the Power Down Using SYSTEM II Software heading.
   b. If EXPO32 ADC is the preferred 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.

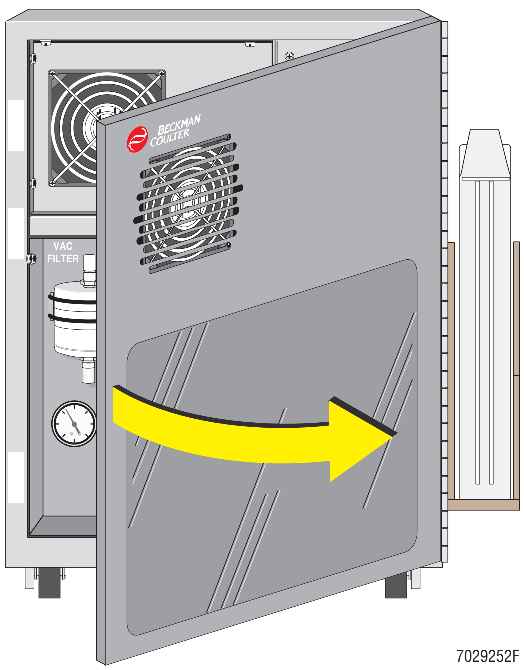
Tools/Supplies Needed

- ❑ 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:

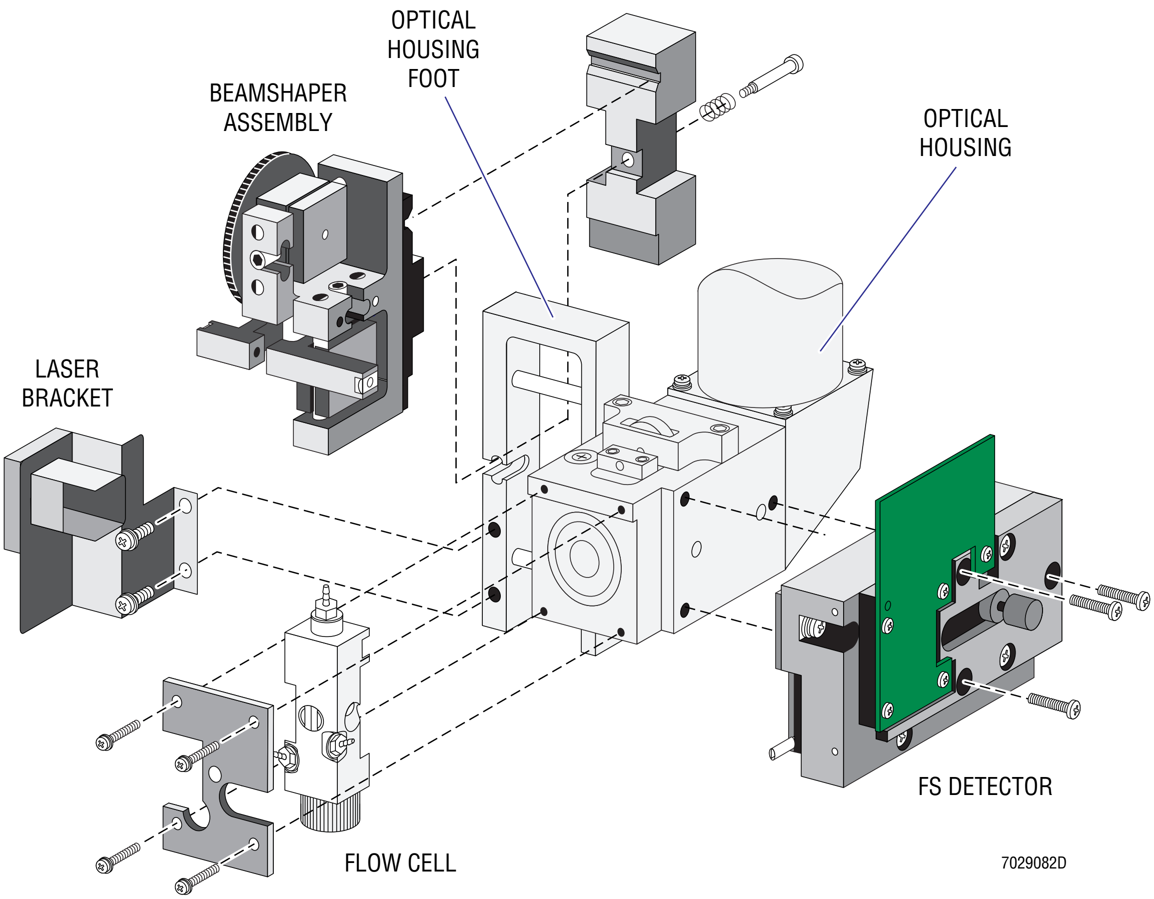
- Wear laser safety glasses as required by the wavelength being used.
- Pay attention to the warning labels.
- Do NOT wear jewelry that might reflect the laser beam.

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.

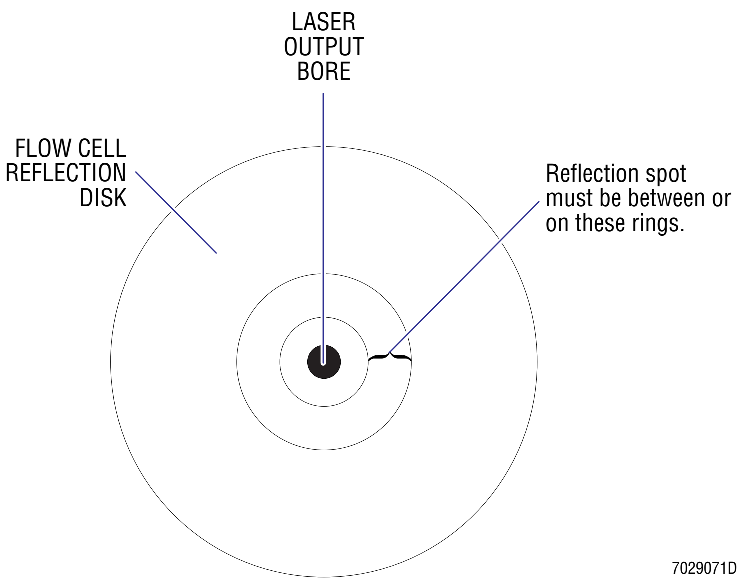
   Note: Pulling up on the Cytometer interlock switch allows the Argon laser to be energized.

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.

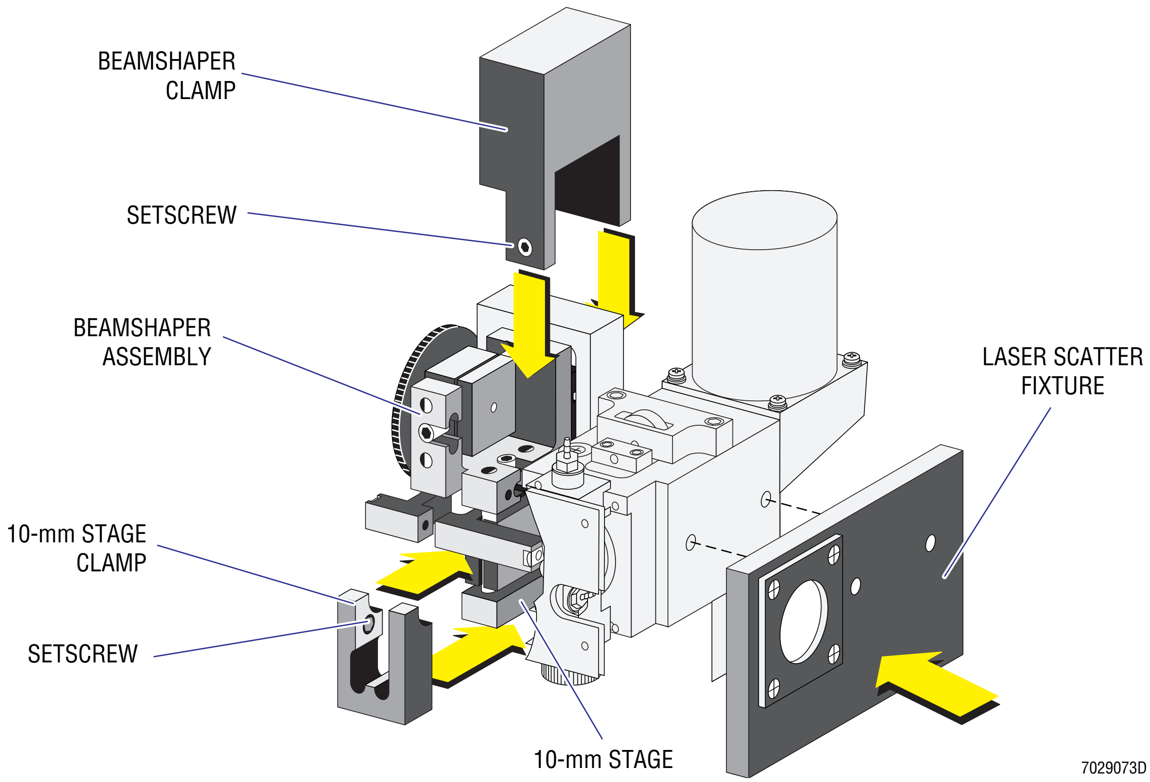
WARNING The laser beam can cause eye damage if the laser beam's path is viewed directly on the same viewing plane. Avoid direct exposure to beam. Do not view directly or with optical instruments except for special service instruments as directed in this service manual.

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

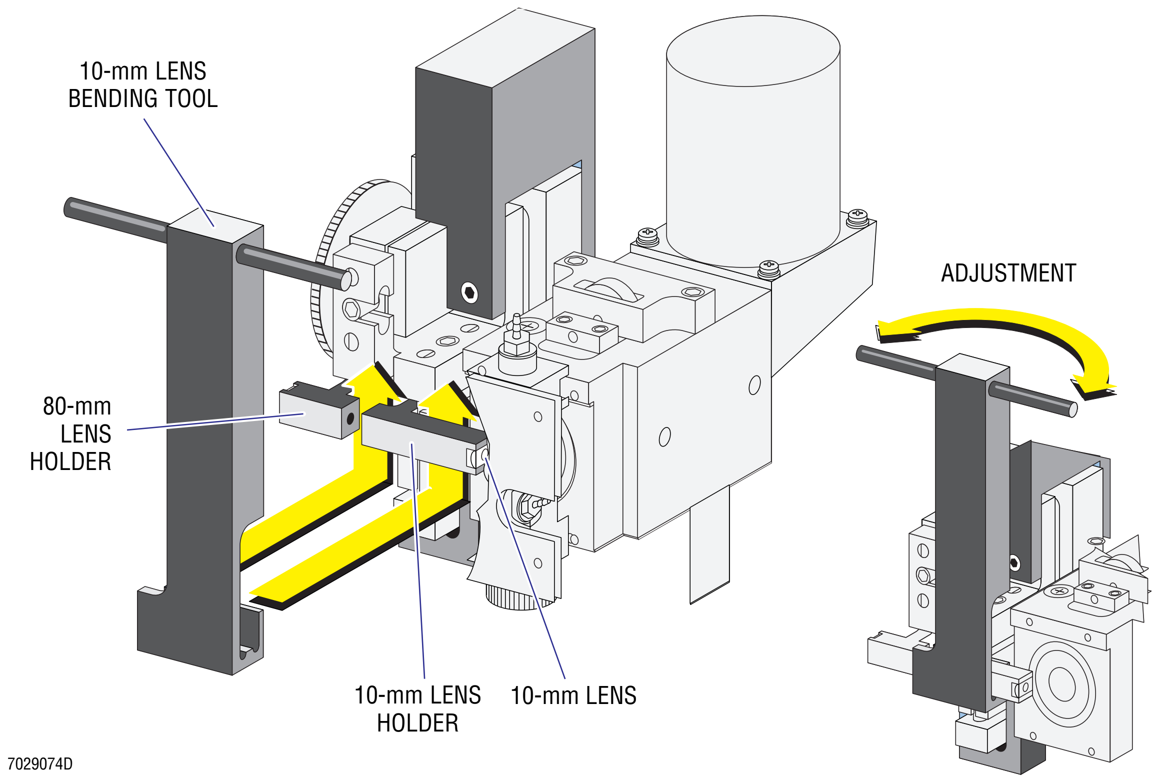


2. Install the beamshaper assembly onto the optical housing foot and secure it to the foot (Figure 4.5-1).
3. Install the beamshaper clamp over the optical housing assembly and secure it by tightening the setscrew (Figure 4.5-3).
4. Remove the FS detector (Figure 4.5-1) from the optical housing and install the laser scatter fixture (Figure 4.5-3).

Alignment

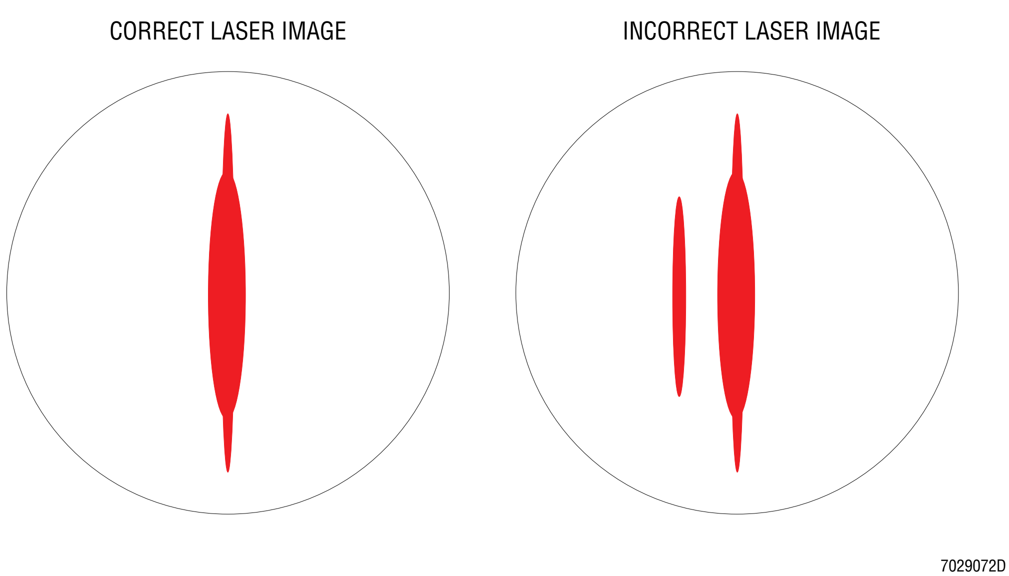
1. Insert the 10-mm lens bending tool into the 10-mm lens and tilt the bending tool forward so the tool remains in place and the laser beam is not clipped. Slip the bending tool in-between the 80-mm and 10-mm lens holders (Figure 4.5-4).

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.

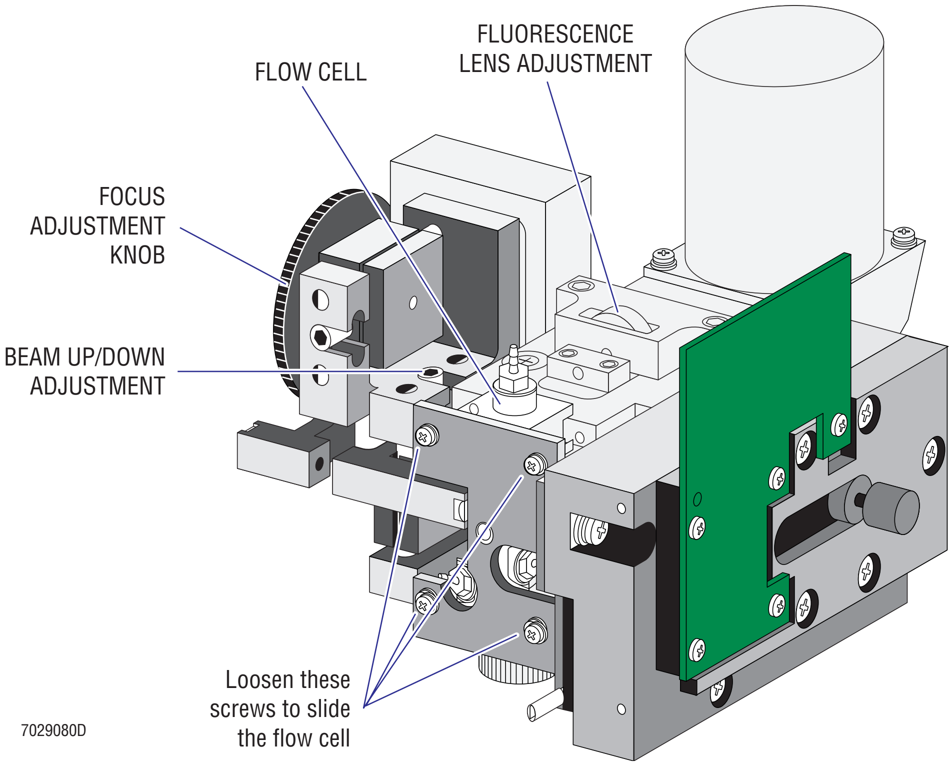
Table 4.6-1 Oscilloscope Settings

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



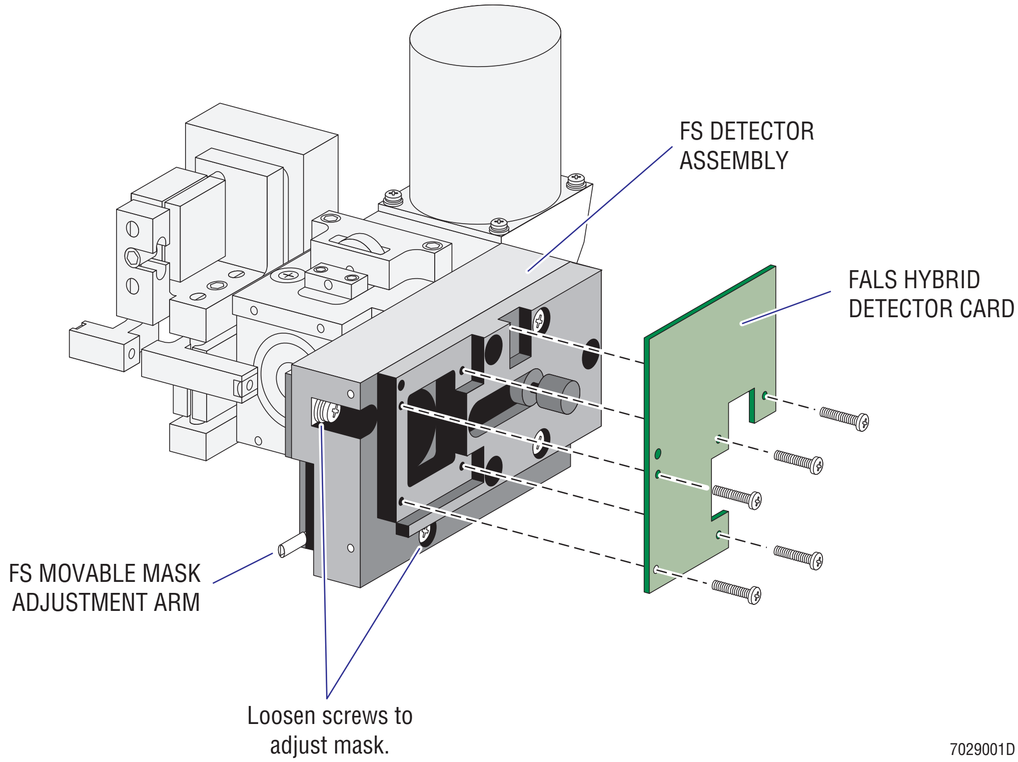
10. Repeat step 6 through 9 until the tightest pulse width for FS is observed.
11. Slide the flow cell slowly back and forth (Figure 4.6-1) until a fluorescent signal is present on the bar graph.
12. Using the L-handle Allen wrench, adjust the beam up/down until the maximum fluorescent signal is present.
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.

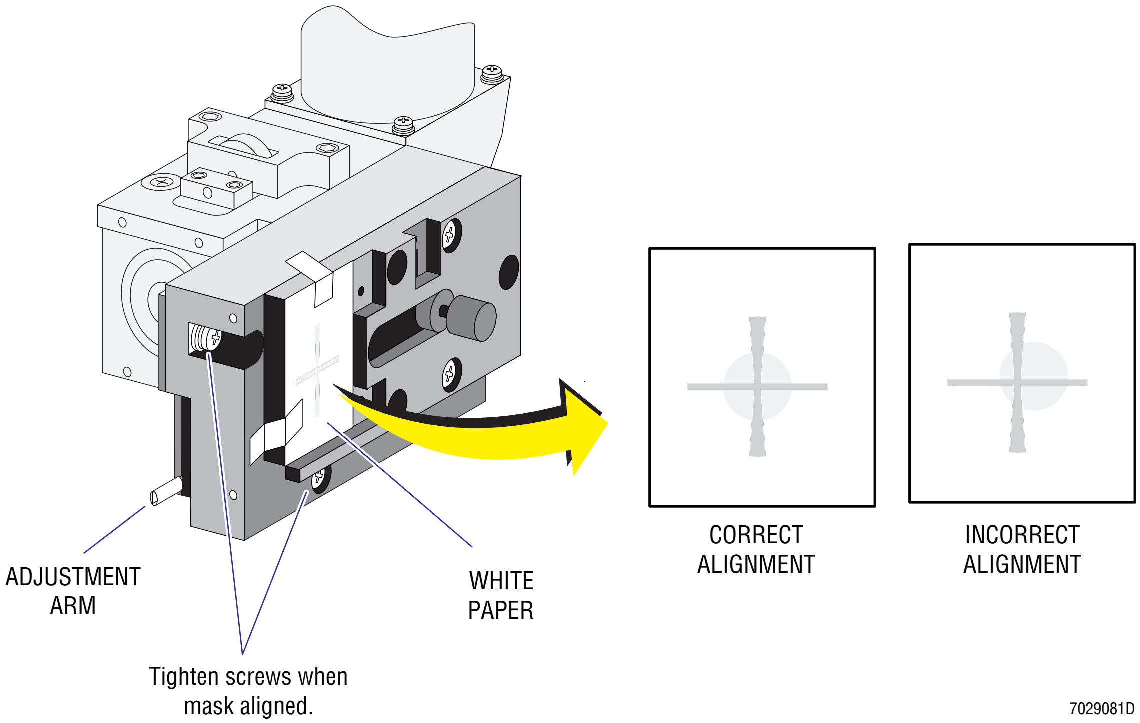
6. Remove the FALS Hybrid Detector card mounted to the FS detector assembly (Figure 4.6-2).

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

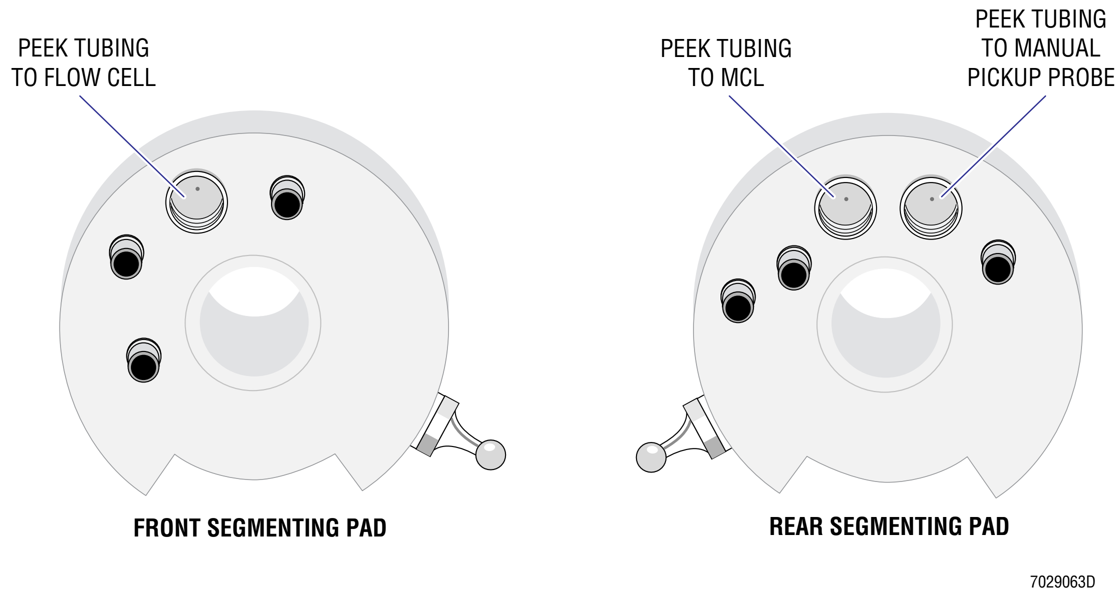
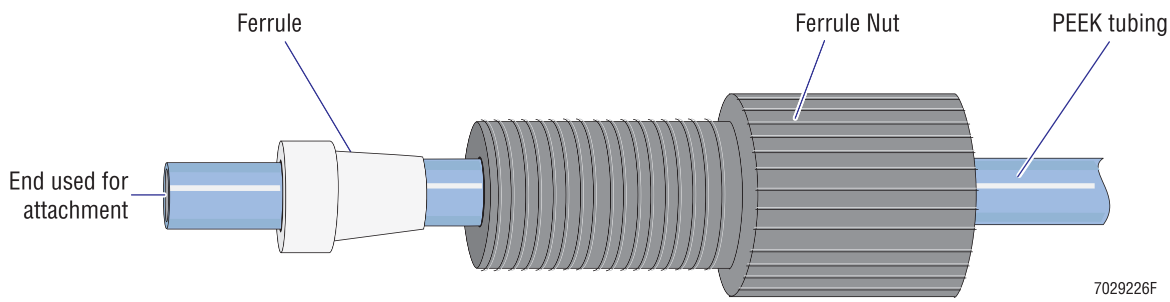


Figure 4.9-2 PEEK Tubing with Ferrule and Ferrule Nut



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.

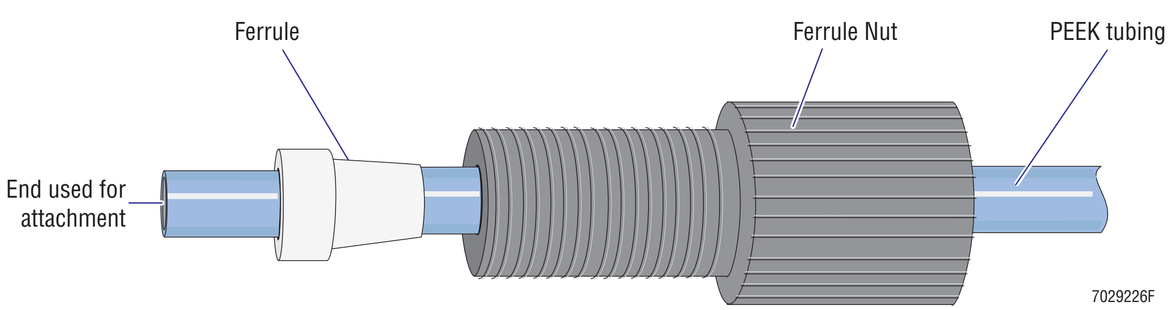
Removal

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

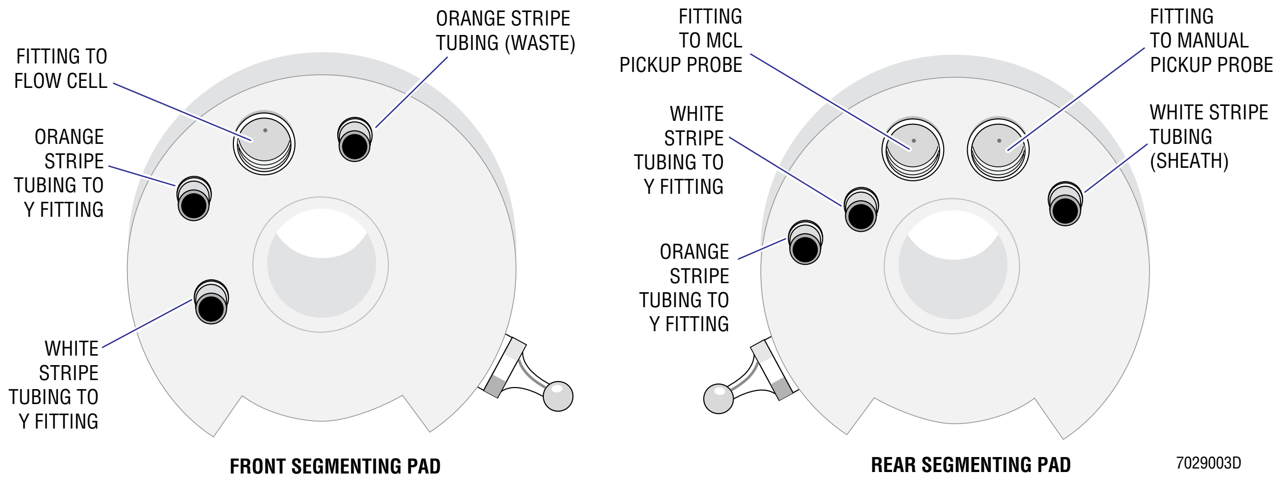
1. Turn the segmenting valve knob counterclockwise to remove the knob from the segmenting valve. To locate the segmenting valve knob, refer to Figure A.5-12 as needed.
2. Unscrew the black ferrule nut and remove the nut (with attached PEEK tubing and ferrule) from the front pad. Make sure the ferrule 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

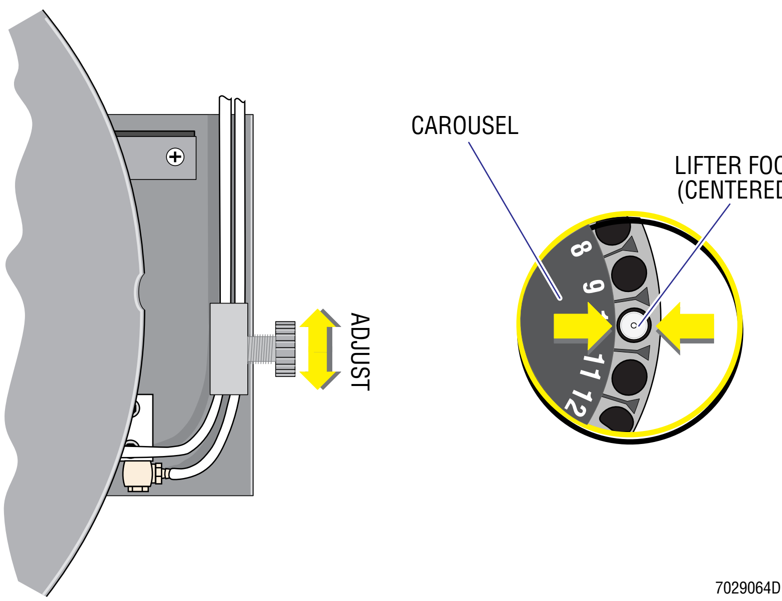
1. At the Prefinal Menu, select **MCL TERMINAL** and press Enter.
2. Place a carousel on the MCL turntable.

   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

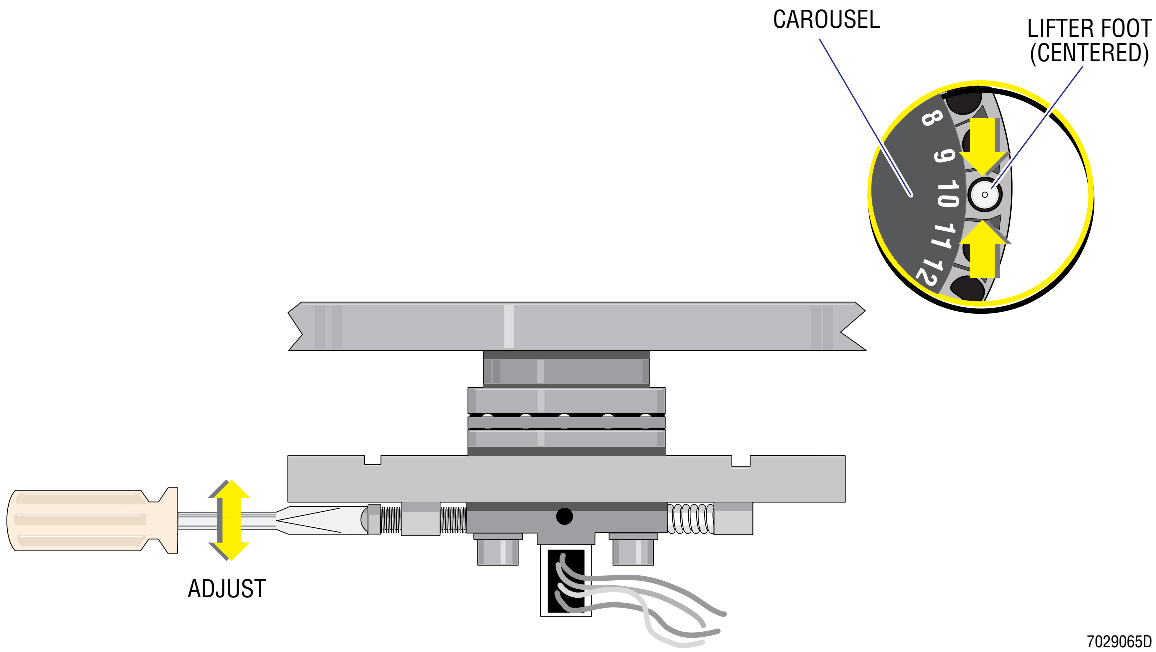
1. Insert a carousel with five test tubes installed in the first five carousel positions.
2. Press Esc, then type `CH`. The carousel rotates to the home position.
3. Press Esc, then type `CI`. The carousel moves in towards the MCL option probe.
4. Press Esc, then type `CR`. The carousel advances to position 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

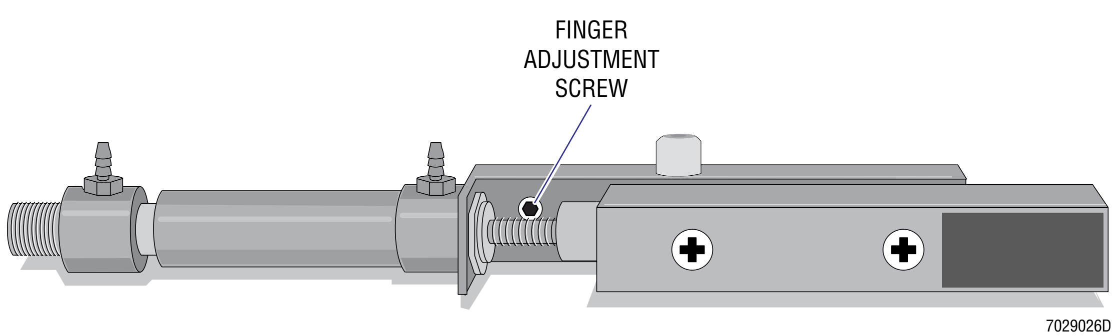


9. Press Esc, then type `LD`. The lifter lowers.
10. Press Esc, then type `CO`. The carousel moves out.
11. Press Esc, then type `CL`. The carousel moves back to the load position.
12. Repeat steps 7 and 8 (under this heading) until no further adjustments are necessary.

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).

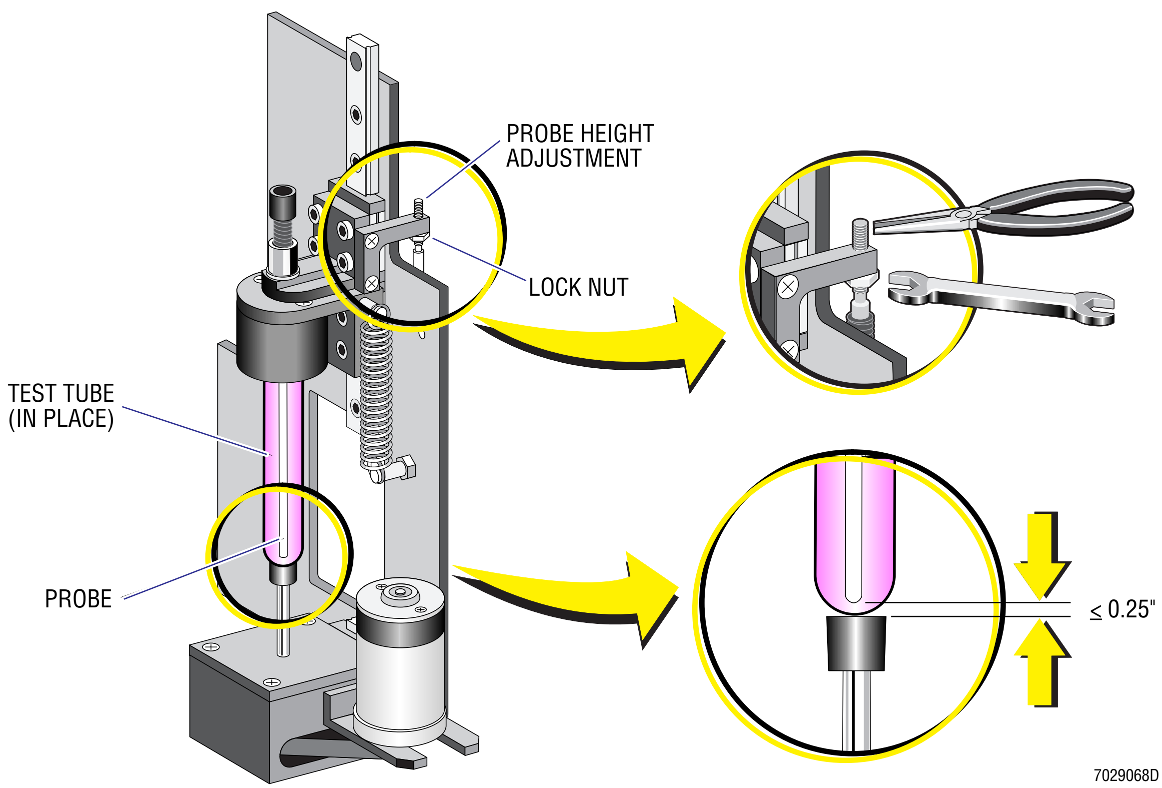
Figure 4.12-3 Finger Adjustment Screw



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

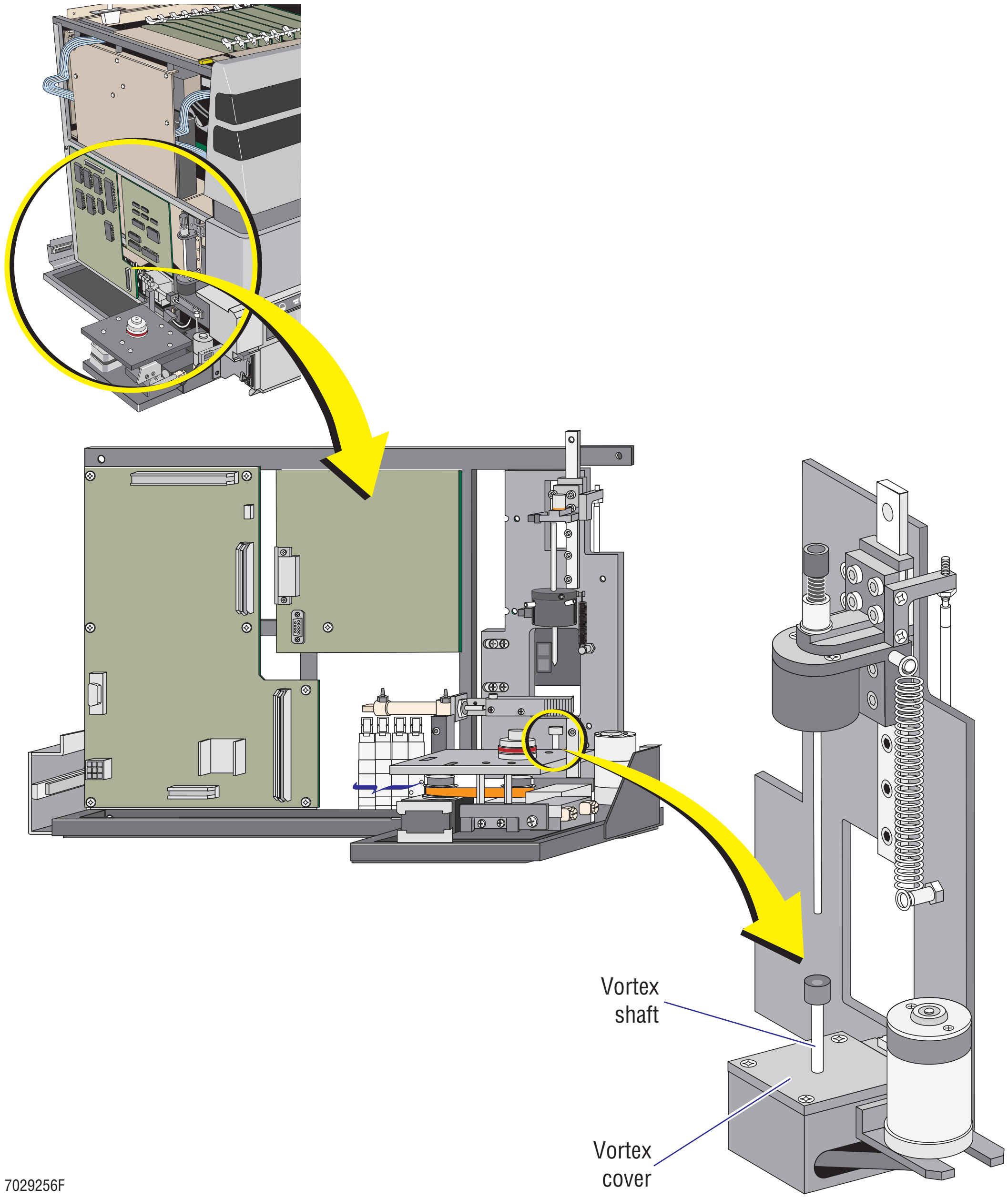
Preparation

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.

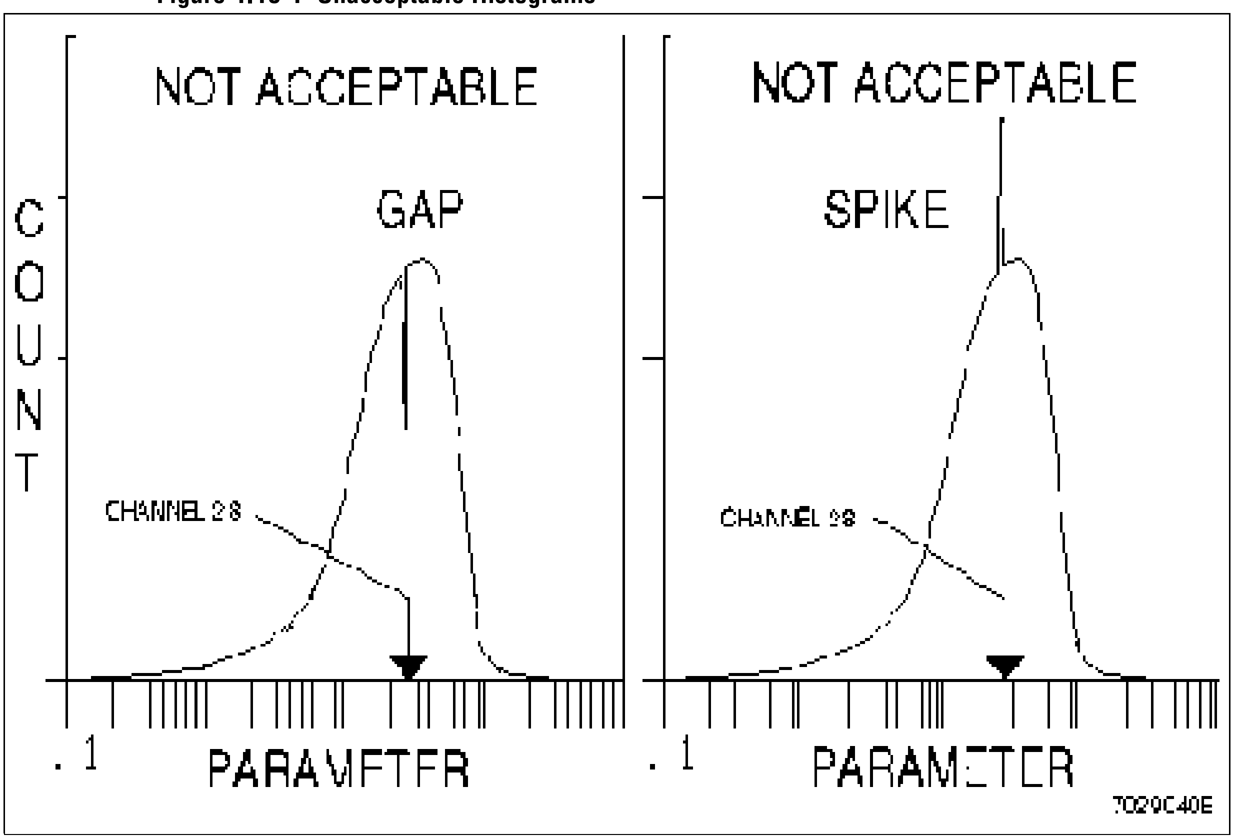
Table 4.15-1 LIN/LOG SWITCH POINT 1 TEST Protocol

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.

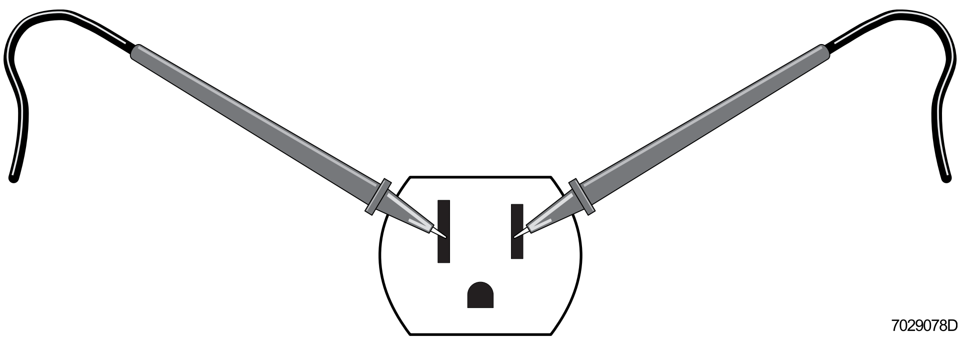
Tools/Supplies Needed

- ❑ 3-wire circuit analyzer, PN 2906883

Procedure

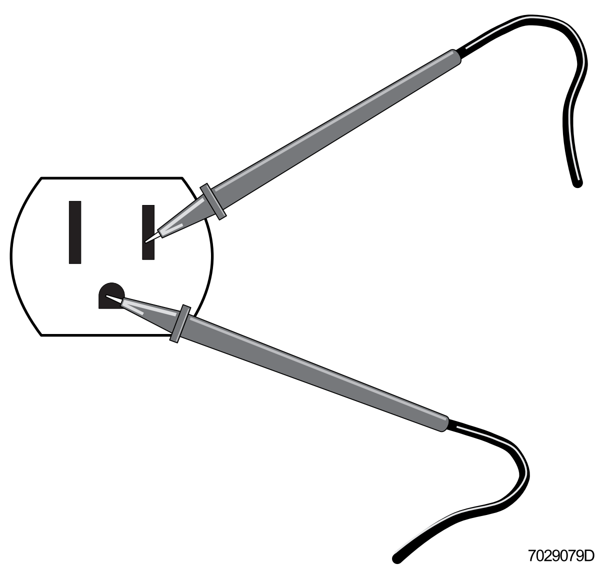
1. Place the 3-wire circuit analyzer's meter leads as shown in Figure 4.18-1. Record the reading.

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

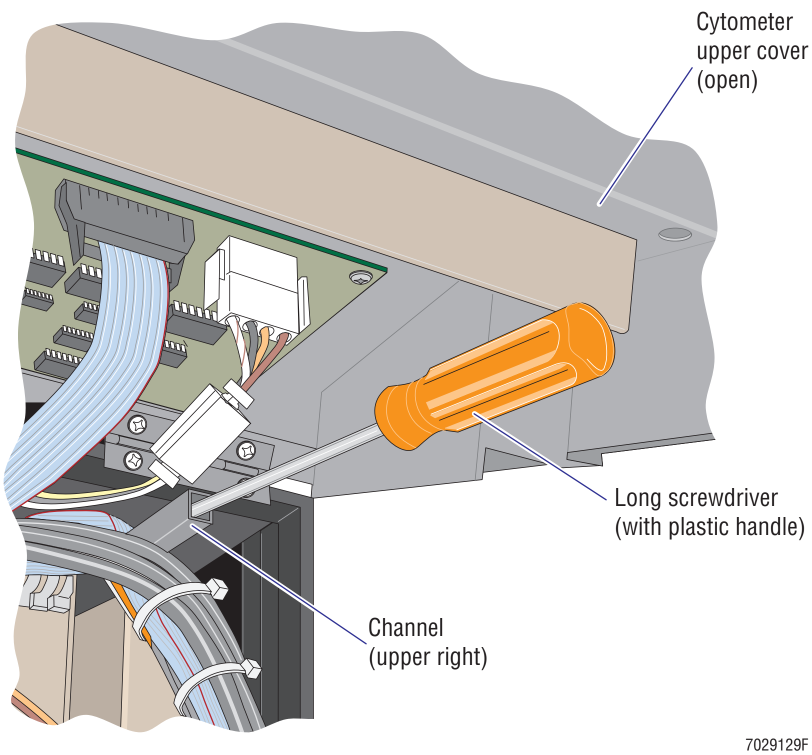
Preparation

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).

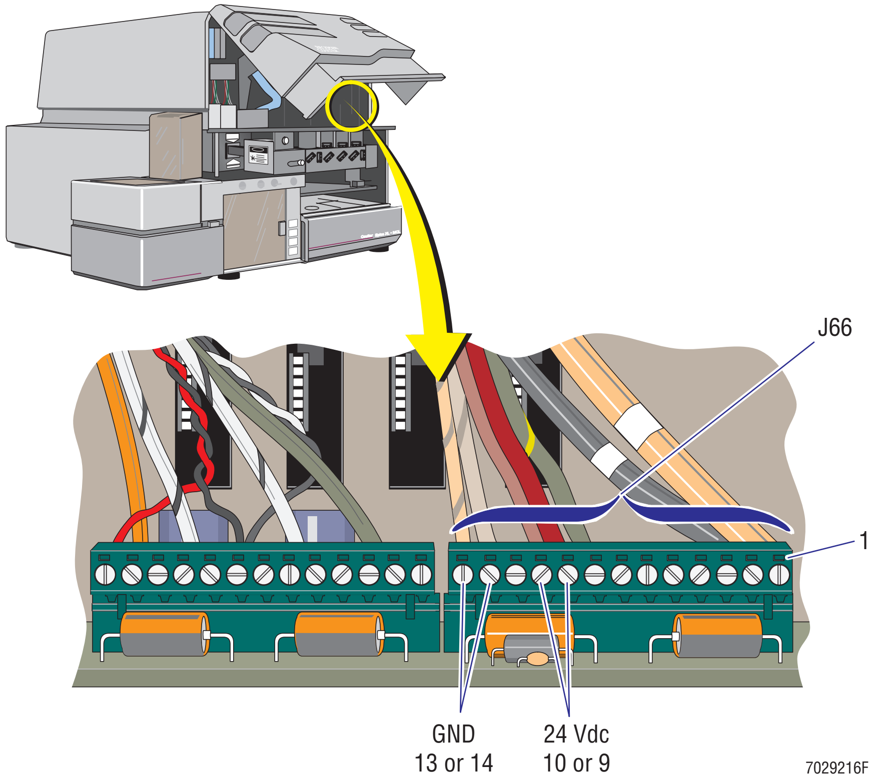
Figure 4.20-1 Use a Long Screwdriver to Brace the Upper Cover Open



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

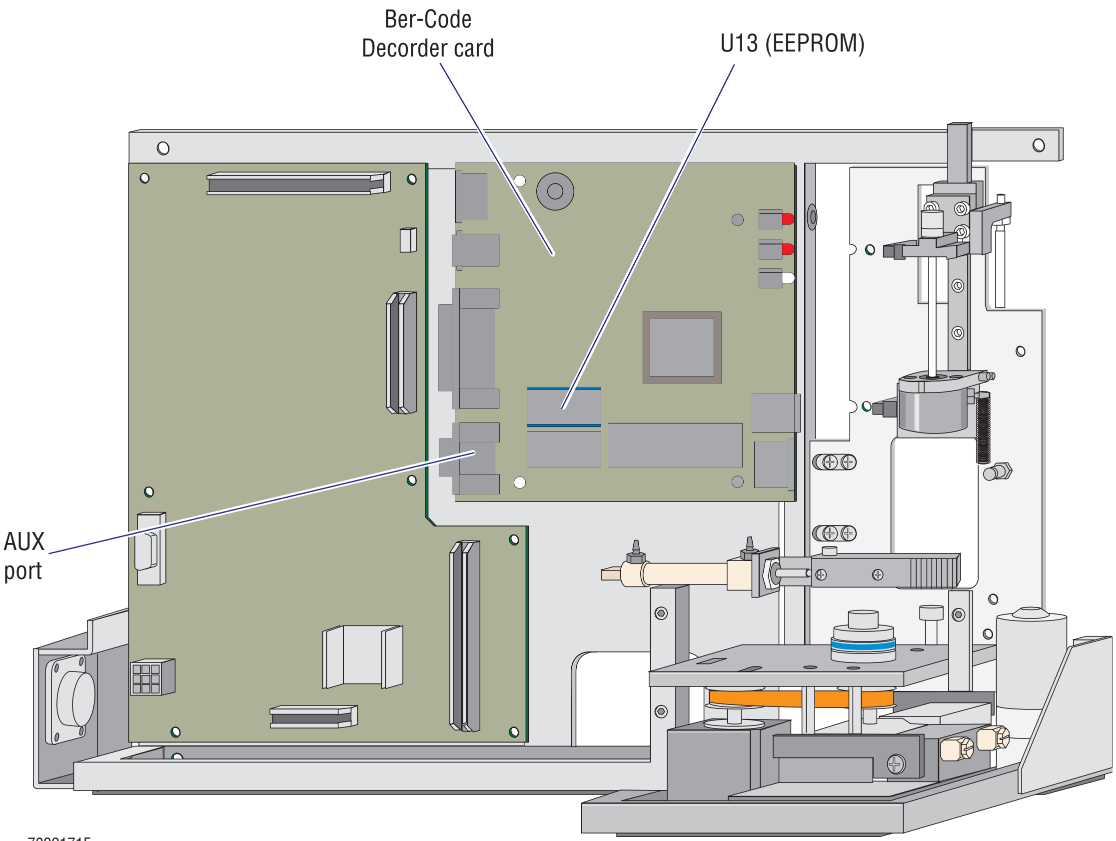
Preparation

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.

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 ______________________

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

6.1 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.

TABLES

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 *Cleanse level warning*	Low cleaning agent.	Fill cleaning agent container.
	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 stream warning*	Data acquisition hardware error.	Replace Trans Data Acquisition card.

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 *Sheath level warning*	Low sheath fluid.	Fill sheath container.
	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 *Vacuum chamber warning*	Waste in vacuum chamber.	Replace level sensor.
	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 protocol and/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 level warning*	Waste container full.	Empty waste container.
	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.

7.2 PREFINAL SERVICE SOFTWARE - A TROUBLESHOOTING TOOL

Purpose

Prefinal Service software can provide a valuable information for locating a problem. this software must be installed and operated using the guidelines provided under Heading 4.2, PREFINAL SERVICE SOFTWARE INSTALLATION AND OPERATION. In this section, the various tests available within this software are listed in alphabetical order, with a short description of the test, the areas of the instrument being checked, and suggestions on what to check if a test should fail. Table A.4-1 provides a quick reference of available tests.

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

Consult, as needed, the instructions for installing and operating the Prefinal Service Software under Heading 4.2, PREFINAL SERVICE SOFTWARE INSTALLATION AND OPERATION.

Note: This software is not intended to be a Pass/Fail for system performance. The SVP must be run after using the Prefinal Service software.

ADC Zero Adjust

ATTENTION: To perform this adjustment, you must prepare the Trans Data Acquisition card by removing the jumper from E1 to E2 and reinstalling it in position E2 to E3 and by placing the circuit card on a card extender which allows access to the adjustment potentiometer. Although the adjustment must be made using the card extender, the desired 0.3 to 0.9 mVdc reading must be obtained while the circuit card is not on the extender. The ADC Zero Adjust must be run anytime the Trans Data Acquisition card or an Amp/Signal Conditioner card is replaced. After running the ADC Zero Adjust, the Grand Canyon Adjust must also be run. Make sure the jumper is installed at E1 to E2 before performing the Grand Canyon Adjust.

Purpose

This test is used to adjust the ADC Zero on the Trans Data Acquisition card. The circuit card is first put on a card extender and E2 is jumpered to E3 to ground the input to the Sample/Hold and ADC circuitry. Potentiometer, R8, is then adjusted to obtain a 0.3 to 0.9 mVdc reading on the screen. The circuit card is then reinstalled without the extender. The test is run again to verify a 0.3 to 0.9 mVdc reading on the screen. If this is not the case, then the circuit card is extended again and adjusted again to get a 0.3 to 0.9 mVdc reading when the card is not on the extender. After the reading is obtained, the jumper must be moved back to the E1 to E2 position. After running the ADC Zero Adjust, the Grand Canyon Adjust must also be run.

Circuit Card Checked in this Test

- Trans Data Acquisition card

Response if Test Fails

- Jumper E2 to E3 may not be properly installed.
- Trans Data Acquisition card may be defective.

Amp Gain Control

Purpose

This selection controls the Amp/Signal Conditioner gain for all the signals.

At the Workstation keyboard, select the desired parameter (PMT1, PMT2, PMT3, PMT4, AUX, FS, or SS) using the ↑ or ↓ key. This selection does not provide a PASS or FAIL message. Press Page Up to increase the gain or Page Down to decrease the gain as needed. While adjusting the amplifier gain, observe the response of the bar graph for the parameter being adjusted.

Circuit Cards Checked in this Test

- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, PMT4, AUX, FS, and SS

Response if Test Fails

- Amp/Signal Conditioner card may be defective.

Amp Saturation Test

Purpose

This test verifies the R164 adjustment is not set too low. If set too low, the pulse before the integrator will saturate before the INTEGRAL output saturates. This is hard to detect because as the pulse before the integrator saturates more, the output of the integrator will increase because the pulse width will increase. A gain of 2 should produce a 5 V pulse while a gain of 5 should produce a 10 V pulse.

Circuit Cards Checked in this Test

- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, PMT4, AUX, FS, and SS

Response if Test Fails

- One of the Amp/Signal Conditioner cards may be defective. **Do not adjust R164. This is a factory adjustment.** Replace the circuit card as instructed under Heading 4.15, AMP/SIGNAL CONDITIONER CARD REPLACEMENT AND/OR CALIBRATION.

Attenuator Control

Purpose

This selection controls the Amp/Signal Conditioner card attenuator for all signals.

At the Workstation keyboard, select the desired parameter (PMT1, PMT2, PMT3, PMT4, AUX, FS, or SS). This selection does not provide a PASS or FAIL message. Use the ↑ or ↓ key to select the parameter. Using the following information as a reference, determine the desired change then press the key designated to produce that change.

Desired Change	Key to Activate Change
To increase attenuation by 10.0%	Press Page Up
To decrease attenuation by 10.0%	Press Page Down
To increase attenuation by 1.0%	Press Home
To decrease attenuation by 1.0%	Press End
To increase attenuation by 0.1%	Press Insert
To decrease attenuation by 0.1%	Press Delete

While adjusting the attenuation, observe the response of the bar graph for the parameter being adjusted.

Circuit Cards Checked in this Test

- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, PMT4, AUX, FS, and SS

Response if Test Fails

- Amp/Signal Conditioner card may be defective.

Beeper Test

Purpose

This test ensures that the beeper on the Cytometer is working properly.

Circuit Card Checked in this Test

- Cyto Transputer card

Response if Test Fails

- Cyto Transputer card may be defective.
- Beeper may be defective.

  Note: This beeper is located on the Cytometer frame, not on the Cyto Transputer card.
- Interconnecting cable from the Analyzer backplane to the beeper is defective.
- Sound port, P67, may be defective.

Canyon Jumper Test

Purpose

This test ensures that the RAMP jumper (E4 to E5) is installed on each Amp/Signal Conditioner card. If the jumper is properly installed on each card, PASS is displayed. If a jumper is not properly installed on a Amp/Signal Conditioner card, the screen freezes with the name of the parameter displayed in red.

Circuit Cards Checked in this Test

- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, PMT4, AUX, FS, and SS

Response if Test Fails

- Install E4 to E5 jumper.

Count Rate Test

Purpose

This test checks the count rate register on the Trans Data Acquisition card. It should read approximately 4.0 kHz. This test provides a PASS or FAIL response.

Circuit Card Checked in this Test

- Trans Data Acquisition card

Response if Test Fails

- Replace the Trans Data Acquisition card.

DMA Acquisition - Not Used

Front Panel Test

Purpose

This test ensures the indicators on the front panel display and the sample station switches (RUN, AUTO, PRIME, and CLEANSE) are working properly. The bar graph signals for the indicators on the front panel display come from the Trans Data Acquisition card. The signals for the other indicators and the sample station switches come from the Cyto Transputer card.

Note: The AUTO switch is present only if the MCL option is installed.

To start, press ↑ and look at the front panel display to ensure the test is functioning. Use the ↑ or ↓ key to move to the next indicator to be checked. A dash (—) indicates the switch is inactive; an asterisk (*) indicates the switch is activated.

Circuit Cards Checked in this Test

- Top Panel Display 2 card
- Front Panel LED and Switch Input 2 card (in the sample station of an XL-MCL Cytometer)
- Front Panel LED and Switch Input card (in the sample station of an XL without the MCL option)
- Interconnecting cable from the Analyzer backplane to the Front Panel LED and Switch Input 2 card or Front Panel LED and Switch Input card, as applicable
- Cyto Transputer card (front panel display indicators and sample station switches)
- Trans Data Acquisition card (bar graphs)

Response if Test Fails

Note: If the malfunction involves the bar graphs, you may want to perform the Pulse RAMP Test.

- Top Panel Display 2 card may be defective.
- Front Panel LED and Switch Input 2 card (in the sample station of an XL-MCL Cytometer) or Front Panel LED and Switch Input card (in the sample station of an XL without the MCL option) may be defective.
- Interconnecting cable from the Analyzer backplane to the Front Panel LED and Switch Input 2 card or Front Panel LED and Switch Input card may be defective.
- If only the front panel display indicators and/or sample station switches are malfunctioning, the Cyto Transputer card may be defective.
- If only the bar graphs are malfunctioning, the Trans Data Acquisition card may be defective.

General Information

This screen lists the operation assigned to the various function keys.

Function Key	Operation
F1	Begin All Tests
F2	Loop All Tests
F3	Loop Single Test
F4	Help
F5	Quick Test
F6	Loop on Error Enable/Disable
F7	System Configuration
F8	Manual I/O
F9	No assigned operation
F10	Exit to DOS

Grand Canyon Adjust

ATTENTION: The Grand Canyon Adjust must be performed anytime the Trans Data Acquisition card or an Amp/Signal Conditioner card is replaced. Always run the ADC Zero Adjust **before** doing this adjustment. Before starting is adjustment, remove jumper E4 to E5 from any Amp/Signal Conditioner card being tested.

Purpose

This test is used to adjust the Gap/Spike on the Amp/Signal Conditioner card for each parameter (PMT1, PMT2, PMT3, PMT4, AUX, FS, and/or SS). This is done by adjusting potentiometer R34 on each Amp/Signal Conditioner card to obtain a reading as close to 00.000 mV as possible. The acceptable range is 00.000 to -05.000 mV. A slightly negative reading within the green display range is better than positive due to a possible positive thermal drift. Jumper E4 to E5 must be removed from any Amp/Signal Conditioner card before making an adjustment. Select the parameter to be adjusted using ↑ or ↓.

Circuit Cards Checked in this Test

- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, PMT4, AUX, FS, and SS

Response if Test Fails

- Amp/Signal Conditioner card may be defective.
- Trans Data Acquisition card may be defective.
- Make sure the ADC Zero Adjust was done on the Trans Data Acquisition card prior to performing the Grand Canyon Adjust.

Grand Canyon Test

Purpose

This test quick checks the Gap/Spike adjustment on the Amp/Signal Conditioner cards.

Circuit Cards Checked in this Test

- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, PMT4, AUX, FS, and SS

Response if Test Fails

- Grand Canyon Adjust may need to be done.
- Trans Data Acquisition card may have been adjusted after the Grand Canyon Adjust rather than before the Grand Canyon Adjust.
- One or more of the amplifiers on the Amp/Signal Conditioner cards have drifted.

Histogram Test

Purpose

This test checks the histograms generated by the ADC on the Trans Data Acquisition card. It checks for gaps between channels of a normal distribution.

- To select the parameter to test, press ← or →, as applicable.
- To select the number of bits used to generate the histogram, press ↑ or ↓, as applicable.
- To start the histogram building process which culminates with displaying the histogram on the Workstation screen, press Enter.
    - The histogram is normalized to the center of the screen.
    - Each channel on the screen corresponds to an ADC channel at the resolution selected.
- To return to the selection screen, press Esc.

Initialize System

Purpose

This selection is used to power up the system before any amplifier operation. This command waits for the dc restorers on the amplifier cards to stabilize and then servos the pulse on each card to 5.0 V. All cards are initialized to a known state.

Circuit Cards Checked in this Test

- Cyto Transputer card
- Trans Data Acquisition card
- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, PMT4, AUX, FS, and SS

Response if Test Fails

- Amp/Signal Conditioner card may not be triggering conversion.
- Trans Data Acquisition card may not be converting.

Laser Control

Purpose

This selection controls the laser. The laser can be turned ON and OFF through this screen. The power and current from the laser are monitored and displayed on the screen.

Options

At the Workstation keyboard, select the desired option using the ↑ or ↓ key then press the designated key to produce the desired change.

Laser Current Option	Key to Activate Change
To increase laser current by 10.0 Amps	Press Page Up
To decrease laser current by 10.0 Amps	Press Page Down
To increase laser current by 1.0 Amp	Press Home
To decrease laser current by 1.0 Amp	Press End
To increase laser current by 0.1 Amp	Press Insert
To decrease laser current by 0.1 Amp	Press Delete
Laser Power Option	
To increase laser power by 10.0 mW	Press Page Up
To decrease laser power by 10.0 mW	Press Page Down
To increase laser power by 1.0 mW	Press Home
To decrease laser power by 1.0 mW	Press End
To increase laser power by 0.1 mW	Press Insert
To decrease laser power by 0.1 mW	Press Delete
Laser Control Option	
Toggle the laser ON/OFF	Press Enter

Components Checked in this Test

- System Interface card
- Argon laser head
- Argon laser power supply

Response if Test Fails

- System Interface card may be defective.
- Argon laser head may be defective.
- Argon laser power supply may be defective.

Laser Warm Up

Purpose

This selection shows the warm-up characteristics of the laser. It plots the laser current versus time on the Workstation screen.

Lock Up Test - Not Used

MCL Bar Code Head Test

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 the beam directly. Make sure the laser exit port is pointed away from your eyes.

Purpose

This test checks the bar-code head to ensure it is working. It is used to check a replacement head before complete installation. The replacement head must be plugged in but does not need to be mounted to perform this test. It simply enables the head to scan and reports the scanner results on the Workstation screen.

MCL Bar Code Test

Purpose

This test allows the adjustment of the bar-code head to allow the reading of the carousel number label and the carousel position labels. The scan is centered in both labels. The spacebar on the Workstation keyboard is used to move the carousel to the two positions.

MCL Burn In

Purpose

This selection cycles the MCL through a carousel continuously. A carousel full of sample tubes with bar-code labels is used to perform this test. All errors are reported on the Workstation screen.

Error Index Numbers

Each error represents a specific error array element.

Error Message	Error Index Numbers
ERROR_MCL_DISABLED	0X00000001
ERROR_DOOR OPEN	0X00000002
ERROR_LASER DISABLED	0X00000004
ERROR_OUT_OF_BOUNDARIES	0X00000008
ERROR_PROBE_MOVE	0X00000010
ERROR_RLV_MOVE	0X00000020
ERROR_CAROUSEL_HOME	0X00000100
ERROR_CAROUSEL_MOVE	0X00000200
ERROR_CAROUSEL_LABEL	0X00000400
ERROR_CAROUSEL_TURN	0X00000800
ERROR_TUBE_POSITION	0X00001000
ERROR_TUBE_FLUNG	0X00002000
ERROR_TUBE_JAMMED	0X00004000
ERROR_UPLOAD	0X00010000
ERROR_RAM	0X00020000
ERROR_ROM	0X00040000
ERROR_CPU	0X00080000
ERROR_SERIAL 1_SEND	0X00100000
ERROR_SERIAL 1_RCV	0X00200000
ERROR_SERIAL 2_SEND	0X00400000
ERROR_SERIAL 2_RCV	0X00800000
ERROR_PARALLEL_SEND	0X01000000
ERROR_PARALLEL_RCV	0X02000000
ERROR_REQUEST	0X80000000

MCL Carousel Label

Purpose

This test checks that the carousel labels are readable and in the proper positions.

MCL Carousel Status

Purpose

This selection ensures that the MCL Carousel Tube Position and Home sensors are working properly.

Test Sequence

1. The carousel is stepped until the Home sensor goes inactive then active. If this does not take place within a full revolution, an error is reported.
2. The carousel is stepped until the Tube Position sensor goes inactive then active. If this does not take place within eight steps, an error is reported.

Response if Test Fails

- Home sensor may be defective.
- Tube Position sensor may be defective.

MCL Door Switch Test

Purpose

This test ensures that the MCL Door Status is working. It reports the current condition of the MCL door.

Response if Test Fails

- MCL door switch may be defective.
- A cable associated with the MCL door may be defective.

MCL Finger Test

Purpose

This test allows the adjustment of the sample tube rotation finger. The spacebar on the Workstation keyboard is used to cycle the carousel in and out to allow access to the finger for adjustment.

MCL Home Align

Purpose

This test is used to adjust the MCL carousel Home position. The Home sensor is adjusted to align the Home rotational position to its proper place. The carousel in/out adjustment screw is used to adjust the home in/out position.

Summary of Test Sequence

The keyboard spacebar is used to step the MCL through a two step adjustment procedure. The sequence is to place the carousel on the hub and to home the carousel. The position is checked and the Spacebar pressed to move the carousel out of the way to access the carousel in/out position screw. The cycle is repeated until no further adjustments are necessary.

MCL Manual Control

Purpose

This selection allow manual control over the MCL movements. The MCL sensor status is also reported.

Sensor Status

- A dash (—) indicates the sensor is inactive.
- An asterisk (*) indicates the sensor is activated.

Controls

- To select what moves, press the ↑ or ↓ key as needed.
- To toggle movement, press Enter as needed.

MCL Mix Test

Purpose

This test ensures the mix motor is functioning properly. A carousel with a tube of water is placed in position 1 for this test. The MCL will continuously mix this sample until stopped by the user.

MCL Pneumatic Status

Purpose

This selection ensures that the pneumatic cylinder movement sensors are working properly. Each cylinder is moved and the sensor status for that cylinder is monitored. Each of the sensors are blocked as the cylinder is moving and becomes unblocked when the cylinder is fully extended or fully contracted. The probe up/down cylinder is an exception. It is unblocked in the fully extended position.

Sensor Status

- A dash (—) indicates the sensor is inactive (blocked).
- An asterisk (*) indicates the sensor is activated (unblocked).

Response if Test Fails

- Sensor may be defective.
- Air cylinder may be stuck.
- Valve may be defective.

MCL POWER UP Status

Purpose

This selection causes the MCL to do a system reset which causes it to go through its normal power up reset diagnostics. This is the same command the Cytometer software uses to power up the MCL. The result message is then displayed on the Workstation screen. If any errors are encountered, they are reported.

Response if Test Fails

- MCL position sensors may be defective.
- Air cylinder may be stuck.
- One or more valves may be defective.

MCL Probe Align

Purpose

This selection allows the adjustment of the probe height inside the sample tube. The keyboard spacebar is used to cycle the probe up and down.

MCL ROM Test

Purpose

This selection ensures that the ROM in the MCL CPU card is working properly and is the correct version. The ROM is compared to a file on the test disk to ensure that it is the same. The ROM version is also reported.

Response if Test Fails

- MCL ROM may be defective.
- MCL ROM may be an incorrect version.

MCL Scan Reliability

Purpose

This test ensures the reliability of the bar-code reader. A fully loaded carousel with bar-code labels is used for this test. Bad reads are reported on the Workstation screen. The carousel is run continuously until stopped by the user.

MCL Stepper Noise Test

Purpose

This test continuously homes the carousel until stopped by the user. The stepper noise is monitored to ensure it is not excessive.

Response if Test Fails

- Stepper motor may be defective.
- Motor belt may be too tight.

MCL Terminal

Purpose

This selection allow <ESC> codes to be sent to the MCL through the Cytometer parallel port. The MCL can then be controlled manually using its most primitive commands.

Commands

Perform a system reset before running any of these commands.

- MCL_RESET_CMD is activated by pressing Esc M R.
- MCL_VER_LEVEL_CMD is activated by pressing Esc M V.

Any attempt to run a System Level, Carousel Movement, Door, TLV, Sampling Probe, Bar-code Scanner, or High Level command without first resetting the system will be ignored; however, Status and Diagnostic commands do not have this same safeguard and may be run without first resetting the system. As a result, use the Status and Diagnostic commands with caution!

Commands		Keystrokes to Initiate
System Level Commands **Note:** Perform a system reset before running any of these commands. MCL_RESET_CMD (Esc M R) MCL_VER_LEVEL_CMD (Esc M V) Any attempt to run a command without first resetting the system will be ignored.	MCL_DISABLE_CMD	Esc M D
	MCL_ENABLE_CMD	Esc M E
	MCL_FLUSH_CMD	Esc M F
Carousel Movement Commands **Note:** Perform a system reset before running any of these commands. MCL_RESET_CMD (Esc M R) MCL_VER_LEVEL_CMD (Esc M V) Any attempt to run a command without first resetting the system will be ignored.	CARO_MOVE_TUBE_CMD	Esc C A nn
	CARO_DIR_CW_CMD	Esc C C
	CARO_DIRECTION_QUERY_CMD	Esc C D
	CARO_HOME_POS_CMD	Esc C H
	CARO_MOVE_IN_CMD	Esc C I
	CARO_LOAD_POS_CMD	Esc C L
	CARO_MOVE_OUT_CMD	Esc C O
	CARO_PWR_QUERY_CMD	Esc C P
	CARO_VIBRATE_QUERY_CMD	Esc C Q
	CARO_STEP_TUBE_CMD	Esc C R
	CARO_VIBRATE_COUNT_CMD	Esc C U nn
	CARO_VIBRATE_CMD	Esc C V
	CARO_DIR_CCW_CMD	Esc C W
	CARO_LOPWR_CMD	Esc C X
	CARO_HIPWR_CMD	Esc C Y
	CARO_RESET_CNTLR_CMD	Esc C Z

Commands		Keystrokes to Initiate
Door Commands **Note:** Perform a system reset before running any of these commands. MCL_RESET_CMD (Esc M R) MCL_VER_LEVEL_CMD (Esc M V) Any attempt to run a command without first resetting the system will be ignored.	DOOR_LOCK_CMD	Esc D L
	DOOR_WAS_OPENED_CMD	Esc D O
	DOOR_UNLOCK_CMD	Esc D U
TVL Commands **Note:** Perform a system reset before running any of these commands. MCL_RESET_CMD (Esc M R) MCL_VER_LEVEL_CMD (Esc M V) Any attempt to run a command without first resetting the system will be ignored.	RLV_DOWN_CMD	Esc L D
	RLV_MIX_CMD	Esc L M
	RLV_MIX_TIME_QUERY_CMD	Esc L Q
	RLV_TURN_CMD	Esc L R
	RLV_MIX_TIME_CMD	Esc L T nn
	RLV_UP_CMD	Esc L U
Sampling Probe Commands **Note:** Perform a system reset before running any of these commands. MCL_RESET_CMD (Esc M R) MCL_VER_LEVEL_CMD (Esc M V) Any attempt to run a command without first resetting the system will be ignored.	PROBE_DOWN_CMD	Esc P D
	PROBE_UP_CMD	Esc P U
Bar-code Scanner Commands **Note:** Perform a system reset before running any of these commands. MCL_RESET_CMD (Esc M R) MCL_VER_LEVEL_CMD (Esc M V) Any attempt to run a command without first resetting the system will be ignored.	READ_CARO_NO_CMD	Esc S C
	READ_BAR_CODE_CMD	Esc S G
	READ_TUBE_ID_CMD	Esc S I
	SCAN_RESET_CMD	Esc S R
	READ_TUBE_POS_CMD	Esc S T
High Level Commands **Note:** Perform a system reset before running any of these commands. MCL_RESET_CMD (Esc M R) MCL_VER_LEVEL_CMD (Esc M V) Any attempt to run a command without first resetting the system will be ignored.	LOCATE_TUBE_CMD	Esc T L nn
	UNLOAD_TUBE_CMD	Esc T U
	RAISE_TUBE_CMD	Esc T R

Commands		**Keystrokes to Initiate**
Status Commands **Note:** Any status command may be performed without first performing a system reset. **Use these commands with caution!**	MCL_STATUS_CMD	Esc M S
	CARO_STATUS_CMD	Esc C S
	DOOR_STATUS_CMD	Esc D S
	HEAD_STATUS_CMD	Esc H S
	RLV_STATUS_CMD	Esc L S
	PROBE_STATUS_CMD	Esc P S
Diagnostic Commands **Note:** Any status command may be performed without first performing a system reset. **Use these commands with caution!**	DIAG_CARO_STEP_CMD	Esc X A
	DIAG_PROBE_RAISE_CMD	Esc X B
	DIAG_PROBE_LOWER_CMD	Esc X C
	DIAG_RLV_RAISE_CMD	Esc X D
	DIAG_RLV_LOWER_CMD	Esc X E
	DIAG_CARO_RESET_CMD	Esc X F
	DIAG_CARO_LOPWR_CMD	Esc X G
	DIAG_CARO_HIPWR_CMD	Esc X H
	DIAG_CARO_DIR_CW_CMD	Esc X I
	DIAG_CARO_DIR_CCW_CMD	Esc X J
	DIAG_CARO_IN_CMD	Esc X K
	DIAG_CARO_OUT_CMD	Esc X L
	DIAG_CARO_HOME_POS_CMD	Esc X M
	DIAG_FINGER_OUT_CMD	Esc X N
	DIAG_FINGER_IN_CMD	Esc X O
	DIAG_READ_BAR_CODE_CMD	Esc X P
	DIAG_SCAN_RESET_CMD	Esc X Q
	DIAG_READ_SENSORS_CMD	Esc Y A
	DIAG_MIX_ON_CMD	Esc Y B
	DIAG_MIX_OFF_CMD	Esc Y C
	DIAG_CARO_STEP_TUBE_CMD	Esc Y D
	DIAG_ROM_DUMP1_CMD	Esc Z A
	DIAG_ROM_DUMP2_CMD	Esc Z B

Memory Test

Purpose

This test ensures that the external memory in all the transputers is working properly. An XL or XL-MCL instrument may have either three or four transputers. These transputers are located on the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II in the Workstation computer and on the Cyto Transputer card in the Cytometer.

- The Opto Transprocessor EXMEM card or Opto Transprocessor EXMEM II card (whichever is applicable) has either one or two transputers.
  - Each transputer has 4 MB of memory per processor.
  - Circuit card is located in the Workstation computer. In the FlowCentre tower computer, this circuit card is located in the bottom slot. In the original FlowCentre computer, this circuit card is located in far left slot.
  - The Opto Transprocessor EXMEM card (non-EMC version) is used in an XL or XL-MCL instrument with a serial number Z09062 or below.
  - The Opto Transprocessor EXMEM II card (EMC version) is used in an XL or XL-MCL instrument with a serial number Z09063 or above.
- The Cyto Transputer card always has two transputers.
  - Each transputer has 1 MB of memory per processor.
  - Circuit card occupies the slot labeled CYTO TRANS PROC in the Data Acquisition card cage in the Cytometer.

Circuit Cards Checked in this Test

- Opto Transprocessor EXMEM card **or** Opto Transprocessor EXMEM II card (whichever is applicable) contains transputers T1 and/or T2.
  - If the circuit card has only one transputer, it is designated T1.
  - If the circuit card has two transputers, the second transputer is designated T2.
- Cyto Transputer card contains two transputers, designated T3 and T4.
  - Transputer T3 is located in socket U52.
  - Transputer T4 is located in socket U54.

Response if Test Fails

Replace the transputer that failed the test and its associated memory.

- Opto Transprocessor EXMEM card **or** Opto Transprocessor EXMEM II card (whichever is applicable) contains transputers T1 and/or T2.
  - If the circuit card has only one transputer, it is designated T1 and is located in socket U16. Its memory is made up of four 1 MB SIMMs (U12, U13, U14, and U15).
  - If the circuit card has two transputers, the second transputer is designated T2 and is located in socket U27. Its memory is also made up of four 1 MB SIMMs (U17, U18, U19, and U22).

- Cyto Transputer card contains two transputers, designated T3 and T4.
  - Transputer T3 is located in socket U52. Its memory is made up of eight 1 MB x 1 Bit DRAMs (U31, U37, U43, U47, U50, U55, U58, and U59).
  - Transputer T4 is located in socket U54. Its memory is made up of eight 1 MB x 1 Bit DRAMs (U18, U26, U30, U34, U40, U46, U48, and U53).

Mike's Test -Not Used

New Board

Purpose

For future hardware development.

Noise Test and Offset

ATTENTION: This test is to be used only as a reference. Do not make adjustments.

Purpose

This test is designed to check the noise and offset of the system. This is accomplished by causing a conversion and generating a histogram of the desired parameters. The input to this parameter is grounded through the test switch. The resulting histogram shows both the offset of the amplifier and the ADC on the Trans Data Acquisition card. It also shows the noise distribution of that parameter.

Circuit Cards Checked in this Test

- Trans Data Acquisition card
- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, PMT4, AUX, FS, and SS

Response if Test Fails

- If all the parameters demonstrate noise, replace the Trans Data Acquisition card.
- If an individual parameter demonstrates noise, replace the corresponding Amp/Signal Conditioner card (PMT1, PMT2, PMT3, PMT4, AUX, FS, or SS).

OPTO DMA Test

Purpose

This test ensures that the Opto Transprocessor EXMEM card or Opto Transprocessor EXMEM II card can perform a Direct Memory Access (DMA) operation to the Workstation computer. The test transfers 256 bytes in each direction and verifies the data. it also ensures that DMA channel 0 (jumpers X7 and X8) is selected.

Circuit Cards Checked in this Test

- Opto Transprocessor EXMEM card is the non-EMC version used in XL and XL-MCL instruments with the serial number Z09062 and below.
- Opto Transprocessor EXMEM II card is the EMC version used in all XL and XL-MCL instruments with the serial number Z09063 and above.

The circuit card is located in the Workstation computer. In the FlowCentre tower computer, this circuit card is located in the bottom slot. In the original FlowCentre computer, this circuit card is located in far left slot.

Response if Test Fails

- Verify that jumpers X7 and X8 are properly installed on the circuit card.
- Possible DMA conflict on DMA 0 on the Workstation computer bus.

OPTO Interrupt Test

Purpose

This test ensures that the interrupt on the Opto Transprocessor EXMEM card or Opto Transprocessor EXMEM II card is working properly. It also ensures that the interrupt is on IRQ11 (jumper X12).

Circuit Cards Checked in this Test

- Opto Transprocessor EXMEM card is the non-EMC version used in XL and XL-MCL instruments with the serial number Z09062 and below.
- Opto Transprocessor EXMEM II card is the EMC version used in all XL and XL-MCL instruments with the serial number Z09063 and above.

The circuit card is located in the Workstation computer. In the FlowCentre tower computer, this circuit card is located in the bottom slot. In the original FlowCentre computer, this circuit card is located in far left slot.

Response if Test Fails

- Verify that jumper X12 is properly installed on the circuit card.
- Possible IRQ conflict on IRQ11 on the Workstation computer bus.

OPTO Link Test

Purpose

This test ensures that the Transputer Link path from the Opto Transprocessor EXMEM card or Opto Transprocessor EXMEM II card in the Workstation computer through the optical cable and into the last (third or fourth) transputer located on the Cyto Transputer card in the Data Acquisition card cage in the Cytometer is working properly. It echoes 10 256-byte loops from one end to the other.

Circuit Cards Checked in this Test

- Opto Transprocessor EXMEM card is the non-EMC version used in XL and XL-MCL instruments with the serial number Z09062 and below.

  or

  Opto Transprocessor EXMEM II card is the EMC version used in all XL and XL-MCL instruments with the serial number Z09063 and above.
- Cyto Transputer card that occupies the slot labeled CYTO TRANS PROC in the Data Acquisition card cage in the Cytometer.
- Optical cable connecting the two circuit cards.

Response if Test Fails

- Verify the optical cable connection is correct:

Workstation Computer		Cytometer
TX	→	RX
RX	←	TX

- Check the jumpers on the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card, as applicable.

  Note: This circuit card is located in the Workstation computer. In the FlowCentre tower computer, this circuit card is located in the bottom slot. In the original FlowCentre computer, this circuit card is located in far left slot.

  - If the card is an Opto Transprocessor EXMEM card (the non-EMC version used in XL and XL-MCL instruments with the serial number Z09062 and below), see Figure A.2-12 and the jumper settings that follow.
  - If the card is an Opto Transprocessor EXMEM II card (EMC version used in all XL and XL-MCL instruments with the serial number Z09063 and above), see Figure A.2-13 and the jumper settings that follow.
- Check the jumpers on the Cyto Transputer card. See Figure A.2-6 and the jumper settings that follow the illustration.

PMT Voltage Control

Purpose

This selection controls the high voltage supplies for PMT1, PMT2, PMT3, and PMT4. A separate Bertan power supply drives each Amp/Signal Conditioner card.

Note: PMT4 and the Bertan power supply for PMT4 are on 4-color systems only.

At the Workstation keyboard, select the desired PMT using the ↑ or ↓ key then press the designated key to produce the desired change.

Option	Key to Activate Change
To increase PMT voltage by 100.0 Vdc	Press Page Up
To decrease PMT voltage by 100.0 Vdc	Press Page Down
To increase PMT voltage by 10.0 Vdc	Press Home
To decrease PMT voltage by 10.0 Vdc	Press End
To increase PMT voltage by 1.0 Vdc	Press Insert
To decrease PMT voltage by 1.0 Vdc	Press Delete

Circuit Cards Checked in this Test

- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, and PMT4 (optional)

Response if Test Fails

- High voltage Bertan power supply may be defective.
- DAC on an Amp/Signal Conditioner card may be defective.

Pneumatic Sensor Test

Purpose

This test checks the condition of the bellow sensors. The system pressure and vacuum sensors are expected to go on several seconds after the compressor is turned ON. The sample pressure and vacuum sensors are activated by applying pressure and vacuum to the sample station while a sample tube is in place. The sample station up/down sensor is activated by moving the sample station up and down.

Circuit Cards Checked in this Test

- System Interface card
- System pressure sensor
- System vacuum sensor
- Sample pressure sensor
- Sample vacuum sensor
- Manual sample station up/down sensor

Response if Test Fails

- System Interface card may be defective.
- Sensor may be defective.

Pulse RAMP Test

Purpose

This test ensures the bar graphs on the front panel display are working properly. These signals originate from the Trans Data Acquisition card. Each signal is ramped from zero to full scale. The bar graph should ramp up and down with the signal. The screen indicates how the bar graph should look in real time.

Components Checked in this Test

- Top Panel Display 2 card
- Interconnecting cable from the Analyzer backplane to the Top Panel Display 2 card
- Trans Data Acquisition card (bar graphs)

Response if Test Fails

- Top Panel Display 2 card may be defective.
- Trans Data Acquisition card may be defective.
- Interconnecting cable from the Analyzer backplane to the Top Panel Display 2 card may be defective.

ROM Test

Purpose

This test ensures the two ROM chips (U25 and U51) on the Cyto Transputer card are the correct version and that they are working properly. To accomplish this check, the ROM on the circuit card is compared to files on the test disk to ensure they are the same. The ROM version is also reported.

Circuit Card Checked in this Test

- Cyto Transputer card

Response if Test Fails

- Verify the correct version is installed.
- Verify the ROM chips are installed correctly. To locate U25 and U51, refer to Figure A.2-6 as needed.
- One or both ROM chips may be defective. To locate U25 and U51, refer to Figure A.2-6 as needed.

Run Beads

Purpose

This test allows a sample to be run on the Cytometer. It allows the usage of a digital oscilloscope to align the optical system of the Cytometer.

Sample Leak Test

Purpose

This test ensures that the sample station seals on the manual sample station and the MCL sample station are not leaking. To perform this test, a sample tube must be inserted in the manual sample station and a fully loaded carousel must be loaded in the MCL. The manual sample station is tested first by pressurizing a sample tube for a few seconds and then the pressure is removed from the sample tube. The sample pressure switch is then monitored for 30 seconds. If the switch indicates pressure then the sample station is not leaking. The MCL is tested in a similar manner.

Components Checked in this Test

- Manual sample station
- MCL sample station

Response if Test Fails

- If a leak is detected in the manual sample station only, check for leaks in associated tubings.
- If a leak is detected in the MCL sample station only, check for leaks in associated tubings.
- If a leak is detected in both the manual and MCL sample stations, check for a leak in tubing that is common to both sample stations.

Scope Test - Not Used

Segment Valve Test

Purpose

This test checks the segmenting valve to ensure proper rotation.

Response if Test Fails

- One or more of the segmenting valve cylinders may be defective.
- One or more tubings may be attached incorrectly to one or more segmenting valve cylinders.
- Segmenting pads may be binding.

Set N Transputers

Purpose

Checks and sets the number of transputers in the system (Cytometer and Workstation computer).

System Parameter Test

Purpose

This test shows the level variation (noise) on the system parameters of the system.

T805 Test

Purpose

This test ensures that the T805 chip is in the proper socket on the Opto Transprocessor EXMEM card (non-EMC version used in XL and XL-MCL instruments with the serial number Z09062 and below) or Opto Transprocessor EXMEM II card (EMC version used in all XL and XL-MCL instruments with the serial number Z09063 and above), as applicable.

This circuit card is located in the Workstation computer. In the FlowCentre tower computer, this circuit card is located in the bottom slot. In the original FlowCentre computer, this circuit card is located in far left slot.

The T805 has a floating point processor and must be the first transputer in the transputer path in order for the system software to function properly. A floating point operation is performed and tested to verify this.

Circuit Cards Checked in this Test

- If an XL or XL-MCL instrument with the serial number Z09062 or below, the Opto Transprocessor EXMEM card (non-EMC version) is checked.
- If an XL or XL-MCL instrument with the serial number Z09063 or above, the Opto Transprocessor EXMEM II card (EMC version) is checked.

Response if Test Fails

Failure of this test may indicate the circuit card has an INS425/INS405 transputer (instead of the INS805 transputer). If the test fails, inspect U16. If the T805 (INS805) is missing or has been replaced by a 400 series device, then disregard the failure.

Temperature Test

Purpose

This test shows the warm-up characteristics of the Cytometer. It plots the temperature versus time on the Workstation screen. It uses the temperature sensor on the System Interface card to read the temperature.

Valve Burn In

Purpose

This selection continuously exercises the manual sample station up/down cylinder and the segmenting valve.

Valve Control

Purpose

This selection controls the pneumatic system. It allows manual control over each individual valve in the system. The sheath and sample pressures are also monitored and displayed here. The Sheath Sample Differential can also be adjusted here. If an emergency shutdown is required, pressing the Spacebar immediately turns off all the valves.

Options

At the Workstation keyboard, select valve to control using the ↑, ↓, ←, or → key, as needed, then press the key designated in the following table to produce the desired response.

Valve Control Option	Key to Select or Activate Option
To select valve to control	Press ↑, ↓, ←, or → as needed.
To toggle selected valve condition	Press Enter.
To set continuous toggle of selected valve	Press Tab. **Note:** Pressing the Tab key a second time stops the continuous toggle.
To turn off all valves including the compressor	Press Spacebar.
Differential Pressure Control*	**Key to Activate Change***
To increase differential pressure by 0.001 psi	Press Insert.
To decrease differential pressure by 0.001 psi	Press Delete.
To increase differential pressure by 0.010 psi	Press Home.
To decrease differential pressure by 0.010 psi	Press End.
To increase differential pressure by 0.100 psi	Press Page Up.
To decrease differential pressure by 0.100 psi	Press Page Down.

* Differential pressure is adjusted by six keys (Insert, Delete, Home, End, Page Up, and/or Page Down) on the Workstation keyboard. On the keyboard, the upper keys (Insert, Home, and Page Up) increase pressure and the lower keys (Delete, End, and Page Down) decrease pressure. The left keys (Insert and Delete) produce small increment changes and the right keys (Page Up and Page Down) produce larger increment changes.

Circuit Card Checked in this Test

- System Interface card

Response if Test Fails

- System Interface card may be defective.
- Associated pinch valve may be defective.
- Compressor may be defective.
- Associated pressure sensor and/or pressure switch may be defective.

Valve Sequence

Purpose

This selection allow the system to be drained and cleaned out for shipment.

DRAIN VACUUM CHAMBER

Drains the waste chamber if full.

SHUTDOWN AND CLEANUP

Performs the shutdown and cleanup procedure on the Cytometer to ready it for shipment.

VME Addr Bus Test

Purpose

This test ensures that the Cyto Transputer card can communicate with each card in the Data Acquisition card cage through the VME bus on the P1 connector. Each card has a readback register that can be written to and read from. Each circuit card has an individual address that is written to that card's readback register. After all the circuit cards have been written to, the readback registers are then read. The values read from each card should match its address. If these values do not match, the card was not addressed properly. The address may be overlapping or missing.

Circuit Cards Checked in this Test

- Cyto Transputer card
- System Interface card
- Trans Data Acquisition card
- Amp/Signal Conditioner card for SS, FS, AUX, PMT4, PMT3, PMT2, and PMT1

Response if Test Fails

- VME Address Bus may be open or shorted.
- Cyto Transputer VME Bus Drivers may be defective.
- Address Decoder on one or more of the circuit cards being tested may be defective.

VME Data Bus Test

Purpose

This test ensures that the Cyto Transputer card can communicate with each card in the Data Acquisition card cage through the VME bus on the P1 connector. Each card has a readback register that can be written to and read from. A rotating bit is written to each of these registers and then read back. The value that is read is checked to ensure it is the same value that was written.

Circuit Cards Checked in this Test

- Cyto Transputer card
- System Interface card
- Trans Data Acquisition card
- Amp/Signal Conditioner card for PMT1, PMT2, PMT3, PMT4, AUX, FS, and SS

Response if Test Fails

- VME Data Bus may be open or shorted.
- Cyto Transputer VME Bus Drivers may be defective.
- Readback register on one or more of the circuit cards being tested may be defective.

Waste Chamber Full Test

Note: Appears as Waste Cham. Full Test on the Workstation display.

Purpose

This test ensures the waste chamber sensor, often referred to as the eyeball sensor, is working properly.

This check involves the following sequence of events:

1. The waste chamber is emptied and then filled. As it is filling, the eyeball sensor is monitored. When the liquid level reaches the sensor, the fill operation should cease. If this does not occur within a specified amount of time, the fill operation is stopped and an error is reported.
2. The waste chamber is emptied for 5 seconds.
3. The waste chamber is then filled until the sensor detects the liquid again. The time for this is reported and the Fill/Empty ratio is displayed. This is an indicator of the liquid flow from the sheath container, through the flow cell to the waste chamber and out to the waste container.

   Note: Pinched tubing will affect these time. Currently, there is no specification for these times. This specification is currently being developed.

Components Checked in this Test

- System Interface card
- Waste chamber liquid level sensor

Response if Test Fails

- System Interface card may be defective.
- Waste chamber liquid-level sensor may be defective.

XY Display - Not Used

ILLUSTRATIONS

TABLES

8.1 MASTER PARTS LISTS

ATTENTION: Part numbers issued by the Oracle system are six-digit numbers.

The components in the master parts list are listed alphabetically by their common names or categories. Table 8.1-1 lists the common names and categories used, further defines the categories, and references the table in this section where those components appear. Within each table the part numbers are listed in numeric order. When applicable, a component is cross referenced to its illustration in Heading 8.2.

Table 8.1-1 Common Names and Categories used in Master Parts List

Common Name/ Category	Category Includes	Table
Adaptor	Cleaning tube	8.1-2
Assembly	Front door (Power Supply module), XL overlay panel, and solenoid valve and manifold used in the lower pneumatics drawer	8.1-2
Bracket		8.1-2
Cable	Assemblies, harnesses, power, and coaxial	8.1-3
Choke		8.1-3
Circuit breaker		8.1-3
Computer		8.1-3
Consumable	Gloves, beads, reagents, storage media	8.1-3
Cover	All non-hinged panels and component covers	8.1-3
Cylinder		8.1-3
Disk drive	CD-ROM and floppy	8.1-4
Documentation	Operator manuals	8.1-4
Door	All hinged panels	8.1-4
Duct		8.1-4
Fan		8.1-5
Filter	Optical, gas, light and water; filter holders	8.1-5
Fingerguard		8.1-5
Fitting	Barbed, brass, feed-through, insert, panel, quick-disconnect, T- and Y- connectors	8.1-5
FRU		8.1-5
Fuse		8.1-5
Gasket		8.1-6
Hinge		8.1-7
Holder	Cylinder, pinch valve, prism and tube	8.1-7
Insert		8.1-7
Jumper		8.1-8
Keyboard		8.1-8
Kit	4-color installation, PMI, and sheath filter	8.1-8
Label	For light filters, shields, reagent containers, carousel, and test tubes	8.1-9

Table 8.1-1 Common Names and Categories used in Master Parts List *(Continued)*

Common Name/ Category	Category Includes	Table
Manifold		8.1-10
Module	Power Supply	8.1-10
Monitor		8.1-10
Motor		8.1-10
Mount		8.1-10
Muffler		8.1-10
Nut		8.1-11
O-ring		8.1-11
Panel	For front of reagent drawer and front of Power Supply module	8.1-12
PCB	All printed circuit boards	8.1-12
Plate		8.1-12
Power supply		8.1-12
Printer		8.1-12
Regulator	All pressure and vacuum regulators	8.1-13
Screw		8.1-14
Sensor		8.1-14
Software		8.1-14
Spring		8.1-14
Stage		8.1-14
Switch		8.1-14
Tank	Sheath, cleanse, waste (also referred to as container or bottle)	8.1-15
Target		8.1-15
Tie wrap		8.1-15
Tool	Individual hand tools, Beckman Coulter service tool kit, Service Resource Kit	8.1-15
Transducer		8.1-15
Tray		8.1-15
Tubing	PEEK, polyurethane, silicone	8.1-15
Valve	Check, pinch, solenoid (pneumatic and hydraulic)	8.1-16
Washer		8.1-17

Table 8.1-2 Master Parts List - A and B

Description	Part Number	Figure	Item
Adaptor, cleaning tube	6859297		
Arm. probe, for manual sample station	1020873	8.2-33	2
Assembly, front door, Power Supply module, black	6856160	8.2-5	11
Assembly, front door, Power Supply module, grey	6807047	8.2-5	11
Assembly, solenoid valve, pressure relief valves and manifold, used in the lower pneumatics drawer	6232587	8.2-39	
Assembly, XL overlay panel	6855862	8.2-12	10
Backplane, Analyzer	6705220		
Block, stop, used with MCL carousel base assembly	1022128	8.2-8	9
Bracket, 45° angled, used to secure fitting inserts	6805879	8.2-41	12
Bracket, cleanse tank (also referred to as detergent bottle bracket)	1020978	8.2-29	10
Bracket, door angle **Note:** Verify proper orientation before attaching.	6856945	8.2-30 8.2-32	12 13
Bracket, front panel	1021769	8.2-12	1
Bracket, gas cylinder upper	1021764	8.2-3	17
Bracket, hinged machine, attaches MCL upper and lower bases	6858657	8.2-3	5
Bracket, MCL lower base	6858635	8.2-3	19
Bracket, MCL sample station	6805649	8.2-31	12
Bracket, sheath tank (also referred to as sheath bottle bracket)	1020981	8.2-28	9
Bracket, shut-off valve	6856718	8.2-27	5
Bracket, two pinch valve	6855212	8.2-16	1
Bushings, shock mount, rubber axial, 4 lb., 73 lb./in., 84 Hz, for laser cooling fan module	2523659		
Buzzer, cable assembly	6028318		

Table 8.1-3 Master Parts List - C

Description	Part Number	Figure	Item
Cable assembly, MCL door open detector	6028424	8.2-3	14
Cable assembly, MCL, CPU main	6028428		
Cable assembly, MCL, PCB to opto	6028423		
Cable assembly, mini-universal MATE-N-LOK 3-position plug to Hall Effect sensor, for manual sample station	6028330	8.2-33	11
Cable assembly, Printer, bar-code, 25-pin, D-plug	6028303		
Cable assembly, sheath pressure	6028328		
Cable, +24 Vdc	6028311		

Table 8.1-3 Master Parts List - C *(Continued)*

Description	Part Number	Figure	Item
Cable, +24 Vdc, EMC	6028689		
Cable, +5 Vdc	6028305		
Cable, +5 Vdc, EMC	6028687		
Cable, ±15 Vdc	6028306		
Cable, ±15 Vdc, EMC	6028688		
Cable, analog/logic power (non EMI)	6028307		
Cable, bar-code communications (also referred to as the bar-code programming cable)	6028275		
Cable, bar-code scanner	6003011		
Cable, cont B interface	6028308		
Cable, CYT12, fiber optic	6028716		
Cable, Cyto dc power	6028319		
Cable, CYTO dc power EMI harness	6028700	8.2-42	11
Cable, Cytometer CYT12	6028314		
Cable, external, analog power	6027106		
Cable, external, analog power, EMC	6028696		
Cable, external, CYT12	6028304		
Cable, external, logic power, 9 V	6027105		
Cable, external, logic power, 9 V, EMC	6028694		
Cable, external, MCL power	6027108		
Cable, external, MCL power, EMC	6028695		
Cable, external, Power Supply module control, 25-pin, laser control	6028302		
Cable, fiber optic interface (FL rib)	6028294		
Cable, fiber optic interface, shielded, EMC	6028650		
Cable, front panel power	6028430		
Cable, ground braid, 6 inches long with two #8 rings	6028152	8.2-13 8.2-24	12 6
Cable, ground strap, on Power Supply module	6027875	8.2-5	9
Cable, harness that includes Logic, MCL, and Analog power supply dc internal cables **Note:** Attach using three female screw lock assembly kits for D-type connectors, PN 2104261.	6028693	8.2-57	2
Cable, laser control (FL rib)	6028292		
Cable, laser control interface	6028299		
Cable, laser control, shielded, Cytometer, EMC	6028651		
Cable, laser supply control, EMC	6028652		
Cable, MCL, CPU interface	6004071		

Table 8.1-3 Master Parts List - C *(Continued)*

Description	Part Number	Figure	Item
Cable, MCL, dc, CYTO	6028431		
Cable, MCL, dc, CYTO, EMC	6028699		
Cable, scanner interface	6028432		
Cable, sensor	6028290		
Cable, sensor/reg control (FL rib)	6028289		
Cable, sensor/reg control, shielded, EMC	6028702		
Cable, solenoid power, 2 position connector for solenoid with two 60 in. 22 AWG conductor wires for circuit card connection, lower pneumatics drawer	6028130	8.2-39	7
Cable, solenoid power, Clippard 3 position connector for solenoid with two 26 AWG (19/38) tinned copper conductor wires for circuit card connection, lower pneumatics drawer	6028287	8.2-38	9
Cable, solenoid, 25 conductor flat ribbon cable with 3 subminiature D insulation displacement connectors, 81 in. length, lower pneumatics drawer	6028293		
Cable. level sensor, with undercut O-ring groove **Note:** O-ring seal, PN 2512031, is not needed with the sheath tank assembly but is needed with the cleanse tank assembly.	6028526	8.2-28 8.2-29	8 8
Calibration test box, pneumatic	2907103		
Cap, cleanse	1021818	8.2-29	4
Cap, sheath tank (or bottle)	1018613	8.2-28	4
Cap, waste tank	1022581		
Carousel, MCL	6859682		
Cartridge, hard drive, Bernoulli, 90 MB	2016551		
Cartridge, removable drive, Bernoulli, 150 MB	2016646		
Cartridge, toner, Hewlett Packard, for HP LaserJet 6P/SPSe	2016708		
Caster, swivel with brake, 2 in. diameter wheel	2523658	8.2-5	13
Choke, metal, black, 0.010 orifice	6213011	8.2-59	7
Choke, metal, blue, 0.012 orifice	6213010	8.2-59	7
Choke, metal, brown, 0.006 orifice	6213009	8.2-59	7
Choke, metal, gold, 0.004 orifice	6213008	8.2-59	7
Choke, metal, green, 0.016 orifice	6213007	8.2-59	7
Choke, metal, red, 0.008 orifice **Note:** Designated as CK 2 and 3 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886.	6213006	8.2-59	7
Choke, plastic, grey, 0.016 in. orifice **Note:** Designated as CK 12 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886.	6213012	8.2-14 8.2-59	13 8

Table 8.1-3 Master Parts List - C *(Continued)*

Description	Part Number	Figure	Item
Choke, plastic, brown, 0.025 in. orifice **Note:** Designated as CK 4, 5, 6, 7, 8, 9, 10, and 11 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886.	6213015	8.2-59	8
Choke, pneumatic, 0.0102 diameter, 0.062 barb and 10-32 threaded connections, brass **Note:** Choke must be oriented as shown in the associated figure when installation is complete.	6232637	8.2-8 8.2-10 8.2-11	15 3 1
Circuit breaker, 0.5 A, 250 Vac **Note:** Circuit breaker locations may differ according to system power requirements. Use Figure 8.2-57 to verify the circuit breaker amperage required for the system being serviced.	5101028	8.2-57	7
Circuit breaker, 1 A, 250 Vac, for 220 Vac and 240 Vac systems	5101025	8.2-57	4
Circuit breaker, 1.5 A, 250 Vac **Note:** Circuit breaker locations may differ according to system power requirements. Use Figure 8.2-57 to verify the circuit breaker amperage required for the system being serviced.	5101026	8.2-57 8.2-57	5 6
Circuit breaker, 2 A, 250 Vac **Note:** Circuit breaker locations may differ according to system power requirements. Use Figure 8.2-57 to verify the circuit breaker amperage required for the system being serviced.	5120227	8.2-57 8.2-57	3 4
Circuit breaker, 3 A, 250 Vac **Note:** Circuit breaker locations may differ according to system power requirements. Use Figure 8.2-57 to verify the circuit breaker amperage required for the system being serviced.	5120228	8.2-57 8.2-57	4 5
Circuit breaker, 0.8 A, 250 Vac **Note:** Circuit breaker locations may differ according to system power requirements. Use Figure 8.2-57 to verify the circuit breaker amperage required for the system being serviced.	5101027	8.2-57 8.2-57	6 7
Circuit breaker, 4 A, 250 Vac, for 100 Vac and 120 Vac systems **Note:** Circuit breaker locations may differ according to system power requirements. Use Figure 8.2-57 to verify the circuit breaker amperage required for the system being serviced.	5120229	8.2-57	3
Cleaning tube, adaptor	6859297		
Clip, MCL sample probe retainer	2837022	8.2-9	7
Clip, red shipping, for pinch valves	1008315		
Coil, cooling, for Power Supply module	6856536	8.2-55	3
Coil, cooling, used in right side compartment	6856551	8.2-44	14
Computer, Atlas PCI III Pentium 200 processor, referred to as FlowCentre computer, also includes PN 2016665 (mouse) and PN 2016758 (keyboard)	2016753	8.2-7	1
Computer, Pentium 133 MHz, 16 MB RAM, minimum 540 MB hard drive, 2 MB video, Atlas, also includes a Microsoft serial mouse	2016669(R)		

Table 8.1-3 Master Parts List - C *(Continued)*

Description	Part Number	Figure	Item
Computer, Pentium III processor, 550 MHz minimum, referred to as FlowCentre II tower computer, also includes PN 2016876 (mouse) and PN 2016881 (keyboard)	2016874	8.2-6	3
Computer, Pentium processor, 166 MHz minimum, 16 MB RAM, minimum 1.2 GB HDD, minimum 2 MB video, Atlas PCI III, replacement for PN 2016669, also includes a serial compatible mouse, PN 2016161	2016802(R)		
Connector, BNC coaxial, panel mount, jack-to-jack adapter	2121644	8.2-42	10
Connector, universal mate-n-lock 2-pin plug, panel/cable mount	2104356	8.2-44	7
Consumable, COULTER CLENZ cleaning agent, 10-L box	8546931		
Consumable, COULTER CLENZ cleaning agent, 500 mL-bottle	8546929		
Consumable, COULTER CLENZ cleaning agent, 5-L box	8546930		
Consumable, CYTO-TROL™ control cells	6604248		
Consumable, Flow-Check™ fluorospheres	6605359		
Consumable, Flow-Set™ fluorospheres	6607007		
Consumable, IsoFlow sheath fluid	8547008		
Consumable, latex gloves, large/extra large	5415175		
Consumable, latex gloves, medium/large	5415174		
Consumable, latex gloves, small/medium	5415179		
Consumable, storage media, 3.5 in. floppy diskette, DSHD, 10 per box, unformatted	2016394		
Consumable, test tubes, 12 x 75 mm	2523749		
Coupling joint, cylinder rod end, 8-32 fastening, black oxide **Note:** Coupling has an internal hex for tightening.	2523700	8.2-8	16
Coupling, quick-connect, panel-mount adapter and nut assembly for attaching 10 tube quick-disconnect couplings to a panel, black	6232530	8.2-18 8.2-40	1 7
Coupling, quick-disconnect QD10, male body, 10 tube capacity body (includes the 8 fittings shown in Figure 8.2-40)	6232532	8.2-40	1
Coupling, quick-disconnect QD11, female body, 10 tube capacity body (includes the 8 fittings shown in Figure 8.2-40)	6232531	8.2-40	2
Coupling, quick-disconnect QD13, female body, 10 tube capacity body (includes the 7 fittings shown in Figure 8.2-18)	6232533	8.2-18	3
Coupling, quick-disconnect QD14, male body, 10 tube capacity body (includes the 7 fittings shown in Figure 8.2-18)	6232534	8.2-18	2
Cover, filter, black	6856735	8.2-2 8.2-4	3 3
Cover, filter, grey	6807084	8.2-2 8.2-4	3 3
Cover, flow cell shield	1020965	8.2-23	14
Cover, left-side, for XL Cytometer without MCL option, black	6856727	8.2-4	10
Cover, left-side, for XL Cytometer without MCL option, grey	6807074	8.2-4	10

Table 8.1-3 Master Parts List - C *(Continued)*

Description	Part Number	Figure	Item
Cover, left-side, for XL-MCL Cytometer, black	6858522	8.2-2	15
Cover, left-side, for XL-MCL Cytometer, grey	6807076	8.2-2	15
Cover, Power Supply module three-surface (left-side, top, right-side), black	6856369	8.2-5	14
Cover, Power Supply module three-surface (left-side, top, right-side), grey	6807082	8.2-5	14
Cover, rear duct, Laser vent	1022440		
Cover, right-side, black	6856494	8.2-2 8.2-4	2 2
Cover, right-side, grey	6807079	8.2-2 8.2-4	2 2
Cover, sample station	6858247	8.2-33	23
Cover, top, black **Note:** Attach using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head), PN 2839039, and #6 flat washers, PN 2827147.	6858129	8.2-2 8.2-4	1 1
Cover, upper rear, black	1018854	8.2-2 8.2-4	16 12
Cover, upper rear, grey	1025310	8.2-2 8.2-4	16 12
Cover, top, grey **Note:** Attach using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head), PN 2839039, and #6 flat washers, PN 2827147.	6807080	8.2-2 8.2-4	1 1
Cylinder, air, double-acting with single-end spring-return, universal mount, 0.63 bore, 3.25 stroke, 150 psi maximum pressure, for manual sample station	6232575	8.2-33	12
Cylinder, air, double-acting, single-ended, front block mount, 0.63 bore, 1.50 stroke, 250 psi maximum pressure, used to move front and rear segmenting valve pads	6232574	8.2-36	4
Cylinder, air, in/out	6232570	8.2-8	13
Cylinder, air, MCL	6232572		
Cylinder, air, probe up/down, double acting, 150 psi, 0.375 bore, front stud and rear clevis mount **Note:** Remove the large nut from the cylinder. Make sure you replace the small cylinder rod nut before installing.	6232595	8.2-9 8.2-11	15 3
Cylinder, air, STD	6232602		
Cylinder, double-acting air, 0.75 bore, rotating rod with 1.50 stroke, used to move segmenting valve's middle pad	6232723	8.2-35	4
Cylinder, gas, MCL door (may also be referred to as MCL bay cylinder)	6858666	8.2-3	18
Cylinder, lifter air, double acting, 250 psi, 0.56 bore, stud mount each end **Note:** If present, remove and discard the large nut on each end before installing.	6232591	8.2-9 8.2-10	14 1
Cylinder, piston rod clevis for 0.56 bore, 250 psi cylinder, 10-32 threaded with hex nut for mounting	6232590	8.2-10	4

Table 8.1-4 Master Parts List - D

Description	Part Number	Figure	Item
Data entry, keyboard, long	2016392		
Data entry, keyboard, short	2016592		
Data entry, membrane, overlay and switch, for XL-MCL sample station	1021734	8.2-30	6
Data entry, overlay and membrane switch sample cup XL **Note:** Before installation, remove paper backing.	1016815	8.2-32	6
Disk drive, 3.5 in. floppy	2016454		
Disk drive, 3.5 in. floppy, 1.44 MB, black, for FlowCentre computer PN 2016753	2016962	8.2-7	2
Disk drive, 3.5 in. floppy, 1.44 MB, white, for FlowCentre II tower computer PN 2016874	2016972	8.2-6	1
Disk drive, 5.25 in. floppy	2016298		
Disk drive, CD-ROM, 8X minimum, internal IDE, for FlowCentre computer PN 2016753	2016959	8.2-7	3
Disk drive, CD-ROM, 8X minimum, internal IDE, for FlowCentre II tower computer PN 2016874	175742	8.2-6	2
Display, monitor, 21 in., SVGA, color	2016754		
Display, monitor, Sony® Trinitron®, 17 in., multiscan color	2016721		
Display, sample cup membrane, for XL-MCL Cytometer	1021696	8.2-30	11
Display, window **Note:** Remove the protective plastic sheet. Ensure the LED grooves are lined up with the LEDs on the panel overlay (PN 6855862). Install the lower center screw (PN 2806084) in the display window before placing the display window on the panel overlay. Hand tighten this screw. Do not use a power driven screwdriver.	1016814	8.2-12	11
Documentation, COULTER® FlowCentre™ Multimedia Workstation	4237415		
Documentation, Data Management, COULTER® EPICS® XL and COULTER® EPICS® XL-MCL SYSTEM II™	4237237		
Documentation, Getting Started, COULTER® EPICS® XL and COULTER® EPICS® XL-MCL SYSTEM II™	4237238		
Documentation, Master Index, COULTER® EPICS® XL and COULTER® EPICS® XL-MCL SYSTEM II™	4237295		
Documentation, Operating Summary, COULTER® EPICS® XL and COULTER® EPICS® XL-MCL SYSTEM II™	4237299		
Documentation, Operator's Guide, COULTER® EPICS® XL and COULTER® EPICS® XL-MCL SYSTEM II™	4237297		
Documentation, Reference, COULTER® EPICS® XL and COULTER® EPICS® XL-MCL SYSTEM II™	4237298		
Documentation, Special Procedures and Troubleshooting, COULTER® EPICS® XL and COULTER® EPICS® XL-MCL SYSTEM II™	4237296		
Door, MCL sample station, with handle and magnet attached	6858842	8.2-30	7
Door, XL sample station, with attached handle	6858840	8.2-32	8

Table 8.1-4 Master Parts List - D *(Continued)*

Description	Part Number	Figure	Item
Door, front panel display, black **Note:** Attach door using two 3-in. #5 swag hinges, PN 1021176. Attach each hinge using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head), PN 2839039, and #6 flat washers, PN 2827147.	6856490	8.2-2 8.2-4 8.2-12	14 11 7
Door, front panel display, grey **Note:** Attach door using two 3-in. #5 swag hinges, PN 1021176. Attach each hinge using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head), PN 2839039, and #6 flat washers, PN 2827147.	6807085	8.2-2 8.2-4 8.2-12	14 11 7
Drive, hard, 20 GB minimum, 7200 RPM IDE HDD **Note:** Drive may be used in FlowCentre II tower computer PN 2016874 or FlowCentre computer PN 2016753.	2016963		
Drive, removable, Bernoulli, SCSI	2016552		
Duct, flexible, 3 1/8 i.d. x 10-in. length, rectangular flange at one end, needed to assemble flexible duct for Argon laser assembly **Note:** Assembly instructions are illustrated in Figure 8.2-62.	2603060	8.2-24 8.2-62	24 2

Table 8.1-5 Master Parts List - F

Description	Part Number	Figure	Item
Fan, 64 CFM, 24 Vdc, 6.37 in. square, 1.6 in. deep, for laser cooling	2603054	8.2-24	11
Fan, box, 106 CFM, 24 Vdc (4.68 square x 1.5 thickness) **Note:** To ensure proper cable length, verify fan orientation before attaching the fan to the Cytometer frame. • Cable for B1 (fan near the MCL side of the unit) must be oriented center to top as seen in the “fan to shock mount” illustration in Figure 8.2-43. • Cable for B2 (fan near the HeNe laser head extension) must be oriented left of center as seen in the “filter assembly to fan” illustration in Figure 8.2-43.	2603025	8.2-42 8.2-43	1 4
Fan, box, 90 CFM, 24 Vdc, 4.69 square x 1.0 in. thickness, used in Power Supply module **Note:** Fans on the rear panel should be positioned so that its output wires are inside the panel near the other fan (upper fan’s wires are oriented towards the bottom; lower fan’s wires, towards the top).	2603058	8.2-47 8.2-57 8.2-58	1 13 4
Fan, chassis, for FlowCentre computer PN 2016753	2016961		
Fan, chassis, for FlowCentre II tower computer PN 2016874	175741	8.2-6	9
Fan, shock mount, for 4-inch fan, black	2603053	8.2-43	3
Fastener, ball stud	2840037	8.2-24	2
Filter, air, 4-inch pad, 45 PPI	2603010	8.2-5 8.2-43 8.2-58	5 10 1

Table 8.1-5 Master Parts List - F *(Continued)*

Description	Part Number	Figure	Item
Filter, gas, hydrophobic, 0.2 micron, disposable plastic	6232561	8.2-47 8.2-53	7 3
Filter, light, used in filter slot 1, 525 band pass (525 BP)	3814134	8.2-20	9
Filter, light, used in filter slot 2, 575 band pass (575 BP)	3814135	8.2-20	9
Filter, light, used in filter slot 3, 620 band pass (620 BP)	3814289	8.2-20	9
Filter, light, used in filter slot 4, 488 dichroic long pass (488 DL)	3814136	8.2-20	9
Filter, light, used in filter slot 5, 488 laser blocker (488 BK)	3802072	8.2-20	9
Filter, light, used in filter slot 6, 550 dichroic long pass (550 DL)	3814067	8.2-20	9
Filter, light, used in filter slot 7, 600 dichroic long pass (600 DL)	3814138	8.2-20	9
Filter, light, used in filter slot 8, 645 dichroic long pass (645 DL)	3814274	8.2-20	9
Filter, light, used in filter slot 9, 675 band pass (675 BP)	3814139	8.2-20	9
Filter, water trap (air/water filter separator), 5 micron **Note:** May need to apply a thin line of pipe sealant, PN 1601056, across threads before insertion. A note in the item description of the associated figure explains the application, if applicable.	6232725	8.2-44 8.2-47 8.2-49	12 3 2
Finger guard, grille for fan air filter on 4-inch box fan **Note:** Raised ribs should face out.	2603009	8.2-5 8.2-43 8.2-58	4 9 3
Fitting, elbow, adjustable, 10-32 ports, O-ring sealed brass miniature, for bulkhead mounting	6232360	8.2-8	14
Fitting, elbow, adjustable, 3/32 i.d. hose barb to 10-32 threaded, brass miniature **Note:** Fitting must be oriented as shown after tightening.	6232813	8.2-38	2
Fitting, elbow, hose barb, 0.187 i.d. to 1/8 MPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown in the associated figure after tightening.	6216128	8.2-44 8.2-46 8.2-48 8.2-49	13 1 1 1
Fitting, feed-thru isolator, white, with 10-32 threads	1016486	8.2-60	2
Fitting, feed-thru, hose-barb union, 0.062 i.d. to 0.093 i.d. with 10-22 threaded	6216353	8.2-60	3
Fitting, feed-thru, hose-barb union, metal, 0.093 i.d. to 0.093 i.d. with 10-32 threads	1005699	8.2-60	1
Fitting, ferrule nut, black, for 0.062 o.d. tubing	6232526	8.2-34	6
Fitting, ferrule, natural, for 0.062 o.d. tubing	6232525	8.2-34	7
Fitting, hex-head adapter, 10-32 tap to 1/8 MPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion.	6216004	8.2-44	9

Table 8.1-5 Master Parts List - F *(Continued)*

Description	Part Number	Figure	Item
Fitting, hose barb union, 0.062 i.d. to 10-32 threaded	6232086	8.2-15	1
		8.2-17	4
		8.2-33	10
		8.2-35	3
		8.2-36	3
		8.2-39	9
		8.2-44	1
Fitting, hose barb union, 0125 i.d. to 10-32 threaded	6232085	8.2-17	1
		8.2-44	3
Fitting, hose barb, elbow, 0.093 i.d. to 10-32 threaded, white, nylon **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Tighten until the O-ring is squeezed then continue to tighten until the fitting is oriented as shown in Figure 8.2-27.	6232208	8.2-27	10
Fitting, hose barb, elbow, 0.187 i.d. to 1/8 FPT, nickel-plated brass **Note:** After tightening, fitting must be oriented as shown in the associated figure. Application of a thin line of pipe sealant, PN 1601056, across attachment threads may be required.	6232214	8.2-49	3
		8.2-51	1
		8.2-54	1
Fitting, hose-barb union, 0.062 i.d. to 0.062 i.d.	1005697	8.2-16	2
		8.2-33	22
Fitting, hose-barb union, 0.062 i.d. to 0.062 i.d., clear	6232109	8.2-60	6
Fitting, hose-barb union, 0.062 i.d. to 0.093 i.d.	6232352	8.2-60	4
Fitting, hose-barb union, 0.062 i.d. to 10-32 threaded	1005693	8.2-59	5
Fitting, hose-barb union, 0.093 i.d. to 0.093 i.d.	9908083	8.2-60	7
Fitting, hose-barb union, 0.093 i.d. to 0.125 i.d. tubing, clear	6232246	8.2-60	5
Fitting, hose-barb union, 0.115 i.d. to 0.180 i.d.	6232104	8.2-16	3
Fitting, insert, black female quick-connect, internal connector to 0.125 i.d. hose barb	6232469	8.2-18	5
		8.2-40	4
		8.2-41	11
Fitting, insert, black male quick-connect, internal connector to 0.125 i.d. hose barb	6232468	8.2-18	7
		8.2-40	5
		8.2-41	10
Fitting, insert, white female quick-connect, internal connector to 0.082 i.d. hose barb	6232588	8.2-18	4
		8.2-40	3
		8.2-41	4
Fitting, insert, white female quick-connect, internal connector to 0.094 i.d. hose barb (inserted three places in the 45° angled bracket, PN 6805879)	6232799	8.2-41	3

Table 8.1-5 Master Parts List - F *(Continued)*

Description	Part Number	Figure	Item
Fitting, insert, white male quick-connect, internal connector to 0.082 i.d. hose barb	6232581	8.2-18 8.2-40 8.2-41	6 6 5
Fitting, Luer, 0.125 i.d.	6232527		
Fitting, miniature adapter, 10-32 tap in 0.125 MPT plug, nickel-plated brass	6232683	8.2-35	5
Fitting, miniature tee branch with 10-32 ports	6232359	8.2-15 8.2-17	3 3
Fitting, miniature, 10-32 threaded, 10-32 tap, adjustable, brass	6216002	8.2-10 8.2-11 8.2-35 8.2-36	2 2 1 1
Fitting, poly-flow, poly-flow, elbow, 0.250 o.d. to 1/8 MNPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads that will be screwed in the pressure relief valve. Fitting must be oriented as shown in the associated figure after tightening.	6216027	8.2-52	3
Fitting, quick-connect, blue male, couples with female blue body, PN 6232309	6232306		
Fitting, quick-connect, female, 0.125 flow, 0.375 MNPT, white acetal delrin, single connect	6232703	8.2-53	2
Fitting, quick-connect, female, 0.250 flow, 0.375 MNPT, white acetal delrin, single connect	6232700	8.2-53	4
Fitting, quick-connect, female, internal panel mount, 0.125 flow, coupling pair latch, barb, white acetal delrin	6232478	8.2-28 8.2-29	7 7
Fitting, quick-connect, female, internal panel mount, 0.125 i.d., coupling pair latch, barb, white acetal delrin	6232470	8.2-28 8.2-29	2 2
Fitting, quick-connect, green male, couples with female green body, PN 6232606	6232607		
Fitting, quick-connect, internal, panel mount, 10-32, white female body, 0.125 flow (couples with white insert, PN 6232266)	6232466	8.2-27	7
Fitting, quick-connect, male, elbow, 0.250 o.d., white acetal delrin	6232702	8.2-53	1
Fitting, quick-connect, male, external elbow, 0.250 o.d., white acetal delrin	6232472	8.2-26 8.2-27 8.2-28 8.2-29	2 6 1 1
Fitting, quick-connect, male, external elbow, 0.375 o.d., white acetal delrin	6232522	8.2-26 8.2-53	3 5
Fitting, quick-connect, orange male, couples with female orange body, PN 6232304	6232305		

Table 8.1-5 Master Parts List - F *(Continued)*

Description	Part Number	Figure	Item
Fitting, quick-connect, panel mount, blue female body with nut, automatic shut-off, 0.125 flow x 0.250 o.d. (couples with blue insert, PN 6232306, also with automatic shut-off) **Note:** If installing the quick-connect on the Cytometer rear panel, insert a #50 I-tooth washer, PN 2826042, between the panel and the hex nut.	6232309	8.2-42 8.2-57	9 12
Fitting, quick-connect, panel mount, green female body with nut, 0.250 o.d. (couples with green insert, PN 6232607)	6232606	8.2-57	9
Fitting, quick-connect, panel mount, orange female body with nut, automatic shut-off, 0.125 flow x 0.250 o.d. (couples with orange insert, PN 6232305, also with automatic shut-off) **Note:** If installing the quick-connect on the Cytometer rear panel, insert a #50 I-tooth washer, PN 2826042, between the panel and the hex nut.	6232304	8.2-42 8.2-57	6 10
Fitting, quick-connect, panel mount, yellow female body with nut, automatic shut-off, 0.125 flow x 0.250 o.d. (couples with yellow insert, PN 6232307, also with automatic shut-off) **Note:** If installing the quick-connect on the Cytometer rear panel, insert a #50 I-tooth washer, PN 2826042, between the panel and the hex nut.	6232303	8.2-42 8.2-57	7 11
Fitting, quick-connect, white male, couples with female white body, PN 6232466	6232266		
Fitting, quick-connect, yellow male, couples with female yellow body, PN 6232303	6232307		
Fitting, T-connector, adjustable, 3/32 i.d. hose barb to 3/32 i.d. hose barb to 10-32 threaded, brass miniature	6232814	8.2-38	1
Fitting, T-connector, hose barb, 0.187 i.d. to 0.187 i.d. to 1/8 MPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown in the associated figure after tightening.	6216127	8.2-44 8.2-46 8.2-52	11 4 2
Fitting, T-connector, hose barb, 0.187 i.d. to 0.187 i.d. to threaded, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown after tightening.	6216129	8.2-39	1
Fitting, T-connector, hose-barb union, 0.093 i.d. to 0.125 i.d. to 0.125 i.d., nylon, white	6232322	8.2-14 8.2-60	10 15
Fitting, Y-connector, adjustable, hose barb, 0.190 o.d. to 0.120 o.d. to 10-32 threaded, brass miniature with stainless steel stud **Note:** Fitting must be oriented as shown after tightening.	6232819	8.2-38	3
Fitting, Y-connector, hose-barb union, 0.050 i.d. x 0.130 o.d., blue	6232263	8.2-60	11
Fitting, Y-connector, hose-barb union, 0.062 i.d. to 0.062 i.d. to 0.062 i.d.	9909059	8.2-60	14
Fitting, Y-connector, hose-barb union, 0.082 i.d. to 0.082 i.d. to 0.062 i.d., clear	6216181	8.2-60	13
Fitting, Y-connector, hose-barb union, 0.085 i.d. x 0.172 o.d., white	1018245	8.2-60	10
Fitting, Y-connector, hose-barb union, 0.093 i.d. to 0.093 i.d. to 0.093 i.d., clear	6232259	8.2-60	12
Fitting, Y-connector, hose-barb union, 0.125 i.d. to 0.125 i.d. to 0.125 i.d., clear	6216081	8.2-60	8
Fitting, Y-connector, hose-barb union, 0.125 i.d. to 0.125 i.d. to 0.125 i.d., nylon, white	6232257	8.2-60	9

Table 8.1-5 Master Parts List - F *(Continued)*

Description	Part Number	Figure	Item
Flow cell	6858386	8.2-23	9
Flow cell, complete	6859156		
Foot, rubber **Note:** Use setscrew, PN 2810028, to attach foot to the Cytometer frame.	6858988	8.2-2 8.2-4	5 5
Frame, Power Supply module	6856206		
FRU, Argon air-cooled laser head	7000358	8.2-24	23
FRU, Argon air-cooled laser power supply, switching, for 100 Vac system	7000431	8.2-24 8.2-45	14 1
FRU, Argon air-cooled laser power supply, switching, for 115 Vac system	7000721	8.2-24 8.2-45	14 1
FRU, Argon air-cooled laser power supply, switching, for 220 or 240 Vac system	7000432	8.2-24 8.2-45	14 1
FRU, beamshaper 2	7000450	8.2-22	1
FRU, Bertan high voltage power supply	7000193	8.2-13	7
FRU, cleanse tank with sensor assembly	7000379	8.2-29	
FRU, coil assembly, waste	7000353		
FRU, compressor assembly, dual-head, for 100/120 Vac system	7000371	8.2-45	2
FRU, compressor assembly, dual-head, for 220/224 Vac system	7000372	8.2-45	2
FRU, fluorescence PMT	7000197	8.2-19 8.2-21	6 2
FRU, focus knob III	7000451	8.2-22	4
FRU, focus knob2	7000449	8.2-22	4
FRU, forward scatter (FS) detector	7000359	8.2-21	5
FRU, laser blower assembly	7000719	8.2-24	10
FRU, lower pneumatics drawer assembly	7000374	8.2-37	
FRU, manual sample head	7000351	8.2-33	18
FRU, manual sample station, for XL-MCL Cytometer with grey covers	7000678	8.2-2 8.2-30 8.2-31	9 Front view Rear view
FRU, MCL cable shorting plug	7000455		
FRU, MCL cable shorting plug, EMC	7000466		
FRU, MCL carousel base assembly	7000189	8.2-8	8
FRU, MCL carousel in/out sensor cable assembly	7000434		
FRU, MCL carousel tube-position sensor cable assembly	7000436		

Table 8.1-5 Master Parts List - F *(Continued)*

Description	Part Number	Figure	Item
FRU, MCL carousel-home sensor cable assembly	7000435		
FRU, MCL head sensor cable assembly	7000438	8.2-9	16
FRU, MCL lift motor (up/down) sensor cable assembly	7000437		
FRU, MCL lifter assembly	7000443	8.2-8	4
FRU, MCL lower base cover, black	7000199	8.2-2	11
FRU, MCL lower base cover, grey	7000676	8.2-2	11
FRU, MCL option assembly	7000433	8.2-8	
FRU, MCL probe sensor cable assembly	7000439	8.2-9	2
FRU, MCL probe slide assembly (low friction precision ball slide assembly with two carriages)	7000446	8.2-9	10
FRU, MCL sample head	7000456	8.2-9	9
FRU, MCL sample station door assembly	7000444	8.2-30	10
FRU, MCL solenoids	7000555	8.2-8	19
FRU, MCL tube rotator assembly **Note:** Attach the tube rotator assembly to the MCL vertical plate using two hex screws (#6-32 x 0.25 in. length, HSC-head), PN 2851395.	7000430	8.2-8	20
FRU, MCL door (upper cover), black	7000376	8.2-2	12
FRU, MCL door (upper cover), grey	7000675	8.2-2	12
FRU, MCL vortexer foot assembly	7000579	8.2-8	5
FRU, Power Supply, +24 Vdc	7000357	8.2-55	2
FRU, Power Supply, +5 Vdc	7000356	8.2-55	4
FRU, Power Supply, ±15 Vdc	7000355	8.2-55	5
FRU, Power Supply, MCL, assembly consisting of a +5 Vdc and ±12 Vdc supply and a +24 Vdc supply	7000362	8.2-55	6
FRU, reagent drawer with slides assembly **Note:** Order front panel separately - for grey XL flow cytometer order PN 6807089; for grey XL-MCL flow cytometer order PN 6807088; for black XL or XL-MCL flow cytometer order PN 6855934.	7000677	8.2-2 8.2-4 8.2-25	4 4 2
FRU, regulator, electronic pressure (electronic transducer), for regulating sample pressure **Note:** Attach to posts using one #25 flat washer (0.265 i.d. x 0.484 o.d. x 0.027 in. thickness), PN 2827064, one #25 split-lock washer (0.26 i.d. x 0.49 o.d. x 0.062 in. thickness), PN 2826051, and one hex nut (#25-20 UNC x 0.437 AF x 0.164 in.thickness), PN 2822072. Requires two sets.	7000192	8.2-14	1
FRU, regulator, pressure, 0-10 psi, for regulating sheath pressure (4 psi flow)	7000720	8.2-14	5

Table 8.1-5 Master Parts List - F *(Continued)*

Description	Part Number	Figure	Item
FRU, sample station, manual, for XL-MCL Cytometer with black covers	7000354	8.2-2 8.2-30 8.2-31	9 Front view Rear view
FRU, segmenting valve assembly	7000370	8.2-34	
FRU, segmenting valve front pad	7000196	8.2-34	3
FRU, segmenting valve knob	7000198	8.2-34	8
FRU, segmenting valve middle pad	7000191	8.2-34	2
FRU, segmenting valve rear pad	7000195	8.2-34	1
FRU, sheath tank with sensor assembly	7000378	8.2-28	
FRU, side scatter diode	7000352	8.2-19	2
FRU, side scatter diode	7000352	8.2-21	1
FRU, sample station assembly, for XL Cytometer (without MCL option) with black covers **Note:** Before attaching sample station to the Cytometer, make sure the flow cell cover and filter shield are attached to the Cytometer.	7000360	8.2-4 8.2-32	9
FRU, sample station, for XL Cytometer without MCL option with grey covers **Note:** Before attaching sample station to the Cytometer, make sure the flow cell cover and filter shield are attached to the Cytometer.	7000679	8.2-4 8.2-32	9
FRU, upper pneumatics drawer assembly	7000375	8.2-14	
FRU, vacuum chamber **Note:** Attach using two self-lock screws (#6-32 x 0.37 in. length, pan-head), PN 2839039.	7000373	8.2-37	3
FRU, visible laser diode scanner (MCL bar-code reader) **Note:** Attach the scanner head to the MCL vertical plate using four machine screws (#6-32 x 0.25 in. length, pan-head), PN 2806009.	7000042	8.2-8	2

Table 8.1-6 Master Parts List - G

Description	Part Number	Figure	Item
Gasket, #10 black, ethylene propylene	6216345	8.2-3 8.2-20 8.2-59	24 6 6
Gasket, cleanse cap	1021812	8.2-29	5
Gasket, ferrule	1021797	8.2-9	6

Table 8.1-6 Master Parts List - G *(Continued)*

Description	Part Number	Figure	Item
Gauge, 0 to 30 in. Hg, for monitoring system vacuum, 1.5-inch diameter, panel mount (includes panel mounting hardware) **Note:** Apply a thin line of pipe sealant, PN 1601056, across gauge threads before attaching the fitting. Gauge must be oriented as shown in Figure 8.2-54 after tightening.	6232183	8.2-47 8.2-54	8 2
Gauge, 0 to 60 psi, for monitoring system pressure, 1.5-inch diameter, panel mount (includes panel mounting hardware) **Note:** Apply a thin line of pipe sealant, PN 1601056, across gauge threads before attaching the fitting. Gauge must be oriented as shown in Figure 8.2-51 after tightening.	6232189	8.2-47 8.2-51	5 2
Grommet, 0.375 i.d. x 0.560 o.d., nylon	2851080	8.2-50	5

Table 8.1-7 Master Parts List - H and I

Description	Part Number	Figure	Item
Hinge (lid stay), left-hand, 4.875 CTRS, 0.56 in. wide, 0.095 in. thick, brass-plated steel	2523666	8.2-13	14
Hinge (lid stay), right-hand, 4.875 CTRS, 0.56 in. wide, 0.095 in. thick, brass-plated steel	2523667	8.2-13	9
Hinge, #5 swag, 3-inch **Note:** Attach each hinge using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head, PN 2839039) and #6 flat washers (PN 2827147).	1021176	8.2-12	6
Hinge, door, for Power Supply module	1020939	8.2-5	2
Holder, finger, for manual sample station	1020897	8.2-33	15
Holder, intro rod **Note:** Attach the intro rod holder to the probe actuator bracket using two machine screws (pan-head, #6-32 x 0.25 in. length), PN 2806009.	1021652	8.2-9	4
Holder, MCL spring	1021765	8.2-31	6
Holder, optical filter	1018542	8.2-20	12
Holder, sample tube, for manual sample station	1021679	8.2-33	17
Housing, MCL probe	6858616	8.2-2	13
Hub, carousel (as referred to as indexing hub)	7701140	8.2-8	7
Insulation, needed to assemble flexible duct for Argon laser assembly **Note:** Assembly instructions are illustrated in Figure 8.2-62.	1018547	8.2-24 8.2-62	24 1
Interlock, high voltage (HV), snap action cheat switch	5110031	8.2-55	1

Table 8.1-8 Master Parts List - J and K

Description	Part Number	Figure	Item
Jumper, use with Cyto Transputer card	2121023		
Keeper, upper base, MCL	1021763		
Keyboard, 104-key minimum, AT®/PS Windows 95, black, for FlowCentre computer PN 2016753	2016758	8.2-7	7
Keyboard, 104-key minimum, AT®/PS Windows 95/98, for FlowCentre II tower computer PN 2016874	2016881	8.2-6	7
Kit, 4 color upgrade	6912932		
Kit, bar-code labels, 35 labels, blank sheet	6913149		
Kit, bar-code labels, for 12 x 75 test tubes	6913343		
Kit, bar-code scanner	6913337		
Kit, bar-code, MCL EPROM	6914990		
Kit, cartridge, color Printer, Hewlett Packard, for HP-1600C	6914967		
Kit, computer, FlowCentre Multimedia Workstation	6915113		
Kit, insertion rod replacement	6913097		
Kit, MCL upgrade in black	6912669		
Kit, MCL upgrade in grey	6915506		
Kit, networking option, server upgrade with LANtastic® network software and Sybase® SQL Anywhere™ PC database server software	6914958		
Kit, optical alignment	6914939		
Kit, PMI	6913241		
Kit, printer, color (includes parallel port card, HP-1600C color Printer and color Printer cartridges)	6913335		
Kit, re-image, for the FlowCentre desktop computer, PN 2016753 **Note:** Kit includes 3.5 in. bootable disk, PN 6417654, CD-ROM for Caching Controller, PN 7270409, and CD-ROM for Ultra 33 ATA Controller, PN 7270413.	6915175		
Kit, re-image, for the FlowCentre II tower computer, PN 2016874	7270464		
Kit, Sample/MCL Intro Line	6912941	8.2-34	4
Kit, sheath filter replacement	6912942	8.2-26	1
Kit, software replacement, COULTER EPICS XL/XL-MCL SYSTEM II Version 3.0	6915303		
Knob, pinch valve	1018728	8.2-27	2
Knob, snout	1021682	8.2-23	3

Table 8.1-9 Master Parts List - L

Description	Part Number	Figure	Item
Label (J69)	2427902	8.2-44	6
Label, 488 BK / Slot 5	2429706	8.2-20	11
Label, 488 DL / Slot 4	2429704	8.2-20	11
Label, 525 BP / Slot 1	2429708	8.2-20	11
Label, 550 DL / Slot 6	2429703	8.2-20	11
Label, 575 BP / Slot 2	2429709	8.2-20	11
Label, 600 DL / Slot 7	2430206	8.2-20	11
Label, 620 BP / Slot 3	2429858	8.2-20	11
Label, 645 DL / Slot 8	2429857	8.2-20	11
Label, 675 BP / Slot 9	2430195	8.2-20	11
Label, caution, interlock defeat, attach to MCL drip pan flange (PN 6858636)	2430416	8.2-3	21
Label, caution, laser radiation, attach to MCL drip pan flange (PN 6858636)	2430417	8.2-3	22
Label, Class 3B Laser Product	2430348	8.2-20	1
Label, laser danger	2427785	8.2-20 8.2-23	2 15
Label, waste container	2428039	8.2-56	3
Labels, bar-code, 1, for carousel	2430185		
Labels, keyboard short	2430458		
Labels, keyboard, long	2429044		
Labels, tube position, 1-32	2430186		
Labels, XL with MCL	1021770		
Latch, concealed pull-up catch and keeper, 1.9 x 1.1 x 0.3 in., black nylon **Note:** Use associated figures to verify proper orientation of latch catch and keeper.	2851859	8.2-2 8.2-3 8.2-4 8.2-31 8.2-31	6 12 6 1 11
Latch, magnetic, 0.24 width x 0.82 length x 0.52 thickness, for Power Supply module front door	2840053	8.2-5	6
Lens holder, 10 mm	6859219	8.2-22	2
Lens holder, 80 mm	6859220	8.2-22	3
Letter tray, upgrade, Hewlett Packard, for LaserJet IIP Plus Printer	2016557		
Line cord, 125 Vac / 15 A, shielded, 14 AWG stranded, NEMA 5-15 plug to a stripped end, 9-ft. 10-in. length including connector **Note:** Strain relief set for one line cord, PN 6027766.	6028530	8.2-45 8.2-57	7 8

Table 8.1-10 Master Parts List - M

Description	Part Number	Figure	Item
Magnet, disk, rare earth, 0.187 o.d. x 0.063 thickness **Note:** Before installation, remove the sample station door and lay the door near the edge of a table with the handle positioned over the edge. With the door flat, apply one drop of instant adhesive, PN 1601082 inside the hole behind the handle then immediately install the magnet in the hole. Be very careful not to smear the adhesive.	2523394	8.2-32	7
Manifold, rear panel	1018616	8.2-44	4
MCL compression spring, for XL-MCL sample station door, rated 8.1 lb. per inch, (0.148 in. diameter x 0.75 in. length x 0.021 in. width)	2523737	8.2-30	9
MCL drip pan flange	6858636	8.2-3	20
MCL option assembly	6706138		
MCL push cylinder, for XL-MCL sample station door	6858841	8.2-30	8
MCL upper base, black	6858519	8.2-3	2
MCL upper base, grey	6807078	8.2-3	2
MCL upper window **Note:** Before installing the window in the upper cover, remove the paper covering from the bottom side only (leave the paper on the top side), apply a thin line of epoxy, PN 1615132, to the rim of the upper cover, install the window, allow the epoxy to set, then remove the paper covering from the top of the window.	1021737	8.2-3	3
Memory, 128 MB, PC 100 SDRAM, ECC correctable, DIMM module, for FlowCentre II tower computer PN 2016874	2016969		
Memory, 16 MB, 70 NS tin-plated SIMM, for FlowCentre computer PN 2016753	2016973		
Monitor, 17-inch display, flat screen	2016938	8.2-6 8.2-7	4 4
Monitor, 22-inch CRT display	2016951		
Mount, pull-apart pinch valve	1017501	8.2-15 8.2-17 8.2-27 8.2-38	7 8 13 5
Mount, shock, rubber, axial mount, 16 lb, 256 lb/in., 78 Hz	2523660	8.2-24	13
Mount, shock, rubber, axial mount, 4 lb, 73 lb/in., 84 Hz, for laser cooling fan module (may also be referred to as bushings)	2523659		
Mount, wire tie, 0.51 in. length x 0.33 in. width, for use with #6 screw	6011019	8.2-3 8.2-41 8.2-61	10 2 3
Mount, wire tie, 0.75 x 0.75, with #6 hole, adhesive back	6027284	8.2-61	1
Mount, wire tie, 1 x 1, with #6 hole, adhesive back	6011015	8.2-61	2
Mouse pad	2016725	8.2-6 8.2-7	5 5

Table 8.1-10 Master Parts List - M *(Continued)*

Description	Part Number	Figure	Item
Mouse pointing device, for use with 166 MHz Pentium computer PN 2016802 and 133 MHz Pentium computer PN 2016669	2016161		
Mouse pointing device, PS/2 compatible, for FlowCentre computer PN 2016753	2016665	8.2-7	6
Mouse pointing device, PS/2 scroll point, for FlowCentre II tower computer PN 2016874	2016876	8.2-6	6
Muffler, exhaust	6216286		
Muffler, noise reducing pneumatic, 0.125 MNPT, 0.812 diameter, 2.125 length **Note:** Hand tighten only.	6232501	8.2-46 8.2-52	5 1

Table 8.1-11 Master Parts List - N and O

Description	Part Number	Figure	Item
Nut, hex (#10-32 UNF x 0.375 AF x 0.130 in. thickness)	2822016	8.2-33 8.2-36	13 5
Nut, hex (#25-28 UNF x 0.437 AF x 0.140 in. thickness)	2822040	8.2-35	6
Nut, hex (#2-56 UNC x 0.187 AF x 0.066 in. thickness)	2822050	8.2-30 8.2-32	2 10
Nut, hex (0.25-36 UNS x 0.375 AF x 0.094 in. thickness)	2851995	8.2-42	5
Nut, hex (47-32 UNS x 0.562 AF x 0.078 in. thickness)	2822033	8.2-27	3
Nut, self-lock (#4-40 x 0.250 AF x 0.109 in. thickness)	2821009	8.2-45	6
Nut, self-lock (#6-32 x 0.250 AF x 0.109 in. thickness)	2821010	8.2-5 8.2-12 8.2-13 8.2-24 8.2-31 8.2-43 8.2-50 8.2-58	3 9 13 4 10 1 1 5
Nut, self-lock (10-32 x 0.375 AF x 0.156 in. thickness)	2821018	8.2-33	8
Nut, thumb, diamond knurl (#6-32 UNC x 0.500 o.d. x 0.625 in. length), black dichromate	2851998	8.2-3	16
Optical media, rewritable, 1 G	2016567		
Optical media, rewritable, 650 MB	2016568		
Optical media, write once, 1 G	2016570		
Optical media, write once, 650 MB	2016569		
O-ring, 1.864 i.d. x 0.070 w, BUNA 60, for vacuum chamber	2512098		

Table 8.1-11 Master Parts List - N and O *(Continued)*

Description	Part Number	Figure	Item
O-ring, ethylene propylene seal, 0.187 i.d. x 0.050 wall	2523062	8.2-15	2
		8.2-17	2
		8.2-27	9
		8.2-33	9
		8.2-35	2
		8.2-36	2
		8.2-39	8
		8.2-44	2
O-ring, silicone seal, 0.364 i.d. x 0.070 width	2512031	8.2-29	9
		8.2-37	2
O-ring, silicone seal, 1.850 i.d. x 0.210 width, for sheath container	2523724	8.2-28	5
O-ring, silicone, used as rubber band, 2.300 i.d. x 0.103 width	2523451	8.2-25	1
		8.2-53	6

Table 8.1-12 Master Parts List - P

Description	Part Number	Figure	Item
Panel, front window, plexiglass, for Power Supply module	1020931		
Panel, front window, smoked dark Lexan, Power Supply module front door	1025141	8.2-5	8
Panel, reagent drawer front, for XL flow cytometer, grey	6807089	8.2-25	3
Panel, reagent drawer front, for XL or XL-MCL flow cytometer, black	6855934	8.2-25	5
Panel, reagent drawer front, for XL-MCL flow cytometer, grey	6807088	8.2-25	4
PCB, 3 Com Ethernet, replacement card not available	N/A	8.2-6	12
PCB, Adaptor SCSI Host	2016457		
PCB, Amp/Signal Conditioner	6705321	8.2-13	5
PCB, Bar-Code Decoder	2016561	8.2-8	1
PCB, CYT12 Receiver, EMC **Note:** Attach using hex nut, PN 2851995 (0.25-36 UNS x 0.375 AF x 0.094 in. thickness).	6706391	8.2-57	1
PCB, Cyto Transputer (also referred to as Cytometer Transputer card)	6705318	8.2-13	1
PCB, FALS Hybrid Detector	6705706		
PCB, Fiber Optic Interface **Note:** Uses fiber interface cable, PN 6028650 (9-position, D-receptacle to plug, 55-in. long).	6705324	8.2-42	4
PCB, Front Panel LED and Switch Input 2, for XL-MCL instrument only	6705742	8.2-31	9
PCB, Front Panel LED and Switch Input, for XL Cytometer without MCL option	6705193	8.2-32	3

Table 8.1-12 Master Parts List - P *(Continued)*

Description	Part Number	Figure	Item
PCB, MCL CPU	6705712	8.2-8	21
PCB, MCL Interface	6705700	8.2-13	2
PCB, Motor Filter, EMC	6706409	8.2-8	3
PCB, Network Interface	2016621		
PCB, Sensor **Note:** Place a hole spacer (0.140 i.d. x 0.250 o.d. x 0.250 in. length), PN 2843032, on each post before installing the circuit card. Secure using self-lock nuts (#6-32 x 0.312 AF x 0.140 in. thickness), PN 2821021.	6705217	8.2-14	4
PCB, Opto Transprocessor EXMEM, non-EMC, 2 fiber connectors **Note:** Card may be used in FlowCentre II tower computer PN 2016874 or FlowCentre computer PN 2016753.	6705355		
PCB, Opto Transprocessor EXMEM II, EMC, 3 fiber connectors **Note:** Card may be use in FlowCentre II tower computer PN 2016874 or FlowCentre computer PN 2016753.	6706394	8.2-6 8.2-7	10 8
PCB, Parallel Port Adapter (computer card requires PCI bus)	2016883		
PCB, PCI Sound, for FlowCentre II tower computer PN 2016874 **Note:** No replacement card is available for FlowCentre computer PN 2016753.	2016971	8.2-6	11
PCB, PCI Video, for FlowCentre computer PN 2016753	2016974	8.2-7	12
PCB, PCI Video, for FlowCentre II tower computer PN 2016874	2016970	8.2-6	13
PCB, Power Module Control II, EMC version, for instruments with a serial number Z09063 or higher	6706390	8.2-45	8
PCB, Power Module Control, for instruments with a serial number Z09062 or lower	6705231	8.2-45	8
PCB, Serial/Parallel Adapter Interface (computer card requires ISA bus)	2016678		
PCB, Solenoid Power Distribution	6705761	8.2-37	7
PCB, System Interface	6705340	8.2-13	3
PCB, Top Panel Display 2	6705206	8.2-12	5
PCB, Trans Data Acquisition	6705314	8.2-13	4
PCB, Transient Absorber EMC (also referred to as Transient Voltage Suppressor 2 card)	6706401	8.2-45	4
PCB, Transient Voltage Suppressor 2 (also referred to as Transient Absorber EMC card)	6706401	8.2-45	4
PCB, Voltage Selector, for 100 Vac system	6705442	8.2-45	9
PCB, Voltage Selector, for 120 Vac system	6705237	8.2-45	9
PCB, Voltage Selector, for 220 Vac system	6705470	8.2-45	9
PCB, Voltage Selector, for 230/240 Vac system	6705472	8.2-45	9
PCB, Voltage Supply Monitor	6705720	8.2-47 8.2-50	4 3

Table 8.1-12 Master Parts List - P *(Continued)*

Description	Part Number	Figure	Item
PCB, PMT Distribution and Laser Fan Control **Note:** Refers to the two cooling fans mounted on the Cytometer frame. These fans cool the Argon laser.	6705199	8.2-19 8.2-24	5 20
Pin, universal mate-n-lock connector, 20-14 AWG, brass and gold	2104365	8.2-44	5
Plate, 12 insert fitting, with captive knurl knob, lower pneumatics drawer	6858589	8.2-41	6
Plate, 5 insert fitting, with captive knurl knob, used only on XL with MCL option installed, for QD68, QD71, and QD89 connections, lower pneumatics drawer	6858590	8.2-41	9
Plate, 6 insert fitting, with captive knurl knob, for QD64, QD65 and QD72 connections, lower pneumatics drawer	6858591	8.2-41	7
Plate, 6 insert fitting, with captive knurl knob, for QD66, QD67, QD74, and QD75 connections, lower pneumatics drawer	6858592	8.2-41	8
Plate, Argon laser power supply mounting	6856067	8.2-24	15
Plate, compressor shock mount	6855960		
Plate, flow cell	1022362	8.2-23	10
Plate, lens holder	1018737	8.2-20	7
Plate, magnet catcher **Note:** Attach using instant adhesive, PN 1601082. Apply only one drop.	1019621	8.2-30 8.2-32	5 9
Plate, top, for manual sample station	1020910	8.2-33	19
Plenum, laser duct out	6856941	8.2-24	1
Plunger, ball (#6-40 x 0.312 long)	2516002	8.2-20	13
Power Supply, ATX power supply with PFC (power factor correction) for self adjustment and regulation, manufactured by 3Y Power Technology, voltage range 90 to 264 Vac, for FlowCentre II tower computer PN 2016874	2016919	8.2-6	8
Power Supply, with EMI shielding assembly, for FlowCentre computer, PN 2016753	2016977	8.2-7	13
Printer, Hewlett Packard, HP InkJet 2280, color printer, 14 PPM minimum in draft mode, 1200 x 600 DPI minimum, 100/240 Vac, includes bi-directional parallel port interface cable	2016953		
Printer, Hewlett Packard, HP LaserJet 2200D, black print only, 8 PPM minimum, 600 DPI minimum, 110/120 Vac, includes parallel interface cable	2016752		
Printer, Hewlett Packard, HP LaserJet 4	2016707		
Printer, Hewlett Packard, HP LaserJet 4P	2016616		
Printer, Hewlett Packard, HP LaserJet 5P	2016575		
Printer, Hewlett Packard, HP LaserJet IIP Plus	2016554		
Printer, Hewlett Packard, HP-1600C, color Printer	2016675		
Printer, Inkjet, 120 Vac	2016553		
Printer, Zebra STRIPE S-500, bar	2016676		
Probe, MCL sample	6858663	8.2-9	5
Probe, sample pickup holder	1020977		

Table 8.1-12 Master Parts List - P *(Continued)*

Description	Part Number	Figure	Item
Probe, sample, used in manual sample station	6858174	8.2-33	6
Promise, Ultra 66 IDE PCI Controller with cable, for FlowCentre tower computer PN 2016753	2016960		
Push-button, for opening MCL upper base door, black	6858700	8.2-2	10
Push-button, for opening MCL upper base door, grey **Note:** MCL push-button must be properly positioned before inserting the shoulder screw, PN 2852256	6807075	8.2-2 8.2-31	10 4

Table 8.1-13 Master Parts List - R

Description	Part Number	Figure	Item
Regulator, vacuum	6232254	8.2-14	11
Regulator, voltage to pressure	2306059		
Re-imaging CD-ROM for Caching Controller, for the FlowCentre desktop computer PN 2016753	7270409		
Re-imaging CD-ROM for Ultra 33 ATA Controller, for the FlowCentre desktop computer PN 2016753	7270413		
Re-imaging CD-ROM, bootable, FlowCentre Workstation Restoration Disk for FlowCentre II tower computer PN 2016874	7270464		
Re-imaging disk, Imagining Utility Boot, 3.5 in. floppy diskette, for the FlowCentre desktop computer PN 2016753 **Note:** For larger hard drives that use the Ultra 66 controller, use the re-imaging bootable CD-ROM, PN 7270626. The 3.5 in. diskette is not needed.	6417654		
ROMLOCK, special connector for use with EXPO32 Cytometer Acquisition software	2016892		

Table 8.1-14 Master Parts List - S

Description	Part Number	Figure	Item
Sample station, for an XL with black covers **Note:** Before attaching sample station to the Cytometer, make sure the flow cell cover and filter shield are attached to the Cytometer.	6856869	8.2-32	4
Sample station, for an XL with grey covers **Note:** Before attaching sample station to the Cytometer, make sure the flow cell cover and filter shield are attached to the Cytometer.	6807083	8.2-32	4
Sample station, for an XL-MCL with black covers **Note:** Before attaching sample station to the Cytometer, make sure the flow cell cover and filter shield are attached to the Cytometer.	6858518	8.2-30	1
Sample station, for an XL-MCL with grey covers **Note:** Before attaching sample station to the Cytometer, make sure the flow cell cover and filter shield are attached to the Cytometer.	6807081	8.2-30	1

Table 8.1-14 Master Parts List - S *(Continued)*

Description	Part Number	Figure	Item
Sample station, long screw, top	2806117		
Screw, machine (#2-56 x 0.19 in. length, pan-head)	2802006	8.2-3	15
Screw, machine (#4-40 x 0.25 in. length, HSC-head)	2804083	8.2-8	11
Screw, machine (#4-40 x 0.38 in. length, FL82 flat-head), used to mount MCL head	2804044	8.2-9	8
Screw, machine (#4-40 x 0.75 in. length, pan-head)	2804039	8.2-33	24
Screw, machine (#6-32 x 0.19 in. length, UF82-head), used to secure lens holder in filter slot 9 only	2806077	8.2-20	8
Screw, machine (#6-32 x 0.25 in. length, UF82 flat-head) **Note:** When securing lens holders in filter slots, use this screw to secure lens holders 1 through 8 only. Use PN 2806077 to secure the lens holder in slot 9.	2806104	8.2-3 8.2-14 8.2-20	11 2 8
Screw, machine (#6-32 x 0.31 in. length, pan-head)	2806182	8.2-3	13
Screw, machine (#6-32 x 0.38 in. length, FL82 flat-head)	2806137	8.2-3 8.2-8	23 6
Screw, machine (#6-32 x 0.38 in. length, hex-head)	2806102	8.2-23	7
Screw, machine (#6-32 x 0.38 in. length, HSC button-head)	2806201	8.2-3	8
Screw, machine (#6-32 x 0.38 in. length, UF82-head)	2806140	8.2-25	7
Screw, machine (#6-32 x 0.44 in. length, FL82 flat-head)	2806162	8.2-32	5
Screw, machine (#6-32 x 0.62 in. length, FL82 flat-head)	2806073	8.2-43 8.2-58	11 2
Screw, machine (#6-32 x 0.62 in. length, pan-head)	2806075	8.2-43	5
Screw, machine (#6-32 x 0.75 in. length, pan-head)	2806128	8.2-33 8.2-43	5 8
Screw, machine (#6-32 x 0.75 in. long, FL82 flat-head) **Note:** At the bottom of the display window, install the center screw in the display window before placing the display window on the panel overlay (PN 6855862). This screw must be hand tightened. Do not use a power driven screwdriver.	2806084	8.2-12	8
Screw, machine (#6-32 x 1.00 in length, HSC head)	2806200	8.2-33	16
Screw, machine (#6-32 x 1.25, pan-head)	2806096	8.2-23 8.2-39	13 5
Screw, machine (#6-32 x 2.00 in. length, FL82 flat-head)	2806148	8.2-24	9
Screw, machine (#6-32 x 2.00 in. length, pan-head)	2806159	8.2-24	8
Screw, machine (#6-40 x 1.125 in. length, hex-head)	2851982	8.2-23	5
Screw, machine (#8-32 x 0.25 in. length, UF82-head)	2808080	8.2-46	3
Screw, machine (#8-32 x 0.75 in. length, black FL82 flat-head)	2808099	8.2-3	4
Screw, machine (#6-32 x 0.38 in. length, pan-head) **Note:** Apply one drop of adhesive sealant, PN 1601065, to screw threads before insertion.	2806017	8.2-5	1

Table 8.1-14 Master Parts List - S *(Continued)*

Description	Part Number	Figure	Item
Screw, machine, knurled (#4-40 x 0.75 in. length, hex socket head)	2851975	8.2-8	12
		8.2-23	1
Screw, self-lock (#10-32 x 0.75 in. length, pan-head)	2839051	8.2-24	16
Screw, self-lock (#4-40 x 0.25 in. length, pan-head)	2839024	8.2-31	8
Screw, self-lock (#4-40 x 0.37 in. length, pan-head)	2839025	8.2-33	21
Screw, self-lock (#6-32 x 0.25 in. length, pan-head)	2839009	8.2-24	22
Screw, self-lock (#6-32 x 0.37 in. length, pan-head)	2839039	8.2-2	7
		8.2-4	7
		8.2-5	12
		8.2-12	2
		8.2-13	11
		8.2-19	3
		8.2-20	4
		8.2-23	16
		8.2-27	8
		8.2-31	3
		8.2-32	1
		8.2-37	8
		8.2-41	1
		8.2-42	3
Screw, self-lock (#6-32 x 0.38 in. length, hex-head), self-lock by nylon strip lock installed on the screw thread	2851989	8.2-8	10
Screw, self-lock (#6-32 x 0.62 in. length, pan-head)	2839043	8.2-21	4
Screw, self-lock (#6-32 x 1.12 in. length, pan-head)	2839074	8.2-39	4
Screw, self-lock (#8-32 x 0.37 in. length, pan-head)	2839057	8.2-8	17
Screw, setscrew (#4-40 x 0.125 in length, hex-head)	2807026	8.2-23	4
		8.2-27	1
Screw, setscrew (#4-40 x 0.156 in length, hex-head)	2807052	8.2-20	10
Screw, shoulder (#6-32 x 0.188 length, 0.500 long shoulder, hex-head)	2851978	8.2-9	11
Screw, shoulder (#6-32 x 0.30 in. length, 0.117 in. shoulder)	1017593	8.2-13	8
Screw, shoulder (#8-32 x 0.188 length, 0.750 long shoulder)	2851952	8.2-9	12
Screw, shoulder (#4-40 x 0.156 length, 0.560 long shoulder, hex socket head) **Note:** MCL push-button, PN 6807075, must be properly positioned before inserting this shoulder screw.	2852256	8.2-31	5
Screw, special laser mounting	1022396	8.2-24	3
Screw, stainless steel setscrew with locking element, (#6-32 x 0.25 in. length, half dog point, hex head), for MCL finger	2852321	8.2-8	18

Table 8.1-14 Master Parts List - S *(Continued)*

Description	Part Number	Figure	Item
Screw, thumb, knurled nickel-plated brass (6-32 x 0.375 in. length)	2815003	8.2-19	1
Screwlock, female assembly kit for attaching a D-type connector	2104261	8.2-42	8
Sensor assembly, waste level	6858159	8.2-56	2
Sensor flag, MCL guide cup	1021706	8.2-9	17
Sensor flag, MCL probe	1021708	8.2-9	3
Sensor, optical, reagent level	6028327		
Sensor, waste chamber, with undercut O-ring groove **Note:** Replace the original rubber gasket with O-ring seal, PN 2512031. Discard the original rubber gasket.	6028599	8.2-37	2
Setscrew, for rubber foot, PN 6858988	2810028		
Shaft, 0.375 square, for manual sample station	1020914	8.2-33	1
Shield, EMC, removable side	6858802	8.2-14	3
Shield, EMI/EMC, contact strip with adhesive mount, beryllium copper alloy, on Power Supply module front door	5704051	8.2-5	7
Shield, filter, for 3-color system	6859189		
Shield, filter, for 4-color system	6859190	8.2-20	5
Slide rail, deep channel (6.0 in.), lower pneumatics drawer	1405017		
Snout, pinhole	6858921	8.2-23	8
Socket joint, quick-disconnect with spring loaded sleeve, for 0.253-inch diameter ball stud, stainless steel	2523743	8.2-33 8.2-36	14 6
Socket joint, quick-disconnect with spring loaded sleeve, for 0.253-inch diameter ball stud, stainless steel	2523798	8.2-35	7
Software, COULTER EPICS XL/XL-MCL Prefinal, on 3.5 in. floppy diskette	7231244		
Software, COULTER EPICS XL/XL-MCL SYSTEM II, Version 3.0	6706441		
Software, EXPO32™ ADC Cytometer, on CD-ROM, also includes appropriate ROMLOCK connector (PN 2016892)	6418337		
Software, LANtastic network V8.0, 2 to 10 user license, on CD-ROM	6417325		
Software, LANtastic network V8.0, single-user license, on CD-ROM	6417324		
Software, Sybase® SQL Anywhere™ PC database server software, 4 user license, on CD-ROM	6417323		
Solenoid, 2-way, normally-open (N.O.)	6214067	8.2-44	8
Solenoids with manifold, MCL 4	6232582		
Spacer, cylinder, 0.500 i.d. x 0.562 o.d. x 0.062 thickness	6216012	8.2-15 8.2-17 8.2-38	6 7 6
Spacer, hole, #10 (0.194 i.d. x 0.250 o.d. x 0.360 in. long), aluminum	2851953	8.2-9	13
Spacer, hole, 0.140 i.d. x 0.250 o.d. x 0.250 in. length	2843032	8.2-50	4

Table 8.1-14 Master Parts List - S *(Continued)*

Description	Part Number	Figure	Item
Spacer, internally and externally threaded (#6-32 x 0.250 DP to #6-32 x 0.375, aluminum alloy)	2851866	8.2-24	19
Spacer, tapped, 6-32 x 1.625 in. length x 0.250 in. hex, aluminum	2851363	8.2-37	6
Spring, extension, 0.180 o.d. x 0.50 in. coiled length, 0.026 in. wire diameter, rated at 20.2 lbs/in. **Note:** Hook spring first to the spring holder, PN 1021765, and then to the post on the MCL push-button, PN 6807075. Make sure the push-button does not bind on the plastic.	2523733	8.2-31	7
Spring, extension, 0.250 o.d. x 1.38 in. coiled length, 0.026 in. wire diameter, rated at 1.42 lbs/in.	2515109	8.2-9	1
Stage, snout	6859217	8.2-23	6
Stage, snout support	1021703	8.2-23	2
Stud, ball (10-32 x 0.50 length) **Note:** Apply one drop of adhesive sealant, PN 1601065, to screw threads before insertion.	1022369	8.2-33	7
Switch bar, MCL	1021762		
Switch, hall effect, manual, station	5120177		
Switch, normally-open vacuum/pressure (single pole, double throw), used to monitor 2-inches Hg **Note:** Attach using two self-lock nuts (#4-40 x 0.250 AF x 0.109 in. thickness), PN 2821009.	5120232	8.2-14	6
Switch, normally-open vacuum/pressure (single pole, single throw), used to monitor 3 psi **Note:** Attach using two self-lock nuts (#4-40 x 0.250 AF x 0.109 in. thickness), PN 2821009.	5120221	8.2-14	7
Switch, straight lever	5111211		
Switch, vacuum/pressure (single pole, double throw), used to monitor 10-inches Hg **Note:** Attach to post using a self-lock nut (#4-40 x 0.250 AF x 0.109 in. thickness), PN 2821009. Secure lower opening to the panel using a #4 flat washer (0.125 i.d. x 0.250 o.d. x 0.036 in. thickness), PN 2827146, and machine screw (#4-40 x 0.75 in. length, pan-head), PN 2804039.	5120224	8.2-14	8
Switch, vacuum/pressure (single pole, double throw), used to monitor 25 psi **Note:** Attach using two self-lock nuts (#4-40 x 0.250 AF x 0.109 in. thickness), PN 2821009.	5120178	8.2-14	9
Switch, vacuum/pressure, 17 in.	5120222		
Switch, vacuum/pressure; waste pressure, normally open, single pole single throw, 3-in. water, located in the Power Supply module **Note:** Must be installed with contacts up so that wires can be connected as shown in Figure 8.2-45. The blue wire from E14 on the Power Module Control card is attached to SN13's left contact and the white wire (from E15) is attached to SN13's right contact.	5120230	8.2-45	5

Table 8.1-15 Master Parts List - T

Description	Part Number	Figure	Item
Tank, cleanse, without sensor (also referred to as cleanse bottle)	2523650	8.2-29	6
Tank, sheath without sensor (also referred to as sheath bottle)	2523649	8.2-28	6
Tank, waste, l-gallon rectangular (also referred to as bottle	2523697	8.2-56	1
Test tubes, 12 x 75 mm	2523749		
Tie wrap with flag marker, 4.4 in. long, 0.1 in. wide, marker size 0.31 in. x 0.75 in.	6011017	8.2-61	6
Tie wrap, nylon, 15 in. long, 0.19 in. wide, nylon	6011003	8.2-24 8.2-61 8.2-62	24 8 3
Tie wrap, nylon, 4 in. long, 0.1 in. wide, nylon	6011001	8.2-3 8.2-61	9 5
Tie wrap, nylon, 6.7 in. long, 0.14 in. wide, nylon	6011002	8.2-61	7
Tie wrap, screw mount, #6 sizer, 7.4 in. long, 0.19 in wide	6011006	8.2-24 8.2-43 8.2-58 8.2-61	12 6 6 4
Tool kit, Beckman Coulter service	5415102		
Tool, card extender	6705582		
Tool, circuit analyzer, 3-wire	2906883		
Tool, ESD kit, static-dissipative field kit	5415097		
Tool, Service Resource Kit CD-ROM	6417471		
Tool, trimmer pot adjustment	5402071		
Trap, vacuum	6232176		
Trap, vacuum, with miniature polycarbonate bowl	6232724	8.2-47 8.2-48	2 2
Trap, water	6232177		
Tray, MCL drip	1021735	8.2-3	1
Tube, pickup	1020976	8.2-28 8.2-29	3 3
Tubing, clear with black stripe, polyurethane, 0.082 i.d. x 0.144 o.d.	3202203		
Tubing, clear with blue stripe, polyurethane, 0.082 i.d. x 0.144 o.d.	3202209		
Tubing, clear with green stripe, polyurethane, 0.082 i.d. x 0.144 o.d.	3202208		
Tubing, clear with grey stripe, polyurethane, 0.082 i.d. x 0.144 o.d.	3202211		
Tubing, clear with orange stripe, polyurethane, 0.082 i.d. x 0.144 o.d.	3202206		
Tubing, clear with red stripe, polyurethane, 0.082 i.d. x 0.144 o.d.	3202205		
Tubing, clear with violet stripe, polyurethane, 0.082 i.d. x 0.144 o.d.	3202210		
Tubing, clear with white stripe, polyurethane, 0.082 i.d. x 0.144 o.d.	3202212		

Table 8.1-15 Master Parts List - T *(Continued)*

Description	Part Number	Figure	Item
Tubing, clear, polyurethane, 0.076 i.d. x 0.144 o.d., referred to as sheath tubing	3213215		
Tubing, clear, polyurethane, 0.082 i.d. x 0.144 o.d.	3202036		
Tubing, PEEK, flow cell intro line, 3.75 in. 0.013 i.d. x 0.025 wall, tan	1022073	8.2-34	5
Tubing, PEEK, manual sample intro line, 14 in. 0.010 i.d. x 0.026 wall, blue	1021636	8.2-34	5
Tubing, PEEK, MCL sample intro line, 15 in. 0.010 i.d. x 0.026 wall, blue	1021654	8.2-34	5
Tubing, pull-apart I-beam with black stripe, silicone, 0.062 i.d.	3213136	8.2-27	12

Table 8.1-16 Master Parts List - V

Description	Part Number	Figure	Item
Valve, electro-pneumatic, solenoid and pilot actuator combination valve, 24 Vdc / 30 psi, 4.5 lbs. pinch force **Note:** In the lower pneumatics drawer, attach using two self-lock screws (#6-32 x 0.37 in. length, pan-head), PN 2839039.	6232492	8.2-15 8.2-17 8.2-37 8.2-38	4 5 1 8
Valve, black-striped check, 0.125 i.d. to 0.125 i.d. tubing	6232080	8.2-59	3
Valve, check, 0.125 i.d. to 0.082 i.d. tubing	6232605	8.2-59	2
Valve, check, 0.125 i.d. to 0.125 i.d. tubing	6214107	8.2-59	3
Valve, check, 0.156 i.d. to 0.156 i.d. tubing **Note:** Designated as CV 1, 3, 6, 9, and 10 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886.	6214106	8.2-14 8.2-37 8.2-59	12 4 1
Valve, check, for 0.062 i.d. to 0.062 i.d. tubing **Note:** Designated as CV 2, 4, 5, 7, and 8 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886.	6214108	8.2-27 8.2-44 8.2-59	14 10 4
Valve, double solenoid, pilot-actuated latching two-position five-port spool valve, 24 Vdc, operating pressure 14 to 100 psi	6232393	8.2-39	2
Valve, dump, system pressure, for 100/120 Vac system	6232368	8.2-45 8.2-46	3 2
Valve, dump, system pressure, for 220/240 Vac system	6232367	8.2-45 8.2-46	3 2
Valve, pressure relief (with plugs), 30 psi	6208005	8.2-47 8.2-52	6 4
Valve, pressure relief, 30 psi, solenoid valve and manifold assembly, used in the lower pneumatics drawer	6232587	8.2-39	

Table 8.1-16 Master Parts List - V *(Continued)*

Description	Part Number	Figure	Item
Valve, pull-apart pinch, double-action, white, standard	6855763	8.2-15	8
		8.2-17	9
		8.2-27	11
		8.2-37	5
		8.2-38	4
Valve, single solenoid, pilot-actuated two-position five-port spool valve, 24 Vdc, operating pressure 20 to 100 psi	6232376	8.2-39	6
Valve, vacuum relief	6214017		
Valve, water trap drain, 24 V (Cytometer)	6214067		

Table 8.1-17 Master Parts List - W

Description	Part Number	Figure	Item
Washer, E-tooth, #6, 0.140 i.d. x 0.312 o.d. x 0.022 thickness	2826012	8.2-25	6
Washer, flat, #10 (0.21 i.d. x 0.51 o.d. x 0.051 thickness)	2827021	8.2-24	18
Washer, flat, #2 (0.094 i.d. x 0.25 o.d. x 0.02 in. thickness)	2827095	8.2-30	4
		8.2-32	12
Washer, flat, #4 (0.125 i.d. x 0.250 o.d. x 0.036 thickness)	2827146	8.2-33	20
		8.2-42	12
Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)	2827147	8.2-2	8
		8.2-4	8
		8.2-5	10
		8.2-12	3
		8.2-13	10
		8.2-20	3
		8.2-21	3
		8.2-23	11
		8.2-24	5
		8.2-31	2
		8.2-32	2
		8.2-33	3
		8.2-37	9
		8.2-39	3
		8.2-42	2
		8.2-43	2
		8.2-50	2
Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)	2827159	8.2-3	6

Table 8.1-17 Master Parts List - W *(Continued)*

Description	Part Number	Figure	Item
Washer, flat, #6 (0.156 i.d. x 0.375 o.d. x 0.031 in. thickness)	2827056	8.2-3	25
Washer, flat, #6 (0.156 i.d. x 0.375 o.d. x 0.046 thickness)	2827134	8.2-19	4
		8.2-24	21
Washer, flat, #8 (0.172 i.d. x 0.359 o.d. x 0.030 thickness)	2827081	8.2-12	4
Washer, I-tooth, #47, 0.47 i.d. x 0.60 o.d. x 0.020 thickness	2826030	8.2-15	5
		8.2-17	6
		8.2-27	4
		8.2-38	7
Washer, split-lock, #10 (0.19 i.d. x 0.33 o.d. x 0.047 in. thickness)	2826045	8.2-24	17
Washer, split-lock, #2 (0.09 i.d. x 0.17 o.d. x 0.02 in. thickness)	2826001	8.2-30	3
		8.2-32	11
Washer, split-lock, #4 (0.12 i.d. x 0.20 o.d. x 0.25 in. thickness)	2826002	8.2-33	25
Washer, split-lock, #6 (0.14 i.d. x 0.25 o.d. x 0.03 in. thickness)	2826035	8.2-23	12
		8.2-24	7
		8.2-33	4
		8.2-43	7
Washer, split-lock, #6 (0.14 i.d. x 0.25 o.d. x 0.031 in. thickness)	2826059	8.2-3	7
Waste tank holder	6859001		

8.2 ILLUSTRATED PARTS

ATTENTION: Part numbers issued by the Oracle system are six-digit numbers.

Overview

To expedite finding a part number, the illustrations in this section are organized in functional groups. Figure 8.2-1 is the anchor illustration from which you can quickly access a specific illustration. Illustrations that cannot be accessed from Figure 8.2-1 are listed in Table 8.2-1.

Figure 8.2-1 is referred to as the anchor illustration because it serves as the reference point for accessing other illustrations. There are no part numbers associated with this illustration, only referrals to other more specific illustrations. Each referral either accesses a specific illustration or an anchor illustration for the selected area.

Illustrations in this section use an arabic numeral and alphabetic letter configuration.

- An arabic numeral is used to identify a part listed in the associated table.
- A capital letter indicates a component or assembly that has additional detailed illustrations available.

Locating a Part Number

1. To quickly locate a part number, always begin at the anchor illustration, Figure 8.2-1.
    a. Locate the problem area on the anchor illustration and note the associated letter.
    b. Locate the associated letter in the **Figure Reference** column and note the figure number that best fits the configuration of the instrument being repaired.
    c. Go to the referenced figure number.

    Note: In the electronic version, each figure reference is in hypertext so that when you select the reference, the illustration quickly appears. A single selection may provide the needed illustration; however, it can require up to three selections to see an exploded view of an assembly.

    Using the hypertext links is the fastest way to access an illustration. If you choose to scroll through the IPL, you will encounter stop points. Because illustrations require a large amount of memory, an IPL file must be split into smaller files to enhance its loading and accessibility features. Unless you are scrolling, these divisions are invisible. When you scroll to the end of a section and encounter a stop point, use the navigation bar. Select the left pointer to jump back to the previous section or select the right pointer to continue to the next section.
2. If the needed part is not illustrated, review the **Figure Reference** column to determine if another illustration is available.
    a. If another illustration is available, go to the referenced figure number.
    b. If no additional illustrations are available, see the master parts list. Some parts are not illustrated.

Figure 8.2-1 XL Cytometer with MCL Option, Illustrated Components

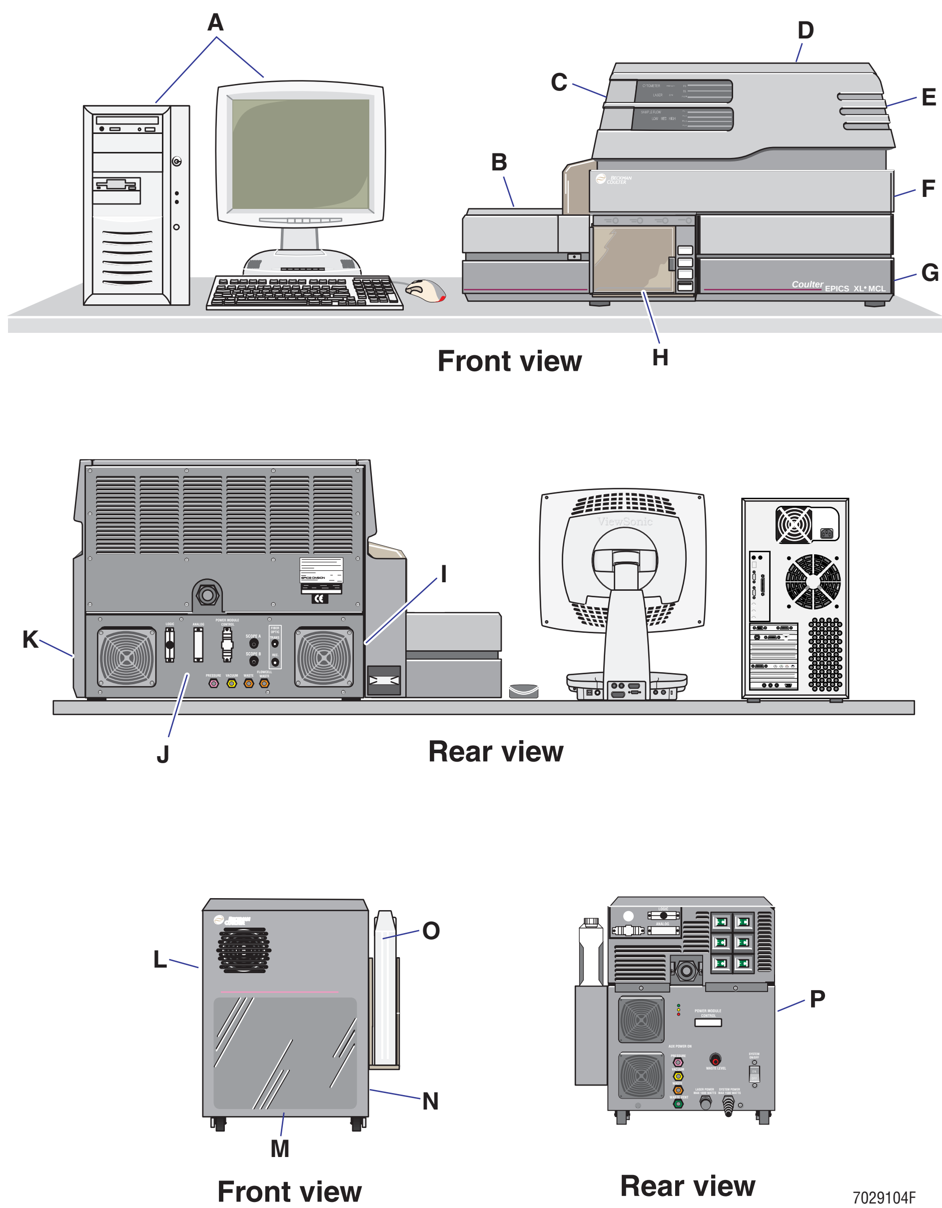


Figure Reference

A Workstation
- FlowCentre II, Figure 8.2-6
- FlowCentre, Figure 8.2-7

At the Cytometer . . .

B MCL option, Figure 8.2-8

Vertical plate components, Figure 8.2-9

C Front display panel, Figure 8.2-12

D Data Acquisition card cage, Figure 8.2-13

E Upper pneumatics drawer, Figure 8.2-14

F Optical collection area (includes laser, optics, filters, and PMTs), Figure 8.2-19

G Reagent drawer, Figure 8.2-25

H Manual sample station
- Unit **with** MCL option, Figure 8.2-30
- Unit **without** MCL option, Figure 8.2-32
- Mechanical assembly, Figure 8.2-33

Segmenting valve, Figure 8.2-34

I Lower pneumatics drawer, Figure 8.2-37

J Rear panel components, Figure 8.2-42

K Right side compartment, Figure 8.2-44

At the Power Supply . . .

L Left side compartment, Figure 8.2-45

M Front panel components, Figure 8.2-47

Front door and related hardware, Figure 8.2-5

N Right side compartment, Figure 8.2-55

O Waste container, Figure 8.2-56

P Rear panel components, Figure 8.2-57

Table 8.2-1 Illustrations Not Referenced from Figure 8.2-1

Title	Figure Number
XL-MCL Cytometer Covers, Doors, and Latches	Figure 8.2-2
MCL Covers and Associated Hardware	Figure 8.2-3
XL Cytometer Covers, Doors, and Latches	Figure 8.2-4
Power Supply Cover, Door, Latches, and Casters	Figure 8.2-5
Check Valves and Chokes with Related Components	Figure 8.2-59
Fittings	Figure 8.2-60
Tie Wraps and Mounting Hardware	Figure 8.2-61

Figure 8.2-2 XL-MCL Cytometer Covers, Doors, and Latches (See Table 8.2-2)

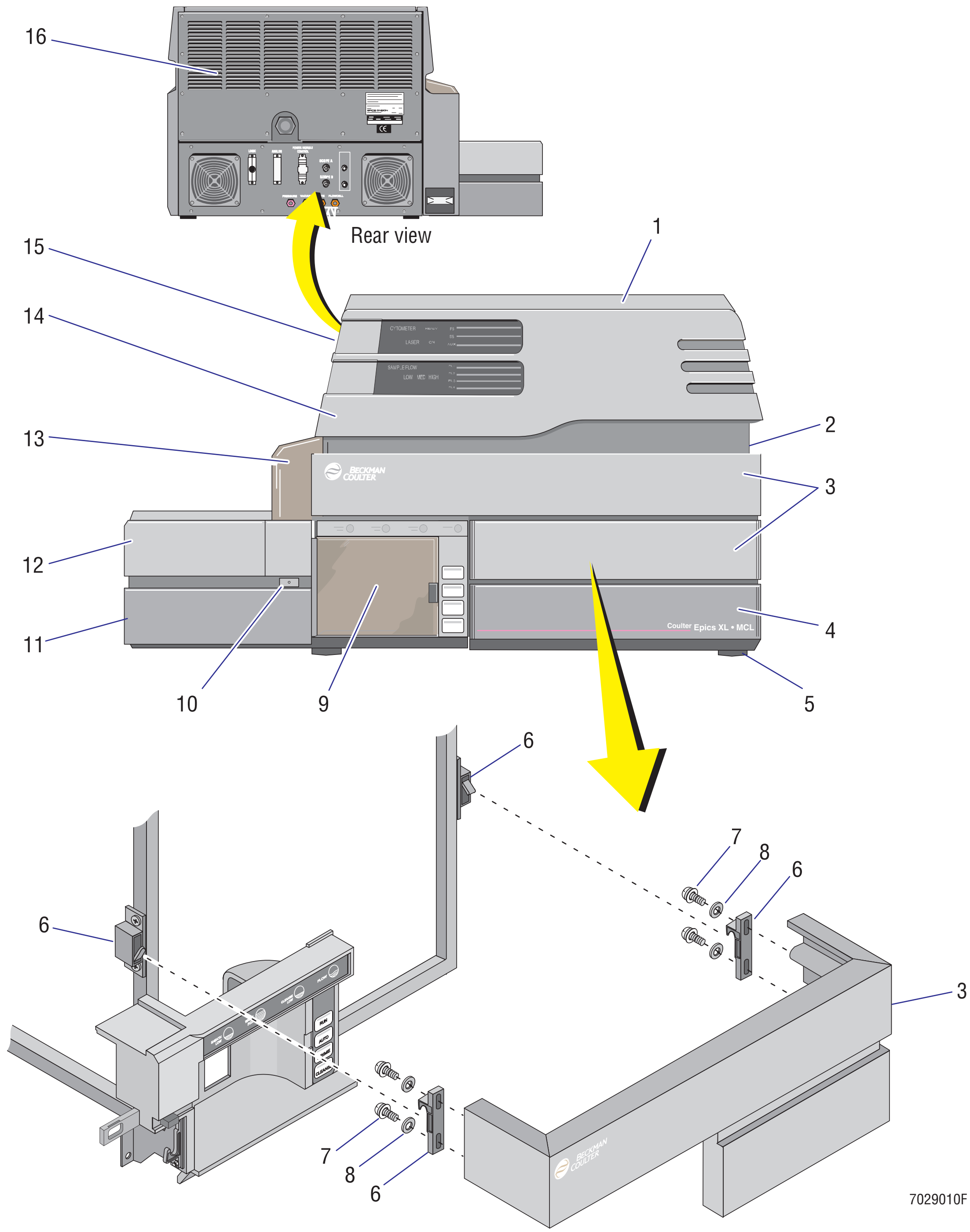


Table 8.2-2 XL-MCL Cytometer Covers, Doors, and Latches (See Figure 8.2-2)

Item	Part Number	Description
1	6807080	Cover, top, grey
	6858129	Cover, top, black **Note:** Attach using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head), PN 2839039, and #6 flat washers, PN 2827147.
2	6807079	Cover, right-side, grey
	6856494	Cover, right-side, black
3	6807084	Cover, filter, grey
	6856735	Cover, filter, black
4	7000677	FRU, reagent drawer with slides assembly **Note:** Order front panel separately - for grey flow cytometer order PN 6807088; for black flow cytometer order PN 6855934.
5	6858988	Foot, rubber **Note:** Use setscrew, PN 2810028, to attach foot to the Cytometer frame.
6	2851859	Latch, concealed pull-up catch and keeper, 1.9 x 1.1 x 0.3 in., black nylon **Note:** The latch catches are attached to the Cytometer frame and latch keepers, to the center front cover (filter cover). Use Figure 8.2-2 to verify proper orientation of each latch catch and keeper.
7	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
8	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
9	7000678	FRU, sample station, manual, for XL-MCL Cytometer with grey covers
	7000354	FRU, sample station, manual, for XL-MCL Cytometer with black covers **Note:** See Figure 8.2-30 for an exploded view of components.
10	6807075	Push-button, for opening MCL upper base door, grey
	6858700	Push-button, for opening MCL upper base door, black
11	7000676	FRU, MCL lower base cover, grey
	7000199	FRU, MCL lower base cover, black
12	7000675	FRU, MCL door (upper cover), grey
	7000376	FRU, MCL door (upper cover), black
13	6858616	Housing, MCL probe
14	6807085	Door, front panel display, grey
	6856490	Door, front panel display, black **Note:** Attach door using two 3-in. #5 swag hinges, PN 1021176. Attach each hinge using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head), PN 2839039, and #6 flat washers, PN 2827147.
15	6807076	Cover, left-side, for XL-MCL Cytometer, grey
	6858522	Cover, left-side, for XL-MCL Cytometer, black
16	1025310	Cover, upper rear, grey
	1018854	Cover, upper rear, black

Figure 8.2-3 MCL Covers and Associated Hardware (See Table 8.2-3)

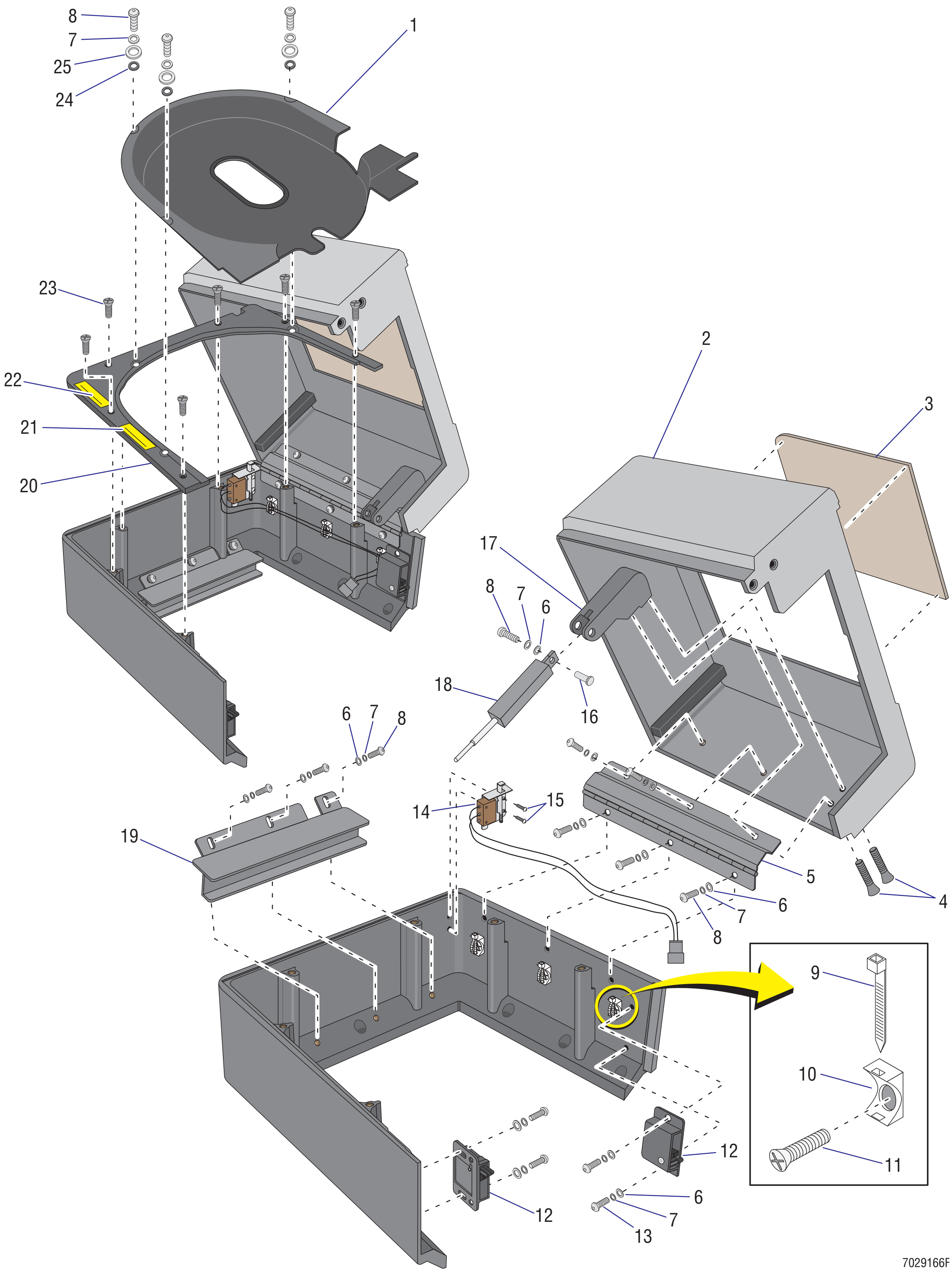


Table 8.2-3 MCL Covers and Associated Hardware (See Figure 8.2-3)

Item	Part Number	Description
1	1021735	Tray, MCL drip
2	6807078	MCL upper base, grey
	6858519	MCL upper base, black
3	1021737	MCL upper window **Note:** Before installing the window in the upper cover, remove the paper covering from the bottom side only (leave the paper on the top side), apply a thin line of epoxy, PN 1615132, to the rim of the upper cover, install the window, allow the epoxy to set, then remove the paper covering from the top of the window.
4	2808099	Screw, machine (#8-32 x 0.75 in. length, black FL82 flat-head)
5	6858657	Bracket, hinged machine, attaches MCL upper and lower bases
6	2827159	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
7	2826059	Washer, split-lock, #6 (0.14 i.d. x 0.25 o.d. x 0.031 in. thickness)
8	2806201	Screw, machine (#6-32 x 0.38 in. length, HSC button-head)
9	6011001	Tie wrap, nylon, 4 in. long, 0.1 in. wide, nylon
10	6011019	Mount, wire tie, 0.51 in. length x 0.33 in. width, for use with #6 screw
11	2806104	Screw, machine (#6-32 x 0.25 in. length, UF82 flat-head)
12	2851859	Latch, concealed pull-up catch and keeper, 1.9 x 1.1 x 0.3 in., black nylon **Note:** Only latch catches are shown in Figure 8.2-3. Use Figure 8.2-3 to verify proper orientation of each latch catch. The latch keeper that connects with the front latch catch is located on the left side of the manual sample station. The latch keeper that connects to the back latch catch is located on the MCL frame.
13	2806182	Screw, machine (#6-32 x 0.31 in. length, pan-head)
14	6028424	Cable assembly, MCL door open detector
15	2802006	Screw, machine (#2-56 x 0.19 in. length, pan-head)
16	2851998	Nut, thumb, diamond knurl (#6-32 UNC x 0.500 o.d. x 0.625 in. length), black dichromate
17	1021764	Bracket, gas cylinder upper
18	6858666	Cylinder, MCL gas (may also be referred to as MCL bay cylinder)
19	6858635	Bracket, MCL lower base
20	6858636	MCL drip pan flange
21	2430416	Label, caution, interlock defeat
22	2430417	Label, caution, laser radiation
23	2806137	Screw, machine (#6-32 x 0.38 in. length, FL82 flat-head)
24	6216345	Gasket, #10 black, ethylene propylene
25	2827056	Washer, flat, #6 (0.156 i.d. x 0.375 o.d. x 0.031 in. thickness)

Figure 8.2-4 XL Cytometer Covers, Doors, and Latches (See Table 8.2-4)

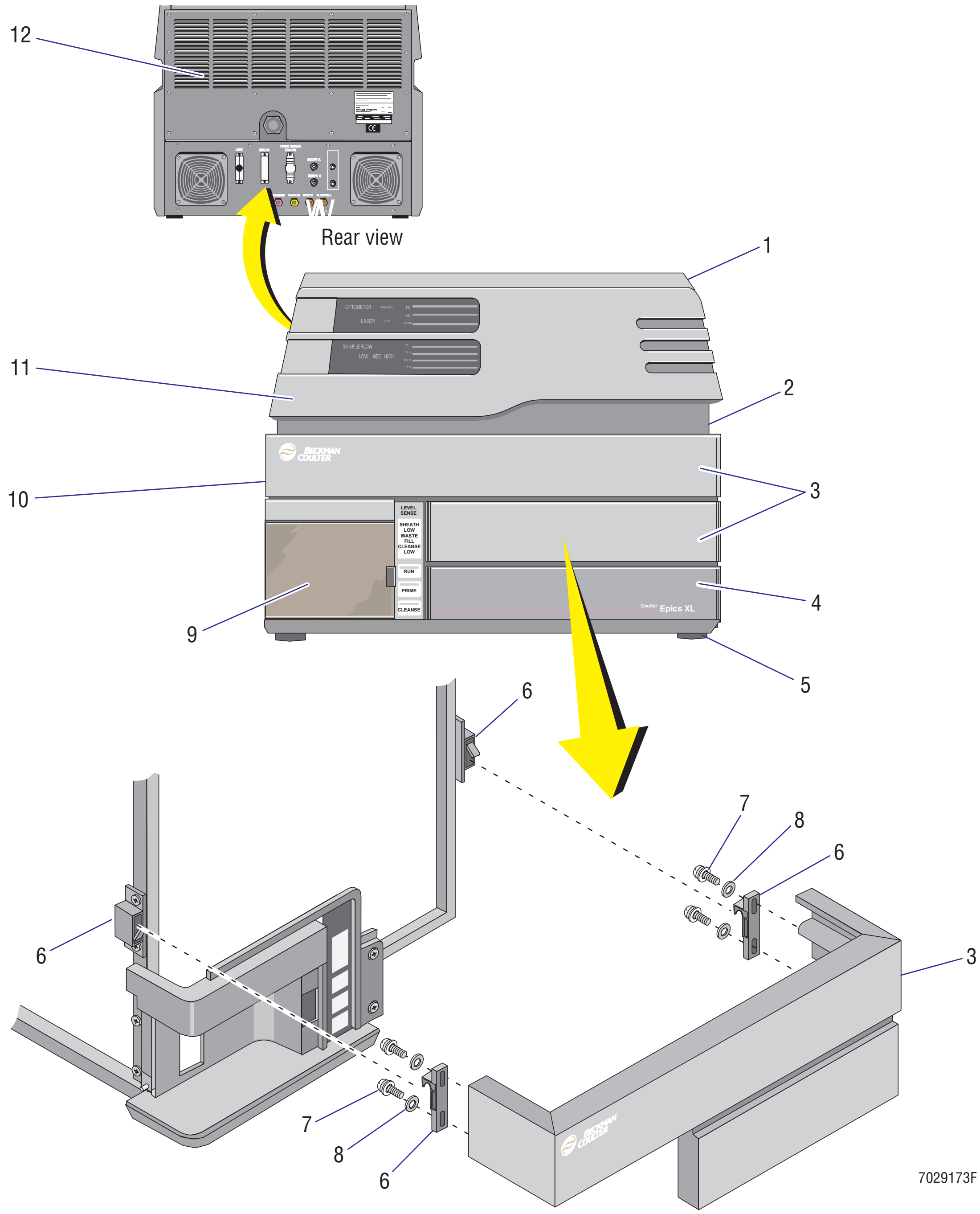


Table 8.2-4 XL Cytometer Covers, Doors, and Latches (See Figure 8.2-4)

Item	Part Number	Description
1	6807080	Cover, top, grey
	6858129	Cover, top, black
		Note: Attach using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head), PN 2839039, and #6 flat washers, PN 2827147.
2	6807079	Cover, right-side, grey
	6856494	Cover, right-side, black
3	6807084	Cover, filter, grey
	6856735	Cover, filter, black
4	7000677	FRU, reagent drawer with slides assembly
		Note: Order front panel separately - for grey flow cytometer order PN 6807089; for black flow cytometer order PN 6855934.
5	6858988	Foot, rubber
		Note: Use setscrew, PN 2810028, to attach foot to the Cytometer frame.
6	2851859	Latch, concealed pull-up catch and keeper, 1.9 x 1.1 x 0.3 in., black nylon
		Note: The latch catches are attached to the Cytometer frame and latch keepers, to the center front cover (filter cover). Use Figure 8.2-4 to verify proper orientation of each latch catch and keeper.
7	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
8	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
9	7000679	FRU, sample station, for XL Cytometer, grey
	7000360	FRU, sample station, for XL Cytometer, black
		Note: See Figure 8.2-32 for an exploded view of components.
10	6807074	Cover, left-side, for XL Cytometer, grey
	6856727	Cover, left-side, for XL Cytometer, black
11	6807085	Door, front panel display, grey
	6856490	Door, front panel display, black
		Note: Attach door using two 3-in. #5 swag hinges, PN 1021176. Attach each hinge using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head), PN 2839039, and #6 flat washers, PN 2827147.
12	1025310	Cover, upper rear, grey
	1018854	Cover, upper rear, black

Figure 8.2-5 Power Supply Cover, Door, Latches, and Casters (See Table 8.2-5)

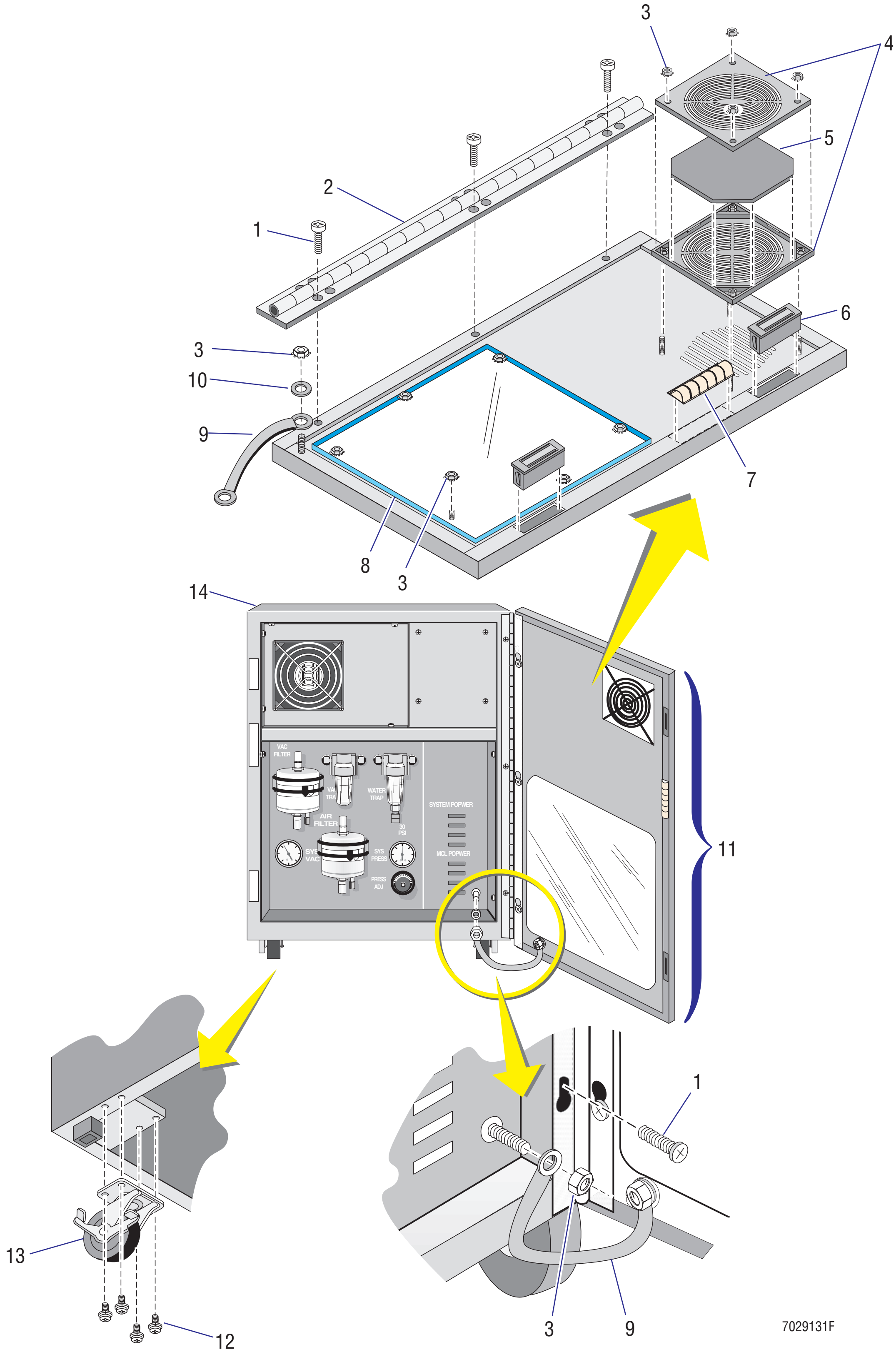


Table 8.2-5 Power Supply Cover, Door, Latches, and Casters (See Figure 8.2-5)

Item	Part Number	Description
1	2806017	Screw, machine (#6-32 x 0.38 in. length, pan-head) **Note:** Apply one drop of adhesive sealant, PN 1601065, to screw threads before insertion.
2	1020939	Hinge, door
3	2821010	Nut, self-lock (#6-32 x 0.250 AF x 0.109 in. thickness)
4	2603009	Finger guard, grille for fan air filter on 4-inch box fan **Note:** Raised ribs should face out.
5	2603010	Filter, air, 4-inch pad, 45 PPI
6	2840053	Latch, magnetic, 0.24 width x 0.82 length x 0.52 thickness
7	5704051	Shield, EMI/EMC, contact strip with adhesive mount, beryllium copper alloy
8	1025141	Panel, front window, smoked dark Lexan
9	6027875	Cable, ground strap
10	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
11	6807047 6856160	Assembly, front door, grey Assembly, front door, black
12	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
13	2523658	Caster, swivel with brake, 2 in. diameter wheel
14	6807082 6856369	Cover, three-surface (left-side, top, right-side), grey Cover, three-surface (left-side, top, right-side), black

Figure 8.2-6 FlowCentre II Workstation (See Table 8.2-6)

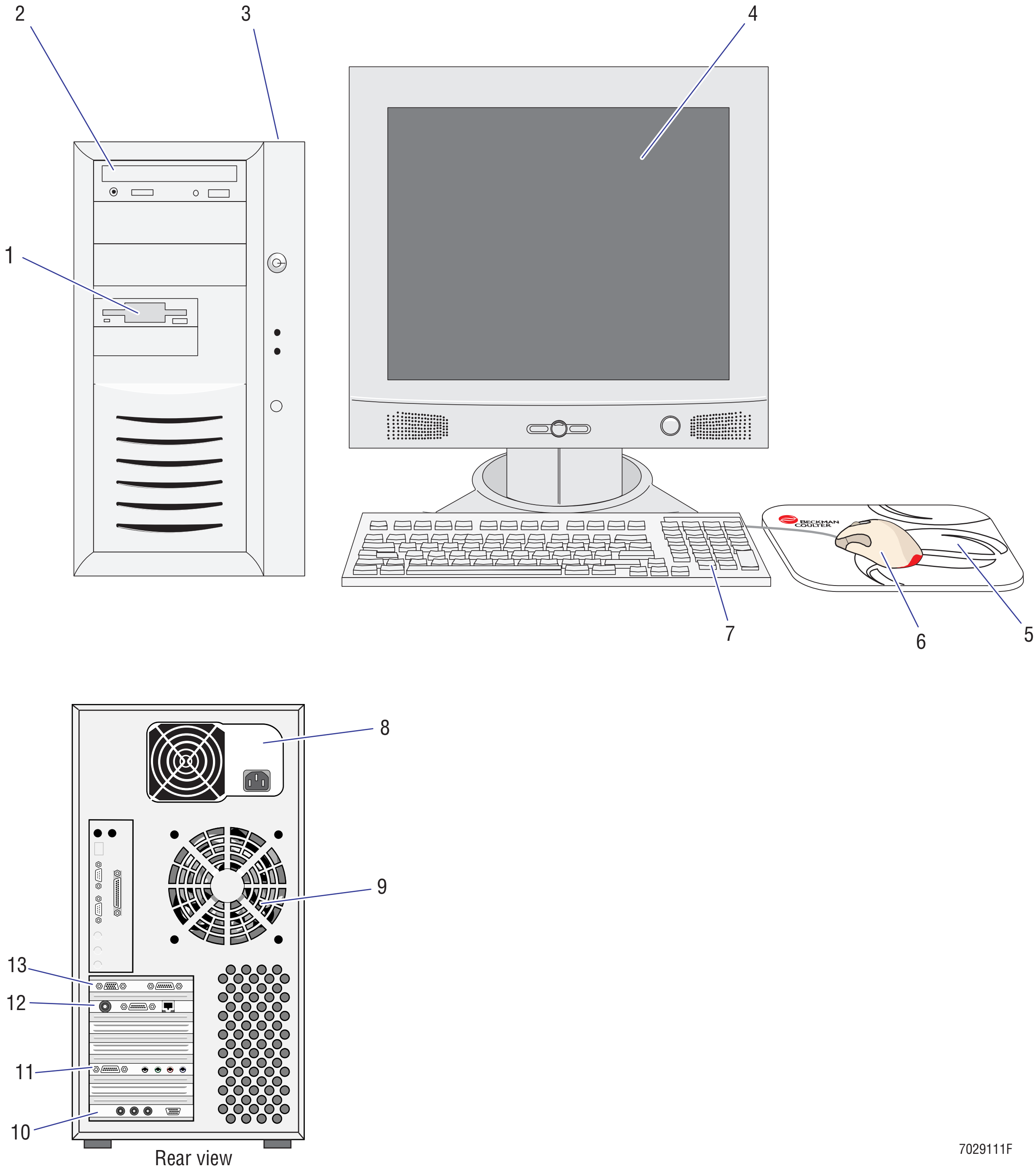


Table 8.2-6 FlowCentre II Workstation (See Figure 8.2-6)

Item	Part Number	Description
1	2016972	Drive, diskette, 3.5 in., 1.44 MB, white
2	175742	Drive, CD-ROM, 8X minimum, internal IDE
3	2016874	Computer, Pentium III processor, 550 MHz minimum, referred to as FlowCentre II Tower Computer, also includes PN 2016876 (mouse) and PN 2016881 (keyboard)
4	2016938	Monitor, 17-inch display, flat screen
	2016951	Monitor, 22-inch CRT display (not shown)
5	2016725	Mouse pad
6	2016876	Mouse pointing device, PS/2 scroll point
7	2016881	Keyboard, 104-key minimum, AT®/PS Windows 95/98
8	2016919	Power Supply, ATX power supply with PFC (power factor correction) for self adjustment and regulation, voltage range 90 to 264 Vac, manufactured by 3Y Power Technology Model YM-6042A
9	175741	Fan, chassis
10	6706394	Card, Opto Transprocessor EXMEM II, EMC, 3 fiber connectors
	6705355	Card, Opto Transprocessor EXMEM, non-EMC, 2 fiber connectors (not shown) **Note:** Cards may be used in the FlowCentre II tower computer, PN 2016874, or FlowCentre desktop computer, PN 2016753.
11	2016971	Card, PCI Sound
12	N/A	Card, 3 Com Ethernet, replacement card not available
13	2016970	Card, PCI Video
Not shown	2016963	Drive, hard, 20 GB minimum, 7200 RPM IDE HDD **Note:** Drive may be used in the FlowCentre II tower computer, PN 2016874, or FlowCentre desktop computer, PN 2016753.
Not shown	2016969	Memory, 128 MB, PC 100 SDRAM, ECC correctable, DIMM module
Not shown	2016892	ROMLOCK, special connector for use with EXPO32 Cytometer Acquisition software

Figure 8.2-7 FlowCentre Workstation (See Table 8.2-7)

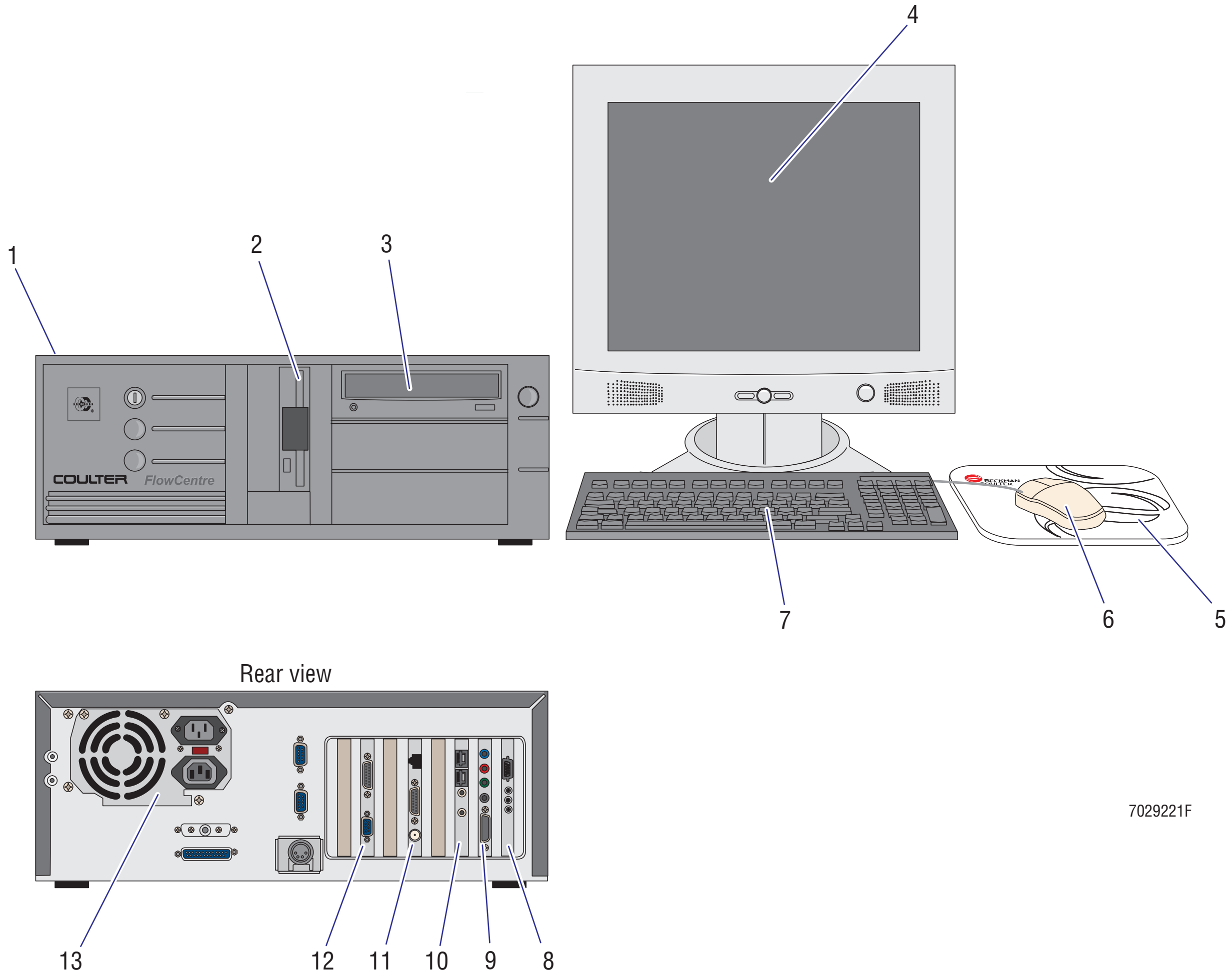


Table 8.2-7 FlowCentre Workstation (See Figure 8.2-7)

Item	Part Number	Description
1	2016753	Computer, Atlas PCI III Pentium 200 processor, referred to as FlowCentre Computer, also includes PN 2016665 (mouse) and PN 2016758 (keyboard)
2	2016962	Drive, diskette, 3.5 in., 1.44 MB, black
3	2016959	Drive, CD-ROM, 8X minimum, internal IDE
4	2016938 2016951	Monitor, 17-inch display, flat screen Monitor, 22-inch CRT display (not shown)
5	2016725	Mouse pad
6	2016665	Mouse pointing device, PS/2 compatible
7	2016758	Keyboard, 104-key minimum, AT®/PS Windows 95, black
8	6706394 6705355	Card, Opto Transprocessor EXMEM II, EMC, 3 fiber connectors Card, Opto Transprocessor EXMEM, non-EMC, 2 fiber connectors (not shown) **Note:** Cards may be used in the FlowCentre II tower computer, PN 2016874, or FlowCentre desktop computer, PN 2016753.
9	N/A	Card, PCI Sound, replacement card not available
10	N/A	Card, Modem (may not be found in all FlowCentre computers)
11	N/A	Card, 3 Com Ethernet, replacement card not available
12	2016974	Card, PCI Video
13	2016977	Power Supply, with EMI shielding assembly
Not shown	2016963	Drive, hard, 20 GB minimum, 7200 RPM IDE HDD **Note:** Drive may be used in the FlowCentre II tower computer, PN 2016874, or FlowCentre desktop computer, PN 2016753.
Not shown	2016973	Memory, 16 MB, 70 NS tin-plated SIMM
Not shown	2016960	Promise, Ultra 66 IDE PCI Controller with cable
Not shown	2016892	ROMLOCK, special connector for use with EXPO32 Cytometer Acquisition software

Figure 8.2-8 MCL Option Assembly (See Table 8.2-8)

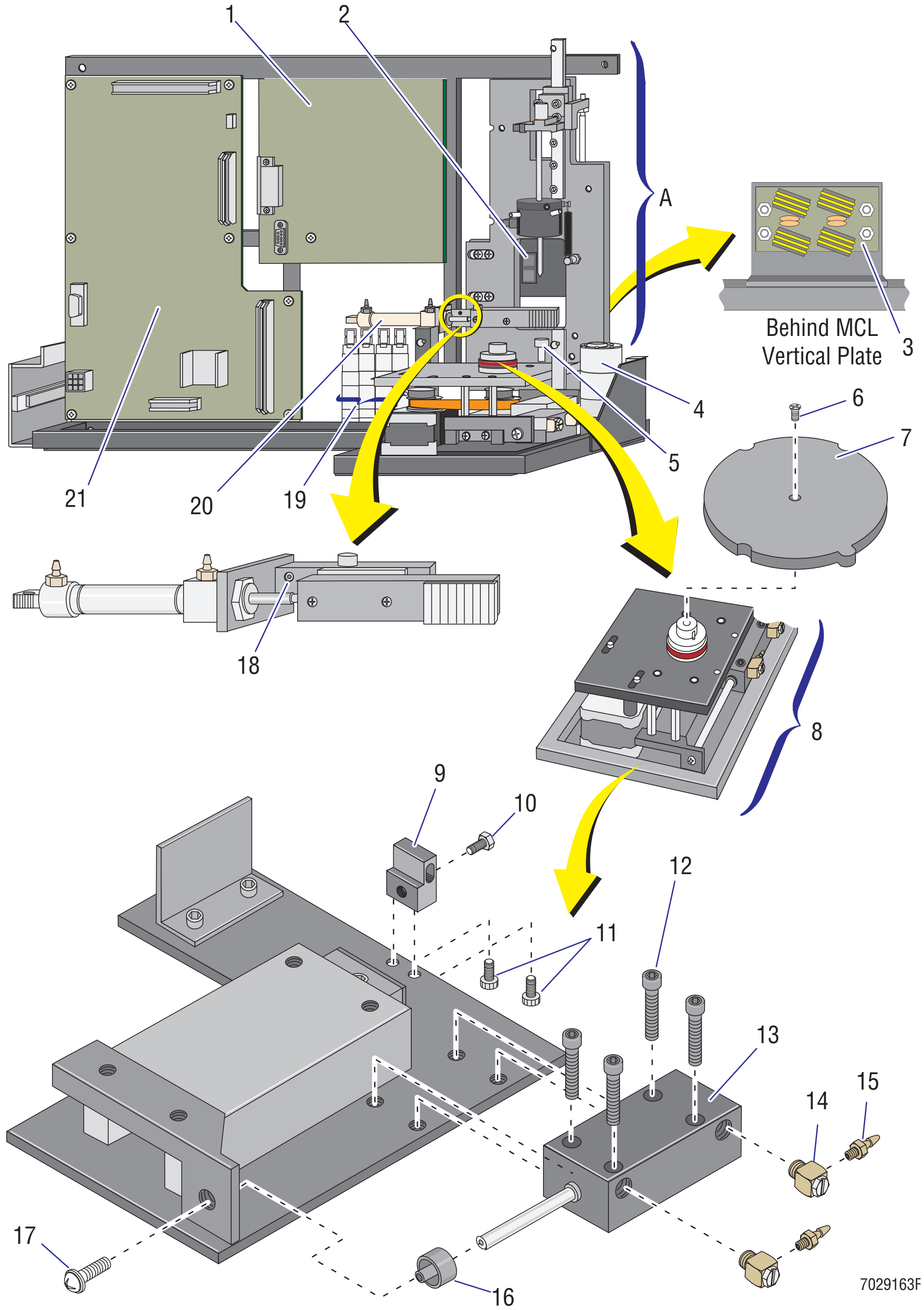


Figure Reference

A Vertical plate components, Figure 8.2-9

Table 8.2-8 MCL Option Assembly (See Figure 8.2-8)

Item	Part Number	Description
	7000433	FRU, MCL option assembly
1	2016561	Card, Bar-Code Decoder
2	7000042	FRU, visible laser diode scanner (bar-code reader) **Note:** Attach the scanner head to the MCL vertical plate using four machine screws (#6-32 x 0.25 in. length, pan-head), PN 2806009.
3	6706409	Card, Motor Filter, EMC
4	7000443	FRU, MCL lifter assembly
5	7000579	FRU, MCL vortexer foot assembly
6	2806137	Screw, machine (#6-32 x 0.38 in. length, FL82 flat-head)
7	7701140	Hub, carousel (also referred to as indexing hub)
8	7000189	FRU, MCL carousel base assembly
9	1022128	Block, stop
10	2851989	Screw, self-lock (#6-32 x 0.38 in. length, hex-head), self-lock by nylon strip lock installed on the screw thread
11	2804083	Screw, machine (#4-40 x 0.25 in. length, HSC-head)
12	2851975	Screw, machine, knurled (#4-40 x 0.75 in. length, hex socket head)
13	6232570	Cylinder, air, in/out
14	6232360	Fitting, elbow, adjustable, 10-32 ports, O-ring sealed brass miniature, for bulkhead mounting
15	6232637	Choke, pneumatic, 0.0102 diameter, 0.062 barb and 10-32 threaded connections, brass **Note:** Choke must be oriented as shown when installation is complete.
16	2523700	Coupling joint, cylinder rod end, 8-32 fastening, black oxide **Note:** Coupling has an internal hex for tightening.
17	2839057	Screw, self-lock (#8-32 x 0.37 in. length, pan-head)
18	2852321	Screw, stainless steel setscrew with locking element, (#6-32 x 0.25 in. length, half dog point, hex head)
19	7000555	FRU, MCL solenoids
20	7000430	FRU, MCL tube rotator assembly **Note:** Attach the tube rotator assembly to the MCL vertical plate using two hex screws (#6-32 x 0.25 in. length, HSC-head), PN 2851395.
21	6705712	Card, MCL CPU

Figure 8.2-9 MCL Vertical Plate Components (See Table 8.2-9)

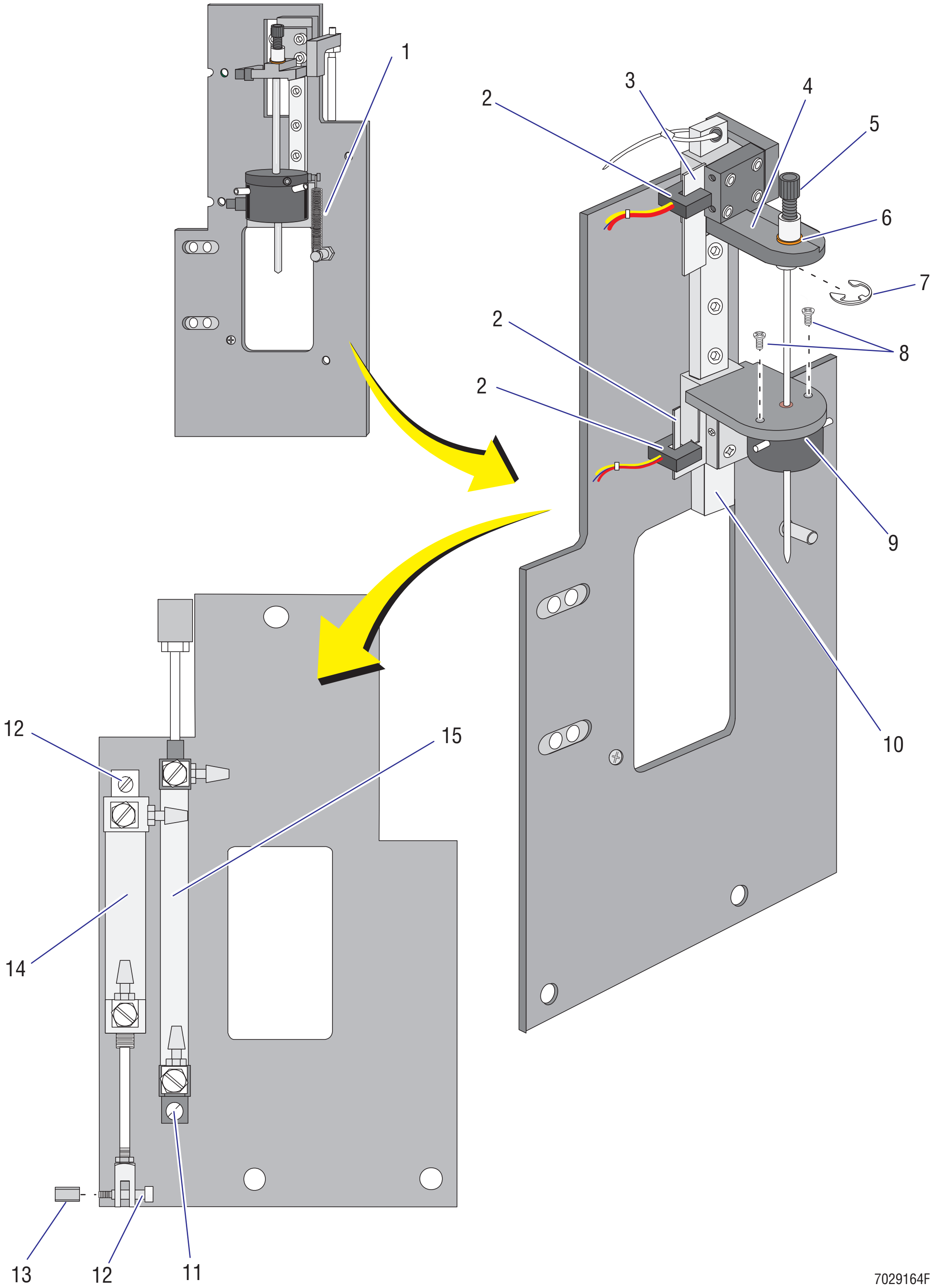


Table 8.2-9 MCL Vertical Plate Components (See Figure 8.2-9)

Item	Part Number	Description
1	2515109	Spring, extension, 0.250 o.d. x 1.38 in. coiled length, 0.026 in. wire diameter, rated at 1.42 lbs/in.
2	7000439	FRU, probe sensor cable assembly
3	1021708	Sensor flag, MCL probe
4	1021652	Holder, intro rod **Note:** Attach the intro rod holder to the probe actuator bracket using two machine screws (pan-head, #6-32 x 0.25 in. length), PN 2806009.
5	6858663	Probe, MCL sample
6	1021797	Gasket, ferrule
7	2837022	Clip, MCL sample probe retainer
8	2804044	Screw, machine (#4-40 x 0.38 in. length, FL82 flat-head)
9	7000456	FRU, MCL sample head
10	7000446	FRU, MCL probe slide assembly (low friction precision ball slide assembly with two carriages)
11	2851978	Screw, shoulder (#6-32 x 0.188 length, 0.500 long shoulder, hex-head)
12	2851952	Screw, shoulder (#8-32 x 0.188 length, 0.750 long shoulder)
13	2851953	Spacer, hole, #10 (0.194 i.d. x 0.250 o.d. x 0.360 in. long), aluminum
14	6232591	Cylinder, lifter air, see Figure 8.2-10 for an exploded view that includes attachments
15	6232595	Cylinder, probe up/down air, see Figure 8.2-11 for an exploded view that includes attachments
16	7000438	FRU, head sensor cable assembly
17	1021706	Sensor flag, MCL guide cup

Figure 8.2-10 Lifter Air Cylinder and Attachments (See Table 8.2-10)

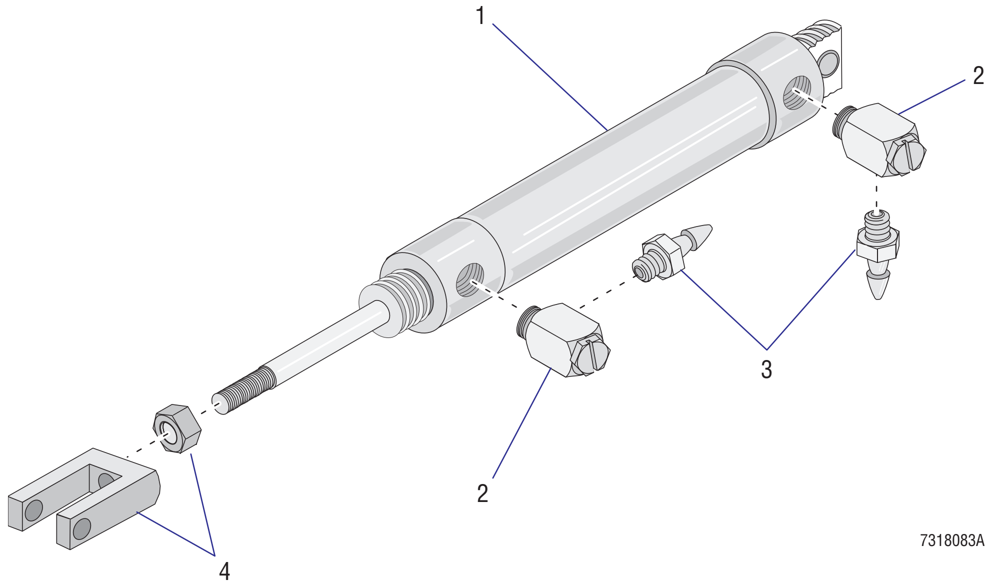


Table 8.2-10 Lifter Air Cylinder and Attachments (See Figure 8.2-10)

Item	Part Number	Description
1	6232591	Cylinder, lifter air, double acting, 250 psi, 0.56 bore, stud mount each end **Note:** If present, remove and discard the large nut on each end before installing.
2	6216002	Fitting, miniature, 10-32 threaded, 10-32 tap, adjustable, brass
3	6232637	Choke, pneumatic, 0.0102 diameter, 0.062 barb and 10-32 threaded connections, brass **Note:** Choke must be oriented as shown when installation is complete.
4	6232590	Cylinder, piston rod clevis for 0.56 bore, 250 psi cylinder, 10-32 threaded with hex nut for mounting

Figure 8.2-11 Probe Up/Down Air Cylinder and Attachments (See Table 8.2-11)

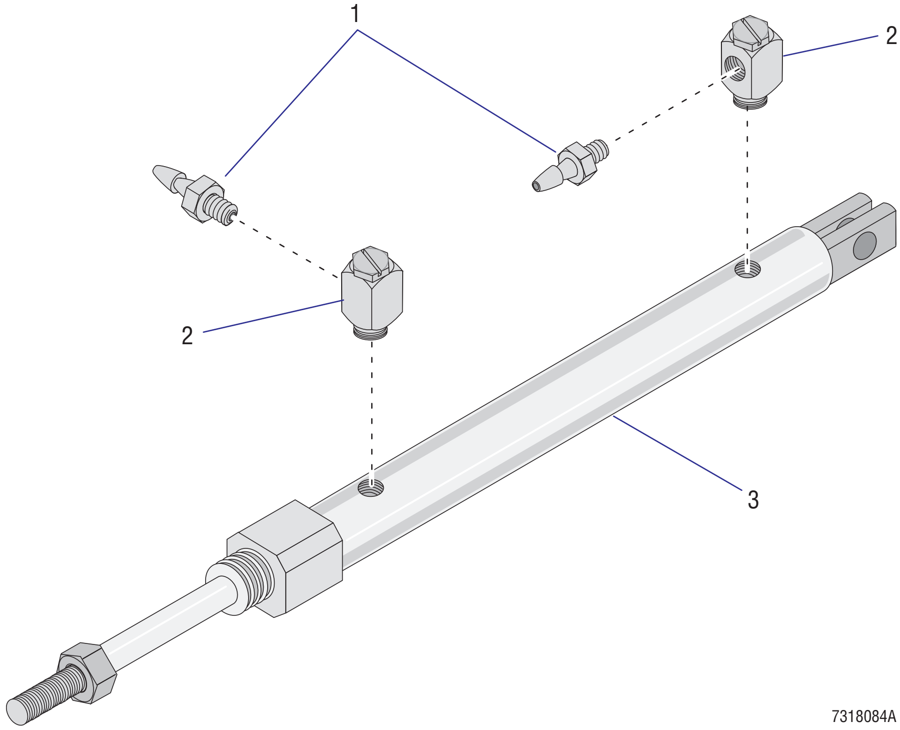


Table 8.2-11 Probe Up/Down Air Cylinder and Attachments (See Figure 8.2-11)

Item	Part Number	Description
1	6232637	Choke, pneumatic, 0.0102 diameter, 0.062 barb and 10-32 threaded connections, brass **Note:** Choke must be oriented as shown when installation is complete.
2	6216002	Fitting, miniature, 10-32 threaded, 10-32 tap, adjustable, brass
3	6232595	Cylinder, air, probe up/down, double acting, 150 psi, 0.375 bore, front stud and rear clevis mount **Note:** Remove the large nut from the cylinder. Make sure you replace the small cylinder rod nut before installing.

Figure 8.2-12 Front Display Panel (See Table 8.2-12)

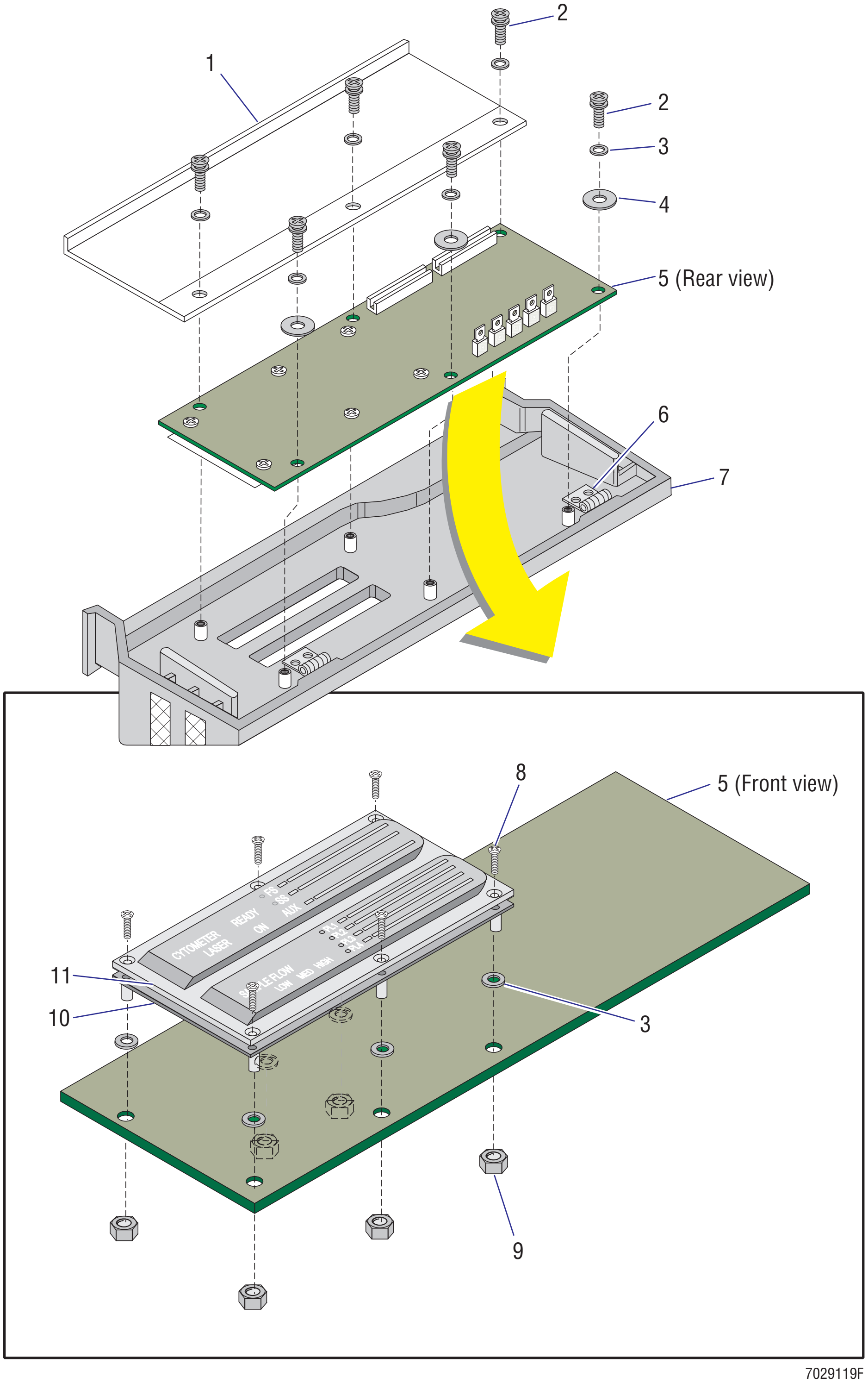


Table 8.2-12 Front Display Panel (See Figure 8.2-12)

Item	Part Number	Description
1	1021769	Bracket, front panel
2	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
3	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
4	2827081	Washer, flat, #8 (0.172 i.d. x 0.359 o.d. x 0.030 thickness)
5	6705206	Card, Top Panel Display 2
6	1021176	Hinge, #5 swag, 3-inch **Note:** Attach each hinge using four sets of self-lock screws (#6-32 x 0.37-in. length, pan-head, PN 2839039) and #6 flat washers (PN 2827147).
7	6807085 6856490	Door, front panel display, grey Door, front panel display, black
8	2806084	Screw, machine (#6-32 x 0.75 in. long, FL82 flat-head) **Note:** At the bottom of the display window, install the center screw in the display window before placing the display window on the panel overlay (PN 6855862). This screw must be hand tightened. Do not use a power driven screwdriver.
9	2821010	Nut, self-lock (#6-32 x 0.250 AF x 0.109 in. thickness)
10	6855862	Assembly, XL overlay panel
11	1016814	Display, window **Note:** Remove the protective plastic sheet. Ensure the LED grooves are lined up with the LEDs on the panel overlay (PN 6855862). Install the lower center screw (PN 2806084) in the display window before placing the display window on the panel overlay. Hand tighten this screw. Do not use a power driven screwdriver.

Figure 8.2-13 Data Acquisition Card Cage (See Table 8.2-13)

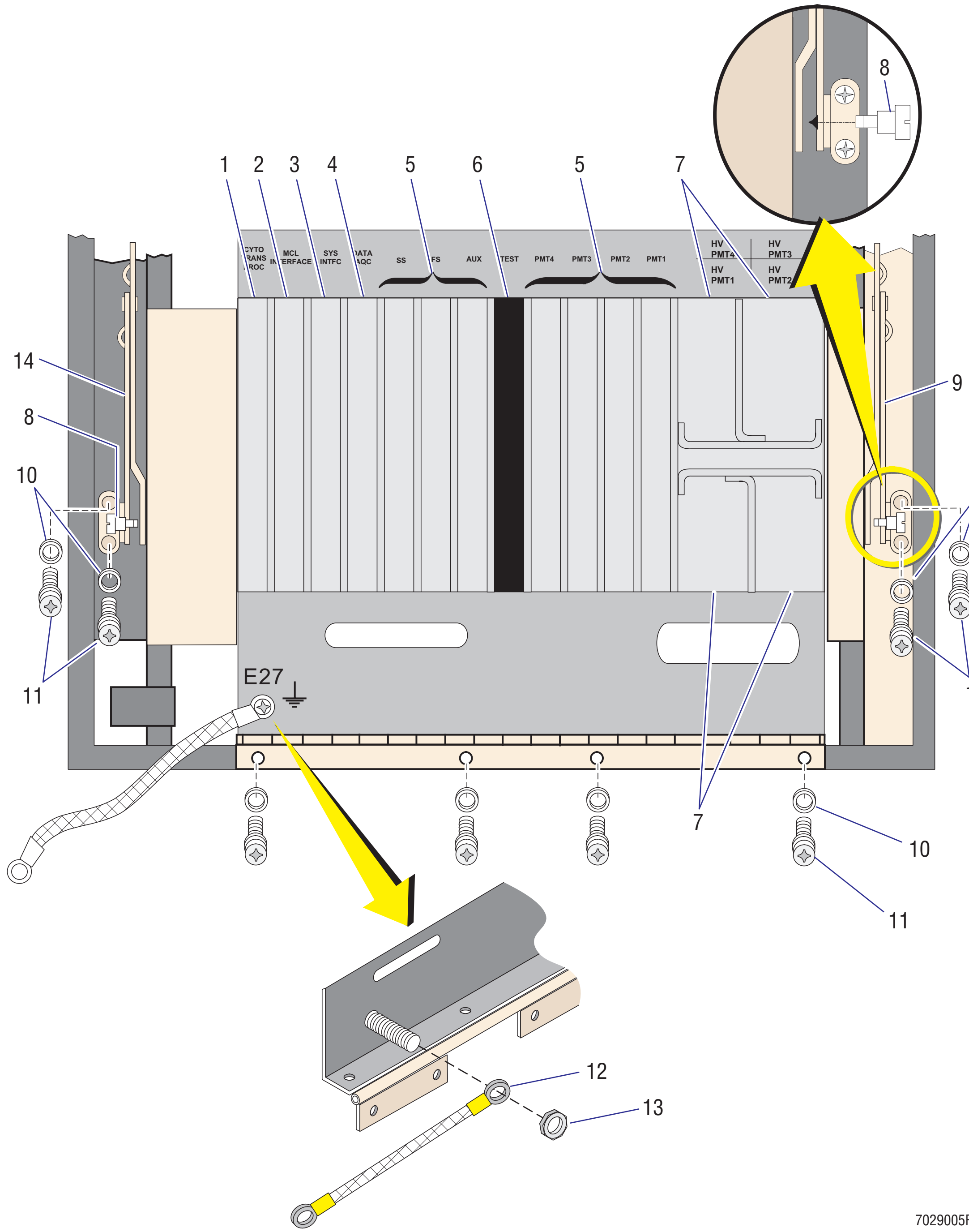


Table 8.2-13 Data Acquisition Card Cage (See Figure 8.2-13)

Item	Part Number	Description
1	6705318	Card, Cyto Transputer (also referred to as Cytometer Transputer card)
2	6705700	Card, MCL Interface
3	6705340	Card, System Interface
4	6705314	Card, Trans Data Acquisition
5	6705321	Card, Amp/Signal Conditioner
6	N/A	Spare slot (used as a test slot in manufacturing)
7	7000193	FRU, Bertan high voltage power supply
8	1017593	Screw, shoulder (#6-32 x 0.30 in. length, 0.117 in. shoulder)
9	2523667	Hinge (lid stay), right-hand, 4.875 CTRS, 0.56 in. wide, 0.095 in. thick, brass-plated steel
10	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
11	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
12	6028152	Cable, ground braid, 6 inches long with two #8 rings
13	2821010	Nut, self-lock (#6-32 x 0.250 AF x 0.109 in. thickness)
14	2523666	Hinge (lid stay), left-hand, 4.875 CTRS, 0.56 in. wide, 0.095 in. thick, brass-plated steel
Not shown	6705220	Backplane, Analyzer

Figure 8.2-14 Upper Pneumatics Drawer (See Table 8.2-14)

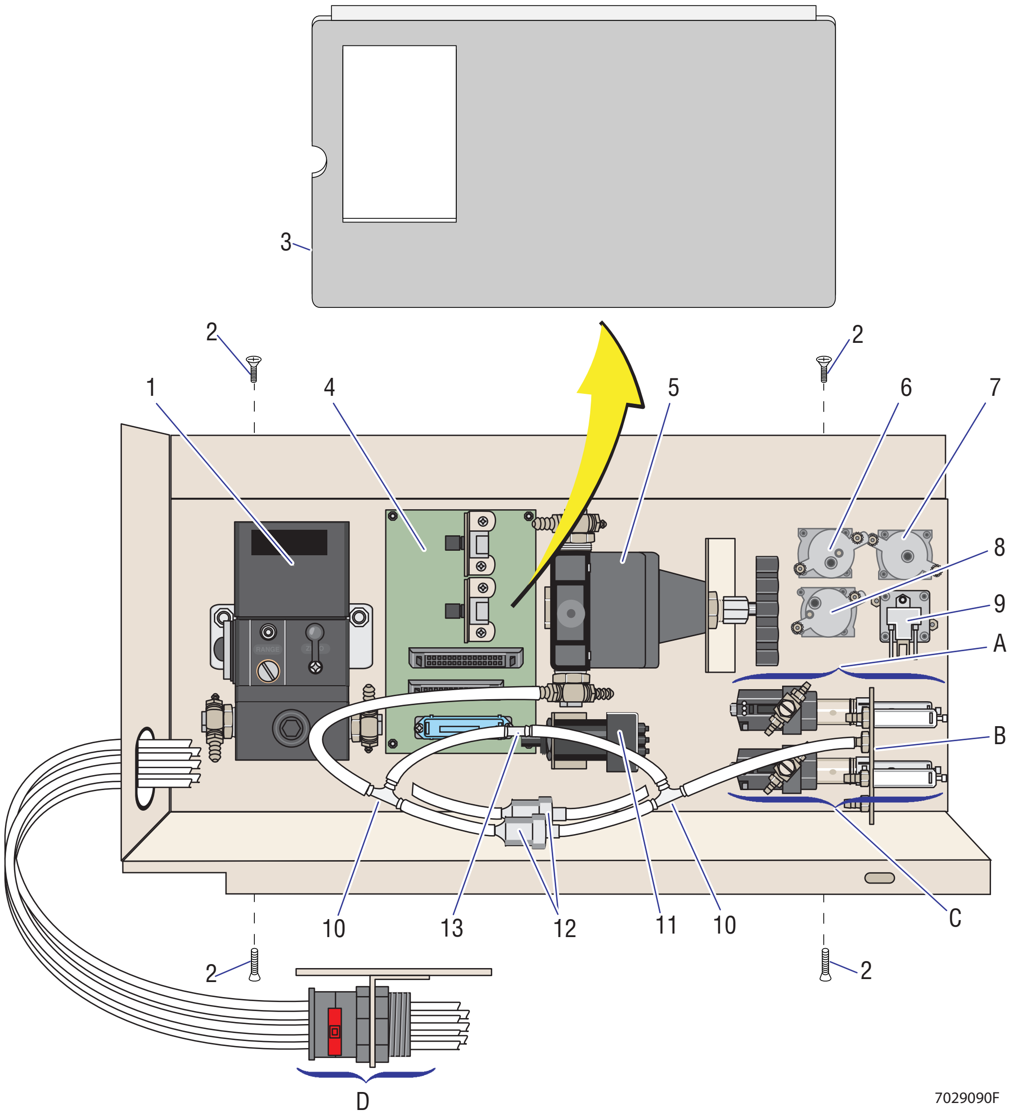


Figure Reference

A VL22 (upper valve), Figure 8.2-15

B Bracket and fittings, Figure 8.2-16

C VL21 (lower valve), Figure 8.2-17

D Quick Disconnects (QD13 and QD14), Figure 8.2-18

Table 8.2-14 Upper Pneumatics Drawer (See Figure 8.2-14)

Item	Part Number	Description
	7000375	FRU, upper pneumatics drawer assembly
1	7000192	FRU, regulator, electronic pressure (electronic transducer), for regulating sample pressure **Note:** Attach to posts using one #25 flat washer (0.265 i.d. x 0.484 o.d. x 0.027 in. thickness), PN 2827064, one #25 split-lock washer (0.26 i.d. x 0.49 o.d. x 0.062 in. thickness), PN 2826051, and one hex nut (#25-20 UNC x 0.437 AF x 0.164 in.thickness), PN 2822072. Requires two sets.
2	2806104	Screw, machine (#6-32 x 0.25 in. length, UF82 flat-head)
3	6858802	Shield, EMC, removable side
4	6705217	Card, Sensor **Note:** Place a hole spacer (0.140 i.d. x 0.250 o.d. x 0.250 in. length), PN 2843032, on each post before installing the circuit card. Secure using self-lock nuts (#6-32 x 0.312 AF x 0.140 in. thickness), PN 2821021.
5	7000720	FRU, regulator, pressure, 0-10 psi, for regulating sheath pressure (4 psi flow)
6	5120232	Switch, normally-open vacuum/pressure (single pole, double throw), used to monitor 2-inches Hg **Note:** Attach using two self-lock nuts (#4-40 x 0.250 AF x 0.109 in. thickness), PN 2821009.
7	5120221	Switch, normally-open vacuum/pressure (single pole, single throw), used to monitor 3 psi **Note:** Attach using two self-lock nuts (#4-40 x 0.250 AF x 0.109 in. thickness), PN 2821009.
8	5120224	Switch, vacuum/pressure (single pole, double throw), used to monitor 10-inches Hg **Note:** Attach to post using a self-lock nut (#4-40 x 0.250 AF x 0.109 in. thickness), PN 2821009. Secure lower opening to the panel using a #4 flat washer (0.125 i.d. x 0.250 o.d. x 0.036 in. thickness), PN 2827146, and machine screw (#4-40 x 0.75 in. length, pan-head), PN 2804039.
9	5120178	Switch, vacuum/pressure (single pole, double throw), used to monitor 25 psi **Note:** Attach using two self-lock nuts (#4-40 x 0.250 AF x 0.109 in. thickness), PN 2821009.
10	6232322	Fitting, T-connector, hose-barb union, 0.093 i.d. to 0.125 i.d. to 0.125 i.d., nylon, white
11	6232254	Regulator, vacuum
12	6214106	Valve, check, 0.156 i.d. to 0.156 i.d. tubing
13	6213012	Choke, gray, 0.016 orifice

Figure 8.2-15 VL22 - Exploded View of Upper Valve (See Table 8.2-15)

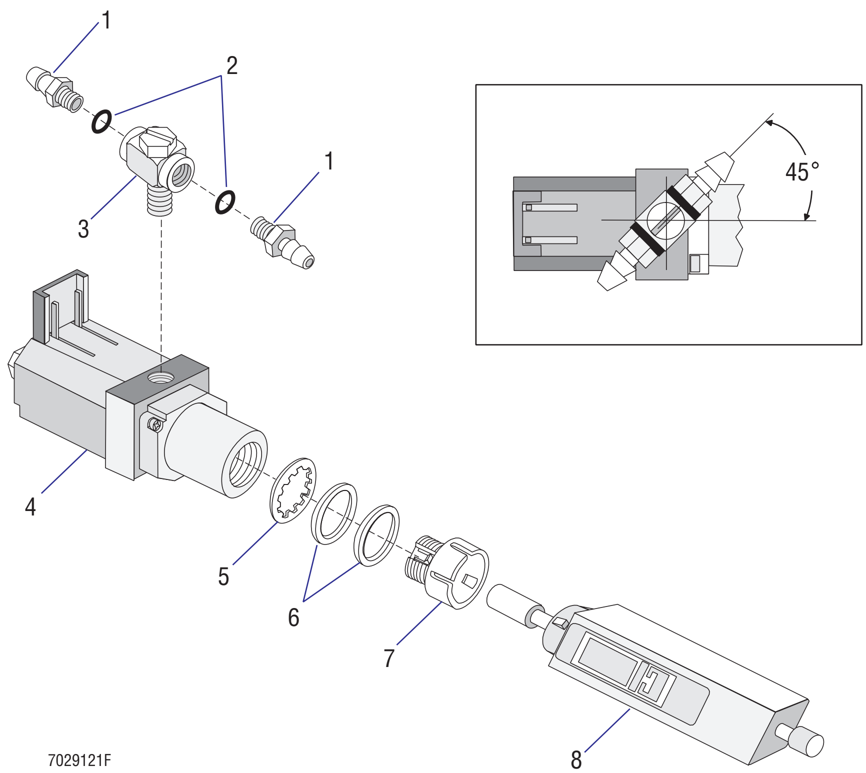


Table 8.2-15 VL22 - Exploded View of Upper Valve (See Figure 8.2-15)

Item	Part Number	Description
1	6232086	Fitting, hose barb union, 0.062 i.d. to 10-32 threaded
2	2523062	O-ring, ethylene propylene seal, 0.187 i.d. x 0.050 wall
3	6232359	Fitting, miniature tee branch with 10-32 ports
4	6232492	Valve, electro-pneumatic, solenoid and pilot actuator combination valve, 24 Vdc / 30 psi, 4.5 lb pinch force
5	2826030	Washer, I-tooth, #47, 0.47 i.d. x 0.60 o.d. x 0.020 thickness
6	6216012	Spacer, cylinder, 0.500 i.d. x 0.562 o.d. x 0.062 thickness
7	1017501	Mount, pull-apart pinch valve
8	6855763	Valve, pull-apart pinch, double-action, white, standard

Figure 8.2-16 Bracket and Fittings - Upper Pneumatics Drawer (See Table 8.2-16)

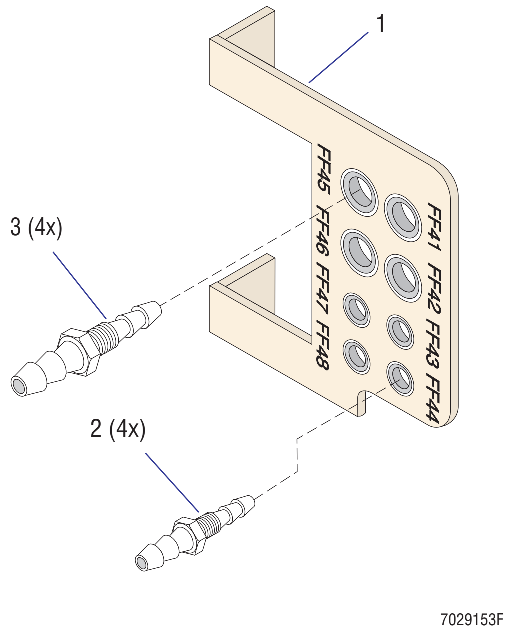


Table 8.2-16 Bracket and Fittings - Upper Pneumatics Drawer (See Figure 8.2-16)

Item	Part Number	Description
1	6855212	Bracket, two pinch valve
2	1005697	Fitting, hose-barb union, 0.062 i.d. to 0.062 i.d.
3	6232104	Fitting, hose-barb union, 0.115 i.d. to 0.180 i.d.

Figure 8.2-17 VL21 - Exploded View of Lower Valve (See Table 8.2-17)

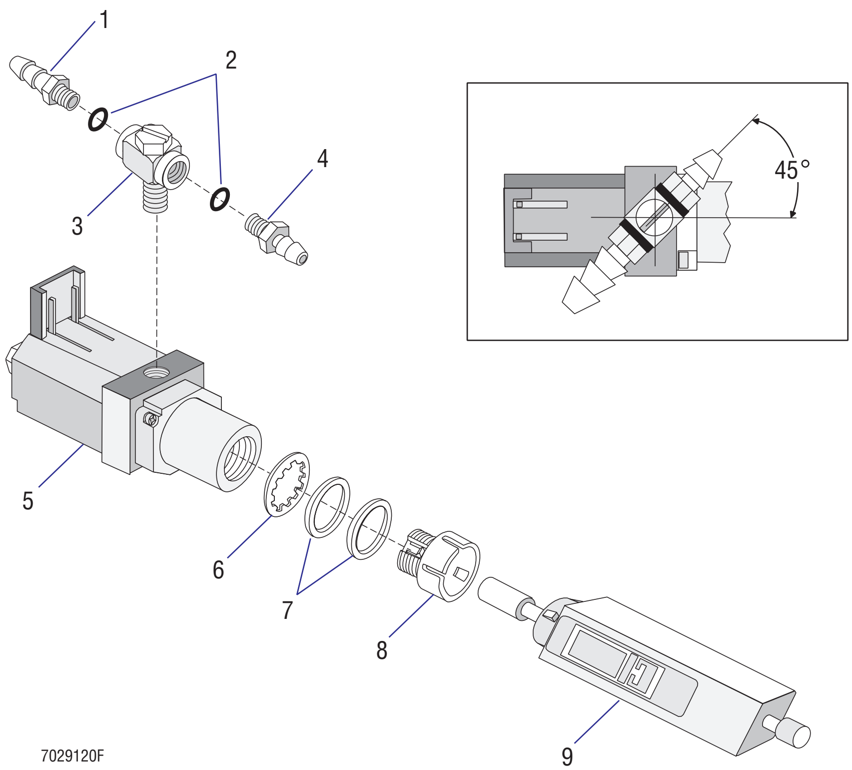


Table 8.2-17 VL21 - Exploded View of Lower Valve (See Figure 8.2-17)

Item	Part Number	Description
1	6232085	Fitting, hose barb union, 0125 i.d. to 10-32 threaded
2	2523062	O-ring, ethylene propylene seal, 0.187 i.d. x 0.050 wall
3	6232359	Fitting, miniature tee branch with 10-32 ports
4	6232086	Fitting, hose barb union, 0.062 i.d. to 10-32 threaded
5	6232492	Valve, electro-pneumatic, solenoid and pilot actuator combination valve, 24 Vdc / 30 psi, 4.5 lb pinch force
6	2826030	Washer, I-tooth, #47, 0.47 i.d. x 0.60 o.d. x 0.020 thickness
7	6216012	Spacer, cylinder, 0.500 i.d. x 0.562 o.d. x 0.062 thickness
8	1017501	Mount, pull-apart pinch valve
9	6855763	Valve, pull-apart pinch, double-action, white, standard

Figure 8.2-18 Quick Disconnects Below Upper Pneumatics Drawer (See Table 8.2-18)

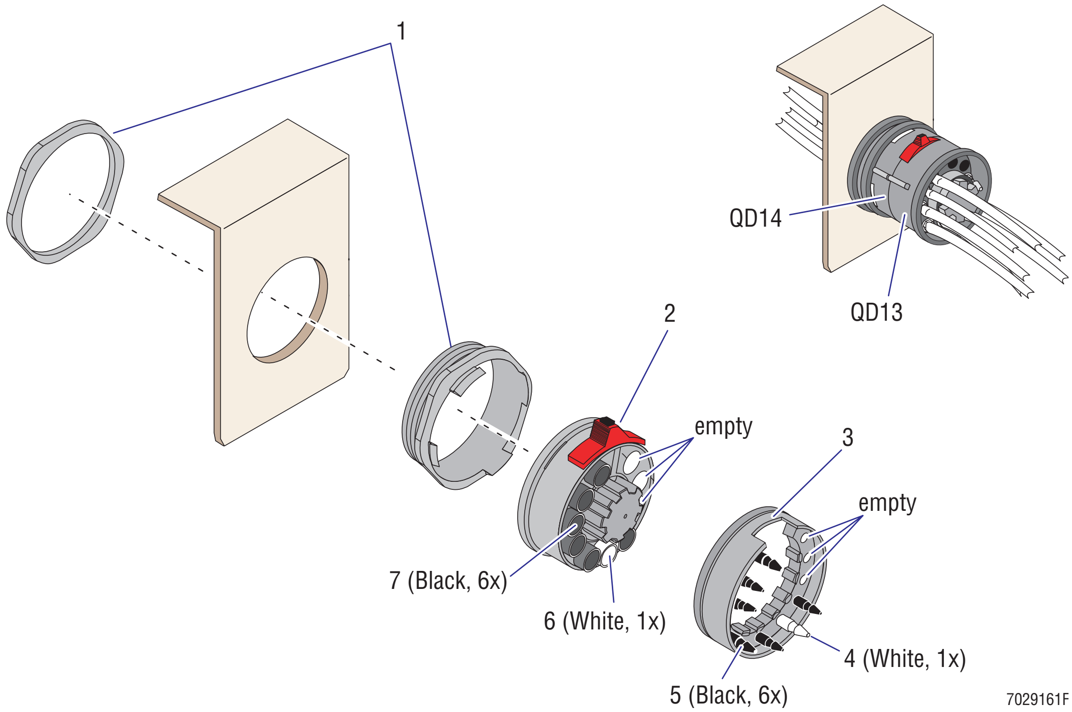


Table 8.2-18 Quick Disconnects Below Upper Pneumatics Drawer (See Figure 8.2-18)

Item	Part Number	Description
1	6232530	Coupling, quick-connect, panel-mount adapter and nut assembly for attaching 10 tube quick-disconnect couplings to a panel, black
2	6232534	Coupling, quick-disconnect QD14, male body, 10 tube capacity body (includes the 7 fittings shown in Figure 8.2-18)
3	6232533	Coupling, quick-disconnect QD13, female body, 10 tube capacity body (includes the 7 fittings shown in Figure 8.2-18)
4	6232588	Fitting, insert, white female quick-connect, internal connector to 0.082 i.d. hose barb
5	6232469	Fitting, insert, black female quick-connect, internal connector to 0.125 i.d. hose barb
6	6232581	Fitting, insert, white male quick-connect, internal connector to 0.082 i.d. hose barb
7	6232468	Fitting, insert, black male quick-connect, internal connector to 0.125 i.d. hose barb

Figure 8.2-19 Optical Collection Area, Rear View (See Table 8.2-19)

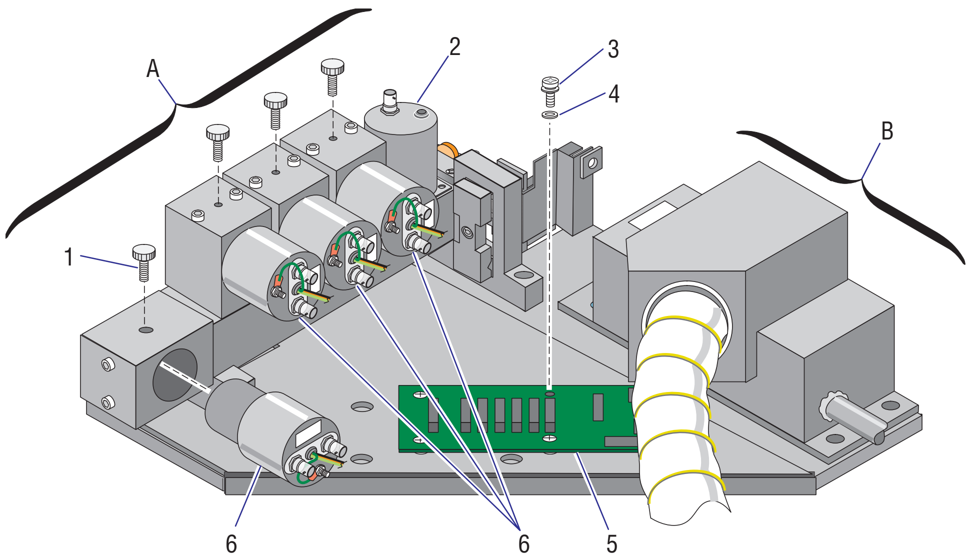


Figure Reference

A Front view (includes filter shield and filters), Figure 8.2-20

Front view with filter shield removed (includes flow cell and FALS detector), Figure 8.2-21

B Argon Laser (includes Power Supply and mounting hardware), Figure 8.2-24

Table 8.2-19 Optical Collection Area, Rear View (See Figure 8.2-19)

Item	Part Number	Description
1	2815003	Screw, thumb, knurled nickel-plated brass (6-32 x 0.375 in. length)
2	7000352	FRU, side scatter diode
3	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
4	2827134	Washer, flat, #6 (0.156 i.d. x 0.375 o.d. x 0.046 thickness)
5	6705199	Card, PMT Distribution and Laser Fan Control
6	7000197	FRU, fluorescence PMT

Figure 8.2-20 Optical Collection Area, Front View (See Table 8.2-20)

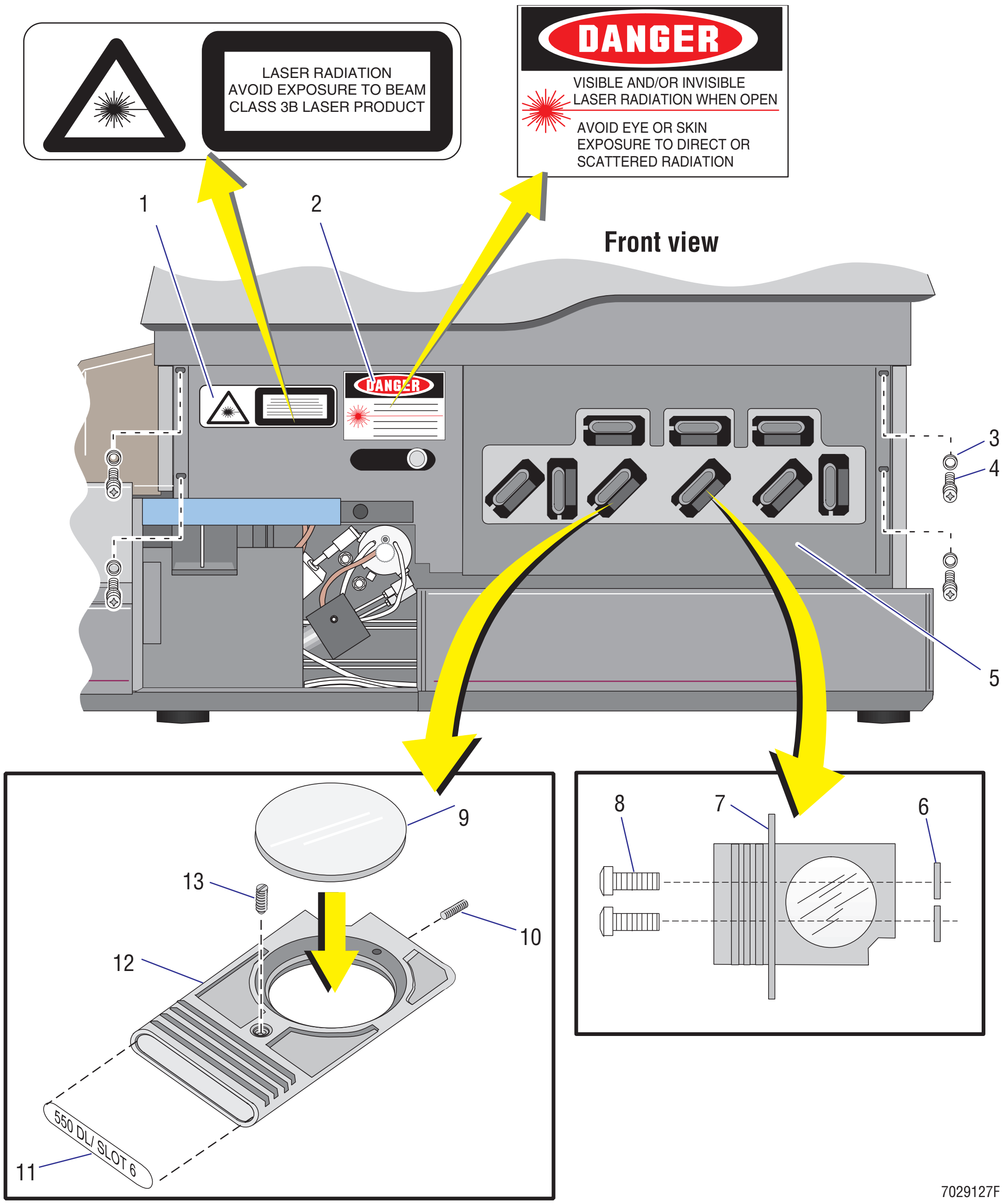


Table 8.2-20 Optical Collection Area, Front View (See Figure 8.2-20)

Item	Part Number	Description
1	2430348	Label, Class 3B Laser Product
2	2427785	Label, laser danger
3	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
4	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
5	6859190	Shield, filter for 4-color system
	6859189	Shield, filter for 3-color system (not shown)
6	6216345	Gasket, #10 black, ethylene propylene, used only in slot 9 between lens holder and PMT housing
7	1018737	Plate, lens holder
8	2806104	Screw, machine (#6-32 x 0.25 in. length, UF82-head), used to secure lens holders in slots 1 through 8 only
	2806077	Screw, machine (#6-32 x 0.19 in. length, UF82-head), used to secure lens holder in slot 9 only
9	3814134	Filter, light, used in slot 1, 525 band pass (525 BP)
	3814135	Filter, light, used in slot 2, 575 band pass (575 BP)
	3814289	Filter, light, used in slot 3, 620 band pass (620 BP)
	3814136	Filter, light, used in slot 4, 488 dichroic long pass (488 DL)
	3802072	Filter, light, used in slot 5, 488 laser blocker (488 BK)
	3814067	Filter, light, used in slot 6, 550 dichroic long pass (550 DL)
	3814138	Filter, light, used in slot 7, 600 dichroic long pass (600 DL)
	3814274	Filter, light, used in slot 8, 645 dichroic long pass (645 DL)
	3814139	Filter, light, used in slot 9, 675 band pass (675 BP)
10	2807052	Screw, setscrew (#4-40 x 0.156 in length, hex-head)
11	2429708	Label, 525 BP / Slot 1
	2429709	Label, 575 BP / Slot 2
	2429858	Label, 620 BP / Slot 3
	2429704	Label, 488 DL / Slot 4
	2429706	Label, 488 BK / Slot 5
	2429703	Label, 550 DL / Slot 6
	2430206	Label, 600 DL / Slot 7
	2429857	Label, 645 DL / Slot 8
	2430195	Label, 675 BP / Slot 9
12	1018542	Holder, filter
13	2516002	Plunger, ball (#6-40 x 0.312 long)

Figure 8.2-21 Optical Collection Area with Filter Shield Removed (See Table 8.2-21)

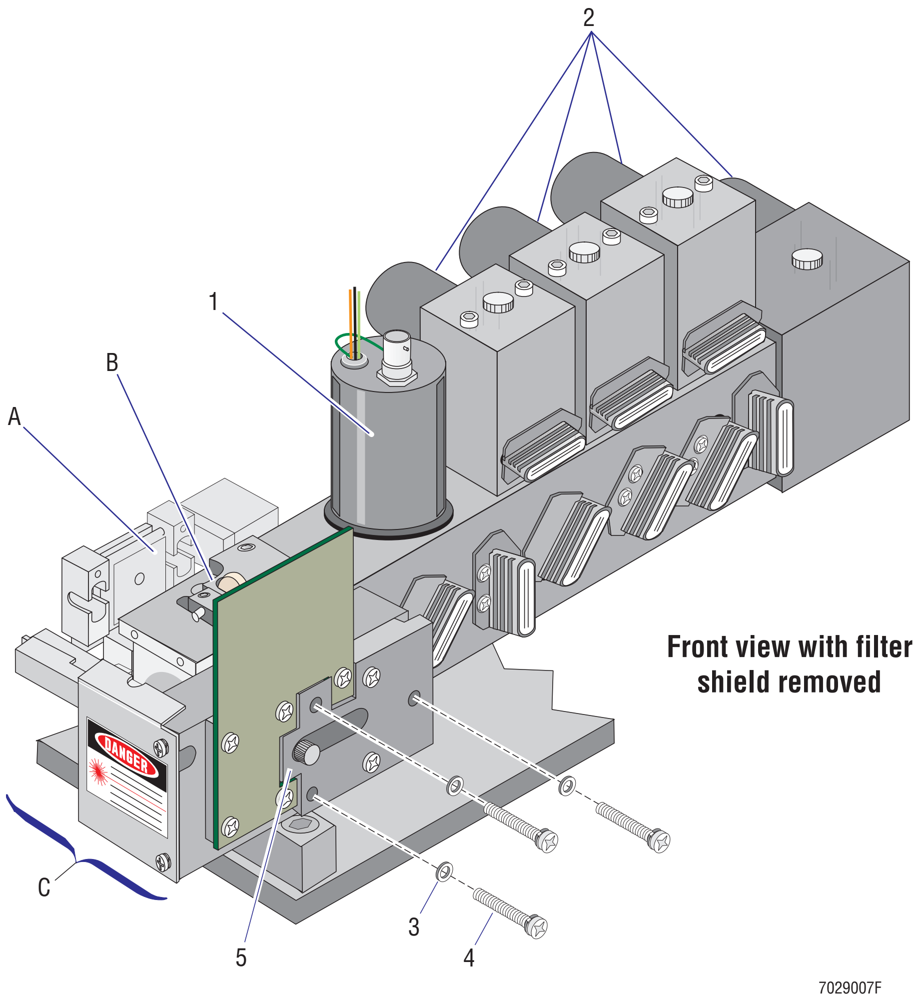


Figure Reference

- **A** Beamshaper assembly, Figure 8.2-22
- **B** Fluorescence pickup lens and adjustment hardware, Figure 8.2-23
- **C** Flow cell and associated hardware, Figure 8.2-23

Table 8.2-21 Optical Collection Area with Filter Shield Removed (See Figure 8.2-21)

Item	Part Number	Description
1	7000352	FRU, side scatter diode
2	7000197	FRU, fluorescence PMT
3	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
4	2839043	Screw, self-lock (#6-32 x 0.62 in. length, pan-head)
5	7000359	FRU, forward scatter (FS) detector

Figure 8.2-22 Beam-Shaping Stage Components (See Table 8.2-22)

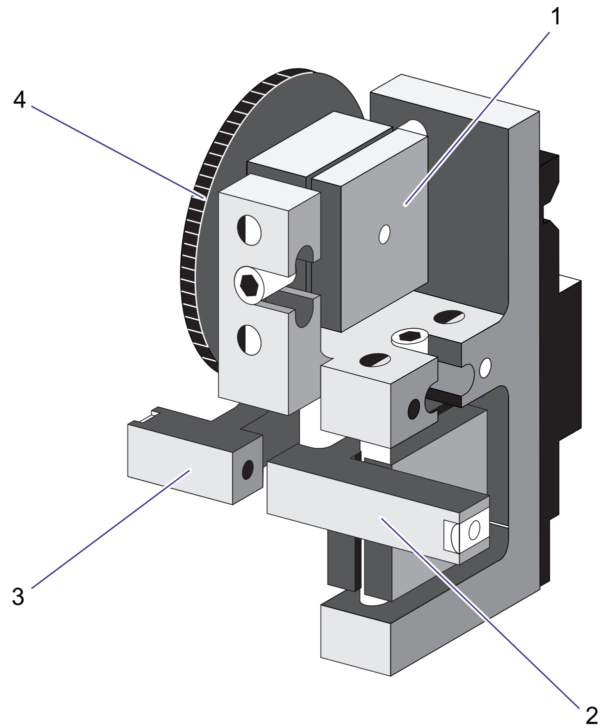


Table 8.2-22 Beam-Shaping Stage Components (See Figure 8.2-22)

Item	Part Number	Description
1	7000450	FRU, beamshaper 2
2	6859219	Lens holder, 10 mm
3	6859220	Lens holder, 80 mm
4	7000451	FRU, focus knob III
	7000449	FRU, focus knob2

Figure 8.2-23 Flow Cell and Fluorescence Pickup Lens with Associated Hardware (See Table 8.2-23)

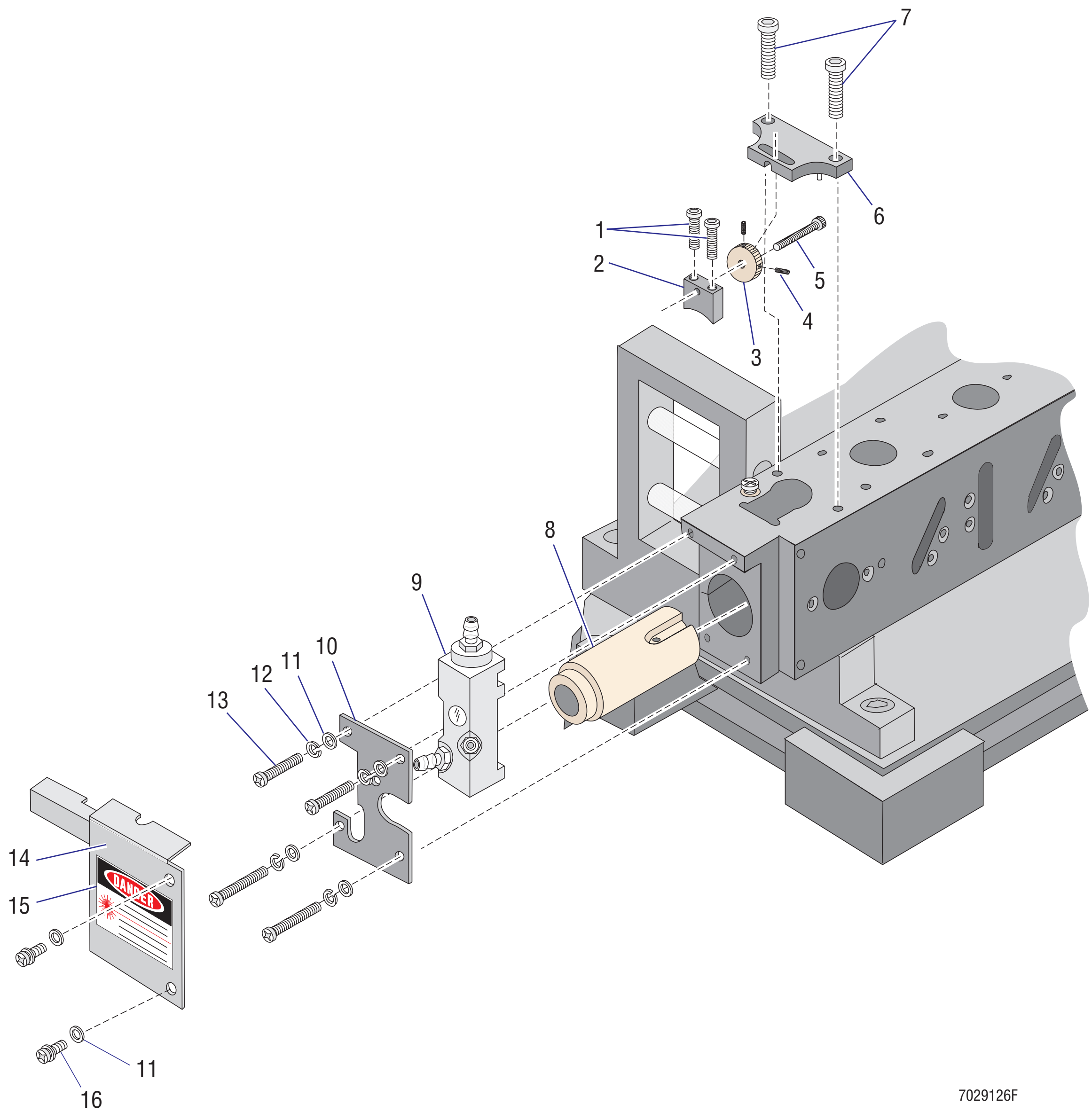


Table 8.2-23 Flow Cell and Fluorescence Pickup Lens with Associated Hardware (See Figure 8.2-23)

Item	Part Number	Description
1	2851975	Screw, machine, knurled (#4-40 x 0.75 in. length, hex socket head)
2	1021703	Stage, snout support
3	1021682	Knob, snout
4	2807026	Screw, setscrew (#4-40 x 0.125 in length, hex-head)
5	2851982	Screw, machine (#6-40 x 1.125 in. length, hex-head)
6	6859217	Stage, snout
7	2806102	Screw, machine (#6-32 x 0.38 in. length, hex-head)
8	6858921	Snout, pinhole
9	6858386	Flow cell
10	1022362	Plate, flow cell
11	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
12	2826035	Washer, split-lock, #6 (0.14 i.d. x 0.25 o.d. x 0.03 in. thickness)
13	2806096	Screw, machine (#6-32 x 1.25 in. length, pan-head)
14	1020965	Cover, flow cell shield
15	2427785	Label, laser danger
16	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)

Figure 8.2-24 Argon Laser, Power Supply, and Mounting Hardware (See Table 8.2-24)

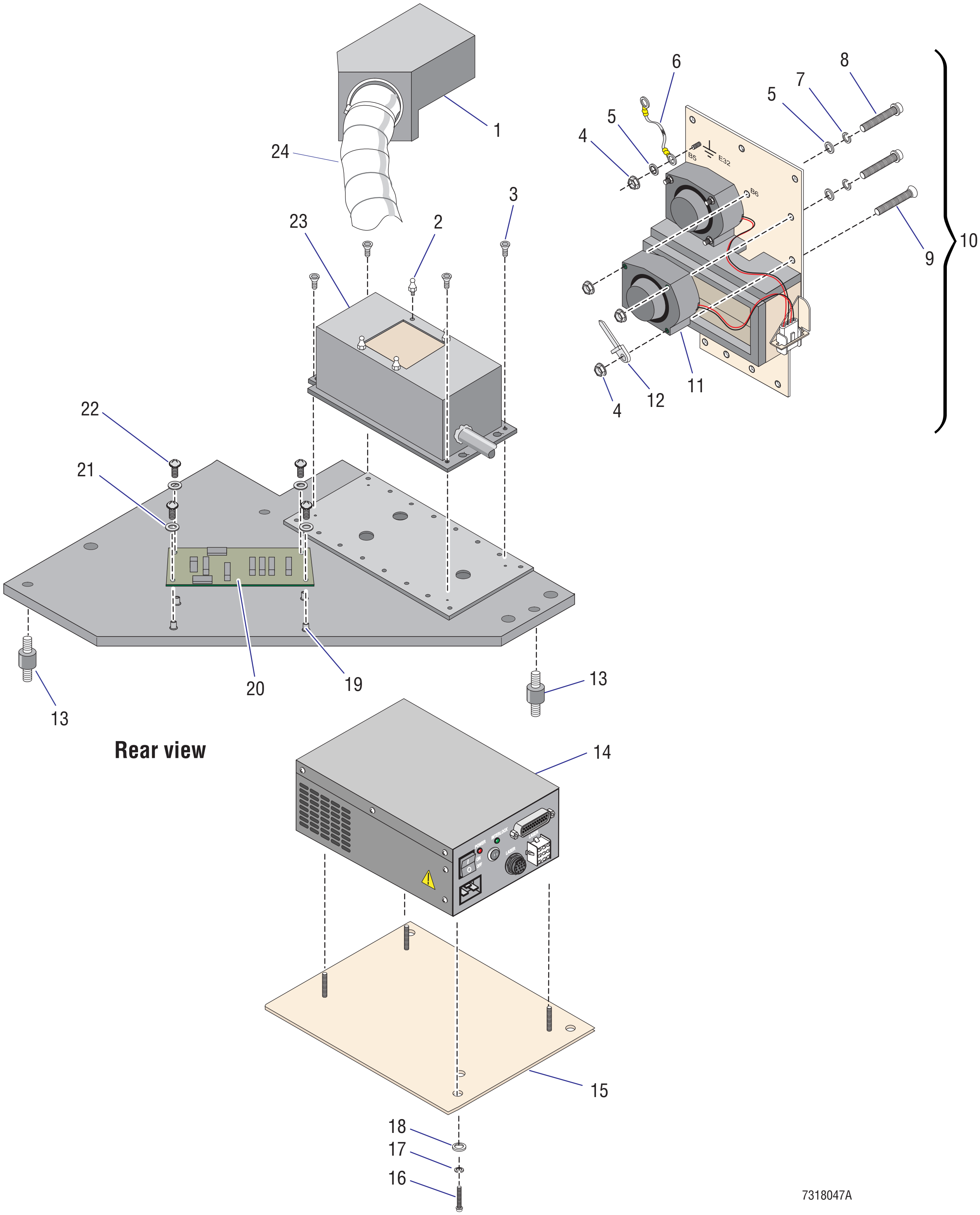


Table 8.2-24 Argon Laser, Power Supply, and Mounting Hardware (See Figure 8.2-24)

Item	Part Number	Description
1	6856941	Plenum, laser duct out
2	2840037	Fastener, ball stud
3	1022396	Screw, special laser mounting
4	2821010	Nut, self-lock (#6-32 x 0.250 AF x 0.109 in. thickness)
5	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
6	6028152	Cable, ground braid, 6 in. length with two #8 rings
7	2826035	Washer, split-lock, #6 (0.14 i.d. x 0.25 o.d. x 0.03 in. thickness)
8	2806159	Screw, machine (#6-32 x 2.00 in. length, pan-head)
9	2806148	Screw, machine (#6-32 x 2.00 in. length, FL82 flat-head)
10	7000719	FRU, laser blower assembly
11	2603054	Fan, 64 CFM, 24 Vdc, 6.37 in. square, 1.6 in. deep
12	6011006	Tie wrap, screw mount, #6 sizer, 7.4 in. long, 0.19 in wide
13	2523660	Mount, shock, rubber, axial mount, 16 lb, 256 lb/in., 78 Hz
14	7000431 7000721 7000432	Power supply, Argon air-cooled laser, switching, for 100 Vac system Power supply, Argon air-cooled laser, switching, for 115 Vac system Power supply, Argon air-cooled laser, switching, for 220 or 240 Vac system
15	6856067	Plate, Argon laser power supply mounting
16	2839051	Screw, self-lock (#10-32 x 0.75 in. length, pan-head)
17	2826045	Washer, split-lock, #10 (0.19 i.d. x 0.33 o.d. x 0.047 in. thickness)
18	2827021	Washer, flat, #10 (0.21 i.d. x 0.51 o.d. x 0.051 thickness)
19	2851866	Spacer, internally and externally threaded (#6-32 x 0.250 DP to #6-32 x 0.375, aluminum alloy)
20	6705199	Card, PMT Distribution and Laser Fan Control **Note:** Refers to the two cooling fans mounted on the Cytometer frame. These fans cool the Argon laser.
21	2827134	Washer, flat, #6 (0.156 i.d. x 0.375 o.d. x 0.046 thickness)
22	2839009	Screw, self-lock (#6-32 x 0.25 in. length, pan-head)
23	7000358	FRU, Argon air-cooled laser head
24	 1018547 2603060 6011003	Flexible duct must be assembled using the following parts: Insulation Duct, flexible, 3 1/8 i.d. x 10-in. length, rectangular flange at one end Tie wrap, nylon, 15 in. long, 0.19 in. wide, nylon (need three of these) **Note:** Assembly instructions are illustrated in Figure 8.2-62.
Not shown	2523659	Mount, shock, rubber, axial mount, 4 lb, 73 lb/in., 84 Hz, for laser cooling fan module (may also be referred to as bushings)

Figure 8.2-25 Reagent Drawer (See Table 8.2-25)

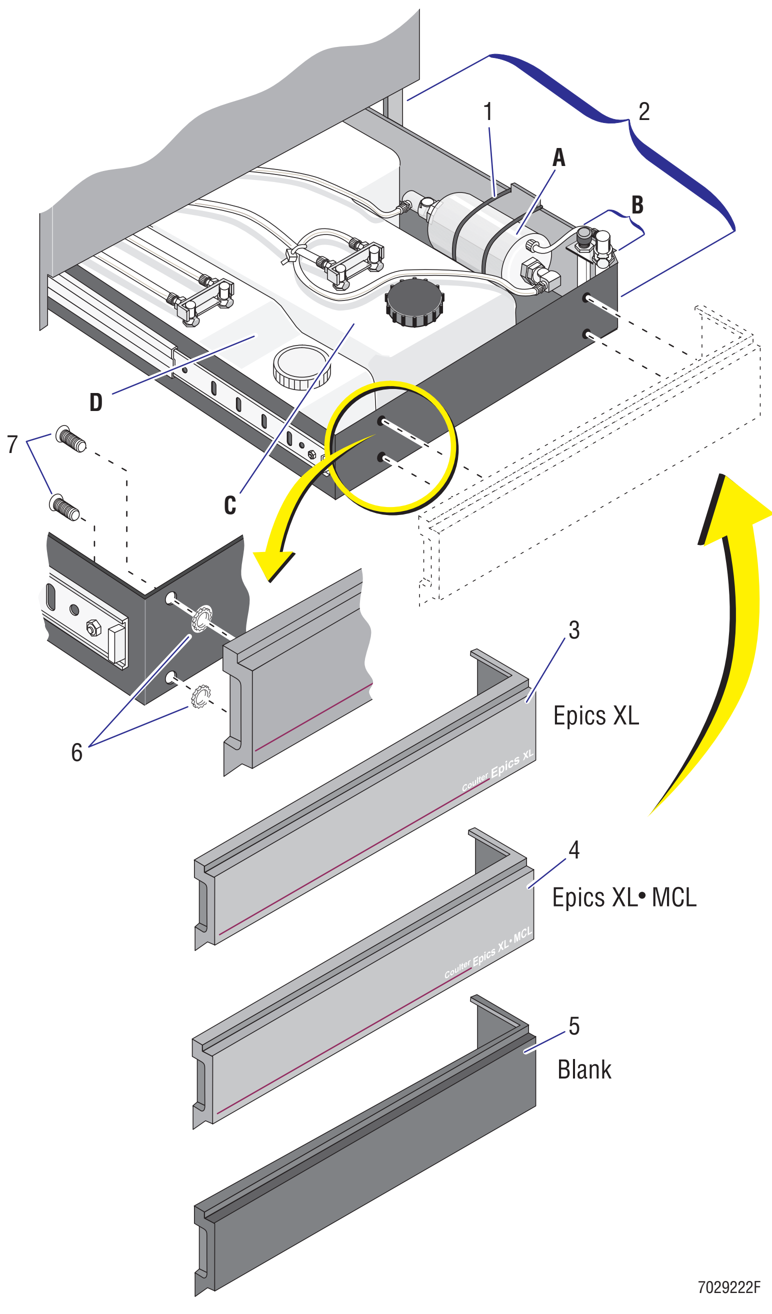


Figure Reference

- **A** Sheath liquid filter, Figure 8.2-26
- **B** Sheath liquid filter purge (vent) connections, Figure 8.2-27
- **C** Sheath container, Figure 8.2-28
- **D** Cleaning agent container, Figure 8.2-29

Table 8.2-25 Reagent Drawer (See Figure 8.2-25)

Item	Part Number	Description
1	2523451	O-ring, silicone, used as rubber band, 2.300 i.d. x 0.103 width
2	7000677	FRU, reagent drawer with slides assembly
3	6807089	Panel, reagent drawer front, for XL flow cytometer, grey
4	6807088	Panel, reagent drawer front, for XL-MCL flow cytometer, grey
5	6855934	Panel, reagent drawer front, for XL or XL-MCL flow cytometer, black
6	2826012	Washer, E-tooth, #6, 0.140 i.d. x 0.312 o.d. x 0.022 thickness
7	2806140	Screw, machine (#6-32 x 0.38 in. length, UF82-head)

Figure 8.2-26 Sheath Liquid Filter (See Table 8.2-26)

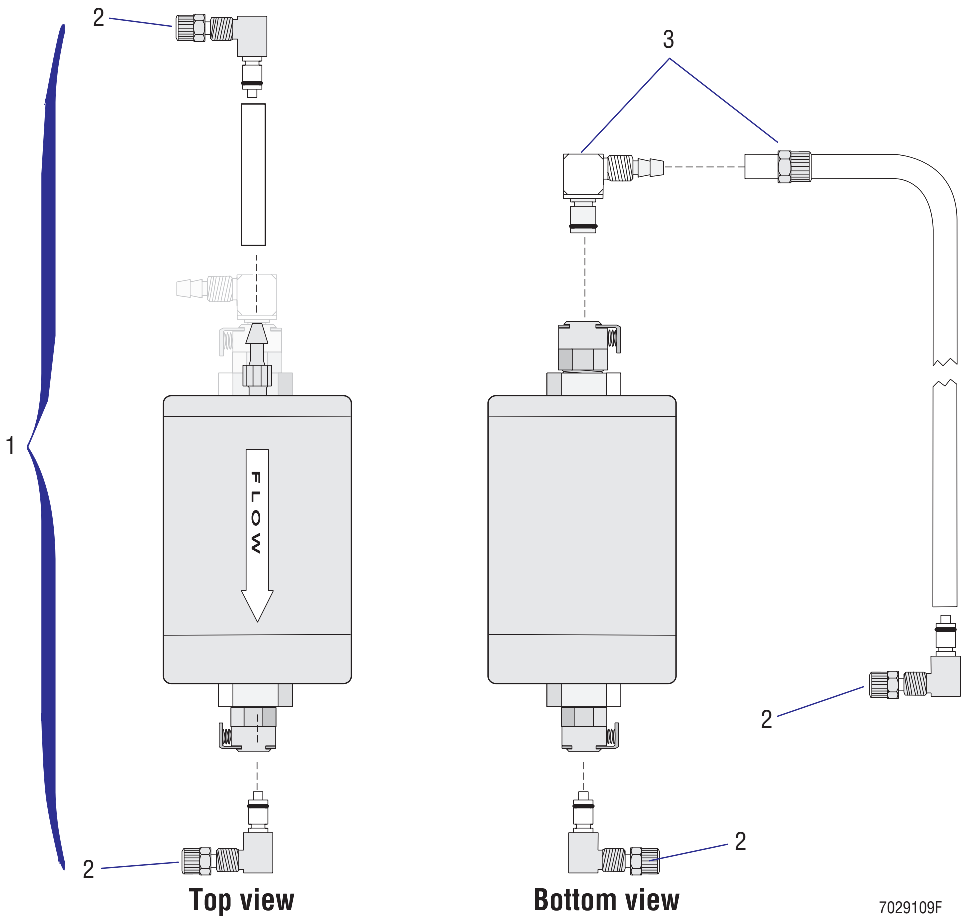


Table 8.2-26 Sheath Liquid Filter (See Figure 8.2-26)

Item	Part Number	Description
1	6912942	Assembly, sheath filter
2	6232472	Quick-connect, male, external elbow, 0.250 o.d., white acetal delrin
3	6232522	Quick-connect, male, external elbow, 0.375 o.d., white acetal delrin

Figure 8.2-27 Sheath Liquid Filter Purge (Vent) Connections (See Table 8.2-27)

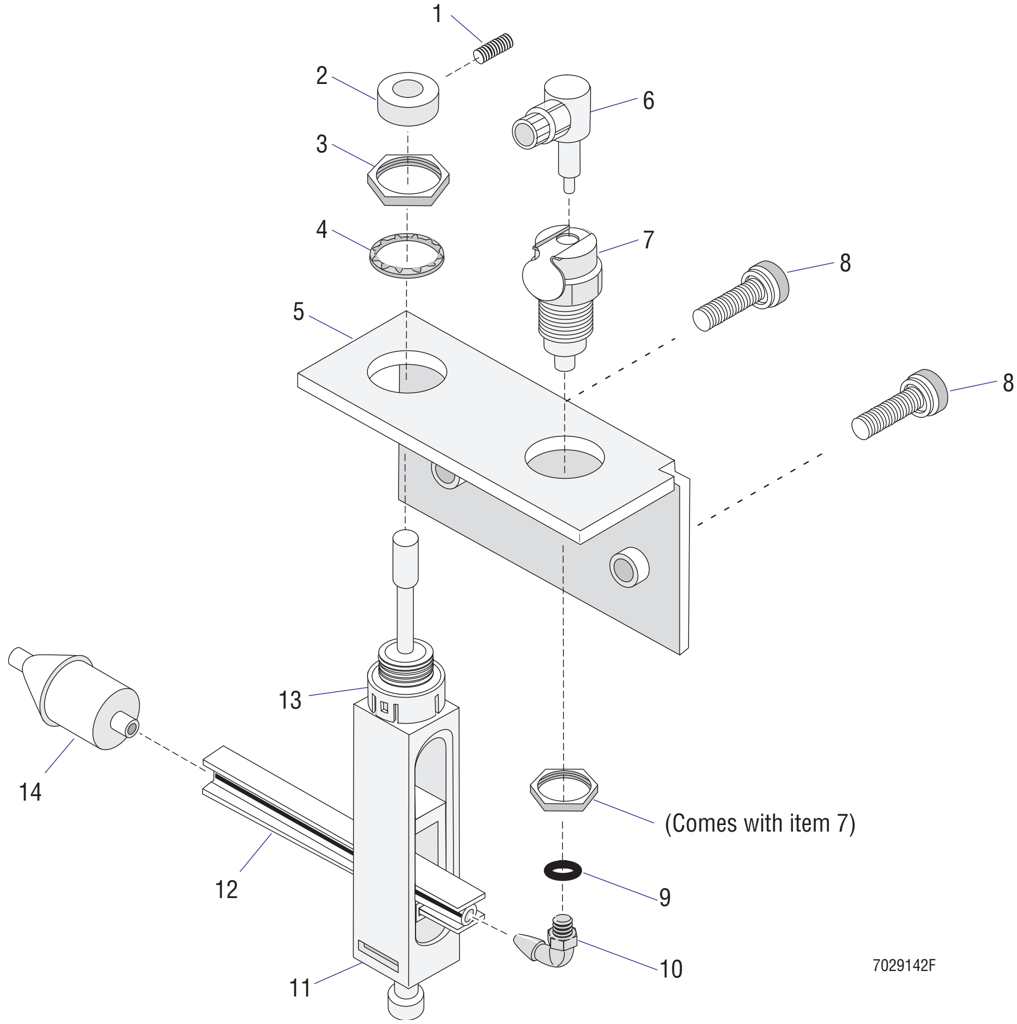


Table 8.2-27 Sheath Liquid Filter Purge (Vent) Connections (See Figure 8.2-27)

Item	Part Number	Description
1	2807026	Screw, setscrew (#4-40 x 0.125 in length, hex-head)
2	1018728	Knob, pinch valve
3	2822033	Nut, hex (47-32 UNS x 0.562 AF x 0.078 in. thickness)
4	2826030	Washer, I-tooth, #47, 0.47 i.d. x 0.60 o.d. x 0.020 thickness
5	6856718	Bracket, shut-off valve
6	6232472	Quick-connect, male, external elbow, 0.250 o.d., white acetal delrin
7	6232466	Quick-connect, internal, panel mount, 10-32, white, 0.125 flow (couples with white insert, PN 6232266)
8	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
9	2523062	O-ring, ethylene propylene seal, 0.187 i.d. x 0.050 wall
10	6232208	Fitting, hose barb, elbow, 0.093 i.d. to 10-32 threaded, white, nylon **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Tighten until the O-ring is squeezed then continue to tighten until the fitting is oriented as shown in Figure 8.2-27.
11	6855763	Valve, pull-apart pinch, double-action, white, standard
12	3213136	Tubing, pull-apart I-beam with black stripe, silicone, 0.062 i.d., approximate 8-inch length
13	1017501	Mount, pull-apart pinch valve
14	6214108	Valve, check, for 0.062 i.d. to 0.062 i.d. tubing

Figure 8.2-28 Sheath Container (See Table 8.2-28)

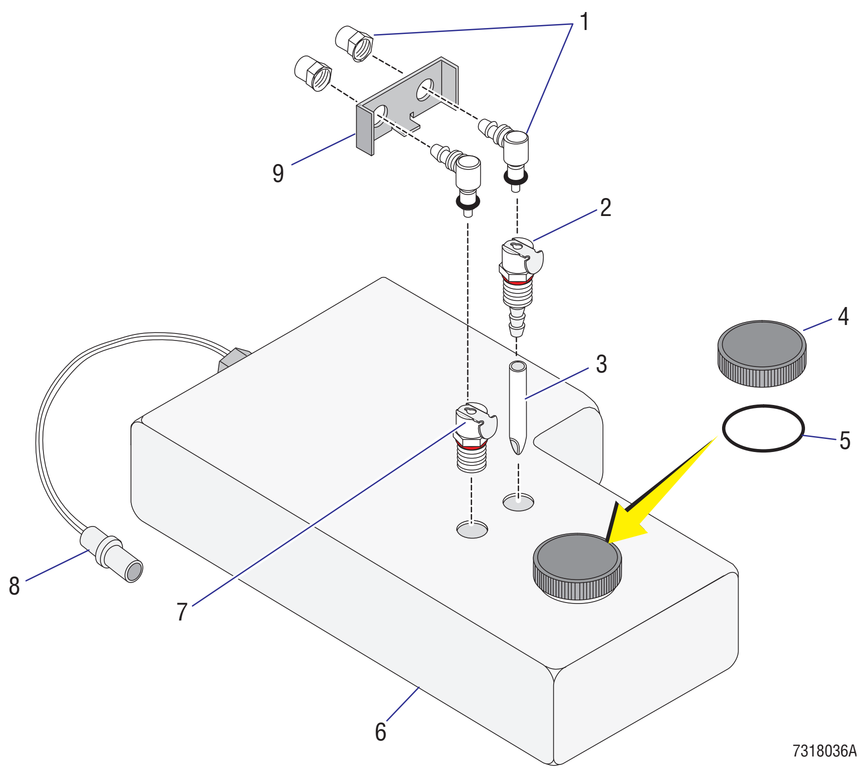


Table 8.2-28 Sheath Container (See Figure 8.2-28)

Item	Part Number	Description
	7000378	FRU, sheath tank with sensor assembly
1	6232472	Quick-connect, male, external elbow, 0.250 o.d., white acetal delrin
2	6232470	Quick-connect, female, internal panel mount, 0.125 i.d., coupling pair latch, barb, white acetal delrin
3	1020976	Tube, pickup
4	1018613	Cap, sheath tank (or bottle)
5	2523724	O-ring, silicone seal, 1.850 i.d. x 0.210 width
6	2523649	Tank, sheath without sensor (also referred to as sheath bottle)
7	6232478	Quick-connect, female, internal panel mount, 0.125 flow, coupling pair latch, barb, white acetal delrin
8	6028526	Cable. level sensor, with undercut O-ring groove (O-ring is not needed)
9	1020981	Bracket, sheath tank (also referred to as sheath bottle bracket)

Figure 8.2-29 Cleaning Agent Container (See Table 8.2-29)

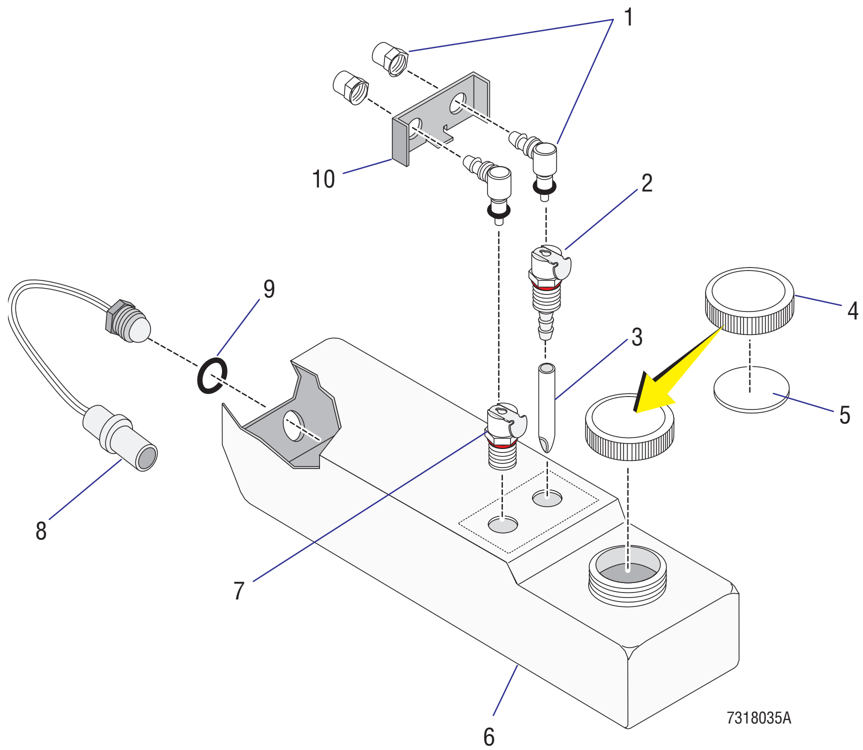
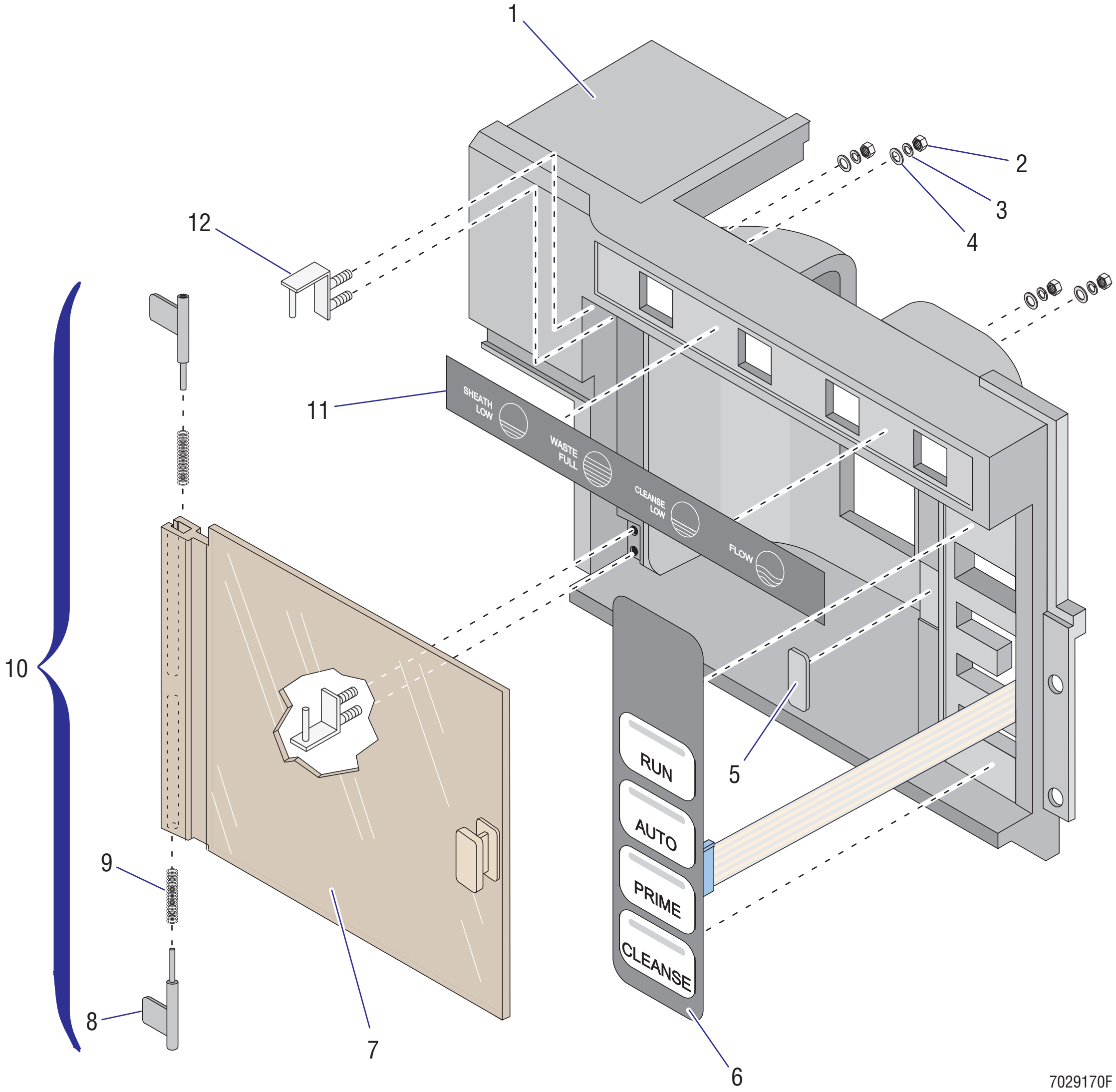


Table 8.2-29 Cleaning Agent Container (See Figure 8.2-29)

Item	Part Number	Description
	7000379	FRU, cleanse tank with sensor assembly
1	6232472	Quick-connect, male, external elbow, 0.250 o.d., white acetal delrin
2	6232470	Quick-connect, female, internal panel mount, 0.125 i.d., coupling pair latch, barb, white acetal delrin
3	1020976	Tube, pickup
4	1021818	Cap, cleanse
5	1021812	Gasket, cleanse cap
6	2523650	Tank, cleanse, without sensor (also referred to as cleanse bottle)
7	6232478	Quick-connect, female, internal panel mount, 0.125 flow, coupling pair latch, barb, white acetal delrin
8	6028526	Cable. level sensor, with undercut O-ring groove **Note:** Must use with O-ring seal, PN 2512031.
9	2512031	O-ring, silicone seal, 0.364 i.d. x 0.070 width
10	1020978	Bracket, cleanse tank (also referred to as detergent bottle bracket)

Figure 8.2-30 Sample Station (Manual) for XL-MCL Cytometer, Front View (See Table 8.2-30)

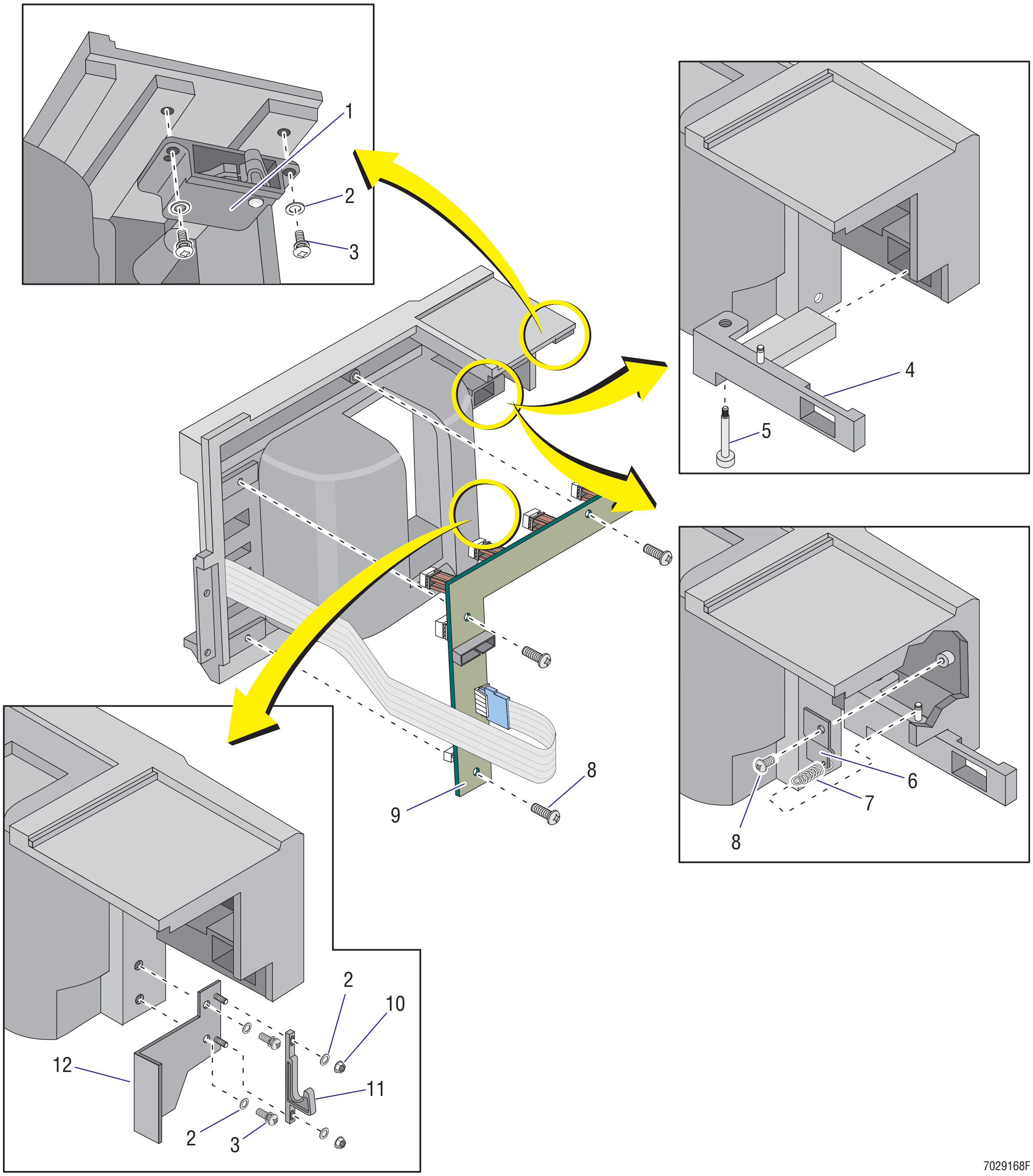


Note: See Figure 8.2-31 for the rear view of the manual sample station on an XL-MCL flow cytometer.

Table 8.2-30 Sample Station (Manual) for XL-MCL Cytometer, Front View (See Figure 8.2-30)

Item	Part Number	Description
	7000678	FRU, manual sample station, for XL-MCL Cytometer with grey covers
	7000354	FRU, manual sample station, for XL-MCL Cytometer with black covers
1	6807081	Sample station, for an XL-MCL with grey covers
	6858518	Sample station, for an XL-MCL with black covers
		Note: Before attaching sample station to the Cytometer, make sure the flow cell cover and filter shield are attached to the Cytometer.
2	2822050	Nut, hex (#2-56 UNC x 0.187 AF x 0.066 in. thickness)
3	2826001	Washer, split-lock, #2 (0.09 i.d. x 0.17 o.d. x 0.02 in. thickness)
4	2827095	Washer, flat, #2 (0.094 i.d. x 0.25 o.d. x 0.02 in. thickness)
5	1019621	Plate, magnet catcher
		Note: Attach using instant adhesive, PN 1601082. Apply only one drop.
6	1021734	Data entry, membrane, overlay and switch, for XL-MCL
7	6858842	Door, XL-MCL sample station, with handle and magnet attached
8	6858841	MCL push cylinder, for sample station door
9	2523737	MCL compression spring, for XL-MCL sample station door, rated 8.1 lbs per inch, (0.148 in. diameter x 0.75 in. length x 0.021 in. width)
10	7000444	FRU, MCL sample station door assembly
11	1021696	Display, sample cup membrane
12	6856945	Bracket, door angle
		Note: Verify proper orientation before attaching.

Figure 8.2-31 Sample Station (Manual) for XL-MCL Cytometer, Rear View (See Table 8.2-31)



Note: See Figure 8.2-30 for the front view of the manual sample station on an XL-MCL flow cytometer.

Table 8.2-31 Sample Station (Manual) for XL-MCL Cytometer, Rear View (See Figure 8.2-31)

Item	Part Number	Description
	7000678	FRU, manual sample station, for XL-MCL Cytometer with grey covers
	7000354	FRU, manual sample station, for XL-MCL Cytometer with black covers
1	2851859	Latch, concealed pull-up catch and keeper, 1.9 x 1.1 x 0.3 in., black nylon **Note:** Only the latch catch is shown in Figure 8.2-31, item 1. Use Figure 8.2-31 to verify proper orientation of this latch catch.
2	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
3	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
4	6807075	MCL push-button **Note:** MCL push-button must be properly positioned before inserting the shoulder screw, PN 2852256
5	2852256	Screw, shoulder (#4-40 x 0.156 length, 0.560 long shoulder, hex socket head) **Note:** MCL push-button, PN 6807075, must be properly positioned before inserting this shoulder screw.
6	1021765	Holder, MCL spring
7	2523733	Spring, extension, 0.180 o.d. x 0.50 in. coiled length, 0.026 in. wire diameter, rated at 20.2 lbs/in. **Note:** Hook spring first to the spring holder, PN 1021765, and then to the post on the MCL push-button, PN 6807075. Make sure the push-button does not bind on the plastic.
8	2839024	Screw, self-lock (#4-40 x 0.25 in. length, pan-head)
9	6705742	Card, Front Panel LED and Switch Input 2
10	2821010	Nut, self-lock (#6-32 x 0.250 AF x 0.109 in. thickness)
11	2851859	Latch, concealed pull-up catch and keeper, 1.9 x 1.1 x 0.3 in., black nylon **Note:** Only the latch keeper is shown in Figure 8.2-31, item 11. Use Figure 8.2-31 to verify proper orientation of the latch keeper. This latch keeper connects with the front latch catch on the MCL lower base cover. See Figure 8.2-3.
12	6805649	Bracket, MCL sample station

Figure 8.2-32 Sample Station for XL Cytometer (See Table 8.2-32)

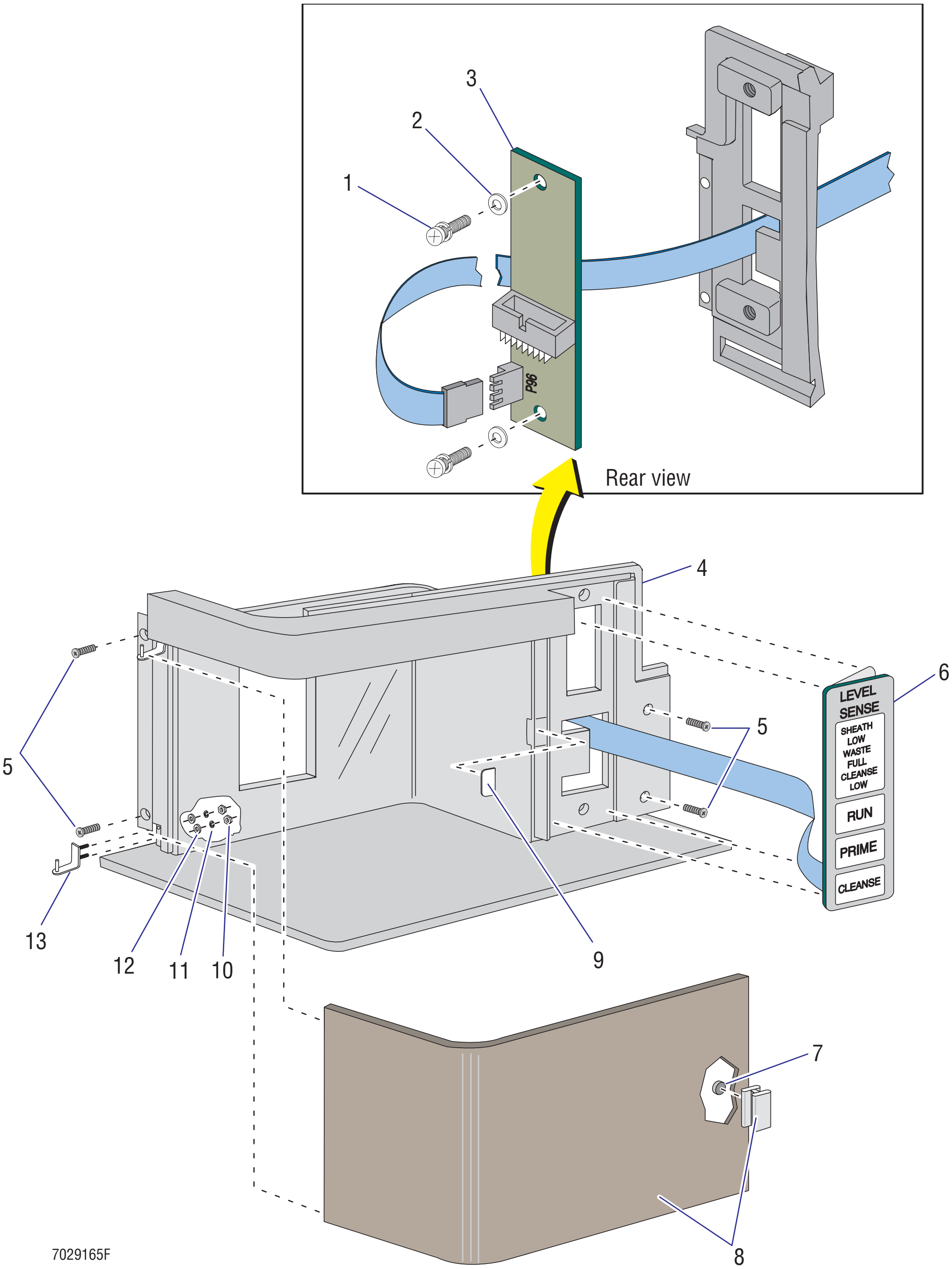


Table 8.2-32 Sample Station for XL Cytometer (See Figure 8.2-32)

Item	Part Number	Description
	7000679 7000360	FRU, sample station assembly, for XL Cytometer with grey covers FRU, sample station assembly, for XL Cytometer with black covers **Note:** Before attaching sample station to the Cytometer, make sure the flow cell cover and filter shield are attached to the Cytometer.
1	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
2	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
3	6705193	Card, Front Panel LED and Switch Input
4	6807083 6856869	Sample station, for an XL with grey covers Sample station, for an XL with black covers **Note:** Before attaching sample station to the Cytometer, make sure the flow cell cover and filter shield are attached to the Cytometer.
5	2806162	Screw, machine (#6-32 x 0.44 in. length, FL82 flat-head)
6	1016815	Data entry, overlay and membrane switch sample cup XL **Note:** Before installation, remove paper backing.
7	2523394	Magnet, disk, rare earth, 0.187 o.d. x 0.063 thickness **Note:** Before installation, remove the sample station door and lay the door near the edge of a table with the handle positioned over the edge. With the door flat, apply one drop of instant adhesive, PN 1601082 inside the hole behind the handle then immediately install the magnet in the hole. Be very careful not to smear the adhesive.
8	6858840	Door, XL sample station, with attached handle
9	1019621	Plate, magnet catcher **Note:** Attach using instant adhesive, PN 1601082. Apply only one drop.
10	2822050	Nut, hex (#2-56 UNC x 0.187 AF x 0.066 in. thickness)
11	2826001	Washer, split-lock, #2 (0.09 i.d. x 0.17 o.d. x 0.02 in. thickness)
12	2827095	Washer, flat, #2 (0.094 i.d. x 0.25 o.d. x 0.02 in. thickness)
13	6856945	Bracket, door angle

Figure 8.2-33 Sample Station for XL-MCL and XL Cytometers - Mechanical Assembly (See Table 8.2-33)

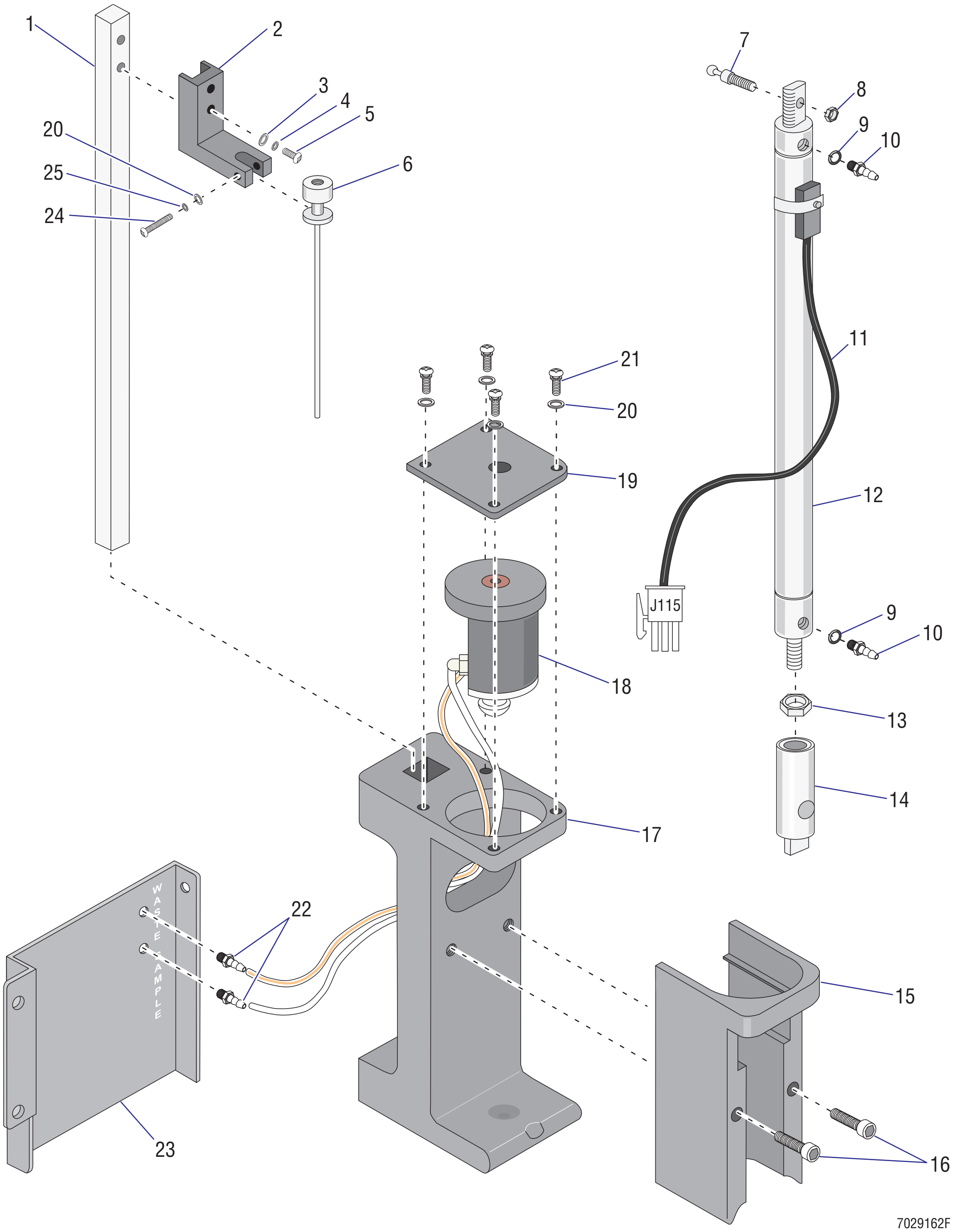


Table 8.2-33 Sample Station for XL-MCL and XL Cytometers - Mechanical Assembly (See Figure 8.2-33)

Item	Part Number	Description
1	1020914	Shaft, 0.375 square
2	1020873	Arm. probe
3	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
4	2826035	Washer, split-lock, #6 (0.14 i.d. x 0.25 o.d. x 0.03 in. thickness)
5	2806128	Screw, machine (#6-32 x 0.75 in. length, pan-head)
6	6858174	Probe, sample
7	1022369	Stud, ball (10-32 x 0.50 length) **Note:** Apply one drop of adhesive sealant, PN 1601065, to screw threads before insertion.
8	2821018	Nut, self-lock (10-32 x 0.375 AF x 0.156 in. thickness)
9	2523062	O-ring, ethylene propylene seal, 0.187 i.d. x 0.050 wall
10	6232086	Fitting, hose barb union, 0.062 i.d. to 10-32 threaded
11	6028330	Cable assembly, mini-universal MATE-N-LOK 3-position plug to Hall Effect sensor
12	6232575	Cylinder, air, double-acting with single-end spring-return, universal mount, 0.63 bore, 3.25 stroke, 150 psi maximum pressure
13	2822016	Nut, hex (#10-32 UNF x 0.375 AF x 0.130 in. thickness)
14	2523743	Socket joint, quick-disconnect with spring loaded sleeve, for 0.253-inch diameter ball stud, stainless steel
15	1020897	Holder, finger
16	2806200	Screw, machine (#6-32 x 1.00 in length, HSC head)
17	1021679	Holder, sample tube
18	7000351	FRU, manual sample head
19	1020910	Plate, top
20	2827146	Washer, flat, #4 (0.125 i.d. x 0.250 o.d. x 0.036 thickness)
21	2839025	Screw, self-lock (#4-40 x 0.37 in. length, pan-head)
22	1005697	Fitting, hose-barb union, 0.062 i.d. to 0.062 i.d.
23	6858247	Cover, sample station
24	2804039	Screw, machine (#4-40 x 0.75 in. length, pan-head)
25	2826002	Washer, split-lock, #4 (0.12 i.d. x 0.20 o.d. x 0.25 in. thickness)

Figure 8.2-34 Segmenting Valve Assembly (See Table 8.2-34)

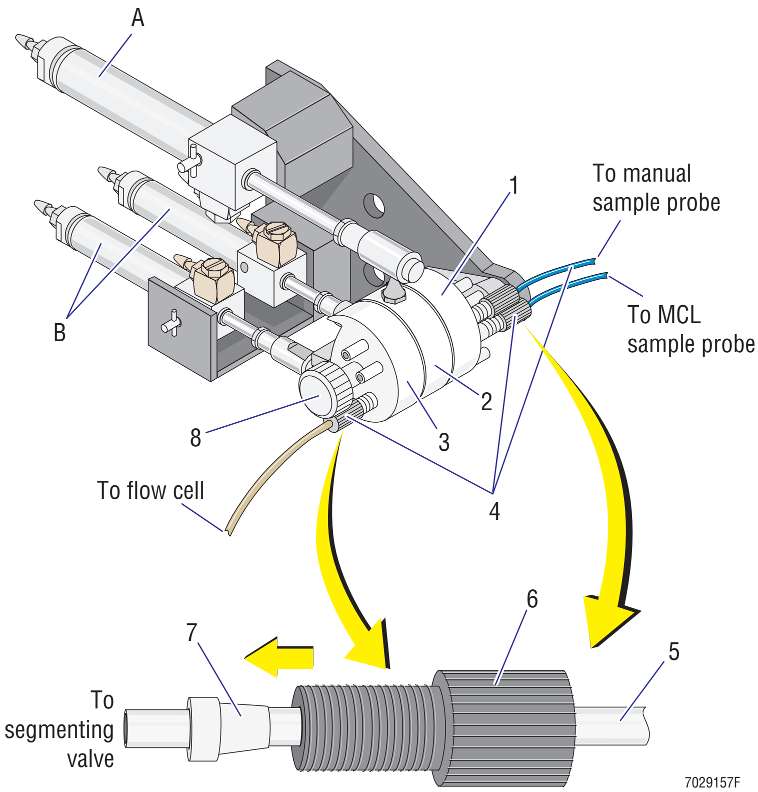


Figure Reference

A Air cylinder and related hardware for segmenting valve middle pad, Figure 8.2-26

B Air cylinder and related hardware for segmenting valve front and rear pads, Figure 8.2-27

Table 8.2-34 Segmenting Valve Assembly (See Figure 8.2-34)

Item	Part Number	Description
	7000370	FRU, segmenting valve assembly
1	7000195	FRU, segmenting valve rear pad
2	7000191	FRU, segmenting valve middle pad
3	7000196	FRU, segmenting valve front pad
4	6912941	Kit, Sample/MCL Intro Line
5	1021636	Tubing, PEEK, manual sample intro line, 14 in. 0.010 i.d. x 0.026 wall, blue
	1021654	Tubing, PEEK, MCL sample intro line, 15 in. 0.010 i.d. x 0.026 wall, blue
	1022073	Tubing, PEEK, flow cell intro line, 3.75 in. 0.013 i.d. x 0.025 wall, tan
6	6232526	Fitting, ferrule nut, black, for 0.062 o.d. tubing
7	6232525	Fitting, ferrule, natural, for 0.062 o.d. tubing
8	7000198	FRU, segmenting valve knob

Figure 8.2-35 Air Cylinder and Related Hardware for Segmenting Valve Middle Pad (See Table 8.2-35)

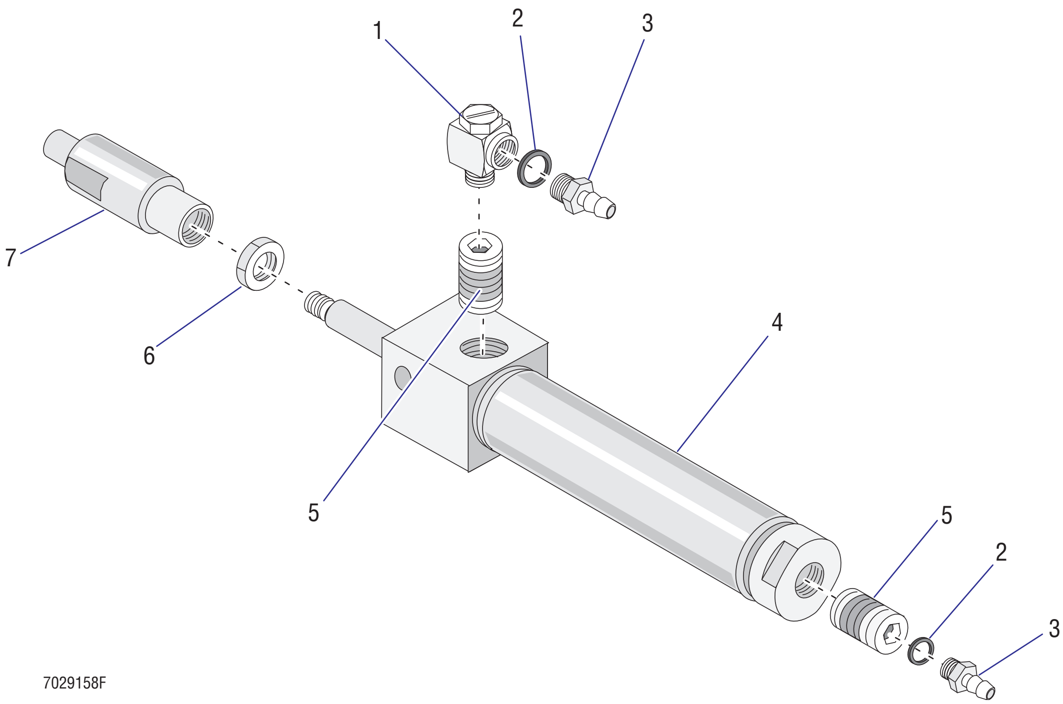


Table 8.2-35 Air Cylinder and Related Hardware for Segmenting Valve Middle Pad (See Figure 8.2-35)

Item	Part Number	Description
1	6216002	Fitting, miniature, 10-32 threaded, 10-32 tap, adjustable, brass
2	2523062	O-ring, ethylene propylene seal, 0.187 i.d. x 0.050 wall
3	6232086	Fitting, hose barb union, 0.062 i.d. to 10-32 threaded
4	6232723	Cylinder, double-acting air, 0.75 bore, rotating rod with 1.50 stroke
5	6232683	Fitting, miniature adapter, 10-32 tap in 0.125 MPT plug, nickel-plated brass
6	2822040	Nut, hex (#25-28 UNF x 0.437 AF x 0.140 in. thickness)
7	2523798	Socket joint, quick-disconnect with spring loaded sleeve, for 0.253-inch diameter ball stud, stainless steel

Figure 8.2-36 Air Cylinder and Related Hardware for Front and Rear Segmenting Valve Pads (See Table 8.2-36)

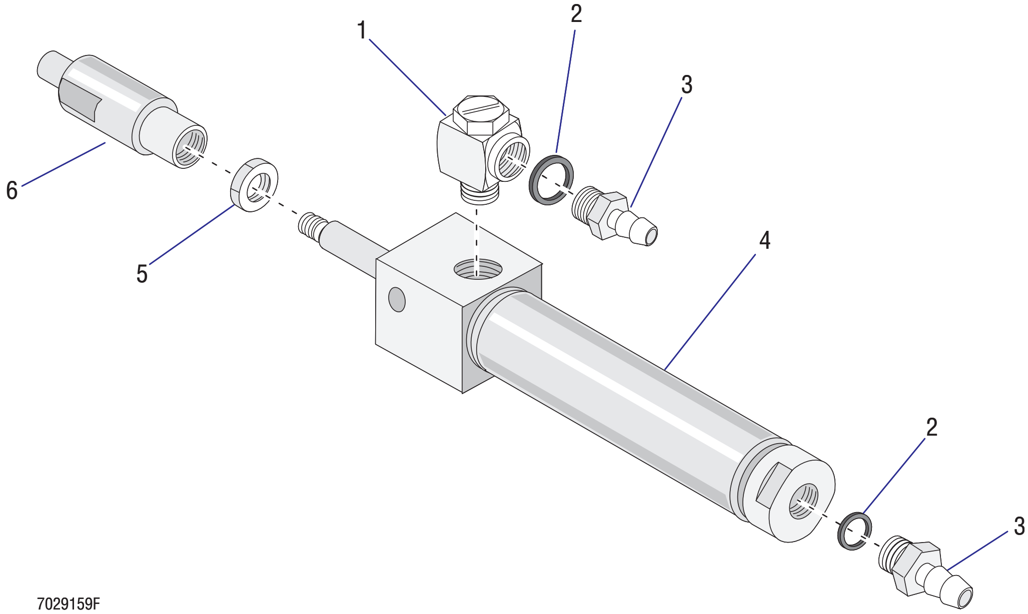


Table 8.2-36 Air Cylinder and Related Hardware for Front and Rear Segmenting Valve Pads (See Figure 8.2-36)

Item	Part Number	Description
1	6216002	Fitting, miniature, 10-32 threaded, 10-32 tap, adjustable, brass
2	2523062	O-ring, ethylene propylene seal, 0.187 i.d. x 0.050 wall
3	6232086	Fitting, hose barb union, 0.062 i.d. to 10-32 threaded
4	6232574	Cylinder, air, double-acting, single-ended, front block mount, 0.63 bore, 1.50 stroke, 250 psi maximum pressure
5	2822016	Nut, hex (#10-32 UNF x 0.375 AF x 0.130 in. thickness)
6	2523743	Socket joint, quick-disconnect with spring loaded sleeve, for 0.253 in. diameter ball stud, stainless steel

Figure 8.2-37 Lower Pneumatics Drawer (See Table 8.2-37)

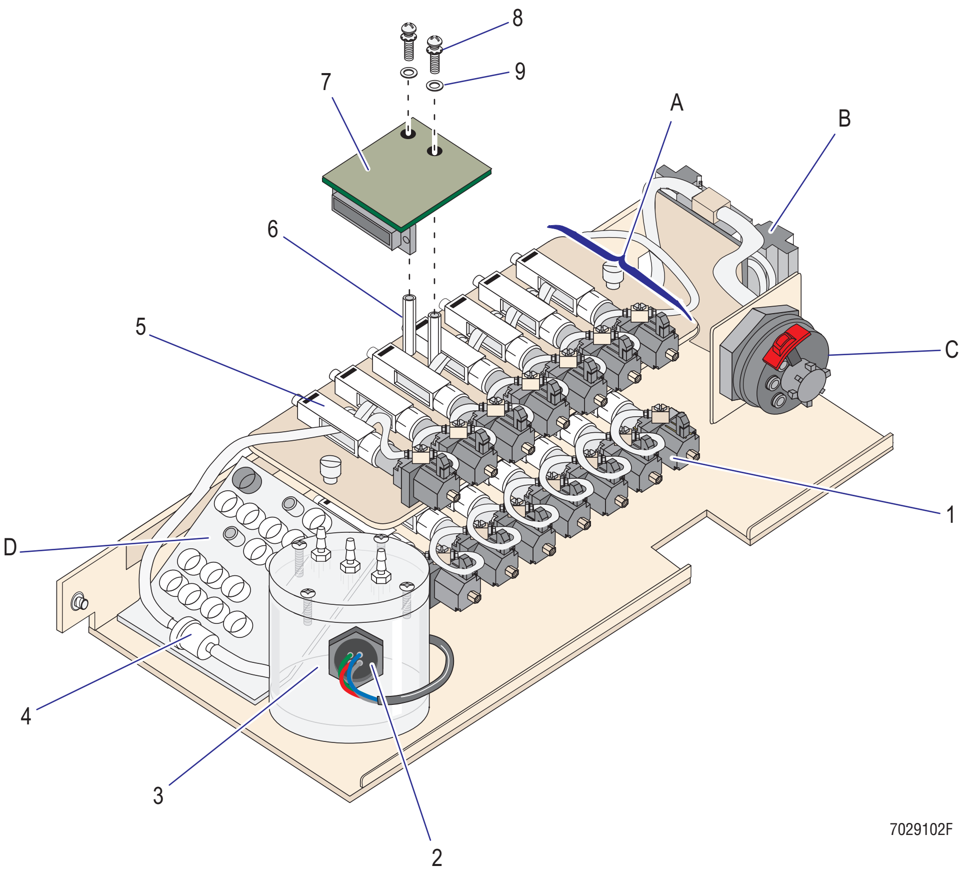


Figure Reference

- **A** Pinch valve and associated components, Figure 8.2-38
- **B** Solenoid manifold, Figure 8.2-39
- **C** QD10 and QD11 (coupling and fittings), Figure 8.2-40
- **D** Quick-disconnect fittings and brackets, Figure 8.2-41

Table 8.2-37 Lower Pneumatics Drawer (See Figure 8.2-37)

Item	Part Number	Description
	7000374	FRU, lower pneumatics drawer assembly
1	6232492	Valve, electro-pneumatic, solenoid and pilot actuator combination valve, 24 Vdc / 30 psi, 4.5 lb pinch force, see Figure 8.2-38 for an exploded view that includes related components **Note:** Attach using two self-lock screws (#6-32 x 0.37 in. length, pan-head), PN 2839039.
2	6028599 2512031	Sensor, waste chamber, with undercut O-ring groove O-ring, silicone seal, 0.364 i.d. x 0.070 width (not shown) **Note:** Replace the original rubber gasket with O-ring seal, PN 2512031. Discard the original rubber gasket.
3	7000373	FRU, vacuum chamber **Note:** Attach using two self-lock screws (#6-32 x 0.37 in. length, pan-head), PN 2839039.
4	6214106	Valve, check, 0.156 i.d. to 0.156 i.d. tubing
5	6855763	Valve, pull-apart pinch, double-action, white, standard, see Figure 8.2-38 for an exploded view that includes related components
6	2851363	Spacer, tapped, 6-32 x 1.625 in. length x 0.250 in. hex, aluminum
7	6705761	Card, Solenoid Power Distribution **Note:** 25 conductor flat ribbon cable assembly with subminiature D connector, PN 6028293, is connected to this circuit card.
8	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
9	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
Not shown	1005697	Fitting, hose-barb union, 0.062 i.d. to 0.062 i.d., metal feed-through fittings for attaching tubings (FF3 through FF16 on the inside bracket and FF18 through FF38 on the upper panel)

Figure 8.2-38 Pinch Valve and Associated Components, Lower Pneumatics Drawer (See Table 8.2-38)

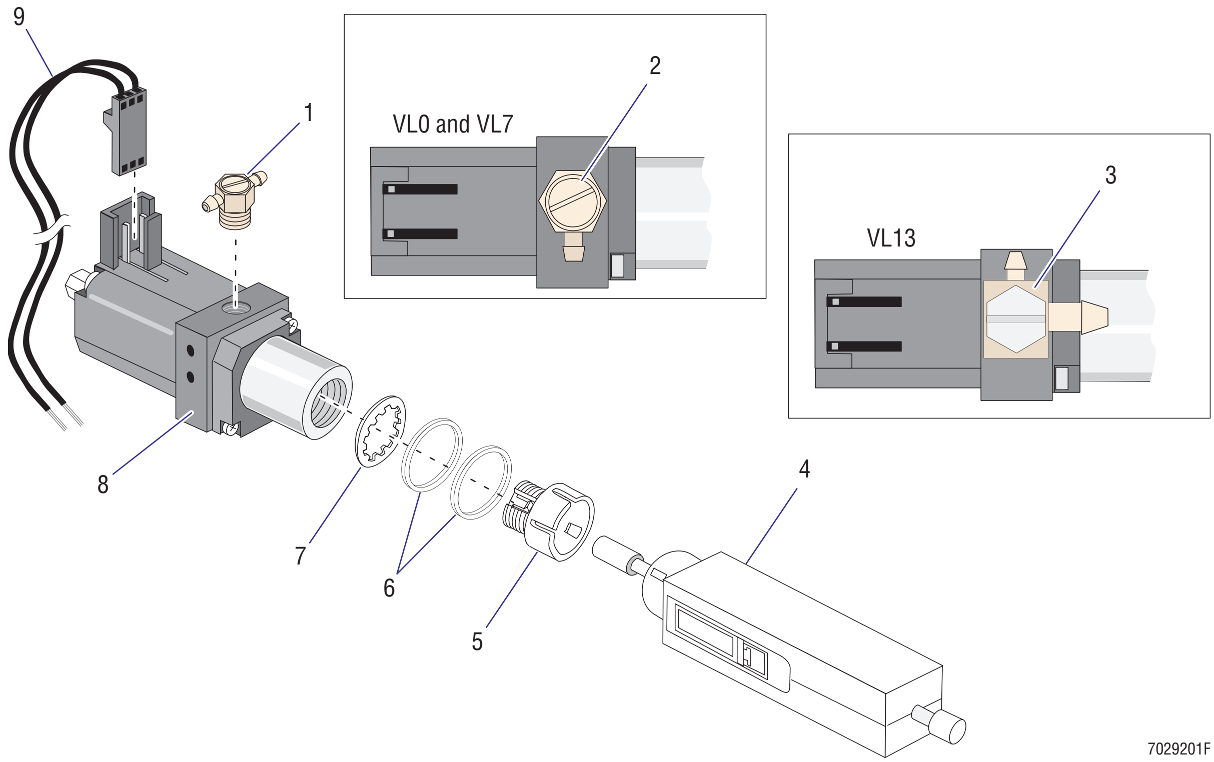


Table 8.2-38 Pinch Valve and Associated Components, Lower Pneumatics Drawer (See Figure 8.2-38)

Item	Part Number	Description
1	6232814	Fitting, T-connector, adjustable, 3/32 i.d. hose barb to 3/32 i.d. hose barb to 10-32 threaded, brass miniature
2	6232813	Fitting, elbow, adjustable, 3/32 i.d. hose barb to 10-32 threaded, brass miniature **Note:** Fitting must be oriented as shown after tightening.
3	6232819	Fitting, Y-connector, adjustable, hose barb, 0.190 o.d. to 0.120 o.d. to 10-32 threaded, brass miniature with stainless steel stud **Note:** Fitting must be oriented as shown after tightening.
4	6855763	Valve, pull-apart pinch, double-action, white, standard
5	1017501	Mount, pull-apart pinch valve
6	6216012	Spacer, cylinder, 0.500 i.d. x 0.562 o.d. x 0.062 thickness
7	2826030	Washer, I-tooth, #47, 0.47 i.d. x 0.60 o.d. x 0.020 thickness
8	6232492	Valve, electro-pneumatic, solenoid and pilot actuator combination valve, 24 Vdc / 30 psi, 4.5 lb pinch force **Note:** Attach using two self-lock screws (#6-32 x 0.37 in. length, pan-head), PN 2839039. Check alignment to ensure it is straight and is parallel to other assemblies before tightening the screws.
9	6028287	Cable, solenoid power, Clippard 3 position connector for solenoid with two 26 AWG (19/38) tinned copper conductor wires for circuit card connection

Figure 8.2-39 Solenoid Manifold, Lower Pneumatics Drawer (See Table 8.2-39)

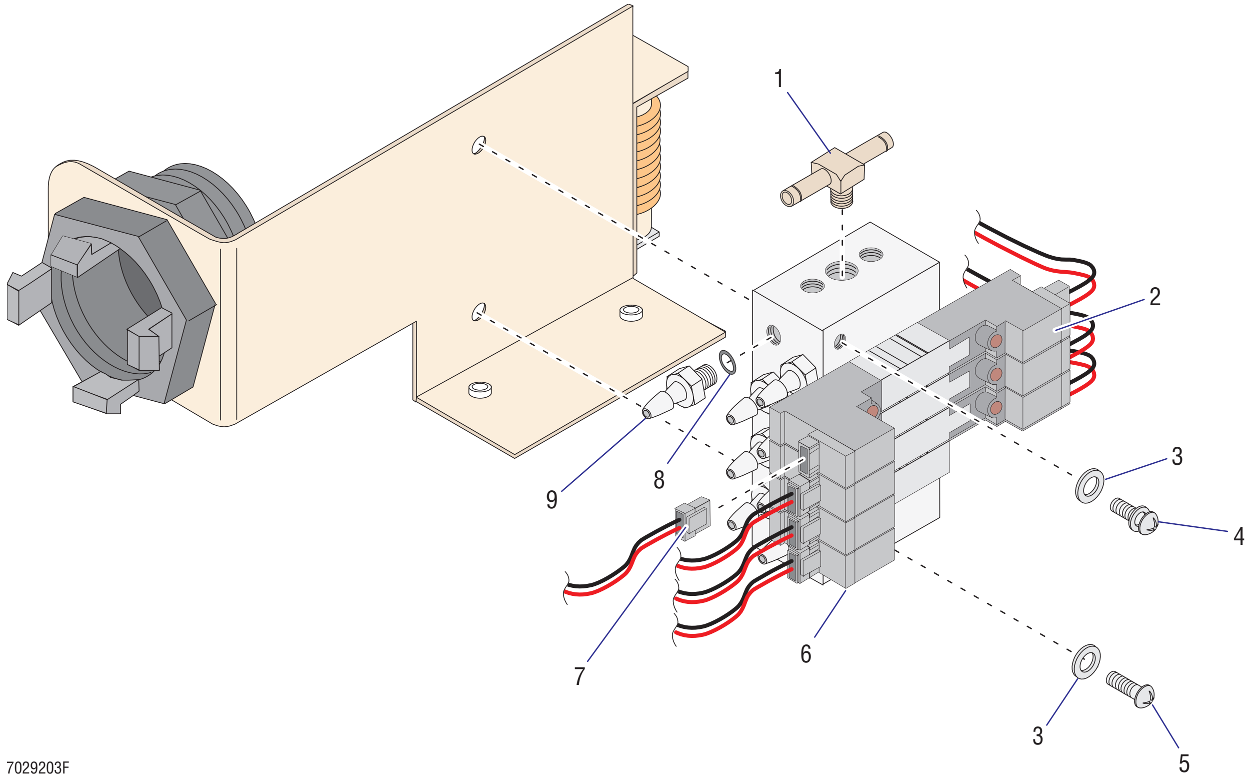


Table 8.2-39 Solenoid Manifold, Lower Pneumatics Drawer (See Figure 8.2-39)

Item	Part Number	Description
	6232587	Assembly, solenoid valve, pressure relief valves and manifold
1	6216129	Fitting, T-connector, hose barb, 0.187 i.d. to 0.187 i.d. to threaded, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown after tightening.
2	6232393	Valve, double solenoid, pilot-actuated latching two-position five-port spool valve, 24 Vdc, operating pressure 14 to 100 psi
3	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
4	2839074	Screw, self-lock (#6-32 x 1.12 in. length, pan-head)
5	2806096	Screw, machine (#6-32 x 1.25 in. length, pan-head)
6	6232376	Valve, single solenoid, pilot-actuated two-position five-port spool valve, 24 Vdc, operating pressure 20 to 100 psi
7	6028130	Cable, solenoid power, 2 position connector for solenoid with two 60 in. 22 AWG conductor wires for circuit card connection
8	2523062	O-ring, ethylene propylene seal, 0.187 i.d. x 0.050 wall
9	6232086	Fitting, hose barb union, 0.062 i.d. to 10-32 threaded

Figure 8.2-40 QD10 and QD11 (Coupling and Fittings), Lower Pneumatics Drawer (See Table 8.2-40)

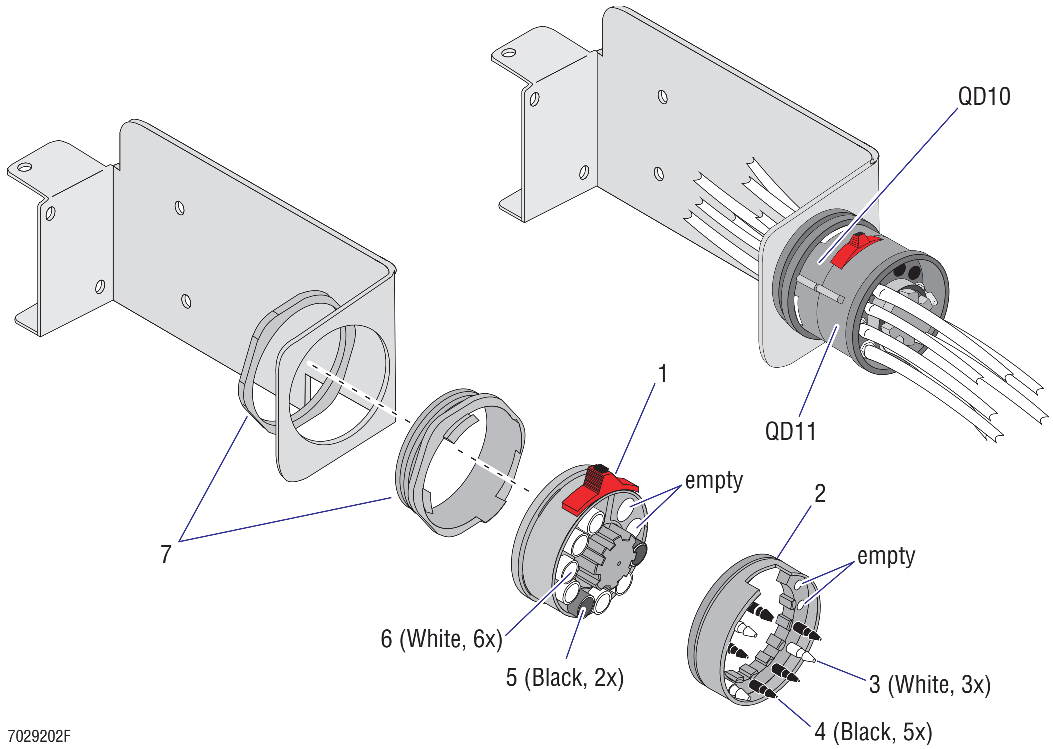


Table 8.2-40 QD10 and QD11 (Coupling and Fittings), Lower Pneumatics Drawer (See Figure 8.2-40)

Item	Part Number	Description
1	6232532	Coupling, quick-disconnect QD10, male body, 10 tube capacity body (includes the 8 fittings shown in Figure 8.2-40)
2	6232531	Coupling, quick-disconnect QD11, female body, 10 tube capacity body (includes the 8 fittings shown in Figure 8.2-40)
3	6232588	Fitting, insert, white female quick-connect, internal connector to 0.082 i.d. hose barb (inserted 3 places in QD11, PN 6232531)
4	6232469	Fitting, insert, black female quick-connect, internal connector to 0.125 i.d. hose barb (inserted 5 places in QD11, PN 6232531)
5	6232468	Fitting, insert, black male quick-connect, internal connector to 0.125 i.d. hose barb (inserted 2 places in QD10, PN 6232532)
6	6232581	Fitting, insert, white male quick-connect, internal connector to 0.082 i.d. hose barb (inserted in 6 places in QD10, PN 6232532)
7	6232530	Coupling, quick-connect, panel-mount adapter and nut assembly for attaching 10 tube quick-disconnect couplings to a panel, black

Figure 8.2-41 Quick-Disconnect Fittings and Brackets, Lower Pneumatics Drawer (See Table 8.2-41)

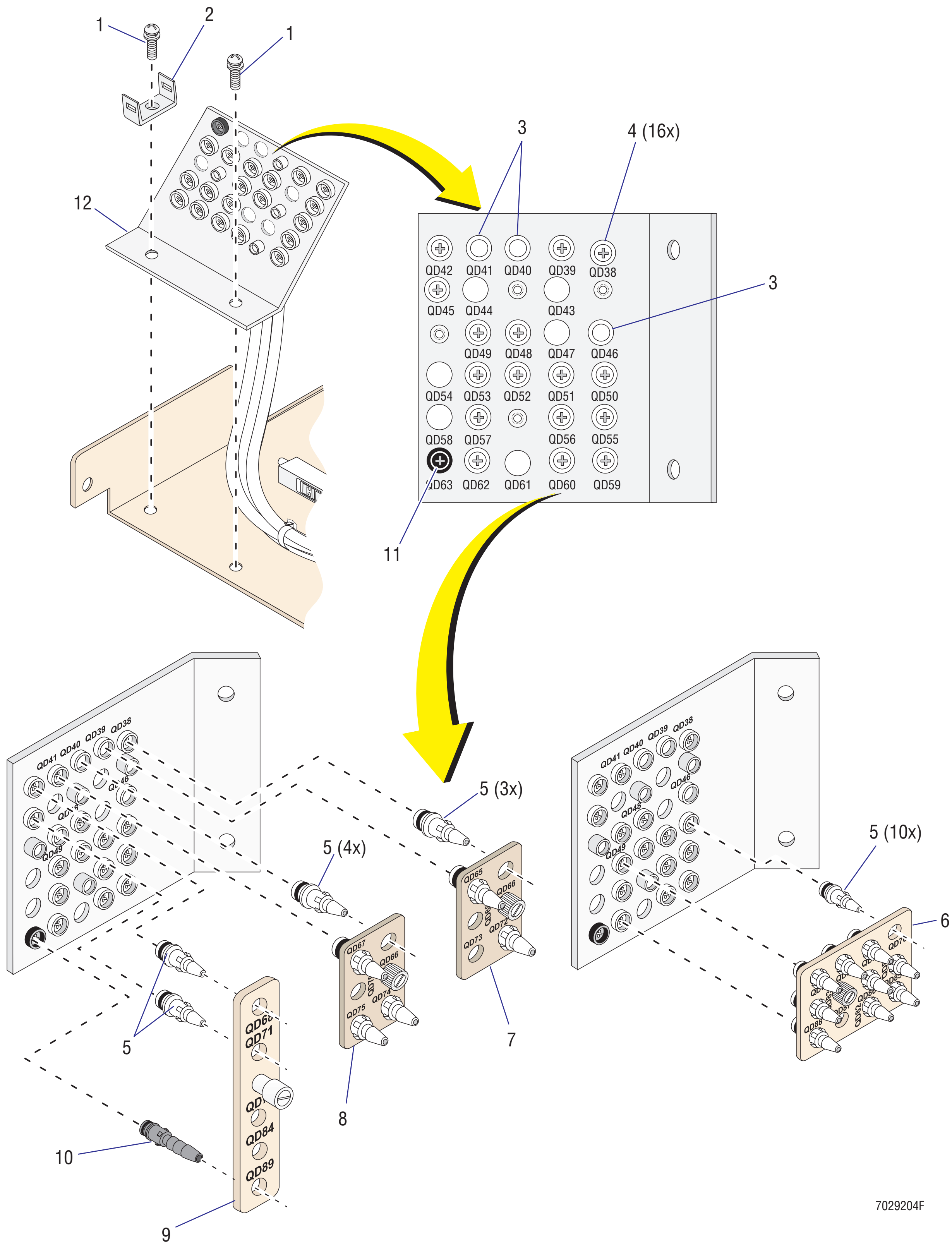


Table 8.2-41 Quick-Disconnect Fittings and Brackets, Lower Pneumatics Drawer (See Figure 8.2-41)

Item	Part Number	Description
1	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
2	6011019	Mount, wire tie, 0.51 in. length x 0.33 in. width, for use with #6 screw
3	6232799	Fitting, insert, white female quick-connect, internal connector to 0.094 i.d. hose barb (inserted three places in the 45° angled bracket, PN 6805879)
4	6232588	Fitting, insert, white female quick-connect, internal connector to 0.093 i.d. hose barb with shutoff valve (inserted 16 places in the 45° angled bracket, PN 6805879)
5	6232581	Fitting, insert, white male quick-connect, internal connector to 0.082 i.d. hose barb (couples with PN 6232588 or PN 6232799)
6	6858589	Plate, 12 insert fitting, with captive knurl knob
7	6858591	Plate, 6 insert fitting, with captive knurl knob, for QD64, QD65 and QD72 connections
8	6858592	Plate, 6 insert fitting, with captive knurl knob, for QD66, QD67, QD74, and QD75 connections
9	6858590	Plate, 5 insert fitting, with captive knurl knob, used only on XL with MCL option installed, for QD68, QD71, and QD89 connections
10	6232468	Fitting, insert, black male quick-connect, externally sealed tube fitting insert (couples with PN 6232469)
11	6232469	Fitting, insert, black female quick-connect, internal connector to 0.125 i.d. hose barb (inserted one place in the 45° angled bracket, PN 6805879)
12	6805879	Bracket, 45° angled, used to secure fitting inserts

Figure 8.2-42 Cytometer Rear Panel, Lower (See Table 8.2-42)

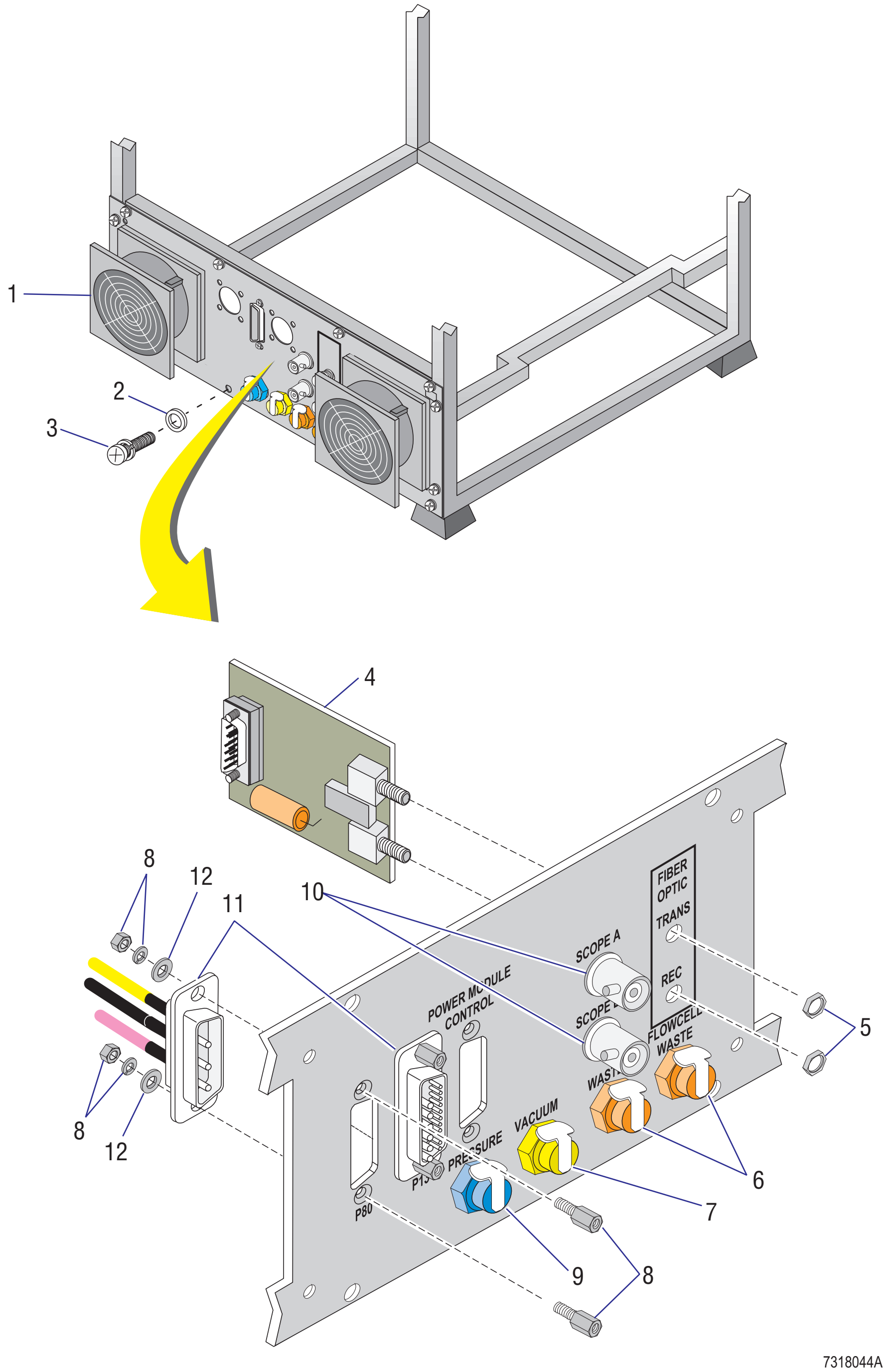


Table 8.2-42 Cytometer Rear Panel, Lower (See Figure 8.2-42)

Item	Part Number	Description
1	2603025	Fan, box, 106 CFM, 24 Vdc (4.68 square x 1.5 thickness) **Note:** To ensure proper cable length, verify fan orientation before attaching the fan to the Cytometer frame. • Cable for B1 (fan near the MCL side of the unit) must be oriented center to top as seen in the “fan to shock mount” illustration in Figure 8.2-43. • Cable for B2 (fan near the HeNe laser head extension) must be oriented left of center as seen in the “filter assembly to fan” illustration in Figure 8.2-43.
2	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
3	2839039	Screw, self-lock (#6-32 x 0.37 in. length, pan-head)
4	6705324	Card, Fiber Optic Interface **Note:** Uses fiber interface cable, PN 6028650 (9-position, D-receptacle to plug, 55-in. long).
5	2851995	Nut, hex (0.25-36 UNS x 0.375 AF x 0.094 in. thickness)
6	6232304	Quick-connect, panel mount, orange body with nut, automatic shut-off, 0.125 flow x 0.250 o.d. (couples with orange insert, PN 6232305, also with automatic shut-off) **Note:** Insert a #50 I-tooth washer, PN 2826042, between the panel and the hex nut.
7	6232303	Quick-connect, panel mount, yellow body with nut, automatic shut-off, 0.125 flow x 0.250 o.d. (couples with yellow insert, PN 6232307, also with automatic shut-off) **Note:** Insert a #50 I-tooth washer, PN 2826042, between the panel and the hex nut.
8	2104261	Screwlock, female assembly kit for attaching a D-type connector
9	6232309	Quick-connect, panel mount, blue body with nut, automatic shut-off, 0.125 flow x 0.250 o.d. (couples with blue insert, PN 6232306, also with automatic shut-off) **Note:** Insert a #50 I-tooth washer, PN 2826042, between the panel and the hex nut.
10	2121644	Connector, BNC coaxial, panel mount, jack-to-jack adapter
11	6028700	Cable, CYTO dc power EMI harness
12	2827146	Washer, flat, #4 (0.125 i.d. x 0.250 o.d. x 0.036 thickness)

Figure 8.2-43 Fan Assembly, Cytometer Rear Panel (See Table 8.2-43)

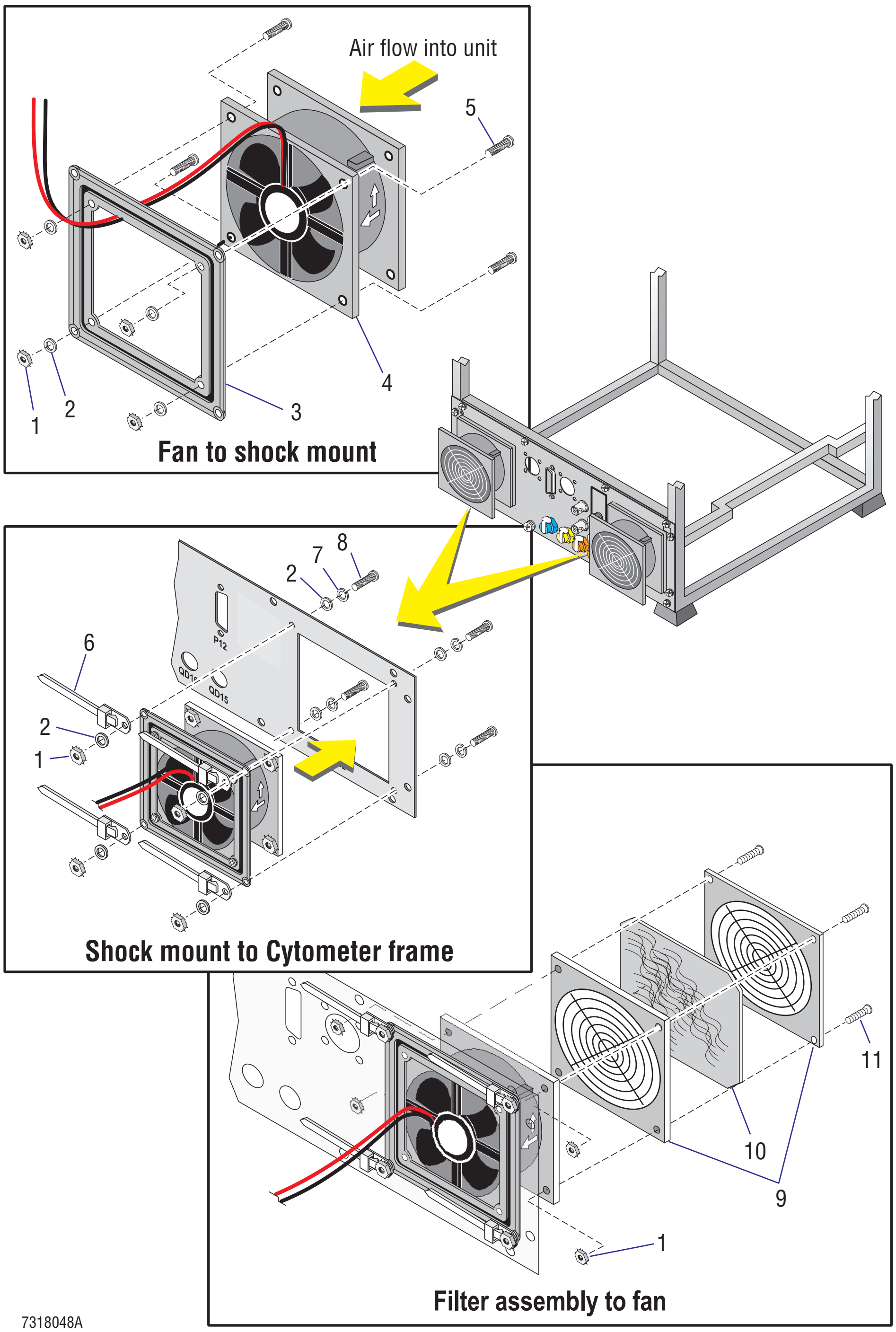


Table 8.2-43 Fan Assembly, Cytometer Rear Panel (See Figure 8.2-43)

Item	Part Number	Description
1	2821010	Nut, self-lock (#6-32 x 0.250 AF x 0.109 in. thickness)
2	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
3	2603053	Fan, shock mount, for 4-inch fan, black
4	2603025	Fan, box, 106 CFM, 24 Vdc (4.68 square x 1.5 thickness) **Note:** To ensure proper cable length, verify fan orientation before attaching the fan to the Cytometer frame. • Cable for B1 (fan near the MCL side of the unit) must be oriented center to top as seen in the “fan to shock mount” illustration in Figure 8.2-43. • Cable for B2 (fan near the HeNe laser head extension) must be oriented left of center as seen in the “filter assembly to fan” illustration in Figure 8.2-43.
5	2806075	Screw, machine (#6-32 x 0.62 in. length, pan-head)
6	6011006	Tie wrap, screw mount, #6 sizer, 7.4 in. long, 0.19 in wide
7	2826035	Washer, split-lock, #6 (0.14 i.d. x 0.25 o.d. x 0.03 in. thickness)
8	2806128	Screw, machine (#6-32 x 0.75 in. length, pan-head)
9	2603009	Finger guard, grille for fan air filter on 4-inch box fan **Note:** Raised ribs should face out.
10	2603010	Filter, air, 4-inch pad, 45 PPI
11	2806073	Screw, machine (#6-32 x 0.62 in. length, FL82 flat-head)

Figure 8.2-44 Cytometer Right Side Compartment (See Table 8.2-44)

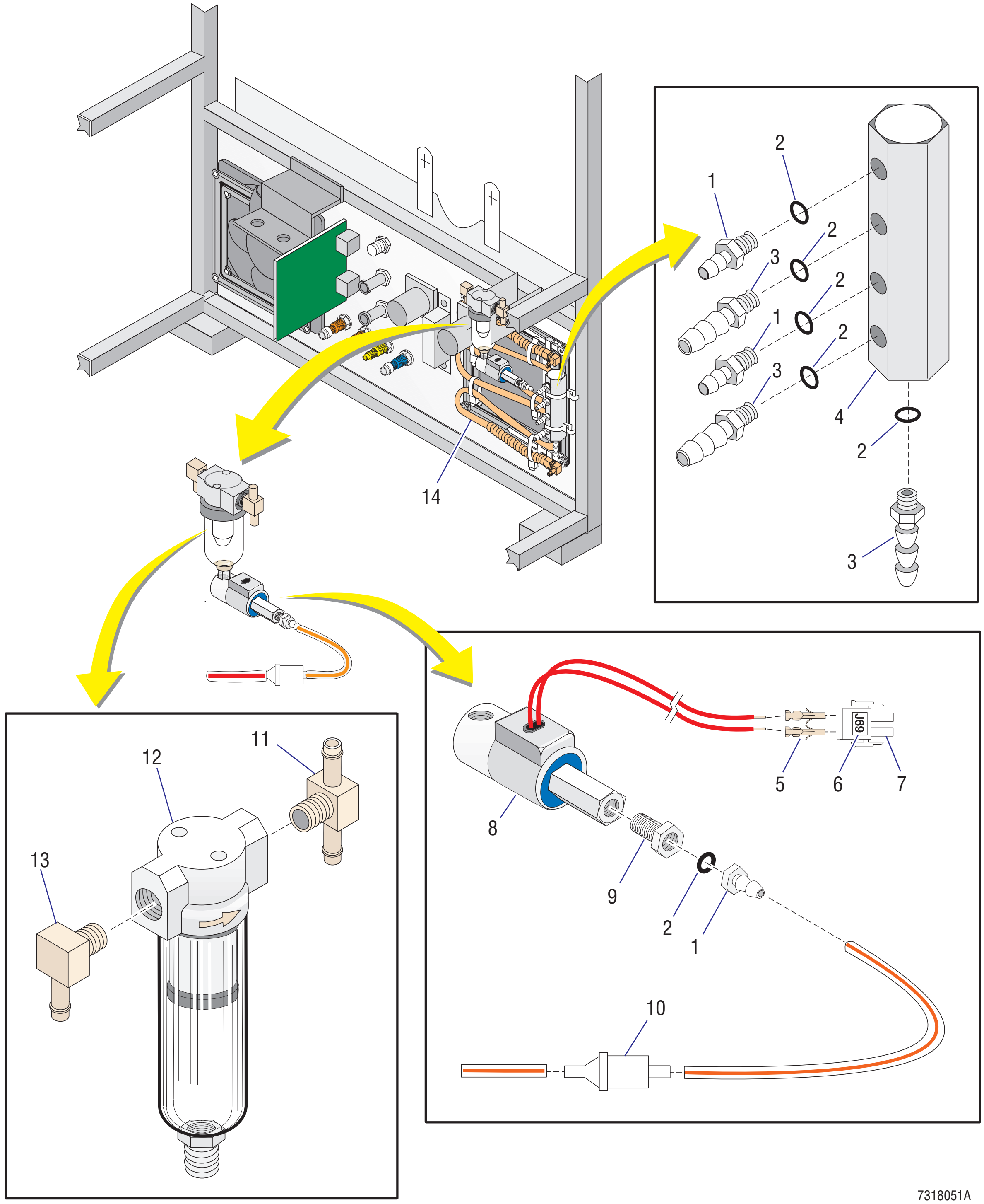


Table 8.2-44 Cytometer Right Side Compartment (See Figure 8.2-44)

Item	Part Number	Description
1	6232086	Fitting, hose barb union, 0.062 i.d. to 10-32 threaded
2	2523062	O-ring, ethylene propylene seal, 0.187 i.d. x 0.050 wall
3	6232085	Fitting, hose barb union, 0.125 i.d. to 10-32 threaded
4	1018616	Manifold rear panel
5	2104365	Pin, universal mate-n-lock connector, 20-14 AWG, brass and gold
6	2427902	Label (J69)
7	2104356	Connector, universal mate-n-lock 2-pin plug, panel/cable mount
8	6214067	Solenoid, 2-way, normally-open (N.O.)
9	6216004	Fitting, hex-head adapter, 10-32 tap to 1/8 MPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion.
10	6214108	Valve, check, for 0.062 i.d. to 0.062 i.d. tubing
11	6216127	Fitting, T-connector, hose barb, 0.187 i.d. to 0.187 i.d. to 1/8 MPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown after tightening.
12	6232725	Filter, water trap (air/water filter separator), 5 micron **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads before inserting the threads in the solenoid.
13	6216128	Fitting, elbow, hose barb, 0.187 i.d. to 1/8 MPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown after tightening.
14	6856551	Coil, cooling

Figure 8.2-45 Power Supply Module - Left Side with Cover Removed (See Table 8.2-45)

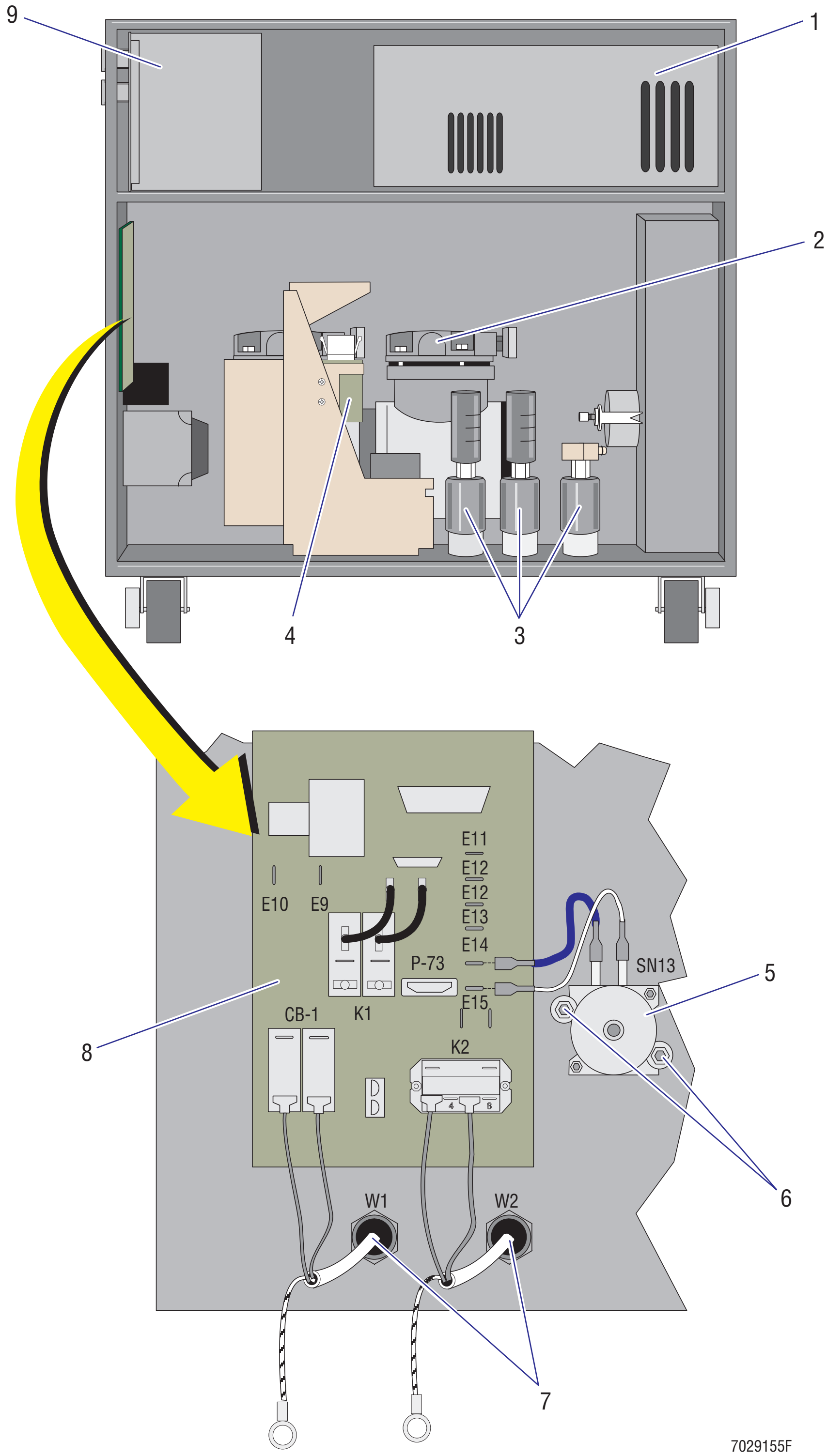


Table 8.2-45 Power Supply Module - Left Side with Cover Removed (See Figure 8.2-45)

Item	Part Number	Description
1	7000431	Power supply, Argon air-cooled laser, switching, for 100 Vac system
	7000721	Power supply, Argon air-cooled laser, switching, for 115Vac system
	7000432	Power supply, Argon air-cooled laser, switching, for 220 or 240 Vac system
2	7000371	FRU, compressor assembly, dual-head, for 100/120 Vac system
	7000372	FRU, compressor assembly, dual-head, for 220/224 Vac system
3	6232368	Valve, dump, system pressure, for 100/120 Vac system, see Figure 8.2-46 for an exploded view that includes attachments
	6232367	Valve, dump, system pressure, for 220/240 Vac system, see Figure 8.2-46 for an exploded view that includes attachments
4	6706401	Card, Transient Absorber EMC (also referred to as Transient Voltage Suppressor 2 card)
5	5120230	Switch, vacuum/pressure; waste pressure, normally open, single pole single throw, 3-in. water **Note:** Must be installed with contacts up so that wires can be connected as shown in Figure 8.2-45. The blue wire from E14 on the Power Module Control card is attached to SN13's left contact and the white wire (from E15) is attached to SN13's right contact.
6	2821009	Nut, self-lock (#4-40 x 0.250 AF x 0.109 in. thickness)
7	6028530	Line cord, 125 Vac / 15 A, shielded, 14 AWG stranded, NEMA 5-15 plug to a stripped end, 9-ft. 10-in. length including connector **Note:** Strain relief set for one line cord, PN 6027766.
8	6705231	Card, Power Module Control, for instruments with a serial number Z09062 or lower
	6706390	Card, Power Module Control II, EMC version, for instruments with a serial number Z09063 or higher
9	6705442	Card, Voltage Selector, for 100 Vac system
	6705237	Card, Voltage Selector, for 120 Vac system
	6705470	Card, Voltage Selector, for 220 Vac system
	6705472	Card, Voltage Selector, for 230/240 Vac system

Figure 8.2-46 VL32, VL30, and VL31 - Exploded View (See Table 8.2-46)

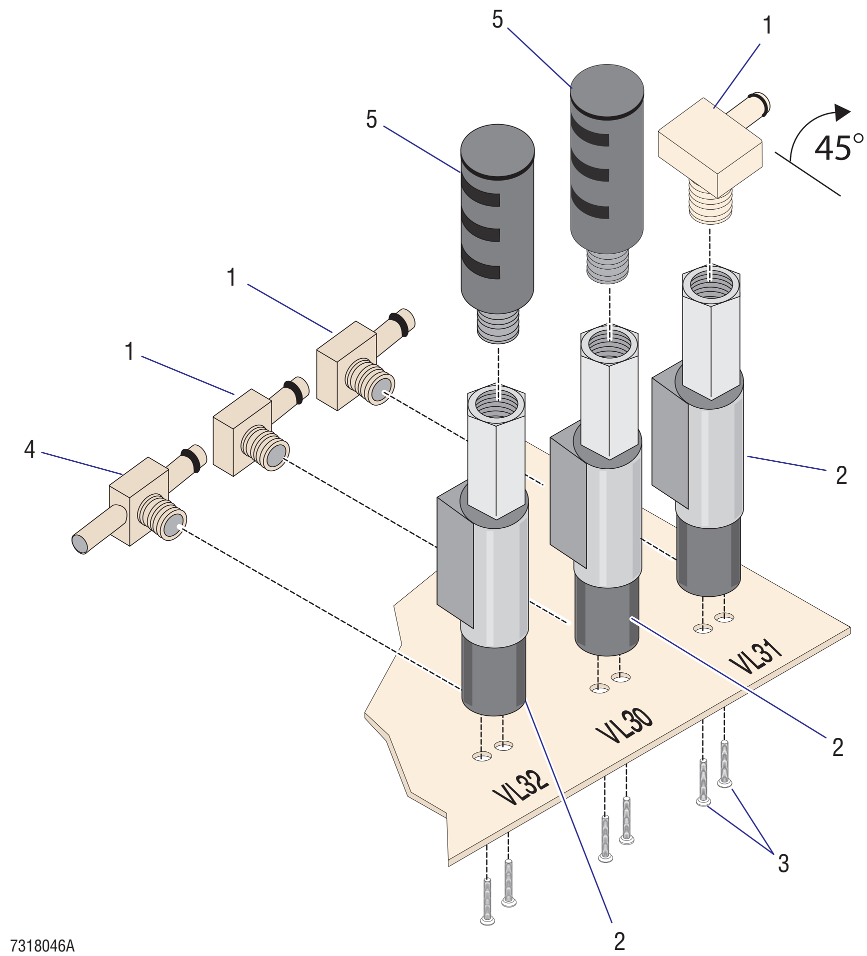


Table 8.2-46 VL32, VL30, and VL31 - Exploded View (See Figure 8.2-46)

Item	Part Number	Description
1	6216128	Fitting, elbow, hose barb, 0.187 i.d. to 1/8 MPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown after tightening.
2	6232368 6232367	Valve, dump, system pressure, for 100/120 Vac system Valve, dump, system pressure, for 220/240 Vac system
3	2808080	Screw, machine (#8-32 x 0.25 in. length, UF82-head)
4	6216127	Fitting, T-connector, hose barb, 0.187 i.d. to 0.187 i.d. to 1/8 MPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown after tightening.
5	6232501	Muffler, noise reducing pneumatic, 0.125 MNPT, 0.812 diameter, 2.125 length **Note:** Hand tighten only.

Figure 8.2-47 Power Supply Module - Front Panel Components (See Table 8.2-47)

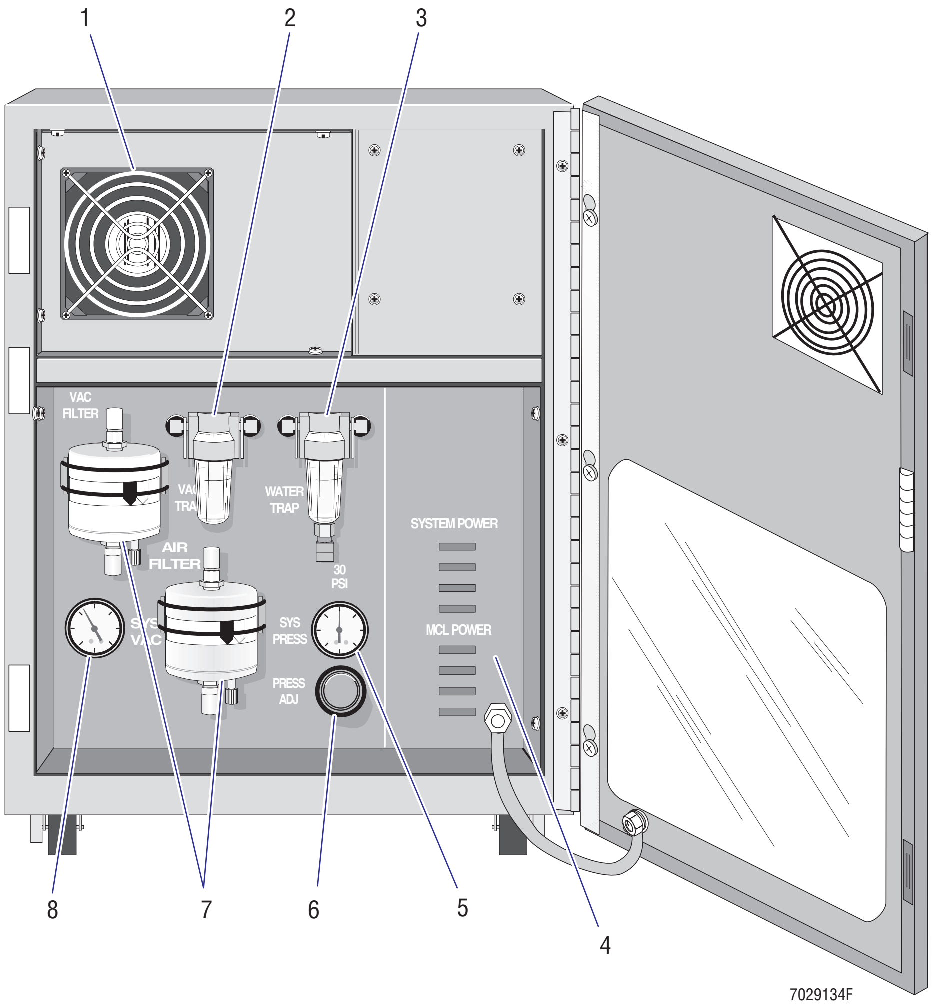


Table 8.2-47 Power Supply Module - Front Panel Components (See Figure 8.2-47)

Item	Part Number	Description
1	2603058	Fan, box, 90 CFM, 24 Vdc, 4.69 square x 1.0 in. thickness
2	6232724	Trap, vacuum, with miniature polycarbonate bowl, see Figure 8.2-48 for an exploded view that includes attachments
3	6232725	Filter, water trap (air/water filter separator), 5 micron, see Figure 8.2-49 for an exploded view that includes attachments
4	6705720	Card, Voltage Supply Monitor, see Figure 8.2-50 for an exploded view that includes attachments
5	6232189	Gauge, 0 to 60 psi, for monitoring system pressure, panel mount, see Figure 8.2-51 for an exploded view that includes attachments
6	6208005	Valve, pressure relief, see Figure 8.2-52 for an exploded view that includes attachments
7	6232561	Filter, gas, hydrophobic, 0.2 micon, disposable plastic, see Figure 8.2-53 for an exploded view that includes attachments
8	6232183	Gauge, 0 to 30 in. Hg, for monitoring system vacuum, panel mount, see Figure 8.2-54 for an exploded view that includes attachments

Figure 8.2-48 Vacuum Trap and Related Components (See Table 8.2-48)

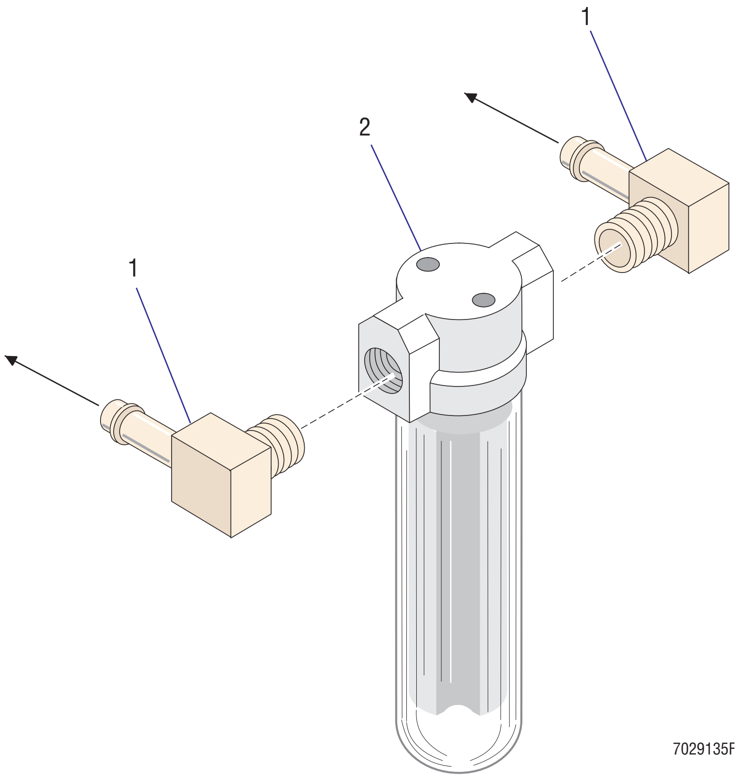


Table 8.2-48 Vacuum Trap and Related Components (See Figure 8.2-48)

Item	Part Number	Description
1	6216128	Fitting, hose barb, elbow, 0.187 i.d. to 1/8 MNPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown after tightening.
2	6232724	Trap, vacuum, with miniature polycarbonate bowl

Figure 8.2-49 Water Trap (Air/Water Filter Separator) and Related Components (See Table 8.2-49)

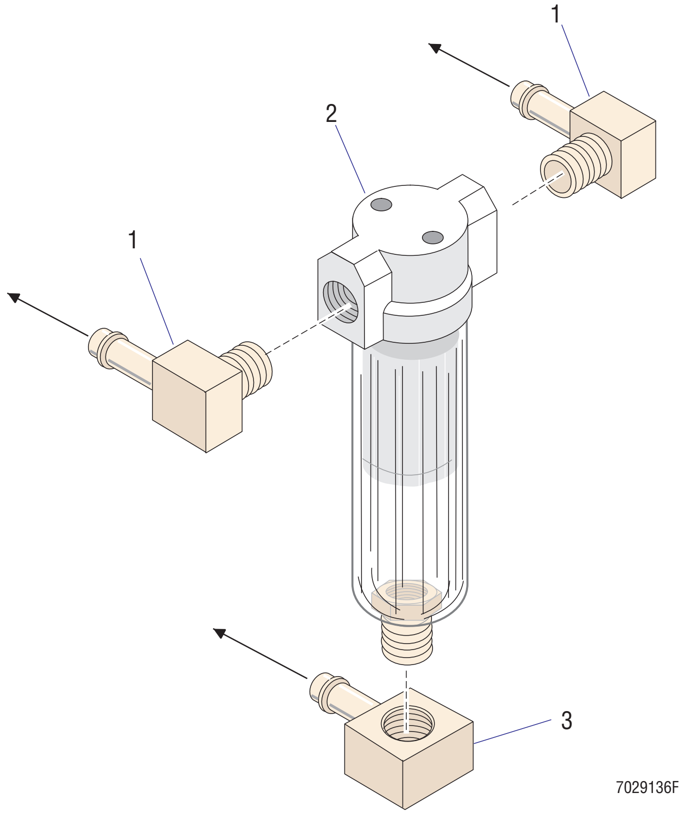


Table 8.2-49 Water Trap (Air/Water Filter Separator) and Related Components (See Figure 8.2-49)

Item	Part Number	Description
1	6216128	Fitting, hose barb, elbow, 0.187 i.d. to 1/8 MNPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown after tightening.
2	6232725	Filter, water trap (air/water filter separator), 5 micron **Note:** Apply a thin line of pipe sealant, PN 1601056, across lower threads before attaching the bottom fitting, PN 6232214.
3	6232214	Fitting, hose barb, elbow, 0.187 i.d. to 1/8 FPT, nickel-plated brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across lower threads of the water trap filter, PN 6232725, before attaching the fitting. Fitting must be oriented as shown after tightening.

Figure 8.2-50 Front Panel including Voltage Supply Monitor Card and Hardware (See Table 8.2-50)

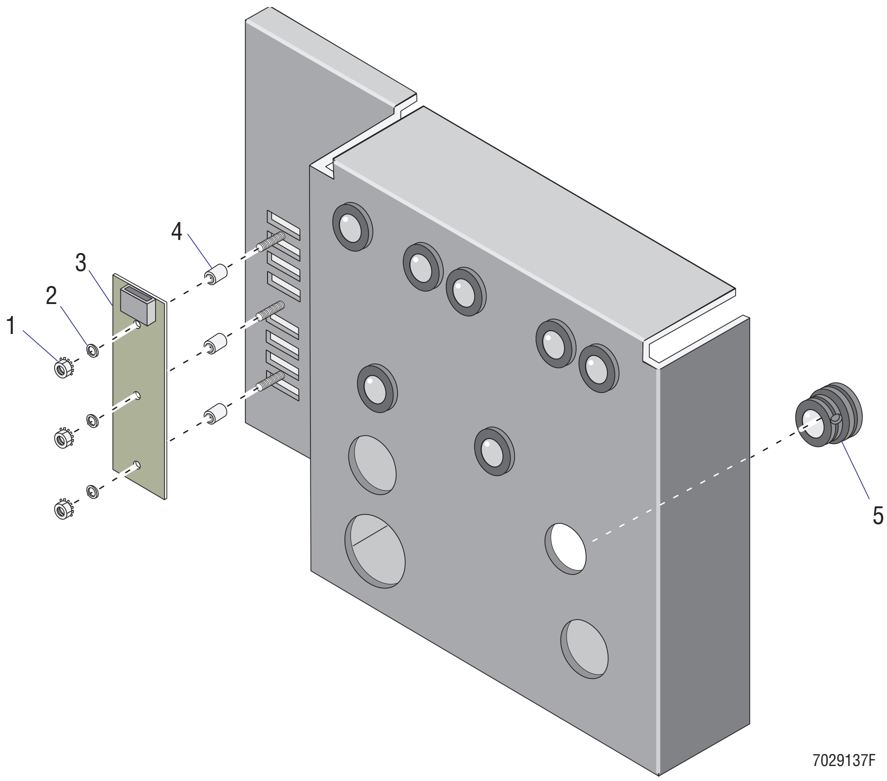


Table 8.2-50 Front Panel including Voltage Supply Monitor Card and Hardware (See Figure 8.2-50)

Item	Part Number	Description
1	2821010	Nut, self-lock (#6-32 x 0.250 AF x 0.109 in. thickness)
2	2827147	Washer, flat, #6 (0.156 i.d. x 0.312 o.d. x 0.036 in. thickness)
3	6705720	Card, Voltage Supply Monitor
4	2843032	Spacer, hole, 0.140 i.d. x 0.250 o.d. x 0.250 in. length
5	2851080	Grommet, 0.375 i.d. x 0.560 o.d., nylon

Figure 8.2-51 System Pressure Gauge and Related Components (See Table 8.2-51)

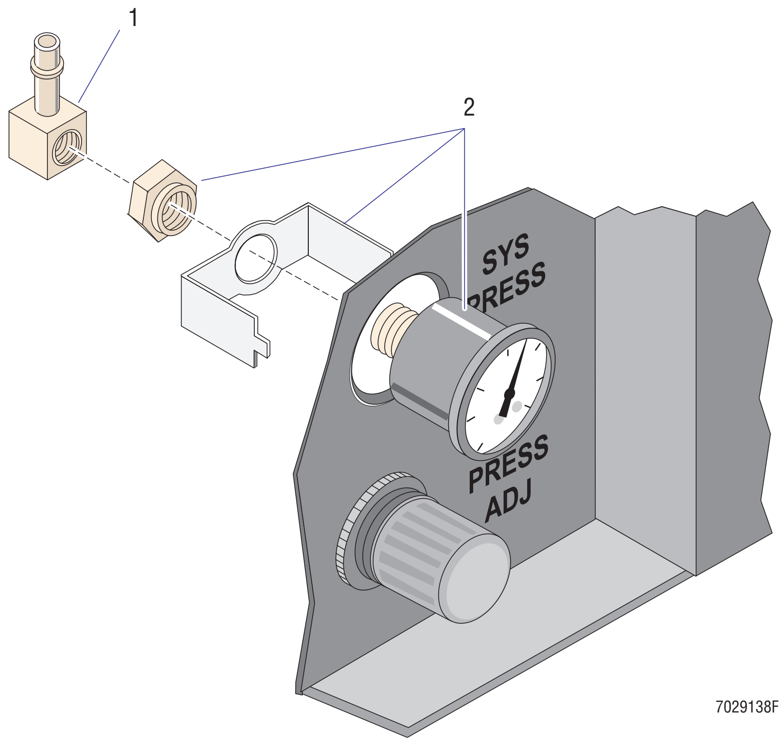


Table 8.2-51 System Pressure Gauge and Related Components (See Figure 8.2-51)

Item	Part Number	Description
1	6232214	Fitting, hose barb, elbow, 0.187 i.d. to 1/8 FPT, nickel-plated brass **Note:** Fitting must be oriented as shown after tightening.
2	6232189	Gauge, 0 to 60 psi, for monitoring system pressure, 1.5-inch diameter, panel mount (includes panel mounting hardware) **Note:** Apply a thin line of pipe sealant, PN 1601056, across gauge threads before attaching the fitting. Gauge must be oriented as shown after tightening.

Figure 8.2-52 System Pressure Adjustment Knob and Related Components (See Table 8.2-52)

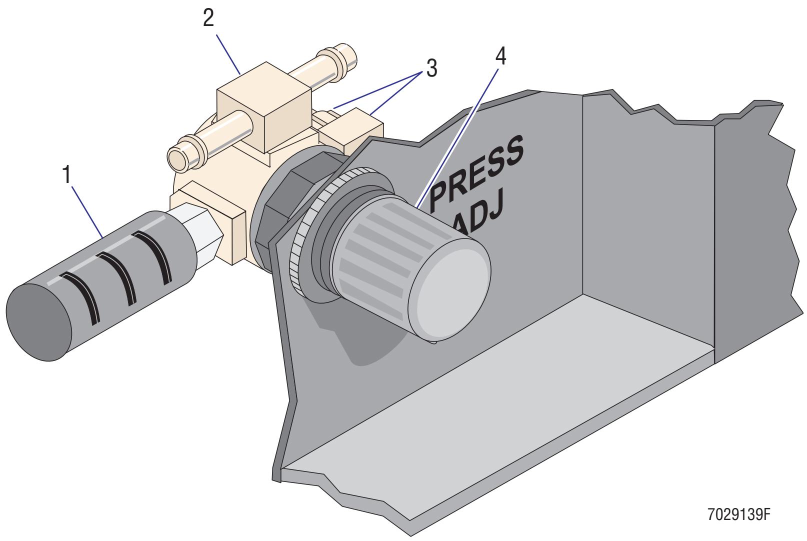


Table 8.2-52 System Pressure Adjustment Knob and Related Components (See Figure 8.2-52)

Item	Part Number	Description
1	6232501	Muffler, noise reducing pneumatic, 0.125 MNPT, 0.812 diameter, 2.125 length
2	6216127	Fitting, T-connector, hose barb, 0.187 i.d. to 0.187 i.d. to 1/8 MNPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads prior to insertion. Fitting must be oriented as shown after tightening.
3	6216027	Fitting, poly-flow, poly-flow, elbow, 0.250 o.d. to 1/8 MNPT, brass **Note:** Apply a thin line of pipe sealant, PN 1601056, across threads that will be screwed in the pressure relief valve. Fitting must be oriented as shown after tightening.
4	6208005	Valve, pressure relief (with plugs), 30 psi

Figure 8.2-53 Vacuum and Air Filters with Related Components (See Table 8.2-53)

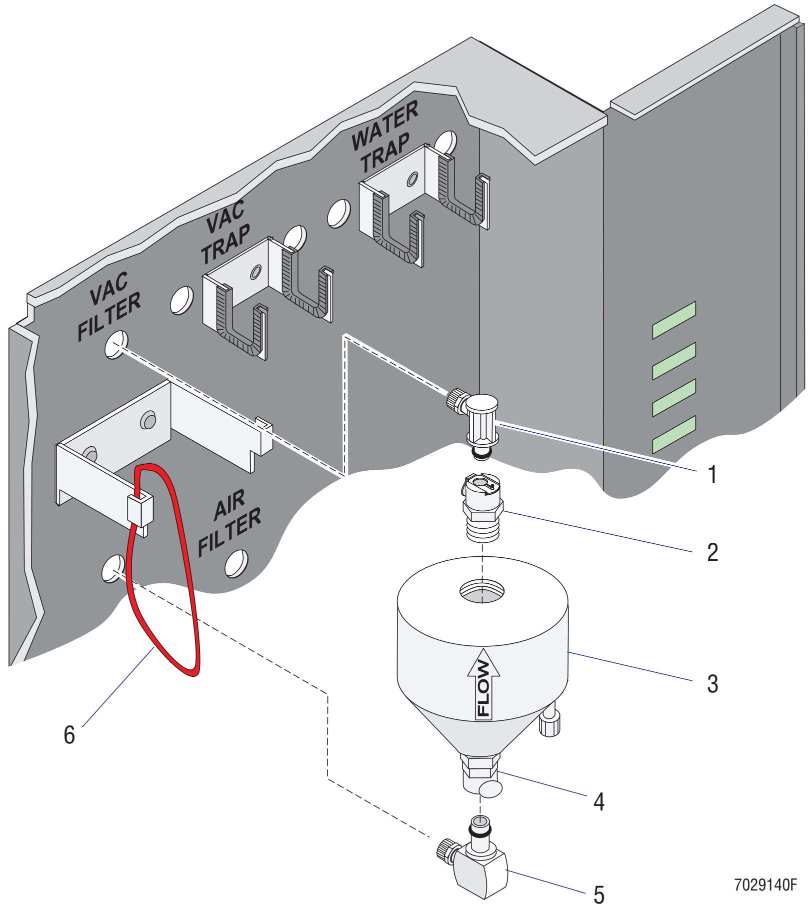


Table 8.2-53 Vacuum and Air Filters with Related Components (See Figure 8.2-53)

Item	Part Number	Description
1	6232702	Quick-connect, male, elbow, 0.250 o.d., white acetal delrin
2	6232703	Quick-connect, female, 0.125 flow, 0.375 MNPT, white acetal delrin, single connect
3	6232561	Filter, gas, hydrophobic, 0.2 micon, disposable plastic
4	6232700	Quick-connect, female, 0.250 flow, 0.375 MNPT, white acetal delrin, single connect
5	6232522	Quick-connect, male, external elbow, 0.375 o.d., white acetal delrin
6	2523451	O-ring, silicone, used as rubber band, 2.300 i.d. x 0.103 width

Figure 8.2-54 System Vacuum Gauge and Related Components (See Table 8.2-54)

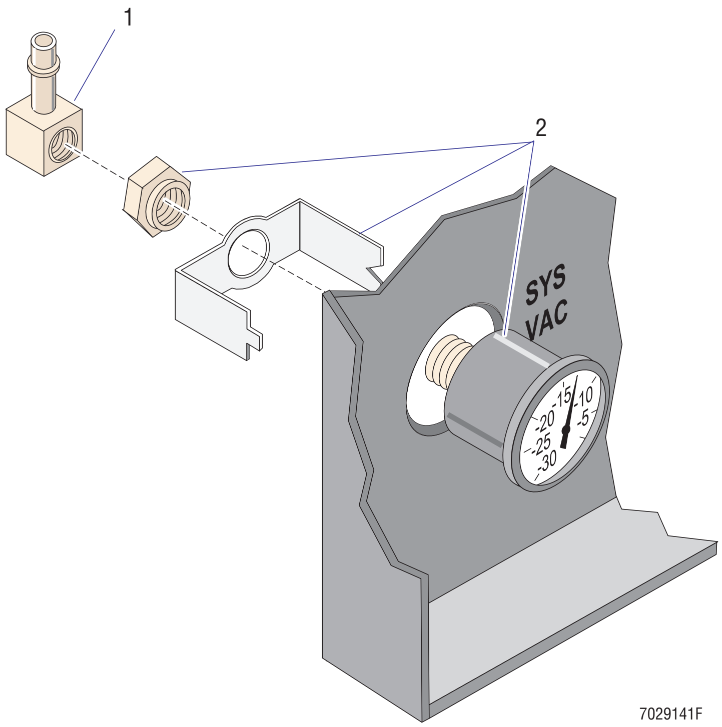


Table 8.2-54 System Vacuum Gauge and Related Components (See Figure 8.2-54)

Item	Part Number	Description
1	6232214	Fitting, hose barb, elbow, 0.187 i.d. to 1/8 FPT, nickel-plated brass **Note:** Fitting must be oriented as shown after tightening.
2	6232183	Gauge, 0 to 30 in. Hg, for monitoring system vacuum, 1.5-inch diameter, panel mount (includes panel mounting hardware) **Note:** Apply a thin line of pipe sealant, PN 1601056, across gauge threads before attaching the fitting. Gauge must be oriented as shown after tightening.

Figure 8.2-55 Power Supply Module - Right Side with Cover Removed (See Table 8.2-55)

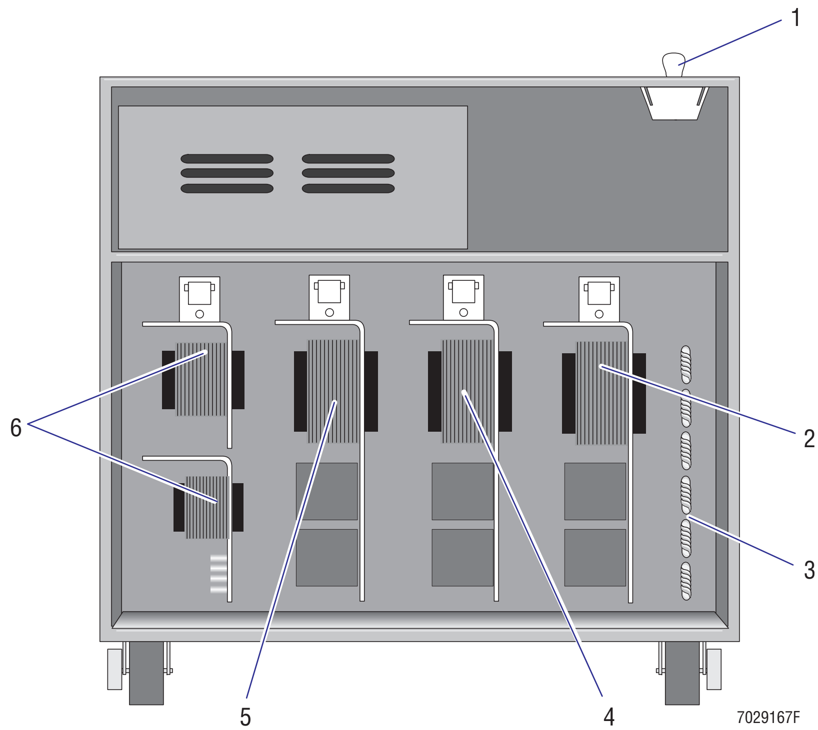


Table 8.2-55 Power Supply Module - Right Side with Cover Removed (See Figure 8.2-55)

Item	Part Number	Description
1	5110031	Interlock, high voltage (HV), snap action cheat switch
2	7000357	FRU, Power Supply, +24 Vdc
3	6856536	Coil, cooling
4	7000356	FRU, Power Supply, +5 Vdc
5	7000355	FRU, Power Supply, ±15 Vdc
6	7000362	FRU, Power Supply, MCL, assembly consisting of a +5 Vdc and ±12 Vdc supply and a +24 Vdc supply

Figure 8.2-56 Waste Container (See Table 8.2-56)

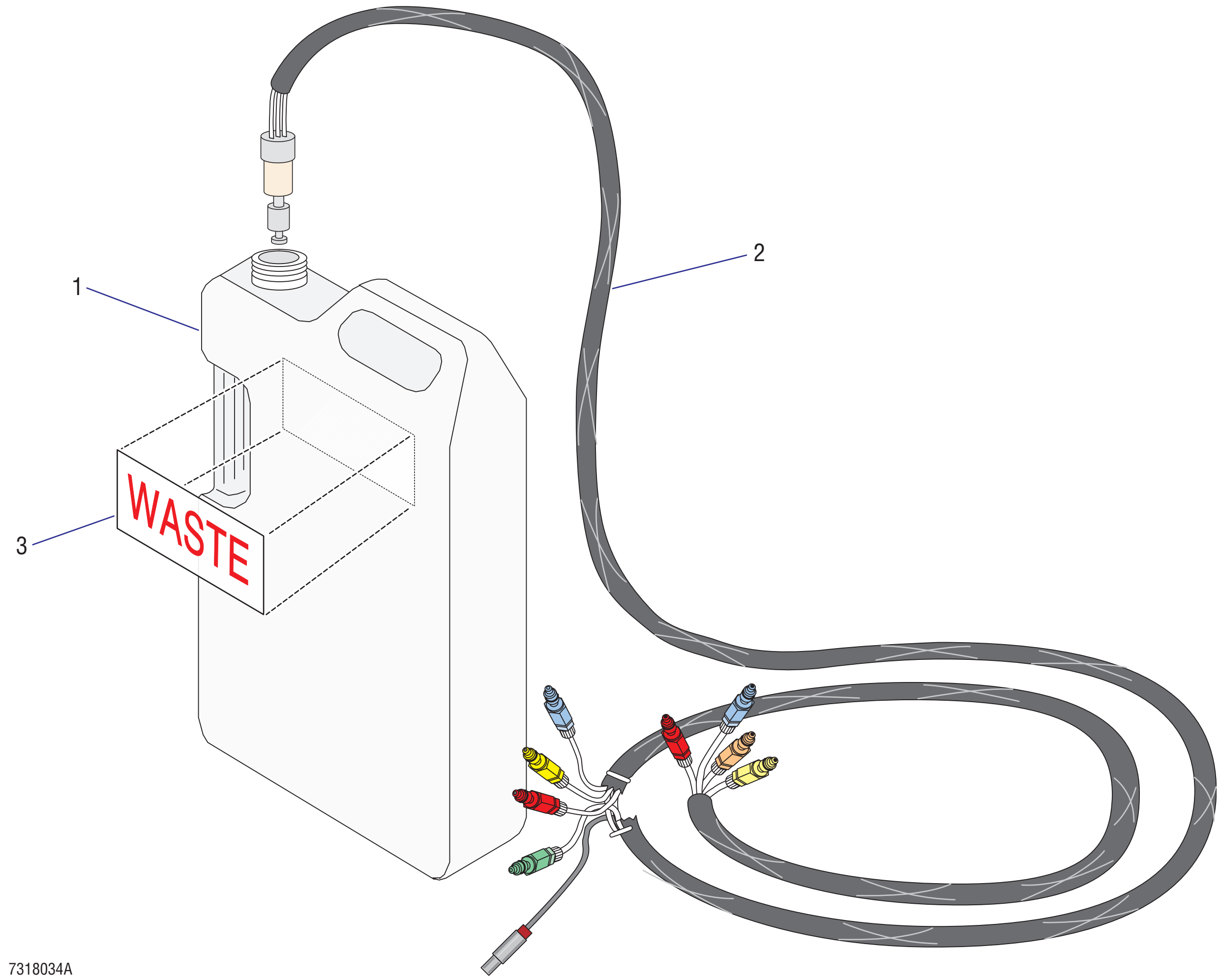


Table 8.2-56 Waste Container (See Figure 8.2-56)

Item	Part Number	Description
1	2523697	Tank, waste, l-gallon rectangular (also referred to as bottle)
2	6858159	Sensor assembly, waste level
3	2428039	Label, waste container

Figure 8.2-57 Power Supply Module - Rear Panel Components (See Table 8.2-57)

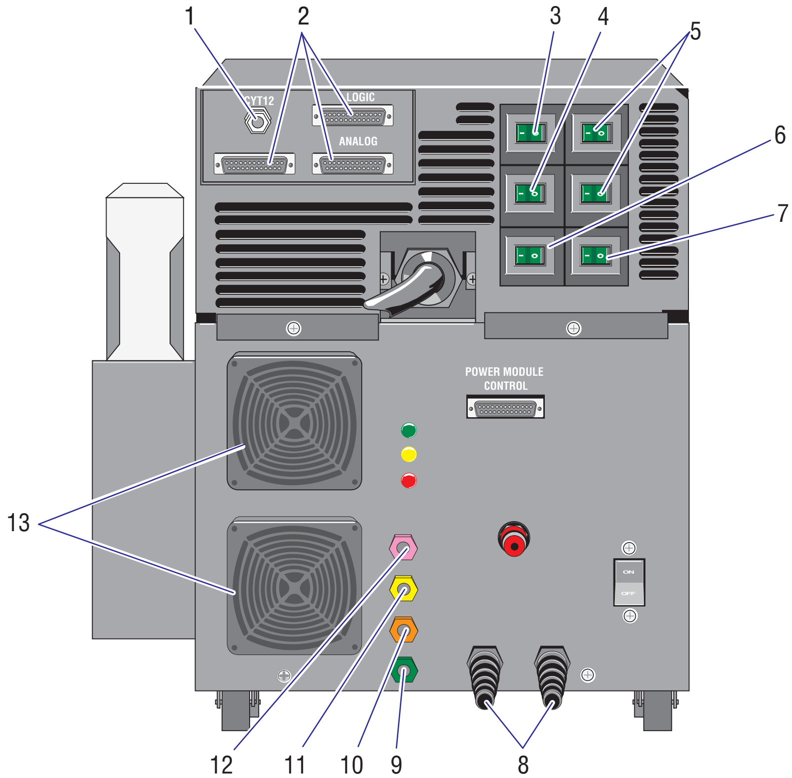


Table 8.2-57 Power Supply Module - Rear Panel Components (See Figure 8.2-57)

Item	Part Number	Description
1	6706391	Card, CYT12 Receiver, EMC **Note:** Attach using hex nut, PN 2851995 (0.25-36 UNS x 0.375 AF x 0.094 in. thickness).
2	6028693	Cable, harness that includes Logic, MCL, and Analog power supply dc internal cables **Note:** Attach using three female screw lock assembly kits for D-type connectors, PN 2104261.
3	5120229	Circuit breaker, 4 A, 250 Vac, for 100 Vac and 120 Vac systems
	5120227	Circuit breaker, 2 A, 250 Vac, for 220 Vac and 240 Vac systems
4	5120228	Circuit breaker, 3 A, 250 Vac, for 100 Vac systems
	5120227	Circuit breaker, 2 A, 250 Vac, for 120 Vac systems
	5101025	Circuit breaker, 1 A, 250 Vac, for 220 Vac and 240 Vac systems
5	5120228	Circuit breaker, 3 A, 250 Vac, for 100 Vac and 120 Vac systems
	5101026	Circuit breaker, 1.5 A, 250 Vac, for 220 Vac and 240 Vac systems
6	5101026	Circuit breaker, 1.5 A, 250 Vac, for 100 Vac and 120 Vac systems
	5101027	Circuit breaker, 0.8 A, 250 Vac, for 220 Vac and 240 Vac systems
7	5101027	Circuit breaker, 0.8 A, 250 Vac, for 100 Vac and 120 Vac systems
	5101028	Circuit breaker, 0.5 A, 250 Vac, for 220 Vac and 240 Vac systems
8	6028530	Line cord, 125 Vac / 15 A, shielded, 14 AWG stranded, NEMA 5-15 plug to a stripped end, 9-ft. 10-in. length including connector **Note:** Strain relief set for one line cord, PN 6027766.
9	6232606	Quick-connect, panel mount, green body with nut, 0.250 o.d. (couples with green insert, PN 6232607)
10	6232304	Quick-connect, panel mount, orange body with nut, automatic shut-off, 0.125 flow x 0.250 o.d. (couples with orange insert, PN 6232305, also with automatic shut-off)
11	6232303	Quick-connect, panel mount, yellow body with nut, automatic shut-off, 0.125 flow x 0.250 o.d. (couples with yellow insert, PN 6232307, also with automatic shut-off)
12	6232309	Quick-connect, panel mount, blue body with nut, automatic shut-off, 0.125 flow x 0.250 o.d. (couples with blue insert, PN 6232306, also with automatic shut-off)
13	2603058	Fan, box, 90 CFM, 24 Vdc, 4.69 square x 1.0 in. thickness, see Figure 8.2-58 for an exploded view that includes related hardware **Note:** Fan should be positioned so that its output wires are inside the panel and near the other fan (upper fan's wires are oriented towards the bottom; lower fan's wires, towards the top).
Not shown	6705231	Card, Power Module Control (behind cover), see Figure 8.2-45 for circuit card location

Figure 8.2-58 Box Fan with Related Hardware (See Table 8.2-58)

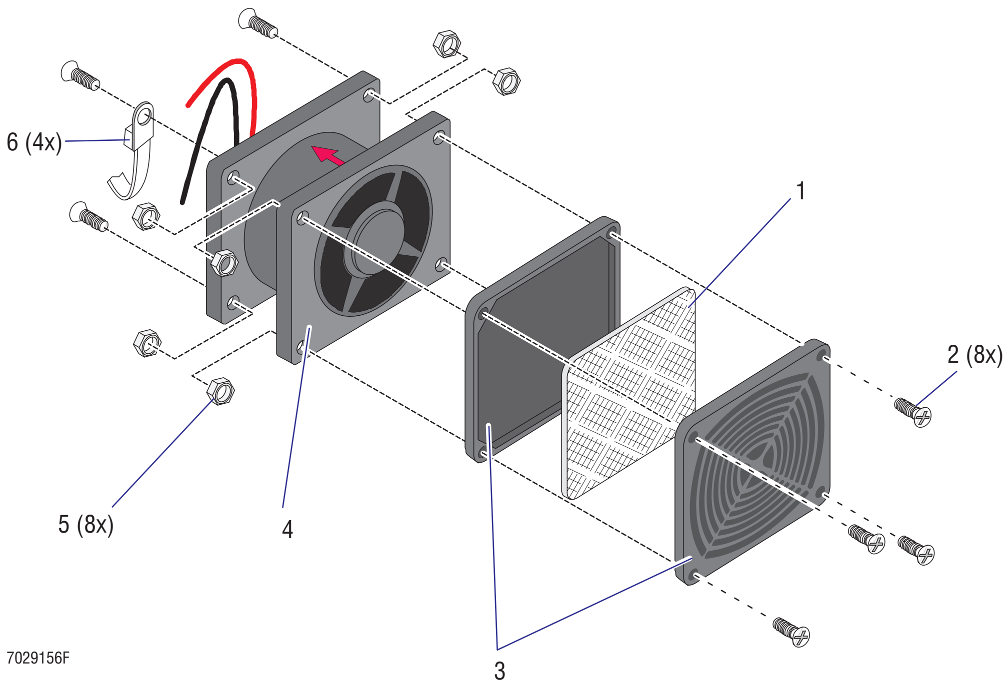


Table 8.2-58 Box Fan with Related Hardware (See Figure 8.2-58)

Item	Part Number	Description
1	2603010	Filter, air, 4-inch pad, 45 PPI
2	2806073	Screw, machine (#6-32 x 0.62 in. length, FL82 flat-head)
3	2603009	Finger guard, grille for fan air filter on 4-inch box fan **Note:** Raised ribs should face out.
4	2603058	Fan, box, 90 CFM, 24 Vdc, 4.69 square x 1.0 in. thickness **Note:** Fan should be positioned so that its output wires are inside the panel and near the other fan (upper fan’s wires are oriented towards the bottom; lower fan’s wires, towards the top).
5	2821010	Nut, self-lock (#6-32 x 0.250 AF x 0.109 in. thickness)
6	6011006	Tie wrap, screw mount, #6 sizer, 7.4 in. long, 0.19 in wide

Figure 8.2-59 Check Valves and Chokes with Related Components (See Table 8.2-59)

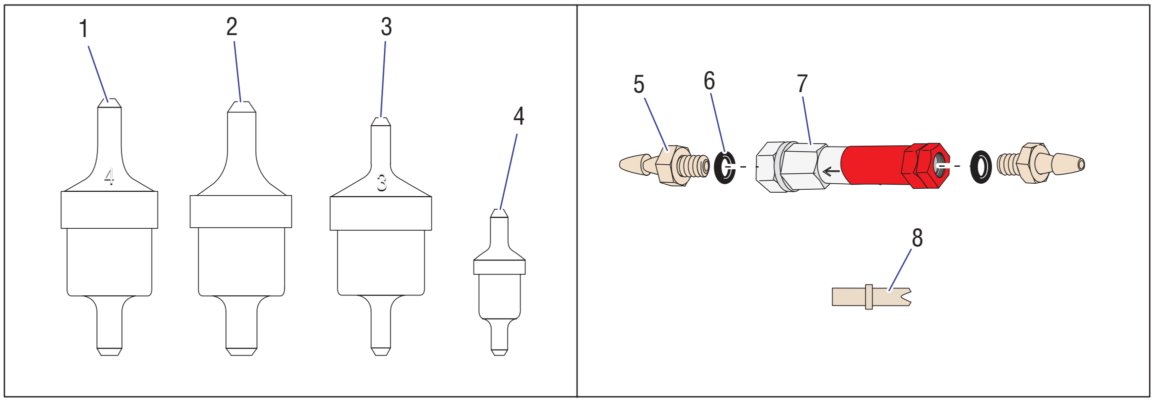


Table 8.2-59 Check Valves and Chokes with Related Components (See Figure 8.2-59)

Item	Part Number	Description
1	6214106	Valve, check, 0.156 i.d. to 0.156 i.d. tubing, designated as CV 1, 3, 6, 9, and 10 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886
2	6232605	Valve, check, 0.125 i.d. to 0.082 i.d. tubing
3	6214107	Valve, check, 0.125 i.d. to 0.125 i.d. tubing
	6232080	Valve, black-striped check, 0.125 i.d. to 0.125 i.d. tubing
4	6214108	Valve, check, for 0.062 i.d. to 0.062 i.d. tubing, designated as CV 2, 4, 5, 7, and 8 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886
5	1005693	Fitting, hose-barb union, 0.062 i.d. to 10-32 threaded
6	6216345	Gasket, #10 black, ethylene propylene
7	6213008	Choke, metal, gold, 0.004 orifice
	6213009	Choke, metal, brown, 0.006 orifice
	6213006	Choke, metal, red, 0.008 orifice, designated as CK 2 and 3 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886
	6213011	Choke, metal, black, 0.010 orifice
	6213010	Choke, metal, blue, 0.012 orifice
	6213007	Choke, metal, green, 0.016 orifice
8	6213015	Choke, plastic, brown, 0.025 orifice, designated as CK 4, 5, 6, 7, 8, 9, 10, and 11 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886
	6213012	Choke, plastic, grey, 0.016 orifice, designated as CK 12 on page 1 of the XL System Pneumatic / Hydraulic Layout, PN 6320886

Figure 8.2-60 Fittings (See Table 8.2-60)

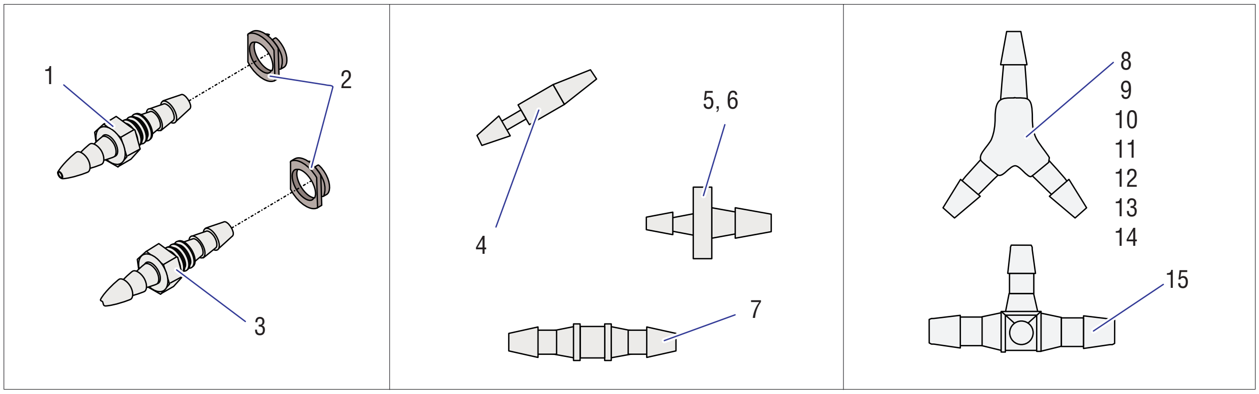
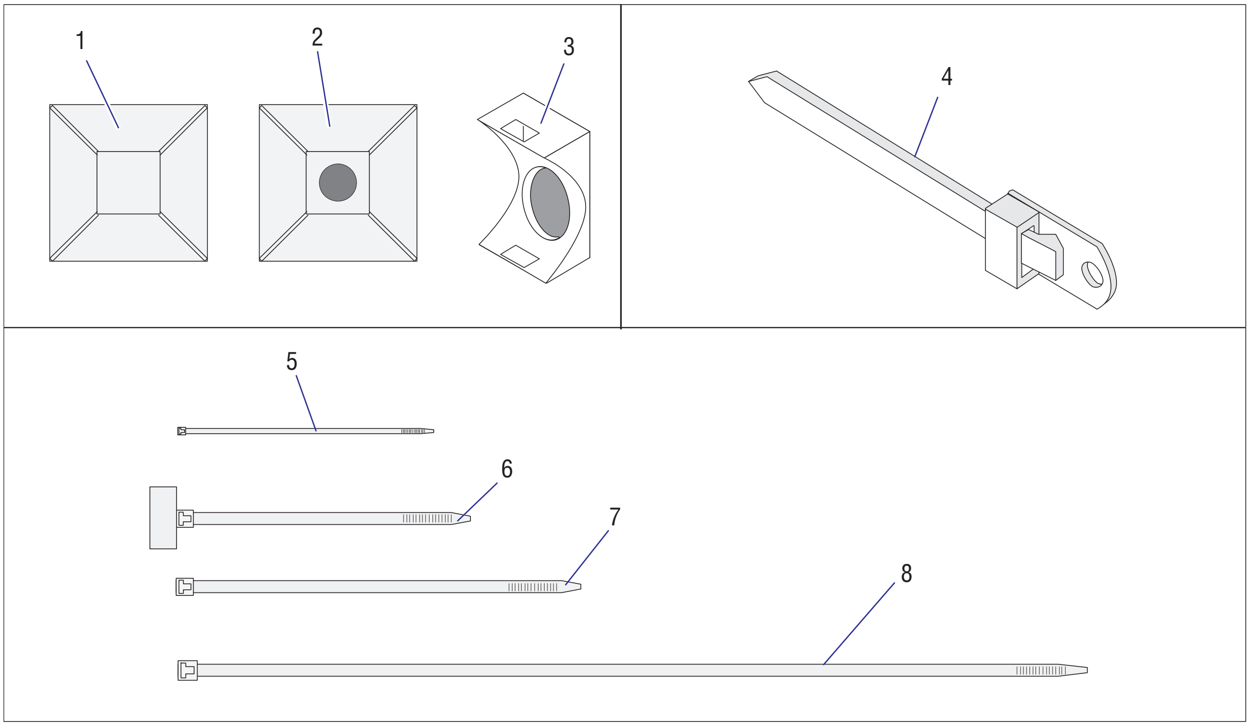


Table 8.2-60 Fittings (See Figure 8.2-60)

Item	Part Number	Description
1	1005699	Fitting, feed-thru, hose-barb union, metal, 0.093 i.d. to 0.093 i.d. with 10-32 threads
2	1016486	Fitting, feed-thru isolator, white, with 10-32 threads
3	6216353	Fitting, feed-thru, hose-barb union, 0.062 i.d. to 0.093 i.d. with 10-22 threaded
4	6232352	Fitting, hose-barb union, 0.062 i.d. to 0.093 i.d.
5	6232246	Fitting, hose-barb union, 0.093 i.d. to 0.125 i.d. tubing, clear
6	6232109	Fitting, hose-barb union, 0.062 i.d. to 0.062 i.d., clear
7	9908083	Fitting, hose-barb union, 0.093 i.d. to 0.093 i.d.
8	6216081	Fitting, Y-connector, hose-barb union, 0.125 i.d. to 0.125 i.d. to 0.125 i.d., clear
9	6232257	Fitting, Y-connector, hose-barb union, 0.125 i.d. to 0.125 i.d. to 0.125 i.d., nylon, white
10	1018245	Fitting, Y-connector, hose-barb union, 0.085 i.d. x 0.172 o.d., white
11	6232263	Fitting, Y-connector, hose-barb union, 0.050 i.d. x 0.130 o.d., blue
12	6232259	Fitting, Y-connector, hose-barb union, 0.093 i.d. to 0.093 i.d. to 0.093 i.d., clear
13	6216181	Fitting, Y-connector, hose-barb union, 0.082 i.d. to 0.082 i.d. to 0.062 i.d., clear
14	9909059	Fitting, Y-connector, hose-barb union, 0.062 i.d. to 0.062 i.d. to 0.062 i.d.
15	6232322	Fitting, T-connector, hose-barb union, 0.093 i.d. to 0.125 i.d. to 0.125 i.d., nylon, white

Figure 8.2-61 Tie Wraps and Mounting Hardware (See Table 8.2-61)



Note: For laser mounting hardware, go to the illustration for the laser.

Table 8.2-61 Tie Wraps and Mounting Hardware (See Figure 8.2-61)

Item	Part Number	Description
1	6027284	Mount, wire tie, 0.75 x 0.75, with #6 hole, adhesive back
2	6011015	Mount, wire tie, 1 x 1, with #6 hole, adhesive back
3	6011019	Mount, wire tie, 0.51 in. length x 0.33 in. width, for use with #6 screw
4	6011006	Tie wrap, screw mount, #6 sizer, 7.4 in. long, 0.19 in wide
5	6011001	Tie wrap, nylon, 4 in. long, 0.1 in. wide, nylon
6	6011017	Tie wrap with flag marker, 4.4 in. long, 0.1 in. wide, marker size 0.31 in. x 0.75 in.
7	6011002	Tie wrap, nylon, 6.7 in. long, 0.14 in. wide, nylon
8	6011003	Tie wrap, nylon, 15 in. long, 0.19 in. wide, nylon

Figure 8.2-62 Flexible Duct Components and Assembly Instructions (See Table 8.2-62)

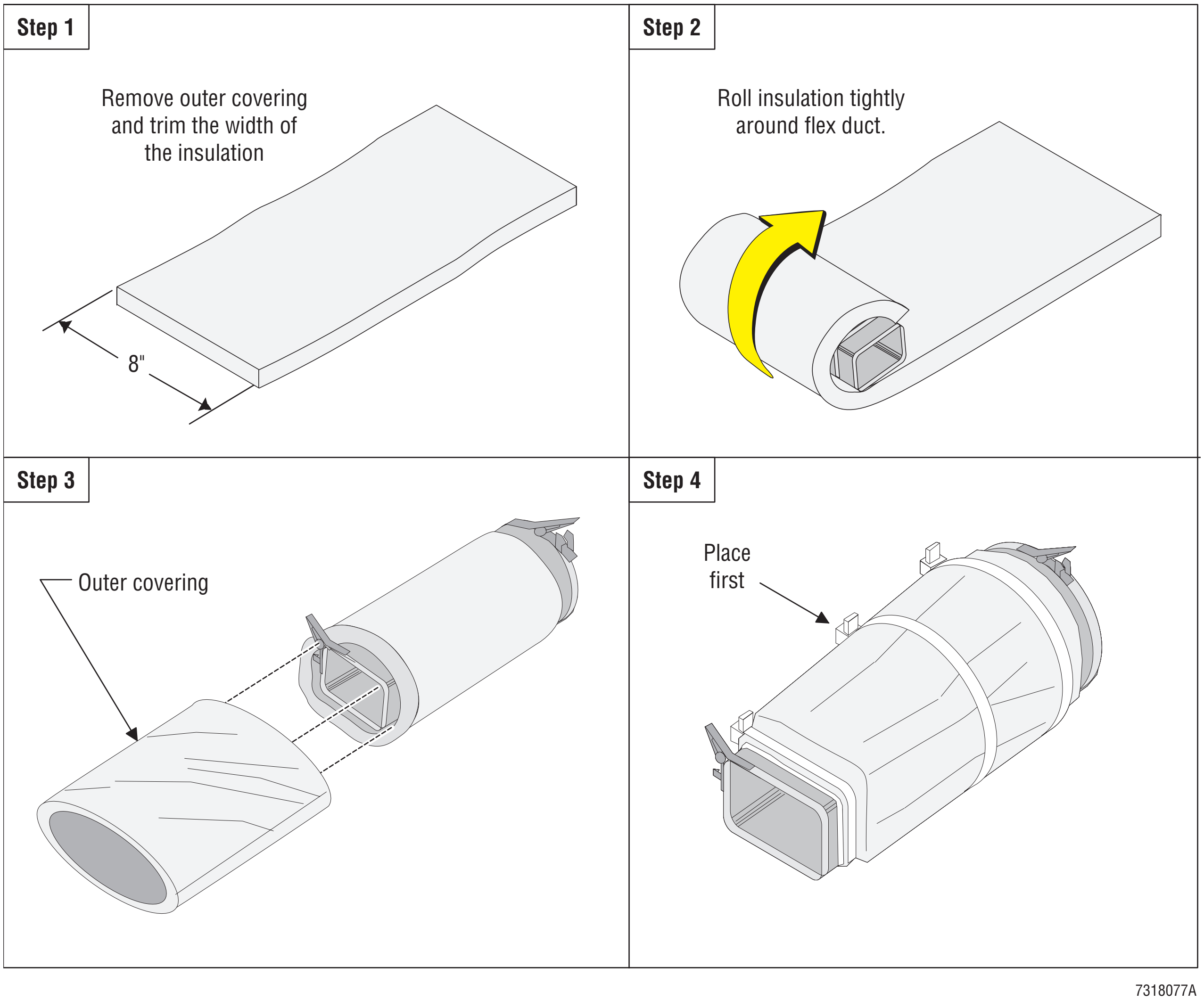


Table 8.2-62 Flexible Duct Components and Assembly Instructions (See Figure 8.2-62)

Item	Part Number	Description
1	1018547	Insulation
2	2603060	Duct, flexible, 3 1/8 i.d. x 10-in. length, rectangular flange at one end
3	6011003	Tie wrap, nylon, 15-in. long, 0.19 in. wide, nylon

ILLUSTRATIONS

TABLES

A.1 TOLERANCES AND LIMITS

MCL CPU Card

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.

Table A.1-1 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)

Table A.1-2 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

Table A.1-3 XL-MCL Flow Cytometer - Acceptable Voltage Ranges

Voltage	Connector	Pins
+5 Vdc	P66	1
+15 Vdc	P65	11, 12, 13
-15 Vdc	P65	2, 3, 4
+24 Vdc	P66	9, 10

A.2 CIRCUIT CARD LAYOUTS WITH KEY COMPONENTS

This appendix contains key component and test point locations as well as applicable jumper and switch settings for the following circuit cards:

Card Name	Figure Reference
Amp / Signal Conditioner Card	Figure A.2-1
Analyzer Backplane - Front View	Figure A.2-2
Analyzer Backplane - Rear View	Figure A.2-3
Bar-Code Decoder Card	Figure A.2-4
CYT12 Receiver EMC Card	Figure A.2-5
Cyto Transputer Card	Figure A.2-6
Fiber Optic Interface Card	Figure A.2-7
Front Panel LED and Switch Input Card (XL only)	Figure A.2-8
Front Panel LED and Switch Input 2 Card (XL-MCL only)	Figure A.2-9
MCL CPU Card	Figure A.2-10
MCL Interface Card	Figure A.2-11
Opto Transprocessor EXMEM Card (Non-EMC Version)	Figure A.2-12
Opto Transprocessor EXMEM II Card (EMC Version)	Figure A.2-13
Power Module Control Card (Non-EMC Version)	Figure A.2-15
Power Module Control II Card (EMC Version)	Figure A.2-16
PMT Distribution and Laser Fan Control Card	Figure A.2-14
Sensor Card	Figure A.2-17
Solenoid Power Distribution Card	Figure A.2-18
System Interface Card	Figure A.2-19
Top Panel Display 2 Card	Figure A.2-20
Trans Data Acquisition Card	Figure A.2-21
Voltage Selector Card	Figure A.2-22
Voltage Supply Monitor Card	Figure A.2-23

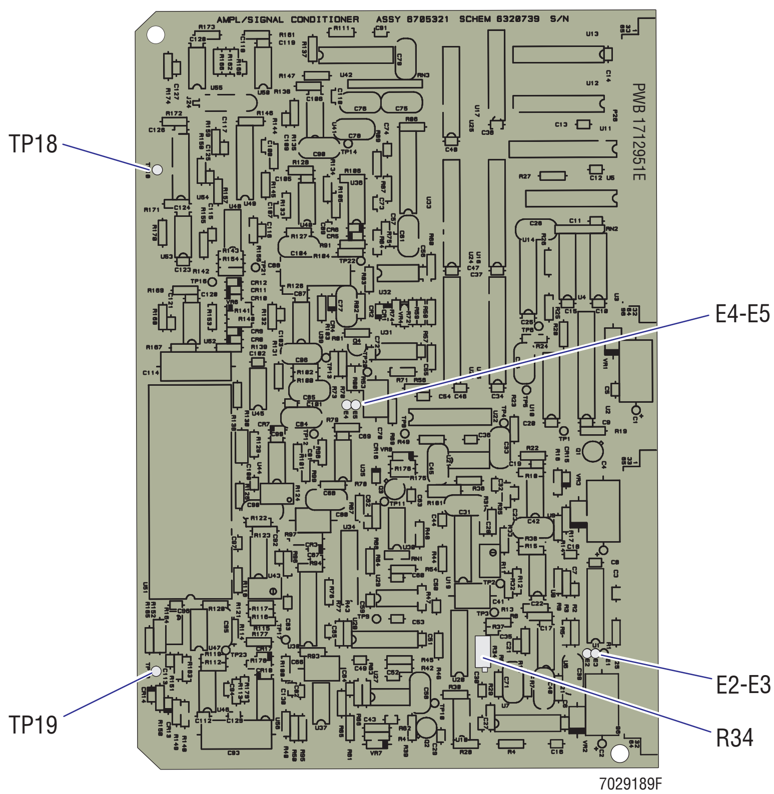
Amp / Signal Conditioner Card

Circuit Card Locations in the Cytometer

On a four-color system, Amp / Signal Conditioner cards occupy seven slots in the Data Acquisition card cage. Only six slots are used if it is a three-color system. This circuit card is used in the slots labeled (left to right) SS, FS, AUX, PMT4 (missing in a three-color system), PMT3, PMT2, and PMT1. To locate these Amp/Signal Conditioner cards, see Figure A.5-3.

Component Locations

Figure A.2-1 Amp / Signal Conditioner Card - Component Locations



Jumpers

E2 to E3 and E4 to E5

Switches

N/A

Analyzer Backplane - Front View

Backplane Location in the Cytometer

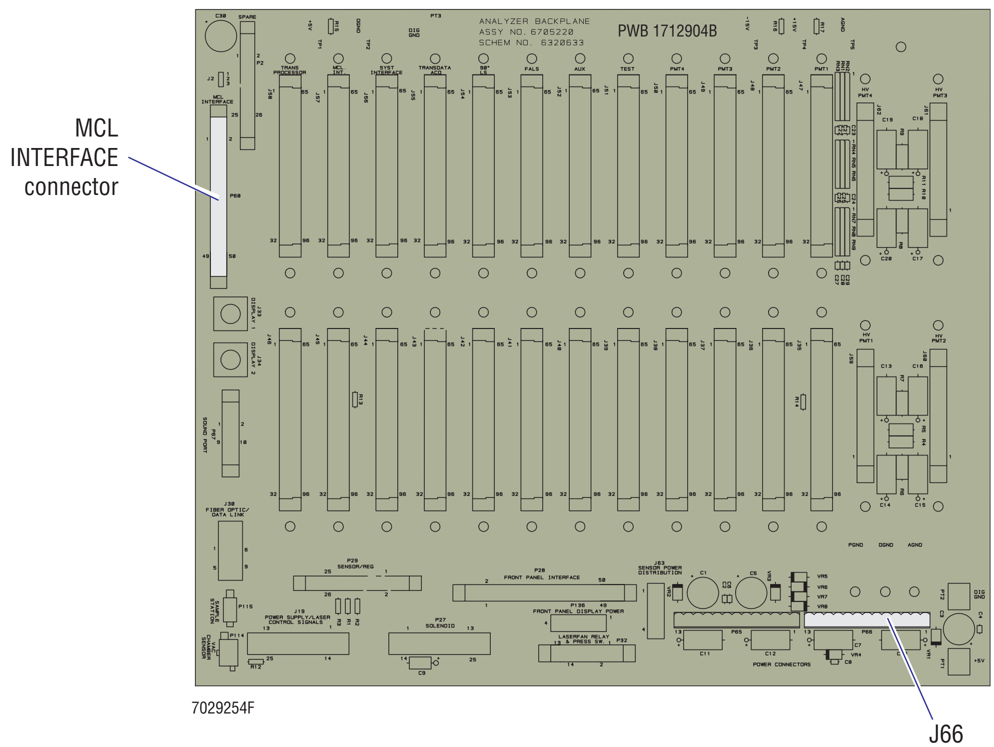
The Analyzer backplane is attached to the rear of the Data Acquisition card cage. Most of this backplane is behind the Data Acquisition card cage so that only those components on the lower portion of this backplane are easily accessible.

To easily access the lower portion of the Analyzer backplane, remove the Cytometer front door and lock the Data Acquisition card cage in its upright position outside the Cytometer.

Components near the lower edge of the backplane (such as J66) may be accessed while the Data Acquisition card cage is inside the Cytometer by simply lifting the front door and unlatching the display panel.

Component Locations

Figure A.2-2 Analyzer Backplane, Front View - Component Locations



Jumpers

N/A

Switches

N/A

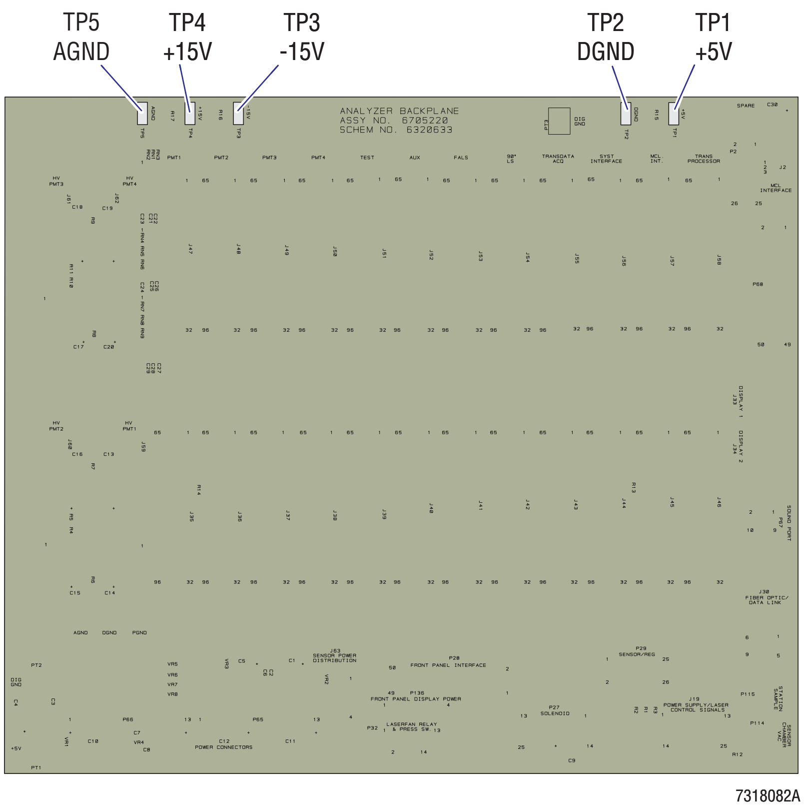
Analyzer Backplane - Rear View

Backplane Location in the Cytometer

The Analyzer backplane is attached to the rear of the Data Acquisition card cage. To access the rear of the Analyzer backplane, remove the Cytometer front door and lock the Data Acquisition card cage in its upright position outside the Cytometer.

Component Locations

Figure A.2-3 Analyzer Backplane, Rear View - Component Locations



Jumpers

N/A

Switches

N/A

Bar-Code Decoder Card

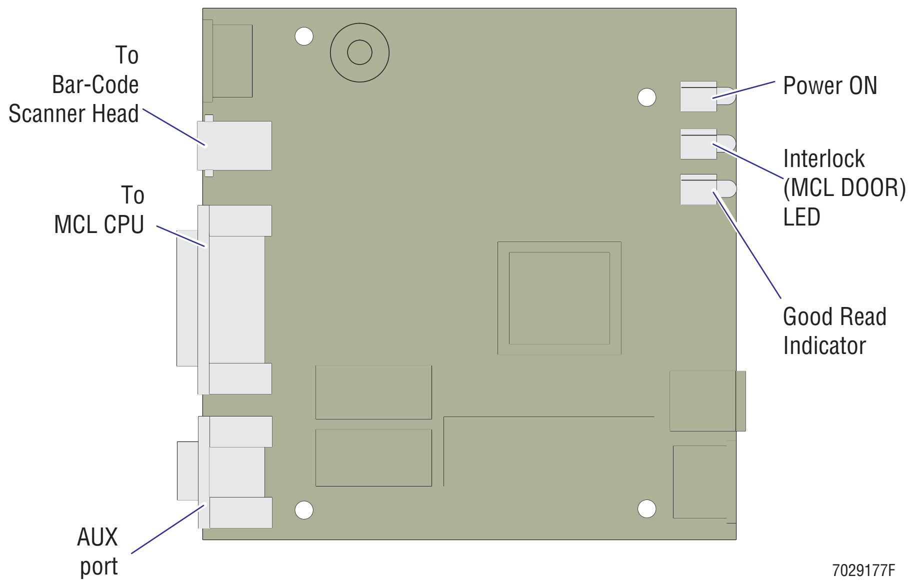
ATTENTION: This card is present only when the MCL option is installed.

Circuit Card Location in the Cytometer

The Bar-Code Decoder card is the smaller of the two circuit cards attached to the MCL main frame on the left-side of the Cytometer. This circuit card is present only when the MCL option is installed. To locate the Bar-Code Decoder card, see Figure A.5-14.

Component Locations

Figure A.2-4 Bar-Code Decoder Card - Component Locations



Jumpers

N/A

Switches

N/A

CYT12 Receiver EMC Card

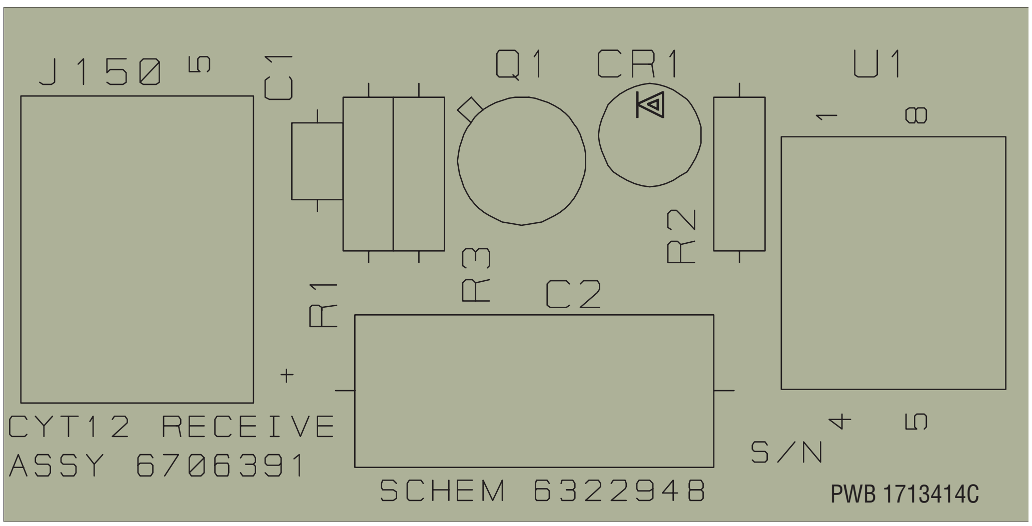
ATTENTION: This circuit card is only used in XL and XL-MCL instruments with the serial number Z09063 or higher. XL and XL-MCL instruments with the serial number Z09062 or lower do not use this circuit card.

Circuit Card Location in the Power Supply Module

The CYT12 Receiver EMC card is attached to the CYT12 connector on the rear of the Power Supply module. The circuit card is inside the Power Supply module. To locate the CYT12 connector, see Figure A.6-5.

Component Locations

Figure A.2-5 CYT12 Receiver EMC Card - Component Locations



7029194F

Jumpers

N/A

Switches

N/A

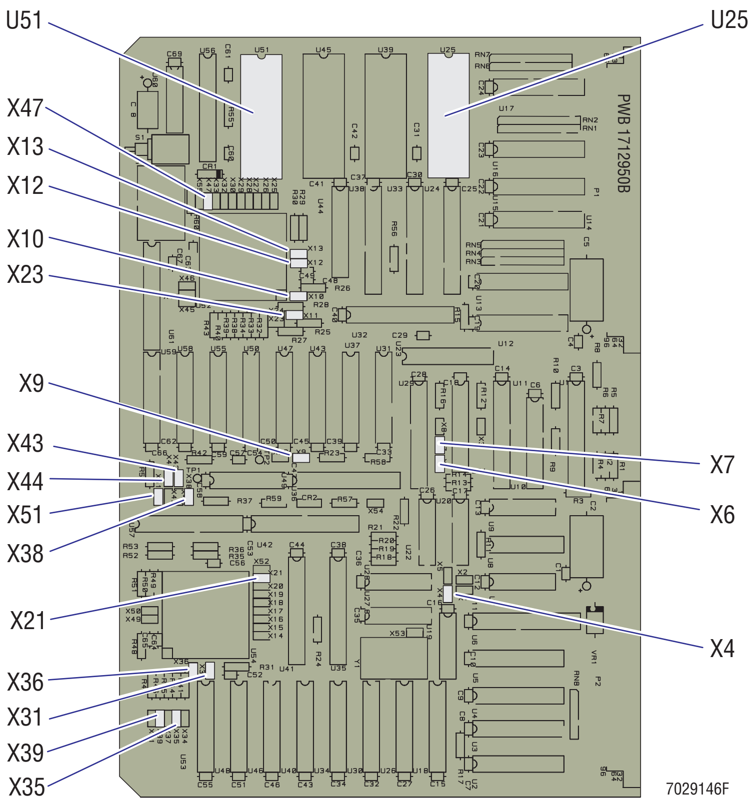
Cyto Transputer Card

Circuit Card Location in the Cytometer

The Cyto (Cytometer) Transputer card occupies the slot labeled CYTO TRANS PROC in the Data Acquisition card cage. To locate the Cyto Transputer card, see Figure A.5-3.

Component Locations

Figure A.2-6 Cyto Transputer Card - Component Locations



Jumpers

X4, X6, X7, X9,

X10, X12, X13,

X21, X23,

X31, X35, X36, X38, X39,

X43, X44, X47,

X51

Switches

N/A

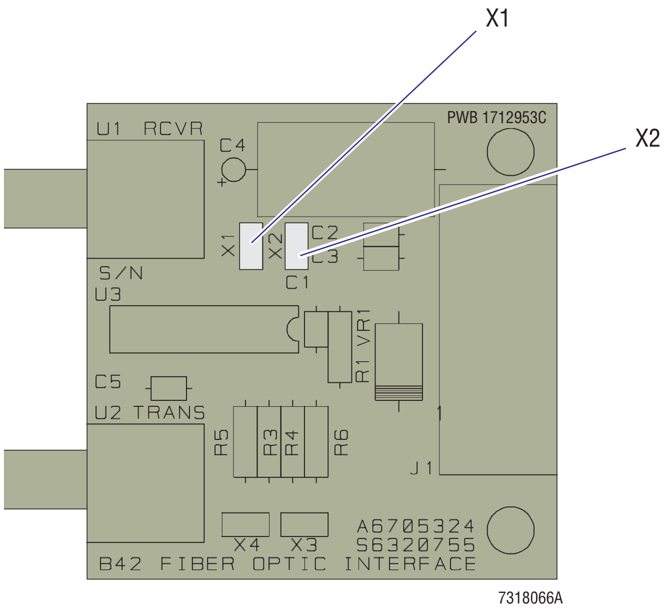
Fiber Optic Interface Card

Circuit Card Location in the Cytometer

The Fiber Optic Interface card is attached to the lower rear panel inside the Cytometer. To locate the Fiber Optic Interface card, see Figure A.5-9.

Component Locations

Figure A.2-7 Fiber Optic Interface Card - Component Locations



Jumpers

X1 and X2

Switches

N/A

Front Panel LED and Switch Input Card

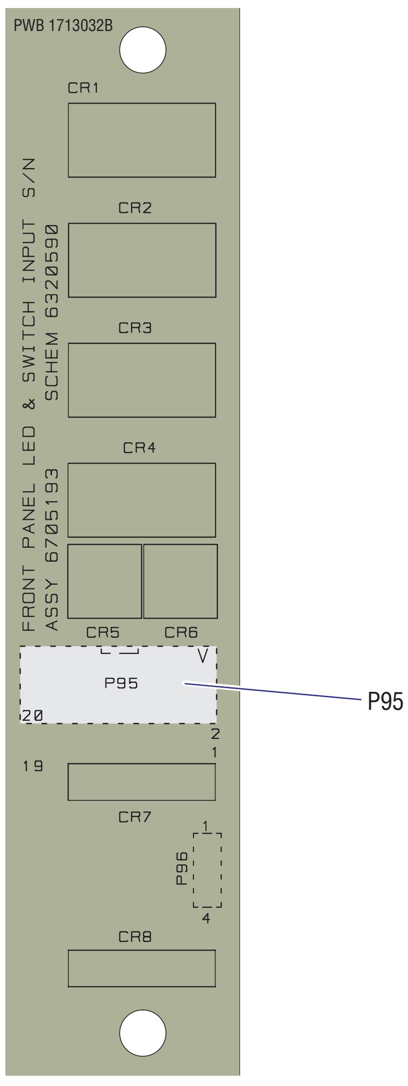
ATTENTION: This card is present only when the MCL option is **not** installed.

Circuit Card Location in the Cytometer

The Front Panel LED and Switch Input card accepts data entry information when the overlay membrane at the manual sample station on an XL flow cytometer is pressed. To locate the Front Panel LED and Switch Input card, see Figure A.5-11.

Component Locations

Figure A.2-8 Front Panel LED and Switch Input Card - Component Locations



Jumpers

N/A

Switches

N/A

Front Panel LED and Switch Input 2 Card

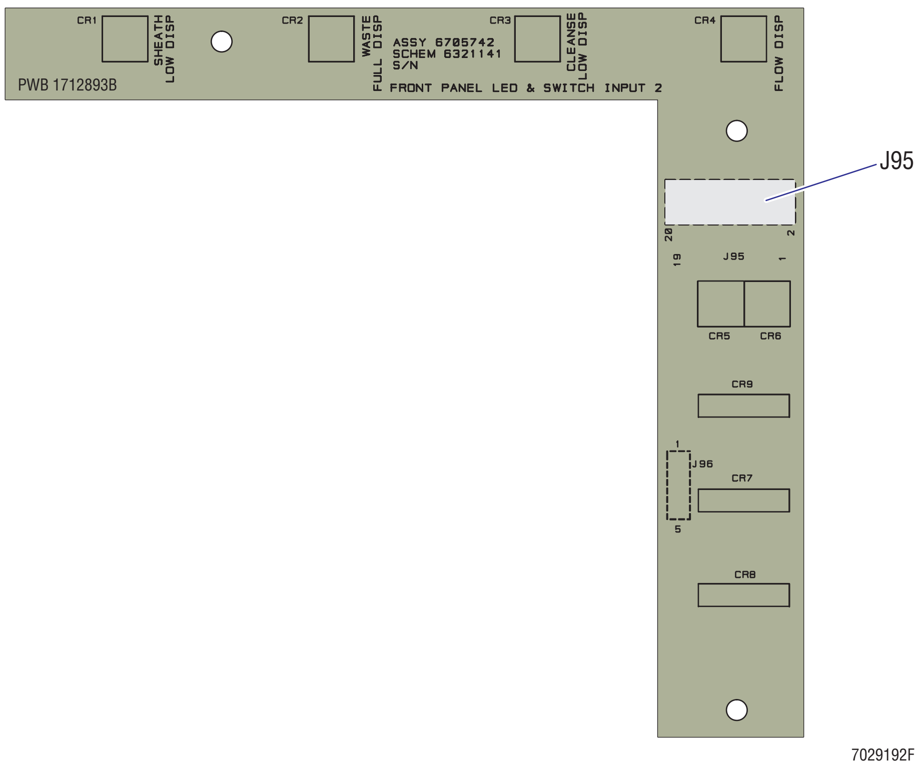
ATTENTION: This card is present only when the MCL option is installed.

Circuit Card Location in the Cytometer

The Front Panel LED and Switch Input 2 card accepts data entry information when the overlay membrane at the manual sample station on an XL-MCL flow cytometer is pressed. To locate the Front Panel LED and Switch Input 2 card, see Figure A.5-10.

Component Locations

Figure A.2-9 Front Panel LED and Switch Input 2 Card - Component Locations



Jumpers

N/A

Switches

N/A

MCL CPU Card

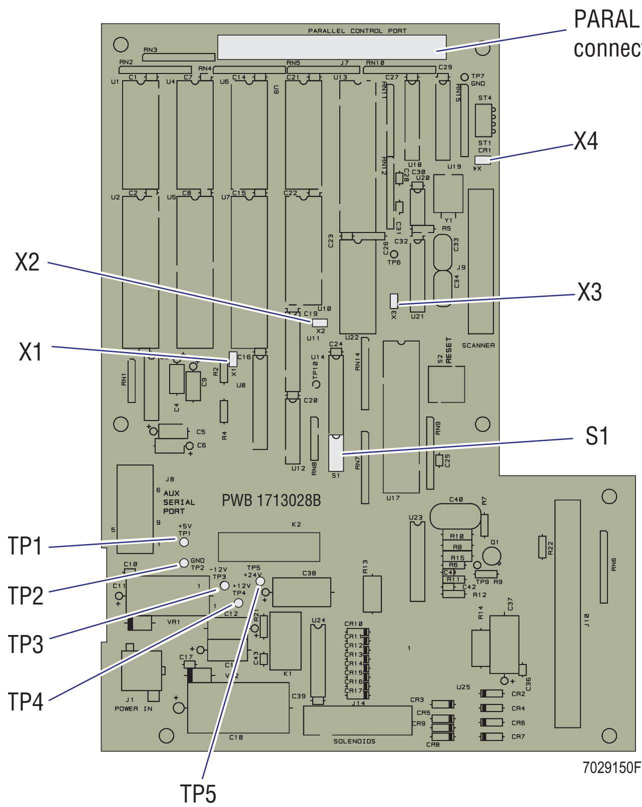
ATTENTION: This card is present only when the MCL option is installed.

Circuit Card Location in the Cytometer

The MCL CPU card is the larger of the two circuit cards attached to the MCL main frame on the left-side of the Cytometer. This circuit card is present only when the MCL option is installed. To locate the MCL CPU card, see Figure A.5-14.

Component Locations

Figure A.2-10 MCL CPU Card - Component Locations



Jumpers

X1, X2, X3, X4

Switches

S1 requires the following settings:

Position 1 = ON

Position 2 = ON

Position 3 = ON

Position 4 = OFF

MCL Interface Card

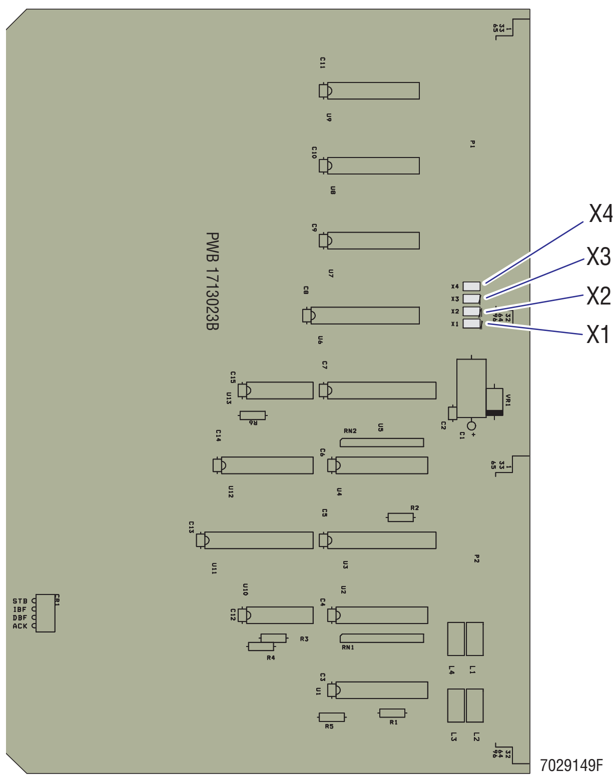
ATTENTION: This card is present only when the MCL option is installed.

Circuit Card Location in the Cytometer

The MCL Interface card occupies the slot labeled MCL INFC in the Data Acquisition card cage. This circuit card is present only when the MCL option is installed. To locate the MCL Interface card, see Figure A.5-3.

Component Locations

Figure A.2-11 MCL Interface Card - Component Locations



Jumpers

X1, X2, X3, X4

Switches

N/A

Opto Transprocessor EXMEM Card (Non-EMC Version)

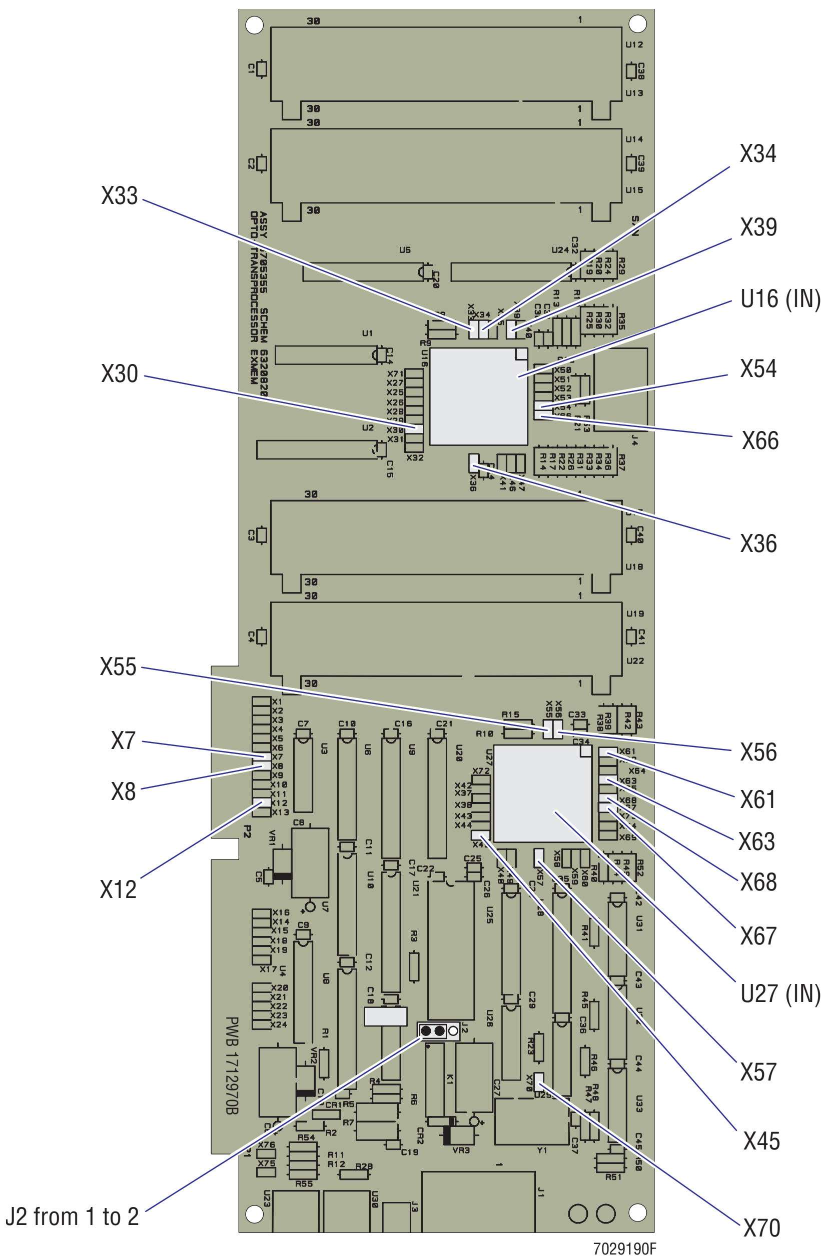
Note: Opto Transprocessor EXMEM is short for Optical Transprocessor Extended Memory card. This circuit card is used in all XL and XL-MCL instruments serial number Z09062 and below.

Circuit Card Location in the Workstation

The Opto Transprocessor EXMEM card is located in the Workstation computer. In the FlowCentre II tower computer, this circuit card is located in the bottom slot. In the original FlowCentre desktop computer, this circuit card is located in far left slot.

Component Locations

Figure A.2-12 Opto Transprocessor EXMEM Card (Non-EMC Version) - Component Locations



Jumpers

Uses 2 Transputers (U16 and U27)

X7, X8,

X12,

X30, X33, X34, X36, X39,

X45,

X54, X55, X56, X57,

X61, X63, X66, X67, X68,

X70,

J2 from 1 to 2

Switches

N/A

Opto Transprocessor EXMEM II Card (EMC Version)

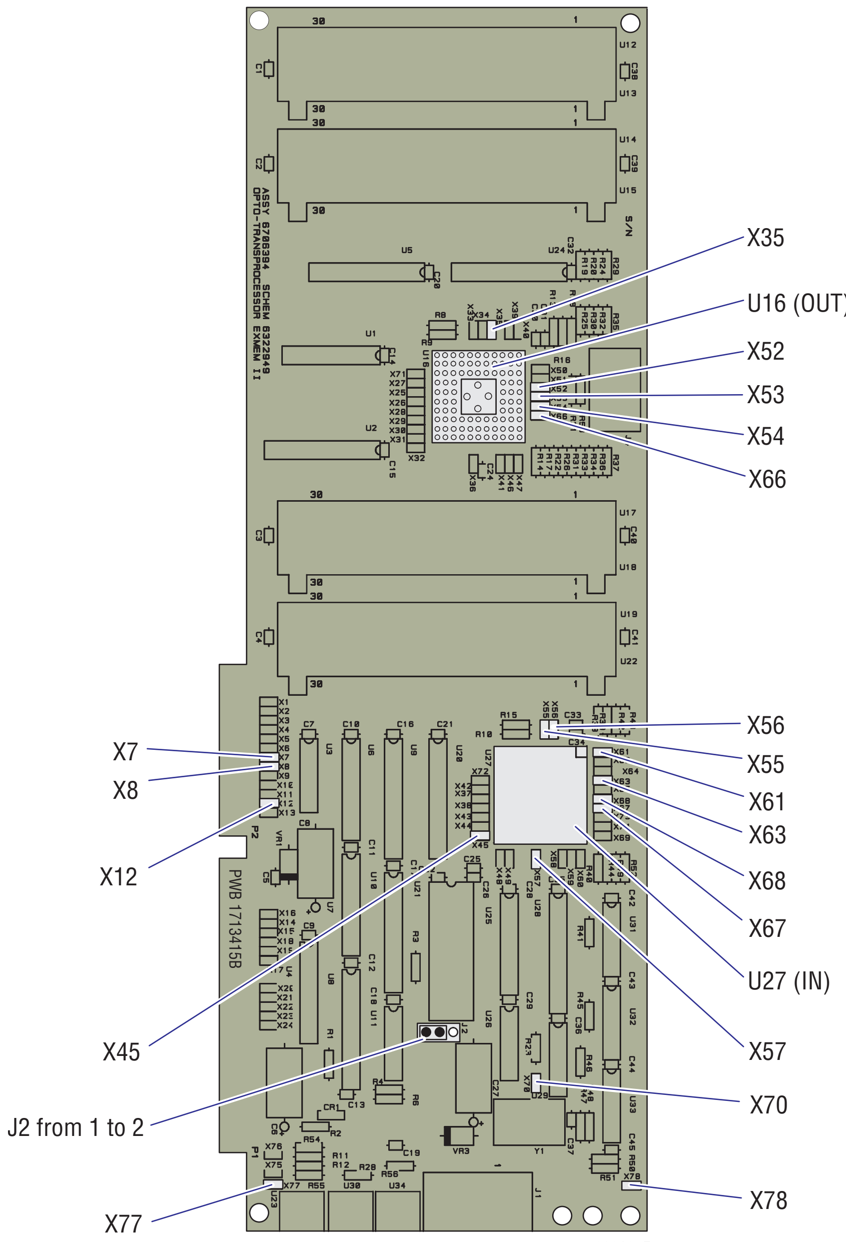
Note: Opto Transprocessor EXMEM II is short for Optical Transprocessor Extended Memory II card. This circuit card is used in all XL and XL-MCL instruments serial number Z09063 and above.

Circuit Card Location in the Workstation

The Opto Transprocessor EXMEM II card is located in the Workstation computer. In the FlowCentre II tower computer, this circuit card is located in the bottom slot. In the original FlowCentre desktop computer, this circuit card is located in far left slot.

Component Locations

Figure A.2-13 Opto Transprocessor EXMEM II Card (EMC Version) - Component Locations



Jumpers

Uses Only 1 Transputer (U27)

X7, X8,
X12,
X35,
X45,
X52, X53, X55, X57,
X61, X63, X66, X67, X68,
X70, X77, X78,
J2 from 1 to 2

Switches

N/A

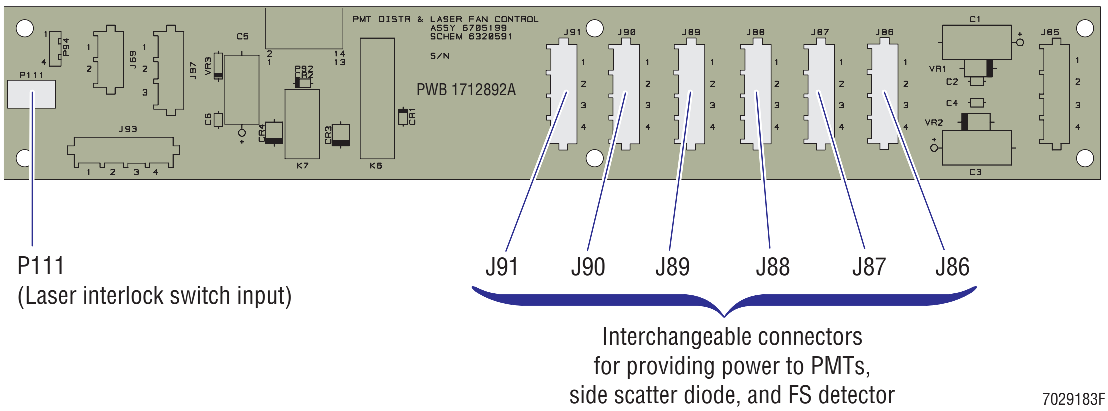
PMT Distribution and Laser Fan Control Card

Circuit Card Location in the Cytometer

The PMT Distribution and Laser Fan Control card is attached to the optical bench inside the Cytometer. To locate the PMT Distribution and Laser Fan Control card, see Figure A.5-4.

Component Locations

Figure A.2-14 PMT Distribution and Laser Fan Control Card - Component Locations



Jumpers

N/A

Switches

N/A

Power Module Control Card (Non-EMC Version)

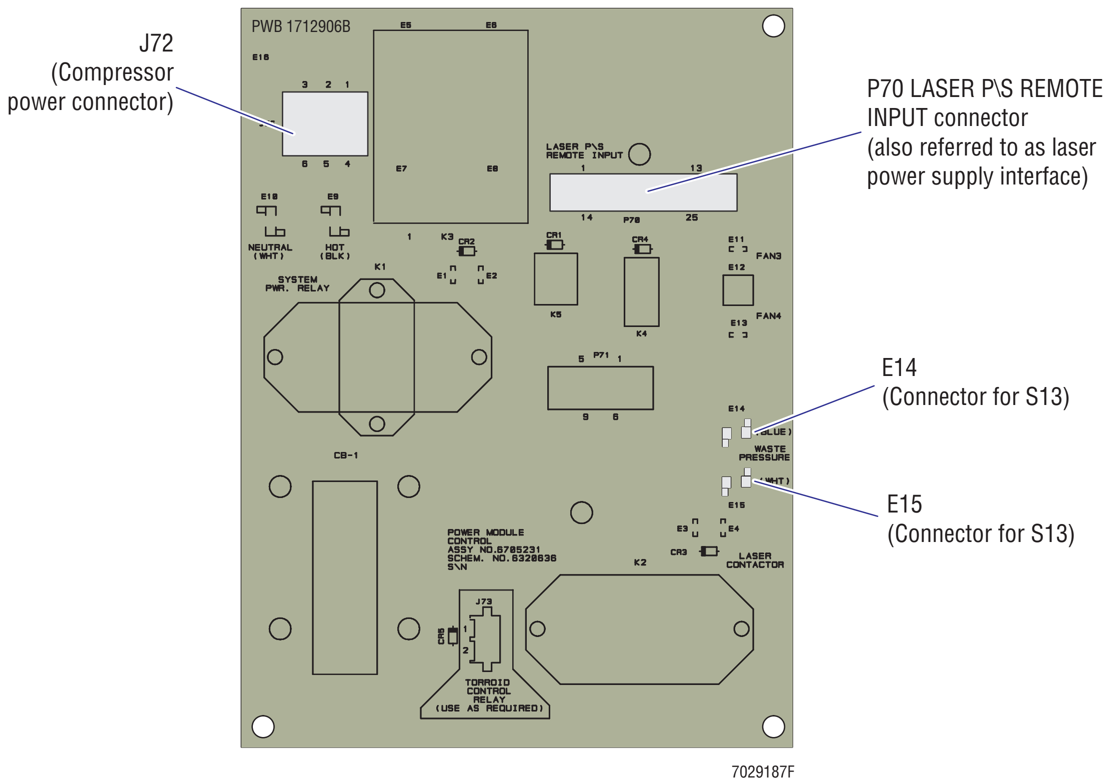
Note: The Power Module Control card is used in XL and XL-MCL instruments with a serial number Z09062 or lower.

Circuit Card Location in the Power Supply Module

The Power Module Control card is inside the Power Supply module. When the three-sided cover is removed from the Power Supply module, the Power Module Control card can be accessed from the left side. The circuit card is attached to the inside rear cover. To locate the Power Control Module card, see Figure A.6-3.

Component Locations

Figure A.2-15 Power Module Control Card (Non-EMC Version) - Component Locations



Jumpers

N/A

Switches

N/A

Power Module Control II Card (EMC Version)

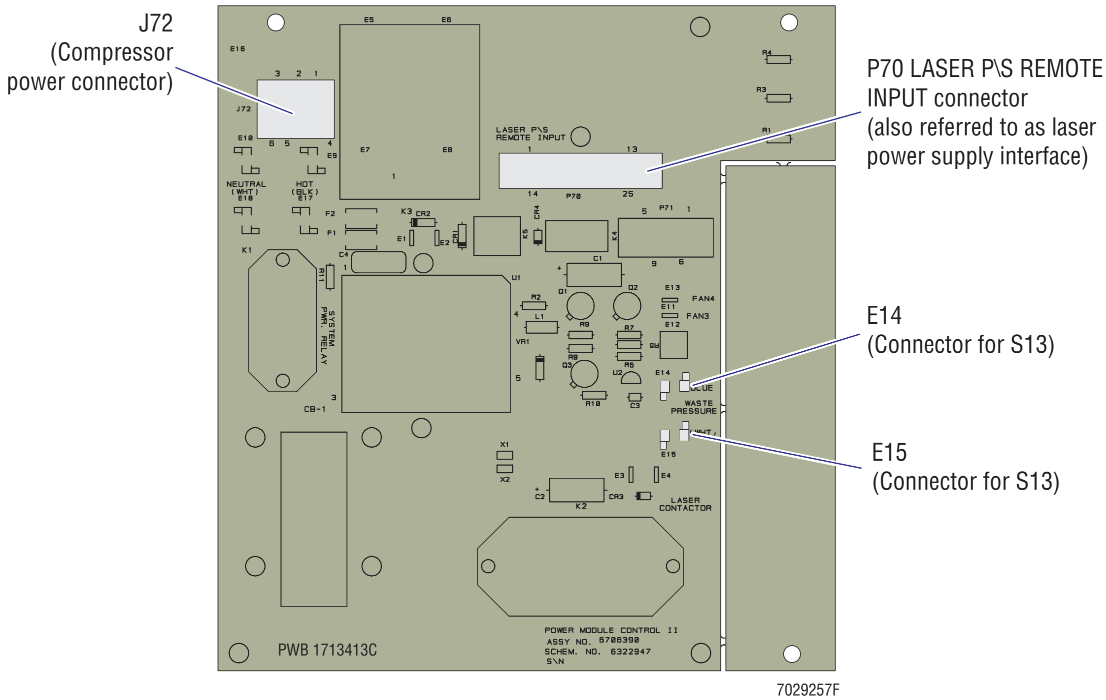
Note: The Power Module Control II card is used in XL and XL-MCL instruments with a serial number Z09063 or higher.

Circuit Card Location in the Power Supply Module

The Power Module Control II card is inside the Power Supply module. When the three-sided cover is removed from the Power Supply module, the Power Module Control II card can be accessed from the left side. The circuit card is attached to the inside rear cover. To locate the Power Control Module II card, see Figure A.6-3.

Component Locations

Figure A.2-16 Power Module Control II Card (EMC Version) - Component Locations



Jumpers

N/A

Switches

N/A

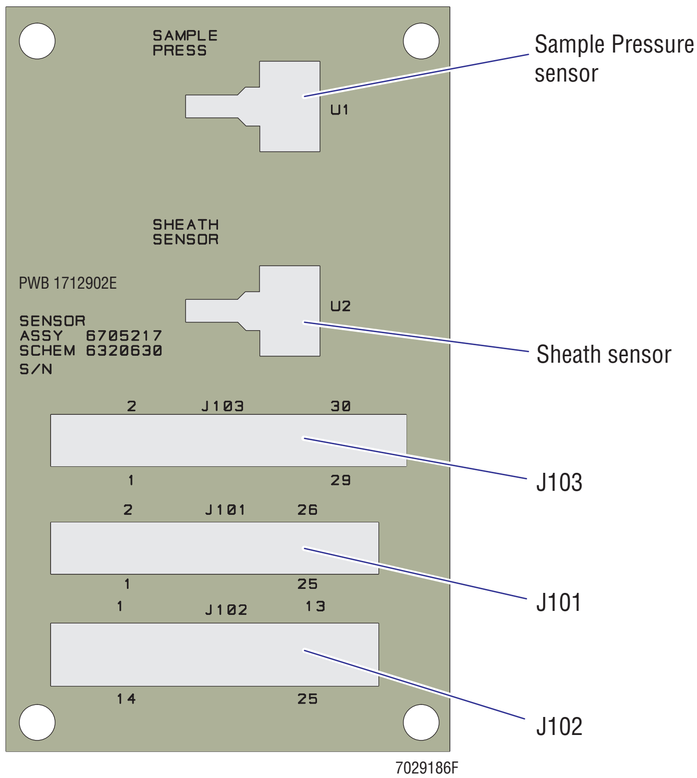
Sensor Card

Circuit Card Location in the Cytometer

The Sensor card is located inside the upper pneumatics drawer. To locate the Sensor card, see Figure A.5-5.

Component Locations

Figure A.2-17 Sensor Card - Component Locations



Jumpers

N/A

Switches

N/A

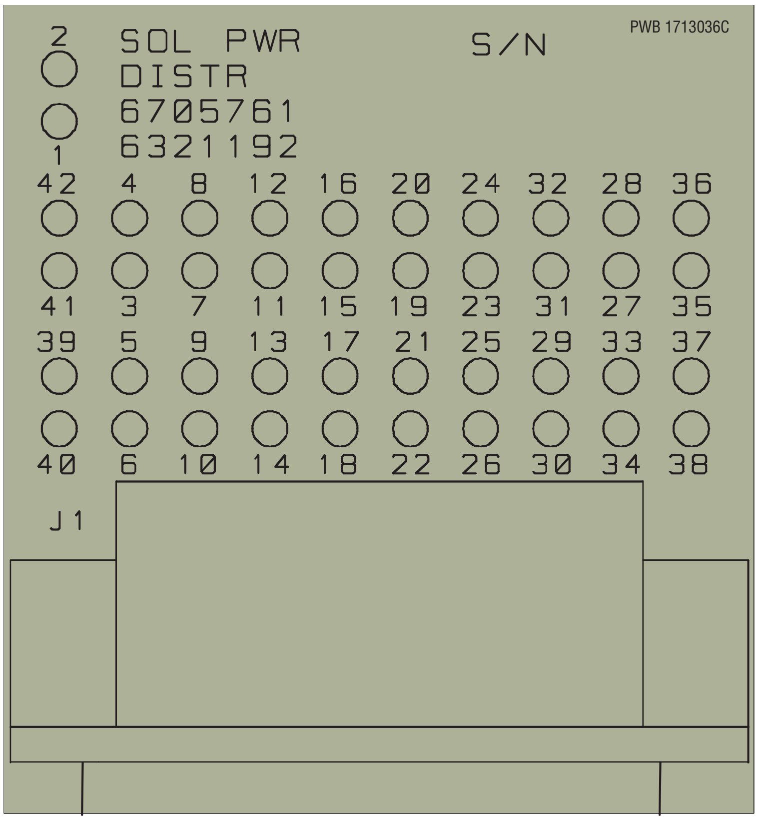
Solenoid Power Distribution Card

Circuit Card Location in the Cytometer

The Solenoid Power Distribution card is located inside the lower pneumatics drawer. To locate the Solenoid Power Distribution card, see Figure A.5-15.

Component Locations

Figure A.2-18 Solenoid Power Distribution Card - Component Locations



7029193F

Jumpers

N/A

Switches

N/A

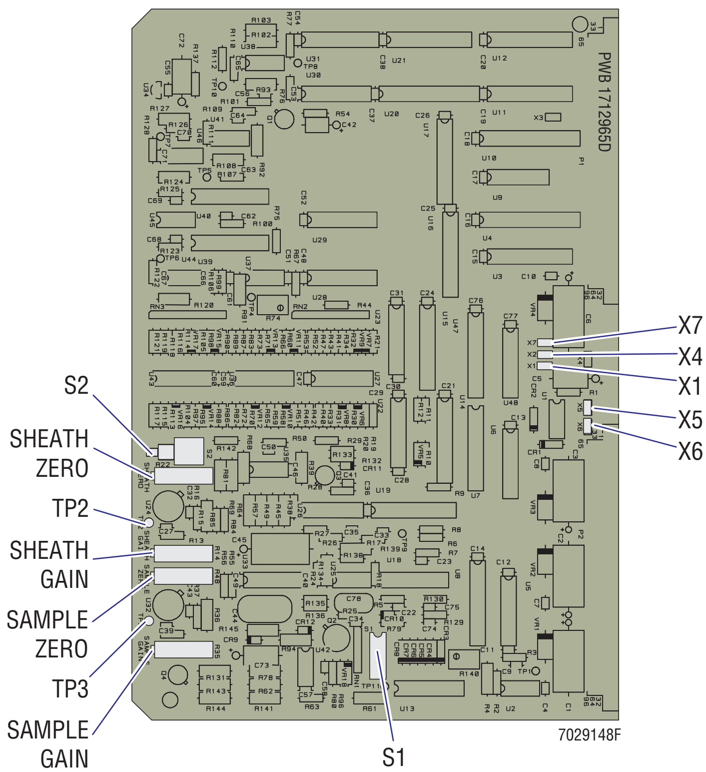
System Interface Card

Circuit Card Location in the Cytometer

The System Interface card occupies the slot labeled SYS INFC in the Data Acquisition card cage. To locate the System Interface card, see Figure A.5-3.

Component Locations

Figure A.2-19 System Interface Card - Component Locations



Jumpers

X1, X4, X5, X6, X7

Switches

S1 requires the following settings:

Position 1 = OFF

Position 2 = OFF

Position 3 = OFF

Position 4 = OFF

Position 5 = ON

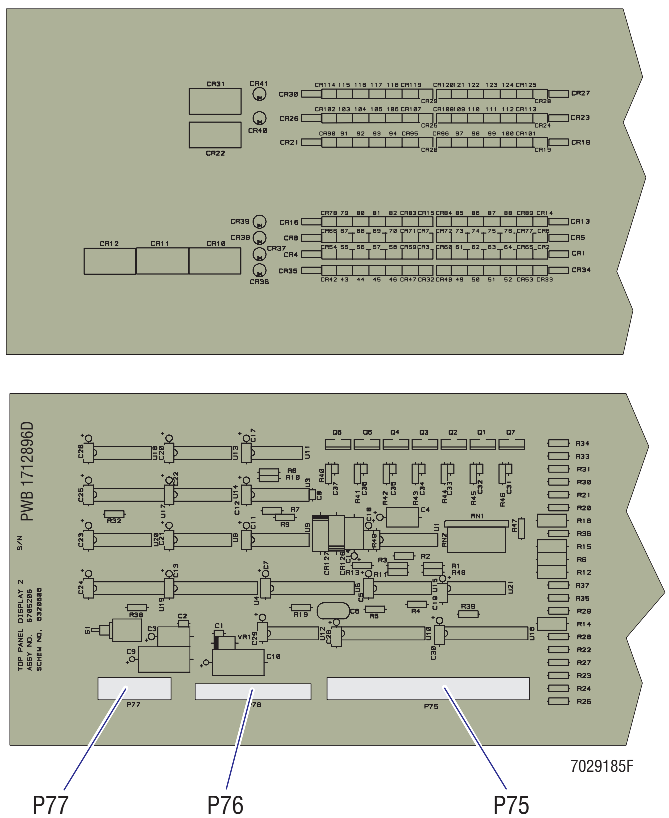
Top Panel Display 2 Card

Circuit Card Location in the Cytometer

The Top Panel Display 2 card is attached to the back of the front display panel. To access this circuit card the front display panel must be lifted. To locate the Top Panel Display 2 card, see Figure A.5-16.

Component Locations

Figure A.2-20 Top Panel Display 2 Card - Component Locations



Jumpers

N/A

Switches

N/A

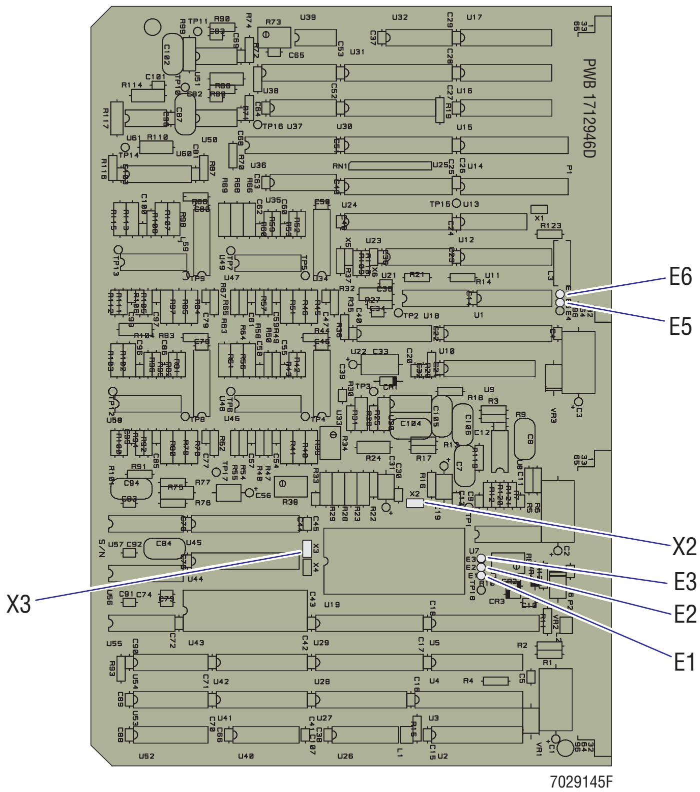
Trans Data Acquisition Card

Circuit Card Location in the Cytometer

The Trans Data Acquisition card occupies the slot labeled DATA AQC in the Data Acquisition card cage. To locate the Trans Data Acquisition card, see Figure A.5-3.

Component Locations

Figure A.2-21 Trans Data Acquisition Card - Component Locations



Jumpers

E1to E2, X2, X3, E5 to E6

Switches

N/A

Voltage Selector Card

Circuit Card Location in the Power Supply Module

The Voltage Selector card is inside the Power Supply module. When the three-sided cover is removed from the Power Supply module, the Voltage Selector card can be accessed in the upper compartment. To locate the Voltage Selector card, see Figure A.6-3.

The Voltage Selector card selects the proper line voltage for the circuit breaker dedicated to that voltage. The Voltage Selector card selects the proper line voltage for six circuit breakers:

- 24 VOLTS circuit breaker
- COMPRESSOR circuit breaker
- MCL 24 VOLTS circuit breaker
- 5 VOLTS circuit breaker
- 15 VOLTS circuit breaker
- MCL 5 VOLTS circuit breaker

For the location of these circuit breakers, see Figure A.6-5. For more information concerning the selected voltages, see Table A.6-5.

The Voltage Selector card is supply voltage specific. To meet the power requirements for various countries, four versions of this circuit card are available:

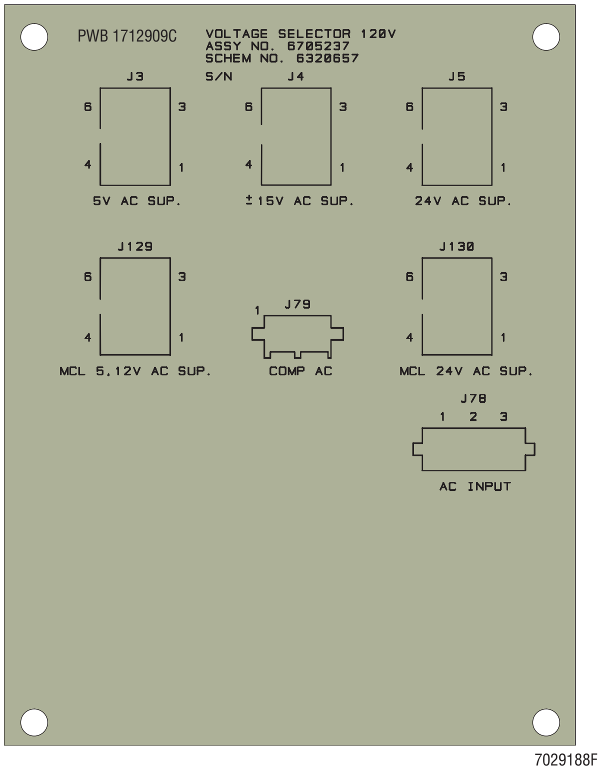
- Voltage Selector card for a 100 Vac system
- Voltage Selector card for a 120 Vac system
- Voltage Selector card for a 220 Vac system
- Voltage Selector card for a 230/240 Vac system

Each circuit card has a unique part number that can be located under Chapter 8, PARTS LISTS.

Since the layout of these circuit cards is similar, only the Voltage Selector card for the 120 Vac system is illustrated. Applicable jumper and switch information is supplied for all versions.

Component Locations

Figure A.2-22 Voltage Selector Card for 120 Vac System - Component Locations



Jumpers

N/A

Switches

N/A

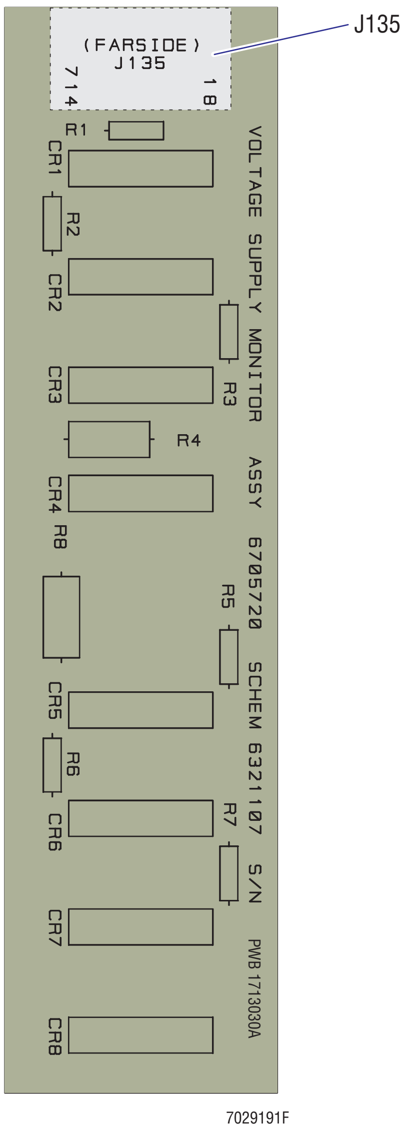
Voltage Supply Monitor Card

Circuit Card Location in the Power Supply Module

The Voltage Supply Monitor card is inside the Power Supply module. When the three-sided cover is removed from the Power Supply module, the Voltage Supply Monitor card can be accessed from the right side. To locate the Voltage Supply Monitor display, see Figure A.6-2. The circuit card is attached to the inside front panel.

Component Locations

Figure A.2-23 Voltage Supply Monitor Card - Component Locations



Jumpers

N/A

Switches

N/A

A.3 PROTOCOL PARAMETERS

CHANNEL 500 Protocol

Table A.3-1 CHANNEL 500 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:	SAMPLE DELIVERY	LOW
	COMPENSATION	All signals = 0%
	DISCRIMINATOR	FS = 100
	STOP	On Histogram 1 for 10,000 events

Switch Point 1 Test

Table A.3-2 LIN/LOG SWITCH POINT 1 TEST Protocol

Histogram	Parameter	Signals	Gain	Gating	Analysis Region
1	Dual	FS vs. SS	N/A	RECT 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

Acquiring Fluorospheres

Table A.3-3 Protocol to Acquire Fluorospheres

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	LOW
	COMPENSATION	All signals = 0%
	DISCRIMINATOR	FS = 100
	Stop	On Histogram 2 for 5,000 events
	Autoprint	ON

A.4 PREFINAL SERVICE SOFTWARE

Table A.4-1 provides a quick reference of available tests that may be accessed when the Prefinal Service software is installed and operated using the guidelines provided under Heading 4.2, PREFINAL SERVICE SOFTWARE INSTALLATION AND OPERATION. The Prefinal tests in Table A.4-1 are listed in alphabetical order.

If you desire more information concerning these tests, go to Heading 7.2, PREFINAL SERVICE SOFTWARE - A TROUBLESHOOTING TOOL where the various tests available within this software are listed with a more detailed description of the test, the areas of the instrument being checked, and suggestions on what to check if a test should fail.

Available Tests

Table A.4-1 Tests on Prefinal Software Diskette

Test	Function
ADC Zero Adjust	Calibrates ADC zero on Trans Data Acquisition card. See Heading 4.14, TRANS DATA ACQUISITION CARD REPLACEMENT AND/OR CALIBRATION for replacement procedures for the Trans Data Acquisition Card.
Amp Gain Control	Allows control of gain for each Amp/Signal Conditioner card.
Amp Saturation Test	Ensures proper calibration of Amp/Signal Conditioner cards for saturation point. **Can not be adjusted in field**.
Attenuator Control	Allows control of each Amp/Signal Conditioner card attenuator.
Beeper Test	Tests for proper beeper operation.
Canyon Jumper Test	Ensures ramp jumper installed on Amp/Signal Conditioner card.
Count Rate Test	Tests count rate register on Trans Data Acquisition card.
DMA Acquisition	Not used.
Front Panel Test	Tests Front Panel Display card indicator LEDs.
General Information	Describes operation of function keys.
Grand Canyon Adjust	Adjusts Gap/Spike on Amp/Signal Conditioner cards. Perform test following replacement of any Amp/Signal Conditioner card; refer to Heading 4.15, AMP/SIGNAL CONDITIONER CARD REPLACEMENT AND/OR CALIBRATION.
Grand Canyon Test	Quick test for gap/spike adjustment.
Histogram Test	Checks the histograms generated by the ADC on the Trans Data Acquisition card for gaps between channels of a normal distribution.
Initialize System	Sets a 5 V peak pulse on all Amp/Signal Conditioner cards.
Laser Control	Turns laser on/off. Can be used to check laser current reading.
Laser Warm Up	Provides a graph of the laser current during startup.
Lock Up Test	Not used.
MCL Bar Code Head Test	Perform this test before installing a replacement scanner head.
MCL Bar Code Test	Allows proper adjustment of bar-code head position alignment.
MCL Burn In	Developed for engineering purposes.
MCL Carousel Label	Ensures carousel label is of readable quality.

Table A.4-1 Tests on Prefinal Software Diskette *(Continued)*

Test	Function
MCL Carousel Status	Checks quickly for carousel alignment.
MCL Door Switch Test	Checks for proper operation of MCL option door switch.
MCL Finger Test	Allows proper adjustment of finger rotator.
MCL Home Align	Allows user to adjust carousel alignment.
MCL Manual Control	Similar to MCL Terminal but does not require keyboard command codes.
MCL Mix Test	Tests proper operation of mixer motor. Stop test to end mixing.
MCL Pneumatic Status	Quick check of flag sensors.
MCL Power Up Status	Resets MCL option to startup mode.
MCL Probe Align	Allows proper adjustment of probe position in test tube.
MCL ROM Test	Checks CPU for correct ROM revision.
MCL Scan Reliability	Developed for engineering purposes.
MCL Stepper Noise Test	Tests stepper motor for excessive noise.
MCL Terminal	Allows manual control of MCL option through keyboard command codes; refer to Table A.4-2.
Memory Test	Tests external memory of all four transputers.
Mike's Test	Not used.
New Board	For future hardware development.
Noise Test and Offset	**ATTENTION:** Use this test only as a reference. Do not make adjustments. Checks the noise and offset of the system.
OPTO DMA Test	Tests DMA transfer of Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card.
OPTO Interrupt Test	Tests Opto Transprocessor interrupt.
OPTO Link Test	Tests fiber optics interface from Computer Workstation to Cytometer.
PMT Voltage Control	Allows control of HV supplies for PMTs.
Pneumatic Sensor Test	Checks for proper operation of System Interface card and pressure sensors.
Pulse RAMP Test	Tests bar graphs on Front Panel Display card and ramp pulse on Trans Data Acquisition card.
ROM Test	Checks ROM on Cyto Transputer card for correct version.
Run Beads	Test allows a sample to be run on the Cytometer to align the optical system using a digital oscilloscope.
Sample Leak Test	Tests both manual and MCL option head for sample pressure leak.
Scope Test	Not used.
Segment Valve Test	Tests for proper rotation of segmenting valve pads.
Set N Transputers	Checks and sets the number of transputers in the system (Cytometer and Workstation computer).
System Parameter Test	Test shows the level variation (noise) on the system parameters of the system.

Table A.4-1 Tests on Prefinal Software Diskette *(Continued)*

Test	Function
T805 Test	Tests to verify proper T805 chip installed on Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card. **Note:** Failure of this test may indicate the circuit card has an INS425/INS405 transputer (instead of the INS805 transputer). If the test fails, inspect U16. If the T805 (INS805) is missing or has been replaced by a 400 series device, then disregard the failure.
Temperature Test	Monitors and check the thermistor on the System Interface card.
Valve Burn In	Continuously tests sample stage up/down and rotation of segmenting valve.
Valve Control	Allows manual control of each valve. Used for pneumatic calibration and locating air leak.
Valve Sequence	Allows system to be drained and cleaned for shipping.
VME Addr Bus Test	Tests VME address bus by writing a digital word and reading it back to see if it matches.
VME Data Bus Test	Tests VME data bus by writing a digital word and reading it back to see if it matches.
Waste Chamber Full Test	Checks for proper operation of eyeball sensor by emptying/filling waste chamber. Currently no specification on elapsed time to empty/fill chamber. Remove panels to perform test.
XY Display	Not used.

MCL Option Commands

Table A.4-2 MCL Option Commands

Name	Keystrokes	Action
Master Reset	Esc M R	Place carousel on turntable before executing this command. **Always execute this command before any other command.** Resets MCL option, brings carousel out, places it in home position.
Carousel Home	Esc C H	Places carousel number label in front of bar-code scanner. Tests carousel home position sensor located under turntable stage.
Carousel In	Esc C I	Moves carousel from out position to in position. Checks operation of carousel in/out sensor. If sensor does not see flag moved through sensor, carousel is pushed back out.
Carousel Out	Esc C O	Moves carousel from in position to out position.
Carousel Load	Esc C L	Places carousel in load-carousel position.
Probe Down	Esc P D	Moves pickup probe to down position. Checks probe up/down sensor to ensure change of state occurred. Probe stays down after successful completion of command.
Probe Up	Esc P U	Moves pickup probe to up position.
Lifter Up	Esc L U	Lifts vortex motor up. Checks lifter sensor for change of state as flag passes through sensor. Lifter stays up after successful completion of command.
Lifter Down	Esc L D	Lowers vortex mixer.
Lifter Mix	Esc L M	Activates vortex motor. Only active when a tube is sensed.
Finger Out	Esc X N	Moves tube rotate finger out.
Finger In	Esc X O	Moves tube rotate finger in.
Scanner Enable	Esc G	Activates scanner head.

A.5 CYTOMETER COMPONENT LOCATIONS AND FUNCTIONS

Overview

Most Cytometer functions are accomplished by fluidic components that are interconnected by tubing and controlled by timed solenoid signals. This section briefly describes the functions of these fluidic components and shows their locations.

Main Cytometer Components

To expedite finding the name, location, or description of a component, the illustrations and tables in this section are organized in functional groups. Figure A.5-1 is the anchor illustration from which you can quickly access a specific illustration.

Figure A.5-1 is referred to as the anchor illustration because it serves as the reference point for accessing other illustrations. This anchor illustration uses an alphabetic letter to indicate a portion of the Cytometer that correlates with a location description provided in the Figure Reference column. This description includes the figure reference that illustrates and provides the name of the main components located in this area of the Cytometer.

Locating a Component

To quickly locate a component, always begin at the anchor illustration, Figure A.5-1.

1. On the anchor illustration, locate the area of the Cytometer where the component in question is located and note the associated letter.
2. Locate the associated letter in the **Figure Reference** column and note the figure number that best fits the configuration of the instrument.
3. Go to the referenced figure number.

   Note: In the electronic version, each figure reference is in hypertext so that when you select the reference, the illustration quickly appears.
4. Locate the component. The number associated with the component identifies its name and also provides a figure reference for locating the component's function on the associated table. Each table also includes the reference designator for the component, where applicable.

Cytometer Anchor Illustration

Figure A.5-1 XL Cytometer with MCL Option, Anchor Illustration for Locating Components

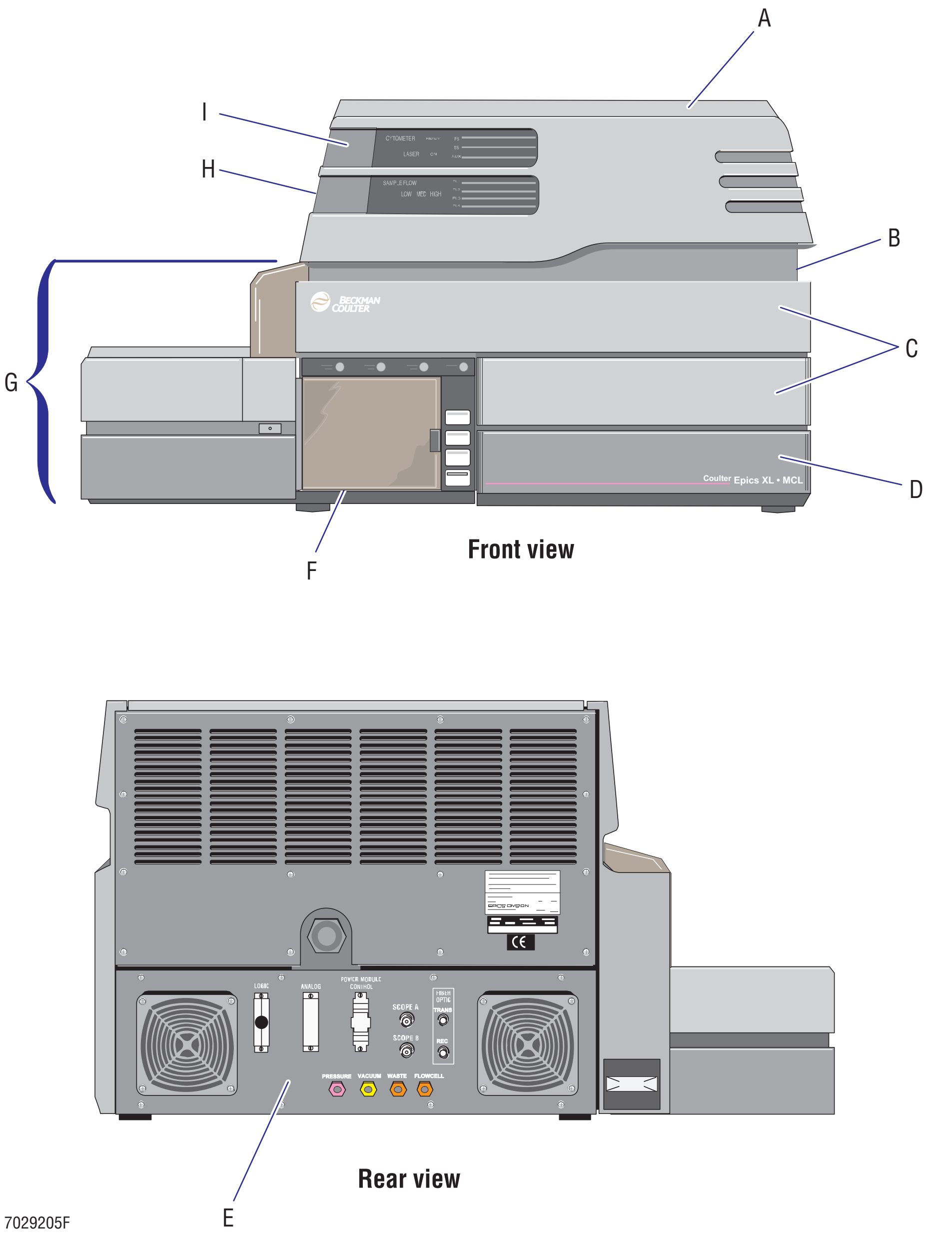


Figure Reference

A Components accessed with the top cover removed, Figure A.5-2

- Interlock switch, Figure A.5-2
- Data Acquisition card cage, Figure A.5-3
- Optical collection area, rear view (includes laser and PMTs), Figure A.5-4

B Components accessed with the right side cover removed, Figure A.5-5

C Components accessed with the center front cover removed, A.5-6

Components accessed with the filter shield removed, A.5-7

D Components inside the reagent drawer, Figure A.5-8

E Rear panel components, Figure A.5-9

F Manual sample station components,

- Unit **with** MCL option, Figure A.5-10
- Unit **without** MCL option, Figure A.5-11

Segmenting valve, Figure A.5-12

G MCL option components,

- Carousel, Figure A.5-13
- Components accessed with covers removed, Figure A.5-14

H Components accessed with the left side cover removed including the lower pneumatics drawer, Figure A.5-15

I Front panel display components, Figure A.5-16

Table A.5-1 XL Cytometer with MCL Option, Component and Assembly Accessibility

Figure Reference	Main Component or Assembly that is Accessible	To Access Component or Assembly
A.5-1, A	Data Acquisition card cage Optical collection area • Argon laser head, plenum, duct • Laser cooling fans • PMT Distribution and Laser Fan Control card • PMT1, PMT2, PMT3, and PMT4 (if a four-color system)	Must remove the top cover.
A.5-1, B	Upper pneumatics drawer QD13 and QD14 Water trap filter and associated components Cooling coil	Must remove the top cover then the right side cover.
A.5-1, C	Light filters in slots 1 through 9 Neutral density spring-loaded knob	Must remove the center front cover (filter cover).
	Side scatter diode Forward Scatter detector Beamshaper assembly Flow cell and/or fluorescence pickup lens	Must remove the center front cover (filter cover), manual sample station, and the filter shield. If the MCL option is installed, must remove the center front cover (filter cover), unlatched the MCL covers from the Cytometer frame, remove the manual sample station, then remove the filter shield.
A.5-1, D	Sheath liquid filter Sheath liquid filter purge (vent) connections Sheath container Cleaning agent container	Must pull the reagent drawer open.
A.5-1, E	Fans Fiber Optics Interface card CYTO dc power EMI harness cable Pressure, vacuum, and two waste quick-connects	If possible, stand behind the Cytometer. **Note:** To replace components, it may be necessary to separate the rear panel from the Cytometer frame. • If it is necessary to remove the left or right-side cover, the top cover must be removed before the side cover can be removed. • If it is necessary to remove the left side cover and the MCL option is installed, you must remove the top cover, unlatch the MCL from the Cytometer frame, then remove the left side cover.

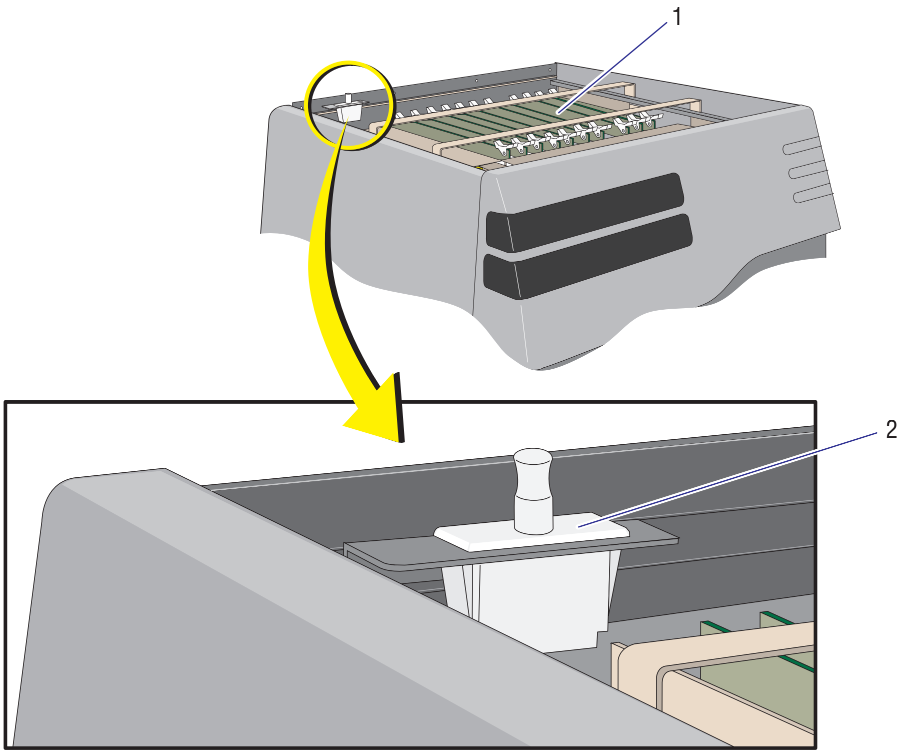
Table A.5-1 XL Cytometer with MCL Option, Component and Assembly Accessibility *(Continued)*

Figure Reference	Main Component or Assembly that is Accessible	To Access Component or Assembly
A.5-1, F	Data entry membrane switches	Exterior access.
	Sample tube holder	Pull open the manual sample station door.
	Front Panel LED and Switch Input card Ribbon cables and latches Segmenting valve	Must remove the manual sample station. If the MCL option is installed, must remove the center front cover (filter cover), unlatched the MCL covers from the Cytometer frame, then remove the manual sample station.
A.5-1, G	Carousel components	Must open or remove MCL covers.
	MCL main frame assembly	Must remove the top cover, unlatch the MCL from the Cytometer frame, and remove the left side cover.
A.5-1, H	Lower pneumatics drawer Back of mounting plate for laser cooling fans	Must remove the top cover then the left side cover. If the MCL option is installed, must remove the top cover, unlatch the MCL from the Cytometer frame, then remove the left side cover.
A.5-1, I	Front panel display	For observation only.
	Top Panel Display 2 card Window display	Must lift the front panel display door.

Components Accessed with the Cytometer Top Cover Removed

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 accessible when the Cytometer top cover is removed and the Data Acquisition card cage is removed from the center cavity.

Figure A.5-2 Components Accessed with the Cytometer Top Cover Removed (See Table A.5-2)



1. Data Acquisition card cage
2. Cytometer interlock switch

Optical collection area
(underneath the Data Acquisition card cage)

7029224F

Table A.5-2 Components Accessed with the Cytometer Top Cover Removed and Their Functions

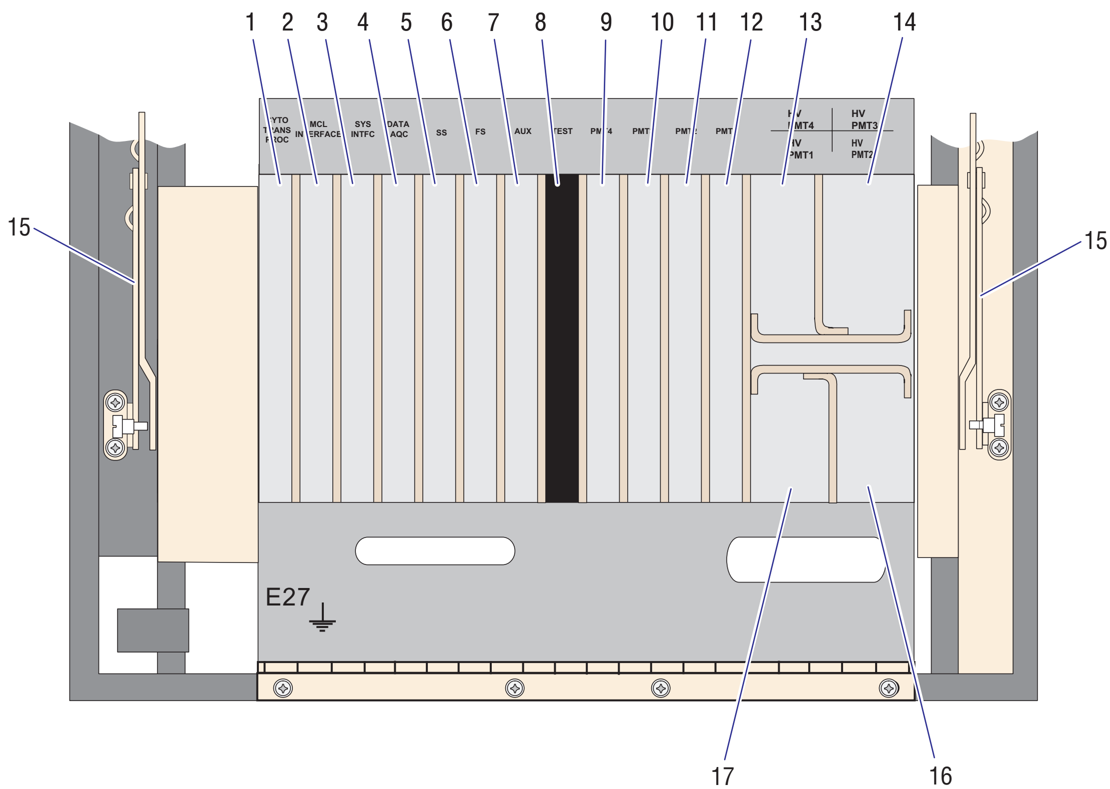
Figure Reference	Component	Function	Reference Designator
A.5-2, 1	Data Acquisition card cage	Houses the electronic circuit cards inside the Cytometer (Figure A.5-3). Most procedures require the card cage be lifted out of the Cytometer and locked in its vertical position. Under Heading 4.3, see Heading Removing the Data Acquisition Card Cage from the Cytometer Center Cavity for instructions.	
A.5-2, 2	Cytometer interlock switch	Safety interlock to ensure the Cytometer top cover is in place when the Argon laser is on. If the laser is on and the cover is removed, this interlock turns off the power to the Argon laser head. **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 covers are properly reinstalled to reactivate any safety interlock switch that was bypassed while servicing the instrument. 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.	
A.5-2	Optical collection area	Houses the Argon laser head, flow cell, and the various optical components needed to detect light and fluorescent signals. Rear section is located underneath the Data Acquisition card cage (Figure A.5-4) and the front section is located behind the filter shield (Figure A.5-7). The center front cover (filter cover) must first be removed to access the filter shield. The front section consists of the beamshaping assembly, flow cell, FS detector, SS diode, and various light filters. The rear section consists of the Argon laser head, air ducts, laser blower assembly, PMT Distribution and Laser Fan Control card, and PMTs.	

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.

Data Acquisition Card Cage, Component Locations

Figure A.5-3 Data Acquisition Card Cage (See Table A.5-3)



1. Cyto Transputer card
2. MCL Interface card
3. System Interface card
4. Trans Data Acquisition card
5. SS Amp/Signal Conditioner card
6. FS Amp/Signal Conditioner card
7. AUX Amp/Signal Conditioner card
8. Empty slot
9. PMT4 Amp/Signal Conditioner card
10. PMT3 Amp/Signal Conditioner card
11. PMT2 Amp/Signal Conditioner card
12. PMT1 Amp/Signal Conditioner card
13. PMT4 HV power supply
14. PMT3 HV power supply
15. Hinge, left and right
16. PMT2 HV power supply
17. PMT1 HV power supply

7029206F

Table A.5-3 Data Acquisition Card Cage, Components and Functions

Figure Reference	Component	Function	Reference Designator
A.5-3, 1	Cyto Transputer card	Circuit card located in Slot 1 of the Data Acquisition card cage (left to right orientation). Master processor for the Cytometer that controls the communication among all the circuit cards in the Cytometer. Via the Fiber Optics Interface card attached to the Cytometer lower rear panel, this circuit card serves as the communication link to the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card located inside the Workstation computer. Receives digital data from the Trans Data Acquisition card and sends this digital data to Fiber Optics Interface card where the digital data is converted to optical data that is sent to the Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II card in the Workstation computer where the optical data is converted back to digital data that is used to create the histograms displayed on the Workstation screen.	Refer to PN 6320738
A.5-3, 2	MCL Interface card	If the MCL option is installed, this circuit card is located in Slot 2 of the Data Acquisition card cage (left to right orientation). Communicates command instructions to the MCL CPU card to operate the MCL option.	Refer to PN 6321034
A.5-3, 3	System Interface card	Circuit card located in Slot 3 of the Data Acquisition card cage (left to right orientation). Controls and monitors all system functions, laser ON/OFF, valve activation. Also monitors internal system temperatures.	Refer to PN 6320782
A.5-3, 4	Trans Data Acquisition card	Circuit card located in Slot 4 of the Data Acquisition card cage (left to right orientation). Receives analog signal data from all Amp/Signal Conditioner cards (SS, FS, AUX, PMT4, PMT3, PMT2, and PMT1). Circuit card contains an ADC that converts the analog signal to digital data which is then sent to the Cyto Transputer card.	Refer to PN 6320732
A.5-3, 5	SS Amp/Signal Conditioner card	Circuit card located in Slot 5 of the Data Acquisition card cage (left to right orientation). Receives the analog signal from the side scatter diode and and amplifies that signal before sending it to the Trans Data Acquisition card. **Note:** All the Amp/Signal Conditioner cards are interchangeable. Addressing for the designated parameter is determined by the location (slot) where the circuit card is inserted into the Analyzer backplane (attached to the rear of the Data Acquisition card cage).	Refer to PN 6320739

Table A.5-3 Data Acquisition Card Cage, Components and Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-3, 6	FS Amp/Signal Conditioner card	Circuit card located in Slot 6 of the Data Acquisition card cage (left to right orientation). Receives the analog signal from the forward scatter detector and amplifies that signal before sending it to the Trans Data Acquisition card. **Note:** All the Amp/Signal Conditioner cards are interchangeable. Addressing for the designated parameter is determined by the location (slot) where the circuit card is inserted into the Analyzer backplane (attached to the rear of the Data Acquisition card cage	Refer to PN 6320739
A.5-3, 7	AUX Amp/Signal Conditioner card	Circuit card located in Slot 7 of the Data Acquisition card cage (left to right orientation). User defined fluorescent channel that receives analog peak voltage pulse signals from either PMT1, PMT2, PMT3, or PMT4. PMT selection is designated by the user via the protocol. When a PMT is selected as AUX on a protocol, peak analog pulses from the designated PMT are simultaneously sent to the AUX Amp/Signal Conditioner card **and** the corresponding PMT Amp/Signal Conditioner card. • At the AUX Amp/Signal Conditioner card, the peak signal is amplified then sent to the Trans Data Acquisition card. • At the corresponding PMT Amp/Signal Conditioner card, the peak signal is amplified and held in an active integrating mode. The integral pulse is then sent to the Trans Data Acquisition card. **Note:** All the Amp/Signal Conditioner cards are interchangeable. Addressing for the designated parameter is determined by the location (slot) where the circuit card is inserted into the Analyzer backplane (attached to the rear of the Data Acquisition card cage	Refer to PN 6320739
A.5-3, 8	Empty slot	Slot 8 of the Data Acquisition card cage (left to right orientation).	

Table A.5-3 Data Acquisition Card Cage, Components and Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-3, 9	PMT4 Amp/Signal Conditioner card (optional)	Circuit card is located in Slot 9 of the Data Acquisition card cage (left to right orientation) only when the four-color option is installed. Receives Gaussian-shaped analog signals from PMT4. Each analog signal is amplified and held in an active integrating mode to produce an integral pulse that is sent to the Trans Data Acquisition card. **Note:** All the Amp/Signal Conditioner cards are interchangeable. Addressing for the designated parameter is determined by the location (slot) where the circuit card is inserted into the Analyzer backplane (attached to the rear of the Data Acquisition card cage	Refer to PN 6320739
A.5-3, 10	PMT3 Amp/Signal Conditioner card	Circuit card located in Slot 10 of the Data Acquisition card cage (left to right orientation). Receives Gaussian-shaped analog signals from PMT3. Each analog signal is amplified and held in an active integrating mode to produce an integral pulse that is sent to the Trans Data Acquisition card. **Note:** All the Amp/Signal Conditioner cards are interchangeable. Addressing for the designated parameter is determined by the location (slot) where the circuit card is inserted into the Analyzer backplane (attached to the rear of the Data Acquisition card cage	Refer to PN 6320739
A.5-3, 11	PMT2 Amp/Signal Conditioner card	Circuit card located in Slot 11 of the Data Acquisition card cage (left to right orientation). Receives Gaussian-shaped analog signals from PMT2. Each analog signal is amplified and held in an active integrating mode to produce an integral pulse that is sent to the Trans Data Acquisition card. **Note:** All the Amp/Signal Conditioner cards are interchangeable. Addressing for the designated parameter is determined by the location (slot) where the circuit card is inserted into the Analyzer backplane (attached to the rear of the Data Acquisition card cage	Refer to PN 6320739
A.5-3, 12	PMT1 Amp/Signal Conditioner card	Circuit card located in Slot 12 of the Data Acquisition card cage (left to right orientation). Receives Gaussian-shaped analog signals from PMT1. Each analog signal is amplified and held in an active integrating mode to produce an integral pulse that is sent to the Trans Data Acquisition card. **Note:** All the Amp/Signal Conditioner cards are interchangeable. Addressing for the designated parameter is determined by the location (slot) where the circuit card is inserted into the Analyzer backplane (attached to the rear of the Data Acquisition card cage	Refer to PN 6320739

Table A.5-3 Data Acquisition Card Cage, Components and Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-3, 13	PMT4 HV power supply (optional)	In the HV power supply section of the Data Acquisition card cage, the PMT4 HV power supply is located in the upper left quadrant when the four-color option is installed. In response to the HV gain setting defined by the operator, provides high voltage (HV) to the PMT4 assembly for amplifying the Gaussian-shaped analog signal before it is sent to the PMT4 Amp/Signal Conditioner card (and AUX Amp/Signal Conditioner card, if applicable). **Note:** All PMT HV power supplies are interchangeable. Addressing for the designated parameter is determined by the location where the power supply is connected to the Analyzer backplane (attached to the rear of the Data Acquisition card cage.	
A.5-3, 14	PMT3 HV power supply	In the HV power supply section of the Data Acquisition card cage, the PMT3 HV power supply is located in the upper right quadrant. In response to the HV gain setting defined by the operator, provides high voltage (HV) to the PMT3 assembly for amplifying the Gaussian-shaped analog signal before it is sent to the PMT3 Amp/Signal Conditioner card (and AUX Amp/Signal Conditioner card, if applicable). **Note:** All PMT HV power supplies are interchangeable. Addressing for the designated parameter is determined by the location where the power supply is connected to the Analyzer backplane (attached to the rear of the Data Acquisition card cage.	
A.5-3, 15	Hinge, left and right	These hinges are use to lock the Data Acquisition card cage in a vertical position outside of the Cytometer. To properly lock the card cage: 1. With one hand, pull the Data Acquisition card cage forward and hold it in an upright position. 2. With your free hand, lock the hinge on each side of the card cage to secure the card cage in this vertical position. 3. **Make sure both hinges are locked before releasing your grip.** To lower the card cage back into the center cavity of the Cytometer: 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.	

Table A.5-3 Data Acquisition Card Cage, Components and Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-3, 16	PMT2 HV power supply	In the HV power supply section of the Data Acquisition card cage, the PMT2 HV power supply is located in the lower right quadrant. In response to the HV gain setting defined by the operator, provides high voltage (HV) to the PMT2 assembly for amplifying the Gaussian-shaped analog signal before it is sent to the PMT2 Amp/Signal Conditioner card (and AUX Amp/Signal Conditioner card, if applicable). **Note:** All PMT HV power supplies are interchangeable. Addressing for the designated parameter is determined by the location where the power supply is connected to the Analyzer backplane (attached to the rear of the Data Acquisition card cage.	
A.5-3, 17	PMT1 HV power supply	In the HV power supply section of the Data Acquisition card cage, the PMT1 HV power supply is located in the lower left quadrant. In response to the HV gain setting defined by the operator, provides high voltage (HV) to the PMT1 assembly for amplifying the Gaussian-shaped analog signal before it is sent to the PMT1 Amp/Signal Conditioner card (and AUX Amp/Signal Conditioner card, if applicable). **Note:** All PMT HV power supplies are interchangeable. Addressing for the designated parameter is determined by the location where the power supply is connected to the Analyzer backplane (attached to the rear of the Data Acquisition card cage.	

Optical Collection Area

The rear section of the optical collection area is accessible when the Cytometer top cover is removed and the Data Acquisition card cage is removed from the center cavity

Optical Collection Area, Component Locations (Rear View)

Figure A.5-4 Optical Collection Area, Rear View (See Table A.5-4)

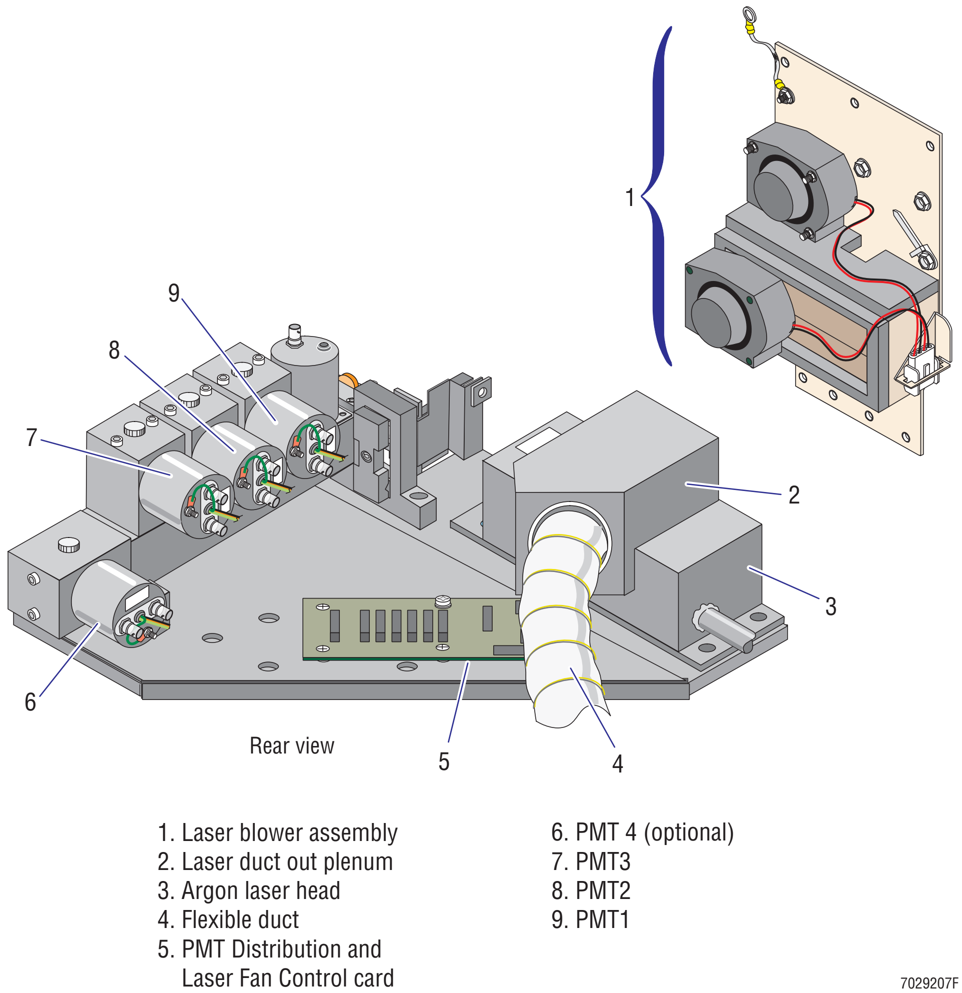


Table A.5-4 Optical Collection Area, Components and Functions

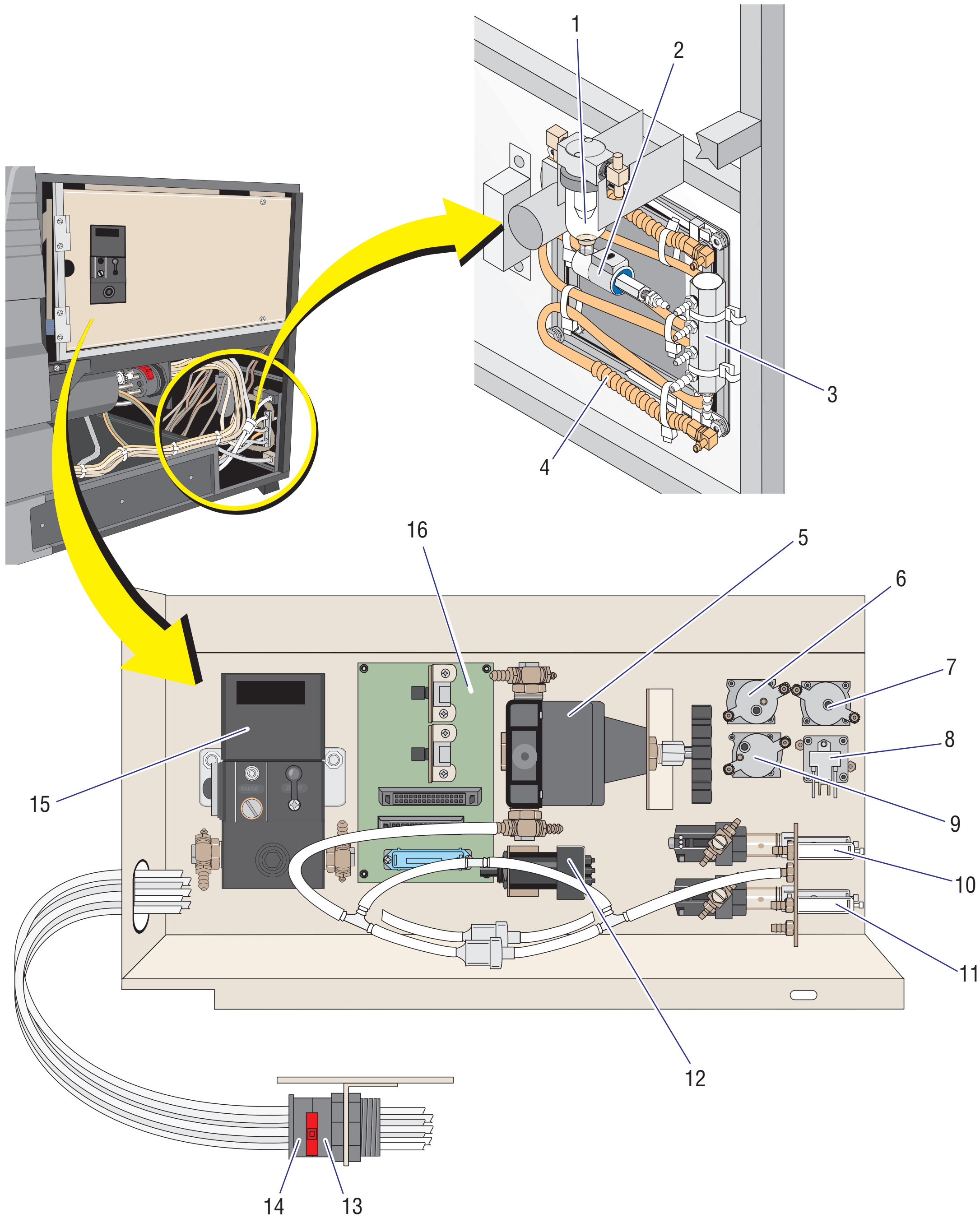
Figure Reference	Component	Function	Reference Designator
A.5-4, 1	Laser blower assembly	Assembly contains two fans that force cooling air across the Argon laser head.	
A.5-4, 2	Laser duct out plenum	Facilitates cooling of the laser head by directing the forced air from the laser blower assembly over the laser tube.	
A.5-4, 3	Argon laser head	Provides the 488 nm laser beam that passes through cross-cylindrical lenses (a vertical and horizontal lens) that shape and focus the laser beam on the sensing area of the flow cell.	
A.5-4, 4	Flexible duct	Provides an exit pathway for the cooling air being forced across the Argon laser by the laser blower assembly to be exhausted out the rear of the Cytometer.	
A.5-4, 5	PMT Distribution and Laser Fan Control card	Provides ±15 Vdc to the PMTs, controls the laser blower assembly and the laser interlock switch that is activated when the Cytometer top cover is removed.	
A.5-4, 6	PMT4 (optional)	Photomultiplier tube that detects the 675 nm wavelength emitted by the PC5 dye. Light entering PMT4 is converted to a Gaussian-shaped analog pulse that is amplified in response to the PMT4 HV gain setting defined by the operator. **Note:** PMTs are interchangeable. PC5, a dye that excites at 488 nm and emits at the red end of the spectrum, is used for cell surface marker applications.	
A.5-4, 7	PMT3	Photomultiplier tube that detects the 620 nm wavelength emitted by the ECD dye (energy coupled dye). Light entering PMT3 is converted to a Gaussian-shaped analog pulse that is amplified in response to the PMT3 HV gain setting defined by the operator. **Note:** PMTs are interchangeable. ECD, a tandem dye that excites at 488 nm and emits at the orange end of the spectrum, is used for cell surface marker applications. A phycoerythrin and Texas red combination is an example.	
A.5-4, 8	PMT2	Photomultiplier tube that detects the 575 nm wavelength emitted by the PE dye (phycoerythrin dye). Light entering PMT2 is converted to a Gaussian-shaped analog pulse that is amplified in response to the PMT2 HV gain setting defined by the operator. **Note:** PMTs are interchangeable. PE, a dye that excites at 488 nm and emits at the yellow end of the spectrum, is used for cell surface marker applications.	

Table A.5-4 Optical Collection Area, Components and Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-4, 9	PMT1	Photomultiplier tube that detects the 525 nm wavelength emitted by the FITC dye (fluorescein isothiocyanate dye). Light entering PMT1 is converted to a Gaussian-shaped analog pulse that is amplified in response to the PMT1 HV gain setting defined by the operator. **Note:** PMTs are interchangeable. FITC, a dye that excites at 488 nm and emits at the green end of the spectrum, is used primarily for cell surface marker applications.	

Components Accessed with the Right Side Cover Removed

Figure A.5-5 Right Side View of the Cytometer with the Cover Removed (See Table A.5-5)



1. Water trap filter
2. VL33
3. Manifold
4. Cooling coil
5. Sheath pressure regulator
6. SN6
7. SN7
8. SN9
9. SN8
10. VL22
11. VL21
12. Vacuum regulator
13. QD14
14. QD13
15. Sample pressure regulator
16. Sensor card

7029198F

Table A.5-5 Components in the Right Side of the Cytometer and their Functions

Figure Reference	Component	Function	Reference Designator
A.5-5, 1	Water trap filter	Component may also be referred to as an air/water filter separator. Compressed air (pressure) generated by the compressor portion of the compressor/vacuum pump is hot. As the hot compressed air leaves the compressor portion or the compressor/vacuum pump, it passes through a cooling coil inside the Power Supply module where moisture in the air condenses. As the cooled air moves out of the cooling coil it is sent through the air/water filter separator to filter particles out of the air and to allow the heavier moisture to drop from the air. There is a second cooling coil inside the Cytometer and this water trap filter inside the Cytometer is a second air/water filter separator to further dry the air and prevent internal rusting of components such as solenoids. When power to the Cytometer is on, solenoid VL 33 is energized, blocking the drain pathway into the waste tank. As a result, once every 24 hours, the customer must power off the Cytometer for 30 minutes to allow the moisture collected inside the water trap to drain through the now de-energized VL 33 into the waste tank.	FL 5 inside the FAN / CONNECTOR REAR PANEL block on PN 6320886
A.5-5, 2	VL33	*Type of Valve* Two-way, normally-open solenoid valve that serves as a dump valve to empty the water trap in the Cytometer. *Energized* - When power to the Cytometer is on, solenoid VL 33 is energized, blocking the drain pathway from the water trap to the waste tank. *De-energized* - Once every 24 hours, the customer must power off the Cytometer for 30 minutes to allow the moisture collected inside the water trap to drain through the now open VL 33 into the waste tank.	VL 33 inside the FAN / CONNECTOR REAR PANEL block on PN 6320886
A.5-5, 3	Waste manifold	Provides a single point for routing waste from various areas of the Cytometer to the external waste tank. • Port 1 - Output from the manifold to the external waste tank. • Port 2 - Input via the normally-closed side of VL22 (located inside the upper pneumatics drawer). • Port 3 - Input via VL33 (when de-energized). • Port 4 - Input from the waste chamber when normally-closed VL7 is energized. • Port 5 - Input from the sheath filter purge valve (VL20 located inside the reagent drawer) when the pinch valve is manually pushed to activate a purge of the sheath filter to remove bubbles.	MF 1 inside the FAN / CONNECTOR REAR PANEL block on PN 6320886

Table A.5-5 Components in the Right Side of the Cytometer and their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-5, 4	Cooling coil	Copper coil that provides a passageway for the once cooled compressed air (pressure) from the Power Supply module to circulate and cool further as fans blow air across the coils to lower the temperature. As the once cooled compressed air passes through this cooling coil, more moisture in the air condenses. As the cooled air moves out of the cooling coil it is sent through the air/water filter separator to filter particles out of the air and to allow the heavier moisture to drop from the air to prevent internal rusting of components such as solenoids.	COOLING COIL inside the FAN / CONNECTOR REAR PANEL block on PN 6320886
A.5-5, 5	Sheath pressure regulator	Mechanical regulator used to regulate sheath pressure. When properly adjusted, provides 4 psi to the sheath and cleanse tanks. The system pressure regulated by this mechanical regulator is commonly referred to as sheath pressure.	RG 2 inside the UPPER PNEUMATICS PANEL block on PN 6320886
A.5-5, 6	SN6	Normally-open vacuum/pressure switch detects when a test tube is placed in the manual sample station. At rest, the sample head has a constant supply of vacuum leaking out to atmosphere. When an operator properly positions a sample tube inside the manual sample station, the tube makes contact with the sample head and seals the vacuum leak. Sufficient vacuum (2 in. Hg) building up inside the tube triggers SN6 to close which in turn triggers the manual stage air cylinder (CL 1) to raise the sample tube up for acquisition.	SN 6 inside the UPPER PNEUMATICS PANEL block on PN 6320886
A.5-5, 7	SN7	Normally-open vacuum/pressure switch monitors the sample pressure inside a sample tube positioned in the manual sample station to make sure the sample pressure inside the sample tube is sufficient to produce the LOW, MEDIUM, or HIGH sample flow rate selected by the operator. If the sample pressure inside the sample tube is not sufficient, a *Sample Pressure Error* message appears on the Workstation screen to alert the operator. If the MCL option is installed, this switch is used to determine if the sample pressure being supplied to the sample tube via the MCL sample head is holding steady. If it is holding steady, acquisition begins. If it is not holding steady, the lifter assembly attempts making a better seal by lowering and relifting the sample tube.	SN 7 inside the UPPER PNEUMATICS PANEL block on PN 6320886

Table A.5-5 Components in the Right Side of the Cytometer and their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-5, 8	SN9	Normally-closed vacuum/pressure switch monitors the system pressure available to the Cytometer. (This is the system pressure generated by the pressure portion of the dual-head compressor/vacuum pump inside the Power Supply module.) if the system pressure falls below 25 psi, a *System Pressure Error* message appears on the Workstation screen to alert the operator.	SN 9 inside the UPPER PNEUMATICS PANEL block on PN 6320886
A.5-5, 9	SN8	Normally-closed vacuum/pressure switch monitors the system vacuum available to the Cytometer. (This is the system vacuum created by the vacuum portion of the dual-head compressor/vacuum pump inside the Power Supply module.) if the system vacuum falls below 10 in. Hg, a *System Vacuum Error* message appears on the Workstation screen to alert the operator.	SN 8 inside the UPPER PNEUMATICS PANEL block on PN 6320886
A.5-5, 10	VL22	*Type of Valve* Pinch valve (double-action, solenoid-actuated) used to control flow of sheath pressure to the sheath and cleanse tanks. *Actuated* - Sheath pressure (regulated by RG 2) flows to the sheath and cleanse tanks. Valve is always actuated except when the Cytometer is placed in the IDLE mode or when power to the Cytometer is turned off. *De-actuated* - Flow of sheath pressure to the sheath and cleanse tanks is blocked. This occurs only when the Cytometer is placed in the IDLE mode or when power to the Cytometer is turned off.	VL 22 inside the UPPER PNEUMATICS PANEL block on PN 6320886
A.5-5, 11	VL21	*Type of Valve* Pinch valve (double-action, solenoid-actuated) used to control sample pressure flow. *De-actuated* - Resting state. Sample pressure is blocked. *Actuated* - When data acquisition begins, sample pressure (regulated by RG 1) is available via VL13 at the sample head. • If VL13 is de-actuated, sample pressure is available at the manual sample head. • If VL13 is actuated, sample pressure is available at the MCL sample head.	VL 21 inside the UPPER PNEUMATICS PANEL block on PN 6320886
A.5-5, 12	Vacuum regulator	Regulates the constant vacuum being supplied to the manual sample head. If the MCL option is installed, vacuum is supplied to the waste port of the MCL sample head. Vacuum is adjusted based on what is required at the manual sample head.	RG 3 inside the UPPER PNEUMATICS PANEL block on PN 6320886

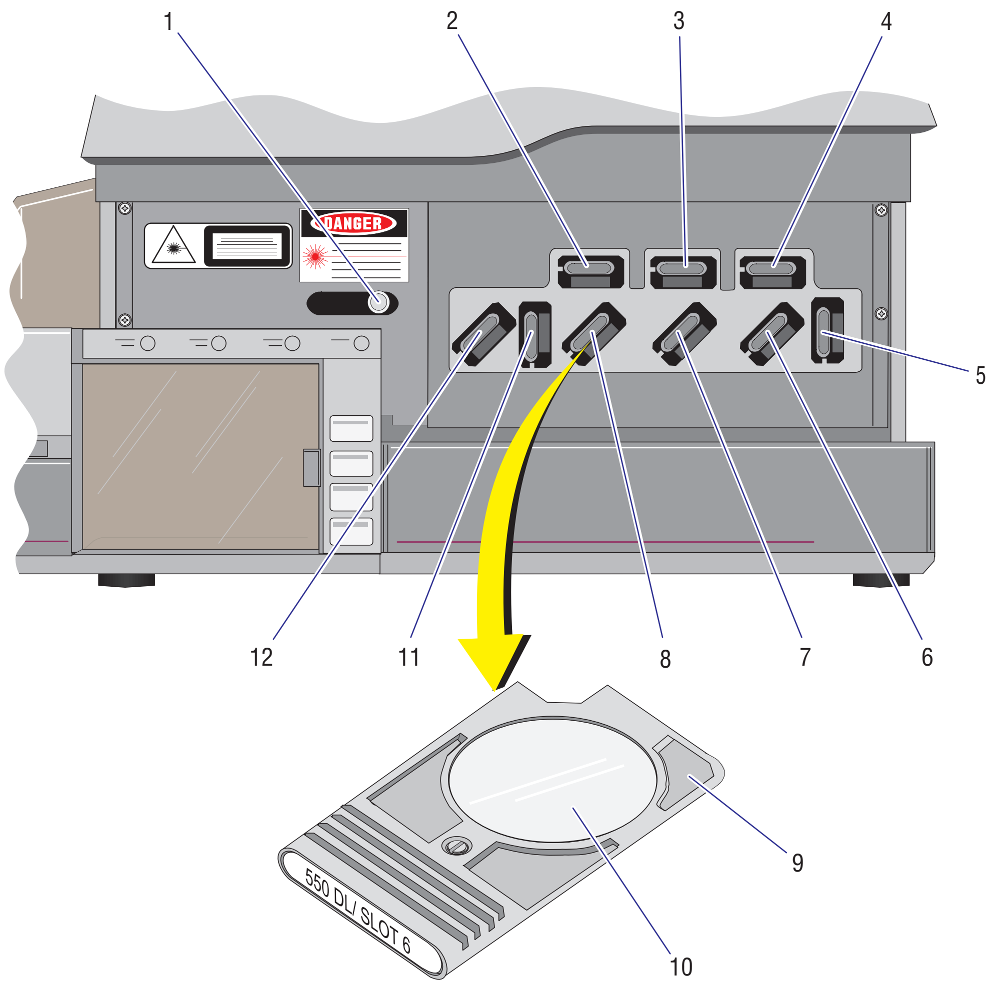
Table A.5-5 Components in the Right Side of the Cytometer and their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-5, 13	QD14	Quick-disconnect male coupling that provides one central connector for routing pneumatics to components inside the upper pneumatics drawer and then routing regulated pneumatics to components inside the Cytometer	QD 14 left of the UPPER PNEUMATICS PANEL block on PN 6320886
A.5-5, 14	QD13	Quick-disconnect female coupling that provides one central connector for routing pneumatics to components inside the upper pneumatics drawer and then routing regulated pneumatics to components inside the Cytometer.	QD 13 inside the UPPER PNEUMATICS PANEL block on PN 6320886
A.5-5, 15	Sample pressure regulator	Electronic pressure regulator (electronic transducer) regulates the sample pressure to comply with the LOW, MEDIUM, or HIGH sample flow rate selected by the operator. The system pressure regulated by this electronic pressure regulator is commonly referred to as sample pressure.	RG 1 inside the UPPER PNEUMATICS PANEL block on PN 6320886
A.5-5, 16	Sensor card	Circuit card that: • Monitors the sheath and sample pressures. • Reports sheath and sample pressure values to the System Interface card.	Refer to PN 6320630

Components Accessed with the Center Front Cover Removed

The center front cover may also be referred to as the filter cover or center front panel.

Figure A.5-6 Inside View of the Cytometer with the Center Front Cover Removed (See Table A.5-6)



1. ND1 filter postioning knob
2. 525 BP light filter
3. 575 BP light filter
4. 620 BP light filter
5. 675 BP light filter
6. 645 DL light filter
7. 600 DL light filter
8. 550 DL light filter
9. Filter holder
10. Light filter
11. 488 BK light filter
12. 488 DL light filter

Table A.5-6 Components Behind the Center Front Cover and their Functions

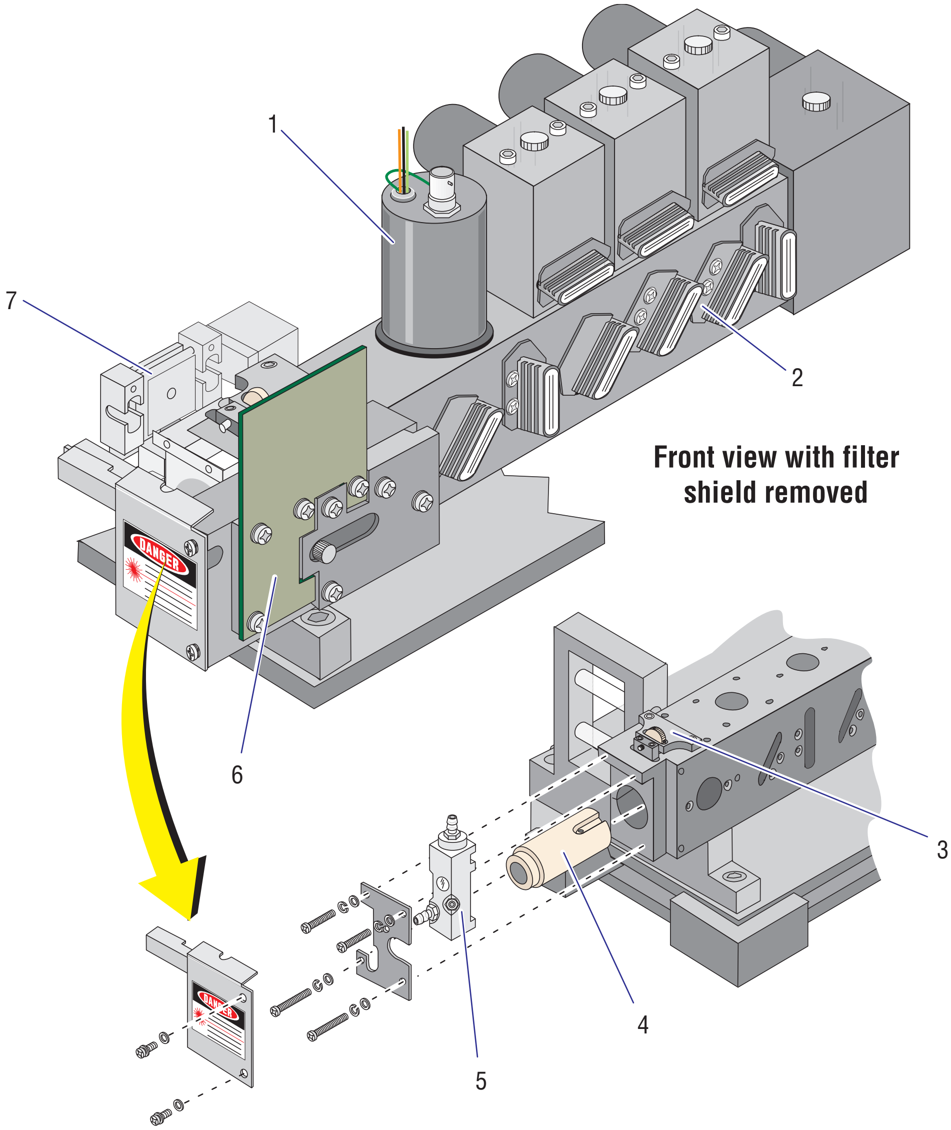
Figure Reference	Component	Function	Reference Designator
A.5-6, 1	ND1 filter positioning knob	ND1 is short for a neutral density 1 filter. This filter is already located in the sensing area. The operator positions the filter for use by sliding the spring-loaded knob along a track. When the knob is at the right end of its track, the filter is not used. **Note:** Neutral density filters do not discriminate light by wavelength; they block all wavelengths equally. The ND1 filter is used primarily in those laboratories that analyze large particles such as plant cells. This filter blocks the larger forward scatter particles that emit brighter scattered light to prevent detector saturation.	
A.5-6, 2	525 BP light filter	Fluorescent band pass filter that transmits emissions in the 525 nm region (filter passes 515 nm to 535 nm wavelengths). **Note:** Band pass filters pass a narrow band of wavelengths and block all others. These filters are used to pass fluorescence light from a single dye, while blocking light from other dyes.	
A.5-6, 3	575 BP light filter	Fluorescent band pass filter that transmits emissions in the 575 nm region (filter passes 567.5 nm to 582.5 nm wavelengths). **Note:** Band pass filters pass a narrow band of wavelengths and block all others. These filters are used to pass fluorescence light from a single dye, while blocking light from other dyes.	
A.5-6, 4	620 BP light filter	Fluorescent band pass filter that transmits emissions in the 620 nm region (filter passes 610 nm to 630 nm wavelengths). **Note:** Band pass filters pass a narrow band of wavelengths and block all others. These filters are used to pass fluorescence light from a single dye, while blocking light from other dyes.	
A.5-6, 5	675 BP light filter	Fluorescent band pass filter that transmits emissions in the 675 nm region (filter passes 660 nm to 690 nm wavelengths). **Note:** Band pass filters pass a narrow band of wavelengths and block all others. These filters are used to pass fluorescence light from a single dye, while blocking light from other dyes.	

Table A.5-6 Components Behind the Center Front Cover and their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-6, 6	645 DL light filter	Dichroic long pass filter used to pass 655 nm to 725 nm fluorescent emissions while reflecting 607 nm to 630 nm wavelengths. **Note:** The filter occupying this slot is actually a 640 DL filter labeled as 645 DL. Dichroic long pass filters pass longer wavelengths and reflect shorter ones. These filters are identified by their 50% transmittance wavelength and must be placed in a diagonal position.	
A.5-6, 7	600 DL light filter	Dichroic long pass filter used to pass 612 nm to 725 nm fluorescent emissions while reflecting 550 nm to 590 nm wavelengths. **Note:** Dichroic long pass filters pass longer wavelengths and reflect shorter ones. These filters are identified by their 50% transmittance wavelength and must be placed in a diagonal position.	
A.5-6, 8	550 DL light filter	Dichroic long pass filter used to pass 560 nm to 725 nm fluorescent emissions while reflecting 500 nm to 540 nm wavelengths. **Note:** Dichroic long pass filters pass longer wavelengths and reflect shorter ones. These filters are identified by their 50% transmittance wavelength and must be placed in a diagonal position.	
A.5-6, 9	Filter holder	Plastic assembly that holds the round glass filter.	
A.5-6, 10	Light filter	Optical grade filter used for signal processing.	
A.5-6, 11	488 BK light filter	Long pass laser blocking filter that blocks scattered laser light in the 488 nm region from entering the optical collection area where the PMTs are housed (filter passes fluorescent light 505 nm to 725 nm wavelengths). **Note:** Blocking filters pass light at all wavelengths except for a narrow band of blocked wavelengths. The filters are identified by the laser line they most effectively block; they typically pass about 0.01 to 1.0% of those wavelengths. Blocking filters are used in the detector compartment to block intense laser light scatter.	
A.5-6, 12	488 DL light filter	Dichroic long pass filter used to pass 510 nm to 725 nm fluorescent emissions while reflecting the 488 nm wavelength. **Note:** Dichroic long pass filters pass longer wavelengths and reflect shorter ones. These filters are identified by their 50% transmittance wavelength and must be placed in a diagonal position.	

Components Accessed with the Filter Shield Removed

Figure A.5-7 Inside View of the Cytometer with the Filter Shield Removed (See Table A.5-7)



1. Side scatter diode
2. Lens holder plate
3. Fluorescense pickup lens adjustment hardware
4. Fluorescense pickup lens
5. Flow cell
6. Forward scatter detector
7. Beamshaper assembly

7029212F

Table A.5-7 Components Behind the Filter Shield and their Functions

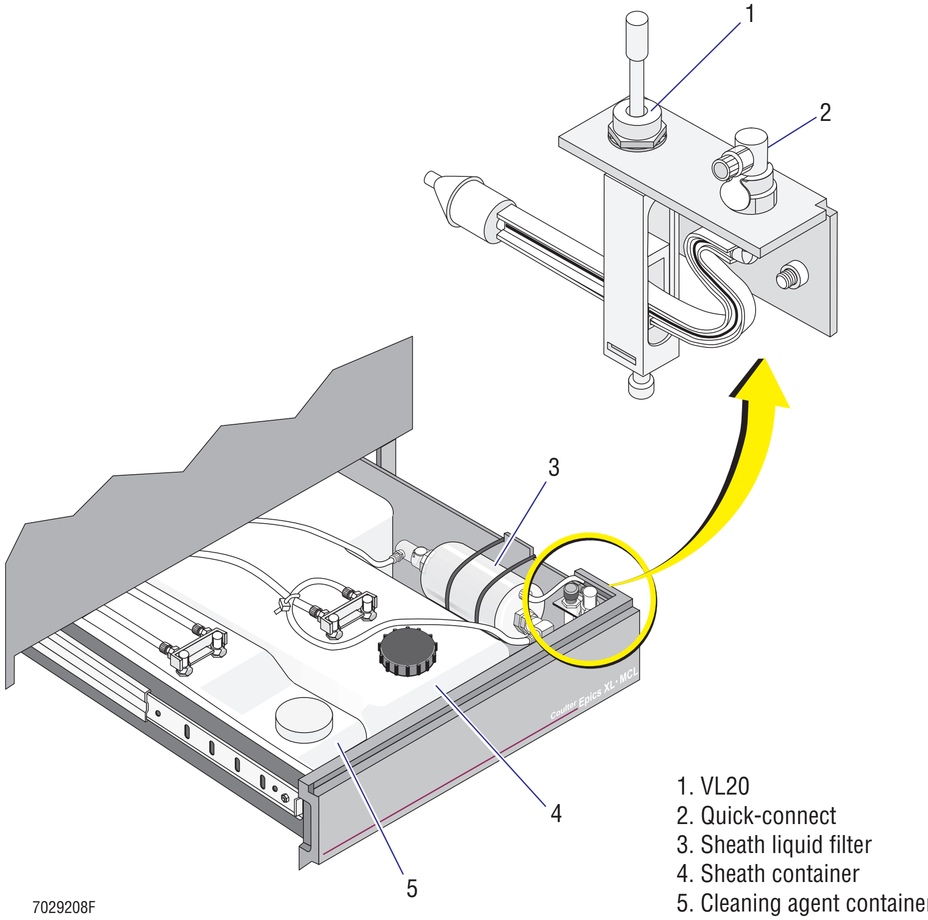
Figure Reference	Component	Function	Reference Designator
A.5-7, 1	Side scatter diode	Also referred to as SS diode, SS sensor, or SS detector. Collects the laser light that is scattered at about a 90° angle to the axis of the laser beam as a particle passes through the laser beam. The amount of laser light scattered is referred to as side scatter (SS) and is proportional to the granularity of the cell that scattered the laser light. **Note:** SS is used to differentiate between lymphocytes, monocytes, and granulocytes.	
A.5-7, 2	Lens holder plate	Blocks ambient light from entering the optical filter block. Also secures filter holder when two screws are properly installed.	
A.5-7, 3	Fluorescence pickup lens adjustment hardware	Provides an easy way to move the pickup lens to maximize the fluorescent signals.	
A.5-7, 4	Fluorescence pickup lens	Collimates fluorescent light emitted by the sample as it is excited by the laser.	
A.5-7, 5	Flow cell	Contains the sensing area where the individual cells are intersected by the laser beam. A process called hydrodynamic focusing ensures the cells move through the laser beam one at a time, along the same path. The flow cell 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. 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. Because the pressure being applied to the sheath differs from the pressure being applied to the sample stream, the two streams are traveling at different rates so that the sheath stream surrounds, but does not mix, with the sample stream. 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).	FC 1 on PN 6320886

Table A.5-7 Components Behind the Filter Shield and their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-7, 6	Forward scatter detector	Also referred to as FS detector, FS sensor or forward scatter sensor. Collects the laser light that is scattered at narrow angles to the axis of the laser beam as a particle passes through the laser beam. The amount of forward scatter (FS) is proportional to the size of the cell that scattered the laser light. When the light reaches the FS detector, the detector generates voltage pulse signals that are proportional to the intensity of light the detector received. These signals are processed to measure the characteristics of the cells that scattered the light.	
A.5-7, 7	Beamshaper assembly	Contains two cross-cylindrical lenses that shape and focus the laser beam produced by the laser head. The first lens controls the width of the beam; the second, the height. The cross-cylindrical lenses shape the round laser beam into an elliptical beam and focus the laser beam into the flow cell chamber. Focusing keeps the beam perpendicular to the sample stream flow while making the beam small enough to illuminate only one cell at a time.	

Components Inside the Reagent Drawer

Figure A.5-8 View of an Open Reagent Drawer (See Table A.5-8)



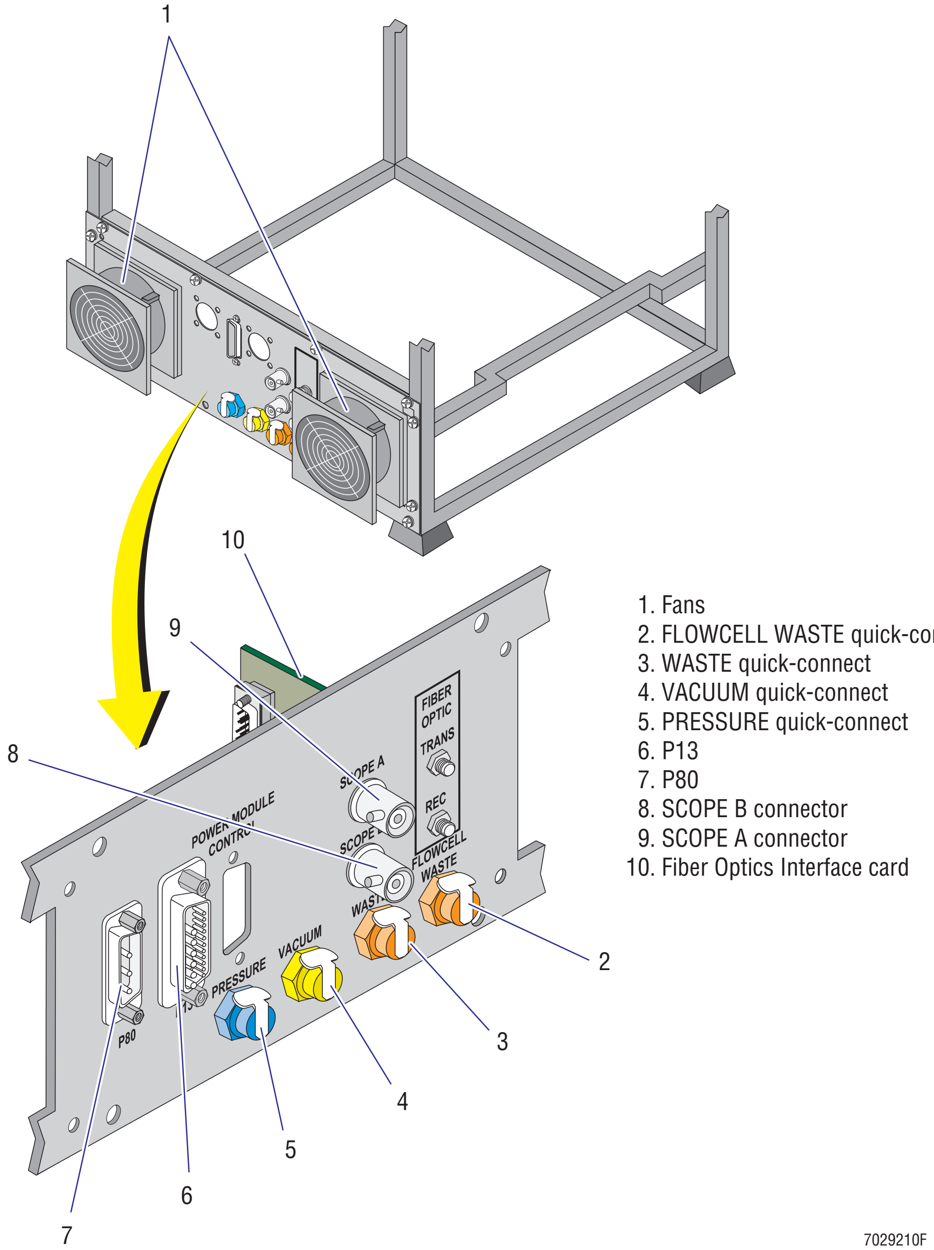
1. VL20
2. Quick-connect
3. Sheath liquid filter
4. Sheath container
5. Cleaning agent container

Table A.5-8 Components Inside the Reagent Drawer and their Functions

Figure Reference	Component	Function	Reference Designator
A.5-8, 1	VL20	Commonly referred to as the sheath filter purge valve. Normally-closed pinch valve that is manually pushed to activate a purge of the sheath filter to remove bubbles.	PV 20 inside the BOTTLE DRAWER block on PN 6320886
A.5-8, 2	QD35	90° quick-connect (external male elbow) connects VL20 with the vent port on the sheath liquid filter to facilitate replacement of sheath filter purge components.	QD 35 inside the BOTTLE DRAWER block on PN 6320886
A.5-8, 3	Sheath liquid filter	Disposable 0.2 micron hydrophilic filter used to remove particles 0.2 µm or larger from the sheath fluid.	FL 6 inside the BOTTLE DRAWER block on PN 6320886
A.5-8, 4	Sheath container	May also be referred to as sheath tank or sheath bottle. Holds fluid used to create the hydrodynamic focus for sample analysis referred to as sheath flow. IsoFlow™ sheath fluid, a non fluorescent, balanced electrolyte solution, or its equivalent is the recommended reagent. The sheath container has a working capacity of about 2 L. The amount of sheath fluid the container holds beyond the working capacity is for pressurization and level sensing.	SHEATH BOTTLE or RS 1 inside the BOTTLE DRAWER block on PN 6320886
A.5-8, 5	Cleaning agent container	May also be referred to as the cleanse tank or cleanse bottle. Holds cleaning agent for cleaning the sample lines and flow cell. COULTER CLENZ® cleaning agent or its equivalent is recommended to flush the sample tubing and to help reduce protein buildup and particle accumulation in the instrument. Each cleanse cycle uses about 15 mL of cleaning agent. The cleaning agent container has a working capacity of about 500 mL. That is enough cleaning agent to use the Cleanse mode once a day for one month. The amount of cleaning agent the container holds beyond the working capacity is for pressurization and level sense.	DETERGENT BOTTLE or RS 2 inside the BOTTLE DRAWER block on PN 6320886

Rear Panel Components

Figure A.5-9 Rear Panel Components, Exterior View (See Table A.5-9)



1. Fans
2. FLOWCELL WASTE quick-connect
3. WASTE quick-connect
4. VACUUM quick-connect
5. PRESSURE quick-connect
6. P13
7. P80
8. SCOPE B connector
9. SCOPE A connector
10. Fiber Optics Interface card

Table A.5-9 Components Attached to the Rear Panel and their Functions, Exterior View

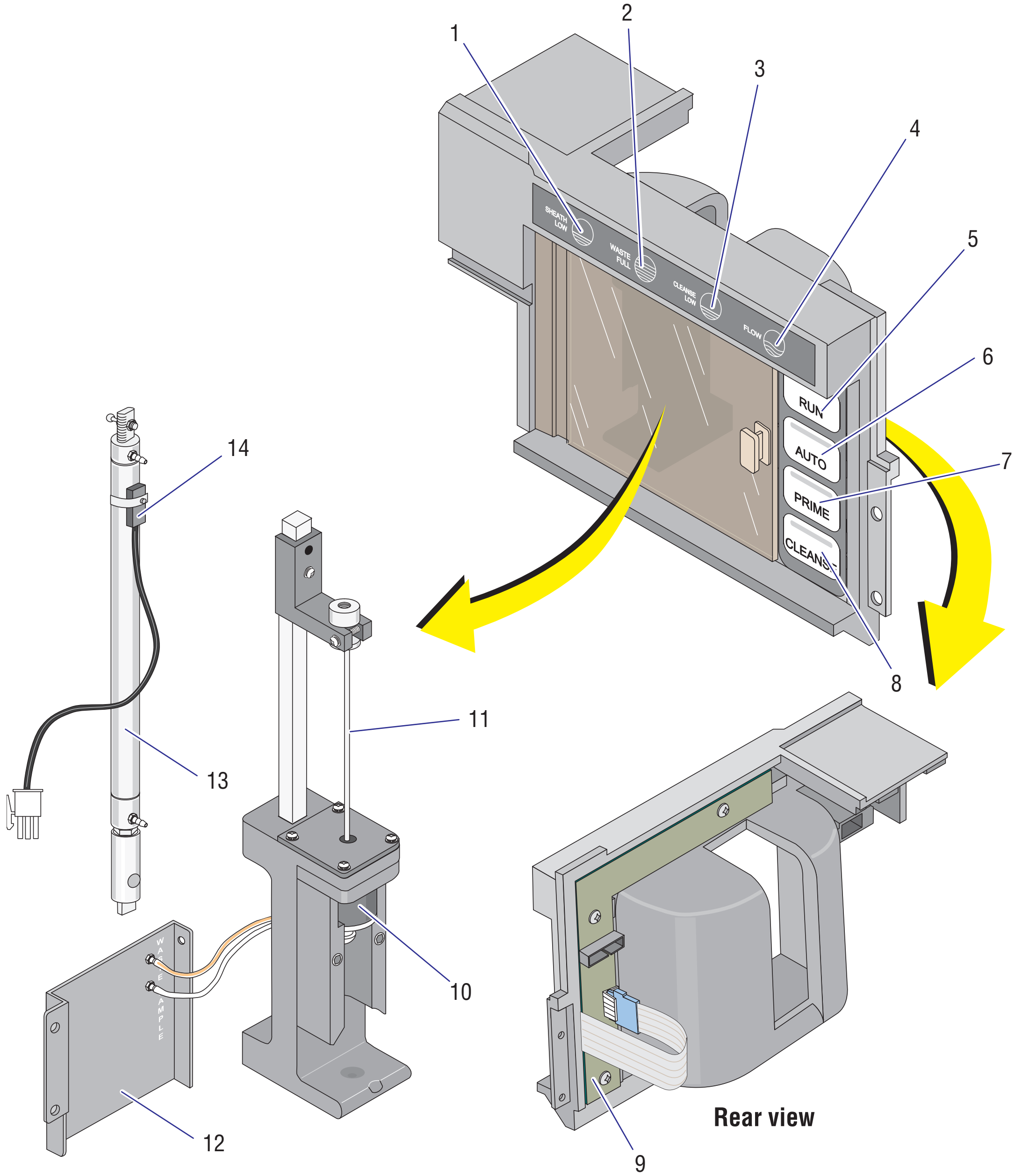
Figure Reference	Component	Function	Reference Designator
A.5-9, 1	Fans	When power to the Cytometer is turned on, these fans provide a constant flow of room air into the Cytometer to keep the electronic components inside the Cytometer from overheating.	
A.5-9, 2	FLOWCELL WASTE quick-connect (orange)	Female panel mount quick-connect that when coupled with QD26 (orange male quick-connect) provides a pathway to the external waste container for the sample waste that exits the flow cell during acquisition analysis.	QD 18 inside the FAN / CONNECTOR REAR PANEL block on PN 6320886
A.5-9, 3	WASTE quick-connect (orange)	Female panel mount quick-connect that when coupled with QD25 (orange male quick-connect) provides a pathway to the external waste container for emptying waste routed through the waste manifold (MF1). **Note:** To locate the waste manifold, refer to Figure A.5-5, item 3.	QD 17 inside the FAN / CONNECTOR REAR PANEL block on PN 6320886
A.5-9, 4	VACUUM quick-connect (yellow)	Female panel mount quick-connect that when coupled with QD24 (yellow male quick-connect) provides an input to supply vacuum created in the Power Supply module to the Cytometer.	QD 16 inside the FAN / CONNECTOR REAR PANEL block on PN 6320886
A.5-9, 5	PRESSURE quick-connect (blue)	Female panel mount quick-connect that when coupled with QD23 (blue male quick-connect) provides an input to supply 30 psi (generated and regulated in the Power Supply module) to the cooling coils and water trap filter inside the Cytometer. **Note:** To locate the cooling coils and water trap filter inside the Cytometer, refer to Figure A.5-5, items 4 and 1 respectively.	QD 15 inside the FAN / CONNECTOR REAR PANEL block on PN 6320886
A.5-9, 6	P13	Connector for CYTO dc power EMI harness cable	
A.5-9, 7	P80	Connector for CYTO dc power EMI harness cable	
A.5-9, 8	SCOPE B connector	May be used by the Service representative to connect an oscilloscope to measure the FL3 signal.	
A.5-9, 9	SCOPE A connector	May be used by the Service representative to connect an oscilloscope to measure the signal assigned to the discriminator.	

Table A.5-9 Components Attached to the Rear Panel and their Functions, Exterior View *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-9, 10	Fiber Optics Interface card	Circuit card 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. Two fiber optic cables are connected to this circuit card. This fiber optic cables are joined together as one cable with 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 are inserted into jacks on the Cytometer and the terminal posts on the other end of the cable are inserted into jacks on the Opto Transprocessor EXEM or Opto Transprocessor EXMEM II card in the Workstation computer. • At the rear of the Cytometer: ▸ The terminal post labeled RX goes in the jack labeled FIBER OPTIC REC. ▸ The terminal post labeled TX goes in the jack labeled FIBER OPTIC TRANS. • At the rear of the tower computer: ▸ The terminal post labeled TX goes in the outer left jack labeled XMIT on the edge of the Opto Transprocessor EXMEM II card (in the bottom slot). ▸ The terminal post labeled TX goes in the inner (middle) jack labeled REC on the edge of the Opto Transprocessor EXMEM II card. If installed incorrectly, the Cytometer powers up but the Workstation comes up in listmode.	

Manual Sample Station Components, Cytometer with MCL Option

Figure A.5-10 XL-MCL Manual Sample Station Components (See Table A.5-10)



1. SHEATH LOW level sense indicator
2. WASTE FULL level sense indicator
3. CLEANSE LOW level sense indicator
4. FLOW indicator
5. RUN push button and indicator
6. AUTO push button
7. PRIME push button
8. CLEANSE push button
9. Front Panel LED and Switch Input 2 card
10. Manual sample head
11. Manual sample probe
12. Sample and waste connect panel
13. Manual stage air cylinder
14. Manual stage position sensor

7029213F

Table A.5-10 XL-MCL Manual Sample Station Components and their Functions

Figure Reference	Component	Function	Reference Designator
A.5-10, 1	SHEATH LOW level sense indicator	Red symbol when the sheath fluid is low. During sample analysis, the operator has 5 minutes to finish analyzing the current sample after the indicator starts flashing red. When the indicator glows red, the operator must fill the sheath container before the instrument can be cycled again. The fill the sheath container, the Cytometer needs to be in the Idle mode.	
A.5-10, 2	WASTE FULL level sense indicator	Red symbol when the external waste container is full. During sample analysis, the operator has 5 minutes to finish analyzing the current sample after the indicator starts flashing red. When the indicator glows red, the operator must empty the external waste container before the instrument can be cycled again.	
A.5-10, 3	CLEANSE LOW level sense indicator	Red symbol when the cleaning agent is low. When the indicator glows red, the operator must fill the cleanse container before starting the cleanse cycle. The fill the cleaning agent container, the Cytometer needs to be in the Idle mode.	
A.5-10, 4	FLOW indicator	Green symbol means the sample tube is pressurized and sample is going through the flow cell.	
A.5-10, 5	RUN push-button and indicator	Micro contact switch used to place the Cytometer in the Idle or Run mode. Press once to use the Run mode. Press again for Idle mode. The indicator color shows the Cytometer operating mode. • Glowing (solid) green indicates the Cytometer is in the Run mode. Cytometer is waiting for the operator to insert a sample tube. • Flashing green indicates the Cytometer is in the Idle mode. • Glowing (solid) orange indicates the Run mode during sample analysis.	
A.5-10, 6	AUTO push-button	Available only if the MCL option is installed. Micro contact switch for MCL operation. Press to use the optional Automatic mode. Press again to use the Manual mode. Glowing (solid) green indicator means the Cytometer is in the Auto mode and a carousel is in the MCL.	

Table A.5-10 XL-MCL Manual Sample Station Components and their Functions *(Continued)*

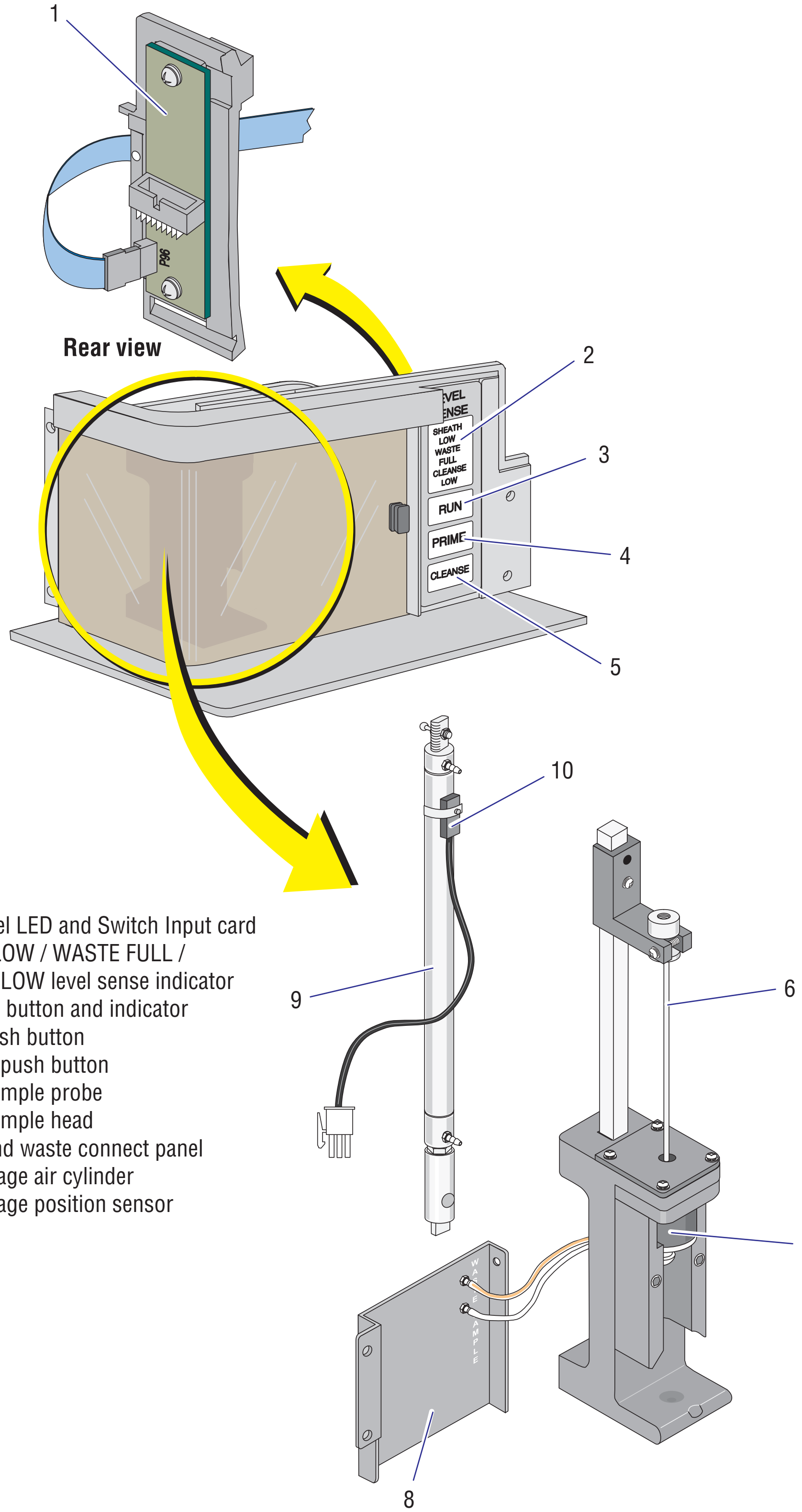
Figure Reference	Component	Function	Reference Designator
A.5-10, 7	PRIME push-button	Micro contact switch used to initiate the Prime cycle. Press to flush the flow cell with sheath fluid. Data acquisition pauses until the prime cycle is done. During the 10-second cycle, indicator is green.	
A.5-10, 8	CLEANSE push-button	Micro contact switch used to initiate the Cleanse cycle. Press to flush the flow cell with cleaning agent. During the 60-second cycle, indicator is green. There must not be a tube on the sample stage.	
A.5-10, 9	Front Panel LED and Switch Input 2 card	Used only on instruments with the MCL option, this circuit card contains the microswitch membrane switches used to initiate the RUN, AUTO, PRIME, or CLEANSE functions and illuminate the corresponding indicators. It also contains the circuitry for illuminating the FLOW indicator or the SHEATH LOW, WASTE FULL, CLEANSE LOW level sense indicators as directed by the Top Panel Display 2 card.	
A.5-10, 10	Manual sample head	At rest, the sample head has a constant supply of vacuum leaking out to atmosphere. When an operator properly positions a sample tube inside the manual sample station, the tube makes contact with the sample head and seals the vacuum leak. Sufficient vacuum (2 in. Hg) building up inside the tube triggers SN6, a normally-open vacuum/pressure switch, to close which in turn triggers the manual stage air cylinder (CL1) to raise the sample tube up. The vacuum supply is shut off and sample pressure enters the tube. SN7, a normally-open vacuum/pressure switch, monitors the sample pressure inside the tube to make sure the sample pressure inside the sample tube is sufficient to produce the LOW, MEDIUM, or HIGH sample flow rate selected by the operator for data acquisition. If the sample pressure inside the sample tube is not sufficient, a *Sample Pressure Error* message appears on the Workstation screen to alert the operator. **Note:** To locate SN6 or SN7, refer to Figure A.5-5, items 6 and 7.	
A.5-10, 11	Manual sample probe	Provides a pathway for the pressurized sample (in the test tube) to move out of the test tube towards the flow cell.	
A.5-10, 12	Sample and waste connect panel	Panel that contains two fittings - SAMPLE for connecting the tubing that provides vacuum (from RG3) to the manual sample head and WASTE for connecting the tubing that provides a pathway from the manual sample head to the waste chamber (VC1).	

Table A.5-10 XL-MCL Manual Sample Station Components and their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-10, 13	Manual stage air cylinder	Solenoid-actuated / spring-return air cylinder used to raise or lower the manual sample stage. Operation controlled via a solenoid (VL14) in the lower pneumatics drawer. **Note:** To locate VL14, refer to Figure A.5-15, item 11.	CL 1 inside the SAMPLE STATION block on PN 6320886
A.5-10, 14	Manual stage position sensor	Verifies the manual sample stage is in the proper position - raised or lowered.	SN 4 inside the SAMPLE STATION block on PN 6320886

Manual Sample Station Components, Cytometer without MCL Option

Figure A.5-11 XL Manual Sample Station Components (See Table A.5-11)



1. Front Panel LED and Switch Input card
2. SHEATH LOW / WASTE FULL / CLEANSE LOW level sense indicator
3. RUN push button and indicator
4. PRIME push button
5. CLEANSE push button
6. Manual sample probe
7. Manual sample head
8. Sample and waste connect panel
9. Manual stage air cylinder
10. Manual stage position sensor

7029214F

Table A.5-11 XL Manual Sample Station Components and their Functions

Figure Reference	Component	Function	Reference Designator
A.5-11, 1	Front Panel LED and Switch Input card	Used only on instruments without the MCL option, this circuit card contains the microswitch membrane switches used to initiate the RUN, PRIME, or CLEANSE functions. It also contains the circuitry for illuminating the SHEATH LOW / WASTE FULL / CLEANSE LOW level sense indicator as directed by the Top Panel Display 2 card.	
A.5-11, 2	SHEATH LOW / WASTE FULL / CLEANSE LOW level sense indicator	Red means the sheath fluid or cleaning agent is low or the external waste container is full. • If the sheath fluid is low: During sample analysis, the operator has 5 minutes to finish analyzing the current sample after the indicator starts flashing red. When the indicator glows red, the operator must fill the sheath container before the instrument can be cycled again. The fill the sheath container, the Cytometer needs to be in the Idle mode. • If the external waste container is full: During sample analysis, the operator has 5 minutes to finish analyzing the current sample after the indicator starts flashing red. When the indicator glows red, the operator must empty the external waste container before the instrument can be cycled again. • If cleaning agent is low: When the indicator glows red, the operator must fill the cleanse container before starting the cleanse cycle. The fill the cleaning agent container, the Cytometer needs to be in the Idle mode.	
A.5-11, 2	FLOW indicator	Green means the sample tube is pressurized and sample is going through the flow cell.	
A.5-11, 3	RUN push-button and indicator	Micro contact switch used to place the Cytometer in the Idle or Run mode. Press once to use the Run mode. Press again for Idle mode. The indicator color shows the Cytometer operating mode. • Glowing (solid) green indicates the Cytometer is in the Run mode. Cytometer is waiting for the operator to insert a sample tube. • Flashing green indicates the Cytometer is in the Idle mode. • Glowing (solid) orange indicates the Run mode during sample analysis.	

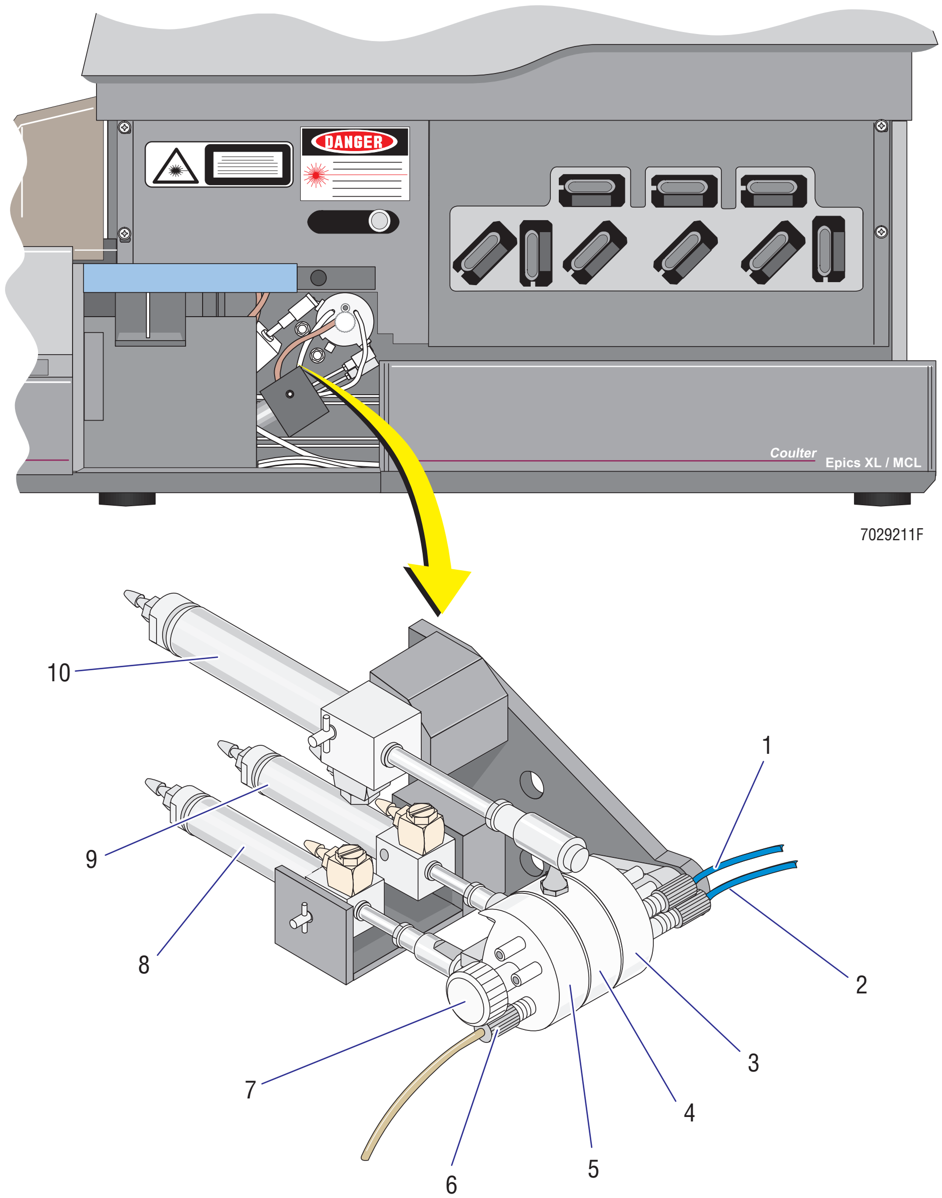
Table A.5-11 XL Manual Sample Station Components and their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-11, 4	PRIME push-button	Micro contact switch used to initiate the Prime cycle. Press to flush the flow cell with sheath fluid. Data acquisition pauses until the prime cycle is done. During the 10-second cycle, indicator is green.	
A.5-11, 5	CLEANSE push-button	Micro contact switch used to initiate the Cleanse cycle. Press to flush the flow cell with cleaning agent. During the 60-second cycle, indicator is green. There must not be a tube on the sample stage.	
A.5-11, 6	Manual sample probe	Provides a pathway for the pressurized sample (in the test tube) to move out of the test tube towards the flow cell.	
A.5-11, 7	Manual sample head	At rest, the sample head has a constant supply of vacuum leaking out to atmosphere. When an operator properly positions a sample tube inside the manual sample station, the tube makes contact with the sample head and seals the vacuum leak. Sufficient vacuum (2 in. Hg) building up inside the tube triggers SN6, a normally-open vacuum/pressure switch, to close which in turn triggers the manual stage air cylinder (CL1) to raise the sample tube up. The vacuum supply is shut off and sample pressure enters the tube. SN7, a normally-open vacuum/pressure switch, monitors the sample pressure inside the tube to make sure the sample pressure inside the sample tube is sufficient to produce the LOW, MEDIUM, or HIGH sample flow rate selected by the operator for data acquisition. If the sample pressure inside the sample tube is not sufficient, a *Sample Pressure Error* message appears on the Workstation screen to alert the operator. **Note:** To locate SN6 or SN7, refer to Figure A.5-5, items 6 and 7.	
A.5-11, 8	Sample and waste connect panel	Panel that contains two fittings - SAMPLE for connecting the tubing that provides vacuum (from RG3) to the manual sample head and WASTE for connecting the tubing that provides a pathway from the manual sample head to the waste chamber (VC1).	
A.5-11, 9	Manual stage air cylinder	Solenoid-actuated / spring-return air cylinder used to raise or lower the manual sample stage. Operation controlled via a solenoid (VL14) in the lower pneumatics drawer. **Note:** To locate VL14, refer to Figure A.5-15, item 11.	CL 1 inside the SAMPLE STATION block on PN 6320886
A.5-11, 10	Manual stage position sensor	Verifies the manual sample stage is in the proper position - raised or lowered.	SN 4 inside the SAMPLE STATION block on PN 6320886

Segmenting Valve Components

Figure A.5-12 Segmenting Valve Components (See Table A.5-12)

Front view



1. PEEK tubing to manual sample probe
2. PEEK tubing to MCL sample probe
3. Segmenting valve rear pad
4. Segmenting valve middle pad
5. Segmenting valve front pad
6. PEEK tubing to flow cell
7. Segmenting valve knob
8. Air Cylinder for front segmenting valve pad
9. Air Cylinder for rear segmenting valve pad
10. Air Cylinder for middle segmenting valve pad

Table A.5-12 Segmenting Valve Components and Their Functions

Figure Reference	Component	Function	Reference Designator
A.5-12, 1	Peek tubing to MCL	Provides a pathway for sample flow from the MCL sample probe to the segmenting valve rear pad.	MCL inside the PROBE NORMAL block on PN 6320886
A.5-12, 2	Peek tubing to manual sample probe	Provides a pathway for sample flow from the manual sample probe to the segmenting valve rear pad.	PROBE inside the PROBE NORMAL block on PN 6320886
A.5-12, 3	Segmenting valve rear pad	Switches between manual and MCL. Pad has cleaning channel and rotates during the cleaning cycle.	
A.5-12, 4	Segmenting valve middle pad	Only used with SYSTEM II operating system to perform the Stop On Volume function.	
A.5-12, 5	Segmenting valve front pad	Provides pathway to the flow cell. Pad has cleaning channel and rotates during the cleaning cycle.	
A.5-12, 6	Peek tubing to flow cell	Provides a pathway for sample flow from the segmenting valve rear pad to the flow cell.	FLOWCELL inside the PROBE NORMAL block on PN 6320886
A.5-12, 7	Segmenting valve knob	When properly tightened, this knob provides sufficient tension to secure the segmenting pads so that they rotate smoothly without leaking.	
A.5-12, 8	Air Cylinder for front segmenting valve pad	Double action air cylinder controlled by 30 psi provided by either VL15 or VL18. VL18 is normally energized to hold the front pad in its normal position. When VL15 is energized, the front pad rotates for cleaning. **Note:** To locate VL15 or VL18, refer to Figure A.5-15, items 10 and 7 respectively.	CYL 2 inside the PROBE NORMAL block on PN 6320886

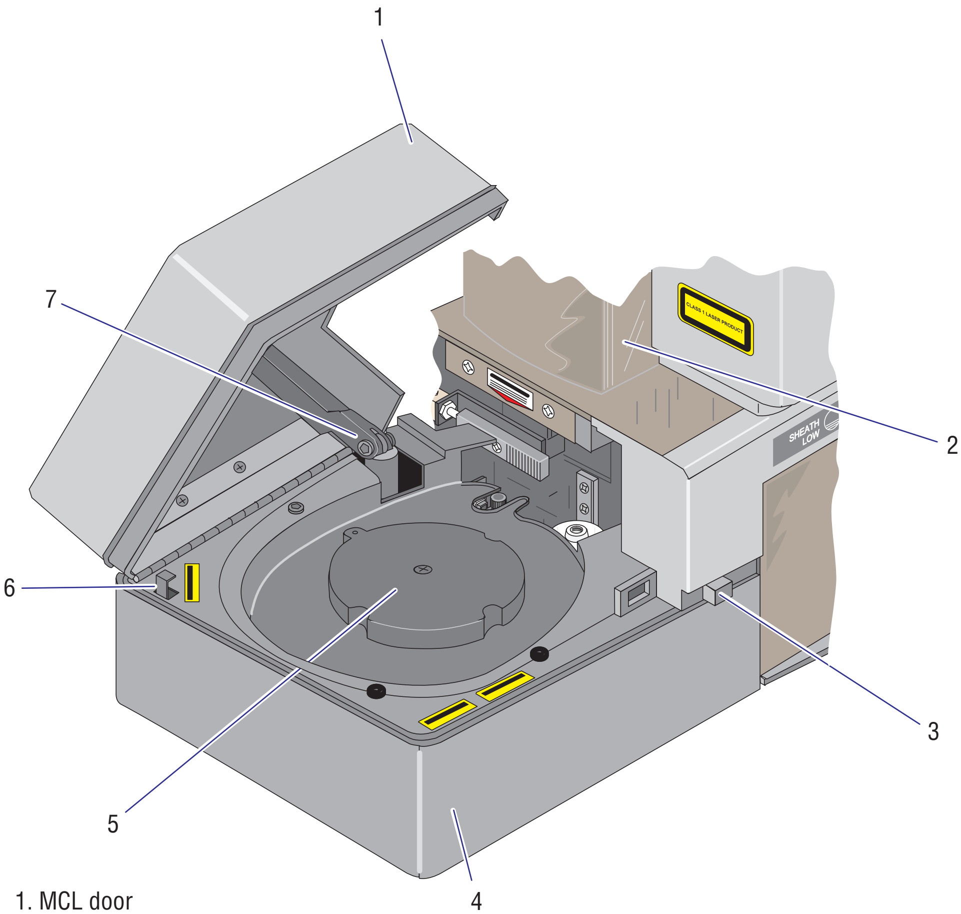
Table A.5-12 Segmenting Valve Components and Their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-12, 9	Air Cylinder for rear segmenting valve pad	Double action air cylinder controlled by 30 psi provided by either VL17 or VL20. VL17 is normally energized to hold the rear pad in its normal position that allows sample flow through the PROBE port. When VL20 is energized, the rear pad rotates to allow sample flow through the MCL port. **Note:** To locate VL17 or VL20, refer to Figure A.5-15, items 8 and 5 respectively.	CYL 4 inside the PROBE NORMAL block on PN 6320886
A.5-12, 10	Air Cylinder for middle segmenting valve pad	Double action air cylinder controlled by 30 psi provided by either VL16 or VL19. VL16 is normally energized to hold the middle pad in its normal position. When VL19 is energized, the middle pad rotates to perform the Stop On Volume function. **Note:** To locate VL16 or VL19, refer to Figure A.5-15, items 9 and 6 respectively.	CYL 3 inside the PROBE NORMAL block on PN 6320886

Components on the MCL Option

Carousel Components

Figure A.5-13 Carousel Components (See Table A.5-13)



1. MCL door
2. MCL probe housing
3. MCL carousel pushbutton
4. MCL base
5. Carousel hub
6. Interlock switch
7. MCL gas cylinder and bracket

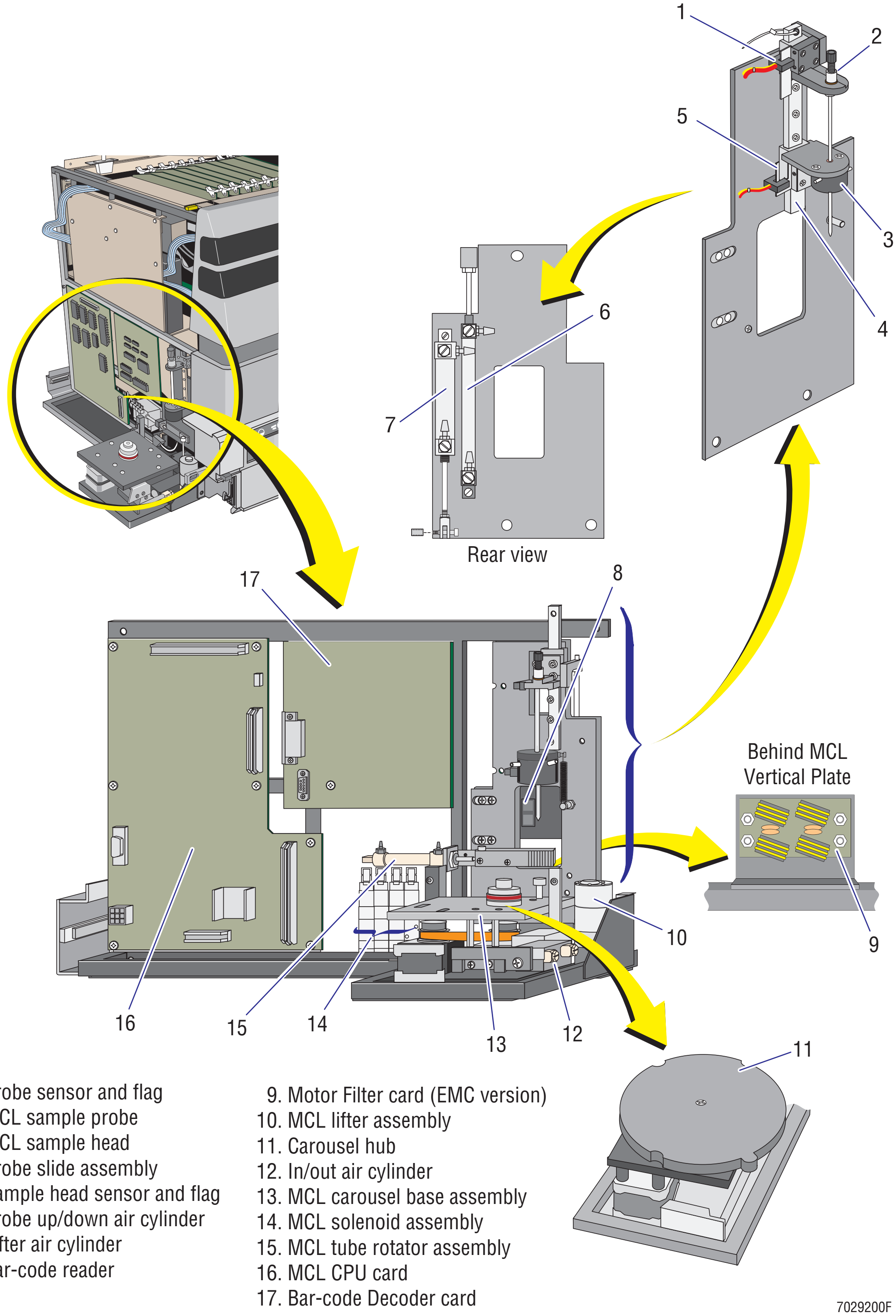
7029223F

Table A.5-13 Carousel Components and Their Functions

Figure Reference	Component	Function	Reference Designator
A.5-13, 1	MCL door	Exterior cover also referred to as the MCL lid or MCL upper lid and may also be referred to as MCL cover or MCL upper cover. When lifted, the tube carousel can be positioned on or removed from the carousel hub. To open this door, the push-button (A.5-13, item 3) must be pressed to release the latch. When the latch is released, the MCL gas cylinder (A.5-13, item 7) controls the door's movement as it opens automatically.	
A.5-13, 2	MCL probe housing	Protective covering for the MCL sample probe and sample head attached to the vertical plate (Figure A.5-14).	
A.5-13, 3	MCL carousel push-button	Press this push-button to release the latch that opens the MCL door (upper base cover).	
A.5-13, 4	MCL base	Houses carousel base assembly and lifter assembly. This base must unlatched **before** removing the left-side cover.	
A.5-13, 5	Carousel hub	Hub for securing and indexing the carousel.	
A.5-13, 6	Interlock switch	Safety interlock 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 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 though 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.	
A.5-13, 7	MCL gas cylinder and bracket	Controls the opening movement of the MCL door when the push-button (A.5-13, item 3) is pressed and unlatches the door.	

MCL Components Accessible with Covers Removed

Figure A.5-14 MCL Components Accessible with Covers Removed (See Table A.5-14)



1. Probe sensor and flag
2. MCL sample probe
3. MCL sample head
4. Probe slide assembly
5. Sample head sensor and flag
6. Probe up/down air cylinder
7. Lifter air cylinder
8. Bar-code reader
9. Motor Filter card (EMC version)
10. MCL lifter assembly
11. Carousel hub
12. In/out air cylinder
13. MCL carousel base assembly
14. MCL solenoid assembly
15. MCL tube rotator assembly
16. MCL CPU card
17. Bar-code Decoder card

Table A.5-14 MCL Components Accessible with Covers Removed and Their Functions

Figure Reference	Component	Function	Reference Designator
A.5-14, 1	Probe sensor and flag	Used to monitor the position of the MCL sample probe.	
A.5-14, 2	MCL sample probe	Provides a pathway for the pressurized sample (in the test tube) to move out of the test tube towards the flow cell.	
A.5-14, 3	MCL sample head	When a sample tube makes contact with the MCL sample head, sample pressure enters the tube. SN7 is used to determine if the sample pressure being supplied to the sample tube via the MCL sample head is holding steady. If it is holding steady, acquisition begins. If it is not holding steady, the lifter assembly attempts making a better seal by lowering and relifting the sample tube. If the sample pressure inside the sample tube is not sufficient, a *Sample Pressure Error* message appears on the Workstation screen to alert the operator. **Note:** To locate SN7, refer to Figure A.5-5, item 7.	
A.5-14, 4	Probe slide assembly	Provides smooth up/down travel for the MCL sample probe.	
A.5-14, 5	Sample head sensor and flag	Used to detect if a sample tube is underneath the MCL sample head for sample processing.	
A.5-14, 6	Probe up/down air cylinder	Double action air cylinder controlled by 30 psi and venting used to lower the MCL sample probe into the sample tube and raise the MCL sample probe out of the sample tube.	
A.5-14, 7	Lifter air cylinder	Double action air cylinder controlled by 30 psi and venting used to raise and lower the lifter assembly.	
A.5-14, 8	Bar-code reader	Used to read the bar-code labels placed on the sample tubes for specimen identification and to read the MCL carousel to verify correct position during operational rotations.	
A.5-14, 9	Motor Filter card (EMC version)	Circuit card that suppresses EMC interference for CE certification.	
A.5-14, 10	MCL lifter assembly	Used to lift and vortex sample to the MCL sample head.	
A.5-14, 11	Carousel hub	Resting place for MCL carousel.	
A.5-14, 12	In/out air cylinder	Double action air cylinder controlled by 30 psi and venting used to move the carousel base assembly in or out to position the sample tube over the lifter and under the MCL sample head.	
A.5-14, 13	MCL carousel base assembly	Contains the mechanical and electrical hardware to rotate and locate the carousel position.	
A.5-14, 14	MCL solenoid assembly	Used to control the probe up/down, lifter, and in/out air cylinders, as well as the air cylinder in the MCL tube rotator assembly.	

Table A.5-14 MCL Components Accessible with Covers Removed and Their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-14, 15	MCL tube rotator assembly	Double action air cylinder controlled by 30 psi and venting used to move the finger in and out to rotate the sample tube for reading the bar-code label and guides the tube as it is being lifted to the MCL sample head.	
A.5-14, 16	MCL CPU card	Circuit card that controls all MCL functions.	
A.5-14, 17	Bar-code Decoder card	Circuit card that controls and decodes input from the bar-code reader.	

Components in the Left Side of the Cytometer

The main assembly located in the left side of the Cytometer is the lower pneumatics drawer. To access the lower pneumatics drawer, the left side cover must first be removed. If the MCL option is installed, access is more time consuming because the entire MCL option must be removed to access the lower pneumatics drawer. This removal not only involves removing the MCL covers but also removing the manual sample station to facilitate removal of the MCL main frame assembly from the Cytometer frame.

The left side cover must also be removed to replace a laser cooling fan. If the MCL option is installed, the MCL covers must be unlatched, not removed, from the Cytometer frame to remove the left side cover. It is not necessary to remove the MCL main frame assembly from the Cytometer frame.

Figure A.5-15 Lower Pneumatics Drawer Components (See Table A.5-15)

1. Solenoid Power Distribution card
2. Solenoid manifold
3. QD10
4. QD11
5. VL20
6. VL19
7. VL18
8. VL17
9. VL16
10. VL15
11. VL14
12. VL0
13. VL1
14. VL2
15. VL3
16. VL4
17. VL5
18. VL6
19. VL7
20. VL8
21. VL9
22. VL10
23. VL11
24. VL12
25. VL13
26. 12 insert fitting plate
27. 5 insert fitting plate (MCL option only)
28. Upper 6 insert fitting plate
29. Lower 6 insert fitting plate
30. Waste chamber sensor
31. Waste chamber

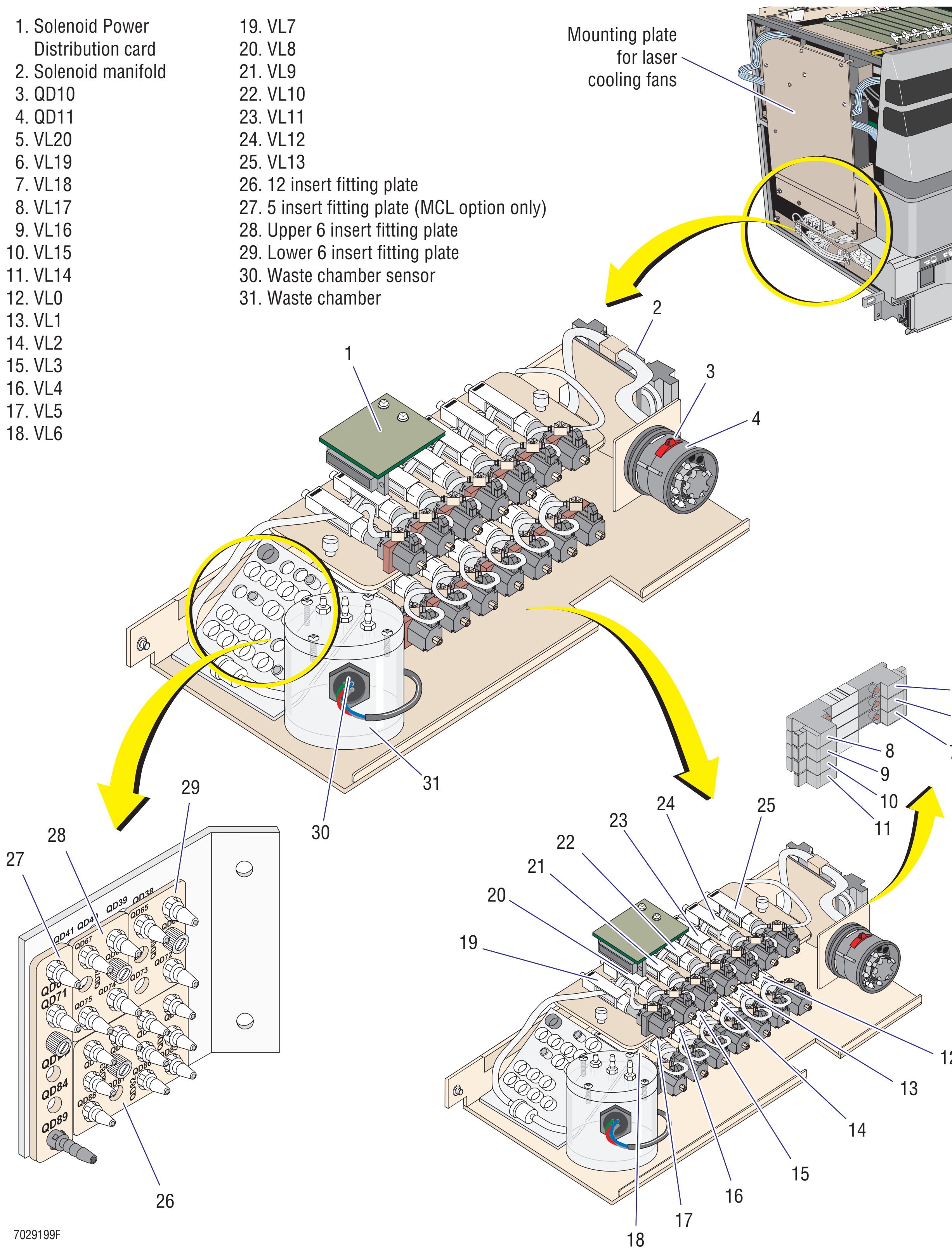


Table A.5-15 Components in the Lower Pneumatics Drawer and Their Functions

Figure Reference	Component	Function	Reference Designator
A.5-15, 1	Solenoid Power Distribution card	Circuit card that provides the 24 Vdc needed to operate the various solenoid valves.	Refer to PN 6321192
A.5-15, 2	Solenoid manifold	Provides 30 psi to the pilot actuators.	
A.5-15, 3	QD10	Quick-disconnect female coupling that provides one central connector for routing pneumatics to components inside the lower pneumatics drawer and then routing solenoid-controlled pneumatics to components inside the Cytometer.	QD 10 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 4	QD11	Quick-disconnect male coupling that provides one central connector for routing pneumatics to components inside the lower pneumatics drawer and then routing solenoid-controlled pneumatics to components inside the Cytometer.	QD 11 is to the right of the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 5	VL20	One of two solenoids that provide the 30 psi needed to operate the double action air cylinder (CYL 4) that controls movement of the segmenting valve rear pad. VL17 is normally energized to hold the rear pad in its normal position that allows sample flow through the PROBE port. When VL20 is energized, the rear pad rotates to allow sample flow through the MCL port. **Note:** To locate the air cylinder (CYL 4), refer to Figure A.5-12, item 9.	VL 20 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 6	VL19	One of two solenoids that provide the 30 psi needed to operate the double action air cylinder (CYL 3) that controls movement of the segmenting valve middle pad. VL16 is normally energized to hold the middle pad in its normal position. When VL19 is energized, the middle pad rotates to perform the Stop On Volume function. **Note:** To locate the air cylinder (CYL 3), refer to Figure A.5-12, item 10.	VL 19 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 7	VL18	One of two solenoids that provide the 30 psi needed to operate the double action air cylinder (CYL 2) that controls movement of the segmenting valve front pad. VL18 is normally energized to hold the front pad in its normal position. When VL15 is energized, the front pad rotates for cleaning. **Note:** To locate the air cylinder (CYL 2), refer to Figure A.5-12, item 8.	VL 18 inside the LOWER PNEUMATICS DRAWER block on PN 6320886

Table A.5-15 Components in the Lower Pneumatics Drawer and Their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-15, 8	VL17	One of two solenoids that provide the 30 psi needed to operate the double action air cylinder (CYL 4) that controls movement of the segmenting valve rear pad. VL17 is normally energized to hold the rear pad in its normal position that allows sample flow through the PROBE port. When VL20 is energized, the rear pad rotates to allow sample flow through the MCL port. **Note:** To locate the air cylinder (CYL 4), refer to Figure A.5-12, item 9.	VL 17 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 9	VL16	One of two solenoids that provide the 30 psi needed to operate the double action air cylinder (CYL 3) that controls movement of the segmenting valve middle pad. VL16 is normally energized to hold the middle pad in its normal position. When VL19 is energized, the middle pad rotates to perform the Stop On Volume function. **Note:** To locate the air cylinder (CYL 3), refer to Figure A.5-12, item 10.	VL 16 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 10	VL15	One of two solenoids that provide the 30 psi needed to operate the double action air cylinder (CYL 2) that controls movement of the segmenting valve front pad. VL18 is normally energized to hold the front pad in its normal position. When VL15 is energized, the front pad rotates for cleaning. **Note:** To locate the air cylinder (CYL 2), refer to Figure A.5-12, item 8.	VL 15 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 11	VL14	Controls the up/down movement of the manual sample stage via a solenoid-actuated / spring-return air cylinder (CL 1) referred to as the manual stage air cylinder. *Energized* 30 psi is routed to the air cylinder to raise the sample stage. *De-energized* 30 psi is no longer available to the air cylinder. The air cylinder vents as the spring returns the internal piston to its resting position which lowers the manual sample stage.	VL 14 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 12	VL0	Controls the flow of sheath to the flow cell. *Type of Valve* Normally closed pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 0 inside the LOWER PNEUMATICS DRAWER block on PN 6320886

Table A.5-15 Components in the Lower Pneumatics Drawer and Their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-15, 13	VL1	Controls the flow of cleaning agent to the flow cell. *Type of Valve* Normally closed pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 1 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 14	VL2	Controls flow cell flush waste during the Prime cycle. Tubing from this pinch valve is attached to the waste port on the flow cell opposite the sheath port so that when VL2 is energized during the Prime cycle, sheath fluid flows through the flow cell and out the waste port to quickly remove (flush) air bubbles from the flow cell. *Type of Valve* Normally closed pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 2 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 15	VL3	Controls the flow of waste from the flow cell to the external waste container. *Type of Valve* Normally closed pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 3 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 16	VL4	Controls the flow of waste from the flow cell to the waste chamber. *Type of Valve* Normally closed pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 4 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 17	VL5	Controls the flow of waste from the sample head to the waste chamber. *Type of Valve* Normally open pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 5 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 18	VL6	Controls waste fill to the waste chamber. *Type of Valve* Normally closed pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 6 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 19	VL7	Controls the flow of waste from the waste chamber. *Type of Valve* Normally closed pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 7 inside the LOWER PNEUMATICS DRAWER block on PN 6320886

Table A.5-15 Components in the Lower Pneumatics Drawer and Their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-15, 20	VL8	Controls pushing sheath for Stop on Volume. *Type of Valve* Normally closed pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 8 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 21	VL9	Opens pathway from the segmenting valve waste loop to the waste chamber. *Type of Valve* Normally closed pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 9 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 22	VL10	Provides the pushing sheath to the segmenting valve input waste loop. *Type of Valve* Normally open pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 10 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 23	VL11	Supplies (via VL 7) vacuum or sheath pressure to control the filling and draining of the waste chamber. Normally-open side provides a supply of vacuum to VL7. When VL7 is energized, the vacuum pulls liquid into the waste chamber. Normally-closed side provides sheath pressure for draining the waste chamber. *Type of Valve* Double-action pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 11 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 24	VL12	Controls vacuum on sample head waste. *Type of Valve* Double-action pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 12 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 25	VL13	Controls sample pressure to heads. *Type of Valve* Double-action pinch valve controlled by an electro-pneumatic valve (solenoid/pilot actuator combination valve)	VL 13 inside the LOWER PNEUMATICS DRAWER block on PN 6320886

Table A.5-15 Components in the Lower Pneumatics Drawer and Their Functions *(Continued)*

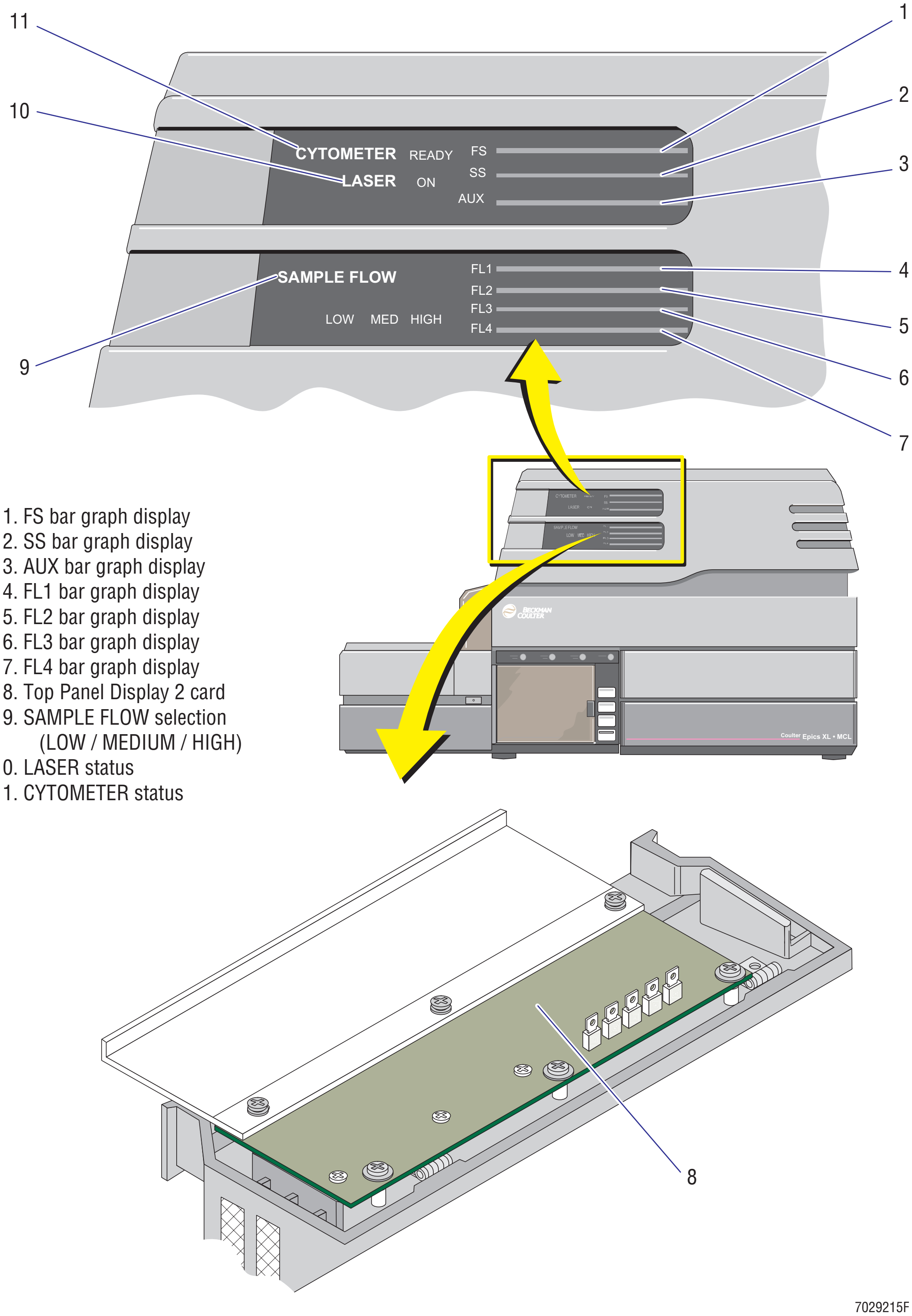
Figure Reference	Component	Function	Reference Designator
A.5-15, 26	12 insert fitting plate	Plate contains a captive knurl knob with fitting inserts at QD76, QD77, QD78, QD79, QD81, QD82, QD83, QD85, QD86, and QD88. • QD76 couples with QD50 on the 45° angled bracket • QD77 couples with QD51 on the 45° angled bracket • QD78 couples with QD52 on the 45° angled bracket • QD79 couples with QD53 on the 45° angled bracket • QD81 couples with QD55 on the 45° angled bracket • QD82 couples with QD56 on the 45° angled bracket • QD83 couples with QD57 on the 45° angled bracket • QD85 couples with QD59 on the 45° angled bracket • QD86 couples with QD60 on the 45° angled bracket • QD88 couples with QD62 on the 45° angled bracket **Note:** The opening at QD87 is empty. The knurl knob occupies QD83.	QD 76, QD 77, QD 78, QD 79, QD 81, QD 82, QD 83, QD 85, QD 86, and QD 88 are to the right of the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 27	5 insert fitting plate	Only used if the MCL option is installed. Plate contains a captive knurl knob with fitting inserts at QD68, QD71, and QD89. • QD68 couples with QD42 on the 45° angled bracket • QD71 couples with QD45 on the 45° angled bracket • QD89 couples with QD63 on the 45° angled bracket **Note:** The openings at QD80 and QD84 are empty.	QD 89, QD 68, and QD 71 are to the right of the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 28	Upper 6 insert fitting plate	Plate contains a captive knurl knob with fitting inserts at QD66, QD67, QD74, and QD75. • QD66 couples with QD40 on the 45° angled bracket • QD67 couples with QD41 on the 45° angled bracket • QD74 couples with QD48 on the 45° angled bracket • QD75 couples with QD49 on the 45° angled bracket **Note:** The opening at QD70 is empty. The knurl knob occupies the remaining opening.	QD 66, QD 67, QD 74, and QD 75 are to the right of the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 29	Lower 6 insert fitting plate	Plate contains a captive knurl knob with fitting inserts at QD64, QD65, and QD72. • QD64 couples with QD38 on the 45° angled bracket • QD65 couples with QD39 on the 45° angled bracket • QD72 couples with QD46 on the 45° angled bracket **Note:** The openings at QD69 and QD73 are empty. The knurl knob occupies the remaining opening	QD 64, QD 65, and QD 72 are to the right of the LOWER PNEUMATICS DRAWER block on PN 6320886

Table A.5-15 Components in the Lower Pneumatics Drawer and Their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-15, 30	Waste chamber sensor	Often referred to as the eyeball sensor. Optical sensor monitors the level of sample waste from the sample head and flow cell. As the waste chamber is filling, the optical sensor is monitored. If the liquid level reaches the sensor, the fill operation should cease to prevent overfilling of the waste chamber.	SN 12 inside the LOWER PNEUMATICS DRAWER block on PN 6320886
A.5-15, 31	Waste chamber	Collects and isolates waste from the waste line of the sample heads until it can be routed to the external waste container.	VC 1 inside the LOWER PNEUMATICS DRAWER block on PN 6320886

Front Panel Display Components

Figure A.5-16 Front Panel Display Components (See Table A.5-16)



1. FS bar graph display
2. SS bar graph display
3. AUX bar graph display
4. FL1 bar graph display
5. FL2 bar graph display
6. FL3 bar graph display
7. FL4 bar graph display
8. Top Panel Display 2 card
9. SAMPLE FLOW selection (LOW / MEDIUM / HIGH)
10. LASER status
11. CYTOMETER status

Table A.5-16 Front Panel Display Components and Their Functions

Figure Reference	Component	Function	Reference Designator
A.5-16, 1	FS bar graph display	Forward scatter signal amplitude indicator. The bar graph shows the intensity of the signal that particles generate during sample analysis. • Low, off-scale signals are yellow. • On-scale signals are green. • High, off-scale signals are red. **Note:** If the indicator to the left of the FS label is green, the FS signal is assigned to AUX.	
A.5-16, 2	SS bar graph display	Side scatter signal amplitude indicator. The bar graph shows the intensity of the signal that particles generate during sample analysis. • Low, off-scale signals are yellow. • On-scale signals are green. • High, off-scale signals are red. **Note:** If the indicator to the left of the SS label is green, the SS signal is assigned to AUX.	
A.5-16, 3	AUX bar graph display	Auxiliary signal amplitude indicator. This is defined by the operator. Once defined, the indicator to the left of the parameter label glows green, indicating that signal is assigned to AUX. The bar graph shows the intensity of the signal that particles generate during sample analysis. • Low, off-scale signals are yellow. • On-scale signals are green. • High, off-scale signals are red.	
A.5-16, 4	FL1 bar graph display	Fluorescence 1 signal amplitude indicator. The bar graph shows the intensity of the signal that particles generate during sample analysis. • Low, off-scale signals are yellow. • On-scale signals are green. • High, off-scale signals are red. **Note:** If the indicator to the left of the FL1 label is green, the FL1 signal is assigned to AUX.	
A.5-16, 5	FL2 bar graph display	Fluorescence 2 signal amplitude indicator. The bar graph shows the intensity of the signal that particles generate during sample analysis. • Low, off-scale signals are yellow. • On-scale signals are green. • High, off-scale signals are red. **Note:** If the indicator to the left of the FL2 label is green, the FL2 signal is assigned to AUX.	

Table A.5-16 Front Panel Display Components and Their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-16, 6	FL3 bar graph display	Fluorescence 3 signal amplitude indicator. The bar graph shows the intensity of the signal that particles generate during sample analysis. • Low, off-scale signals are yellow. • On-scale signals are green. • High, off-scale signals are red. **Note:** If the indicator to the left of the FL3 label is green, the FL3 signal is assigned to AUX.	
A.5-16, 7	FL4 bar graph display	Only appears when the 4-color option is installed. Fluorescence 4 signal amplitude indicator. The bar graph shows the intensity of the signal that particles generate during sample analysis. • Low, off-scale signals are yellow. • On-scale signals are green. • High, off-scale signals are red. **Note:** If the indicator to the left of the FL4 label is green, the FL4 signal is assigned to AUX.	
A.5-16, 8	Top Panel Display 2 card	This circuit card provides a visual display for each parameter via LEDs mounted in a row format. As these LEDs glow, they reflect the direct signal amplitude in an image commonly referred to as a bar graph. The intensity of the parameter signal correlates with the number of LEDs glowing, which in turn, affects the length of the bar graph. A weak signal produces a short bar graph (because few LEDs are glowing); an intense signal produces a long bar graph (because more LEDs are glowing). This circuit card also provides visual indicators for selecting the rate of SAMPLE FLOW (Figure A.5-16, item 9), LASER status (Figure A.5-16, item 10), and CYTOMETER status (Figure A.5-16, item 11). A blue-ribbon cable connects the Top Panel Display 2 card to the Analyzer backplane. A 24 Vdc and 5 Vdc power connector are also attached to this circuit card.	

Table A.5-16 Front Panel Display Components and Their Functions *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.5-16, 9	SAMPLE FLOW selection (LOW / MED / HIGH)	Sample flow rate indicators. When, at the Workstation, the operator chooses a flow rate to control the speed of the sample delivery to the flow cell, the corresponding indicator (LOW / MED / HIGH) glows green at the Cytometer. When, at the Workstation, the user chooses a flow rate they are actually choosing the sample tube pressurization which in turn controls the speed of sample delivery to the flow cell. Approximations of the sample pressure and sample volume delivery when the sample pressure is properly calibrated (controlled electronically) follow: LOW = 3.72 psi MED = 3.92 psi HIGH = 4.12 psi.	
A.5-16, 10	LASER status	When the ON indicator glows green, the laser is on.	
A.5-16, 11	CYTOMETER status	When the READY indicator glows green, the Cytometer can be put in an operating mode.	

A.6 POWER SUPPLY MODULE COMPONENT LOCATIONS AND FUNCTIONS

Overview

The Power Supply module provides and monitors the main electronic and pneumatic power (vacuum and pressure) to the Cytometer. This section identifies the main components and/or assemblies in the Power Supply module, briefly describing their functions and showing their locations.

Main Power Supply Module Components

To expedite finding the name, location, or description of a component, the illustrations and tables in this section are organized according to major areas of the Power Supply module. Figure A.6-1 is the anchor illustration from which you can quickly access a specific illustration.

Figure A.6-1 is referred to as the anchor illustration because it serves as the reference point for accessing other illustrations. This anchor illustration uses an alphabetic letter to indicate a portion of the Power Supply module that correlates with a location description provided in the Figure Reference column. This description includes the figure reference that illustrates and provides the name of the main components located in this area of the Power Supply module.

Locating a Component

To quickly locate a component, always begin at the anchor illustration, Figure A.6-1.

1. On the anchor illustration, locate the area of the Power Supply module where the component in question is located and note the associated letter.
2. Locate the associated letter in the **Figure Reference** column and note the figure number.
3. Go to the referenced figure number.

   Note: In the electronic version, each figure reference is in hypertext so that when you select the reference, the illustration quickly appears.
4. Locate the component. The number associated with the component identifies its name and also provides a figure reference for locating the component's function on the associated table. Each table also includes the reference designator for the component, where applicable.

Power Supply Module Anchor Illustration

Figure A.6-1 Power Supply Module, Anchor Illustration for Locating Components

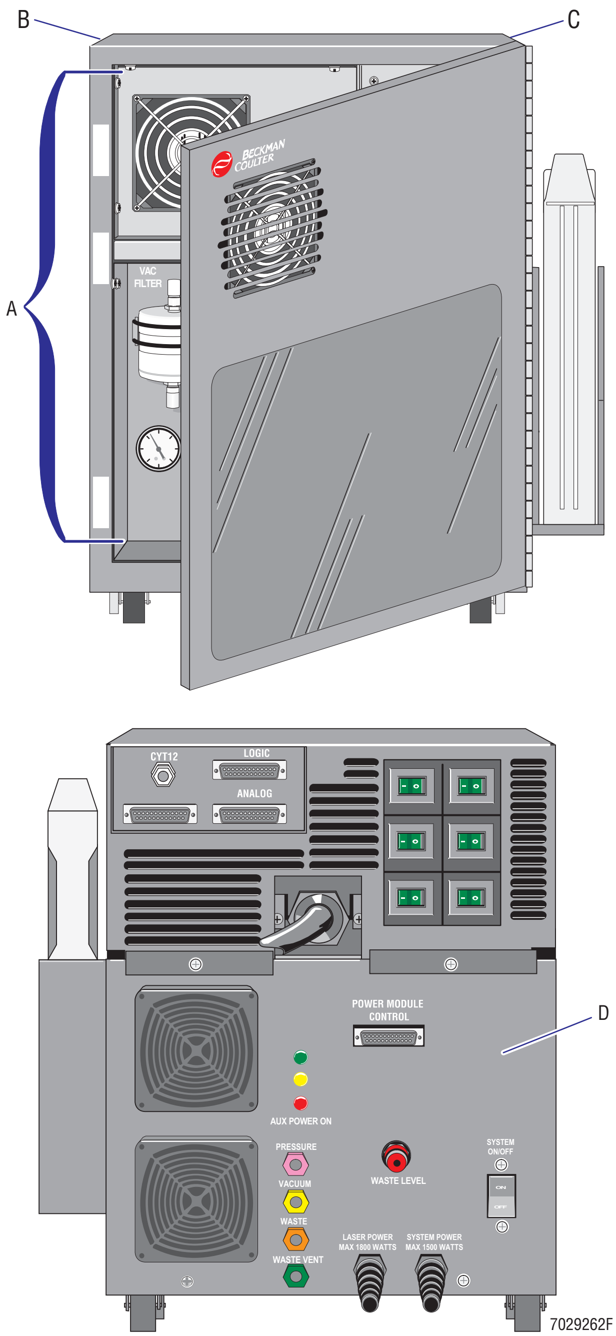


Figure Reference

A Components behind the front door, Figure A.6-2.

B Components in the left-side compartment, Figure A.6-3

C Components in the right-side compartment, Figure A.6-4

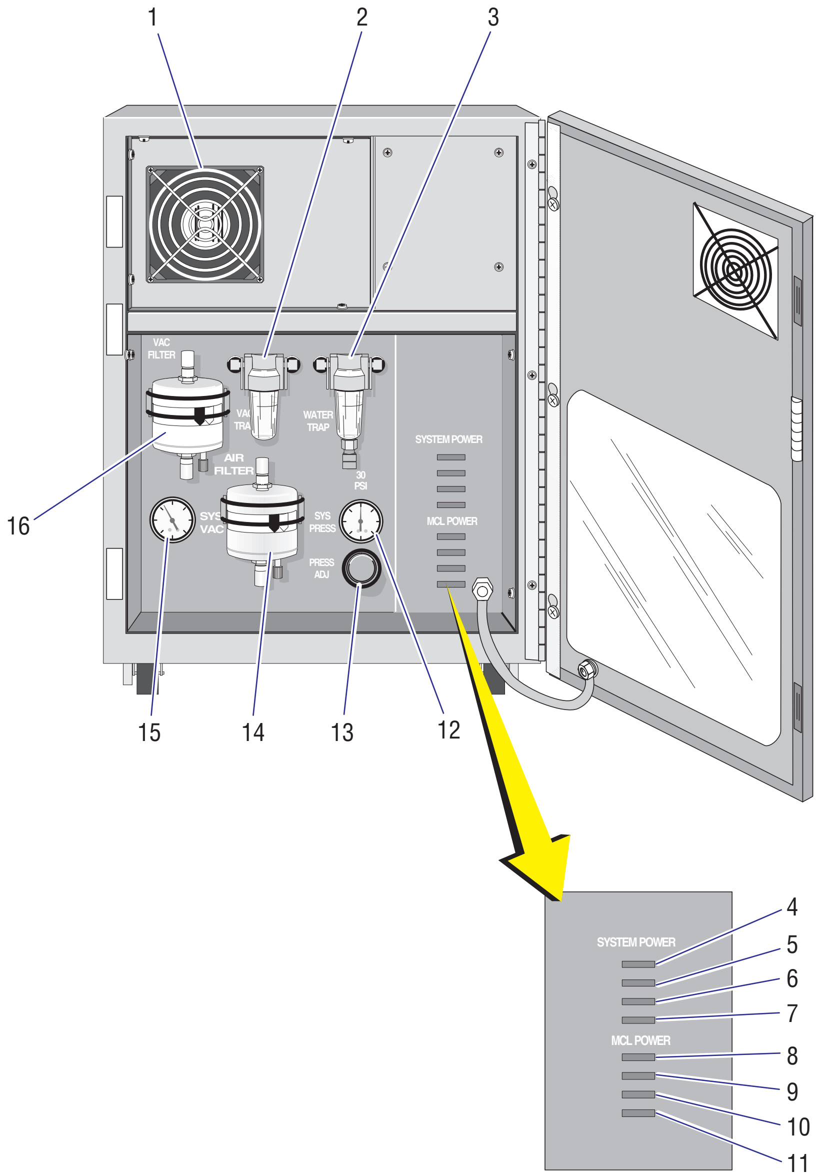
D Components on the rear panel, Figure A.6-5

Table A.6-1 Power Supply Module, Component and Assembly Accessibility

Figure Reference	Main Component or Assembly that is Accessible	To Access Component or Assembly
A.6-1, A	Various pneumatic components including: • Vacuum and water traps • System pressure and system vacuum gauges • System pressure adjust knob • Air and vacuum filters Voltage supply indicators for: • System power (+5 V, +15 V, -15 V, +24 V) • MCL power (+5 V, +12 V, -12 V, +24 V)	Open the front door.
A.6-1, B	Argon laser power supply Various pneumatic components including: • Compressor • VL31, VL30, VL32 Transient Voltage Suppressor 2 card Power Module Control or Power Module Control II card Voltage Selector card	Remove the three-sided cover.
A.6-1, C	Interlock bypass switch Cooling coil Power supplies including: • +24 Vdc system power supply • +5 Vdc system power supply • ±15 Vdc system power supply • +5 and ±12 Vdc MCL power supply • +24 Vdc MCL power supply	Remove the three-sided cover.
A.6-1, D	Connectors for MCL, CYT12, LOGIC, ANALOG, POWER MODULE CONTROL, and WASTE LEVEL Circuit breakers for: • +24 Vdc system power supply • +5 Vdc system power supply • ±15 Vdc system power supply • +5 (and ±12 Vdc) MCL power supply • +24 Vdc MCL power supply • compressor CYT12 ACTIVE, COMP ON, and AUX POWER ON indicators SYSTEM POWER cables PRESSURE, VACUUM, VENT, and WASTE quick-connects Cooling fans Laser umbilical cord	Exterior components that may require interior access for replacement.

Components Located Behind the Front Door of the Power Supply Module

Figure A.6-2 View of the Power Supply Module with the Front Door Open (See Table A.6-2)



1. Argon laser power supply
2. Vacuum trap
3. Water trap
4. SYSTEM POWER +5 V supply indicator
5. SYSTEM POWER +15 V supply indicator
6. SYSTEM POWER -15 V supply indicator
7. SYSTEM POWER +24 V supply indicator
8. MCL POWER +5 V supply indicator
9. MCL POWER +12 V supply indicator
10. MCL POWER -12 V supply indicator
11. MCL POWER +24 V supply indicator
12. System pressure gauge
13. System pressure adjust knob
14. Air filter
15. System vacuum gauge
16. Vacuum filter

7029178F

Table A.6-2 Components behind the Front Door of the Power Supply Module

Figure Reference	Component	Function	Reference Designator
A.6-2, 1	Argon laser power supply	Provides control and ac voltages to the Argon laser head.	
A.6-2, 2	Vacuum trap	Safety device to prevent liquid from entering the vacuum pump in the compressor/vacuum pump. As liquid (most likely from the vacuum chamber, VC 1, in the lower pneumatics drawer) fills the bowl, the float rises and occludes the high vacuum line. With the high vacuum line physically occluded, liquid cannot get pulled into the vacuum pump. However, if the float should get stuck and does not rise to occlude the opening, liquid can then enter the vacuum pump causing irreparable damage. The compressor/vacuum pump must be replaced.	FL 3 inside the POWER MODULE block on PN 6320886
A.6-2, 3	Water trap	Component may also be referred to as an air/water filter separator. Compressed air (pressure) generated by the compressor portion of the compressor/vacuum pump is hot. As the hot compressed air passes through the cooling coil, moisture in the air condenses. As the cooled air moves out of the cooling coil it is sent through the air/water filter separator to filter particles out of the air and to allow the heavier moisture to drop from the air to prevent internal rusting of components such as solenoids. When power to the Cytometer is on, solenoid VL 31 is energized, blocking the drain pathway into the waste tank. As a result, once every 24 hours, the customer must power off the Cytometer for 30 minutes to allow the moisture collected inside the water trap to drain through the now de-energized VL 31 into the waste tank.	FL 4 inside the POWER MODULE block on PN 6320886
A.6-2, 4	SYSTEM POWER +5 V voltage supply indicator	Indicates the presence or absence of +5 Vdc to the system. When +5 Vdc is available for use in the system, the SYSTEM POWER +5 V LED is lighted. If power is turned on and this LED is not lighted, either the +5 Vdc linear power supply has a problem or the SYSTEM POWER +5 V LED on the Voltage Supply Monitor card is defective.	
A.6-2, 5	SYSTEM POWER +15 V supply indicator	Indicates the presence or absence of +15 Vdc to the system. When +15 Vdc is available for use in the system, the SYSTEM POWER +15 V LED is lighted. If power is turned on and this LED is not lighted, either the ±15 Vdc linear power supply has a problem or the SYSTEM POWER +15 V LED on the Voltage Supply Monitor card is defective. **Note:** If the SYSTEM POWER -15 V LED is also out, the problem most likely involves the ±15 Vdc linear power supply.	

Table A.6-2 Components behind the Front Door of the Power Supply Module *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.6-2, 6	SYSTEM POWER -15 V supply indicator	Indicates the presence or absence of -15 Vdc to the system. When -15 Vdc is available for use in the system, the SYSTEM POWER -15 V LED is lighted. If power is turned on and this LED is not lighted, either the ±15 Vdc linear power supply has a problem or the SYSTEM POWER -15 V LED on the Voltage Supply Monitor card is defective. **Note:** If the SYSTEM POWER +15 V LED is also out, the problem most likely involves the ±15 Vdc linear power supply.	
A.6-2, 7	SYSTEM POWER +24 V supply indicator	Indicates the presence or absence of +24 Vdc to the system. When +24 Vdc is available for use in the system, the SYSTEM POWER +24 V LED is lighted. If power is turned on and this LED is not lighted, either the +24 Vdc linear power supply has a problem or the SYSTEM POWER +24 V LED on the Voltage Supply Monitor card is defective.	
A.6-2, 8	MCL POWER +5 V supply indicator	Indicates the presence or absence of +5 Vdc to the MCL. When +5 Vdc is available for use by the MCL, the MCL POWER +5 V LED is lighted. If power is turned on and this LED is not lighted, either the MCL +5 Vdc linear power supply has a problem or the MCL POWER +5 V LED on the Voltage Supply Monitor card is defective. **Note:** If the MCL POWER +12 V and -12 V LEDs are also out, the problem most likely involves the MCL power supply. However, be aware that the ±12 Vdc section of the power supply may be operational even when the +5 Vdc portion is defective	
A.6-2, 9	MCL POWER +12 V supply indicator	Indicates the presence or absence of +12 Vdc to the MCL. When +12 Vdc is available for use by the MCL, the MCL POWER +12 V LED is lighted. If power is turned on and this LED is not lighted, either the MCL +12 Vdc linear power supply has a problem or the MCL POWER +12 V LED on the Voltage Supply Monitor card is defective. **Note:** If the MCL POWER -12 V and/or +5 V LEDs are also out, the problem most likely involves the MCL power supply. However, be aware that the +12 Vdc and -5 Vdc sections of the power supply may be operational even when the +12 Vdc portion is defective	

Table A.6-2 Components behind the Front Door of the Power Supply Module *(Continued)*

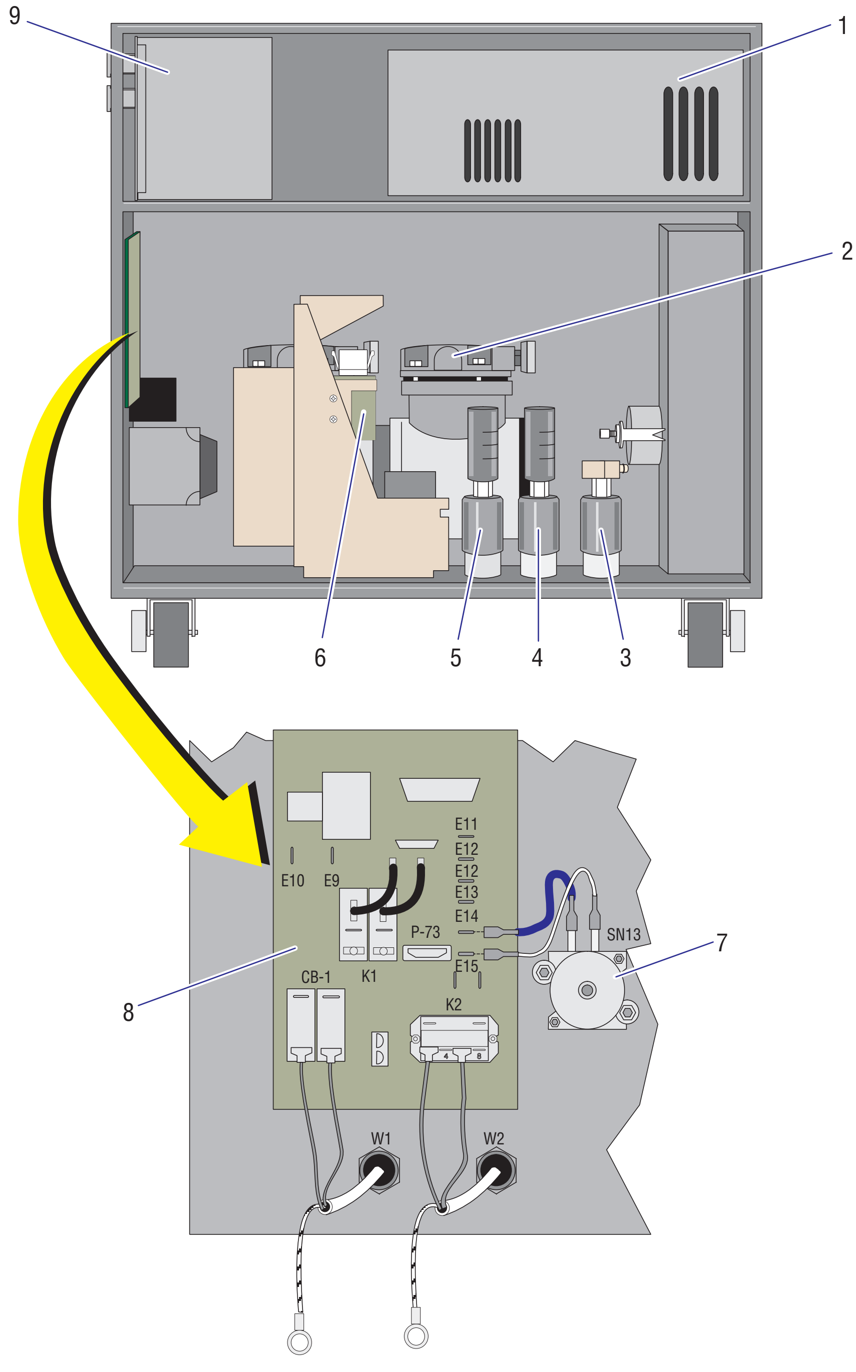
Figure Reference	Component	Function	Reference Designator
A.6-2, 10	MCL POWER -12 V supply indicator	Indicates the presence or absence of -12 Vdc to the MCL. When -12 Vdc is available for use by the MCL, the MCL POWER -12 V LED is lighted. If power is turned on and this LED is not lighted, either the MCL -12 Vdc linear power supply has a problem or the MCL POWER -12 V LED on the Voltage Supply Monitor card is defective. **Note:** If the MCL POWER +12 V and/or +5 V LEDs are also out, the problem most likely involves the MCL power supply. However, be aware that the +12 Vdc and +5 Vdc sections of the power supply may be operational even when the -12 Vdc portion is defective	
A.6-2, 11	MCL POWER +24 V supply indicator	Indicates the presence or absence of +24 Vdc to the MCL. When +24 Vdc is available for use by the MCL, the MCL POWER +24 V LED is lighted. If power is turned on and this LED is not lighted, either the MCL +24 Vdc linear power supply has a problem or the MCL POWER +24 V LED on the Voltage Supply Monitor card is defective.	
A.6-2, 12	System pressure gauge	External 0 to 60 psi gauge for monitoring the system pressure output from the compressor portion of the compressor/vacuum pump. 30 psi is the recommended pressure for normal operation. If the pressure falls below 28 psi, the *System Pressure Error* message appears on the Workstation screen to alert the operator.	GA 2 inside the POWER MODULE block on PN 6320886
A.6-2, 13	System pressure adjust knob	Knob used to manually adjust the pressure release valve (VL34). Adjusting VL34 produces a controlled air leak that lowers the 60 psi output from the compressor portion of the compressor/vacuum pump to the pressure registered on the system pressure gauge. Acceptable pressure for operation (that is, the pressure input needed to the Cytometer for proper operation) is 28 to 32 psi.	VL 34 inside the POWER MODULE block on PN 6320886
A.6-2, 14	Air filter	Hydrophobic gas filter removes contaminants in the air being displaced as waste from the Cytometer enters the waste container (waste tank).	FL 1 inside the POWER MODULE block on PN 6320886
A.6-2, 15	System vacuum gauge	External 0 to 30 in. Hg gauge for monitoring the system vacuum created by the vacuum portion of the compressor/vacuum pump. A minimum 17 in. Hg is recommended for normal operation. If the vacuum is too low for proper operation, the *System Vacuum Error* message appears on the Workstation screen to alert the operator.	GA 1 inside the POWER MODULE block on PN 6320886

Table A.6-2 Components behind the Front Door of the Power Supply Module *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.6-2, 16	Vacuum filter	Hydrophobic gas filter removes any particles or moisture in the vacuum line before it reaches the system vacuum gauge and the vacuum head of the compressor/vacuum pump.	FL 2 inside the POWER MODULE block on PN 6320886

Components in the Left Side of the Power Supply Module

Figure A.6-3 Left Side View of the Power Supply Module with Cover Removed (See Table A.6-3)



1. Argon laser power supply
2. Compressor
3. VL31
4. VL30
5. VL32
6. Transient Voltage Suppressor 2 card
7. SN13
8. Power Module Control card or Power Module Control II card
9. Voltage Selector card

7029179F

Table A.6-3 Components in the Left Side of the Power Supply Module

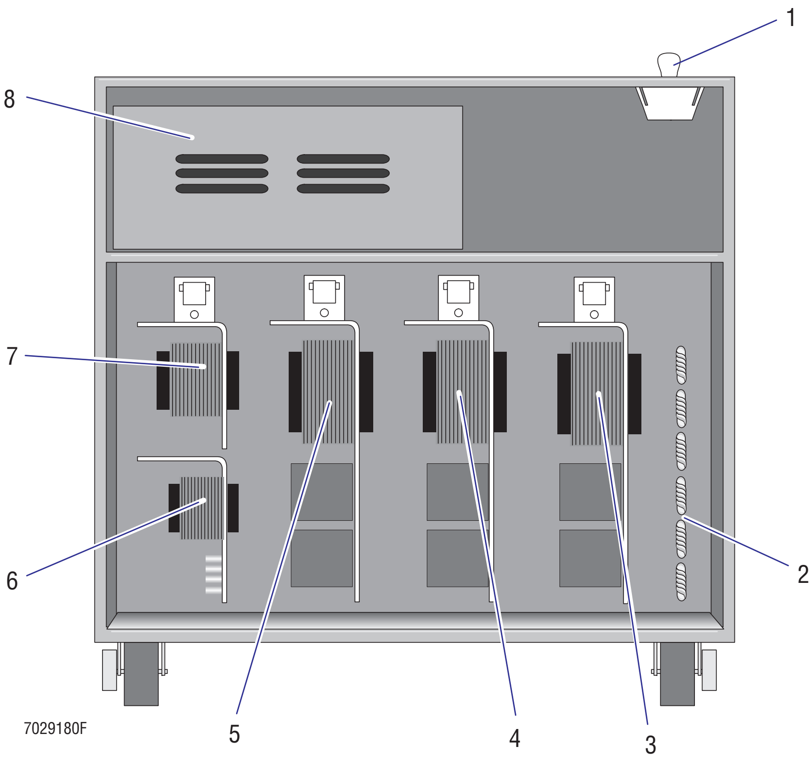
Figure Reference	Component	Function	Reference Designator
A.6-3, 1	Argon laser power supply	Provides control and ac voltages to the Argon laser head.	
A.6-3, 2	Compressor	Dual-head compressor/vacuum pump. The compressor head supplies the 60 psi that is regulated to the 30 psi and the vacuum head supplies the high vacuum (at least 17 in. Hg) needed for proper operation of the Cytometer.	PM 1 inside the POWER MODULE block on PN 6320886
A.6-3, 3	VL31	Two-way, normally-open solenoid valve that serves as a dump valve to empty the water trap. *Energized* - When power to the Cytometer is on, solenoid VL 31 is energized, blocking the drain pathway from the water trap to the waste tank. *De-energized* - Once every 24 hours, the customer must power off the Cytometer for 30 minutes to allow the moisture collected inside the water trap to drain through the now open VL 31 into the waste tank.	VL 31 inside the POWER MODULE block on PN 6320886
A.6-3, 4	VL30	Two-way, normally-open solenoid valve that serves as a dump valve to quickly release pressure from the system to the atmosphere when the power to the Cytometer is turned off. *Energized* - When power to the Cytometer is on, solenoid VL 30 is energized to block the pressure release pathway to atmosphere so that proper system pressure can be maintained. *De-energized* - When power to the Cytometer is turned off, air pressure inside the system is allowed to quickly escape to atmosphere through the now open VL 30.	VL 30 inside the POWER MODULE block on PN 6320886
A.6-3, 5	VL32	Two-way, normally-open solenoid valve that serves as a dump valve that allows air to enter the system and equalize residual vacuum to the current atmospheric pressure when the power to the Cytometer is turned off. *Energized* - When power to the Cytometer is on, solenoid VL 32 is energized to block air from entering the system so that proper system vacuum can be maintained. *De-energized* - When power to the Cytometer is turned off, atmospheric air is allowed to enter the system through the now open VL 32. Residual vacuum is quickly equalized to the current atmospheric pressure.	VL 32 inside the POWER MODULE block on PN 6320886

Table A.6-3 Components in the Left Side of the Power Supply Module *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.6-3, 6	Transient Voltage Suppressor 2 card	Also referred to as the Transient Absorber EMC card, this small circuit card is mounted to the ac line filter bracket. This card protects the internal system from high voltage transients that may occur on the ac voltage input provided by the laboratory's power source. **Note:** This circuit card is found in XL and XL-MCL instruments with the serial number Z09063 or higher. If the compressor assembly is replaced on XL and XL-MCL instrument with the serial number Z09062 or lower, this circuit card is part of the assembly but it is not connected.	
A.6-3, 6	SN13	Normally-open vacuum/pressure switch is used to detect a plug in the filtered waste tank (or container) vent line. Waste entering the waste tank displaces air inside the container through the air filter (labeled F1 on PN 6323706) on the front of the Power Supply module. If this air filter becomes clogged, the pressure building up inside the waste tank triggers SN13 and the *Waste Backpressure Error* message appears on the Workstation screen to alert the operator.	SN 13 inside the POWER MODULE block on PN 6320886
A.6-3, 7	Power Module Control card or Power Module Control II card	Circuit card that: • Provides power to the Voltage Selector card. • Interfaces the Cytometer to the Power Supply module. • Provides a relay for supplying ac to the Argon laser power supply. The same relay supplies ac to the HeNe power supply, if this option is installed.	
A.6-3, 8	Voltage Selector card	Selects the proper line voltage for the circuit breaker dedicated to that voltage.	

Components in the Right Side of the Power Supply Module

Figure A.6-4 Right Side View of the Power Supply Module with Cover Removed (See Table A.6-4)



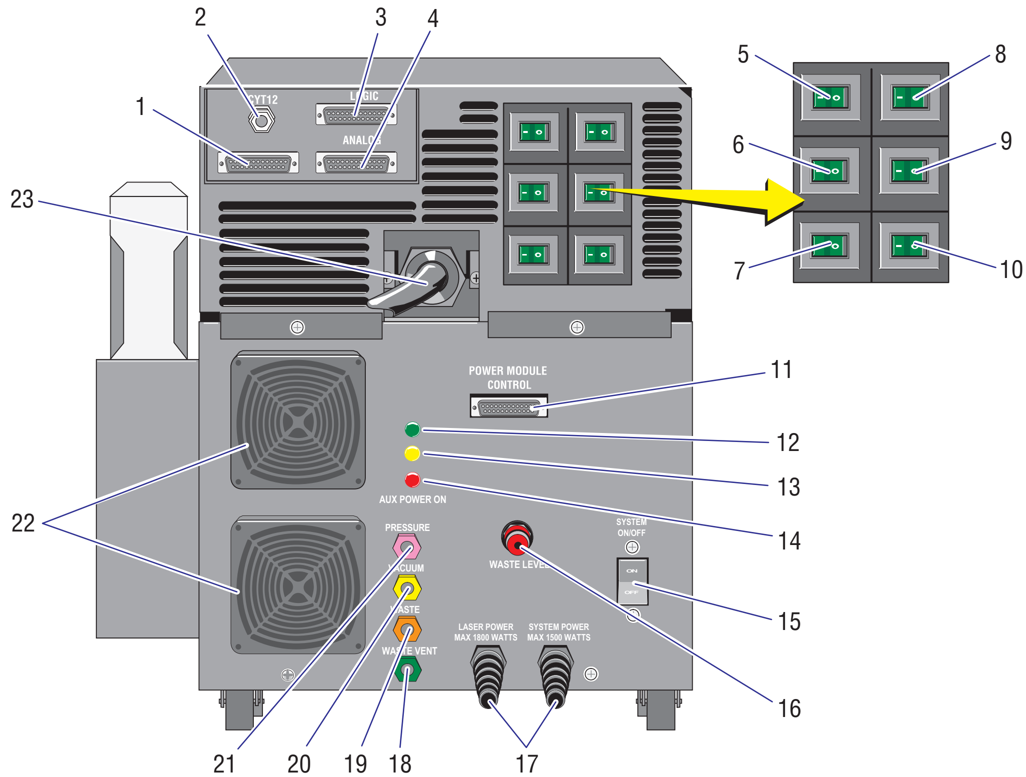
1. Interlock bypass switch
2. Cooling coil
3. +24 Vdc system power supply
4. +5 Vdc system power supply
5. ±15 Vdc system power supply
6. +5 and ±12 Vdc MCL power supply
7. +24 Vdc MCL power supply
8. Argon laser power supply

Table A.6-4 Components in the Right Side of the Power Supply Module

Figure Reference	Component	Function	Reference Designator
A.6-4, 1	Interlock switch	Safety interlock to ensure the three-sided cover is covering the components inside the Power Supply module 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. **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.	
A.6-4, 2	Cooling coil	Copper coil that provides a passageway for the hot compressed air (pressure) generated by the compressor portion of the compressor/vacuum pump to circulate while fans blow air across the coils to lower the temperature. As the hot compressed air passes through this cooling coil, moisture in the air condenses. As the cooled air moves out of the cooling coil it is sent through the air/water filter separator to filter particles out of the air and to allow the heavier moisture to drop from the air to prevent internal rusting of components such as solenoids.	COOLING COIL inside the POWER MODULE block on PN 6320886
A.6-4, 3	+24 Vdc system power supply	Receives ac supply voltage input and converts it to the +24 Vdc needed to power the solenoids and fans.	
A.6-4, 4	+5 Vdc system power supply	Receives ac supply voltage input and converts it to the +5 Vdc needed for the digital logic circuitry.	
A.6-4, 5	±15 Vdc system power supply	Receives ac supply voltage input and converts it to the +15 Vdc and -15 Vdc required to operate the analog devices, such as PMTs, DACs, and op amps.	
A.6-4, 6	+5 and ±12 Vdc MCL power supply	Receives ac supply voltage input and not only converts it to the +5 Vdc needed for the MCL CPU digital logic circuitry but also converts it to the +12 Vdc and -12 Vdc required to operate the bar-code scanner (or bar-code reader head).	
A.6-4, 7	+24 Vdc MCL power supply	Receives ac supply voltage input and converts it to the +24 Vdc needed to power the MCL solenoids.	
A.6-4, 8	Argon laser power supply	Provides control and ac voltages to the Argon laser head. Key must be in and rotated for the laser power to come on.	

Components on the Rear Panel of the Power Supply Module

Figure A.6-5 Rear View of the Power Supply Module (See Table A.6-5)



1. MCL connector
2. CYT12 connector
3. LOGIC connector
4. ANALOG connector
5. 24 VOLTS circuit breaker
6. COMPRESSOR circuit breaker
7. MCL 24 VOLTS circuit breaker
8. 5 VOLTS circuit breaker
9. 15 VOLTS circuit breaker
10. MCL 5 VOLTS circuit breaker
11. POWER MODULE CONTROL connector
12. CYT12 ACTIVE indicator lamp
13. COMP ON indicator lamp
14. AUX POWER ON indicator lamp
15. SYSTEM ON/OFF rocker switch
16. WASTE LEVEL connector
17. SYSTEM POWER cables
18. VENT quick-connect (green)
19. WASTE quick-connect (orange)
20. VACUUM quick-connect (yellow)
21. PRESSURE quick-connect (blue)
22. Fans
23. Laser umbilical cord

7029181F

Table A.6-5 Components on the Rear Panel of the Power Supply Module

Figure Reference	Component	Function	Reference Designator
A.6-5, 1	MCL connector	Provides the external interface from the Power Supply module to the MCL assembly. The cable attached to this connector passes +5 Vdc, ±15 Vdc, +24 Vdc, and ±12 Vdc. The CYT12 signal, which is also looped in this connector, enables a relay that provides power to the Cytometer.	
A.6-5, 2	CYT12 connector	Connector for the fiber optics cable that provides the external CYT12 interface between the computer system and the Power Supply module. When powering up the Cytometer, a signal is sent to the computer and to the Power Supply module enabling them to power up. If the CYT12 cable connecting the Workstation computer and the Power Supply module is loose or disconnected, the system will not power up the Cytometer and the Workstation comes up in listmode.	
A.6-5, 3	LOGIC connector	Provides the external connection from the Power Supply module to the Cytometer. The cable attached to this connector provides the +5 Vdc digital voltage and ground, as well as the connection for the Power Supply module safety interlock.	
A.6-5, 4	ANALOG connector	Provides the external connection from the Power Supply module to the Cytometer. The cable attached to this connector provides the analog system power, ±15 Vdc, +24 Vdc, ground, and the power supply sense lines.	
A.6-5, 5	24 VOLTS circuit breaker	Protects the Cytometer if a short occurs in the +24 Vdc supply circuitry. This is an electromagnetic breaker so it must be switched off then back on again to reset the circuit.	
A.6-5, 6	COMPRESSOR circuit breaker	Protects the compressor/vacuum pump if a short occurs in the ac supply lines or on the Power Module Control card. This is an electromagnetic breaker so it must be switched off then back on again to reset the compressor/vacuum pump.	
A.6-5, 7	MCL 24 VOLTS circuit breaker	Protects the MCL if a short occurs in the MCL +24 Vdc supply circuitry. This is an electromagnetic breaker so it must be switched off then back on again to reset the circuit.	
A.6-5, 8	5 VOLTS circuit breaker	Protects the Cytometer if a short occurs in the +5 Vdc supply logic circuitry. This is an electromagnetic breaker so it must be switched off then back on again to reset the circuit.	
A.6-5, 9	15 VOLTS circuit breaker	Protects the Cytometer if a short occurs in either the +15 Vdc or -15 Vdc supply circuitry. This is an electromagnetic breaker so it must be switched off then back on again to reset the circuit.	

Table A.6-5 Components on the Rear Panel of the Power Supply Module *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.6-5, 10	MCL 5 VOLTS circuit breaker	Protects the MCL if a short occurs in the MCL +5 Vdc, +12 Vdc, or -12 Vdc supply circuitry. This is an electromagnetic breaker so it must be switched off then back on again to reset the circuit.	
A.6-5, 11	POWER MODULE CONTROL connector	Provides the external connection from the Power Supply module to the Cytometer. At the Power Supply module, the cable attached to this connector provides a in-line connection with the Power Module Control card and the Argon laser (and HeNe laser, if installed) power supply. The cable interface provides the following signals: • Interlock • Laser Discharge • Idle On/Off • Light/Current • Laser Power Out • Laser Current Out • Laser Power In • Laser Current In • Compressor On • Laser Start	
A.6-5, 12	CYT12 ACTIVE indicator lamp	Indicates CYT12 is connected and active.	
A.6-5, 13	COMP ON indicator lamp	Indicates signal was sent to start the compressor.	
A.6-5, 14	AUX POWER ON indicator lamp	Indicates ac power to system.	
A.6-5, 15	SYSTEM ON/OFF rocker switch	Used to turn the Power Supply module on or off. • To supply ac to the Power Supply module, press the rocker switch to ON, position **I**. • To stop the supply of ac to the Power Supply module, press the rocker switch to OFF, position **O**.	
A.6-5, 16	WASTE LEVEL connector	Monitors level of system waste inside the external waste container.	
A.6-5, 17	SYSTEM POWER cables	Provides ac input to the Power Supply module and Argon laser power supply (as well as the optional HeNe power supply, if installed).	
A.6-5, 18	VENT quick-connect (green)	Provides back pressure vent to the external waste container.	QD 22 inside the POWER MODULE block on PN 6320886

Table A.6-5 Components on the Rear Panel of the Power Supply Module *(Continued)*

Figure Reference	Component	Function	Reference Designator
A.6-5, 19	WASTE quick-connect (orange)	Provides a pathway to the waste container for emptying waste that accumulates in the air/water separator (located on the front of the Power Supply module).	QD 20 inside the POWER MODULE block on PN 6320886
A.6-5, 20	VACUUM quick-connect (yellow)	Provides vacuum to the Cytometer.	QD 21 inside the POWER MODULE block on PN 6320886
A.6-5, 21	PRESSURE quick-connect (blue)	Provides 30 psi to the Cytometer.	QD 19 inside the POWER MODULE block on PN 6320886
A.6-5, 22	Fans	Provide air flow for cooling the inner compartments of the Power Supply module.	
A.6-5, 23	Laser umbilical cord	Connects the Argon laser head to the Argon power supply.	

A.7 HOT KEYS AVAILABLE WITH SYSTEM II™ SOFTWARE

ATTENTION: Hot Keys are not functional when the Acquisition screen is accessed using EXPO32™ software.

Acquisition Screen

The following Hot Keys are available when the Acquisition screen is displayed using SYSTEM II software.

Table A.7-1 Hot Keys Available When the Acquisition Screen is Displayed

Hot Keys	Access
Alt C	Cytosettings
Alt G	Run regions
Alt N	Panel
Alt P	Protocol
Alt R	Archive Status pop-up box
Alt T	Protocol
Alt U	Run
Alt V	Displays the current version of SYSTEM II software, the operating system, and Cytometer code for the XL or XL-MCL flow cytometer
Alt W	Worklist
Alt Z	Displays system error messages

Listmode Screen

The following Hot Keys are available when the Listmode screen is displayed using SYSTEM II software.

Table A.7-2 Hot Keys Available When the Listmode Screen is Displayed

Hot Keys	Access
Alt G	Analysis regions
Alt H	Analysis
Alt I	File information
Alt N	Panel
Alt P	Protocol
Alt R	Archive Status pop-up box
Alt T	Protocol
Alt U	Analysis
Alt V	Displays the current version of SYSTEM II software, the operating system, and Cytometer code for the XL or XL-MCL flow cytometer

B.1 FlowCentre™ II MULTIMEDIA WORKSTATION COMPUTER CONFIGURATION

The FlowCentre II Multimedia Workstation is a dual-boot system that features both Windows 98 and MS-DOS 6.22. The XL SYSTEM II software is loaded in MS-DOS 6.22 only and is not supported in the Windows 98 operating system.

The FlowCentre II computer chassis is now in a tower, not a desktop case. The computer consists of the following hardware as standard:

- AMI Megarum II Dual Pentium motherboard, utilizing the 440GX chipset, installed with one Pentium® III, 550 or 600 MHz processor (processor contains 512K of internal Cache)
- 100 MHz front side Bus
- 128 MB of PC100 System RAM, ECC correctable, registered
- 400 Watt power supply
- Two on–board IDE channels, supporting up to four hard drives
- Seven total expansion slots: one ISA slot, three PCI 32 bit slots, one PCI 64 bit slot, and one shared PCI 64 bit slot / PCI 32 bit slot

Installed Peripherals

- On-board SCSI channel, providing up to 80 MB per second transfer and supporting up to seven SCSI Devices (two SCSI Channels, only one will be utilized)
- 32 MB dual head display AGP video display adapter, providing support for up to two monitors
- Network Interface card, providing either 10 or 100 MB per second connectivity
- PCI Sound card

Installed Drives

- 13 GB Ultra ATA hard drive (installed as Ultra DMA Mode 2, 33 MB per second data transfer) minimum
- 1.44 MB 3.5-inch floppy drive
- 40x IDE CD-ROM drive minimum

Preloaded Software

- Windows 98 Operating System and MS-DOS 6.22 Operating System, with dual-boot menu
- XL SYSTEM II version 3.0

BIOS SETUP Defaults

The BIOS setup default is preset at the factory for optimal operation. If the BIOS setup information has been changed and is suspected of causing a problem, it can be restored to original factory default by selecting the option **AUTO CONFIGURATION WITH OPTIMAL SETTINGS** in the Main Menu of the system BIOS. To access the system BIOS, press Delete during boot up.

DEFAULT Settings for the System BIOS

Standard CMOS Setup

Floppy Drive A:	1.44 MB 3½
Floppy Drive B:	Not Installed
Pri Master (Primary Master Disk):	Auto
Pri Slave (Primary Slave Disk):	Not Installed
Sec Master (Secondary Master Disk):	Auto
Sec Slave (Secondary Slave Disk):	Not Installed
Boot Sector Virus Protection:	Disabled

Advanced CMOS Setup

Primary Display:	VGA / EGA
PS/2 Mouse Support:	Enabled
Display BIOS P. O. S. T. Messages:	Yes
Pause-On Configuration Screen:	2 sec
BootUp Num-Lock:	On
Password Check:	Setup
Boot to OS/2:	No
S.M.A.R.T. for Hard Disks:	Enabled
Quick Boot:	Enabled
1st Boot Device:	Floppy
2nd Boot Device:	ATAPI CDROM
3rd Boot Device:	1st IDE-HDD
4th Boot Device:	Disabled
Try other Boot Devices:	Yes
C000, 16K Shadow:	Cached
C400, 16K Shadow:	Cached
C800, 16K Shadow:	Cached
CC00, 16K Shadow:	Disabled
D000, 16K Shadow:	Cached
D400, 16K Shadow:	Cached
D800, 16K Shadow:	Cached
DC00, 16K Shadow:	Cached

Advanced Chipset Setup

USB Function:	Enabled
Onboard SCSI-1:	Enabled
Onboard SCSI-2:	Disabled
BX Master Latency Timer (Clks):	64
Multi-Trans Timer (Clks):	32
Graphics Aperture Size:	64MB
AGP Mlti-Trans Timer (AGP Clks):	32
AGP Low-Priority Timer (AGP Clks):	16

Power Management Setup

ACPI Aware O/S:	No
Power Management / APM:	Disabled
Power Button Function:	On/Off
Green PC Monitor Power State:	Off
Video Power Down Mode:	Disabled
Hard Drive Power Down Mode:	Disabled
Hard Drive Time Out (Minute):	Disabled
Power Saving Type:	POS
Standby/Suspend Timer Unit:	4 min
Standby Time Out:	Disabled
Suspend Time Out:	Disabled
Slow Clock Ratio:	50% - 62.5%
Display Activity:	Ignore
Device 6 (Serial port 1):	Ignore
Device 7 (Serial port 2):	Ignore
Device 8 (Parallel port):	Ignore
Device 5 (Floppy disk):	Ignore
Device 0 (Primary master IDE):	Ignore
Device 1 (Primary slave IDE):	Ignore
Device 2 (Secondary master IDE):	Ignore
Device 3 (Secondary slave IDE):	Ignore

PCI / Plug and Play Setup

AMI RAID Express Installed:	No
Plug and Play Aware O/S:	Yes
PCI VGA Palette Snoop:	Disabled
Allocate IRQ to PCI VGA:	No
Primary Bus Options	
USB Device Latency:	64
PCI Slot-1 Latency:	64
PCI Slot-2 Latency:	N/A
PCI Slot-3 Latency:	N/A
PCI Slot-4 Latency Timer:	64
AGP Slot IRQ Priority:	Auto
USB Device IRQ Priority:	Auto
PCI Slot-1 IRQ Priority:	Auto
PCI Slot-2 IRQ Priority:	N/A
PCI Slot-3 IRQ Priority:	N/A
PCI Slot-4 IRQ Priority:	Auto
Secondary Bus Options	
PCI SCSI-1 Latency:	64
PCI SCSI-2 Latency:	N/A
PCI Slot-5 Latency:	N/A
PCI Slot-6 Latency:	N/A
PCI SCSI-1 IRQ Priority:	IRQ 10
PCI SCSI-2 IRQ Priority:	N/A
PCI Slot-5 IRQ Priority:	N/A
PCI Slot-6 IRQ Priority:	N/A
Bus IRQ Resource Owner	
IRQ3:	PnP
IRQ4:	PnP
IRQ5:	ISA
IRQ7:	ISA
IRQ9:	Primary PCI
IRQ10:	Secondary PCI (greyed out)
IRQ11:	ISA
IRQ12:	PnP

IRQ14:	PCI
IRQ15:	PCI
DMA Resource Owner	
DMA Channel 0:	PnP
DMA Channel 1:	PnP
DMA Channel 3:	PnP
DMA Channel 5:	PnP
DMA Channel 6:	PnP
DMA Channel 7:	PnP
ISA Memory Resource	
Reserved ISA Card Memory Size:	16K
Reserved ISA Card Memory Address:	CC000

Peripheral Setup

OnBoard Floppy Controller:	Enabled
OnBoard Primary/Secondary IDE:	Both
IDE Bus Mastering:	Enabled
Primary Prefetch:	Disabled
Secondary Prefetch:	Disabled
OffBoard PCI/ISA IDE Card:	N/A
Primary/Secondary:	N/A
PCI IDE Card Primary IRQ:	N/A
PCI IDE Card Secondary IRQ:	N/A
OnBoard Serial Port1 IRQ:	IRQ 4
Serial Port1 Address:	3F8h
Serial Port1 FIFO:	Disabled
OnBoard Serial Port2 IRQ:	IRQ 3
Serial Port2 Address:	2F8h
Serial Port2 FIFO:	Enabled
Serial Port2 Mode:	Normal
IR Duplex Mode	N/A
IrDA Protocol:	N/A

OnBoard Parallel Port IRQ:	Disabled
Parallel Port Address:	N/A
Parallel Port Mode:	N/A
Parallel Port DMA Channel:	N/A
EPP Version:	N/A

WINDOWS 98 Configuration from Device Manager

Note: To access, select the Windows **Start** button ▸▸ **Settings** ▸▸ **Control Panel** ▸▸ **System** ▸▸ **Device Manager**.

Control Panel Setup, Device Manager, Computer

IRQ 00:	System Timer
IRQ 01:	Std 101/102 Key Keyboard
IRQ 02:	Programmable Interrupt Controller
IRQ 03:	Comm Port 2
IRQ 04:	Comm Port 1
IRQ 05:	Printer Port (LPT1)
IRQ 06:	Std Floppy Disk Controller
IRQ 07:	System Reserved
IRQ 08:	System CMOS / RTC
IRQ 09:	PCI Sound card
IRQ 09:	PCI Network Interface card
IRQ 09:	AGP Display Adapter
IRQ 10:	On Board SYMBIOS SCSI 1 Channel
IRQ 11:	System Reserved
IRQ 12:	PS/2 Mouse
IRQ 13:	Numeric Data Processor
IRQ 14:	Dual PCI-IDE Controller
IRQ 14:	Primary IDE Controller (DUAL FIFO)
IRQ 15:	Dual PCI-IDE Controller
IRQ 15:	Secondary IDE Controller (DUAL FIFO)

CONFIG.SYS Configuration

```
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\DOS\EMM386.EXE NOEMS X=D100-DCFF
BUFFERS=63,0
FILES=60
DOS=UMB

FCBS=4,0
REM DEVICE=C:\OAKCDROM.SYS /D:MSCD000
DOS=HIGH

REM THE NEXT 2 LINES ARE FOR LANTASTIC NETWORKING
REM DEVICEHIGH=C:\LANTASTI\PROTMAN.DOS /I:C:LANTASTI
REM DEVICEHIGH=C:\LANTASTI\EL90X.DOS
REM DEVICEHIGH /L:2,12048 =C:\DOS\SETVER.EXE
SHELL=C:\DOS\COMMAND.COM /P /E:1024
REM DEVICE=C:\LANTASTI\PROTMAN.DOS /I:C:\LANTASTI
REM DEVICE=C:\LANTASTI\EL90X.DOS

LASTDRIVE=Z
```

AUTOEXEC.BAT Configuration

```
@echo off
REM VERIFY ON
LH C:\APPS\MOUSE\MOUSE
REM THE NEXT LINE IS THE CD-ROM DRIVER
REM C:\DOS\MSCDEX.EXE /D:MSCD000
REM THE NEXT LINE ENABLES THE FONT FOR THE ELITE/ALTRA SOFTWARE
C:\MATROX\UTIL\VBEXT.EXE
PATH=C:\;C:\DOS;C:\XL;C:\APPS\MOUSE;C:\RTSQL
REM THE NEXT LINE IS FOR THE LANTASTIC NETWORK OPTION
REM call C:\LANTASTI\STARTNET.BAT

REM *** DATABASE ENVIRONMENT ***
SET SQLCONNECT=DBA,SQL,,
SET SQLPATH=C:\RTSQL
SET SQLSTART=C:\RTSQL\rtstart /q C:\XL\DBF\xl2.db
SET WSQL=C:\RTSQL
SET DOS16M=:3M

CD \XL
XL2
```

B.2 FlowCentre™ MULTIMEDIA WORKSTATION COMPUTER CONFIGURATION

The FlowCentre Multimedia Workstation is a dual-boot system that features both Windows 95 and MS-DOS 6.22. XL SYSTEM II software is loaded in MS-DOS 6.22 only and is not supported in the Windows 95 operating system.

In the FlowCentre computer, an Ultra ATA controller replaces the Caching controller used in the INTEL® Pentium® 166 processor. The Ultra ATA Controller features a 33 MB per second data transfer rate, to and from the PCI Bus to the Hard Drive.

The FlowCentre computer chassis is in a desktop case that contains an AMI ATLAS PCI III Motherboard with:

- 200 MHz INTEL Pentium processor
- 512 K pipeline burst cache
- 32 MB System Parity RAM (2 to 16 MB SIMMS@ 70 nS RAS), expandable up to 256 MB memory
- Three PCI, three ISA slots and one shared PCI/ISA slot (PCI bus conforms to the PCI 2.1 Specification)
- Four 72-pin memory SIMM sockets supporting up to 256 MB of Fast Page, ECC or EDO Ram
- Two on-board PCI-IDE connectors, supporting up to four large hard drives
- Two serial ports
- One bi-directional parallel port
- Two 4-pin connectors for a Universal Serial Bus
- PS/2 Mouse Support option
- One Keyboard Port
- AMI Plug and Play BIOS

Installed Peripherals

- PCI Ultra ATA Controller with 33 MB per second transfer rate
- PCI Video Display Adapter with 4 MB W-RAM
- PCI SCSI Host Adapter with support for optional Maxoptix Tahiti Optical Drives, 90/150 MB Bernoulli Drives or an optional Sony Spressa External Recordable CD-ROM Drive
- PCI Network Interface card (combo card) providing a maximum transfer rate of 10 MB per second
- Soundblaster Compatible Sound card with Wavetable Synthesis
- 33,600 BAUD FAX/Modem (requires an analog line at the Customer's Account)
- Black Windows 95 full-size keyboard
- PS/2 mouse

Installed Drives

- 32X Internal IDE CD-ROM drive
- 3.2 Gigabyte IDE hard drive, (mode 4)
- 1.44 MB floppy drive, 3.5-inch

Preloaded Software

- Windows 95 Operating System and MS-DOS 6.22 Operating System, with dual-boot menu
- XL SYSTEM II version 3.0
- Adaptec EZ-SCSI version 4.x (SCSI Host Adapter software are loaded in C:\SCSI.)
- Matrox Millenium PowerDesk (Software for Video Display Adapter.)
- 16 Bit Sound card software (Files for sound card are loaded in C:\PROGRAM FILES.)
- CONFIG.SYS and AUTOEXEC.BAT files (Backup CONFIG.SYS and AUTOEXEC.BAT files for XL are loaded in C:\XLCONFIG directory.)
- CONFIG.DOS and AUTOEXEC.DOS files (MS-DOS configuration files used when booting into MS-DOS 6.22.)
- FNT8X14 (Loads the 8X14 font for Video card.)
- MOUSE.SYS (Mouse driver for MS-DOS is loaded in C:\APPS\MOUSE.)
- ALTRA version 1.0

Circuit Card Locations

Slot	Circuit Card
PCI Slot 1 (slot closest to the Power Supply)	PCI Video Display Adapter
PCI Slot 2	PCI Ultra ATA Controller
PCI Slot 3	PCI SCSI Host Adapter
PCI Slot 4	PCI Network Interface
ISA Slot 1 (slot closest to the edge of the Motherboard)	Opto Transprocessor EXMEM or Opto Transprocessor EXMEM II (slot is free in the stand-alone Workstation)
ISA Slot 2	16 Bit Sound
ISA Slot 3	Modem
ISA Slot 4 (shared slot with PCI Slot)	Empty

BIOS Password

The BIOS is password protected. The password is AUER.

AMI WIN BIOS Configuration

Standard Setup

Pri Master (Primary Master Disk):	Auto
Pri Slave (Primary Slave Disk):	Not Installed
Sec Master (Secondary Master Disk):	Not Installed
Sec Slave (Secondary Slave Disk):	Not Installed
Floppy A: Drive:	1.44 MB 3½
Floppy B: Drive:	Not Installed

Advanced Setup

System Keyboard:	Present
Primary Display:	VGA / EGA
PS/2 Mouse Support:	Enabled
Setup Color Scheme:	LCD
Display BIOS P. O. S. T. Messages:	Yes
Display Add-On ROM Messages:	Yes
Pause-On Configuration Screen:	2 sec
BootUp Num-Lock:	On
Password Check:	Setup
Boot to OS/2:	No
Floppy Drive Seek:	Enabled
Floppy Drive Swap	Disabled
Floppy Access Control:	Read-Write
Hard drive Access Control:	Read-Write
S.M.A.R.T. for Hard Disks:	Enabled
1st Boot Device:	Floppy
2nd Boot Device:	CDROM
3rd Boot Device:	IDE-0
4th Boot Device:	Disabled
Try Other Boot Devices:	Yes
External Cache:	WriteBack
System BIOS Cacheable:	Enabled
Caching Controller:	Absent
Video Shadow C000, 32K:	Cached
Shadow C800, 16K:	Disabled

Shadow CC00, 16K:	Disabled
Shadow D000, 16K:	Disabled
Shadow D400, 16K:	Disabled
Shadow D800, 16K:	Disabled
Shadow DC00, 16K:	Disabled

Chipset Setup

Memory Hole:	Disabled
DRAM ECC Mode:	Enabled
USB Function:	Disabled
USB Keyboard / Mouse Legacy Support:	Disabled

Power Mgmt (Power Management) Setup

Power Management / APM:	Enabled (by default from DRAM ECC mode)
Instant-On Timeout (Minute):	N/A
Green PC Monitor Power State:	Standby
Video Power Down Mode:	Disabled
Hard Drive Power Down Mode:	Disabled
Hard Drive Time Out (Minute):	Disabled
Suspend Time Out:	Disabled
Slow Clock Ratio:	1:8
IRQ3:	Monitor
IRQ4:	Monitor
IRQ5:	Ignore
IRQ7:	Ignore
IRQ9:	Ignore
IRQ10:	Ignore
IRQ11:	Ignore
IRQ12:	Monitor
IRQ13:	Ignore
IRQ14:	Monitor
IRQ15:	Monitor

PCI / PnP Setup

PCI VGA Palette Snoop:	Disabled
PCI Slot-1 Latency Timer:	64
PCI Slot-2 Latency Timer:	64
PCI Slot-3 Latency Timer:	Empty Slot
PCI Slot-4 Latency Timer:	64
USB Device Latency Timer:	Disabled
USB Device IRQ Preference:	Disabled
PCI Slot-1 IRQ Preference:	Auto
PCI Slot-2 IRQ Preference:	Auto
PCI Slot-3 IRQ Preference:	Empty Slot
PCI Slot-4 IRQ Preference:	Auto
IRQ3:	PnP
IRQ4:	ISA
IRQ5:	PnP
IRQ7:	ISA
IRQ9:	PCI / PnP
IRQ10:	ISA
IRQ11:	ISA
IRQ12:	PnP
IRQ14:	PCI
IRQ15:	PCI / PnP
DMA CHANNEL 0:	PnP
DMA CHANNEL 1:	PnP
DMA CHANNEL 3:	PnP
DMA CHANNEL 5:	PnP
DMA CHANNEL 6:	PnP
DMA CHANNEL 7:	PnP
Reserved ISA Card Memory Size:	16K
Reserved ISA Card Memory Address:	CC000

Peripheral Setup

OnBoard Floppy Controller:	Enabled
OnBoard Primary/Secondary IDE:	Primary
OnBoard IDE BusMaster:	Enabled
IDE Bus Mastering:	Enabled
OnBoard Primary Prefetch:	Disabled
OnBoard Secondary Prefetch:	N/A
OffBoard PCI/ISA IDE Card:	N/A
OffBoard Primary/Secondary:	N/A
OffBoard PCI IDE Primary IRQ:	N/A
OffBoard PCI IDE Secondary IRQ:	N/A
Serial Port1 IRQ:	Disabled
Serial Port1 Address:	N/A
Serial Port1 FIFO:	N/A
Serial Port2 IRQ:	IRQ 3
Serial Port2 Address:	2F8h
Serial Port2 FIFO:	Enabled
Parallel Port IRQ:	IRQ 5
Parallel Port Address:	378h
Parallel Port Mode:	EPP
Parallel Port DMA Channel:	N/A
EPP Version:	1.7

Supervisor

Supervisor Password:	AUER

WINDOWS 95 Configuration from Device Manager

Note: To access, select the Windows **Start** button ▸▸ **Settings** ▸▸ **Control Panel** ▸▸ **System** ▸▸ **Device Manager**.

Control Panel Setup, Device Manager, Computer

IRQ 00:	System Timer
IRQ 01:	Std 101/102 Key Keyboard
IRQ 02:	Programmable Interrupt Controller
IRQ 03:	Comm Port 2
IRQ 04:	Comm Port 1
IRQ 05:	Printer Port (LPT1)
IRQ 06:	Std Floppy Disk Controller
IRQ 07:	Not to be allocated by Windows 95, must remain available
IRQ 08:	System CMOS / RTC
IRQ 09:	PCI ULTRA ATA Controller
IRQ 09:	PCI Network Interface card
IRQ 09:	PCI VGA Display Adapter
IRQ 10:	16 Bit Sound card
IRQ 11:	Not to be allocated by Windows 95, must remain available
IRQ 12:	PS/2 Mouse
IRQ 13:	Numeric Data Processor
IRQ 14:	Dual PCI-IDE Controller
IRQ 14:	Primary IDE Controller (Single FIFO)
IRQ 15:	PCI SCSI Host Adapter

CONFIG.SYS Configuration

```
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\DOS\EMM386.EXE NOEMS X=CA00-CAFF
BUFFERS=63,0
FILES=60
DOS=UMB
LASTDRIVE=Z
FCBS=4,0
REM DEVICE=C:\DOS\SETVER.EXE
DOS=HIGH
SHELL=C:\DOS\COMMAND.COM /P /E:1024

REM THE NEXT LINE ACTIVATES THE INTERNAL CD-ROM DRIVE
REM DEVICE=C:\SONY_CD\ATAPI_CD.SYS /D:MSCD000 /Q /I:0
REM DEVICEHIGH /L:1,40800 =C:\OAKCDROM.SYS /D:MSCD000

REM THE NEXT 2 LINES ARE FOR THE LANTASTIC NETWORK
REM DEVICE=C:\LANTASTI\PROTMAN.DOS /I:C\LANTASTI
REM DEVICE=C:\LANTASTI\EL90X.DOS

DEVICEHIGH /L:1,12048 =C:\DOS\SETVER.EXE
REM DEVICE=C:\LANTASTI\PROTMAN.DOS /I:C:\LANTASTI
REM DEVICE=C:\LANTASTI\EL90X.DOS
```

AUTOEXEC.BAT Configuration

```
@ECHO OFF
REM C:\DOS\SMARTDRV.EXE /X
PROMPT $P$G
SET TEMP=C:\DOS
PATH=C:\;C:\XL;C:\DOS;C:\RTSQL

REM THE NEXT LINE INSTALLS THE MOUSE DRIVER, V11.00
LH /L:0 C:\APPS\MOUSE\MOUSE
REM LH /L:1,27952 C:\DOS\MSCDEX.EXE /D:MSCD000
REM THE NEXT LINE IS FOR THE LANTASTIC NETWORK OPTION
REM call C:\LANTASTI\STARTNET.BAT
REM THE STARTNET.BAT FILE

REM C:\DOS\MSCDEX.EXE /D:MSCD000 /M:12 /V

REM *** DATABASE ENVIRONMENT ***
SET SQLCONNECT=DBA,SQL,,
SET SQLPATH=C:\RTSQL
SET SQLSTART=C:\RTSQL\rtstart /q C:\XL\DBF\xl2.db
SET WSQL=C:\RTSQL
SET DOS16M=:3M

CD \XL
XL2
```

B.3 INTEL® PENTIUM® 166 PROCESSOR CONFIGURATION

The INTEL Pentium 166 processor contains an AMI ATLAS PCI III Motherboard with:

- 166 MHz INTEL Pentium processor
- 512 K pipeline burst cache
- 16 MB system parity RAM (2 to 8 MB SIMMS at 70 ns RAS), expandable to 256 MB memory
- 3 PCI, 3 ISA slots and 1 shared PCI/ISA slot (PCI bus conforms to the PCI 2.1 Specification)
- 4, 72-pin memory SIMM sockets
- 2 on-board PCI-IDE controllers
- 2 serial ports
- 1 bi-directional parallel port
- Support for a Universal Serial Bus
- PS-2 Mouse Support Option (used only on the FlowCentre Multimedia Workstation)
- 1 keyboard port
- AMI Plug and Play BIOS.

Installed Peripherals

- PCI caching controller with 4 MB cache provides a sustained data transfer rate of 12 MB/sec
- PCI video display adapter with 2 MB W-RAM

Installed Drives

- 1.2 GB IDE hard drive (mode 4)
- 3.5 in. 1.44 MB floppy diskette drive card location.

Preloaded Software

- MS-DOS 6.22 Operating System
- MOUSE.SYS mouse driver

BIOS Password

The BIOS is password protected. The password is AUER.

AMI WIN BIOS Configuration

Standard Setup

Floppy A: Drive:	1.44 MB 3½
Floppy B: Drive:	Not Installed
Pri Master (Primary Master Disk):	Auto
LBA/LARGE Mode:	On
Block Mode:	Off
32-Bit Mode	Off
PIO Mode:	Mode 4
Pri Slave (Primary Slave Disk):	Not Installed
Sec Master (Secondary Master Disk):	Not Installed
Sec Slave (Secondary Slave Disk):	Not Installed

Advanced Setup

System Keyboard:	Present
Primary Display:	VGA / EGA
Setup Color Scheme:	LCD
Pause-On Configuration Screen:	2 sec
PS/2 Mouse Support	Disabled
BootUp Num-Lock:	On
Display BIOS P. O. S. T. Messages:	Yes
Password Check:	Setup
Boot to OS/2:	No
Floppy Drive Seek at Boot:	Enabled
Floppy Drive Swap	Disabled
Floppy Access Control:	Read-Write
Hard drive Access Control:	Read-Write
S.M.A.R.T. for Hard Disks:	Disabled
1st Boot Device:	IDE-0
2nd Boot Device:	Floppy
3rd Boot Device:	Disabled
4th Boot Device:	Disabled
Try Other Boot Devices:	No
External Cache:	WriteBack
System BIOS Cacheable:	Enabled

Caching Controller:	Present
Video Shadow C000, 32K:	Cached
Shadow C800, 16K:	Disabled
Shadow CC00, 16K:	Disabled
Shadow D000, 16K:	Disabled
Shadow D400, 16K:	Disabled
Shadow D800, 16K:	Disabled
Shadow DC00, 16K:	Disabled

Chipset Setup

Memory Hole:	Disabled
DRAM ECC Mode:	Enabled
USB Function:	Disabled
USB Keyboard / Mouse Legacy Support:	No Selection

Power Mgmt (Power Management) Setup

Power Management / APM:	Enabled (by default from DRAM ECC mode)
Video Power Down Mode:	Disabled
Hard Drive Power Down Mode:	Disabled
Hard Drive Time Out (Minute):	Disabled
Standby Time Out (Minute):	Disabled
Suspend Time Out:	Disabled

PCI / PnP Setup

PCI VGA Palette Snoop:	Disabled
PCI Slot-1 Latency Timer:	64
PCI Slot-2 Latency Timer:	64
PCI Slot-3 Latency Timer:	Empty Slot
PCI Slot-4 Latency Timer:	Empty Slot
USB Device Latency Timer:	No Selection
USB Device IRQ Preference:	No Selection
PCI Slot-1 IRQ Preference:	Auto
PCI Slot-2 IRQ Preference:	Auto
PCI Slot-3 IRQ Preference:	Empty Slot
PCI Slot-4 IRQ Preference:	Empty Slot
IRQ3:	No Selection
IRQ4:	No Selection
IRQ5:	No Selection
IRQ7:	ISA
IRQ9:	ISA
IRQ10:	PCI / PnP
IRQ11:	ISA
IRQ12:	PCI / PnP
IRQ14:	No Selection
IRQ15:	No Selection
DMA CHANNEL 0:	PnP
DMA CHANNEL 1:	PnP
DMA CHANNEL 3:	PnP
DMA CHANNEL 5:	PnP
DMA CHANNEL 6:	PnP
DMA CHANNEL 7:	PnP
Reserved ISA Card Memory Size:	16K
Reserved ISA Card Memory Address:	CC000

Peripheral Setup

OnBoard Floppy Controller:	Enabled
OnBoard Primary/Secondary IDE:	No Selection
OnBoard IDE BusMaster:	No Selection
OffBoard PCI/ISA IDE Card:	PCI Slot 1
OffBoard Primary/Secondary:	Both
OffBoard PCI IDE Primary IRQ:	Disabled
OffBoard PCI IDE Secondary IRQ:	Hardwired
Serial Port1 IRQ:	IRQ 4
Serial Port1 Address:	3F8h
Serial Port1 FIFO:	Disabled
Serial Port2 IRQ:	IRQ 3
Serial Port2 Address:	2F8h
Serial Port2 FIFO:	Enabled
Parallel Port IRQ:	IRQ 5
Parallel Port Address:	378h
Parallel Port Mode:	Normal
Parallel Port DMA Channel:	No Selection

Supervisor

Supervisor Password:	AUER

B.4 LANtastic® NETWORK OPERATING SYSTEM MINIMUM REQUIREMENTS

The following are the minimum requirements for the LANtastic network operating system (NOS) as provided by Artisoft, Inc. These are for a dedicated network server and do not include support for SYSTEM II software installed on the server.

DOS Requirements

- IBM® PC or compatible - 8086 or higher
- 640K available RAM (DOS)
- MS-DOS - 5.0 and higher
- Artisoft LANtastic NOS - 8.0
- 9.5 MB free hard disk space.

Windows Requirements

- IBM PC or compatible - 486/66 processor or higher
- 8 MB available RAM - minimum (16 MB recommended)
- Windows 95 or 98
- Artisoft LANtastic NOS - 8.0
- 12.5 MB free hard disk space.

B.5 Sybase® SQL ANYWHERE™ MINIMUM REQUIREMENTS

The following are the minimum requirements for the Sybase SQL Anywhere PC database server software as provided by Sybase, Inc. These are for a dedicated network server and do not include support for SYSTEM II software installed on the server.

Client Requirements

- IBM® PC or compatible
- MS-DOS - 3.3 and higher
- Windows 95 or higher (Windows 3.x, Windows NT 3.x, or OS/2 version 2.x or higher are also acceptable)
- 12 MB free hard disk space for DOS operating system
- 9 MB free hard disk space for Windows 95 or higher operating system.

Database Server Requirements

- IBM PC or compatible
- Intel 80386 or higher processor
- 8 MB available RAM
- MS-DOS - 3.3 and higher
- Windows 95 or higher (Windows 3.x, Windows NT 3.x, Novell NetWare version 3.11 or higher, DOS version 3.3 or higher, or OS/2 version 2.x or higher are also acceptable)
- 14 MB free hard disk space.

Network Requirements

- NetBIOS, TCP/IP, or Novell NetWare IPX (DOS clients support NetBIOS and IPX only).

C.1 WORKSHEETS

Field Engineer Worksheet

	FS		FL1		FL2		FL3		FL4	
Run #	HP CV	Mean Channel	HP CV	Mean Channel	HP CV	Mean Channel	HP CV	Mean Channel	HP CV	Mean Channel
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										
Add lines 0 through 9 to get TOTALS										
Totals										

Network Configuration Worksheet

Serial Number ________________________________

Network Node Name ________________________________

Server Attached To ________________________________

CPU Type ________________ RAM Size ________________

PRINTER TYPE ________________________________

LPT1 ________________________________

LPT2 ________________________________

DISK DRIVES

A: ________________

B: ________________

C: ________________

D: ________________

E: ________________

MS DOS Version ________________

Cytometer Software Version ________________

Network Node ID ________________

NETWORK INTERFACE CARD

Manufacturer ________________________________

Address ________________________________

IRQ ________________________________

I/O DEVICES

Device Name	Base I/O	IRQ

D.1 CLIENT FLOW CYTOMETER

Config.sys

```
DEVICE=C:\DOS\HIMEM.SYS
DOS=HIGH
DEVICE=C:\DOS\SETVER.EXE
FILES=60
BUFFERS=30
LASTDRIVE=Z
DEVICE=C:\APPS\MOUSE\MOUSE.SYS
DEVICE=C:\LAN\PROTMAN.DOS /I:C:\LAN
DEVICE=C:\LAN\ELNK3.DOS
```

Autoexec.bat

```
SET CGIPATH=C:\XL\GSS
@ECHO OFF
PROMPT $p$g
PATH C:\DOS
SET TEMP=C:\DOS
call C:\LAN\STARTNET.BAT
C:
kwcaf 500,100
cd \XL
XL2
```

Startnet.bat

```
@echo off
C:
cd C:\LAN

SET LAN_CFG=C:\LAN

rem If LANtastic is disabled, skip everything.
IF EXIST DISABLED GOTO :STARTNET_DONE

@echo ===== Begin LANtastic configuration =====

PATH C:\LAN;%PATH%

LOADHIGH AI-NDIS BIND_TO=ELNK3_NIF
AILANBIO @STARTNET.CFG

REDIR MYRA @STARTNET.CFG

NET USE S: \\JEEVES\E-DRIVE
NET USE T: \\Research_Lab\D-DRIVE
NET USE LPT2: \\Research_Lab\@PRINTER

rem If CONNECT.BAT exists, run it to set up connections.
IF EXIST CONNECT.BAT GOTO :CONNECT
```

```
rem Otherwise set up connections specified during install.
NET LPT TIMEOUT 10
GOTO :CONNECT_DONE

:CONNECT
@echo Setting up LANtastic connections from CONNECT.BAT
rem Build CONNECT.BAT like this: "NET SHOW/BATCH > C:\LAN\CONNECT.BAT"
rem   (or run the batch file SETNET.BAT)
call CONNECT.BAT

:CONNECT_DONE
NET POSTBOX

@echo ===== End LANtastic configuration =====

:STARTNET_DONE
cd \
```

XI_graph.cng

```
V=TS41024
S=SYS16.FNT
M=SYS24.FNT
L=P7x9.FNT
K=ROMANTRI.FNT
N=NET SHOW
```

D.2 FILE SERVER

Config.sys

```
DEVICE=C:\CORELDRV\ASPIDRV.SYS

DEVICE=C:\DOS\SETVER.EXE
DEVICE=C:\DOS\HIMEM.SYS
DOS=HIGH
FILES=100
BUFFERS=30
STACKS=9,256
LASTDRIVE=Z

DEVICEHIGH=C:\CORELDRV\UNI_ASP.SYS

DEVICE=C:\LANTASTI\PROTMAN.DOS /I:C:\LANTASTI
DEVICE=C:\LANTASTI\ELNK3.DOS

rem DEVICE=C:\CORELDRV\CUNI_ASP.SYS
```

Autoexec.bat

```
C:\DOS\SMARTDRV.EXE /X
@ECHO OFF
PROMPT $p$g
PATH c:\wsql40\win;C:\WINDOWS;C:\DOS
SET MSINPUT=C:\MSINPUT
C:\MSINPUT\MOUSE\MOUSE.EXE /Q
SET TEMP=C:\DOS
call C:\LANTASTI\STARTNET.BAT
cd c:
SET PATH=%PATH%;C:\CORELDRV
REM C:\CORELDRV\CORELCDX
c:\dos\doskey
SET WSQL=c:\wsql40
win c:\wsql40\win\dbservew -x netbios -n XL20_DBASE c:\wsql40\xl2.db
```

Startnet.bat

```
@echo off
C:
cd C:\LANTASTI

SET LAN_CFG=C:\LANTASTI

rem If LANtastic is disabled, skip everything.
IF EXIST DISABLED GOTO :STARTNET_DONE
```

```
@echo ===== Begin LANtastic configuration =====

PATH C:\LANTASTI;C:\LANTASTI\NW;%PATH%
SET LAN_DIR=C:\LANTASTI.NET
SET NWDBPATH=C:\LANTASTI\NW

LOADHIGH AI-NDIS BIND_TO=ELNK3_NIF
AILANBIO @STARTNET.CFG

REDIR RESEARCH_LAB @STARTNET.CFG

net use S: \\jeeves\e-drive

IF EXIST NOSHARE GOTO :NOSHARE
SERVER C:\LANTASTI.NET @STARTNET.CFG
NET LOGIN \\RESEARCH_LAB
GOTO :CONTINUE

:NOSHARE
@echo LANtastic server was installed but turned off.

:CONTINUE

rem If CONNECT.BAT exists, run it to set up connections.
IF EXIST CONNECT.BAT GOTO :CONNECT

rem Otherwise set up connections specified during install.
NET USE LPT1: \\RESEARCH_LAB\@PRINTER
NET LPT TIMEOUT 10
GOTO :CONNECT_DONE

:CONNECT
@echo Setting up LANtastic connections from CONNECT.BAT
rem Build CONNECT.BAT like this: "NET SHOW/BATCH > C:\LANTASTI\CONNECT.BAT"
rem   (or run the batch file SETNET.BAT)
call CONNECT.BAT

:CONNECT_DONE
NET POSTBOX

@echo ===== End LANtastic configuration =====

:STARTNET_DONE
cd \
```

E.1 802.3

Table E.1-1 802.3 Specifications

Item	10BASE5	10BASE2	10BASE-T
Data rate (MBPS)	10	10	10
Signaling type	Baseband/Manchester	Baseband/Manchester	Baseband/Manchester
Maximum segment length (meters)	500	185	100
Media	COAX (thick) 50 ohm RG-8, RG-11	COAX (thin) 50 ohm RG-58	UTP
Topology	Bus Requires transceivers	Bus Requires terminators	Star Requires a hub device
Number of nodes per segment/length	100 2.5 meters apart	30 0.5 meters apart	1 100 meters apart

F.1 BAR-CODE LABELS

A bar code consists of black lines (bars) and white lines (spaces), which are called elements. There are narrow elements (NE) and wide elements (WE). The bar-code symbology determines their arrangement.

IMPORTANT Possible incorrect sample identification. When sample tube bar-code labels do not follow the specification in this section, incorrect sample identification can occur. To prevent incorrect sample identification, your sample tube bar-code labels must follow the specifications listed in this section.

The XL-MCL flow cytometer supports preprinted labels (See Heading 8.1, MASTER PARTS LISTS, Table 8.1-9 for part numbers.)

Acceptable Bar Codes

The XL-MCL flow cytometer and the optional hand-held bar-code scanner automatically distinguish the bar-codes in Table F.1-1 with the specifications shown.

Table F.1-1 Acceptable Bar Codes

Bar Code	Specification
Code 39®	7 characters - maximum 6 data characters + 1 check character
Codabar	10 characters - maximum 9 data characters + 1 check character
Interleaved 2 of 5	14 characters - fixed 13 data characters + 1 check character
Code 128B	8 characters - maximum alphanumeric
Code 128C	16 characters - maximum numeric

Optical Characteristics of Bar-Code Labels

- Print Contrast Signal (PCS) - 80% minimum
- Reflectivity of Media (RW) - 80% minimum
- Reflectivity of Ink (RB) - 16% maximum
- No spots or voids; no ink smearing
- Edge roughness is included in the bar and space tolerances.

$$PCS = (RW - RB)/RW \times 100\%$$

Table F.1-2 Code-Related Specifications

Code	Interleaved 2-of-5*	Codabar*	Code 39*	Code 128 *
Narrow element (NE) width	0.010 in. ±0.001 in.	0.010 in. ±0.001 in.	0.010 in. ±0.001 in.	0.010 in. ±0.001 in.
Wide element/narrow element ratio (WE/NE)	3:1	N/A	3:1	N/A
Intercharacter gap	No	0.010 in. minimum	≥NE	No
Data digits	14†	1 to 10†	1 to 7†	2 to 16

* See AIM® USA uniform Symbology specification, Rev. 1993 for detailed specification.
† Includes check sum character.

NE (Narrow Elements) Width

0.01 in.

WE/NE (Wide Elements/Narrow Elements) Ratio

3:1

Printing Methods

Optional bar-code Printer. See Heading 3.11, BAR-CODE PRINTER OPTION for installation information.

Check Sum Algorithm

Use of bar codes is an extremely accurate and effective method of positive patient identification. Certain features, such as check sum digits, maximize accuracy in reading Codabar, Code 39 and Interleaved 2-of-5 labels. In one study, the use of check sum digits detected 97% of misread errors.

Beckman Coulter strongly recommends the use of bar-code check sums to provide automatic checks for read accuracy. Use check sums to provide protection against occasional misread errors caused by problems such as damaged or misapplied labels. If you must use bar codes without check sums, Beckman Coulter recommends that you verify each bar-code reading to assure correct patient identification.

F.2 MCL BAR-CODE SCANNER

Types of Scanners

The XL-MCL flow cytometer uses a visible laser-type scanner containing a Class II laser, operating at 670 nm, with a maximum power output of 1 mW. The MCL bar-code scanner is used on the XL-MCL flow cytometer only.

A hand-held bar-code scanner is available for use with either the XL or XL-MCL flow cytometer. The hand-held scanner uses a visible laser-type reader containing a Class II laser, operating at 670 nm, with a maximum power output of 1 mW. For more information, refer to Heading F.3, HAND-HELD BAR-CODE SCANNER OPTION.

Decoding

The XL-MCL flow cytometer sends a “GS” ASCII character (hexadecimal 1D) to the decoder to begin operation.

The decoder:

- Turns the scanner on.
- Decodes information that comes from the scanner.
- Keeps the scanner on for up to four seconds.
- Turns the scanner off.
- Sends the decoded information (or no-read message) to the XL-MCL flow cytometer.

Communication Protocol

Communication protocol is determined by the EEPROM (labelled U13) installed on the Bar-Code Decoder card. Two versions of this EEPROM are currently in use. The upgrade version, referred to as the ALL CODES EEPROM, has the OEM part number 35-213064-11 printed on the chip. The part number for the original version ends with 10 (OEM part number 35-213064-10).

For an Instrument with the ALL CODES EEPROM Installed

If the XL-MCL flow cytometer has the ALL CODES EEPROM (OEM part number 35-213064-11) installed on the Bar-Code Decoder card, use the following AUX port settings:

Bits per second:	9600
Parity:	None
Data bits:	8
Stop bits:	1
Flow control:	Xon/Xoff

For an Instrument with an Original EEPROM Installed

If the XL-MCL flow cytometer has the original EEPROM (OEM part number 35-213064-10) installed on the Bar-Code Decoder card, use the following AUX port settings:

Bits per second:	1200
Parity:	Odd
Data bits:	8
Stop bits:	1
Flow control:	Xon/Xoff

MCL Bar-Code Scanner Setup

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.

Default Configurations for the EEPROM

Table F.2-1 MCL Bar-Code Scanner - Default Configuration

	Bar-Code Symbology				
Item	**Code 39**	**Codabar**	**Interleaved 2 of 5**	**UPC**	**Code 128***
Code type	Enabled	Enabled	Enabled	Disabled	Enabled
Fixed length	Disabled	Disabled	N/A	N/A	Disabled
Code length #1	7	10	14	N/A	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

** Do not reprogram this symbology.*

Symbologies

IMPORTANT Possible incorrect identification of sample tubes. If sample tube bar-code labels use FNC1, FNC4, and FS (hexadecimal 1C) characters in the bar-code information, incorrect identification of sample tubes can occur. To prevent incorrect identification of sample tubes, do not use FNC1, FNC4, and FS (hexadecimal 1C) characters in your bar-code information.

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.

Special Considerations

When using one of these bar-code symbologies, consider the following:

- CODE 39 - Make sure the label does not interfere with carousel operation.
- Interleaved 2 of 5 - Character length must be an even number of characters, with or without the check digit.
- CODABAR - Make sure the label does not interfere with carousel operation.
- CODE 128 - Must always be enabled to read the carousel identification and tube position bar-code labels.

F.3 HAND-HELD BAR-CODE SCANNER OPTION

Types of Scanners

The hand-held bar-code scanner uses a visible laser-type reader containing a Class II laser, operating at 670 nm, with a maximum power output of 1 mW. This optional scanner may be attached to an XL or XL-MCL flow cytometer.

The XL-MCL flow cytometer also uses a visible laser-type scanner containing a Class II laser, operating at 670 nm, with a maximum power output of 1 mW. For more information, refer to Heading F.2, MCL BAR-CODE SCANNER.

Hand-Held Bar-Code Scanner Setup Parameters

Default Configurations

Table F.3-1 Hand-Held Bar-Code Scanner - Default Configuration

	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

General Parameters

Table F.3-2 Hand-Held Bar-Code Scanner - General Parameters

Item	Code*	Function
AUTOSENSE OPERATION	NN	Disabled
WEDGE MODE	CE	Enabled
BEEPER OPERATION	AD	Beeper ON; volume LOUD
INTERCHARACTER DELAY	GA	No intercharacter delay
PREFIX	IA	None
SUFFIX	MC	Suffix CR
TERMINAL ID	JA	Disabled
CODE IDENTIFIER	FA	Disabled
PREAMBLE	KA	None
POSTAMBLE	LA	None
POWER CONSUMPTION	@A	Enable full power
LASER REDUNDANCY	BE	Enable four times laser redundancy
SET LASER TIMEOUT	BH	Set scan beam timeout to six seconds

** Scan this code from the OEM User's Manual.*

Serial Communication Parameters

Not applicable.

Symbologies

IMPORTANT Possible incorrect identification of sample tubes. If sample tube bar-code labels use FNC1, FNC4, and FS (hexadecimal 1C) characters in the bar-code information, incorrect identification of sample tubes can occur. To prevent incorrect identification of sample tubes, do not use FNC1, FNC4, and FS (hexadecimal 1C) characters in your bar-code information.

Table F.3-3 Hand-Held Bar-Code Scanner - Symbologies

Item	Code*	Function
UPC (A & E)	QA	Disable UPC (both A & E)
EAN/JAN	RA	Disable EAN/JAN
CODE 39	0B	Enable standard CODE 39
CODE 39 CHECK CHARACTER	0E	Enable MODULO 43 check character
CODE 39 MINIMUM LENGTH	0H	Minimum length = 01
CODE 39 MAXIMUM LENGTH	0I	Maximum length = 06
CODE 39 START/STOP CHAR.	0F	Do not XMIT START/STOP character
CODE 39 CHECK CHARACTER	0K	Disable transmit of check character

** Scan this code from the OEM User's Manual.*

Table F.3-3 Hand-Held Bar-Code Scanner - Symbologies *(Continued)*

Item	Code*	Function
CODE I-2 0F 5	PC	Enable I-2 of 5 with check digit
CODE I-2 OF 5 MINIMUM LENGTH	PD	Minimum length = 14
CODE I-2 OF 5 MAXIMUM LENGTH	PE	Maximum length = 14
CODE I-2 OF 5 START/STOP CHAR.	P0	Disable 1-2 of 5 check digit transmission
CODE 2 OF 5 STANDARD	PF	Disable standard CODE 2 of 5
CODE 128	TB	Enable CODE 128
CODE 128 MINIMUM LENGTH	TC	Minimum length = 01
CODE 128 MAXIMUM LENGTH	TD	Maximum length = 10
CODABAR	VB	Enable CODABAR
CODABAR CHECK CHARACTER	VJ	Do not transmit check character
CODABAR CHECK CHARACTER	VI	Enable CODABAR check character
CODABAR MINIMUM LENGTH	VE	Minimum length = 01
CODABAR MAXIMUM LENGTH	VF	Maximum length = 09
CODABAR START/STOP XMIT	VC	Disable START/STOP XMIT
SYMBOLOGY IDENTIFIERS	FA	Disable XMIT of symbology identifiers

** Scan this code from the OEM User's Manual.*

Wand Emulation Parameters

Not applicable.

Keyboard Wedge Parameters

Table F.3-4 Hand-Held Bar-Code Scanner - Keyboard Wedge Parameters

Item	Code*	Function
WEDGE MODE	CE	WEDGE MODE enable
TERMINAL TYPE	CF	Enable PC-AT, PS/2 and 50/60/80
ALPHABETIC CHARACTERS	EP	Normal alphabetic characters

** Scan this code from the OEM User's Manual.*

Memory Module Set Up

Not applicable.

Supplemental Programming Symbols

Not applicable.

F.4 BAR-CODE PRINTER

Table F.4-1 Bar-Code Printer - DIP Switch Settings

Switch	Setting	Position	Function
1	OFF	Right	
2	OFF	Right	Sets BAUD rate to 9600
3	OFF	Right	
4	ON	Left	Sets Data Bit length to 8
5	ON	Left	Sets Parity to Disabled
6	ON	Left	
7	OFF	Right	Sets X ON/OFF Flow Control
8	OFF	Right	Sets no error detection

CONTENTS 10

The following list is a composite of the abbreviations, acronyms and reference designators used in this manual. When the same abbreviation (or reference designator) is used for more than one word (or type of component), all meanings relevant to this manual are included.

SYMBOLS

> - greater than

< - less than

≥ - greater than or equal to

% - percent

+ - plus

- - minus

± - plus or minus

°C - degrees Celsius

°F - degrees Fahrenheit

® - registered trademark

™ - trademark

µ - micron

µL - micro liter

µs- microsecond

A

A - ampere

ac - alternating current

ADC - analog-to-digital conversion

AMI - American Megatrends, Inc.

Amp - amplifier

AMPL. - amplifier

ANSI - American National Standards Institute

ASA - American Standards Association

ASCII - American Standard Code for Information Interchange

AUI - thick coaxial cable

AUX - auxiliary

B

baud - bits per second

BIOS - basic input/output system

BNC connector - bayonet Neil-Concelman connector

C

C - centigrade

CAR - carousel sensor

CD - collision detection

CD-ROM - compact disc - read only memory

CDRH - National Center for Devices and Radiological Health

CHL - channel

CLKS - clocks

cm - centimeter

CMOS - complimentary metal oxide semiconductor

COM - communication

CPU - central processing unit

CR - carriage return

CRBC - chicken red blood cells

CSMA - carrier sense multiple access

CTRL - control

CV - check valve; coefficient of variation

CYT - cytometer connector

Cyto - cytometer

D

DACs - digital-to-analog converters

dba - decibels a-weighted

DBUS - data bus

dc - direct current

DCN - document control number

DEC - Digital Equipment Corporation

DET - detector

DIN - Deutsche International Norm (German specification)

DIP switch - dual in-line package switch

DISTR. - distributor

DMA - direct memory address

DNA - deoxyribonucleic acid

DOS - disk operating system

DPI - dots per inch

DRAM - direct random access memory

DVM - digital volt meter

E

E - receptacle connector

ECC - electronic cycle check

EMI - electromagnetic interference

EEPROM - electronically erasable programmable read-only memory

EPROM - electronically programmable read-only memory

Err - error

ESD - electrostatic discharge

ETL - Electrical Testing Labs

EXMEM - extended memory

F

F - fahrenheit

FF - fitting

FIFO - first in, first out

FL - fluorescent light; fluorescent light sensor; fluorescent light signal

FRU - field replacable unit

FS - forward scatter; forward scatter sensors; forward scatter signals

ft - feet

G

gal. - gallon

G.F.C.I. - ground fault circuit interrupt

GND - ground

H

HM - home sensor

Hg - mercury

HISTO - histogram

HP - Hewlett Packard; half peak

HP CV - half peak coefficient of variation

HV - high voltage

Hz - hertz

I

i.d. - internal diameter

I/O - input/output

ID - identification

IDE - integrated drive electronics

IEEE - Institute of Electrical Engineers

in. - inches

in. Hg - inches/mercury

INTF - interface

IRQ - interrupt request

ISA - industry standard architecture

ISO - IsoFlow

J

J - receptacle connector

K

K - constant; thousand

KYBD - keyboard

L

lb/in. - pounds per inch

LAN - local area network

LBA - large block access

LCD - liquid crystal display

LED - light emitting diode; Artisoft line editor

LIS - laboratory information systems

LPT - parallel communications port

LPTINT - parallel communications port interrupt

LS - light scatter

LV - sensor; solenoid

M

M - Mega

MB - megabyte

MBPS - megabytes per second

MCL - multi-tube carousel loader

MHz - mega hertz

MIMD - multiple instruction multiple data

mL - milliLiter

mm - millimeter

MS-DOS - Microsoft-disk operating system

mV - milliVolts

mW - milliwatts

N

na - not applicable

ND - neural density filter

NDIS - Network Driver Interface Specification

NE - narrow elements

NEMA - National ELectronics Manufacturing Association

NIC - Network Interface card

nm - nanometer

NOS - network operating system

ns - nanosecond

Num - number

O

OEM - original equipment manufacturer

Opto - optical

P

P - receptacle connector; test point

PC - personal computer

PCB - printed circuit board

PCMCIA - Personal Computer Memory Card International Association

PCS - print contrast signal

PIO - programmed input/output

PMI - preventative maintenance inspection

PMT - photo-multiplier tube

PN - part number

PNP - plug and play

pot - potentiometer

PPM - pages per minute

PROM - programmable read-only memory

psi - pounds per square inch

R

R - potentiometer; resistor

RAM - random access memory

RAS - remote access services

RB - reflectivity of ink

REM - remark or comment

RG - pressure regulator

ROM - read only memory

RW - reflectivity of media

S

S - switch

SCSI - small computer system interface

SER - serial

SIMMs - single inline memory module

SQL - structured query language

SS - side scatter; side scatter sensor; side scatter signal

SVP - system verification procedure

SW - software; switch

T

TCP/IP - telecommunications protocol/Internet protocol

TEMP - temperature

TB - tube-position sensor

TP - test point

T.P. - twisted pair cable

Trans and Rec - transmit and receive

U

U - integrated circuit package

UL - Underwriter's Laboratory

UPC - universal product code

USB - universal serial bus

V

V - volts

Vac - volts alternating current

Vdc - volts direct current

VDI - video display interface

VGA - video graphics array

W

WAN - wide area network

WE - wide elements

X

X - receptacle connector

XMITTER - transmitter

This glossary is a collection of specialized terms, with their meanings. If a term has more than one meaning, all meanings relevant to this manual are included.

µL - Microliter, a unit of volumetric measurement equal to 10^{-6} liter.

µm - Micron or micrometer, a unit of linear measurement equal to 10^{-6} meter.

absorbance filter - A glass filter with a dye embedded in the glass. The dye converts the energy of certain wavelengths to heat and, under higher intensity, fluorescence.

acridine orange - A dye that binds to DNA and fluoresces green, or RNA and fluoresces orange. AO, the acronym for acridine orange, may be used interchangeably.

ADC - Advanced Digital Compensation is a feature of EXPO32™ ADC software, a software option available for XL and XL-MCL flow cytometer systems. This ADC feature allows the operator to set optimal voltages for the given application, monitor the voltages with Flow-Set fluorospheres, and set appropriate color compensation based on those voltages. The EXPO32 ADC system holds these cytosettings (2 color, 3 color or 4 color) in an ADC Settings file that can easily update other sample protocols when prompted.

ADC or A/D - The analog to digital conversion of a voltage level (0 to 10 volts) to a representative channel height (on the XL or XL-MCL flow cytometer from 0 to 1024). Also referred to as A to D.

allophycocyanin - An orange exciting, red fluorescing dye binding to protein. APC, the acronym for allophycocyanin, may be used interchangeably.

ambient temperature - Temperature in the surrounding environment.

amorphous region - An irregular plot encircling a portion of a two parameter histogram used to identify a population for gating or analysis.

analog-to-digital - The conversion of a voltage level (0 to 10 volts) to a representative channel height. Also referred to as A to D, A/D, or ADC.

antibody - A molecule produced by a B lymphocyte which binds very specifically to a binding site on an antigen that's on the surface of a cell.

antigen - A cell or part of living tissue foreign to the body such as a cell, virus, or bacteria.

AO - Acridine orange, a dye that binds to DNA and fluoresces green, or RNA and fluoresces orange.

APC - Allophycocyanin, an orange exciting, red fluorescing dye binding to protein.

aspheric lens - A lens whose shape departs slightly from a spherical form and is free from defects which distort the image of an object seen through the lens. It is generally used to collimate diverging light or focus collimated light. An example used is as a fluorescence pickup lens.

assay values - Values for a control established by extensive repeat testing of that control.

A to D - The analog-to-digital conversion of a voltage level (0 to 10 volts) to a representative channel height. Also referred to as A/D or ADC.

attenuation - A variable gain adjustment used typically with photocells.

autoexec.bat - Tells the computer how to start up and typically is used to execute the most commonly used program.

- Echo on displays the command currently executed.
- Verify on checks to see if data has been correctly written to disk and returns error message if not.
- Set path tells the computer where to search for command instructions.
- Prompt pg tells the system to display default drive followed by a > as a prompt.
- Commands load a particular program.

Aux signal - Auxiliary acquisition pathway that allows either control of simultaneous Linear and Log signals or acquisition of a Peak signal.

background count - Measure of the amount of electrical or particle interference.

band block filter - An optical filter that passes all colors except a narrow range of colors.

band pass filter - An optical filter that passes a narrow group of wavelengths and blocks the rest. Also referred to as a BP filter.

BK filter - A laser-blocking optical filter that passes the fluorescence wavelengths but does not pass the laser wavelength.

BP filter - A band-pass optical filter that passes a narrow group of wavelengths and blocks the rest.

block - A section of a disk track between two sectors (see format).

button - A named area on the Workstation screen (for example, a rectangle labeled Yes) that an operator selects to tell the instrument what to do.

channel - In an analog-to-digital converter, the number of equally spaced divisions of the amplified input signal voltage. All XL or XL-MCL flow cytometer signals are resolved into 1024 channels. For dual-parameter histograms, the number of channels is reduced to 64 or 256.

cleaning agent - A detergent used to flush sample from tubing and eliminate protein buildup.

click - To press and release a mouse button.

cm - Centimeter, a unit of linear measurement.

confocal - Having the same focal point; two lenses placed together with the same focal point would be referred to as confocal.

coefficient of variation (CV)

- An expression, in percent (%), of the data spread (variation) as related to the mean value. The standard formula for calculation:

$$CV = \frac{SD}{Mean} \times 100$$

- A measure of the variability in signal intensity that is generated as particles pass repeatedly through the laser beam. This variability is expressed as a percentage of the average signal intensity.

config.sys - Sets up search paths for devices and drivers.

- Buffers sets blocks for the computer to store data.
- Files sets the number of files the system may have open at the same time.
- Device drivers tell the operating system where to locate or search for the information to drive some external devices such as a mouse or optical drive.
- Any statement beginning with REM will not be executed. These statements are reminders to the programmer.

control - A substance with predetermined values used to monitor the performance of an analytical process (for example, CYTO-TROL™ control cells).

controls and indicators - Instrument controls are the mechanisms an operator uses to communicate with the instrument. Indicators are the mechanisms the instrument uses to communicate with the operator. Controls and Indicators is the first chapter of the Operator's Guide.

cross-cylindrical lenses - Used in the Cytometer to focus the laser beam and form an elliptical beam spot.

CV (coefficient of variation)

- Expressed as a percentage (%), is a measure of the data variation (data spread) as related to the mean value. The standard formula for calculation:

$$CV = \frac{SD}{Mean} \times 100$$

- A measure of the variability in signal intensity that is generated as particles pass repeatedly through the laser beam. This variability is expressed as a percentage of the average signal intensity.

cylindrical lens - A lens which looks like half a cylinder generally used to focus a laser beam.

Cytometer - The system component that analyzes the sample, and contains the sheath fluid and cleaning agent bottles.

CYTO-TROL™ control cells - Control cells with assayed values for certain antibodies which can be used as part of a quality control program for the cell surface marker application.

defaults - Original settings for the instrument. An operator may change these settings to customize the instrument for their laboratory.

deionized water - Water freed of salt and some organisms by an ion-exchange process. This water can be used interchangeably with distilled water in procedures. Also referred to as DI H_2O.

dichroic - A filter placed at a 45 degree angle to the incident light used to separate such light into two color bands, one reflected off and the other passing through the filter.

directory - A list, usually referring to items stored on a disk.

discriminator - A voltage level for a parameter measurement at or above which an event will be accepted and included in the data collected. Events below this level are discarded to eliminate signals caused by debris.

DISC SAT EXT - A discriminator satisfied extension is an operator set extension of the peak pulse discriminator window to ensure the integral signals will be properly captured.

distilled water - Water freed of solids and organisms by distillation. This water can be used interchangeably with deionized water in procedures.

DL filter - A dichroic, long-pass optical filter that directs light in different spectral regions to different detectors.

DOS - disk operating system, the basic computer software which allows the computer to recognize commands from the mouse or keyboard.

dynodes - Metal plates within a photomultiplier tube which help to generate a current flow proportional to the amount of light entering the tube.

ECD - Energy coupled dye, a tandem dye exciting at 488 nm and emitting at the orange end of the spectrum used with cell surface markers. For example, a phycoerythrin and Texas red combination.

electron - An elementary particle having a negative charge and found in the region around the nucleus of the atom.

emission curve - A plot of the relative fluorescent light intensity from a dye versus the wavelength of the light.

energy coupled dye - A tandem dye exciting at 488 nm and emitting at the orange end of the spectrum used with cell surface markers. ECD, the acronym for energy coupled dye, may be used interchangeably.

epitope - A binding site on the surface of a cell.

excitation curve - A plot of the amount of light energy absorbed by a dye versus the wavelength of the light.

EXPO32™ ADC software - A software option available for XL and XL-MCL flow cytometer systems. This acquisition, analysis, and Cytometer control software product with an Advanced Digital Compensation feature was developed by Applied Cytometry System (ACS) exclusively for Beckman Coulter. The software may also be used for data analysis on a stand alone PC that has Windows 95 or higher as its operating system.

FITC - Fluorescein isothiocyanate, **a** 488 nm excitable dye fluorescing in the green end of the spectrum used primarily for cell surface marker applications.

FL - Fluorescent light, the emission of electromagnetic radiation that occurs when the emitting body absorbs radiation from some other source. For example, when a fluorescent dye is excited (absorbs radiation), it emits fluorescent light at a wavelength that is different from the wavelength of the light that excited it.

flow cell - A device used to guide particles pass through a laser beam one at a time in a stream of fluid called sheath. This sheath fluid aligns the sample with the center of the flow cell.

flow cell tip - A removable device attached to the end of a flow cell which varies the sensing characteristics of a system.

Flow-Check™ fluorospheres - A 10 µm bead with a bright imbedded full-spectrum dye used to check the alignment of a flow system. Also referred to as Flow-Check beads.

Flow-Count™ fluorospheres - A 10 µm bead of known concentration that can provide an absolute count that is used to help an operator calculate the concentration of an unknown.

flow cytometry - A process for measuring the characteristics of cells or other biological particles as they pass through a measuring apparatus in a fluid stream.

Flow-Set™ fluorospheres - A 3.6 µm bead product with an imbedded dye used as a standard for cell surface marker type applications. Only 2% as bright as Flow-Check fluorospheres. Forward scatter (FS) and side scatter (SS) simulate lymphocytes. May be used to verify PMT operation. Also referred to as Flow-Set beads.

fluorescein isothiocyanate - A 488 nm excitable dye fluorescing in the green end of the spectrum used primarily for cell surface marker applications. FITC, the acronym for fluorescein isothiocyanate, may be used interchangeably.

fluorescence - The property of emitting electromagnetic radiation usually as visible light resulting from and occurring only during the absorption of radiation from some other source.

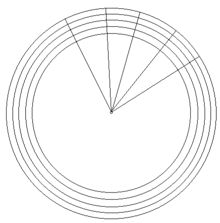
fluorescent compensation - When multiple dyes are used, one dye may interfere with another dye's measurement. If filters are unable to remove the interference, the interference can be removed electronically by subtracting a portion of one signal from another. Compensation can only be performed after filters are installed and high voltage to the PMTs is set.

fluorescent light - The emission of electromagnetic radiation that occurs when the emitting body absorbs radiation from some other source. For example, when a fluorescent dye is excited (absorbs radiation), it emits fluorescent light at a wavelength that is different from the wavelength of the light that excited it.

focal plane - A plane perpendicular to the axis of a lens or mirror and passing through the focal point of the lens or mirror.

focal point - A point at which the rays of light converge or from which they diverge; for example. light rays as they pass through a lens may converge on a point referred to as the focal point of the lens.

format - To lay out a disk in specific tracks, sectors, and blocks so that information can be systematically stored and retrieved to and from the disk.



forward scatter - Light primarily from the surface of a particle as it passes through a laser beam deflected at low angles and traveling in the same direction as the beam. The amount of scattered light is generally proportional to the size of the particle that scattered the laser light. FS, the acronym for forward scatter, may be used interchangeably.

forward scatter sensor - Collects the forward scatter and generates voltage pulse signals. Also referred to as the FS sensor.

FS - Forward scatter, laser light scattered at narrow angles to the axis of the laser beam traveling in the same direction as the beam. The amount of scattered light is generally proportional to the size of the particle that scattered the laser light.

ft - Foot or feet, a unit of linear measurement.

g - Gram, a unit of weight.

gain - The amount of amplification applied to a signal such as a pulse. In this case, a gain of 10 means the pulse height would be increase by a factor of 10. In linear amplification, all of a sensor's signals are increased by the same amount. Contrast with logarithmic amplification.

gating - The use of some criteria that must be met before an event is included in a specific histogram.

Gaussian distribution - A normal or symmetrical distribution; for example. a bell-shaped curve.

ground state - The energy level having the least energy of all its possible states and greatest stability. For example, the resting state of an atom is referred to as its ground state.

high voltage - Can be adjusted to change the sensitivity of a fluorescent light sensor.

histogram - The plot of the count of the number of pulses versus the corresponding channel heights (single parameter) or the plot of count of the number of events versus two channel height measurements simultaneously (two parameter).

histogram, light-scatter - A two dimensional graphic presentation of multidimensional accumulated data. Usually the X-axis is set to Side Scatter and the Y-axis is set to Forward Scatter.

hot keys - A shortcut for changing screens. Instead of using the menu bar to change screens, you can press and hold down ALT while pressing a certain letter key. For example, pressing ALT and F simultaneously displays the File menu.

hydrodynamic focusing - A process that focuses the sample stream through the flow cell. It involves the alignment and narrowing of a sample stream using a second coaxial liquid called sheath to ensure that cells move through the laser beam one at a time, along the same path.

HV - High voltage, a voltage (up to 2000 volts) applied to a PMT to adjust the sensitivity of the PMT.

Hz - Hertz, a unit of frequency.

IMMUNO-BRITE™ standard kit - A five level bead fluorescence product used to check the function of the log amplifiers.

immunofluorescence - Fluorescence as the result of, or identifying, an immune response.

immunophenotyping - Process of identifying/categorizing cells through the use of cell surface antigen marking.

in. - Inch, a unit of measure.

integral signal - A voltage pulse of which height and area are proportional to the total amount of fluorescent material in a cell.

integral pulse - The voltage level created as a particle passes through the beam representing the total amount of light generated by the particle. This pulse is created from the peak pulse and reaches its highest point as the particle exits the beam.

interference filter - A coated piece of glass in which certain wavelengths are reflected off the surface while others pass through.

ion - A charged particle.

kg - Kilogram, a unit of weight equal to 1,000 grams.

laminar flow - The flow of two liquids side by side in which one does not mix with the other.

laser - Light amplification by stimulated emission of radiation.

lb - Pound, a unit of weight.

linear amplification - See gain.

linear amplifier - A circuit which multiplies all pulses by the same amount (gain). Usually the amount is selected by the operator.

linear region - A channel range identifying a portion of a single parameter histogram to be used for analysis or gating purposes.

listmode - The digitized pulses for each parameter for each event; e.g. the raw data.

logarithmic amplification - A method of increasing the gain and dynamic range of a signal. A larger gain is applied to a sensor's smaller signals than to the sensor's larger signals. Also see gain.

long pass filter - A filter that reflects or absorbs short-wavelength light, but passes long-wavelength light. The long pass filter blocks wavelengths of light shorter than a designated reference wavelength and transmits wavelengths longer than the designated reference wavelength. These filters are identified by their 50% transmittance wavelengths. May also be referred to as an LP filter.

LP filter - A long-pass filter reflects or absorbs short-wavelength light, but passes long-wavelength light. The long pass filter blocks wavelengths of light shorter than a designated reference wavelength and transmits wavelengths longer than the designated reference wavelength. These filters are identified by their 50% transmittance wavelengths.

macro - A list of stored keystrokes which are used to reduce the number of operator selections when doing repetitive tasks.

mean - Arithmetic average of a group of data, such as the average channel value. Also see standard deviation and coefficient of variation.

menu - On a Workstation screen, a list of items from which you can choose.

metafile - A stored graphic representation of a screen display.

microprocessor - The integrated circuitry for electronically controlled devices.

mg - Milligram, a unit of weight equal to 10^{-3} gram.

mL - Milliliter, a unit of volumetric measurement equal to 10^{-3} liter.

mm - Millimeter, a unit of linear measurement equal to 10^{-3} meter.

monoclonal antibodies - Antibodies produced by a single cell or its identical progeny, specific for a given antigen.

mW - Milliwatt, a unit of power equal to 10^{-3} watt.

neutral density filter - A filter which equally reduces the intensity of all wavelengths of light. It is usually named by its power of ten reduction in the light intensity; for example, ND1 would reduce the light to 1/10 (10 to the -1 power) its original intensity. Also referred to as an ND filter.

ND filter - A neutral density filter which equally reduces the intensity of all wavelengths of light. It is usually named by its power of ten reduction in the light intensity; for example, ND1 would reduce the light to 1/10 (10 to the -1 power) its original intensity.

nm - Nanometer, a unit of linear measurement equal to 10^{-9} meter.

normalization - Applied to linear statistics from different histogram resolutions to ensure results are comparable. Scales to 1024.

optical filters - Mediums, such as glass, that separate fluorescent light by wavelength, which is measured in nanometers (nm). Also see BK, BP, and DL filters.

panel - A set of protocols to be used in sequence.

PE - Phycoerythrin, a dye exciting at 488 nm and emitting in the yellow end of the spectrum primarily used in cell surface marker applications.

peak channel - Channel on a histogram with the highest count.

peak pulse - The voltage generated by a sensor as a particle passes through a laser beam which rises to its highest point when the particle is at the center of the beam and falls to zero as the particle exits the beam. The pulse height indicates the maximum light produced by the particle and the width indicates the time necessary to pass through the beam.

peak signal - A voltage pulse of which height is proportional to the amount of light the cell scatters or fluoresces.

photocell - An optoelectrical device which generates an electrical voltage when light strikes it.

photodiode - Same as a photocell.

photomultiplier tube - A light-sensitive device that converts light energy into electrical current and generates a voltage pulse signal. Usually these devices are adjustable by setting a high voltage to optimize for the available light. This optoelectrical device generates an electric current proportional to the amount of light striking it and is connected to a circuit that converts the current pulse to a voltage pulse. Also referred to as a PMT.

phycoerythrin - A dye exciting at 488 nm and emitting in the yellow end of the spectrum primarily used in cell surface marker applications. Also referred to as PE.

PI - Propidium iodide, a DNA binding dye exciting at 488 nm and emitting in the orange end of the spectrum.

pickup lens/spatial filter assembly - Collects side scatter and fluorescent light from only the sensing area of the flow cell and collimates it.

PMT - Photomultiplier tube, a light-sensitive device that converts light energy into electrical current and generates a voltage pulse signal. Usually these devices are adjustable by setting a high voltage to optimize for the available light. This optoelectrical device generates an electric current proportional to the amount of light striking it and is connected to a circuit that converts the current pulse to a voltage pulse.

precision - A measure of the ability of the instrument to reproduce similar results when a sample is run repeatedly. May also be referred to as reproducibility.

prism - to separate out:

- Triangular glass used to separate multicolored light into the component colors or redirect a single color light to a different location.
- A circuit which separates multiple cell surface marker measurements into the possible marker phenotypes.
- Phenotype parameter for multicolor analysis.

propidium iodide - A DNA binding dye exciting at 488 nm and emitting in the orange end of the spectrum. Also referred to as PI.

protocol - A set of instructions; for example, a set of instructions to a computer on how to run a sample. A set of instructions that tells the Cytometer what and how to acquire data and relay listmode data.

psi - Pounds per square inch, a unit of pressure measurement.

QC - Quality control is a comprehensive set of procedures a laboratory sets up to ensure that an instrument is working accurately and precisely.

quad-stat - A set of two cursors dividing a two parameter histogram into four sections or quadrants.

quality control - A comprehensive set of procedures a laboratory sets up to ensure that an instrument is working accurately and precisely. QC, the acronym for quality control, may be used interchangeably.

queue - A list of selected items in a specific order.

RD1 - Red dye 1, a PE derivative.

rectilinear region - A box with four sets of channel coordinates describing a portion of a two parameter histogram to be used for analysis or gating.

reflection - Act of bending back; for example, the return of light from a surface.

refraction - Deflection from a straight path undergone by a light ray or energy wave in passing obliquely from one medium to another.

reproducibility - A measure of the ability of the instrument to recover similar results when a sample is run repeatedly. May also be referred to as precision.

resolution - The process or capability of distinguishing the individual components making up a data set. On a histogram, it refers to the ability to separate populations within the histogram.

ratio - A new parameter created by dividing the pulse height of one parameter by another. The resulting histogram scale is 0 to 1.

scattergram - A method of simultaneous pulse display of two parameters in which one parameter is displayed along the X-axis and the other along the Y-axis yielding a plot within the center of the screen.

scopegram - Same as scattergram.

scroll bar - The bar with an up and down arrow on the left of a window. The bar's arrows let you move (scroll) the window's content up or down so that you can see other parts of it. For example, the scroll bar in the Protocol Select window lets you scroll through the entire list of protocol names.

SD - Standard deviation, a measure of deviation from the mean. For example, a measure of the range of channel deviation within a measurement.

$$SD = \sqrt{\frac{\sum(\bar{x} - x)^2}{N - 1}}$$

sector - A specific radius of a disk (see format).

select - At the Workstation, select means to position the mouse cursor on an item, and then press and release a mouse button to choose that item. At the Cytometer screen, select means to touch the designated box.

sensitivity - The ability of the instrument to distinguish very low levels of light scatter and fluorescence from background light or electronic noise.

sheath - A liquid which surrounds and aligns another liquid.

sheath fluid - A balanced electrolyte solution.

short pass filter - A filter that reflects long-wavelength light, but passes short-wavelength light. The short pass filter blocks wavelengths of light longer than a designated reference wavelength and transmits wavelengths shorter than the designated reference wavelength. These filters are identified by their 50% transmittance wavelengths. May also be referred to as an SP filter

side scatter - The amount of laser light measured at about a 90° angle to the axis of the laser beam. The amount of side scatter is proportional to the granularity of the particle that scattered the laser light. May also be referred to as SS.

side scatter sensor - Collects the side scatter and generates voltage pulse signals. May also be referred to as the SS sensor.

SP filter - A short-pass filter reflects long-wavelength light, but passes short-wavelength light. The short pass filter blocks wavelengths of light longer than a designated reference wavelength and transmits wavelengths shorter than the designated reference wavelength. These filters are identified by their 50% transmittance wavelengths.

SS - Side scatter is the amount of laser light measured at about a 90° angle to the axis of the laser beam. The amount of side scatter is proportional to the granularity of the particle that scattered the laser light.

Standard Deviation - A measure of deviation from the mean. For example, a measure of the range of channel deviation within a measurement. SD, the acronym for standard deviation, may be used interchangeably.

$$SD = \sqrt{\frac{\sum(\bar{x} - x)^2}{N - 1}}$$

Texas red - A dye exciting at 595 nm and fluorescing in the orange end of the spectrum usually used with the cell surface marker application. TR, the acronym for Texas red, may be used interchangeably.

thiozole orange - An RNA binding dye exciting at 488 nm and fluorescing in the green end of the spectrum. TO, the acronym for thiozole orange, may be used interchangeably.

TO - Thiozole orange, an RNA binding dye exciting at 488 nm and fluorescing in the green end of the spectrum.

TR - Texas red, a dye exciting at 595 nm and fluorescing in the orange end of the spectrum usually used with the cell surface marker application.

track - A circular location on a disk (see format) where information is stored.

V - Volt, a unit of electrical potential difference measurement.

Vac - Alternating current voltage.

Vdc - Direct current voltage.

vernier - An additional scale to the main scale that allows for accurate fractional reading of the smallest division on the main scale. Allows for fine adjustments of the forward light scatter.

voltage pulse signals - The signals that the forward scatter, side scatter, and fluorescence sensors generate. They are proportional to the intensity of light the sensor received.

W - Watt, a unit of power.

Workstation - The system component that runs the software that lets an operator control the instrument. It displays sample results and other information.

Numerics

A

B

C

G

H

I

J

L

M

N

O

Q

W

X

TRADEMARKS

The BECKMAN COULTER logo, COULTER, COULTER CLENZ, CYTO-TROL, EPICS, EXPO, Flow-Check, FlowCentre, IsoFlow, SYSTEM II, XL and XL-MCL are trademarks of Beckman Coulter, Inc.

All other trademarks, service marks, products, or services are trademarks or registered trademarks of their respective holders.