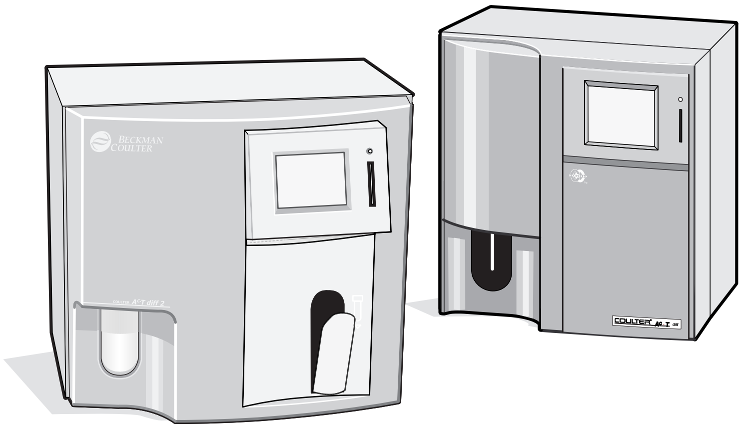
COULTER® A^c•T™ Series Analyzers

Service Manual



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BECKMAN COULTER™

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Initial Issue, 10/96
Software Version 1.03 (8)

Revision B, 4/97
Software Version 1.04 (8 and 10)
Numerous changes were made to this manual to reflect Software Version 1.04, and to keep it current and easier to use. A table of specific AC•T-related problems was added. The master parts list and the Index were updated. Actual text changes, were made on the following pages: Legal Notices, vi through viii, 1.1-14 through 1.1-3, 2.1-1, 2.6-1, 2.6-2, 5.1-1, 7.1-1, 7.1-4 through 7.1-7, 7.2-1, 7.2-1, 7.2-5, 7.2-6, A.3-1, B.1-1, B.1-2, and Trademarks.

Revision C, 11/97
Released by CN 034130-0069
Software Version 1.03 (diff)
A complete revision was made to this manual to reflect Software Version 1.03. This includes the AC•T diff™ Analyzer functionality and the differences between the AC•T 8/10 Analyzer and AC•T diff Analyzer functionality.

Revision D, 4/98
Released by CN 036420-0009
Software Version 1.04 (diff and diff/Veterinary option)
Numerous changes were made to this manual to reflect Software Version 1.04 and to address any Service Memos released since revision C. Updated sections include: Contents, ABBREVIATIONS, and Index. New sections include: Heading 4.14, APERTURE VERIFICATION - AC•T diff/Veterinary Option Analyzer and Appendix C.2, CANON BJC-250 BUBBLE JET PRINTER. Actual text changes were made on the following pages: 1.1-1 through 1.1-3, 2.2-1, 2.2-3, 2.2-4, 2.3-2, 2.7-1, 2.7-3 through 2.7-6, 2.7-9, 2.7-10, 2.7-12, 2.7-13, 2.7-15, 2.8-1, 3.2-1 through 3.2-4, 4.4-2, 4.4-3, 4.10-1, 7.1-1, 7.1-17, 7.4-1, 8.1-1, 8.1-3, 8.1-4, 8.1-6, 8.1-7, 8.2-3, 8.2-5, 8.2-15 and A.3-1 through A.3-3. A new revision of the AC•T Series Analyzers, HYDRO-PNEU, Ac.T SERIES engineering diagram, DCN 6323083, was inserted into Chapter 6.

Revision E, 2/99
Released by CN 037530-0075
Software Version 1.00
Complete revision to include hardware and software information for the AC•T diff 2™ analyzer.

Revision F, 12/01
Released by CN 037560-0170
Software Version: 2.00
The material in revision F change pages was updated for AC•T diff analyzer software version 2.00 and for any hardware changes made since revision E, including relevant information released by the following service memos: SM1 804, SM 1809, SM 1819, SM 1839, SM 1871, SM 1887, SM 1896, SM 1911, SM 1988, SM 1994, SM 3013, SM 3021, SM 3023, SM 3044, SM 3048, SM 3087, SM 3091, and SM 3092. This new information encompasses the hardware changes made to improve reliability - namely, installing a redesigned sweep-flow assembly, replacing the single-head vacuum pump with a dual-head pump, and installing a pair of filters in the diluent lines to the reservoir. In addition, since check digits are not used in the VANTIVE or CARES systems, all check digits have been removed from the part numbers listed in this manual.

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.

Note: Information from the following service memos was considered for this revision but not added because the information is obsolete: SM 1868, SM 1922, SM 1955.

Changes were made on the following pages: 1.1-1, 1.1-3, 1.1-4, 1.1-5, 1.1-6, 1.2-2, 2.1-3, 2.2-2, 2.2-3, 2.2-4, 2.2-5, 2.2-6, 2.2-7, 2.2-8, 2.3-9, 2.3-10, 2.3-11, 2.3-12, 2.3-13, 2.3-14, 2.3-15, 2.3-16, 2.3-17, 2.6-1 through 2.6-4, 2.8-2, 2.8-8 and 2.8-9, 2.8-12 and 2.8-13, 2.8-14 and 2.8-15, 2.8-16 through 2.8-18, 2.9-1, 3.2-5, 3.2-6, 4.4-1, 4.4-2, 4.4-4, 4.5-4, 4.6-1 through 4.6-4, 4.7-1 through 4.7-4, 4.17-6, 4.15-3, 4.16-1, 4.20-2, 5.1-1, 6.1-1, 7.1-1, 7.1-6, 7.1-16, 7.1-17, 7.1-18, 7.1-22, 7.1-23, 7.2-8, 7.4-1, 8.1-1, 8.1-2, 8.1-3, 8.1-4, 8.1-6, 8.1-6, 8.1-7, 8.1-9, 8.1-9, 8.1-10, 8.1-11, 8.1-14, 8.2-1, 8.2-3, 8.2-4, 8.2-5, 8.2-9, 8.2-11, 8.2-12, 8.2-13, 8.2-14, 8.2-15, 8.2-21, 8.2-24, 8.2-25, 8.2-26, 8.2-27, 8.2-28, 8.2-29, 8.2-30, A.2-1 through A.2-18, A.3-1 through A.3-4, A.4-1, A.4-7, A.4-10, A.4-11, A.5-2, A.5-6, A.5-8, A.5-9, A.5-10, A.5-11, A.5-12, and TRADEMARKS page. In addition Headings 4.21, 4.22, and C.3 were added.

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1.1 MANUAL DESCRIPTION

Scope

This manual provides the reference information and procedures needed for servicing and maintaining COULTER® A^C•T™ analyzers (hereafter referred to as the A^C•T analyzer or the instrument). It is available both online and in hard copy. The online manual is released on the Service Resource Kit CD-ROM, PN 6417471.

This manual is to be used in conjunction with the A^C•T analyzer customer documents and does not contain information and procedures already covered in those documents. Table 1.1-1 lists the customer documents available.

Table 1.1-1 A^C•T Analyzer Customer Documents

Instrument	Document	Language	PN
A^C•T 8/10 analyzer	Getting Started	English	4237289
		Chinese	4237355
		French	4237349
		German	4237352
		Italian	4237361
		Japanese	4237358
		Spanish	4237346
	Host Transmission Specification	English	4237283
	Installation and Training Guide for the A^C•T Pak™ Reagent	English	4237414
	Installation and Training Guide for the A^C•T Tainer™ Reagent	English	4237413
	Installation Guide	English	4237407
	Operator's Guide	English	4237287
		Chinese	4237354
		French	4237348
		German	4237351
		Italian	4237360
		Japanese	4237357
		Spanish	4237345
	Reference Manual	English	4237288
	Special Procedures and Troubleshooting	English	4237314
		Chinese	4237353
		French	4237347
		German	4237350
		Italian	4237359
		Japanese	4237356
		Spanish	4237344

Table 1.1-1 A^{C}•T Analyzer Customer Documents *(Continued)*

Instrument	Document	Language	PN
A^{C}•T diff analyzer	Installation and Training Guide for the A^{C}•T Pak™ Reagent	English	4237421
		Chinese	4237444
		French	4237432
		German	4237436
		Italian	4237440
		Spanish	4237428
	Installation and Training Guide for the A^{C}•T Tainer™ Reagent	English	4237417
		Chinese	4237445
		French	4237433
		German	4237437
		Italian	4237441
		Japanese	4237449
		Spanish	4237429
	Operating Summary	English	4237420
		Chinese	4237446
		French	4237434
		German	4237438
		Italian	4237442
		Japanese	4237450
		Spanish	4237430
	Operator's Guide	English	4237416
		Chinese	4237447
		French	4237435
		German	4237439
		Italian	4237443
		Japanese	4237451
		Spanish	4237431
	Reference Manual	English	4237422
	Veterinary Applications Software Options Operator’s Guide	English	4237400

Table 1.1-1 AC•T Analyzer Customer Documents *(Continued)*

Instrument	Document	Language	PN
AC•T diff 2 analyzer	Installation and Training Guide for the diff AC•T Pak™ Reagent and the diff AC•T Tainer™ Reagent	English	4237517
		French	4237553
		German	4237544
		Italian	4237561
		Japanese	4237556
		Spanish	4237550
		Portuguese	4237547
	Operating Summary	English	4237516
		French	4237551
		German	4237557
		Italian	4237562
		Japanese	4237554
		Spanish	4237548
		Portuguese	4237545
	Operator's Guide	English	4237495
		French	4237552
		German	4237543
		Italian	4237563
		Japanese	4237555
		Spanish	4237549
		Portuguese	4237546
	Reference Manual	English	4237515
Printers	AC•T diff Analyzer Canon® Bubble Jet™ Printer User's Guide	English	4237479
	AC•T diff Analyzer Graphics Printer User's Guide	English	4237343
	AC•T Series Analyzer Roll Printer User's Guide	English	4237381
	AC•T Series Analyzer Ticket Printer User's Guide	English	4237380

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. A 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:

- An operator's knowledge of the A^{C}•T analyzer
- A thorough understanding of -
  - Basic electronic and pneumatic principles and devices
  - 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 three appendices. To make it easier to access the information:

- In the electronic manual, each page or screen has -
  - A Contents button linked to a master table of contents.
  - An Illustrations button linked to a master list of illustrations.
  - A Tables button linked to a master list of tables.
  - An Index button linked to an alphabetic index.
- In the printed manual, there is a master table of contents (including master lists of the illustrations and tables) 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.The chapters / appendices contain:

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

Chapter 2, INSTRUMENT DESCRIPTION - An introduction to the A^{C}•T analyzer and a description of how it functions.

Chapter 3, INSTALLATION PROCEDURE - A reference to the Getting Started manual for installation requirements and procedures.

Chapter 4, SERVICE AND REPAIR PROCEDURES - The procedures for servicing/repairing the A^{C}•T analyzer.

Chapter 5, MAINTENANCE PROCEDURES - The procedures for maintaining the A^{C}•T analyzer.

Chapter 6, SCHEMATICS - A list of the engineering schematics needed for servicing the A^{C}•T analyzer.

Chapter 7, TROUBLESHOOTING - An in-depth troubleshooting table.

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

Appendix A, QUICK REFERENCE INFORMATION - Quick reference information: tolerances and limits; connectors, test points and jumpers for the circuit cards; connector locations for the Analyzer cards; the software menu trees; location diagrams and summarized functions for main analyzer components.

Appendix B, ERROR MESSAGES - Tables of fatal and non-fatal error messages.

Appendix C, OPTIONAL PRINTERS - Specifications, operator controls and indicators, switch settings, and self-test procedures for the optional Printers.

ABBREVIATIONS - A list of abbreviations, acronyms, and reference designators used 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 fourth topic covered in Chapter 2 is 2.4.

The page, figure, and table numbers are tied directly to the primary heading number. For example, Heading 2.4 begins on page 2.4-1, the first figure under Heading 2.4 is Figure 2.4-1 and the first table under Heading 2.4 is Table 2.4-1.

Note: Primary headings always begin at 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 online manual.

Note

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

Conventions

1. The A^{C}•T analyzer uses icons exclusively. In this document however, text equivalents (appearing in bold) are substituted for icons. Refer to Figures A.3-1, A.3-2, A.3-3, or A.3-4 for the icons (along with their text equivalents) used to access menus and screens.
2. Select menu item ▸▸ sub-menu item indicates the software options you have to select, as well as the order in which you should select them. For example:

   When the Powerup cycle is completed, select **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Voltages/Sensors** icon.
3. In the electronic manual, links to additional information are in blue and are underlined. To access the linked information, select the blue, underlined text, or in the case of a graphic, the blue box.
4. A reference to A^{C}•T Series analyzers includes the A^{C}•T 8 analyzer, the A^{C}•T 10 analyzer, the A^{C}•T diff analyzer, the A^{C}•T diff with Veterinary Option analyzer, and the A^{C}•T diff 2 analyzer.
5. The A^{C}•T 8 analyzer and A^{C}•T 10 analyzer are two different products. However, since these analyzers are physically identical with only slight differences in their software, the product names are combined in this document. As a result, a reference to the A^{C}•T 8/10 analyzer means the stated information or procedure applies to both the A^{C}•T 8 analyzer and A^{C}•T 10 analyzer.

1.2 SAFETY PRECAUTIONS

Electronic

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.

WARNING Risk of personal injury or damage to electronic components. While performing maintenance or service on the instrument, rings and other metal jewelry can become caught in the instrument. To avoid personal injury or damage to the instrument, remove rings and other metal jewelry before performing maintenance or service on the electronic components of the instrument.

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

CAUTION Risk of damage to electronic components. Electrostatic discharge (ESD) can damage 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.

Biological

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while servicing the instrument 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 instrument with the doors open.

Use care when working with pathogenic materials. Means must be available to decontaminate the instrument, provide ventilation, and to dispose of waste liquid. Refer to the following publications for further guidance on decontamination:

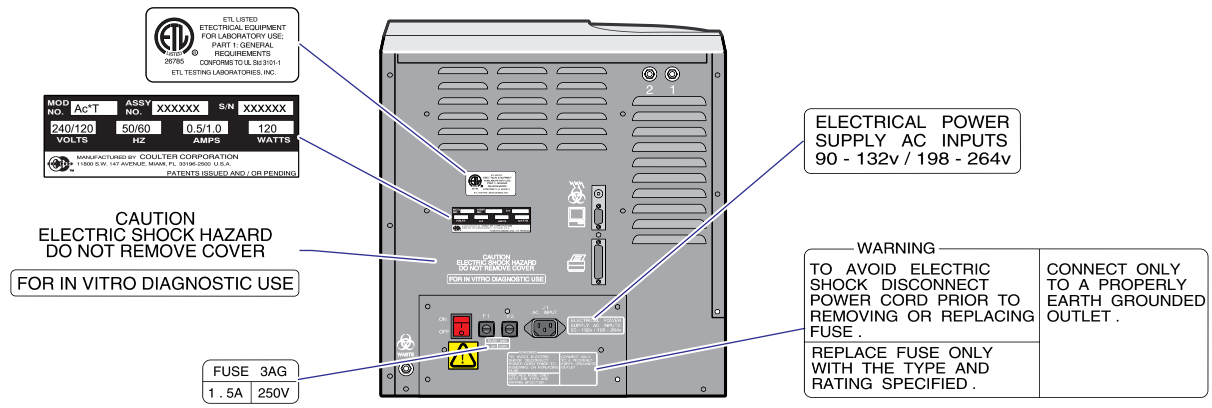
- Biohazards Safety Guide, 1974, National Institute of Health.
- Classifications of Etiological Agents on the Basis of Hazards, 3d ed., June 1974, Center for Disease Control, U.S. Public Health Service.

Troubleshooting

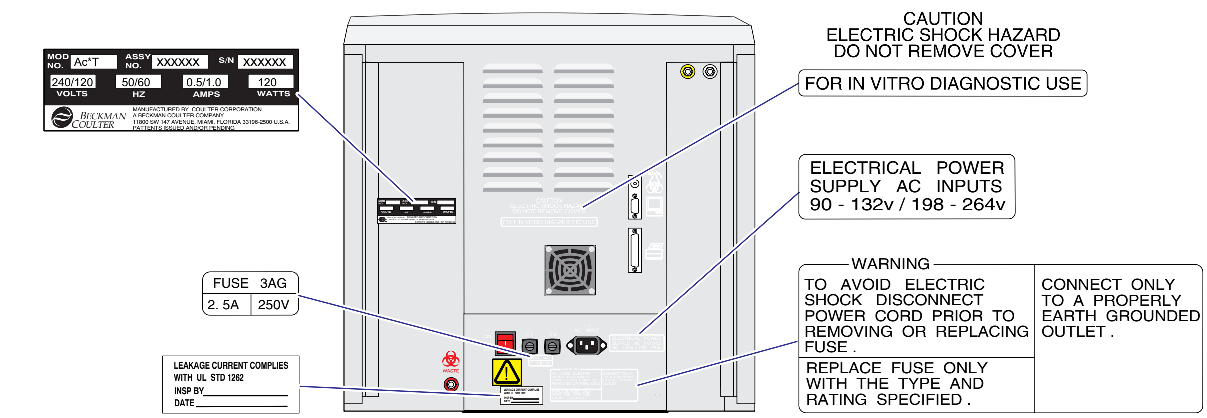
Bring the following Warning to the customer's attention before advising that customer to perform any service, maintenance or troubleshooting procedures on the A^{C}•T analyzer. Also, make sure customers are aware of the Warning and information labels shown in Figure 1.2-1.

WARNING Risk of personal injury or contamination. If you do not properly shield yourself while performing service, maintenance, and troubleshooting procedures, residual fluids 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 gloves throughout the performance of service, maintenance, and troubleshooting procedures to avoid contact with cleaners and residual fluids in the instrument.

Figure 1.2-1 Warning and Information Labels



A^{C}•T 8/10 or A^{C}•T diff Analyzers



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A^{C}•T diff 2 Analyzer

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2.1 SYSTEM OVERVIEW

The AC•T analyzer product line consists of four small, uncomplicated, low cost, hematology analyzers: the AC•T 8 analyzer, the AC•T 10 analyzer, the AC•T diff analyzer, and the AC•T diff 2 analyzer. The AC•T 8/10 and the AC•T diff analyzers use the same diluter but different electronics and software. The AC•T diff and AC•T diff 2 analyzers use very similar electronics and software, but different diluters. All four models accept open-vial whole-blood or prediluted samples. The AC•T diff 2 analyzer also has a Cap-Pierce mode. Table 2.1-1 provides a quick reference to instrument specific information concerning each AC•T system.

Hardware

The instrument has an onboard switching Power Supply module rated at 50/60 Hz with a voltage range of 90 to 264 Vac. The electronics of the instrument are housed on one circuit card, the Analyzer card, although different models use different Analyzer cards. The Analyzer cards for the AC•T 8/10 analyzers use through-hole card technology. The Analyzer cards for the AC•T diff and AC•T diff 2 analyzers use surface-mount technology (SMT).

Fluidic movement on the AC•T 8/10 and AC•T diff analyzers is controlled by the Triple Syringe module using one motor to drive three different volume syringes and two peristaltic pumps. Fluidic movement on the AC•T diff 2 analyzer is controlled by FMI metering pumps or piston/valve pumps.

Three external electrical connectors are provided, one for the waste sensor, one for a parallel Printer, and one for ASTM host communication.

Software

The instruments use 8 bit microprocessors as their main controllers. Software is stored and runs directly from Flash Memory cards. The AC•T 8/10 analyzer has a 512 KB Flash Memory card while the AC•T diff and AC•T diff 2 analyzers use a 1 MB Flash Memory card. Both models use a 128 KB, non-volatile RAM chip to store persistent data such as the calibration factors and the user-configuration settings. The Analyzer card for the AC•T 8/10 analyzer has no additional memory, so the unused portion of non-volatile RAM is used as program runtime memory. The Analyzer cards for the AC•T diff and AC•T diff 2 analyzers have 256 KB RAM that is used during program execution.

Interacting with the AC•T Analyzer

All AC•T analyzers have an Open-Vial mode of operation. Pressing the aspirate switch (Figures 2.1-1 and 2.1-2) tells the instrument to begin aspiration in the Open-Vial mode. Additionally, the AC•T diff 2 analyzer has a cap-pierce door for closed-vial sampling (Figure 2.1-2). Inserting a specimen tube and closing the cap-pierce door initiates aspiration in the Closed-Vial mode.

You also interact with the instrument using the touch screen (Figures 2.1-1 and 2.1-2). To communicate commands to the instrument, the touch screen displays a series of screens containing icons and numbers for your use. Screens are available for initiating sample runs, displaying sample results, establishing instrument settings, and performing various maintenance routines.

Figure 2.1-1 User Interfaces on the A^{C}•T 8/10 and A^{C}•T diff Analyzers

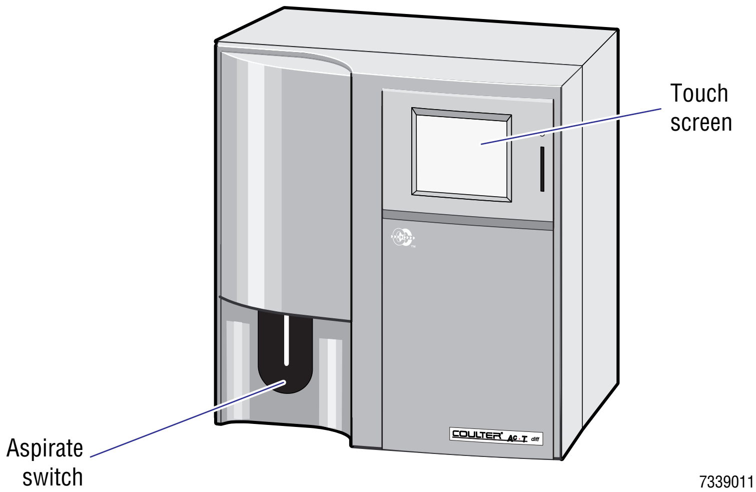


Figure 2.1-2 User Interfaces on the A^{C}•T diff 2 Analyzer

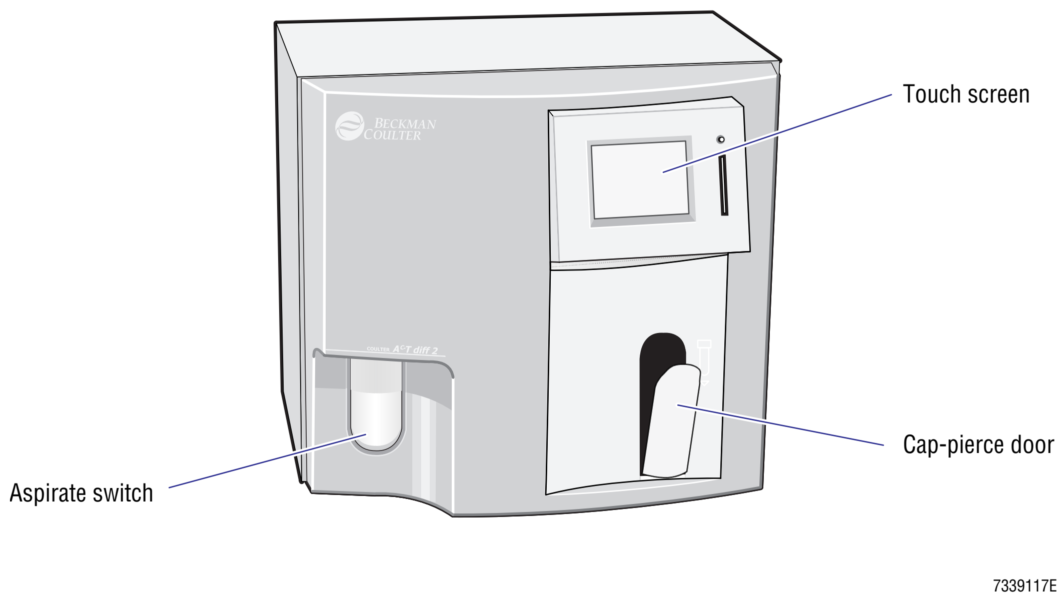


Table 2.1-1 AC•T Series Analyzers - System Specifics

	AC•T 8 Analyzer	**AC•T 10 Analyzer**	**AC•T diff Analyzer**	**AC•T diff 2 Analyzer**
Operating Modes	Whole-Blood Aspirate Predilute	Whole-Blood Aspirate Predilute	Whole-Blood Aspirate Predilute	Closed-Vial Whole-Blood Open-Vial Whole-Blood Predilute
Parameters	WBC RBC Hgb Hct MCV MCH MCHC Plt	WBC RBC Hgb Hct MCV MCH MCHC Plt LY% LY#	WBC RBC Hgb Hct MCV MCH MCHC RDW Plt MPV Pct* PDW* LY% MO% GR% LY# MO# GR#	WBC RBC Hgb Hct MCV MCH MCHC RDW Plt MPV Pct* PDW* LY% MO% GR% LY# MO# GR#
Software Menu Trees	See Figure A.3-1	See Figure A.3-1	See Figure A.3-2 (Figure A.3-3 for system with Veterinary Option)	See Figure A.3-4
Diluter Operation	See Heading 2.2	See Heading 2.2	See Heading 2.2	See Heading 2.3
Power Supply	See Heading 2.4	See Heading 2.4	See Heading 2.4	See Heading 2.4
Analyzer Card	See Heading 2.5	See Heading 2.5	See Heading 2.6	See Heading 2.6
Display Assembly	See Heading 2.7	See Heading 2.7	See Heading 2.7	See Heading 2.7
Powerup Cycle	See Table 2.8-1	See Table 2.8-1	See Table 2.8-1	See Table 2.8-2
Aspirate Cycle	Software Version 1.03, see Table 2.8-3 Software Version 1.04 or 2.00, see Table 2.8-4	See Table 2.8-4	Software Version 1.03, see Table 2.8-5 Software Versions 1.04, 1.05, 1.06, or 2.00, see Table 2.8-6 Veterinary Option for Software Version 1.04, 1.05, 1.06, or 2.00, see Table 2.8-7	See Table 2.8-8

* Pct and PDW are not FDA approved parameters; therefore, these parameter labels and results are not routinely displayed in the United States. The PDW result, however, is used as an internal check in the platelet algorithm.

2.2 DILUTER SYSTEM - A^{C}•T 8/10 AND A^{C}•T diff™ ANALYZERS

The A^{C}•T 8/10 and A^{C}•T diff analyzers use different Analyzer cards and software, but the same diluter. This diluter uses two peristaltic pumps and three syringes to move liquids.

Location diagrams for the fluidic components identified in the following descriptions are under Heading A.4, AC•T 8/10 and AC•T diff COMPONENT LOCATIONS AND FUNCTIONS.

Traverse Module

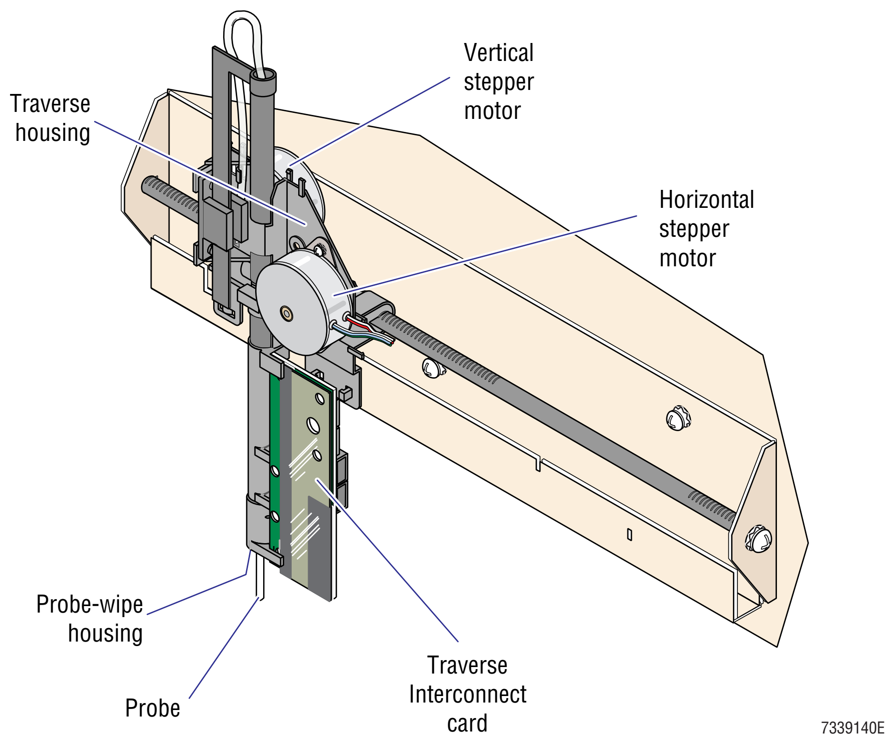
The Traverse module acts as a transport system for the probe. Two stepper motors provide the power that allows the Traverse module to move the probe either vertically or horizontally as needed. Two dual-channel opto sensors control the positioning of the probe so that it is properly aligned, as needed, at the aspiration station, the WBC bath, or the RBC bath.

Components

The Traverse module (Figure 2.2-1) consists of:

- The probe
- The traverse housing
- The probe-wipe housing
- Two stepper motors
- The Traverse Interconnect card
- Two dual-channel opto sensors

Figure 2.2-1 Traverse Module - Components



For horizontal travel, the probe has three positions: the aspirate station, over the WBC bath, and over the RBC bath. The probe also must position itself at three heights: the top position while travelling, the thief position (aspiration for the RBC dilution while in the WBC bath), and the bottom position for sample aspiration.

Two stepper motors move the probe. One motor moves it vertically and the other moves it horizontally. A direct drive gear and rack system is employed for both motors. Two dual-channel opto sensors, one associated with each motor, detect the probe positions. Using these sensors with binary encoding allows detection of three possible positions in each direction with one sensor.

When a function such as aspiration is complete, the probe moves into the traverse housing where the probe-wipe housing surrounds the tip of the probe and a flow of diluent cleanses the outside of the probe and high vacuum dries it.

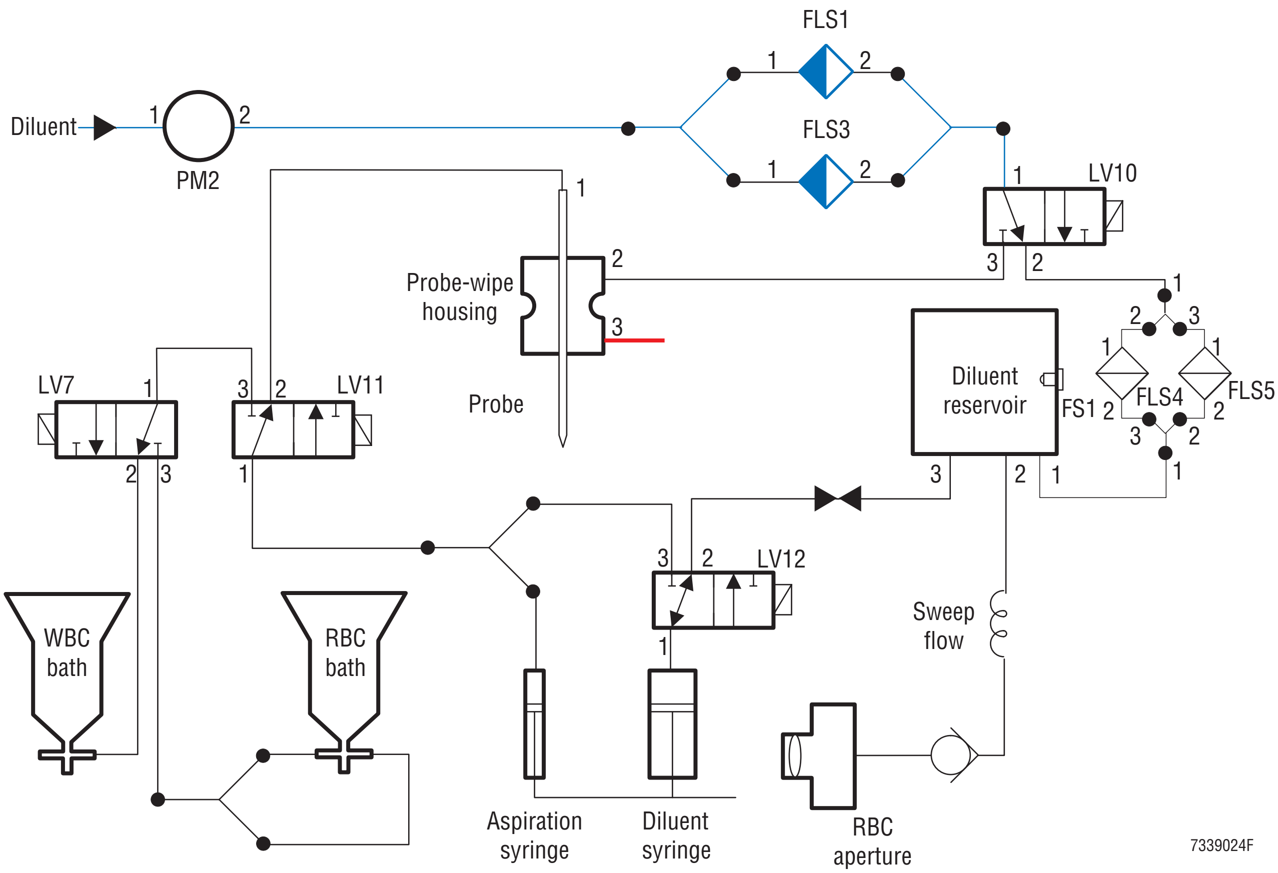
Diluent Delivery System

The A^{C}•T 8/10 and A^{C}•T diff analyzers' diluent delivery system uses an on-board diluent reservoir. The diluent reservoir contains two sensors, a level sensor and a temperature sensor. The level sensor, FS1, verifies delivery of diluent to the instrument. The level sensor used originally was an optical sensor, but a float sensor is used currently. The temperature thermistor sensor provides a reagent temperature reading to the instrument. This sensor is used by the A^{C}•T diff analyzer, but not by the A^{C}•T 8/10 analyzer.

Peristaltic pump PM2 moves diluent from the reagent source to the diluent reservoir via two hydraulic filters, FLS1 and FLS3; a solenoid, LV10; and two hydrophilic filters, FLS4 and FLS5. See Figure 2.2-2 for a simplified diagram of the diluent system.

Note: For details concerning the operation of peristaltic pumps, see Peristaltic Pumps at the end of this section.

Figure 2.2-2 Diluent Delivery System in AC•T 8/10 and AC•T diff Analyzers - Components and Flow



FLS1 and FLS3 filter any large particles from the diluent source as well as from peristaltic pump tubing wear. They are directional and fluid should enter the blue (striped) side of the filter. LV10 normally connects PM2 output to the reservoir, but when energized, connects PM2 to the top port of the probe-wipe housing. This is the diluent supply for cleansing the probe. FLS4 and FLS5 remove smaller contaminating particles, such as some bacteria. (Filters that are small enough to eliminate all possible bacteria would restrict diluent flow too much.) Two filters are used in parallel to facilitate initial priming.

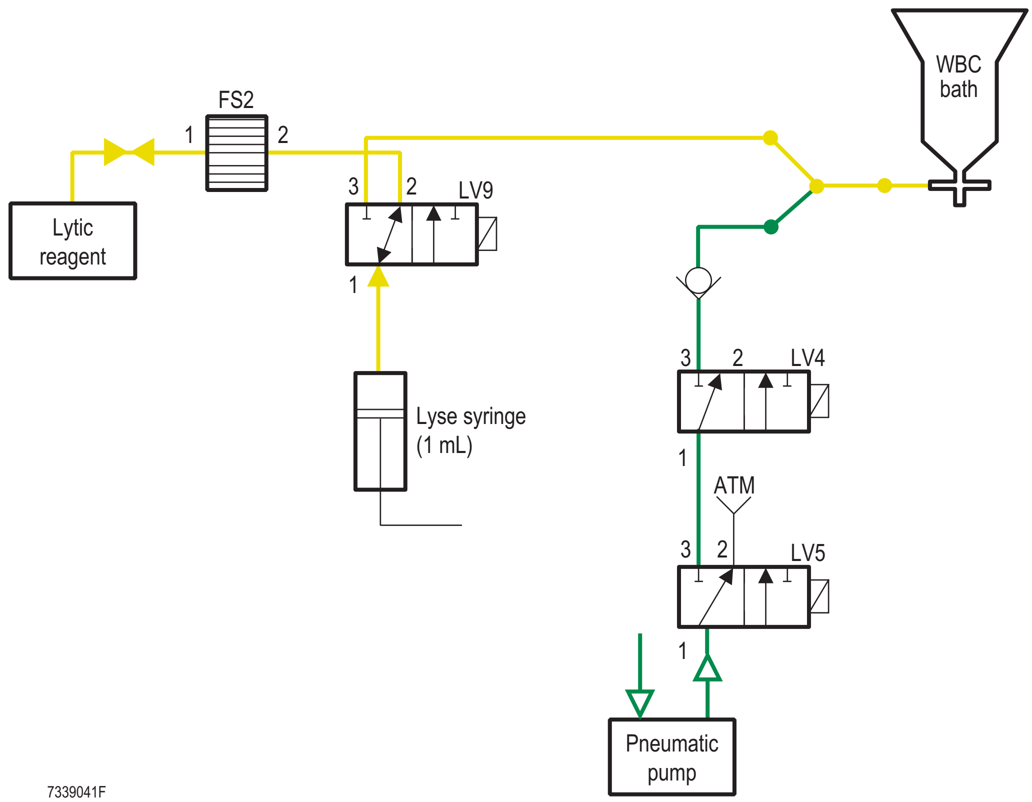
LV12 controls the reservoir diluent usage. In its normal state LV12 connects the reservoir to the 5-mL diluent syringe. This provides diluent while the syringe is being filled, and also allows delivery of diluent back to the reservoir when only lytic reagent dispense or aspirate functions are required. A separate port on the diluent reservoir provides sweep-flow diluent to the RBC aperture through the sweep-flow coil and a check valve.

LV7 and LV11 control diluent output from the syringes. When LV11 is in its normal state, the diluent syringe dispenses through the aspirate probe. When energized, LV11 routes diluent from the syringe to LV7, which routes diluent to lower-side ports on the baths. Diluent is routed to these ports to rinse the baths and to prefill each bath prior to making the dilution. The remainder of the diluent needed to make the dilution is dispensed through the probe with the whole-blood sample. In its normal state LV7 is connected to the WBC bath. When energized, LV7 switches to the RBC bath.

Lytic Reagent Delivery System

Lytic reagent is used to eliminate red blood cells from the WBC/Hgb dilution, similar to most Beckman Coulter hematology analyzers. A 1-mL syringe on the Syringe module pumps and dispenses lytic reagent for the diluter system and LV9 controls the routing of the lytic reagent (Figure 2.2-3).

Figure 2.2-3 Lytic Reagent Delivery System in AC•T 8/10 and AC•T diff Analyzers- Components and Flow



Two features of the AC•T analyzer's lytic reagent delivery system distinguish it from previous Beckman Coulter hematology analyzers. Using a syringe allows the system software to control the amount of lytic reagent dispensed. The AC•T analyzer takes advantage of this versatility, using different amounts of lytic reagent during different cycles. A normal Aspirate cycle uses 415 µL of lytic reagent, the same amount that is dispensed during a Lyse Dispense Verification cycle and a Prime cycle. The Predilute cycle uses 313 µL while the Lyse Prime cycle (which assumes a lytic reagent dry state) uses the full 1-mL syringe stroke several times.

The other difference in the AC•T analyzer's lytic reagent delivery system results from the use of the Syringe module. Since one motor moves three syringes simultaneously, there are instances when diluent is being dispensed and lytic reagent delivery is **not** desired. At these times, lytic reagent is pushed back toward the reagent container.

An optical liquid sensor, FS2, in the lytic reagent line monitors the lytic reagent supply as it enters the instrument. Lytic reagent in the sensor transmits light, but air in the sensor prevents light transmission. The presence of air gaps in the sensor triggers a lytic reagent low warning. A software filter is applied to the data received from the sensor to ensure that microbubbles, inconsequential in their affect on the lytic reagent delivery volume, do not trigger the warning.

Pneumatic System

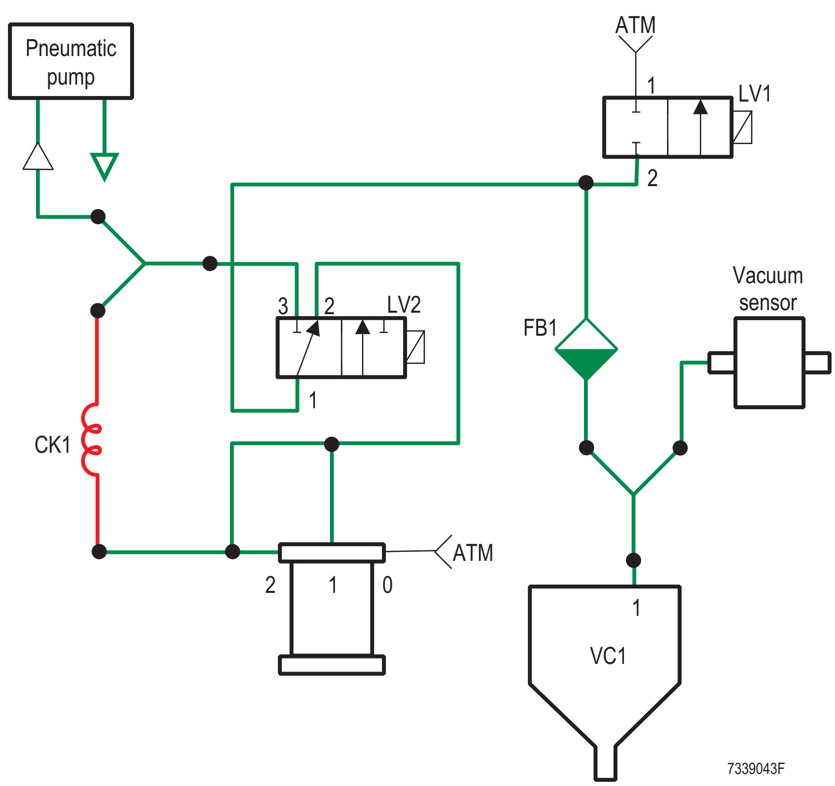
The pneumatic pump is located beneath the on-board reagent compartment. Currently, three models of a 24-Vdc pump are in use: the Brailsford brushless vacuum pump; the ASF Thomas® brush-type, diaphragm vacuum pump; and the KNF dual-head, brushless-type pump. The earliest A^{C}•T analyzers used the Brailsford pump, more recent analyzers (including the A^{C}•T diff 2 analyzer), used the ASF Thomas pump, and the latest use a KNF dual-head pump. These pumps satisfy the three pneumatic supply requirements:

- Raw vacuum from the pump is used unregulated as a high-vacuum source for the probe-wipe function.
- Raw (high) vacuum from the pump is regulated to 6-in. Hg for counting.
- Pressure from the pump (exhaust pressure from the single-head pumps) is used to create bubbles for mixing the WBC and RBC dilutions in their respective baths.

Note: An upgrade to a KNF dual-head pump is required for instruments used at altitudes of 1524 m (5,000 ft) or above.

Five pneumatic solenoids, LV1 through LV5, control this vacuum system. These solenoids are mounted together on a manifold and are available as an assembly. The vacuum system is illustrated in Figure 2.2-4.

Figure 2.2-4 Pneumatic System in A^{C}•T 8/10 and A^{C}•T diff Analyzers - Vacuum Components and Flow



Vacuum Supply

LV2 controls the vacuum level applied to the vacuum chamber, VC1. High vacuum from the pneumatic pump is applied directly to the normally closed port, labelled port 3 (Figure 2.2-4). The normally open port, port 2, is connected to the vacuum being routed through the vacuum regulator. This configuration makes high vacuum and regulated low vacuum available at a common port, port 1 which is connected to VC1, LV1, and the vacuum sensor.

At rest, when the pneumatics are on but the analyzer is not cycling, the high vacuum supply being regulated to 6-in. Hg by the vacuum regulator is the vacuum available inside the vacuum chamber, VC1. Regulated vacuum, monitored by the vacuum sensor, is used during the count portion of the cycle to draw the WBC and RBC dilutions through their respective apertures and to pull sweep-flow diluent behind the RBC aperture.

The high vacuum applied to VC1 when LV2 is energized is used to scavenge waste during the probe-wipe function. Solenoid LV1 is used to vent VC1 to atmosphere when it is draining and during high vacuum/low vacuum transitions.

On the single-head pneumatic pump, LV5 switches the exhaust to atmosphere when vacuum is being used.

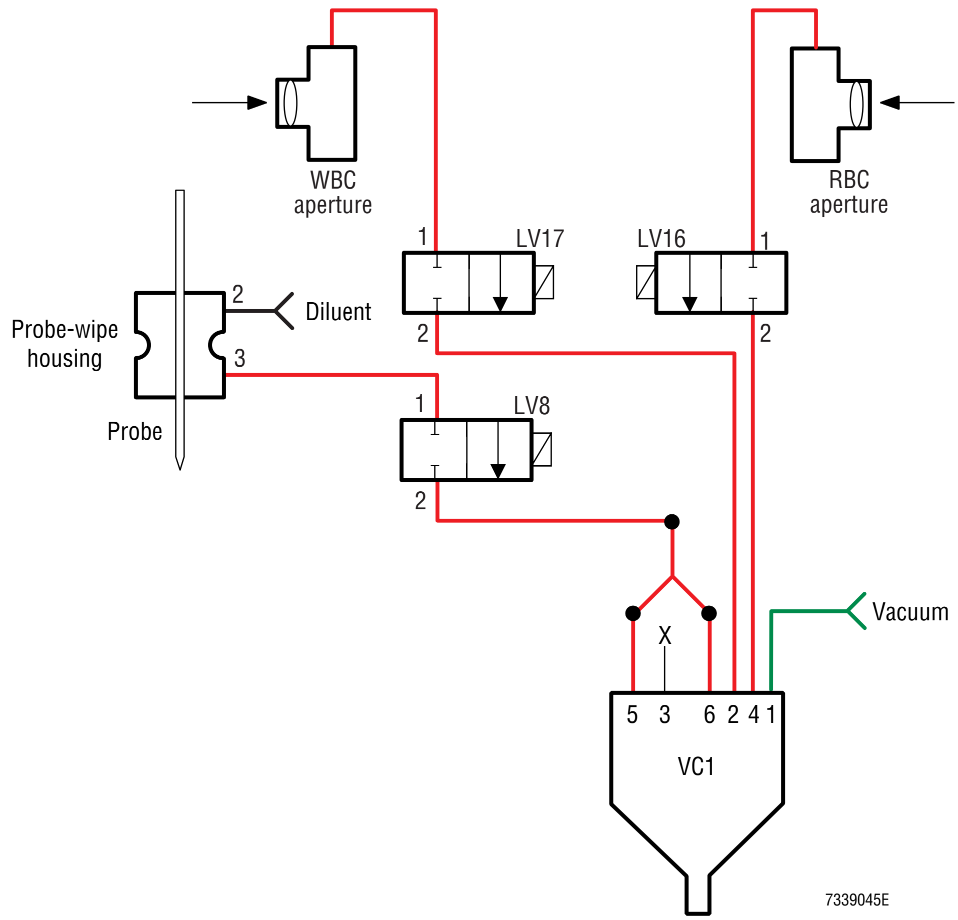
Probe Wipe

The probe-wipe function involves two tasks, probe washing with diluent and probe drying. Both tasks require high vacuum. To supply the high vacuum needed to accomplish these tasks, LV8 connects the high vacuum supply in VC1 to the bottom port of the probe-wipe housing (Figure 2.2-5).

After aspiration, while the probe is moving up into the probe-wipe housing, LV10 is energized to open the pathway from the diluent source to the top port of the probe-wipe housing and peristaltic pump PM2 begins pumping diluent from the source container to the top probe-wipe port. The diluent is forced in a spiral action down to the bottom probe-wipe port, and with high vacuum assistance, is drawn into VC1. The probe-wipe waste path is split into two lines for attachment to two outside fittings on VC1.

It is important to connect these tubings to the two outer fittings that allow the waste to enter behind the splash guards inside VC1. This is necessary to reduce flow rate at each fitting which reduces splashing and cross-talk in VC1. Once the outside of the probe is washed, PM2 is turned off and LV10 is de-energized which stops the supply of wash diluent. The high vacuum being applied to the bottom probe-wipe housing port dries the probe before LV8 de-energizes. When the probe is moved up from inside the baths, the vacuum is reapplied to the VC1 chamber without diluent to dry the probe.

Figure 2.2-5 Vacuum Chamber (VC1) System in AC•T 8/10 and AC•T diff Analyzer- Components and Flow



Count

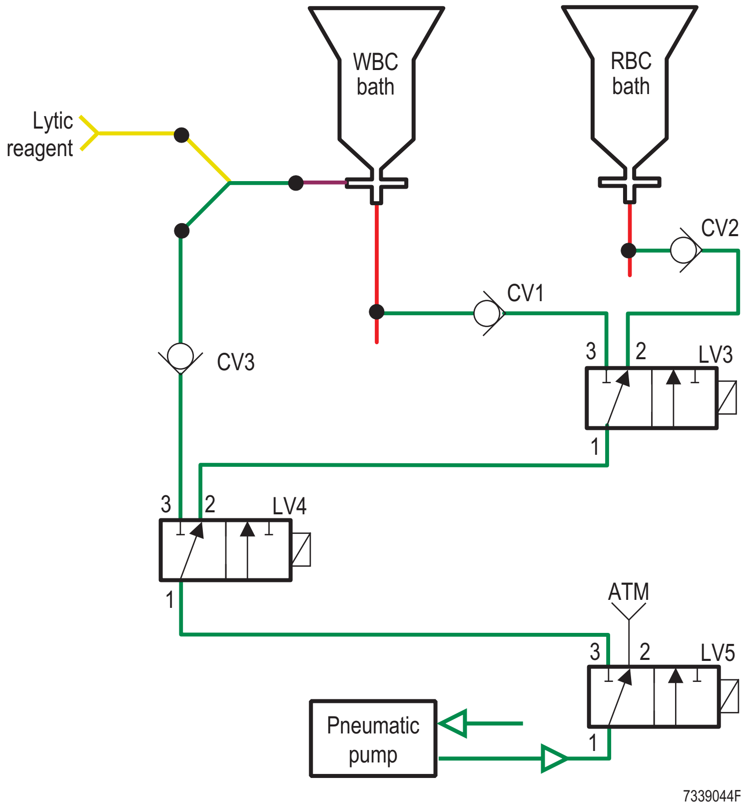
Regulated vacuum (6-in. Hg) is used for counting. The WBC aperture is connected to VC1 through LV17 and the RBC aperture through LV16 (Figure 2.2-5). During the count portion of the cycle, the regulated vacuum available in VC1 is applied to these apertures when valves LV16 and LV17 are energized. Once the pathway is open, the regulated vacuum in VC1 is applied to the apertures and the WBC dilution inside the WBC bath is pulled through the WBC aperture and the RBC dilution inside the RBC bath is pulled through the RBC aperture. Additionally, on the RBC side, regulated vacuum also pulls diluent through the sweep-flow line. Two streams of droplets should be entering VC1 during the count portion of the cycle.

Note: Regulated vacuum, 6-in. Hg, low vacuum, count vacuum, and aperture vacuum are synonymous terms and are, therefore, interchangeable.

Pressure Supply

Exhaust from a single-head pneumatic pump or pressure from a dual-head pneumatic pump is used as the mixing bubble air supply. These air bubbles pass through the sample dilution inside each bath and mix the dilution to ensure the particle suspension is uniform throughout the bath. LV5 switches the pressure between atmosphere and the mixing-bubble path (Figure 2.2-6). The alternate energizing and de-energizing of LV5 breaks up the air flow and creates the individual bubbles.

Figure 2.2-6 Pneumatic System in AC•T 8/10 and AC•T diff Analyzers- Pressure Components and Flow



Solenoids LV3 and LV4 control the path for the mixing bubbles. LV4 switches the air path between the WBC bath lytic reagent (side) port and LV3. LV3 switches the mixing bubbles between the bottom ports of the RBC and WBC baths. The alternate energizing and de-energizing of LV5 provides the bubble rate.

Check valves are used in all three mixing bubble paths to ensure that liquid from the bath does not migrate into the pneumatic system. At the completion of mixing, an air gap remains. This air gap electrically isolates the reagent systems from the dilution in the bath that is about to be counted.

Aperture Sensor System

The aperture sensor system is responsible for sample analysis. It consists of:

- An RBC and a WBC bath and aperture assembly for cell count and size
- A photometer for Hgb measurement
- The vacuum chamber (VC1)
- A sweep-flow tubing spool
- Two fluidic solenoid valves opening the vacuum pathway to each bath

These components are mounted on a plate that is electrically isolated from the chassis and is enclosed with a shield attached to it. A single ground connection between this assembly and the preamp shield on the Analyzer card eliminates undesirable ground loops.

The aperture and bath are one piece. The assembly clips (without fasteners) onto a bath support. The electrical connection to the bath assembly is via one coaxial cable plugged directly into the preamp on the Analyzer card. The internal wire is attached to the internal rear chamber electrode and the coaxial shield is connected to the external bath electrode. Since most of the assembly is enclosed within the isolated shield/plate assembly, there is little need to shield both electrode wires individually, although a portion of the coaxial cable inside the instrument's chassis is not shielded from noise coming from within the chassis.

Note: Two versions of the aperture/bath assembly are currently in use. The newer version has an extra tubing port at the top of the bath that is not used by the A^C•T 8/10 or A^C•T diff analyzer, but is used by the A^C•T diff 2 analyzer. If this bath is used, the newer molded version of the bath clamp must also be used, since it has a notch to accommodate the extra fitting.

Hemoglobin Photometer Assembly

CAUTION The length of the screw used to mount the Hgb photometer assembly is critical. A screw that is too long will punch a hole in the WBC bath aperture assembly. Use the correct length screw to mount the Hgb photometer assembly.

A single screw mounts the Hgb photometer assembly to the WBC bath while two additional screws and posts are used for shipping support. The assembly is composed of two pieces, a housing including the photodiode and preamp, and the removable Hgb lamp. A coaxial cable connects the photodiode preamp to the Analyzer card. A four-wire cable connects the lamp to the Analyzer card. On the A^C•T 8/10 analyzer, two wires are used for the lamp's voltage and two wires are used to sense the voltage applied to the lamp. Lamp sensing is used to keep the lamp's voltage constant at approximately 3.18 Vdc. On the A^C•T diff analyzer, sensing is not used by the Analyzer card and the supply voltage is 3.6 Vdc.

Waste and Cleaner System

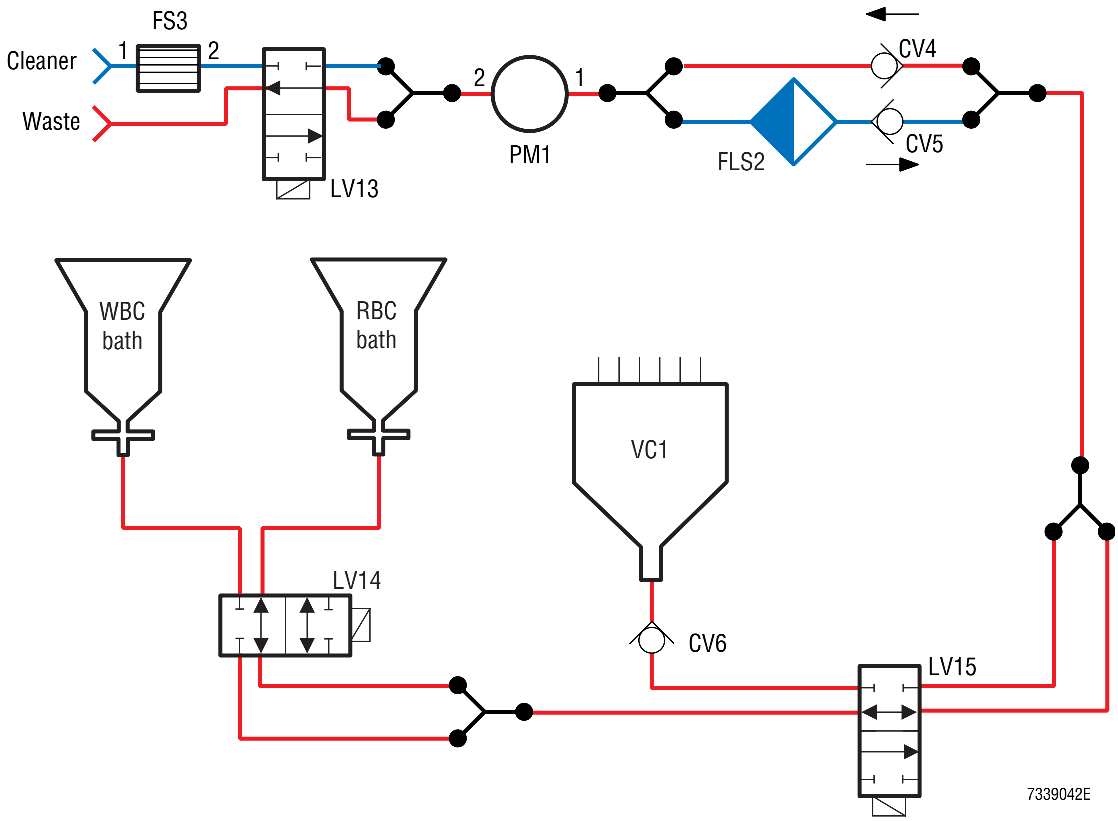
Waste System

At the completion of a sample run, the remaining sample dilutions, the counted sample, and the material washed from the outside of the probe must be cleared from the system in preparation for the next sample. This means the two aperture baths and the vacuum chamber, VC1, must be drained and rinsed then the accumulated waste expelled from the analyzer. Peristaltic pump PM1 drains these chambers and LV14 and LV15 control the flow of waste (Figure 2.2-7).

To effectively remove waste from the system, an individual drain line is attached to the bottom of each chamber (the WBC bath, the RBC bath, and VC1). Each drain line is controlled by a small Bio-Chem pinch valve. LV14 normally connects the waste system to the bottom port of the RBC bath and when energized, switches the waste system to the bottom port of the WBC bath. LV15 is normally connected to LV14 for bath drainage and when energized, connects peristaltic pump PM1 to the bottom port of VC1. When PM1 is rotated clockwise, the selected chamber is drained. LV1 must also be energized to apply atmospheric pressure when draining VC1.

Note: For details concerning the operation of peristaltic pumps, see Peristaltic Pumps at the end of this section.

Figure 2.2-7 Waste/Cleaner System in A^{C}•T 8/10 and A^{C}•T diff Analyzers - Components and Flow



Cleaner System

To limit the number of components used in the instrument, peristaltic pump PM1 does double duty (Figure 2.2-7). Normally PM1 is connected to the waste system, but when LV13 is energized, PM1 is connected to the A^{C}•T Rinse™ shutdown diluent (cleaner). PM1 is rotated counterclockwise and A^{C}•T Rinse shutdown diluent is brought into the system and fills both counting baths through their respective waste ports. An inline optical fluid sensor (FS3) is placed in the tubing from the reagent source to ensure reagent is present.

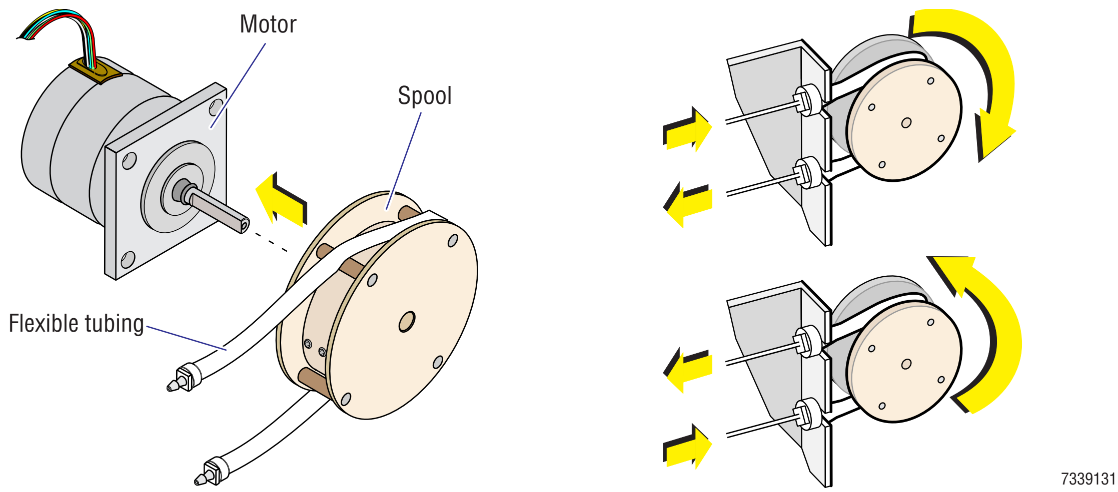
Note: For details concerning the operation of peristaltic pumps, see Peristaltic Pumps at the end of this section.

A parallel check valve/filter combination is used to ensure that waste is not pushed back into the system. When draining waste from the system, the waste passes through CV4. When the A^{C}•T Rinse shutdown diluent is brought into the system, it passes through CV5 and hydraulic particle filter FLS2. FLS2 captures debris from the waste system and from the peristaltic pump tubing wear before debris can enter the baths. FLS2 is directional and fluid should enter the blue (striped) side of the filter.

Peristaltic Pumps

A peristaltic pump consists of a spool with an attached motor (Figure 2.2-8). The spool is a cylindrical device which has a rim or ridge at each end and an axial hole for inserting the motor's shaft. Flexible tubing is wound around the spool and attached to a connector. When the motor is turned on, the motor's rotating shaft rotates the spool. Fluid is forced along by waves of contraction produced mechanically on the flexible tubing. The direction of flow is determined by the clockwise or counterclockwise rotation of the motor's shaft.

Figure 2.2-8 Peristaltic Pump Assembly



Two peristaltic pumps are used on the A^{C}•T 8/10 and A^{C}•T diff analyzers. PM1 is used to either move shutdown diluent (cleaner) into the analyzer or waste out of the analyzer while PM2 is used to move diluent from the reagent source into the diluent reservoir.

2.3 DILUTER SYSTEM - A^{C}•T diff 2™ ANALYZERS

The A^{C}•T 8/10 and the A^{C}•T diff analyzers use different Analyzer cards and software, but the same diluter. The A^{C}•T diff and A^{C}•T diff 2 analyzers have only minimal differences in their electronics and software, but have major differences in their diluters.

The most significant difference between the A^{C}•T diff and the A^{C}•T diff 2 analyzers is that an A^{C}•T diff 2 analyzer is capable of closed-vial sampling. Adding a Closed-Vial mode and the cap-piercing components needed for this mode significantly affected operation of the Traverse module. Additionally, the A^{C}•T diff 2 analyzer uses pumps manufactured by Fluid Metering, Inc., for precision reagent and sample movement. These pumps, which are commonly referred to as FMI pumps, do not require valves to control movement in and out of the pump. As a result, the number of valves required to perform reagent and sample movements on an A^{C}•T diff 2 analyzer is generally less than the number of valves needed to perform the same function on one of the other A^{C}•T analyzers.

Location diagrams for the fluidic components identified in the following descriptions are under Heading A.5, A^{C}•T diff 2 COMPONENT LOCATIONS AND FUNCTIONS.

Traverse Module

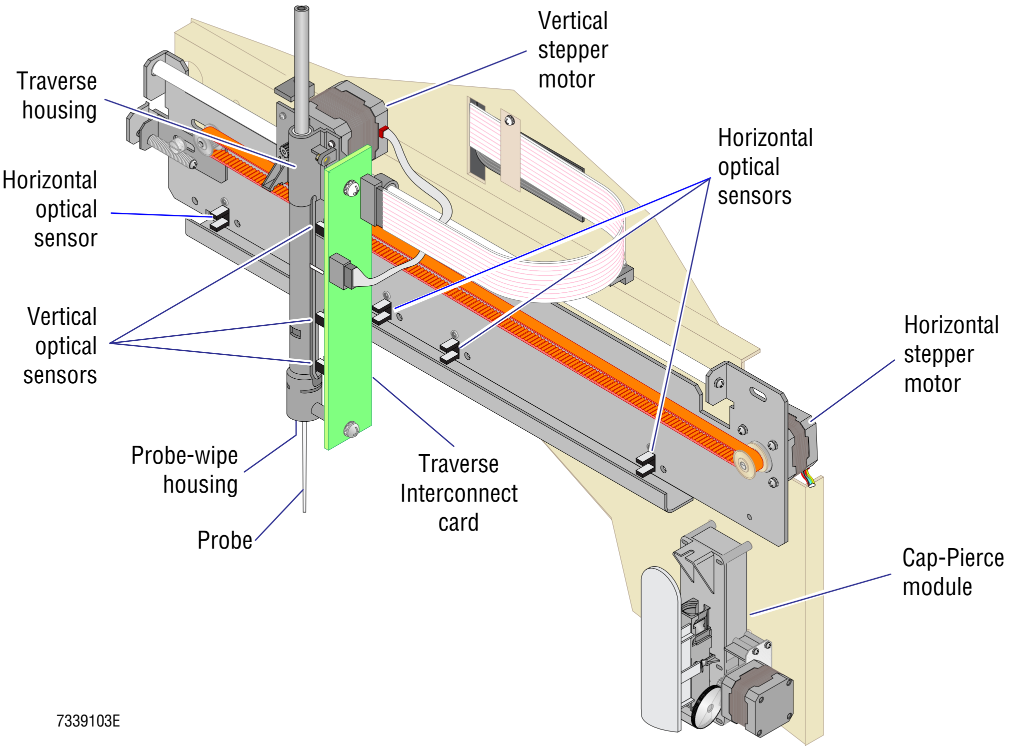
The Traverse module acts as a transport system for the probe which, in this instrument, functions not only as an aspirator tip but also as a cap piercer. Stepper motors provide the power that allows the Traverse module to move the probe either vertically or horizontally as needed. A series of three optical sensors are used to control the vertical positioning of the probe for various aspiration functions, including cap piercing and venting. Additionally, a series of four optical sensors control the horizontal positioning of the probe so that the probe is properly aligned, as needed, over the closed-vial (cap-pierce) aspirate station, over the WBC bath, over the RBC bath, or at the open-vial (manual) aspirate station. When a function such as aspiration is complete, the probe moves into the traverse housing where the probe-wipe housing surrounds the tip of the probe and a flow of diluent cleanses the outside of the probe.

Components

The Traverse module (Figure 2.3-1) consists of:

- The probe, which functions as an aspirator tip and a cap piercer (in the Closed-Vial mode of operation)
- The traverse housing, which encases and protects the probe
- The probe-wipe housing, which surrounds the tip of the probe as it rests inside the traverse housing
- Two stepper motors, one provides power for the vertical probe movements and the second provides power for the horizontal probe movements
- The Traverse Interconnect card, which includes three optical sensors to control vertical positioning of the probe
- Four horizontal optical sensors control probe alignment as needed over the closed-vial (cap-pierce) aspirate station, over the WBC bath, over the RBC bath, or at the open-vial (manual) aspirate station
- The Cap-Pierce module, which uses a stepper motor and two optical sensors

Figure 2.3-1 Traverse Module - Main Components



Probe and Traverse Housing Movement

Two stepper motors move the probe. One motor moves it vertically and the other moves it horizontally. A direct drive gear and rack system is employed for vertical motion while a belt and pulley drive system is used for horizontal motion. Optical sensors control probe movement and location.

Horizontal Optical Sensors

Four horizontal optical sensors on the Traverse module (Figure 2.3-1) control the four horizontal travel positions of the probe: at the open-vial (manual) aspirate station, over the WBC bath, over the RBC bath, and the closed-vial (cap-pierce) station. The flag for interrupting these optical sensors is attached to the back of the traverse housing where the probe resides.

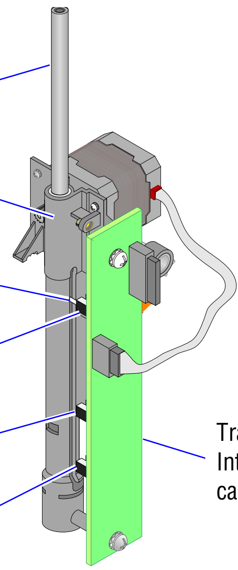
The Closed-Vial mode is considered the primary mode of operation, consequently the cap-pierce aspirate station is considered home position by the instrument.

Vertical Optical Sensors

Vertical positioning of the probe is controlled by four optical sensors. Three of these optical sensors (top, middle, bottom) are located on the Traverse Interconnect card (Figure 2.3-1). The flag for interrupting these optical sensors is attached to the vertical rack and moves with the probe (Figure 2.3-2).

Note: The traverse housing has a long vertical slot on its right through which the roll pin flag attached to the vertical rack protrudes. This is the flag that moves with the probe to interrupt the vertical sensors on the Traverse Interconnect card.

Figure 2.3-2 Vertical Positioning of the Probe - Components



The top optical sensor position is considered the vertical home position and is used when the system is idle or anytime the probe is moving horizontally.

In the Closed-Vial mode, the middle sensor is used to stop downward probe movement during the vent pierce (the first pierce). The middle optical sensor is also used to position the probe in the bath, for aspirating a portion of the WBC dilution from the WBC bath and for dispensing that portion into the RBC bath. For this reason, the middle sensor position is referred to as the thief position. Towards the end of a cycle, while the probe is still positioned over the RBC bath, it moves downward again. The middle sensor stops the probe's movement inside the RBC bath so that liquid expelled during the FMI sample and diluent pump homing process enters the RBC bath and drains to waste when the RBC bath is drained.

The bottom optical sensor position is used as the open-vial (manual) aspirate position, When a standard specimen tube is processed in the Closed-Vial mode, the downward stroke for the aspiration pierce (the second pierce) is stopped when the probe's flag is positioned inside the bottom optical sensor. When the flag is in this position, the probe stops <u>near the bottom</u> of the specimen tube prior to aspiration. This is the typical probe stop point when the length of the inserted specimen tube allows the tube's bottom to rest against the bottom of the tube holder assembly. Most standard specimen tubes fit this criteria.

The fourth optical sensor for controlling vertical positioning of the probe is the tube bottom seeking sensor located inside the cap-pierce housing. When using the Closed-Vial mode of operation, this sensor controls downward probe movement during the aspiration pierce when a smaller volume tube, a tube with a false bottom, or the tube adapter is used. The tube bottom seeking sensor is detailed later in this section.

Cap-Pierce Module

The Cap-Pierce module is the main addition to the A^{C}•T diff 2 analyzer. The Cap-Pierce module provides the capability for closed-vial sampling. This module accepts one specimen tube at a time in a spring-loaded holder that is capable of clamping a variety of tubes with different diameters. Tubes too small for this holder can be accommodated using an adapter.

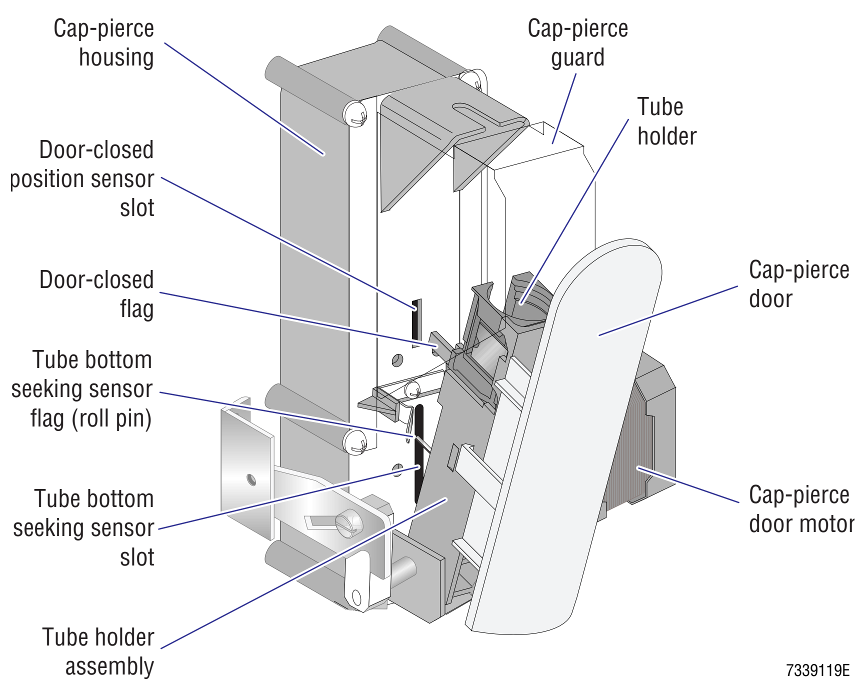
Note: For a list of specimen tubes that are tested and approved for closed-vial sampling on the A^{C}•T diff 2 analyzer, see the Operator's Guide, Appendix B.

Components

Main components of the Cap-Pierce module (Figure 2.3-3) include:

- Cap-pierce housing
- Cap-pierce door
- Tube holder
- Tube holder assembly with attached door-closed flag and bottom-sense (roll pin) flag
- Door-closed optical sensor inside the cap-pierce housing
- Tube bottom seeking optical sensor inside the cap-pierce housing
- Cap-pierce door motor

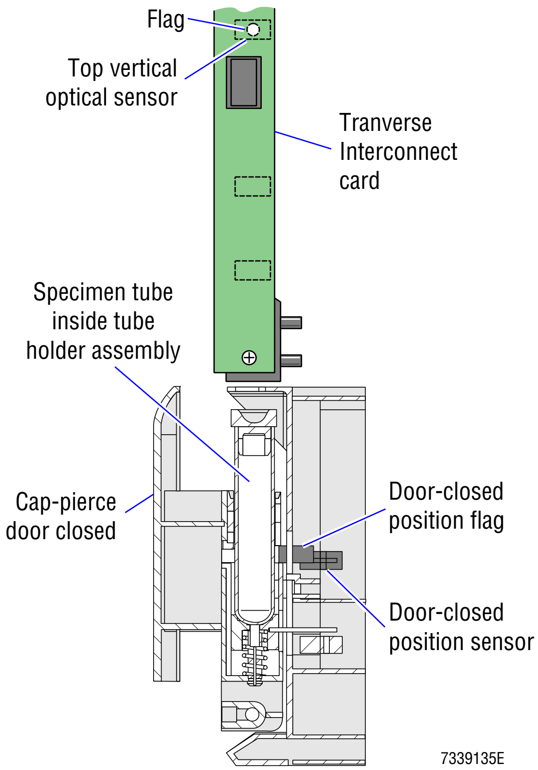
Figure 2.3-3 Cap-Pierce Module - Main Components



Typical Operation

When the cap-pierce door is open, the operator can insert a specimen tube into the tube holder assembly. When the operator manually pushes the cap-pierce door closed, the following sequence occurs.

Figure 2.3-4 Starting the Cycle (right side view)



Starting the Cycle

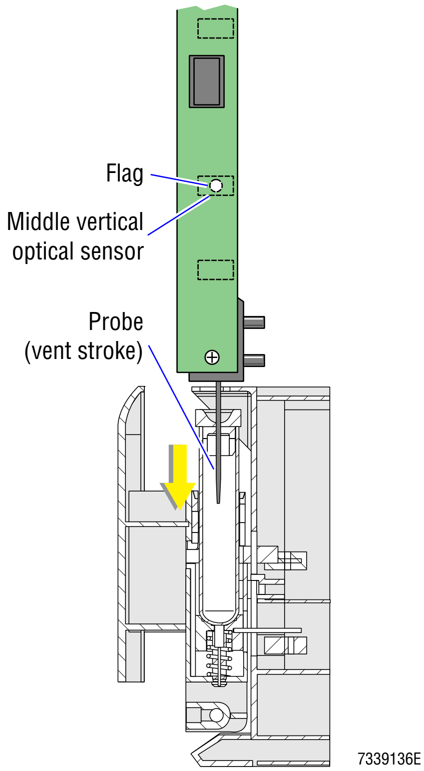
Refer to Figure 2.3-4.

The Closed-Vial mode is considered the primary mode of operation which means the cap-pierce aspirate station is considered the home position. This means the horizontal flag on the traverse housing is inside the horizontal sensor above the cap-pierce aspirate station and the flag on the vertical rack is inside the top optical sensor on the Traverse Interconnect card. These position sensors place the probe above the cap-pierce aspirate station and inside the traverse housing.

When the cap-pierce door is closed, the door-closed position flag (the rectangular flag attached to the back of the tube holder assembly) blocks the light path of the optical door-closed position sensor inside the cap-pierce housing. This optical sensor acts as an aspirate switch to initiate the cycle.

During a cycle, the probe pierces the specimen tube's cap two times - the first pierce is for venting; the second pierce, for aspiration.

Figure 2.3-5 Vent Pierce (right side view)



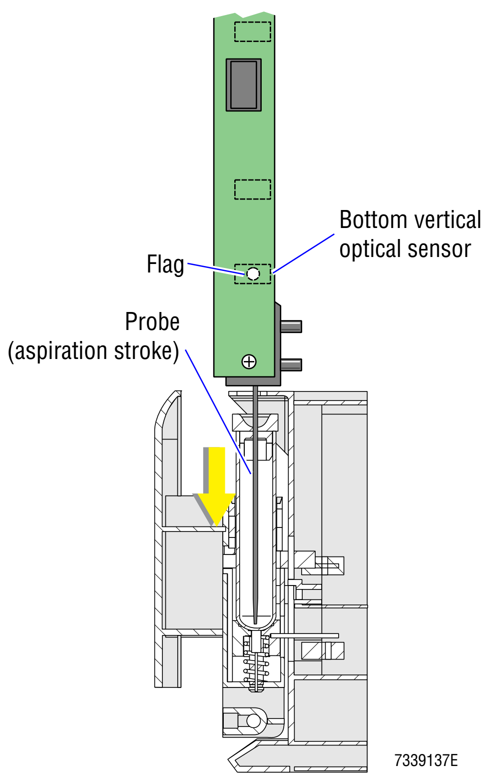
Vent Pierce

Refer to Figure 2.3-5.

When the probe pierces the tube's cap the first time, it retracts immediately. As the probe, which has grooves on its exterior, moves in then out of the tube, the specimen tube vents along the open spaces of these grooves. The probe then pierces the cap a second time for aspiration.

The depth of the pierce for venting is different than the depth of the pierce for aspiration. The depth of pierce is controlled using the vertical optical sensors on the Traverse Interconnect card. From its home position inside the top optical sensor, the probe moves downward. Probe travel for the venting pierce is stopped when the probe's flag is positioned inside the middle optical sensor. This allows the tip of the probe to extend about 2-inches into the specimen tube (less than half the length of a typical specimen tube)

Figure 2.3-6 Aspiration Pierce - Typical (right side view)



Aspiration Pierce - Typical

Refer to Figure 2.3-6.

Downward probe travel for the aspiration pierce is stopped one of two ways. Typically, the aspiration pierce is stopped by positioning the probe's flag inside the bottom optical sensor on the Traverse Interconnect card. At this position, the probe is near the bottom of the specimen tube. This method of stopping probe travel is used when the length of the inserted specimen tube allows the tube's bottom to rest against the bottom of the tube holder assembly.

Smaller volume tubes, tubes with false bottoms, and short plastic tubes use the bottom sense function to stop downward probe travel during the aspiration pierce.

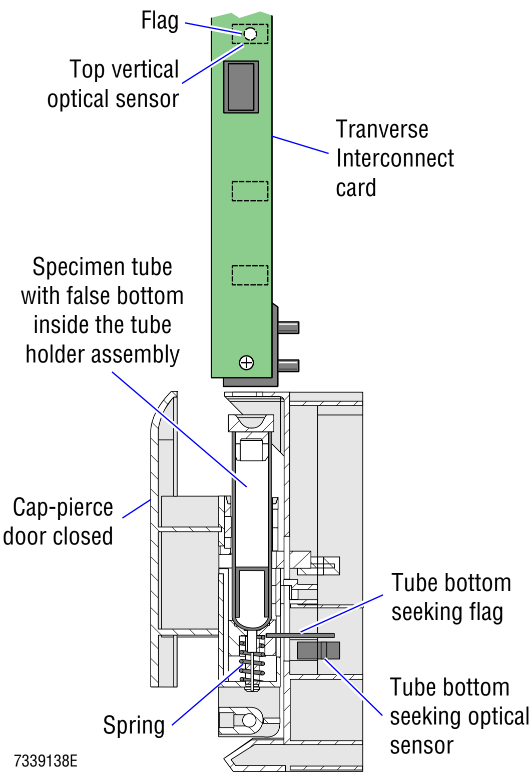
Bottom Sense Function

CAUTION Risk of damage to the probe tip. Use of short glass specimen tubes may damage the probe tip as the probe pushes on the bottom of the glass tube against the strong spring pressure. A damaged probe tip will eventually break glass tubes. Do not use short glass tubes.

The bottom sense function allows small volume specimen tubes and specimen tubes with false bottoms to be processed in the Closed-Vial mode of the A^{C}•T diff 2 analyzer. Use of the bottom sense function also allows small, narrow specimen tubes that require a special tube adapter to be processed in the Closed-Vial mode. Although both glass and plastic specimen tubes can fit in this adapter, only plastic tubes should be used. Depending on the design of the specimen tube, the tube will either fit completely inside the tube adapter or the tube's cap will rest on top of the adapter. The tube adapter and specimen tube are inserted together into the tube holder assembly in the same manner as a normal diameter tube.

Note: For more information about this tube adapter, see the Operator's Guide, Appendix B.

Figure 2.3-7 Bottom Sense Function - Components (right side view)



Bottom Sense Function Components

Refer to Figure 2.3-7.

When a smaller volume specimen tube, a tube with a false bottom, or the tube adapter is inserted into the tube holder assembly, it rests on a spring-loaded platform located at the bottom of the tube holder assembly.

When the operator closes the cap-pierce door, the tube bottom seeking (roll pin) flag, inserted in the side of this spring-loaded platform, rests above the tube bottom seeking optical sensor, located inside the cap-pierce housing.

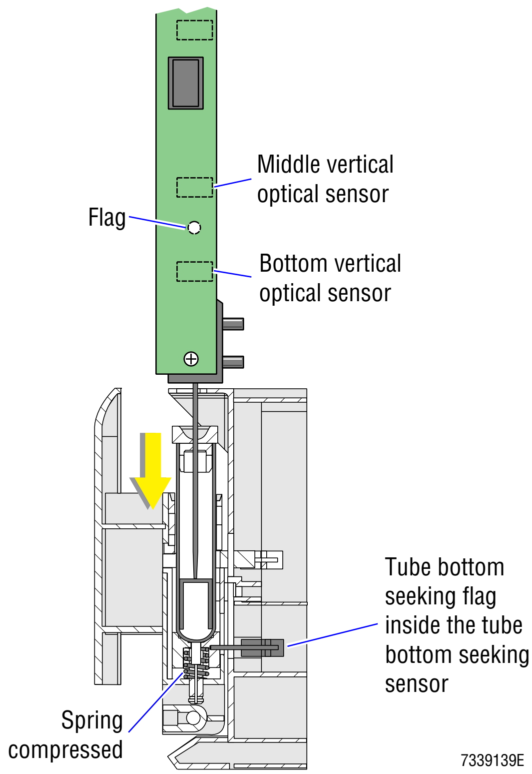
As stated earlier, the door-closed position sensor acts as an aspirate switch when interrupted by the door-closed position flag.

Note: For more information about initiating a cycle, in this section, see Starting the Cycle.

Once the cycle is initiated, the probe makes its first pierce to vent the specimen tube. This process does not differ with the type of specimen tube. It is the probe movement for the aspiration pierce that differs with these special tubes. Figure 2.3-7 illustrates the status of these key components when the vent pierce is complete.

Note: For more information about venting the specimen tube, in this section, see Vent Pierce.

Figure 2.3-8 Aspiration Pierce Using Bottom Sensing (right side view)



Aspiration Pierce Using Bottom Sensing

Refer to Figure 2.3-8.

When the probe pierces the tube's cap the second time for aspiration, the probe makes contact with the bottom of the specimen tube before the flag on the probe reaches the bottom optical sensor on the Traverse Interconnect card (this is the sensor that generally stops downward probe movement during aspiration). Since the probe's flag has not interrupted the bottom optical sensor, the probe continues its downward movement. The probe continues to push on the bottom of the tube against the spring pressure and forces the platform down. The tube bottom seeking (roll pin) flag attached to the platform also moves down. This downward movement continues until the flag interrupts the tube bottom seeking optical sensor (lower sensor inside the cap-pierce housing). This interruption signals the system to stop probe movement. Aspiration then occurs with the probe pressed against the bottom of the specimen tube. This is possible because the aspiration port is on the front, not the bottom, of the probe. Aspirating from the bottom of the tube means a very small specimen volume is required for proper aspiration from these tubes.

ATTENTION: Spring tension is critical to the bottom sense function of cap-pierce operation. **It must not be altered.** Enough pressure must be exerted to pierce all common caps and materials without falsely sensing the bottom, yet not so much pressure that the specimen tube and/or probe are damaged. Spring tension and distance traveled determine this balance of force. Altering the spring tension, such as would happen if you used a different spring, can cause the instrument to malfunction.

When Aspiration is Complete

Because aspiration is typically initiated when the flag on the probe reaches the bottom optical sensor on the Traverse Interconnect card, this bottom sensor is sometimes referred to as the fixed bottom sensor. Because the bottom sense function is only used when either small volume specimen tubes or tubes with false bottoms are processed, the tube bottom seeking optical sensor is sometimes referred to as the alternate bottom sensor.

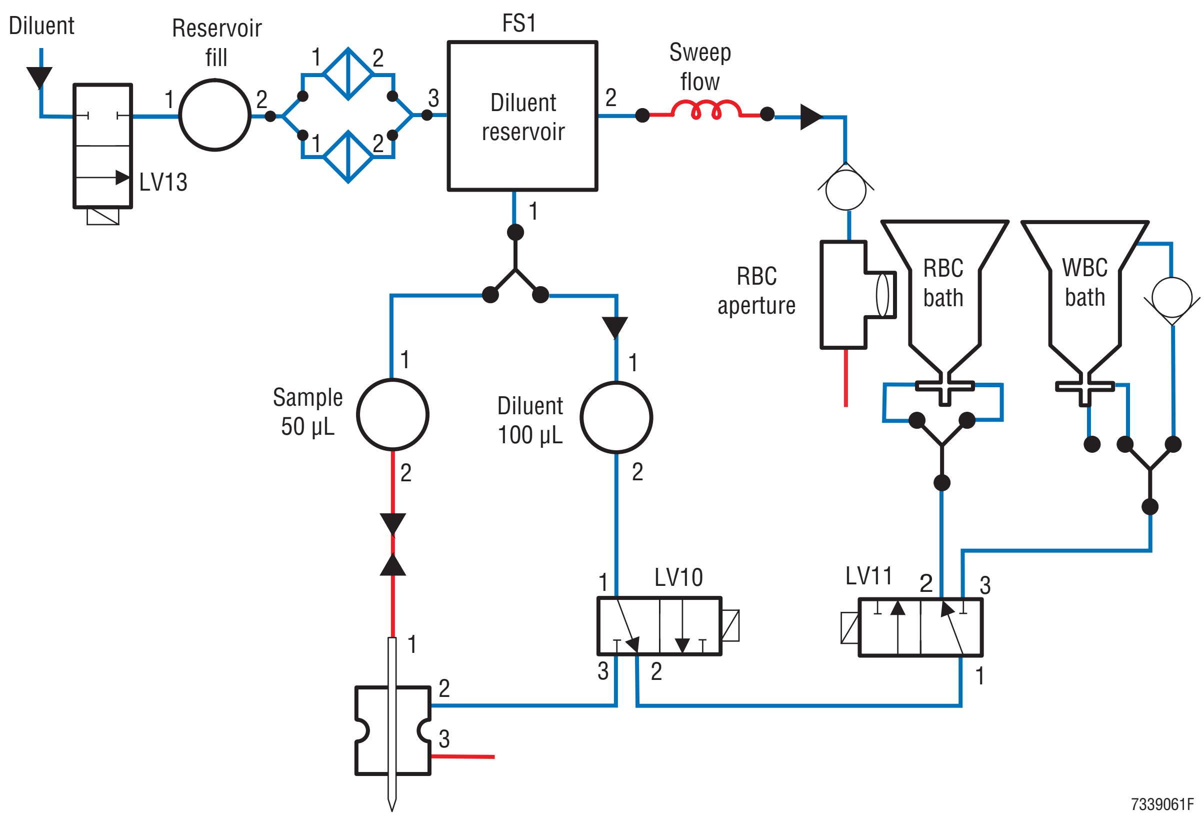
Regardless of how the aspiration is initiated in the Closed-Vial mode, when aspiration is complete, the probe retracts to its home position (determined by the top optical sensor on the Traverse Interconnect card). While the cycle continues, the cap-pierce door opens using a slow, regulated pace controlled by a stepper motor / gear arrangement.

Once the door is open, the operator can remove the last specimen tube. Although the operator can insert the next specimen tube as preparation for the next cycle, the operator should not close the cap-pierce door until the current cycle is complete. If the cap-pierce door is closed before the current cycle is complete, the specimen tube is ignored. When the current cycle is complete, a new cycle does not begin. The AC•T diff 2 analyzer sets at rest with the specimen tube inside the Cap-Pierce module until the cap-pierce door is opened and closed again. This design ensures the current specimen tube is not pierced and cycled again if the operator inadvertently closes the cap-pierce door before removing the specimen tube. Additionally, this design ensures the analyzer does not cycle repeatedly if the cap-pierce door becomes stuck in its closed position.

Diluent Delivery System

The AC•T diff 2 analyzer diluent delivery system uses the same on-board diluent reservoir as the AC•T 8/10 and AC•T diff analyzers. This diluent reservoir contains two sensors, a float level sensor to verify and control the diluent supply in the reservoir and a temperature thermistor sensor to provide a reagent temperature reading for the instrument. See Figure 2.3-9 for a schematic diagram of the diluent system.

Figure 2.3-9 Diluent Delivery System in the AC•T diff 2 Analyzer - Components and Flow



A 24-Vdc brush type motor driven diaphragm liquid pump is used to fill the reservoir from the reagent supply. Solenoid valve LV13 is used to open and close the reagent path since the diaphragm pump does not act as a valve. Filters FLS3 and FLS4 are used to remove contaminating particles down to the size of some bacteria. (Filters that are small enough to eliminate all possible bacteria would restrict diluent flow too much.) Two filters are used in parallel to facilitate initial priming.

The diluent reservoir has two output ports. One port supplies diluent for the sweep flow; the other, for sample preparation and rinsing.

The sweep-flow port is connected to the rear chamber of the RBC bath through a coil of small diameter tubing and a check valve. Sweep-flow diluent is used to “sweep” away red blood cells that have already passed through the aperture, so they do not swirl back into the aperture sensing area and get counted as platelets. The coil of small diameter tubing restricts the flow of the diluent to a rate that allows the same vacuum source to simultaneously pull dilution through the RBC aperture and sweep-flow diluent behind the RBC aperture.

The second output port on the diluent reservoir is connected through a Y-fitting to two FMI® pumps, a 50 µL pump used primarily for sample aspiration and a 100 µL pump used for diluent supply. The sample pump is connected directly to the top of the aspirate probe and is used anytime aspiration through the probe is required. The diluent pump supplies diluent to the probe wipe and the baths. Solenoids LV10 and LV11 control the flow of diluent from the diluent pump. When LV10 is energized, the diluent pump is connected to the top of the probe-wipe housing so it can supply diluent for probe washing. When LV10 is de-energized (at rest), it routes diluent through LV11 to the baths. When LV11 is de-energized, diluent is routed to the RBC bath ports; when LV11 is energized, diluent is routed to the WBC bath ports.

Note: For details about how an FMI pump operates and other considerations, see FMI Pump Operation at the end of this section.

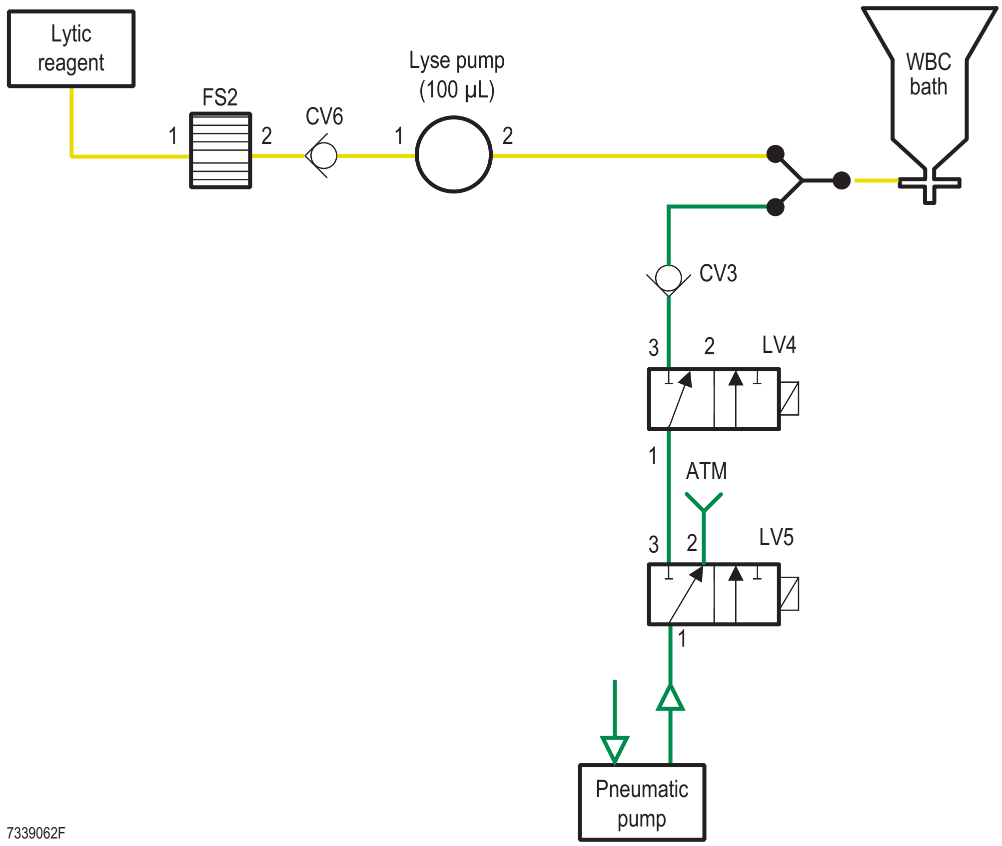
Lytic Reagent Delivery System

Lytic reagent is used to eliminate red blood cells from the WBC/Hgb dilution, similar to most Beckman Coulter hematology analyzers. A 100 µL FMI pump is used to dispense 415 µL of lytic reagent for the diluter system. (See Figure 2.3-10.)

Several features of the FMI pump simplify lytic reagent delivery in the A^{C}•T diff 2 analyzer**.** The FMI pump is an in-line continuous flow pump which eliminates the need for extra valves to control flow direction, such as are needed when using diaphragm pumps or syringe pumps. Although the pump design effectively seals the input from the output during operation, a check valve positioned between the optical liquid sensor (FS2) and the lyse pump prevents any siphoning that might occur when the instrument is at rest. The FMI pump uses a stepper motor to provide accurate reagent delivery. Both volume and flow rate are controlled by the software; therefore, eliminating the need for variables to adjust lyse/diluent timing. This timing will not vary unless it is deliberately changed in a different version of the software.

Note: For details about how an FMI pump operates and other considerations, see FMI Pump Operation at the end of this section.

Figure 2.3-10 Lytic Reagent Delivery System in the A^{C}•T diff 2 Analyzer - Components and Flow



An optical liquid sensor, FS2, in the lytic reagent line monitors the lytic reagent supply as it enters the instrument. Lytic reagent in the sensor transmits light, but air in the sensor prevents light transmission. This sensor is monitored throughout the entire lytic reagent delivery so that any air gaps present in the sensor trigger a lytic reagent low warning. A software filter is applied to the data received from this sensor to ensure that microbubbles, inconsequential in their affect on the lytic reagent delivery volume, do not trigger the warning.

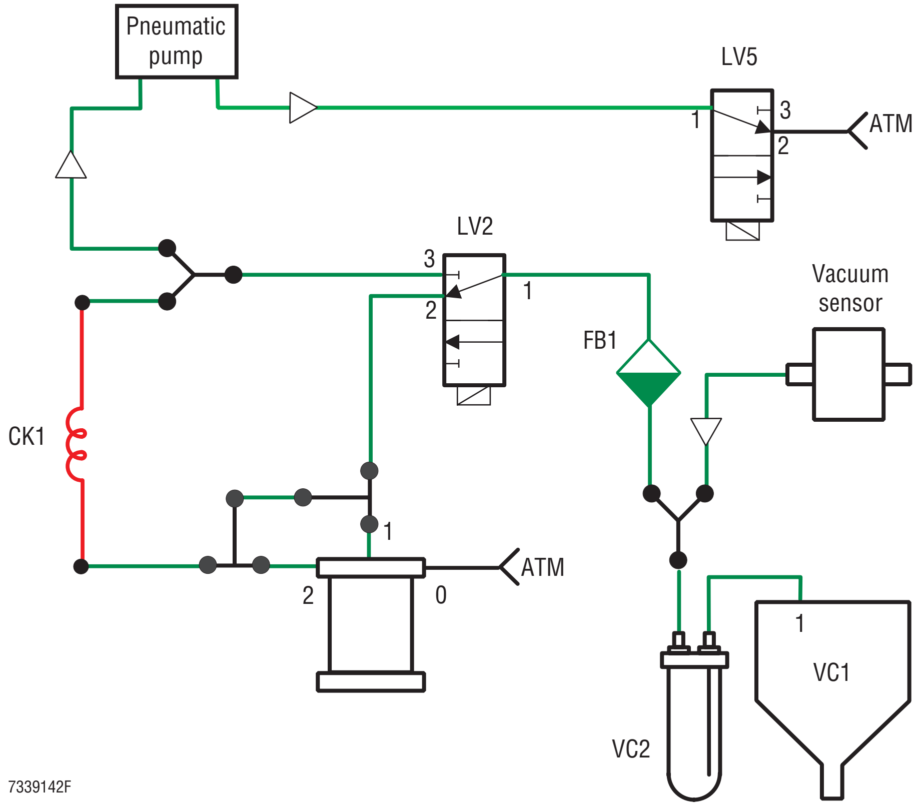
Pneumatic System

The A^{C}•T diff 2 analyzer uses either a 24-Vdc ASF Thomas brush-type, diaphragm vacuum pump or a KNF dual-head vacuum/pressure pump. Both pumps satisfy three pneumatic supply requirements:

- Raw vacuum from the vacuum pump is used unregulated as a high-vacuum source for the probe-wipe function.
- Raw (high) vacuum from the pump is regulated to 6-in. Hg for counting.
- Pressure from the pump (exhaust pressure from the single-head pump) is used to create air bubbles for mixing the WBC and RBC dilutions in their respective baths.

Four pneumatic solenoids, LV2 through LV5, control this vacuum system. These solenoids are mounted together on a manifold and are available as an assembly. The vacuum system is illustrated in Figure 2.3-11.

Figure 2.3-11 Pneumatic System in the A[C]•T diff 2 Analyzer - Vacuum Components and Flow



Vacuum Supply

LV2 controls the vacuum level applied to the vacuum chamber, VC1. High vacuum from the vacuum pump is applied directly to the normally closed port, labeled port 3 (Figure 2.3-11). The normally open port 2 is connected to the vacuum being routed through the vacuum regulator. This configuration makes high vacuum and regulated low vacuum available at a common port, port 1, which is connected to the vacuum sensor and to VC1 (via the foam trap VC2).

At rest, when the pneumatics are on but the analyzer is not cycling, the high vacuum supply being regulated to 6-in. Hg by the vacuum regulator is the vacuum available inside the vacuum chamber, VC1. Regulated vacuum, monitored by the vacuum sensor, is used during the count portion of the cycle to draw the WBC and RBC dilutions through their respective apertures and to pull sweep-flow diluent behind the RBC aperture. The high vacuum applied to VC1 when LV2 is energized is used to scavenge waste during the probe-wipe function.

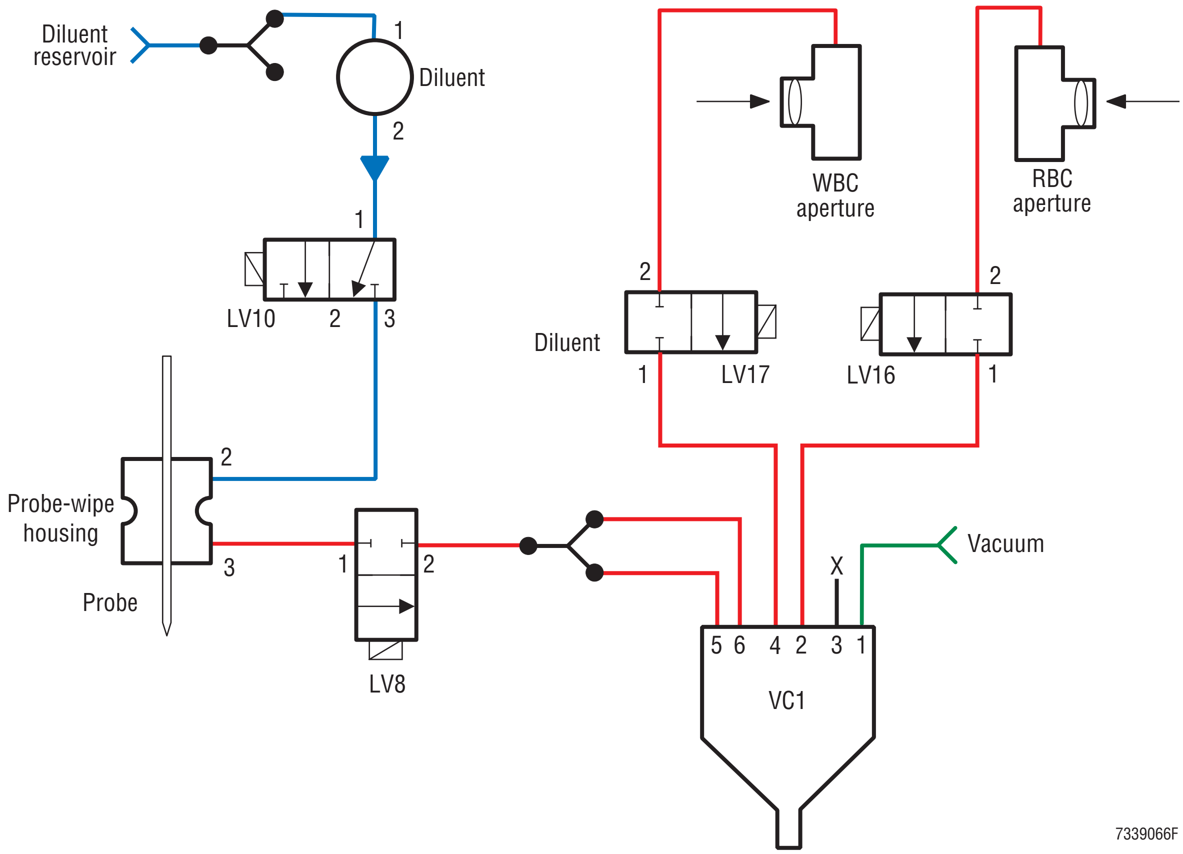
Note: The A[C]•T 8/10 and A[C]•T diff analyzers use an additional solenoid (LV1) to vent VC1 while draining and during the high vacuum /low vacuum transitions. Solenoid LV1 has been removed from the A[C]•T diff 2 analyzer. When venting is required, solenoid LV8, normally used for probe-wipe function, is opened to make the lower port on the probe-wipe housing a vent path.

On the single-head pneumatic pump, LV5 switches the exhaust to atmosphere when vacuum is being used.

Probe Wipe

The probe-wipe function involves two tasks, probe washing with diluent and probe drying. Both tasks require high vacuum. To supply the high vacuum needed to accomplish these tasks, LV8 connects the high vacuum supply in VC1 to the bottom port of the probe-wipe housing (Figure 2.3-12).

Figure 2.3-12 Vacuum Chamber (VC1) System in the AC•T diff 2 Analyzer - Components and Flow



Note: LV8 is a large Bio-Chem solenoid pinch valve. This two-way pinch-tube type of solenoid valve functions like the single-acting pinch-valve used on many other Beckman Coulter instruments. This solenoid valve uses a strong, thick-walled silicon compound tubing and provides a large, straight path for the waste so that any rubber particles from the cap pierce are easily washed through the probe-wipe system.

After aspiration (or venting in the Closed-Vial mode), while the probe is moving up into the probe-wipe housing, LV10 is energized to open the pathway from the FMI diluent pump to the top probe-wipe housing port and the pump begins to move diluent from the diluent reservoir to the top probe-wipe housing port. The diluent is forced in a spiral action down to the bottom probe-wipe housing port, washing sample from the outside of the probe. High vacuum pulls this waste material into VC1.

A Y-fitting is used to split the waste path between LV8 and VC1 into two paths. At VC1, it is important to connect these tubings to the two outer fittings that allow the waste to enter behind the splash guards inside the vacuum chamber. This is necessary to reduce the flow rate at each fitting which reduces splashing and cross-talk in VC1.

Once the outside of the probe is washed, the FMI diluent pump is turned off and LV10 is de-energized which stops the supply of wash diluent. The high vacuum being applied to the bottom probe-wipe housing port dries the probe before LV8 de-energizes. When the probe is moved up from inside the baths, the vacuum is reapplied to the vacuum chamber without diluent to dry the probe.

Count

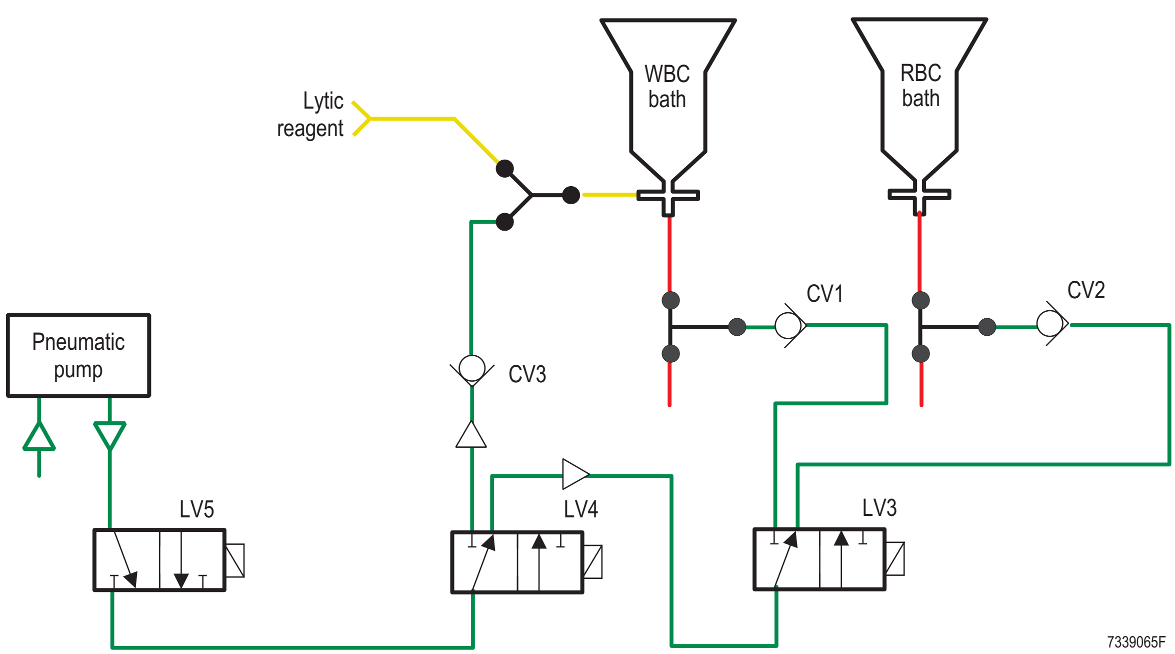
Regulated vacuum (6-in. Hg) is used for counting. The WBC aperture is connected to VC1 through LV17 and the RBC aperture through LV16 (Figure 2.3-12). During the count portion of the cycle, the regulated vacuum available in VC1 is applied to these apertures when valves LV16 and LV17 are energized. Once the pathway is open, the regulated vacuum in VC1 is applied to the apertures and the WBC dilution inside the WBC bath is pulled through the WBC aperture and the RBC dilution inside the RBC bath is pulled through the RBC aperture. Additionally, on the RBC side, regulated vacuum also pulls diluent through the sweep-flow line. Two streams of droplets should be entering VC1 during the count portion of the cycle.

Note: Regulated vacuum, 6-in. Hg, low vacuum, count vacuum, and aperture vacuum are synonymous terms and are, therefore, interchangeable.

Pressure Supply

Exhaust from a single-head pneumatic pump or pressure from a dual-head pneumatic pump is used as the mixing bubble air supply. These air bubbles pass through the sample dilution inside each bath and mix the dilution to ensure the particle suspension is uniform throughout the bath. LV5 switches the pressure between atmosphere and the mixing-bubble path (Figure 2.3-13). The alternate energizing and de-energizing of LV5 breaks up the air flow and creates the individual bubbles.

Figure 2.3-13 Pneumatic System in the AC•T diff 2 Analyzer - Pressure Components and Flow



Solenoids LV3 and LV4 control the path for mixing bubbles. LV4 switches the air path between the WBC bath lytic reagent (side) port and LV3. LV3 switches the mixing bubbles between the bottom ports of the RBC and WBC baths. The alternate energizing and de-energizing of LV5 provides the bubble rate. (This rate is variable according to the altitude setting on the Date/Time screen.)

Check valves are used in all three mixing bubble paths to ensure that liquid from the bath does not migrate into the pneumatic system. At the completion of mixing, an air gap remains. This air gap electrically isolates the reagent systems from the dilution in the bath that is about to be counted.

Note that the air path taken by the mixing bubbles restricts air flow. Air pressure forming the mixing bubbles in the bath is not as great as it is at the pneumatic pump. Additionally, the single-head vacuum pump cannot be simultaneously used as a source of vacuum and mixing bubbles because the vacuum pump cannot create sufficient vacuum when the vacuum exhaust is being used to form mixing bubbles.

Aperture Sensor System

The aperture sensor system is responsible for sample analysis and consists of:

- An RBC aperture/bath assembly for sensing red blood cells and platelets
- A WBC aperture/bath assembly for sensing white blood cells
- A photometer for Hgb measurement
- The vacuum chamber (VC1)
- A sweep-flow tubing spool
- Two fluidic solenoid valves to open the vacuum pathway to each aperture

These components are mounted on a plate that is electrically isolated from the chassis and is enclosed with a shield attached to it. A single ground connection between this assembly and the preamp shield on the Analyzer card eliminates undesirable ground loops.

The aperture and bath are one piece. The assembly clips (without fasteners) onto a bath support. The electrical connection to the bath assembly is via one coaxial cable plugged directly into the preamp on the Analyzer card. The internal wire is connected to the internal rear chamber electrode and the coaxial shield is connected to the external bath electrode. Since most of the assembly is enclosed within the isolated shield/plate assembly, there is little need to shield both electrode wires individually, although a portion of the coaxial cable inside the instrument's chassis is not shielded from internal chassis noise.

Hemoglobin Photometer Assembly

CAUTION The length of the screw used to mount the Hgb photometer assembly is critical. A screw that is too long will punch a hole into the WBC aperture/bath assembly. Use the correct length screw to mount the Hgb photometer assembly.

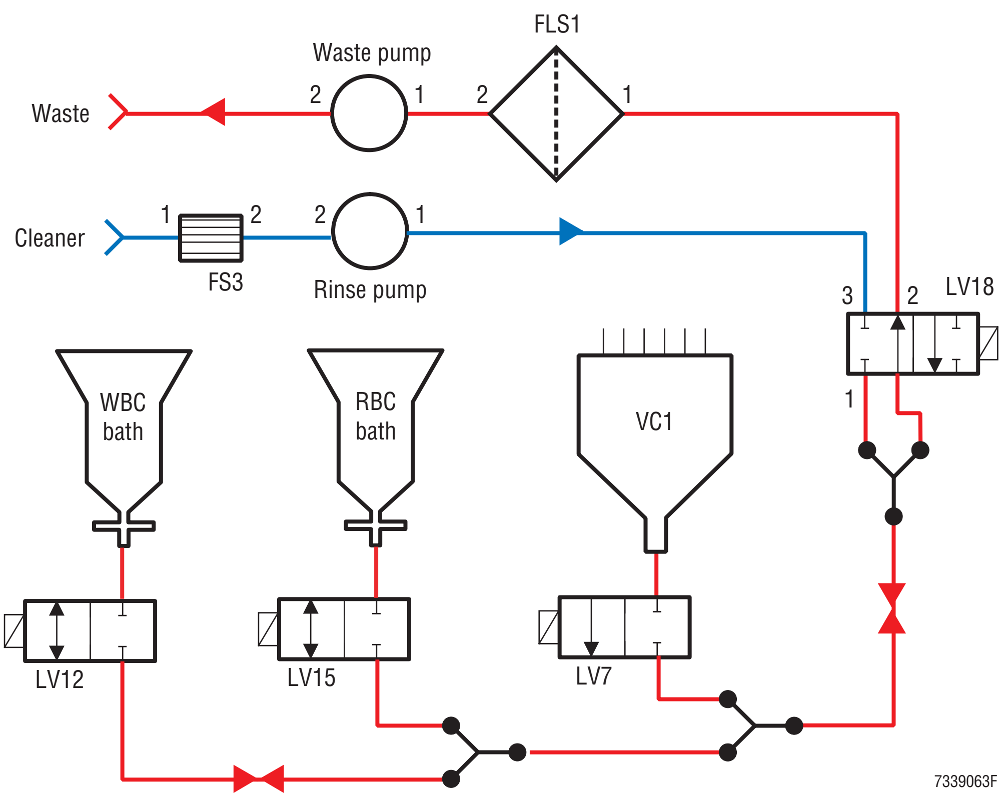
A single screw mounts the Hgb photometer assembly to the WBC bath while two additional screws and posts are used for shipping support. The assembly is composed of two pieces, a housing including the photodiode and preamp, and the removable Hgb lamp. A coaxial cable connects the photodiode preamp to the Analyzer card. A four-wire cable connects the lamp to the Analyzer card. Two of the wires are sense lines for feedback regulation. These sense wires are not used by the Analyzer card in the AC•T diff 2 analyzer. The supply voltage for the Hgb lamp on the AC•T diff 2 analyzer is 3.6 Vdc.

Waste and Cleaner System

Waste System

At the completion of a sample run, the remaining sample dilution, the counted sample, and the material washed from the outside of the probe must be cleared from the system in preparation for the next sample. This means the two aperture baths and the vacuum chamber, VC1, must be drained and rinsed then the accumulated waste expelled from the analyzer. The components used in this waste system are illustrated in Figure 2.3-14.

Figure 2.3-14 Waste and Cleaner System in the AC•T diff 2 Analyzer - Components and Flow



To effectively remove waste from the system, an individual drain line is attached to the bottom of each chamber (the WBC bath, the RBC bath, and VC1). Each drain line is controlled by a two-way solenoid valve. LV12 controls the draining of the WBC bath; LV15, the draining of the RBC bath; and LV7, the draining of the vacuum chamber, VC1.

Note: LV12, LV15, and LV7 are large Bio-Chem solenoid pinch valves. These two-way pinch-tube type of solenoid valves function like the single-acting pinch-valves used on many other Beckman Coulter instruments. Since most fluidic solenoid valve designs tend to develop build up problems when the valve is used in a waste line, a pinch-tube type of solenoid valve was chosen for use in the A^{C}•T diff 2 analyzer. Because the design of this valve provides a large, straight path for the waste, the use of this pinch-tube type of solenoid valve virtually eliminates any build up problems. It also allows you to clean or replace tubing easily, without replacing the entire valve. The valve selected uses a strong, thick-walled silicon compound tubing that will not require frequent replacement and may last the life of the instrument.

The outputs of valves LV12, LV15, and LV7 are joined and routed through the normally open path of solenoid LV18, a three-way pinch-tube type solenoid valve.

Note: LV18 is a large Bio-Chem solenoid pinch valve. This three-way pinch-tube type solenoid valve functions just like the double-acting pinch valve used on many other Beckman Coulter instruments.

The waste is then drawn through a basket type filter, FLS1, by an inline, dc motor-driven, diaphragm pump and sent to an external waste container or drain. FLS1 is a large mesh filter used to trap rubber particles that enter the system from the cap-pierce system. The filter is necessary because large particles can be trapped in the valves of the waste pump, making it inoperable. To enhance performance, the filter is porous so that it traps only large particles and does not plug up prematurely from normal waste. It is large so that it will not require frequent replacement.

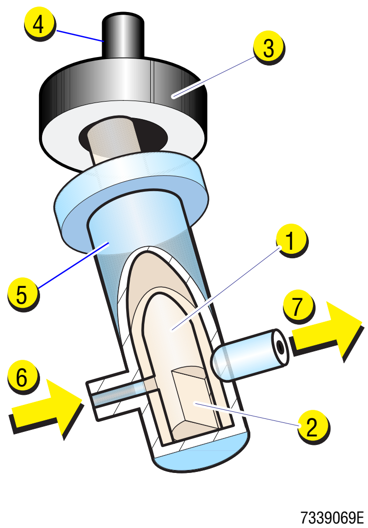
Cleaner System

As with the A^{C}•T 8/10 and A^{C}•T diff analyzers, the shutdown diluent (cleaner) is introduced through the waste system (Figure 2.3-14). When energized, the normally closed path of solenoid LV18 is used to disconnect the external waste from the system and connect the shutdown diluent (cleaner). Shutdown diluent (cleaner) is pumped through LV18 to the baths and VC1 by a small dc motor-driven, peristaltic pump. The tubing used by this pump will last much longer than the tubing used in the peristaltic pumps on the A^{C}•T 8/10 and A^{C}•T diff analyzers. Because a shutdown is performed only once a day, this tubing is not expected to need replacing. An inline optical fluid sensor (FS3) is placed in the tubing from the reagent source to ensure reagent is present.

FMI Pump Operation

The A^{C}•T diff 2 analyzer uses pumps manufactured by Fluid Metering, Inc., for precision reagent and sample movement. These pumps, commonly referred to as FMI pumps, do not require valves to control movement in and out of the pump. An FMI pump uses a ceramic piston moving within a ceramic liner. The seal between these two parts is tight and performs the valve action. Ceramic does not wear quickly, so the pump lasts a long time without parts wearing or failing. No parts require periodic replacement.

Figure 2.3-15 FMI Pump Components



Pump Components

Refer to the item numbers in Figure 2.3-15.

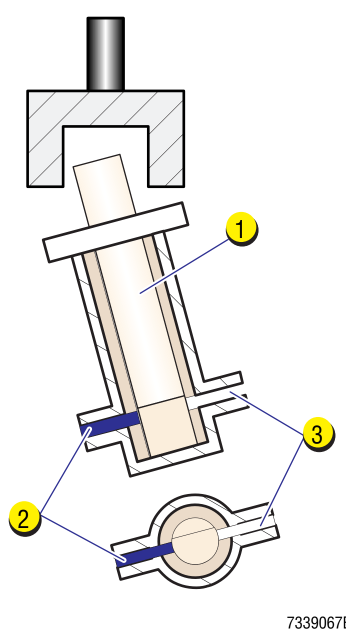
The main component of the FMI pump is a ceramic piston, which is a cylinder (1) with a flattened area (2) at the port or liquid end. The piston is mounted at an angle to the piston mount (3), which is mounted to the motor shaft (4). This angle causes the piston to move up and down inside the pump housing (5) when the piston is rotated.

The piston can be rotated in either direction. For precise control, the pumps in the AC•T diff 2 analyzer use stepper motors driven with 24 Vdc.

When the pump's stepper motor is turned on, the motor shaft, piston mount, and piston rotate simultaneously. In the following descriptions, rotation of the piston implies rotation of the motor shaft and piston mount. The direction of rotation is considered from the pump housing end of the assembly.

The pump housing has two ports, an intake port (6) and an output port (7).

Figure 2.3-16 Crossover from Output to Intake



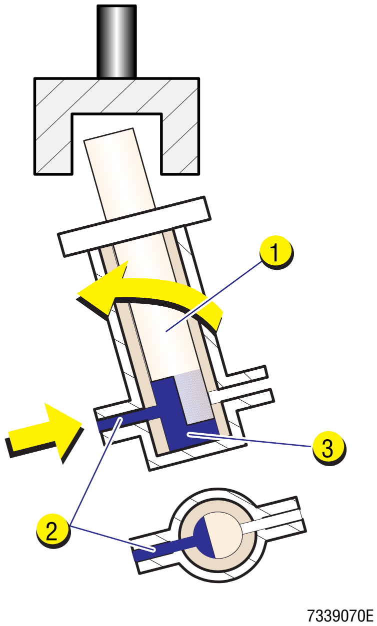
Crossover Position from Output to Intake

Refer to Figure 2.3-16.

When the pump is ready to begin the intake phase of its operation, the top of the piston (1) is flush with the port end of the pump housing and the flattened portion of the piston is facing outward.

When the piston is in this position, both the intake port (2) and output port (3) are blocked by the piston.

Figure 2.3-17 Intake Position



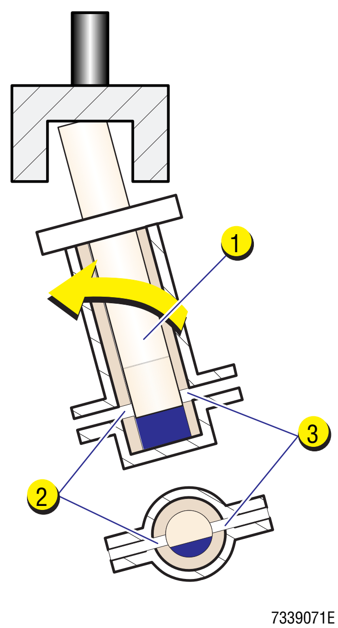
Intake Position

Refer to Figure 2.3-17.

When the stepper motor is turned on, the piston (1) rotates counterclockwise and moves away from the port end of the pump housing towards the motor end of the pump.

Moving the piston unblocks the intake port (2) and provides negative pressure to draw fluid through the open intake port into the pump. As the piston continues to rotate, the internal volume between the top of the piston and the pump housing (3) increases.

Figure 2.3-18 Crossover from Intake to Output



Crossover Position from Intake to Output

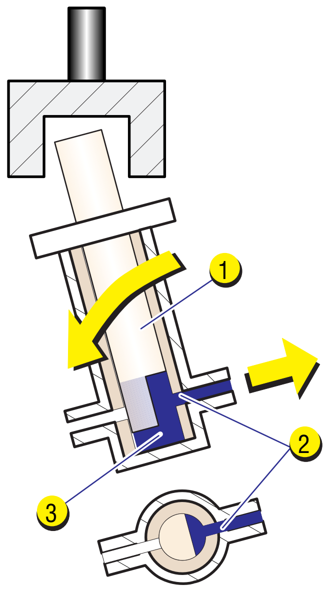
Refer to Figure 2.3-16.

The piston (1) continues its counterclockwise rotation and is drawn as close to the motor end of the pump as it can travel. The flattened portion of the piston is now facing inward.

When the piston is in this position, both the intake port (2) and the output port (3) are again blocked by the piston. The pump now contains its designated volume of reagent.

The pump is now halfway through its rotation.

Figure 2.3-19 Output Position



Output Position

Refer to Figure 2.3-19.

As the counterclockwise rotation of the piston continues, the direction the piston (1) travels is reversed. The piston now moves away from the motor towards the port end of the pump housing.

Moving the piston unblocks the output port (2). As the piston moves towards the port end of the pump housing, the pump's internal volume (3) decreases and fluid is pushed out the open output port.

Continued movement returns the pump to the Crossover Position from Output to Intake where the top of the piston (1) is flush with the port end of the pump housing and the flattened portion of the piston faces outward.

Additional Points about the FMI Pumps

- Each pump has a home sensor that can be used to start from a known position or as a counting mechanism to count the number of revolutions.
- The angle of the piston determines the pump flow rate or volume per revolution. An angle adjustment is set by FMI for the AC•T diff 2 analyzer and must not be altered in the field.
- The pumps are mounted with shock mounts to dampen vibration resonance created by operating the pumps at high speed. If the resonance is not dampened, it could affect operation.
- The pump used for aspiration is not interchangeable with the pumps used to dispense reagents.
  - The sample pump is not linear in its operation.
  - The sample pump only rotates partially for aspiration.
  - There is no intake during half of the sample pump's rotation.
  - Fluid movement in (or out) of the sample pump resembles a sine wave.
  - Although one revolution of the sample pump is 50 µL, only 18 µL of sample is aspirated and, of that, only 12 µL is dispensed. An accurate home position is critical to ensure the accuracy of these volumes.
  - To obtain the required precision, a more precise stepper motor and optical home sensor are used.

IMPORTANT Risk of instrument malfunction. FMI pumps can dry out. If salt crystallizes within the tight seal between the ceramic piston and the liner, it will seize the assembly which will inhibit reagent delivery. Do not let the an FMI pump dry out with saline diluent inside its housing.

- If there is a possibility that the pumps could dry out, run distilled water through the pumps as directed in Heading 4.15, PREPARING THE INSTRUMENT FOR LONG-TERM SHUTDOWN OR SHIPMENT.
- If a pump does dry out, apply warm or hot water to its ports to dissolve the salt as directed in Heading 4.20, FMI PUMP DECRYSTALLIZATION.

2.4 POWER SUPPLY MODULE

Components

The Power Supply module, a single module mounted on the rear of the A^{C}•T analyzer (Figure 2.4-1), provides power for the instrument. The Power Supply modules used in the A^{C}•T Series analyzers vary slightly and, therefore, require three separate part numbers.

The main component of the Power Supply module is a switching supply. See Table 2.4-1 for the specifications.

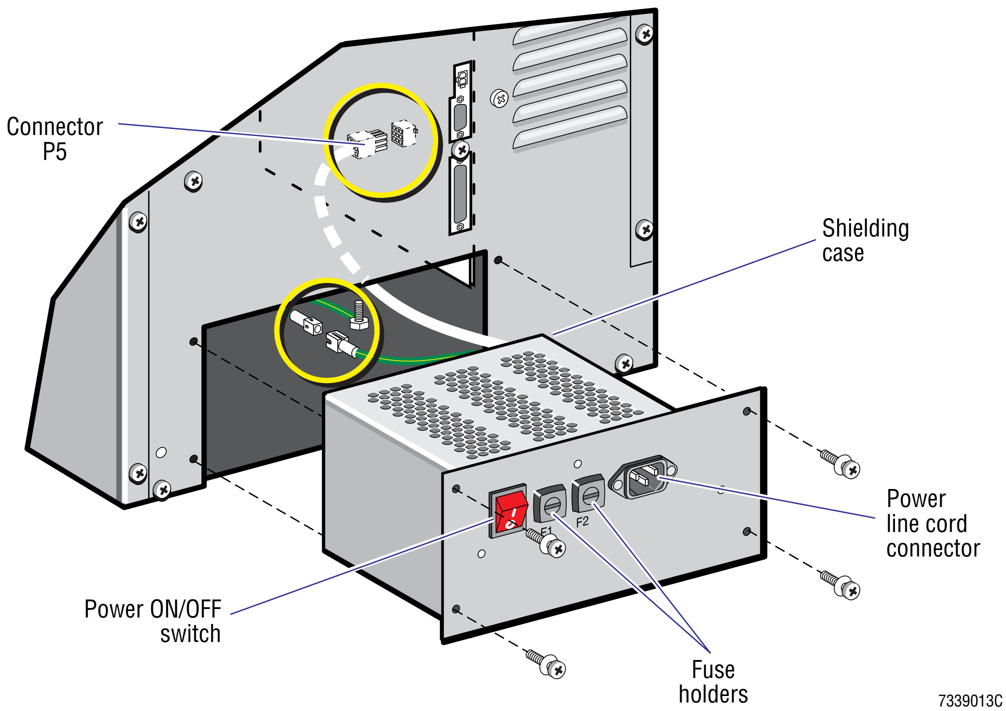
Table 2.4-1 Switching Supply Specifications

Category	Item	Specifications
ac input	Frequency	47 to 63 Hz, single phase
	Voltage	90 to 264 Vac
dc output	Power	80 W, continuous at 50°C
	Output 1	+5 Vdc ±3% at 12 A
	Output 2	+24 Vdc ±5% at 3 A
	Output 3	-15 Vdc ±2% at 1.5 A
	Output 4	+15 Vdc ±2% at 1.5 A
Performance	Minimum load	None required if load on ±15 Vdc <0.5 A
	Adjustment	None required
	Turn-on-Time	2 second maximum at 120 Vac
	Overshoot/undershoot	±5% of output voltage
	Ripple and noise (20 MHz)	1.5% of output voltage, p-p max
Regulation	Output 1 (20% to 100% load)	±1%
	Output 2 (20% to 100% load)	±2%
	Output 3 (20% to 100% load)	±2%
	Output 4 (20% to 100% load)	±2%
General	Input protection	Internal fuse
		Transients
		Surge
	Output protection	Indefinite short circuit protection, all outputs, automatic recovery
		Overload, automatic recovery after fault removal
	Reliability	100,000 hours calculated
		85,000 hours demonstrated
	Operating temperature	0 to 50°C
	Humidity	5 to 95% RH, non-condensing
	Altitude	To 10,000 ft
	Leakage current	Maximum 150 µA, normal conditions at 264 Vac, 47 Hz

Other components comprising the Power Supply module are (Figure 2.4-1):

- Neutral and line 1.5 A, SLO-BLO fuses, A^{C}•T 8/10 and A^{C}•T diff analyzers
  Neutral and line 2.5 A, SLO-BLO fuses, A^{C}•T diff 2 analyzer
- The instrument's ON/OFF switch
- A power line cord connector
- A shielding case
- A power harness
- Connector P5

Figure 2.4-1 Power Supply Module - Main Components



Module Differentiation

Power Harness and Connectors

The Power Supply modules for the A^{C}•T 8/10 and the A^{C}•T diff analyzers are identical except for the power harness and connectors. The Power Supply module for the A^{C}•T 8/10 analyzer uses a 9-pin connector for P5, while the Power Supply module for the A^{C}•T diff analyzer uses a 12-pin connector for P5. Like the A^{C}•T diff analyzer, the A^{C}•T diff 2 analyzer uses a 12-pin connector for P5.

The location of connector P5 is shown in Figure 2.4-1. The nine pinouts for the P5 connector on the A^{C}•T 8/10 analyzer are described in Table A.1-6. The 12 pinouts for P5 connector on the A^{C}•T diff and A^{C}•T diff 2 analyzers are described in Table A.1-7.

The pinouts for P5 were increased to allow for greater +24 Vdc supply current draw by the AC•T diff and AC•T diff 2 analyzers; two wires are used for the +24 Vdc instead of one. The need for two different harnesses arose due to instrument design changes that exceeded the current rating for a single wire. The sense line for the +5 Vdc supply is also passed through the connector to the card in the 12-pin version.

A 12-pin to 9-pin converter harness is available to allow the newer, 12-pin Power Supply module for the AC•T diff analyzer to be used on an older AC•T 8/10 analyzer. The 12-pin Power Supply module for the AC•T diff 2 analyzer is not interchangeable with the Power Supply modules used on the AC•T 8/10 and AC•T diff analyzers.

Fuses

The AC•T 8/10 and AC•T diff Power Supply module circuitry uses two 1.5 A SLO-BLO fuses; whereas, the Power Supply module for the AC•T diff 2 analyzer uses two 2.5 A SLO-BLO fuses.

Appearance

The Power Supply module's exterior cover matches the paint scheme used on the back of the analyzer. The AC•T diff 2 analyzer uses a lighter paint scheme than that used on the AC•T 8/10 and AC•T diff analyzers covers.

Comparison

The major components used in these three Power Supply modules are identical. The modifications requiring them to have separate part numbers are minimal. Table 2.4-2 provides a quick reference of the features that make the Power Supply modules differ enough to require a separate part number.

Table 2.4-2 Power Supply Module - Comparison of Unique Features

	AC•T 8/10 Analyzers	**AC•T diff Analyzer**	**AC•T diff 2 Analyzer**
Connector P5	9-pin	12-pin	12-pin
Output via Connector P5	See Table A.1-6	See Table A.1-7	See Table A.1-7
Fuses	1.5 A SLO-BLO	1.5 A SLO-BLO	2.5 A SLO-BLO
Exterior Finish	dark	dark	light
Interchangeability	Must not be used on any other AC•T analyzer	Can also be used on an AC•T 8/10 analyzer using a 12-pin to 9-pin converter harness	Must not be used on any other AC•T analyzer

2.5 ANALYZER CARD - A^{C}•T 8/10 Analyzer

The Analyzer card is the main electronic printed circuit (PC) card in the instrument. It controls all the input/output functions and data analysis. Refer to Figure 4.4-2 for the location of the Analyzer card.

Currently the A^{C}•T 8/10, the A^{C}•T diff and the A^{C}•T diff 2 analyzers all use a different Analyzer card. The Analyzer cards for the A^{C}•T diff and the A^{C}•T diff 2 analyzers are described in Heading 2.6.

The many different circuits on the Analyzer card can be categorized as analog, digital, and miscellaneous support circuitry. Refer to Figure A.2-1 for the location of the components on the Analyzer card for the A^{C}•T 8/10 analyzer.

Analog Circuitry

The Analyzer card has three main Analog circuits, the WBC, RBC, and Plt Processors. The WBC and RBC Processor circuits accept a PULSE TRAIN signal from the aperture sensors, then amplify and count the pulses that fall within specific size ranges. The RBC Processor circuit also produces information about the average pulse size. The Plt Processor circuit channelizes the pulses according to size. Additional functions include monitoring the voltage across the aperture, providing a high-burn voltage for cleaning the aperture, and producing pulse-width information to be used for clog detection.

WBC Processor Circuitry

The primary input to the WBC processor circuitry is the APERTURE signal from the WBC bath assembly. This signal, received at J8 on the Analyzer card (Figure A.2-1), is sent to the Aperture Voltage Sensor circuit and the Preamplifier circuit. The Aperture Voltage Sensor circuit produces the white aperture voltage (WAV), which is the voltage measured across the aperture. This voltage is used for clog detection and is provided on the Voltages/Sensors screen to monitor aperture integrity. The chief component of this circuit is U65, an operational amplifier. Output from this circuit can be measured at TP29 (Figure A.2-1). The Preamplifier circuit amplifies the pulses the Threshold and Count circuit uses. The main amplifier is an HA-5137 on U76.

Output of the Preamplifier circuit, which can be monitored at TP35 (Figure A.2-1), is fed into the Dc Restorer circuit. Output from the Preamplifier circuit is in the form of a negative-going pulse offset from zero. The Dc Restorer circuit inverts the pulse and sets it to a baseline of 0.0 V. The Dc Restorer circuit uses several operational amplifiers found on chips U49 and U66. The Count Comparator circuit and the Width Integrator circuit use the output from the Dc Restorer circuit. The Count Comparator circuit ensures that only pulses representing a cell >36 fL are used for analysis. The comparator used is an LM311 found on chip U43. Output of the comparator is sent to U73, an EPLD that shapes the pulse before being sent to the 80C188 microprocessor for counting.

Output from the comparator is also input to the Width Integrator circuit with the INITIAL PULSE signal. This ensures that only pulses used for the WBC count are used for establishing the WBC pulse width, WPWV (white pulse-width voltage). The integration process is controlled using a 1.6-µs PULSE signal and the original PULSE TRAIN signal from the Dc Restorer circuit. They control one input of an operational amplifier U65. Output charges C182, making available a voltage representing the average pulse width. Resistor R249 establishes the pulse height at which the width is measured, which should be just above the noise threshold. Output can be monitored at TP34 (Figure A.2-1).

Additional circuitry is added to the input of the WBC processor. The 200-V supply is used to burn protein from the aperture. This voltage is applied directly to the aperture electrode cable from which the APERTURE signal is received. Control is established using a microprocessor signal (ZAPON) applied to the base of Q13. Q13 supplies the burn voltage to both apertures at the same time. Electronic test pulses are also applied to the incoming electrode cable. These pulses are used to test the integrity of the WBC analyzer. They do not have the complexity of the aperture pulse train in terms of timing or shape, therefore they can only impart information on whether the circuit is working, not how well it is working.

RBC Processor Circuitry

The RBC processor circuitry is almost identical to the WBC processor circuitry, with the addition of the MCV circuit. The APERTURE signal is connected to J7 (Figure A.2-1) and input to the Preamplifier and Aperture Voltage Sensor circuits. The amplifier used is on chip U75. TP33 (Figure A.2-1) can be used to monitor preamplifier output. The Aperture Voltage Sensor circuit and its output, red aperture voltage (RAV), measured at TP28 (Figure A.2-1), use the U63 operational amplifier. The Dc Restorer circuit is comprised of amplifiers found on chips U48 and U64. Output from the Dc Restorer circuit is fed to the Count Comparator, Width Integrator, MCV and Plt Processor circuits. The Count Comparator circuit's primary component is an LM311 comparator labelled U42. The Width Integrator circuit primarily uses a pair of analog switches on U54 and an amplifier on U63. Burn voltage and test pulses are added to the beginning of the circuit where the ELECTRODE signal enters.

In addition to the RBC parameter, the RBC Processor circuitry must produce an MCV parameter. Peak Detector, Inverter and MCV Integrator circuits make up the MCV circuitry. The Peak Detector circuit uses the Dc Restorer circuit's output. This circuit establishes and holds the peak voltage of input pulses. Two amplifiers on U28 are used to sample, then hold, this peak voltage. Output of the Peak Detector circuit can be monitored at TP16 (Figure A.2-1). The Inverter circuit uses an operational amplifier on U39 to invert the peak waveform. This inverted signal is then input to the integrator, which uses the other amplifier on U39. Two signals using two analog switches on U29 control the integrator. One signal tells the circuit when to be active, the other controls when the integrator is reset. Output from the integrator can be monitored at TP17 (Figure A.2-1).

Plt Processor Circuitry

The Plt processor circuitry uses the output from the Dc Restorer circuit of the RBC processor circuitry as a signal source. Since Plt pulses are much smaller than RBC pulses, the first action of the Plt processor circuitry is to amplify the signal. An operational amplifier on U24 achieves additional signal gain of 8.09. This larger signal can be monitored at TP38 (Figure A.2-1). It is fed into a Peak Detector circuit and the Plt Window Comparator circuit. The Peak Detector circuit is comprised of two amplifiers on U32, one used to sample the input pulse, the second used to hold the pulse at its peak. Capacitor C65 is used to stretch the pulse at its peak voltage. This stretched signal is fed through a scaling amplifier for input to an A/D converter. This signal (A/D BOUND) can be monitored at TP11 (Figure A.2-1).

The Plt Window Comparator circuit uses two LM311 comparators to set the lower and upper Plt thresholds of 2 fL and 20 fL. U44 sets the lower threshold and can be monitored at TP25 (Figure A.2-1) while U56 sets the upper threshold and can be monitored at TP30

(Figure A.2-1). These signals, along with the 1.25-MHz CLOCK signal, are sent to EPLD U22. This EPLD controls the Plt Processor circuit's actions. One output, SQLCH, inhibits input of additional pulses to the Peak Detector circuit while it is already processing a pulse. Another control signal, DSCHRG, resets the Peak Detector circuit once a pulse has been channelized with the A/D converter. The PCONVERT signal tells the A/D converter to convert the current output of the scaling amplifier.

Digital Circuitry

An 80C188 microprocessor, U74, controls the instrument. It is an interrupt driven microprocessor with an 8-bit data bus, clocked with a 20-MHz oscillator, U90. This microprocessor controls the A/D Converter circuit, the serial and parallel I/O port circuits, the Display Interface circuit, the Stepper Motor Driver circuitry, and the Solenoid Driver circuitry. Memory for the microprocessor is limited, comprised of a non-volatile RAM chip (U58) and a Flash Memory card. The controlling program resides on the Flash Memory card located to the left of the vacuum regulator knob and above the Traverse module. A partial PCMCIA interface implementation allows the ability to read flash memory. The instrument never writes to the Flash Memory card. The program is executed directly from the card, using some of the non-volatile RAM for variable storage in lieu of static RAM. The primary purpose of the non-volatile RAM is to preserve configuration data, such as calibration factors.

A/D Converter Circuit

Many voltages and signals in the instrument require analog to digital conversion before the system can properly use them. Three multiplexer chips, each capable of handling eight inputs, are used to select a voltage to be input to the A/D Converter circuit.The data bus from the 80C188 microprocessor is tied into the select lines of the multiplexers, allowing data on the data bus to select which voltage to convert. The three multiplexers are U11, U1, and U2. All system voltages, parameter voltages, monitored power supplies, and sensor voltages are tied to one input of these three chips. The selected voltage is applied first to a programmable gain amplifier (U3) that scales the voltage for input to U4, the A/D converter chip. The A/D Converter circuit output is 12 bits. Since the microprocessor uses only an 8-bit data bus, four bits are first latched using U5. This allows all bits to be available to the microprocessor when it wants to read the result.

Serial and Parallel I/O Port Circuits

Two octal 3- to 8-bit decoders, the 88C681 DUART, and several latch and buffer chips control the input/output functions from the 80C188 microprocessor. The DUART (U30) is primarily responsible for output through the external serial port. The DUART receives data from the microprocessor bus and transmits it out the serial port using a receiver/transmitter driver chip (U7).

The parallel port is implemented using a latch (U31) and a bus buffer/driver (U9). Data to be sent out the parallel port is latched and made available. The strobe signal is latched with U14.

Data from the parallel device is buffered and made available to the microprocessor with U9. Other discrete system signals are output via U14 and received via the buffer/driver U8 in a similar manner. These ON/OFF signals control the Hgb lamp, burn circuit, aperture current, MCV circuit, and count enabling.

The final I/O functions for the 80C188 are the read and write control for the system device and data ports. Two 3- to 8-bit converters are used, U46 enabling port reads and U47 enabling port writes. The port selection includes display data, display control signals, solenoid drivers, the parallel port, and control of the analog circuitry.

Display Interface Circuit

The Display Interface circuit serves only as a bus interface and buffer between the main processor and the Display Controller Driver card. Data and control signal information from the processor is latched and sent to the Display Controller Driver card via J30. Chip U85 latches display and reagent card reader data and sends it to the Display Controller Driver card. Chip U87 latches display and reagent card reader control signals and sends them out through J30. Input from the Display Controller Driver card uses the same data and control lines. U84, a buffer and bus driver, receives data, making it available to the 80C188 microprocessor. U86, the same buffer as U84, receives control signals making these signals available to the 80C188 microprocessor.

Stepper Motor Driver Circuitry

There are six identical Stepper Motor Driver circuits, though only five are currently used. Microcontroller chip 74HC541 provides the main control. This microcontroller has 64 bytes of on-board control memory containing the stepper driver program. All six chips are loaded with the same program. The program communicates with the main processor using the I-Squared-C (I^2C) protocol. Instructions to the microprocessor include when, what step rate, and for how long the motor should be turned on. If the motor has an associated sensor, the sensor is directly input from the 74HC541, allowing the controller to stop motor movement on sensor when necessary. The microcontroller can pass information such as the number of steps moved, and the state of a sensor, back to the main processor. Output phase information of the 74HC541 microcontroller is input to an L298 driver, which is fed to the motor connector. Table 2.5-1 lists the motors and their associated chips.

Table 2.5-1 Stepper Motors, A^{C}•T 8/10 Analyzer - Associated Chips

Motor	Microcontroller	Driver	Connector
Syringe	U35	U36	J24
Probe horizontal	U16	U67	J14 (flex cable)
Probe vertical	U72	U80	J14 (flex cable)
Waste/Rinse	U53	U34	J26
Diluent pump	U60	U15	J27
Spare	U71	U17	J25

Solenoid Driver Circuitry

The instrument uses solenoids 1 through 5 and 7 through 17. Solenoids 6, 18, 19, and 20 are unused. The Solenoid Driver circuitry consists of three latch/driver chip pairs, controlling the 20 solenoid valves. See Table 2.5-2.

Table 2.5-2 Solenoids Controlled by Solenoid Driver Circuitry, A^C•T 8/10 Analyzer

Latch	Driver	Solenoids Controlled
U38	U40	LV1 through LV8
U25	U26	LV9 through LV16
U10	U19	LV17 through LV20

All solenoids are connected to the +24 V supply. The driver merely connects the other solenoid lead to ground, closing the circuit. Latch U10 also controls two dc motors. The output of one motor at J11 (VL22) is not used. The other motor output at J12 (LV23) is used for the vacuum pump. Since more current is needed to drive motors, discrete FET drivers (Q1 and Q2) are used for LV22 and LV23 current output, respectively.

The output of the drivers for solenoids 1 through 20 and the two dc motors are fed through a voltage divider to a buffer, bus driver chip. The voltage divider pulls the driver output high if the solenoid is open with no current flow, and output goes low when there is current flow. This allows the valve operation to be monitored. If a valve or motor is turned on, and no current flow is indicated, fatal error **14** (Valve) is generated. Chip U41 handles the output for LV1 through LV8, U27 handles the output for LV9 through LV16, and U20 handles the output for LV17 through LV20, LV22 and LV23.

The waste sensor is also implemented through this circuit. The latch and driver output for what would have been LV21 is fed through an inductor (L1) to the waste sensor, and then to ground. When the system turns on this circuit, the same current-sensing mechanism is used to check for current flow or an open circuit across the waste sensor electrodes.

Miscellaneous Support Circuitry

Support circuits include precision regulation of reference voltage supplies, a 1.6-µs Pulse circuit, Hgb Support circuitry, the Power On LED (light emitting diode) circuit, and the Sensor Connector circuit. Several devices require precision voltage supplies for proper operation. Three reference supplies are created on the Analyzer card, +10 V, -10 V, and +15 V. A precision regulator (U45) is used to create the +10 V reference supply using the +15 V power supply voltage. The output of this supply can be measured at TP27 (Figure A.2-1). The +10 V reference is then inverted to produce a -10 V reference supply which can be measured at TP26 (Figure A.2-1). The +10 V supply is also used to control the base of Q7, which produces a precision +15 V reference supply from the +24 V power supply. All three are specified to be within ±2% of their target value.

Pulse Circuit

The RBC and WBC Processor circuitry produce a pulse-width parameter used in the clog detection scheme. The integrators used to produce these parameters require pulses of 1.6 µs. The one shot pulses are created with one chip (U21). The key input to U21 is a 1.25-MHz CLOCK signal. This signal is derived with the A/D Converter circuit using 10 MHz from the 80C188 microprocessor.

Hgb Support Circuitry

The main Hgb circuit is a two-stage preamp using both amplifiers on chip U88. One of the A/D converters on chip U3 is used for microprocessor control of the gain for both stages. The Hgb preamp output can be directly measured at TP7 (Figure A.2-1). There is also a circuit to control the Hgb lamp. Q16 regulates lamp voltage from the +5 V supply, to 3.18 V measured at TP37 (Figure A.2-1). A comparator on chip U77 controls this regulator. Plus and minus sense lines are input to the comparator as well as an ON/OFF signal. The sense lines ensure that the voltage is maintained at 3.18 V and the ON/OFF signal allows control from the microprocessor. The lamp is turned off when the instrument has not been used for two hours.

Power On LED and Sensor Connector Circuits

The Power On LED and Sensor Connector circuits are not much more than interface circuitry. Power is supplied to all sensor LEDs from the same +5 V source that supplies the Power On LED circuit. The /LEDPWR signal enables Q12 which turns on power. This signal originates at pin 15 of U30, output OP7 of the bus-controlled 88C681 DUART. Power for the vacuum sensor is supplied from the +15 V reference supply.

2.6 ANALYZER CARDS - A^{C}•T diff and A^{C}•T diff 2 Analyzers

The Analyzer card is the main electronic printed circuit (PC) card in the instrument. It controls all the input/output functions and data analysis. Refer to Figure 4.4-2 for the location of the Analyzer card.

Currently the A^{C}•T 8/10, the A^{C}•T diff and the A^{C}•T diff 2 analyzers use different Analyzer cards. The Analyzer card for the A^{C}•T 8/10 analyzer is described in Heading 2.5.

A major difference among these Analyzer cards is the additional editor circuitry needed by the A^{C}•T diff and A^{C}•T diff 2 analyzers for creating histograms. The use of surface-mount technology (SMT) for mounting components allows more circuitry on the same size card so the overall size of the Analyzer card has not changed. The numbering for its connectors also remains the same. One obvious difference is the number of mounting holes on the cards. The Analyzer cards for the A^{C}•T 8/10 and A^{C}•T diff analyzers use seven mounting holes; the Analyzer card for the A^{C}•T diff 2 analyzer has an eighth mounting hole in its lower right corner (Figure 4.4-3).

Although the Analyzer card for the A^{C}•T diff 2 analyzer is very similar to the Analyzer card for the A^{C}•T diff analyzer, it has more driver components to handle the additional stepper motors, dc motors, and sensors used by the A^{C}•T diff 2 analyzer. Refer to Figures A.2-2 and A.2-3 for component locations.

New A^{C}•T diff and A^{C}•T diff 2 analyzers are shipped with a Universal A^{C}•T diff/A^{C}•T diff 2 Analyzer card. This card provides better motor drive current and stepping control for the peristaltic pumps in the A^{C}•T diff analyzer and the FMI sample pump in the A^{C}•T diff 2 analyzer, and is required if these pumps are wired for half-winding. Jumpers are used on the Universal A^{C}•T diff/A^{C}•T diff 2 Analyzer card to configure the card for the instrument model and for the type of peristaltic or FMI sample pump (full or half winding) currently in use on the instrument. Refer to Figure A.2-4 for the jumper locations and to Table A.2-10 for the jumper configurations.

Power Supply Filtering and Distribution

The Power Supply module provides +5 Vdc, ±15 Vdc, and +24 Vdc supplies to the Analyzer card. Capacitors are used as filters for all these supplies to eliminate some of the switching noise. The +5 Vdc is used for all the logic circuits. The ±15 Vdc supplies are used for the analog circuitry. The +24 Vdc supply arrives at the Analyzer card on two wires. One wire is used for the solenoid and dc motor-driver circuitry, the dc/dc converter (U7), and the LCD illumination. The other wire is used by the stepper motor drivers. U7 produces a 200 V output from 24 Vdc. The 200 Vdc supply is used for the aperture current supplies and the aperture burn (zap) circuitry. The device has a logical on/off control and is turned on only during data acquisition, aperture zap, and while viewing the Voltages/Sensors screen. An interlock inhibits the 200 Vdc turn on. The interlock is located at J6 (Figures A.2-2 and A.2-3) and should be jumped.

Additional voltages are also created on the Analyzer card. Chip U8, a 7805CT, 5 Vdc regulator produces a clean +5 Vdc supply from the +15 Vdc source. The +5 Vdc supply is free of switching noise and is used for the more sensitive analog circuits. A +15 Vdc precision reference supply is needed by the vacuum transducer. It is created with U7. Finally, the Red and White Amplifier and Editor circuits use ±10 Vdc references. The ±10 Vdc references are generated on the Red and White Editor hybrid circuits, U65 and U73, respectively.

CPU and Memory

The main logic component on the Analyzer card is an Intel® 80C188EC embedded type microprocessor (U116). U116 is capable of addressing 1 MB of memory and is operated at 16-MHz. All diluter control, timing, chip select signals, and computations are performed by the CPU.

The full memory address capability of U116 is used. Chips U111 and U112, are 256 KB of static RAM, and are used for temporary storage. Another 128 KB of non-volatile battery backed static RAM, U109, are used to hold user setup information and stored patient and control results. A 1 MB, Flash Memory card stores the program. Only 640 MB of the 1 MB are used since that is all that the microprocessor can address.

Communication

Communication to Printer and host computer is provided by U3, a TL16C451 device. This is an industry-standard device used on many computer motherboards. It provides both the parallel Centronics™ Printer ouput via a female DB25 connector and RS-232 serial output using a male DB9 connector. The serial output is capable of baud rates up to 19,200 KB. Internal buffering and external resistors provide some ESD protection from the peripherals connected to these ports.

Display

The control of the touch screen and LCD is handled by chip U60, a 74ABT16543 device. U60 is a bidirectional byte-wide data port and byte-wide control port. One bit in the control map determines the direction of data flow. The data lines pass through RN7, a resistor network of 330-Ohm resistors. This provides ESD protection and matches impedance for the long ribbon cable used.

Solenoid Control

Solenoid and dc motor control is provided using two 82C55 I/O expanders, chips U99 and U100. Up to twenty-two dc drivers are selected using U99 and U100. Other lines on U100 are used to control data acquisition and system modes of operation. U99 is also used to monitor system and reagent status.

L603C drivers (U102, U103, and U104) drive solenoids and small dc motors, while RF1K49156 drivers (U124, U125, and U54 on the Analyzer card for the A^{C}•T diff 2 analyzer) drive larger dc motors requiring higher current.

On the Analyzer card for the A^{C}•T diff analyzer, U102 drives solenoids 1 through 8, U103 drives solenoids 9 through 16, and U104 drives solenoids 17 through 20. U124 drives connector J12/LV23 and provides power to the vacuum pump. U125 drives connector J11/LV22 which is currently a spare.

The Analyzer card for the A^{C}•T diff 2 analyzer uses the same components to drive solenoids, but it must drive five dc motors instead of one, creating a greater requirement for high current drivers. Connector J36/LV6 uses higher current driver chip U54 instead of the lower current solenoid driver on U102. The unused solenoid output on U102, formerly used by J36/LV6, is tied to J31/LV1, doubling the power capability of J31/LV1. A similar scheme is used for solenoid connectors LV18/J48 and LV20/J50. Since U104 has eight drivers and only four are used in the Analyzer card for the A^{C}•T diff analyzer, the extra driver outputs are tied to these connectors, doubling their power output capability.

Stepper Motor Control

The Analyzer cards for all the A^{C}•T analyzer models handle stepper motor control in a very similar manner. Each motor is controlled by its own microcontroller communicating with the main CPU on a shared I^2C bus. The Analyzer cards for the A^{C}•T diff and A^{C}•T diff 2 analyzers use an 83C751 (PLCC) device. This PLCC device has the same program as the microcontroller device in the A^{C}•T 8/10 analyzer.

All the Analyzer cards have the circuitry to control six motors, but only the Analyzer card for the A^{C}•T diff 2 analyzer uses six motor drivers. The Analyzer card for the A^{C}•T diff analyzer, like the one for the A^{C}•T 8/10 analyzer, only has five components mounted.

Output from the microcontroller passes through L6506 and TPIC0298 devices. TPIC0298 is a power stage and L6506 a current modulation controller. Table 2.6-1 summarizes the devices and the motor functions they control.

Table 2.6-1 Stepper Motor Function Summary

		Analyzer Card for A^{C}•T diff Analyzer		Analyzer Card for A^{C}•T diff 2 Analyzer	
Microcontroller	**l6506/TPIC0298**	**Output**	**Function**	**Output**	**Function**
U74	U84/U82	J24	M5- Triple syringes*	J24	M5 - 50 µL sample pump*
U75	U85/U79	J14 Flex	M4 - Probe vertical	J14	M4 - Probe vertical
U77	U86/U80	J14 Flex	M3- Probe horizontal	J57	M3- Probe horizontal
U87	U96/U93	J27	M2- Diluent pump	J27	M2- 100 µL diluent pump
U89	U97/U94	J26	M1- Waste pump*	J26	M1 -100 µL lytic reagent pump*
U91	U98/U95	J25	M6 - Spare*	J25	M6 - Cap-pierce motor*

On the Universal A^{C}•T diff/A^{C}•T diff 2 Analyzer card, a jumper is used to configure the card for this specific function. Refer to Table A.2-10.

D/A Conversion

Digital to analog conversion is necessary for several functions. This conversion is accomplished by U43, an AD7228 device. U43 converts digital information supplied by the CPU into a white cell, red cell, and platelet count-threshold voltage, the contrast adjustment voltage for the LCD and the voltage pulses used by the diagnostics pulse test.

Data Acquisition

The data acquisition scheme used by the A^{C}•T diff analyzer is a replica of that used by the COULTER MD II™ Series Analyzer (MD II analyzer). The data acquisition module consists of Red and White Preamplifier circuits with Dc Restorer circuits, Platelet and White Gain and Offset Stages, Red, Platelet and White Peak Detector hybrids, Red And White Pulse Editor hybrids, delay lines, red and white editor state machines, a Platelet Processor circuit and three a/d interfaces providing three DMA channels. The hybrid daughter cards are the same parts used by the MD II analyzer and the state machines. U22 and U33 are the same EPLD with the same program used on the MD II analyzer. The gain is set during latex calibration using an independent gain control stage for the red, platelet, and white channels.

The remainder of the data acquisition module is comprised of two ADG506A multiplexer chips, U35 and U42. U35 and U42 route the system voltages, vacuum voltage, Hgb lamp and photodetector amplifier output, temperature, red and white aperture voltages and the 26-percentile voltages. The selected voltage is fed to an a/d converter, AD7572 chip (U36) for processing.

Jumpers

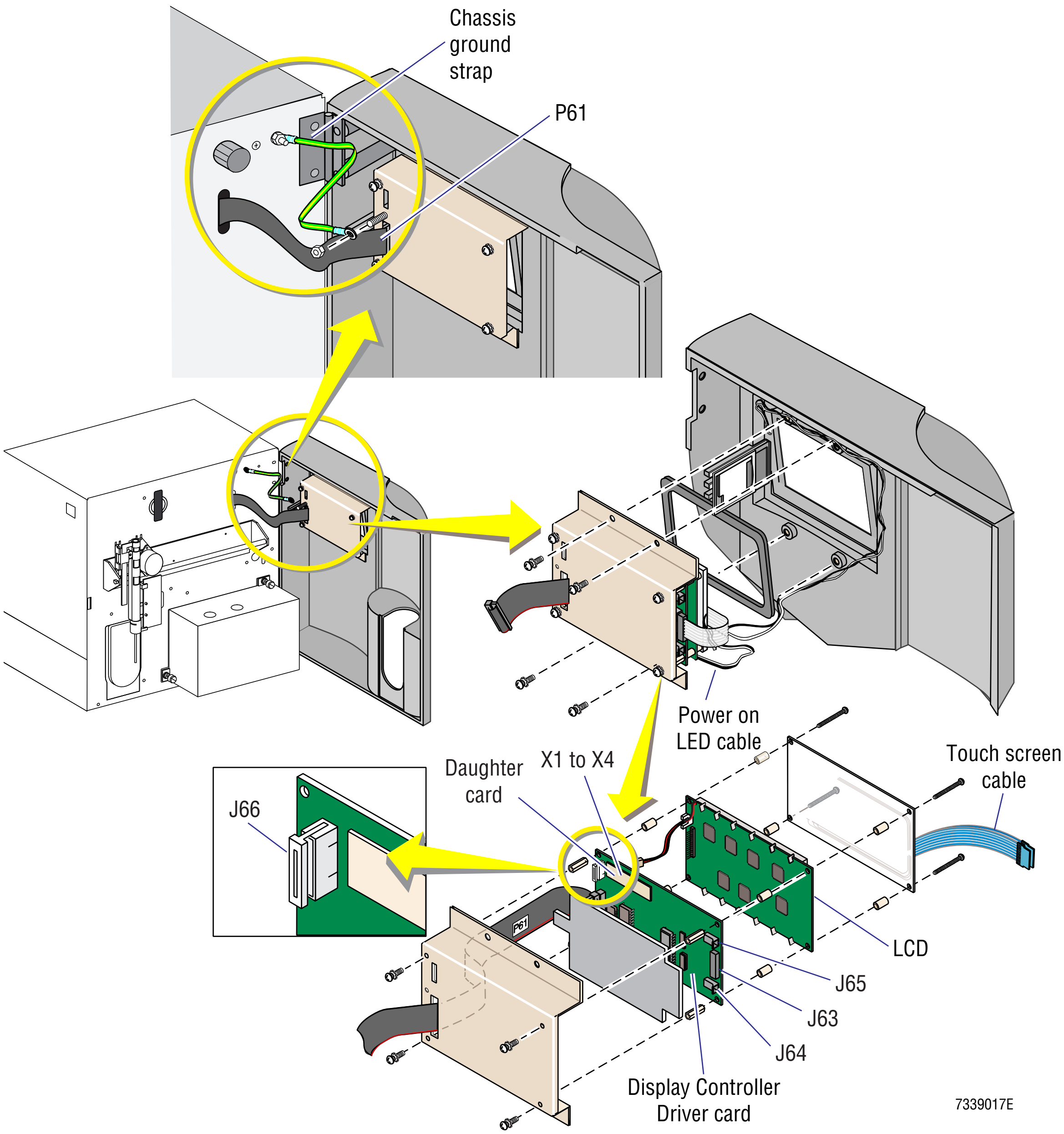
All of the jumpers on the Analyzer card for the A^{C}•T diff analyzer and most of the jumpers on the Analyzer card for the A^{C}•T diff 2 analyzer are used for sub-assembly testing. Two of the jumpers on the A^{C}•T diff 2 analyzer are used for system configuration. Refer to Table A.2-7, Analyzer Card Jumpers - AC•T diff 2 Analyzer (See Figure A.2-3) for the correct jumper settings.

2.7 DISPLAY ASSEMBLY

Main Components

The Display assembly for the A^{C}•T analyzer is mounted on the front door. It is composed of three separate electronic components fastened together: the touch screen, the LCD, and the Display Controller Driver card (Figure 2.7-1). The touch screen and LCD are purchased components while the Display Controller Driver card is designed in-house.

Figure 2.7-1 Display Assembly Components



Touch Screen

An 8 row x 8 column, digital-resistive touch screen provides system input. Table 2.7-1 lists the general specifications for the touch screen.

Table 2.7-1 Touch Screen Specifications

Item	Specification
Actuation force	40 to 80 g
Mechanical life	6 million cycles
Contact resistance (open)	20 MΩ
Contact resistance (closed)	10 to 30 KΩ
Operating voltage	5 V
Operating current	5 mA

Flex cables connect the rows and columns (displayed as a grid) to the Display Controller Driver card at connector J63. To connect the touch screen to the Display Controller Driver card, locate the grid on the back of the touch screen and follow the pinouts on Table 2.7-2. The grid is displayed in rows and columns. The columns correspond to the "front" flex cable and the rows to the "back" flex cable.

Table 2.7-2 Touch Screen Connections to Display Controller Driver Card

Pin	Columns: Front Flex Cable	Destination Pin (J63)	Rows: Back Flex Cable	Destination Pin (J63)
1	4	9	1	1
2	3	10	2	2
3	2	11	3	3
4	1	12	4	4
5	5	13	5	5
6	6	14	6	6
7	7	15	7	7
8	8	16	8	8

LCD

The liquid crystal display (LCD) is a 320 x 240 dot, graphics-capable, supertwist LCD with an effective viewing area of 103 x 80 mm. There are two connectors on the LCD, CN1 and CN2. CN1 connects directly to the Display Controller Driver card, J62, without a cable, while CN2 is a three-pin connector at the end of two wires (black and red) soldered directly to the LCD. This connector plugs into CN2 on the high voltage backlight daughter card mounted to the Display Controller Driver card. Table 2.7-3 and 2.7-4 respectively, describe the pinouts for these connectors.

Table 2.7-3 LCD Connector CN1

Pin	Signal	Function
1	YD (FRAME STARTUP)	Signals start of each screen frame
2	WF (LIQUID CRYSTAL AC)	Provides ac polarity in each display frame
3	LP (DISPLAY DATA LATCH)	Latches data in each common line
4	XSCL (DISPLAY DATA SHIFT)	Shifts data in 4-bit increments to display
5	INHX (DISPLAY ON/OFF)	H=ON
		L=OFF
6	XD0	Data bit 0
7	XD1	Data bit 1
8	XD2	Data bit 2
9	XD3	Data bit 3
10	+5 V	Power supply voltage for logic at +5 Vdc
11	DGND	Digital ground
12	-22 V	Power supply for LCD at -22 Vdc
13		Voltage for LCD contrast adjustment
14	EGND	Chassis (earth) ground

Table 2.7-4 LCD Connector CN2

Pin	Signal	Function
1	AC IN	Ac backlight supply - 1000 V
2		Not connected
3	AC IN	Ac backlight supply - 1000 V

Display Controller Driver Card

Function

The Display Controller Driver card is an interface between the front door components and the Analyzer card. The Display Controller Driver card:

- Receives power from the Analyzer card and distributes the power to the display, the power on LED (J64/P64), and the reagent management card reader.
- Receives display data from the Analyzer card and uses the display data to control the display.
- Receives input data from the touch screen and forwards it to the Analyzer card.
- Provides a two-way communication path between the reagent management card reader and the Analyzer card.

Major components of the Display Controller Driver card include:

- A buzzer (BZ1) that provides sound for touch screen keypress response.

- A high-voltage daughter board for LCD backlighting, which converts 24 Vdc to 1000 Vac. It is bolted onto the Display Controller Driver card and has two connectors, CN1 and CN2. CN1 receives power from the Display Controller Driver main card and CN2 feeds high voltage to the LCD.
- The U5 microcontroller (an 87C51 chip) that manages the touch screen input.
- The U6 display driver chip that drives the graphics LCD screen.
- The U7 memory used for the display by the display controller.

The interface between the Display controller Driver card and the Analyzer card is through connector J61. The pins and functions of J61 are detailed in Table 2.7-5.

Table 2.7-5 Display Controller Driver Card - J61 Pinout

Pin	Signal	Description
1	DD0	Data bit to/from Analyzer card
2	DGND1	Motor and solenoid ground
3	DD1	Data bit to/from Analyzer card
4	+24 Vdc	
5	DD2	Data bit to/from Analyzer card
6	LCD CONTRAST VOLTAGE	Data bit to/from Analyzer card
7	DD3	
8	+5 Vdc	
9	DD4	Data bit to/from Analyzer card
10	+5 Vdc	
11	DD5	Data bit to/from Analyzer card
12	DGND	Digital ground
13	DD6	Data bit to/from Analyzer card
14	EGND	Earth ground
15	DD7	Data bit to/from Analyzer card
16	Not used	Connects to address bit A16 of display memory (U7)
17	RESET	Reset signal for reagent card reader
18		Production instruments do not use
19	/RD	Read enable for display controller chip U6, active low
20	/LEDPWR	Power source for power on LED
21	/WR	Write enable for display controller chip U6, active low
22	SCLK	Clock signal for reagent card reader
23	/CS	Chip select signal for display controller chip U6, active low
24	KINT	Keyboard interrupt signal from U5, keyboard controller
25	/KWR	Write control signal for U5 (keyboard controller) active low
26	/KWD	Read control signal for U5 (keyboard controller) active low

Differences Between the Old and New Versions of the Display Controller Driver Card

Two versions of the Display Controller Driver card are currently being used in AC•T Series analyzers: the old card with the standard through-hole design and the new card with surface-mount design. Currently, both cards will work in any AC•T Series analyzer.

The old through-hole card design was used on the AC•T 8/10 analyzers and on the original AC•T diff analyzers. Unlike the old version of the Display Controller Driver card, the new version of the Display Controller Driver card allows the use of reagent management cards from a different manufacturer. For this reason, when you replace the Display Controller Driver card on an AC•T diff or AC•T diff 2 analyzer, you should always use the new version of the Display Controller Driver card for the replacement. This way, if the decision is made to change the vendor for the reagent management card, the AC•T diff and AC•T diff 2 analyzers will be ready for the change.

Note: The new card is designed as a drop-in replacement and will work in any AC•T Series analyzer; however, if a new Display Controller Driver card is used to replace an old card in an AC•T 8 analyzer, the analyzer will still be unable to use reagent management cards from a different manufacturer. Current software for the AC•T 8 analyzer does not support this capability and there are no plans to add this capability to its program.

Table 2.7-6 lists the connectors used on the two versions of the Display Controller Driver card.

Table 2.7-6 Display Controller Driver Card Connectors

Card Label	Description (Through-Hole Design)	Description (Surface-Mount Design)
J61	Analyzer card	Analyzer card
J62	LCD	LCD
J63	Touchscreen keypad	Touch keypad
J64	Power LED	Power LED
J65	Backlight Power Daughter card	Backlight Power Daughter card
J66	Smart card reader	Reagent Management card reader
J67	N/A	Reagent Management card reader - subassembly testing

Most of these connectors have identical locations on the two versions of this card. Because some connectors are not in the same location, the two versions of the Display Controller Driver card require different electromagnetic shields for the display assembly. FRUs that include both the new Display Controller Driver card and the appropriate shield are available, one for the AC•T 8/10 and AC•T diff analyzers and another for the AC•T diff 2 analyzer. Refer to the master parts list, Table 8.1-1, or the illustrated parts list, Table 8.2-4, for the part numbers.

Note: The AC•T diff 2 analyzer uses the same display assembly and the same Display Controller Driver card as the AC•T diff analyzer. The shield is different because the front door designs are different.

Table 2.7-7 lists the jumpers used on the old through-hole design of the Display Controller Driver card; the new surface-mount design does not need jumpers. Table 2.7-8 lists the test points available on the two versions of the Display Controller Driver card.

Table 2.7-7 Display Controller Driver Card Jumpers

Card Label	Description (Through-Hole Design)	Description (Surface-Mount Design)
X1	ON	N/A
X2	OFF	N/A
X3	ON	N/A
X4	OFF	N/A

Table 2.7-8 Display Controller Driver Card Test Points

Card Label	Description (Through-Hole Design)	Description (Surface-Mount Design)
TP1	Oscillator output	Oscillator output
TP2	-22 Vdc	-22 Vdc
TP3	Digital ground	Digital ground
TP4	+5 Vdc	+5 Vdc

2.8 SOFTWARE STRUCTURE

Overview

The A^{C}•T analyzer software can be divided into two sections, the low-level operating system and the diluter control. The operating system software provides instrument I/O, system error checks, data analysis, and individual diluter subroutines or functions. The diluter control software is responsible for all diluter activity. The operating system software provides diluter functions that energize solenoids, drive motors, and check sensors in the diluter. A sequence of these functions makes up a diluter table. In effect, these diluter functions become a high-level programming language and the program using this language is called a diluter table. Instrument cycles are diluter tables, such as the whole-blood (aspirate) diluter table or the shutdown diluter table.

Menu Trees

Most I/O functions of the operating system software are controlled by the user. This interaction between the user and the instrument is called the user interface. A touch screen and LCD provide the physical user interface, while menus and menu items provide the software user interface. Menus and menu items are displayed on the screen as graphic icons. Pressing an icon selects that function or menu. Icons are used in place of text for language independence. Refer to the following figures for a graphic representation of the available icons and text equivalent for each icon:

- Figure A.3-1, Software Menu Tree - A^{C}•T 8/10 Analyzer
- Figure A.3-2, Software Menu Tree - A^{C}•T diff Analyzer
- Figure A.3-3, Software Menu Tree - A^{C}•T diff/Veterinary Option Analyzer
- Figure A.3-4, Software Menu Tree - A^{C}•T diff 2 Analyzer

Instrument Cycles

Since an instrument cycle is a sequence of diluter functions that makes up a diluter table, running an instrument cycle is simply running the appropriate diluter table. These diluter tables, with appropriate parameters such as duration or rate, are stored in their own files. This method allows changes to an instrument cycle without changing the main program.

Ten instrument cycles provide diluter control in the A^{C}•T 8/10 and A^{C}•T diff analyzers: Powerup, Whole-Blood Aspirate, Predilute, Prime, Wakeup Prime, Startup, Shutdown, Clean Baths, Non-Labile Control Mode (A^{C}•T Tron™ control), and the Prepare-to-Ship cycle.

The A^{C}•T diff 2 analyzer has a Closed-Vial Aspirate cycle and an Open-Vial Aspirate cycle in place of the Whole-Blood Aspirate cycle. The primary aspirate or sample table for the A^{C}•T 8/10 and A^{C}•T diff analyzers is the Whole-Blood Aspirate cycle; the primary aspirate table for the A^{C}•T diff 2 analyzer is the Closed-Vial Aspirate cycle.

The following tables summarize the Powerup and the primary Aspirate cycles:

- Powerup cycles:
  - Table 2.8-1, Powerup Cycle - A^{C}•T 8/10 and A^{C}•T diff Analyzers, All Software Versions
  - Table 2.8-2, Powerup Cycle - A^{C}•T diff 2 Analyzer
- Aspirate cycles:
  - Table 2.8-3, Whole-Blood Aspirate Cycle - A^{C}•T 8 Analyzer, Software Version 1.03
  - Table 2.8-4, Whole-Blood Aspirate Cycle - A^{C}•T 8 and A^{C}•T 10 Analyzers, Software Version 1.04 and 2.00
  - Table 2.8-5, Whole-Blood Aspirate Cycle - A^{C}•T diff Analyzer, Software Version 1.03
  - Table 2.8-6, Whole-Blood Aspirate Cycle - A^{C}•T diff Analyzer, Software Versions 1.04, 1.05, 1.06, and 2.00
  - Table 2.8-7, Whole-Blood Aspirate Cycle - A^{C}•T diff Analyzer with Veterinary Option, Software Versions 1.04, 1.05, 1.06, and 2.00
  - Table 2.8-8, Closed-Vial Aspirate Cycle - A^{C}•T diff 2 Analyzer, Software Version 1.00 and 2.00

Realize that changes in software can result in changes to these cycles. Also times are approximate because they can vary. For example:

- The time to analyze the data depends on the shape of the histogram.
- The time to fill the reservoir up to the sensor depends on the starting level of the reagent and on the state of the filters and the peristaltic pump tubing. This is even more pronounced in the Powerup cycle when the reagent level can be anywhere.
- The position of the syringe, and therefore, the time it takes to home the syringe at the beginning of the Powerup cycle, depends on the state of the instrument when the power was turned off and what was done to the instrument while the power was off. The first movement in the Powerup cycle is to home the syringe. If the syringe is already at home, no time is taken. If the syringe is at the bottom of stroke, up to 2.2 seconds is used. This time affects the rest of the Powerup cycle. For the Powerup cycles described in Tables 2.8-1 and 2.8-2, step duration is given rather than time.

Powerup Cycle

The Powerup cycle is a diluter cycle that is executed once the main program is up and running. When power is applied, the software first checks for valid CMOS data, then displays the copyright screen, does a checksum of the Flash Memory card, checks for clock movement, setting a default if necessary, and finishes by doing a DVM check and a waste level check. This activity takes 25 to 30 seconds. When this activity is complete, the Powerup cycle begins. This Powerup cycle may also be executed when leaving the Diagnostics menu or the Diluter Functions menu, or when entering into the Verify Predilute function.

Tables 2.8-1 and 2.8-2 describe the Powerup cycle for the current models and software versions of the A^{C}•T Series analyzers.

Table 2.8-1 Powerup Cycle - A^{C}•T 8/10 and A^{C}•T diff Analyzers, All Software Versions

Duration	Activity
2.0	Energize LV1, de-energize LV2 through LV17 (when power is applied, some drivers may be on)
0.025	Energize LV1, turn on vacuum pump, energize LV11 and LV7
2.2 to 3.1	Home syringe while draining RBC bath and moving probe up
0.0 to 32.4	Fill diluent reservoir
2.27	Fill diluent syringe (3.0 mL) while draining RBC bath
0.025	Energize LV12
2.45	Dispense diluent syringe into RBC bath, de-energize LV12
9.5	Repeat last 3 steps 2 times
0.0	Energize LV14
0.025	Wait
2.24	Fill diluent syringe (3.0 mL), drain WBC bath
0.025	Energize LV12, energize LV7
2.45	Dispense 3.1 mL from diluent syringe to WBC bath
0.0	De-energize LV12, energize LV7
9.5	Repeat last 5 steps 2 times
2.0	Fill diluent syringe (5.0 mL)
0.0	Check diluent sensor for empty (fluid not at sensor) state
2.9	Dispense diluent syringe to sensor (5.0 mL to reservoir)
2.24	Fill diluent syringe (3.0 mL), drain WBC bath, send probe to aspirate position, check lytic reagent sensor
0.025	De-energize LV14, energize LV12, de-energize LV7, energize LV8
2.45	Dispense 3.0 mL from diluent syringe to WBC bath, fill diluent reservoir
0.0	De-energize LV12, LV8, LV11
BEGIN CLEANUP ROUTINE (performed only if power was turned OFF in midcycle)	
0.0	Energize LV11, LV7
0.025	Delay
2.43	Fill diluent syringe with 3.0 mL while draining RBC bath
3.525	Energize LV12, dispense 3.0 mL from diluent syringe to RBC bath while filling diluent reservoir, de-energize LV12
14.6	Repeat last 3 steps 2 times
0.025	Energize LV14, LV8
2.24	Fill syringe with 3.0 mL while draining WBC bath
0.025	De-energize LV8, energize LV12, de-energize LV7
1.55	Move probe to WBC bath, dispense 0.2 mL from diluent syringe to WBC bath
0.025	De-energize LV11
4.48	Move probe down into WBC bath, dispense (to sensor, about 3.0 mL) from diluent syringe through probe to WBC bath

Table 2.8-1 Powerup Cycle - A^{C}•T 8/10 and A^{C}•T diff Analyzers, All Software Versions *(Continued)*

Duration	Activity
0.0	De-energize LV12, energize LV11, LV7
0.025	Delay
2.24	Fill diluent syringe with 3.0 mL while draining WBC bath
0.025	Energize LV12, de-energize LV7
2.45	Dispense 3.0 mL from diluent syringe to bottom of WBC bath while filling diluent reservoir
0.025	Energize LV7, de-energize LV12
10	Repeat last 5 steps 2 times
0.025	De-energize LV14, LV7, LV11, energize LV8, LV2, LV10
1.85	Fill diluent reservoir without stopping at sensor, move probe up
1.0	De-energize LV10
1.55	De-energize LV2, LV8, move probe to aspirate position
END CLEANUP ROUTINE (resume normal Powerup cycle at next step)	
0.025	Energize LV1, LV15, LV7, LV11
0.9	Fill diluent syringe with 1.8 mL while draining VC1
0.025	De-energize LV7, LV11
1.3 to 3.15	Fill diluent reservoir while further draining VC1
0.025	De-energize LV1, energize LV8
1.3	Aspirate 12.0 µL, move probe down, sound a warning beep, drain VC1
0.025	De-energize LV8, turn vacuum pump off, energize LV1
0.0 to 5.4	Fill diluent reservoir to sensor (tries 5 fills of 10.8 seconds each)
1.127	Overfill diluent reservoir with 2.5 mL (without regard to sensor)
0.0	Check diluent sensor for fluid (system expects fluid at sensor)
0.0	De-energize LV15, LV1

Table 2.8-2 Powerup Cycle - A^{C}•T diff 2 Analyzer

Duration	Activity
0.0	Turn LV1 through LV20, LV22 and LV23 OFF, turn LV20 (fan), LV13 (diluent to reservoir enable) and LV19 (diluent pump) ON
0.1 to 3.26	Home Probe (jog down, move up to top sensor, jog left, then move right to the closed-vial position) and sound probe move warning
0.5 to 2.5	Home sample, diluent, and lyse pumps
2.0	Diluent overfill, (fill past float), then turn OFF LV19 (diluent pump), and LV13 (diluent to reservoir enable)
END STANDARD POWERUP	

Table 2.8-2 Powerup Cycle - A^{C}•T diff 2 Analyzer *(Continued)*

Duration	Activity
	BEGIN EXTENDED CLEANUP
4.0	Turn ON LV13 (diluent to reservoir enable), LV19 (diluent pump), LV12 (WBC bath drain), and LV6 (waste pump)
4.0	Turn OFF LV12 (WBC bath drain) and turn ON LV15 (RBC bath drain)
7.0	Turn OFF LV15, turn ON LV8 (probe wipe waste valve) and LV7 (vacuum isolator drain valve)
0.8	Turn OFF LV7, LV8, turn ON LV12, dispense 100 µL lyse
0.8	Check Lyse sensor
2.86	Turn OFF LV12, turn ON LV15 (RBC bath drain), dispense 2 mL diluent to RBC bath
5.7	Turn OFF LV6 (waste pump) and LV12, dispense 4 mL diluent to RBC bath
5.7	Turn ON LV11 (WBC select diluent), dispense 4 mL diluent to WBC bath
2.17	Turn OFF LV11, sound probe warning, move probe up
1.5	Turn ON LV23 (vacuum pump), LV2 (high vacuum enable)
1.6	Turn ON LV10 (diluent to probe-wipe housing), LV8 (probe-wipe waste valve) and dispense 0.8 mL of diluent
15.0	Turn OFF LV10, LV8, turn ON LV16 (RBC count valve), prime sweep flow and rear chamber for 15 seconds with high vacuum
15.0	Turn OFF LV2, turn ON LV17, prime rear chambers and count lines
2.0	Turn OFF LV16, LV17, wait 1 second and turn OFF vacuum pump
7.0	Turn ON LV8, LV7, LV6 - drain vacuum isolator for 7 seconds
0.0	Turn OFF LV6, LV7, LV8

Aspirate Cycle

Pressing the aspirate switch or closing the cap-pierce door initiates the Aspirate cycle. The main program turns on the vacuum pump and then executes the Aspirate cycle table for the mode selected.

Tables 2.8-3, 2.8-4, 2.8-5, 2.8-6, 2.8-7, and 2.8-8 describe the primary Aspirate cycles for the current models and software versions of the A^{C}•T Series analyzers. The **primary** Aspirate cycles are described because they are the cycles most frequently used and because they use all the instrument's components except the A^{C}•T Rinse shutdown diluent pump and solenoid.

When running repeated Aspirate cycles, the syringe and FMI pump positions and the diluent level are known at the beginning of the cycle, so timing is more accurate than it is for the Powerup cycle. For this reason, the first column (Timing) in the Aspirate cycle tables gives a time relative to the beginning of the cycle.

Table 2.8-3 Whole-Blood Aspirate Cycle - A^{C}•T 8 Analyzer, Software Version 1.03

Timing	Activity
0	Aspirate 12.0 µL of sample, drain RBC bath, take "Hgb Blank2" reading
1.62	Energize LV2, LV14, LV8, LV10, sound probe warning, move up and wipe probe, drain WBC bath, overfill diluent reservoir, check waste sensor
3.62	De-energize LV14, LV10, aspirate 12.0 µL (air gap)
3.94	Energize LV12, LV11
3.96	Drain RBC bath, move probe to WBC bath, prefill WBC bath with about 2.6 mL
5.51	De-energize LV8, LV2, LV12, energize LV14, LV7
5.53	Drain WBC bath, fill diluent reservoir with 3.0 mL, fill diluent syringe with 3.250 mL
7.09	Energize LV12, de-energize LV14
7.12	Dispense 0.24 mL diluent to RBC bath, de-energize LV7
7.28	Dispense 1.5 mL diluent to WBC bath while moving probe into WBC bath
8.78	Take "Hgb Blank1" reading, de-energize LV11
8.81	Dispense 0.98 mL diluent and whole-blood sample from probe into WBC bath while filling diluent reservoir
10.11	Energize LV3, LV11, LV7
10.11	Energize LV5, wait 0.2 seconds, de-energize LV5, wait 0.2 seconds
10.51	Repeat last step 2 times, energize LV5, wait 0.2 seconds, de-energize LV5
11.51	Dispense 0.592 mL into RBC bath (prefill), de-energize LV3, LV12
12.33	Fill diluent syringe with 3.0 mL, fill reservoir to sensor
13.53	De-energize LV11, energize LV15, LV1
13.55	Drain VC1, aspirate 100.0 µL, fill diluent reservoir to sensor, check lytic reagent sensor
15.15	Energize LV8, de-energize LV15, LV1, energize LV2, LV12, LV11
15.18	Dispense 2.0 mL to RBC bath, fill reservoir, move probe up
15.99	De-energize LV8, drain RBC bath, fill reservoir, move probe to RBC bath
18.18	Energize LV8, move probe into RBC bath with vacuum dry, dispense 0.695 mL of diluent from diluent syringe to bottom of RBC bath
18.74	De-energize LV8, LV2, LV7, energize LV9, de-energize LV11, energize LV3
18.76	Dispense 415 µL lytic reagent into WBC bath while dispensing sample and 2.075 mL diluent through probe, fill diluent reservoir
18.76	Alternately energize / de-energize LV5, LV4, and LV3 to mix both baths, de-energize LV9, LV12 during mix; leave LV3, LV4, LV5 de-energized
23.88	Energize LV16, LV17, move probe up, begin acquiring count data **Note:** The time for acquiring count data depends on the number of extended counts. When Plt data is insufficient, sensing is extended up to eight additional 3.0 second counts in an attempt to acquire sufficient data. Because the time for acquiring data varies, the start time for the next sequence of events also varies.
38.88	De-energize LV17, LV16, fill diluent syringe with 3.25 mL, drain RBC bath, move probe into RBC bath
40.53	Energize LV12, LV1, LV15, dispense 0.2 mL diluent from probe

Table 2.8-3 Whole-Blood Aspirate Cycle - A^{C}•T 8 Analyzer, Software Version 1.03 *(Continued)*

Timing	Activity
40.82	Energize LV7, LV11
40.85	Home syringe, dispensing 3.3-mL diluent to RBC bath, drain VC1, fill diluent reservoir, take two Hgb Sample readings 0.5 seconds apart
43.05	De-energize LV1, LV7, energize LV2, LV14, de-energize LV12, LV15, energize LV8
43.07	Fill syringe with 3.6 mL, drain WBC bath, move probe up, analyze data **Note:** The time needed to analyze data depends on the amount of data accumulated during data analysis and the Plt histogram data. A normal blood takes about 6.0 seconds, but can vary from 4.0 to 8.0 seconds. Because the time needed to analyze this data varies, the start time for the next sequence of events also varies.
49.00	De-energize LV8, LV2, energize LV12, LV15, LV1
49.03	Dispense diluent syringe to WBC bath, drain VC1, perform flagging including clog detection
51.43	Energize LV3, LV5, de-energize LV12, LV15, LV1
51.52	De-energize LV5, LV3, drain WBC bath, fill diluent syringe with 3.0 mL, fill diluent reservoir, display sample results
53.73	Energize LV12, de-energize LV14
53.76	Dispense 3.1 mL from diluent syringe to WBC bath, fill reservoir, move probe to aspirate station, print results if autoprint is on **Note:** The time needed to print results depends on the Printer used and increases significantly when automatic host transmission is performed. Because the time needed to print varies, the start time for the next sequence of events also varies.
56.21	De-energize LV12, energize LV7
56.23	Fill diluent syringe with 0.15 mL from RBC bath (this is used to compensate for syringe backlash)
57.09	Energize LV11
57.12	Aspirate 12.0 µL of air, increment cycle counter
57.44	Energize LV11, LV8, LV2
57.64	Overfill diluent reservoir, move probe down, fill diluent syringe with 1.65 mL, sound probe movement warning
58.64	De-energize LV8, LV2, LV11, LV7, turn off vacuum, energize LV1, LV15, fill reservoir to sensor
60.14	Overfill diluent reservoir, drain VC1, do aperture burn
61.27	De-energize LV15, LV1

Table 2.8-4 Whole-Blood Aspirate Cycle - A^{C}•T 8 and A^{C}•T 10 Analyzers, Software Version 1.04 and 2.00

Time	Activity
0	Energize LV2, aspirate 12 µL of sample, drain RBC bath, take “Hgb Blank2” reading
1.62	Energize LV14, LV8, LV10, check for 6 in. Hg in VC1, sound probe warning, move up and wipe probe, drain WBC bath. overfill diluent reservoir
3.62	De-energize LV14, LV10, aspirate 12 µL (air gap)
3.94	Energize LV12, LV11
4.00	Drain RBC bath, move probe to WBC bath, prefill WBC bath with 2.6 mL
5.58	De-energize LV8, LV2, LV12, energize LV14, LV7
5.6	Drain WBC bath, fill diluent reservoir with 2.9 mL and diluent syringe with 3.250 mL
7.16	Energize LV12, de-energize LV14, dispense 240.0 µL diluent to RBC bath
7.32	De-energize LV7, dispense 1.5 mL of diluent to WBC bath through lower port, move probe into WBC bath, fill reservoir
8.86	Take “Hgb Blank1” reading, de-energize LV11
8.89	Dispense 980.0 mL of diluent and whole blood sample from probe into WBC bath while filling diluent reservoir
10.19	Energize LV3, LV11, LV7, mix bubbles (4 bursts from LV5 at 0.2 second intervals)
11.59	Dispense 0.6 mL into RBC bath (lower port)
12.38	De-energize LV3, LV12, fill diluent syringe with 3.0 mL, fill reservoir to sensor
13.61	De-energize LV11, energize LV15, LV1
13.63	Drain VC1, aspirate 100.0 µL from WBC bath, fill diluent reservoir to sensor, check lytic reagent level
15.23	Energize LV8, de-energize LV15, LV1, energize LV2, LV12, LV11
15.26	Dispense 2.0 mL to RBC bath, fill reservoir, move probe up
16.08	De-energize LV8, drain RBC bath, fill reservoir, move probe to RBC bath
18.27	Energize LV8, move probe into RBC bath with vacuum dry, dispense 0.695 mL diluent from diluent syringe to bottom of RBC bath
18.83	De-energize LV8, LV2, LV7, energize LV9, de-energize LV11, energize LV3
18.85	Dispense 415.0 µL lytic reagent to WBC bath (while dispensing 100.0 µL sample and 2.075 mL diluent to RBC bath), mix with 3 bubbles through bottom port, fill diluent reservoir
22.52	De-energize LV3
22.77	De-energize LV9, LV12, Energize LV4, mix WBC through lytic reagent port with 4 bursts from LV5
23.57	De-energize LV4, send two bursts of air for mixing to RBC bath
23.97	Energize LV16, LV17, move probe up, begin acquiring count data **Note:** The time for acquiring count data depends on the number of extended counts. When Plt data is insufficient, sensing is extended up to eight additional 3.0 second counts in an attempt to acquire sufficient data. Because the time for acquiring data varies, the start time for the next sequence of events also varies.
40.97	De-energize LV17, LV16, fill diluent syringe with 3.25 mL, drain RBC bath, move probe into RBC bath
42.63	Energize LV12, LV1, LV15, dispense 0.2 mL diluent from probe

Table 2.8-4 Whole-Blood Aspirate Cycle - A^C•T 8 and A^C•T 10 Analyzers, Software Version 1.04 and 2.00 *(Continued)*

Time	Activity
42.93	Energize LV7, LV11
42.95	Home syringe, dispensing 3.3 mL diluent to RBC bath, drain VC1, fill diluent reservoir, take two Hgb Sample readings 0.5 seconds apart
45.15	De-energize LV1, energize LV2, de-energize LV7, energize LV14, de-energize LV12, LV15, energize LV8
45.18	Fill syringe with 3.6 mL, drain WBC bath, move probe up, analyze CBC data **Note:** The time needed to analyze data depends on the amount of data accumulated during data analysis and the Plt histogram data. A normal blood takes about 6.0 seconds, but can vary from 4.0 to 8.0 seconds. Because the time needed to analyze this data varies, the start time for the next sequence of events also varies.
50.74	De-energize LV8, LV2, energize LV12, LV15, LV1
50.76	Dispense diluent syringe to WBC bath, drain VC1, perform flagging including clog detection
53.2	Energize LV3, LV5, de-energize LV12, LV15, LV1
53.29	De-energize LV5, LV3, drain WBC bath, fill diluent syringe with 3.7 mL, fill diluent reservoir, show results to screen
55.51	Energize LV12, de-energize LV14
55.53	Dispense 3.125 mL from diluent syringe to WBC bath, fill reservoir, move probe to aspirate station, print results if Autoprint is ON **Note:** The time needed to print results depends on the Printer used and increases significantly when automatic host transmission is performed. Because the time needed to print varies, the start time for the next sequence of events also varies.
57.98	De-energize LV12, energize LV7
58.01	Fill diluent syringe, add 2.3 mL to reservoir
59.04	De-energize LV11, aspirate 12 µL air, increment cycle counter
59.38	Energize LV8, LV2, sound probe warning, move probe down
60.11	De-energize LV8, LV2, LV7, turn vacuum pump off, energize LV1, LV15, fill diluent reservoir
64.11	Overfill diluent reservoir, drain VC1, do aperture burn
65.73	De-energize LV15, LV1, energize LV2

Table 2.8-5 Whole-Blood Aspirate Cycle - A^{C}•T diff Analyzer, Software Version 1.03

Time	Activity
0	Energize LV2 (high vacuum), aspirate 12.0 µL
0.32	Energize LV10, LV14, LV8, check for 6 in. Hg at VC1, sound probe warning, move up and wipe probe, drain WBC bath, overfill diluent reservoir
2.32	De-energize LV14, LV10, aspirate 12.0 µL (air gap)
2.64	Energize LV12, LV11
2.7	Drain RBC bath, move probe to WBC bath, rinse WBC bath with 2.6 mL
4.03	De-energize LV8, LV2, LV12, energize LV14, LV7, take “Hgb Blank2” reading
4.08	Drain WBC bath, fill diluent reservoir with 2.5 mL and diluent syringe with 3.250 mL
5.64	Energize LV12, de-energize LV14, prefill RBC bath with 240.0 µL, de-energize LV7
5.84	Prefill WBC bath with 1.5 mL, move probe into WBC bath, partial drain RBC bath, fill reservoir
6.59	Take “Hgb Blank1” reading, de-energize LV11, dispense 980.0 µL with sample from probe to WBC bath, drain RBC bath, fill reservoir
7.92	Energize LV3, LV11, LV7, send mix bubbles through lytic reagent port (Energize/de-energize LV5 4 times)
9.32	0.6 mL rinse to RBC bath (prefill), drain RBC bath
10.11	De-energize LV3, LV12, fill diluent syringe with 3.0 mL, fill reservoir
11.34	De-energize LV11, energize LV15, LV1
11.36	Drain VC1, aspirate 100.0 µL from WBC bath, fill diluent reservoir, check lytic reagent sensor
12.96	Energize LV8, de-energize LV15, LV1, energize LV2, LV12, LV11
12.99	Prefill RBC bath with 2.0 mL, fill reservoir, move probe up
13.8	De-energize LV8, drain RBC bath, fill reservoir, move probe to RBC bath
16.0	Energize LV8, move probe into RBC bath with vacuum dry, dispense 695.0 µL diluent from diluent syringe to bottom of RBC bath
16.55	De-energize LV8, LV2, LV7, energize LV9, de-energize LV11, energize LV3
16.58	Dispense 415.0 µL lytic reagent into WBC bath (while dispensing 100.0 µL sample and 2.075 mL diluent into RBC bath), mix with 3 bubbles through bottom port, fill diluent reservoir
19.85	De-energize LV3, delay 0.25 seconds, de-energize LV9, LV12, energize LV4, mix WBC bath with 4 bubbles through lytic reagent port
20.9	De-energize LV4, mix RBC bath through bottom port with 2 bubbles
21.4	Energize LV16, LV17, delay 1 second, acquire data **Note:** The time for acquiring count data depends on the number of extended counts. When Plt data is insufficient, sensing is extended up to eight additional 3.0 second counts in an attempt to acquire sufficient data. Because the time for acquiring data varies, the start time for the next sequence of events also varies.
36.4	De-energize LV17, LV16, fill diluent syringe with 3.25 mL, drain RBC bath, move probe into RBC bath
37.88	Energize LV12, LV1, LV15, dispense 0.2 mL diluent from probe
38.11	Energize LV7, LV11
38.13	Home syringe, dispense 3.4 mL diluent to RBC bath, drain VC1, fill diluent reservoir, take two Hgb Sample readings 0.5 seconds apart

Table 2.8-5 Whole-Blood Aspirate Cycle - A^{C}•T diff Analyzer, Software Version 1.03 *(Continued)*

Time	Activity
39.78	De-energize LV1, energize LV2, LV14, de-energize LV12, LV15, energize LV8
39.81	Fill syringe with 3.6 mL, drain WBC bath, move probe up, analyze CBC data **Note:** The time needed to analyze data depends on the amount of data accumulated during data analysis and the Plt histogram data. A normal blood takes about 6.0 seconds, but can vary from 4.0 to 8.0 seconds. Because the time needed to analyze this data varies, the start time for the next sequence of events also varies.
46.2	De-energize LV8, LV2, energize LV12, de-energize LV7, energize LV15, LV1
46.23	Dispense diluent syringe to WBC bath, drain VC1, perform histogram analysis, flagging, clog detection
48.06	De-energize LV12, LV15, LV1, energize LV11, LV7, fill diluent syringe with 1.8 mL, fill diluent reservoir, move probe to aspirate position, show results to screen
48.3	De-energize LV11, LV7, LV14, energize LV8, LV2, increment cycle counter
48.33	Energize LV3, LV5 (for 200.0 ms), aspirate 12 µL, fill diluent reservoir (do not look at sensor), sound probe warning, move syringe down
48.84	De-energize LV3, LV8, LV2, LV7, vacuum pump, energize LV1, LV15, fill diluent reservoir to sensor, print results **Note:** The time needed to print results depends on the Printer used and increases significantly when automatic host transmission is performed. Because the time needed to print varies, the start time for the next sequence of events also varies.
52.84	Reservoir overfill, drain VC1, zap aperture
54.46	De-energize LV15, LV1

Table 2.8-6 Whole-Blood Aspirate Cycle - A^{C}•T diff Analyzer, Software Versions 1.04, 1.05, 1.06, and 2.00

Time	Activity
0	Energize LV2 (high vacuum), aspirate 12.0 µL
0.32	Energize LV10, LV14, LV8, check for 6 in. Hg at VC1, sound probe warning, move up and wipe probe, drain WBC bath, overfill diluent reservoir
2.5	De-energize LV14, LV10, aspirate 12.0 µL (air gap)
2.82	Energize LV12, LV11
2.88	Drain RBC bath, move probe to WBC bath, rinse WBC bath with 2.6 mL
4.3	De-energize LV8, LV2, LV12, energize LV14, LV7, take “Hgb Blank2” reading
4.9	Drain WBC bath, fill diluent reservoir with 2.5 mL and diluent syringe with 3.250 mL
6.6	Energize LV12, de-energize LV14, prefill RBC bath with 240.0 µL, de-energize LV7
6.8	Prefill WBC bath with 1.5 mL, move probe into WBC bath, partial drain RBC bath, fill reservoir
7.92	Take “Hgb Blank1” reading, de-energize LV11, dispense 980.0 µL with sample from probe to WBC bath, drain RBC bath, fill reservoir
9.25	Energize LV3, LV11, LV7, send mix bubbles through lytic reagent port (energize/de-energize LV5 4 times)
10.65	0.6 mL rinse to RBC bath (prefill), partial drain RBC bath
11.44	De-energize LV3, LV12, fill diluent syringe with 3.0 mL, fill reservoir, drain RBC bath
12.78	De-energize LV11, energize LV15, LV1
12.8	Drain VC1, aspirate 100.0 µL from WBC bath, fill diluent reservoir, check lytic reagent sensor
14.4	Energize LV8, de-energize LV15, LV1, energize LV2, LV12, LV11
14.43	Rinse RBC bath with 2.0 mL, fill reservoir, move probe up
15.32	De-energize LV8, drain RBC bath, fill reservoir, move probe to RBC bath
17.71	Energize LV8, move probe into RBC bath with vacuum dry, dispense 695.0 µL diluent from diluent syringe to bottom of RBC bath
18.27	De-energize LV8, LV2, LV7, energize LV9, de-energize LV11, energize LV3
18.29	Dispense 415.0 µL lytic reagent into WBC bath (while dispensing 100.0 µL sample and 2.075 mL diluent into RBC bath), mix with 3 bubbles through bottom port, fill diluent reservoir
21.56	De-energize LV3, delay 0.25 seconds, de-energize LV9, LV12, energize LV4, mix WBC bath with 4 bubbles through lytic reagent port
22.61	De-energize LV4, mix RBC bath through bottom port with 2 bubbles
23.11	Energize LV16, LV17, move probe up, delay 1 second, acquire data **Note:** The time for acquiring count data depends on the number of extended counts. When Plt data is insufficient, sensing is extended up to eight additional 3.0 second counts in an attempt to acquire sufficient data. Because the time for acquiring data varies, the start time for the next sequence of events also varies.
38.11	De-energize LV17, LV16, fill diluent syringe with 3.25 mL, drain RBC bath, move probe into RBC bath
39.72	Energize LV12, LV1, LV15, dispense 0.2 mL diluent from probe
39.95	Energize LV7, LV11

Table 2.8-6 Whole-Blood Aspirate Cycle - A^{C}•T diff Analyzer, Software Versions 1.04, 1.05, 1.06, and 2.00

Time	Activity
39.97	Home syringe, dispense 3.3 mL diluent to RBC bath, drain VC1, fill diluent reservoir, take two Hgb Sample readings 0.5 seconds apart
41.77	De-energize LV1, energize LV2, LV14, de-energize LV12, LV15, energize LV8
41.8	Fill syringe with 3.6 mL, drain WBC bath, move probe up, analyze CBC data **Note:** The time needed to analyze data depends on the amount of data accumulated during data analysis and the Plt histogram data. A normal blood takes about 6.0 seconds, but can vary from 4.0 to 8.0 seconds. Because the time needed to analyze this data varies, the start time for the next sequence of events also varies.
48.0	De-energize LV8, LV2, energize LV12, de-energize LV7, energize LV15, LV1
48.03	Dispense diluent syringe to WBC bath, drain VC1, perform histogram analysis, flagging, clog detection
50.02	De-energize LV12, LV15, LV1, energize LV11, LV7, fill diluent syringe with 1.8 mL, fill diluent reservoir, move probe to aspirate position, show results to screen
51.39	De-energize LV11, LV7, LV14, energize LV8, LV2, LV3, LV5 for 200.0 ms, increment cycle counter
51.42	Aspirate 12 µL, fill diluent reservoir (do not look at sensor), sound probe warning, move syringe down
51.95	De-energize LV3, LV8, LV2, LV7, turn vacuum pump off, energize LV1, LV15, fill diluent reservoir to sensor, print results if Autoprint ON **Note:** The time needed to print results depends on the Printer used and increases significantly when automatic host transmission is performed. Because the time needed to print varies, the start time for the next sequence of events also varies.
56.32	Reservoir overfill, drain VC1, zap aperture
58.08	De-energize LV15, LV1

Table 2.8-7 Whole-Blood Aspirate Cycle - A^{C}•T diff Analyzer with Veterinary Option, Software Versions 1.04, 1.05, 1.06, and 2.00

Time	Activity
0	Energize LV2 (high vacuum), aspirate 12.0 µL
0.32	Energize LV10, LV14, LV8, check for 6 in. Hg at VC1, sound probe warning, move up and wipe probe, drain WBC bath, overfill diluent reservoir
2.32	De-energize LV14, LV10, aspirate 12.0 µL (air gap)
2.64	Energize LV12, LV11
2.7	Drain RBC bath, move the probe to WBC bath, rinse WBC bath with 2.6 mL
4.42	De-energize LV8, LV2, LV12, energize LV14, LV7, take “Hgb Blank2” reading
5.22	Drain WBC bath, fill diluent reservoir with 2.9 mL and diluent syringe with 3.250 mL
6.78	Energize LV12, de-energize LV14, prefill RBC bath with 240.0 µL, de-energize LV7
6.98	Prefill WBC bath with 1.5 mL, move probe into WBC bath, partial drain RBC bath, fill reservoir
8.38	Take “Hgb Blank1” reading, de-energize LV11, dispense 980.0 µL with sample from probe to WBC bath, drain RBC bath, fill reservoir
9.71	Energize LV3, LV11, LV7, send mix bubbles through lytic reagent port (Energize/de-energize LV5 4 times)
11.1	0.6 mL rinse to RBC bath (prefill), partial drain RBC bath
11.9	De-energize LV3, LV12, fill diluent syringe with 3.5 mL, fill reservoir, drain RBC bath
13.33	De-energize LV11, energize LV15, LV1
13.35	Drain VC1, aspirate 75.0 µL from WBC bath, fill diluent reservoir, check lytic reagent sensor
14.69	Energize LV8, de-energize LV15, LV1, energize LV2, LV12, LV11
14.71	Rinse RBC bath with 2.0 mL, fill reservoir, move probe up
15.53	De-energize LV8, drain RBC bath, fill reservoir, move probe to RBC bath
17.72	Energize LV8, move probe into RBC bath with vacuum dry, dispense 695.0 µL diluent from diluent syringe to bottom of RBC bath
18.28	De-energize LV8, LV2, LV7, energize LV9, de-energize LV11, energize LV3
18.31	Dispense 415.0 µL lytic reagent into WBC bath (while dispensing 100.0 µL sample and 2.075 mL diluent into RBC bath), mix with 3 bubbles through bottom port, fill diluent reservoir
21.57	De-energize LV3, delay 0.25 seconds, de-energize LV9, LV12, fill lytic reagent syringe
22.62	Energize LV9, dispense 385.0 µL lytic reagent
23.41	De-energize LV9, energize LV4, WBC through lytic reagent port with 3 air bursts
24.21	De-energize LV4, mix RBC bath through bottom port with 2 air bursts
28.51	Energize LV16, LV17, move probe up, delay 1 second, acquire data **Note:** The time for acquiring count data depends on the number of extended counts. When Plt data is insufficient, sensing is extended up to eight additional 3.0 second counts in an attempt to acquire sufficient data. Because the time for acquiring data varies, the start time for the next sequence of events also varies.
45.51	De-energize LV17, LV16, fill diluent syringe with 3.25 mL, drain RBC bath, move probe into RBC bath
49.0	Energize LV12, LV1, LV15, dispense 0.2 mL diluent from probe
49.22	Energize LV7, LV11

Table 2.8-7 Whole-Blood Aspirate Cycle - A^{C}•T diff Analyzer with Veterinary Option, Software Versions 1.04, 1.05, 1.06, and 2.00 ***(Continued)***

Time	Activity
49.25	Home syringe, dispensing 3.3 mL diluent to RBC bath, drain VC1, fill diluent reservoir, take two Hgb Sample readings 0.5 seconds apart
50.9	De-energize LV1, energize LV2, LV14, de-energize LV12, LV15, energize LV8
50.92	Fill syringe with 3.6 mL, drain WBC bath, move probe up, analyze CBC data **Note:** The time needed to analyze data depends on the amount of data accumulated during data analysis and the Plt histogram data. A normal blood takes about 6.0 seconds, but can vary from 4.0 to 8.0 seconds. Because the time needed to analyze data varies, the start time for the next sequence of events also varies.
57.98	De-energize LV8, LV2, energize LV12, de-energize LV7, energize LV15, LV1
58.01	Home diluent syringe while dispensing to WBC bath, drain VC1, perform histogram analysis, flagging, clog detection
59.84	De-energize LV12, LV15, LV1, energize LV11, LV7, fill diluent syringe with 1.8 mL, fill diluent reservoir, move probe to aspirate position, show results to screen
61.08	De-energize LV11, LV7, LV14, energize LV8, LV2, LV3, LV5 for 0.2 seconds, increment cycle counter
61.11	Aspirate 12 µL, fill diluent reservoir (do not look at sensor), sound probe warning, move syringe down
61.61	De-energize LV3, LV8, LV2, LV7, turn vacuum pump off, energize LV1, LV15, fill diluent reservoir to sensor, print results **Note:** The time needed to print results depends on the Printer used and increases significantly when automatic host transmission is performed. Because the time needed to print varies, the start time for the next sequence of events also varies.
65.61	Reservoir overfill, drain VC1, zap aperture
67.24	De-energize LV15, LV1

Table 2.8-8 Closed-Vial Aspirate Cycle - A[C]•T diff 2 Analyzer, Software Version 1.00 and 2.00

Time	Activity
	Note: Vacuum is turned on by the software before execution of this Diluter Table.
0.0	Apply holding current to cap-pierce door, energize LV2 (High Vacuum Enable), take “Hgb Blank2” reading, and aspirate 50 µL air
0.41	Energize LV13 (Enable Diluent Reservoir Fill), energize LV19 (turn diluent pump ON), energize LV12 (WBC drain), energize LV6 (turn waste pump ON), and move probe to middle sensor (cap-pierce vent stroke)
1.57	Energize LV11 (WBC bath diluent), turn OFF waste pump, de-energize LV12, dispense 1 mL from diluent pump, and move probe up to top sensor
2.78	Energize LV10 (diluent to probe), de-energize LV11, energize LV8 (open path from waste port of probe-wipe housing to VC1), check vacuum, and dispense 50 µL from sample pump
3.20	Dispense 1.5 mL from diluent pump (probe wash) and 50 µL from sample pump
4.40	De-energize LV10, energize LV11 (WBC bath diluent), move probe to bottom sensor (cap pierce for aspiration), and dispense 2.0 mL from diluent pump to WBC bath
6.40	De-energize LV8, LV11, energize LV12 (WBC bath drain), turn ON waste pump, aspirate 18 µL sample
7.41	Energize LV8 (open path from waste port of probe-wipe housing to VC1), energize LV10 (diluent to probe), check vacuum, wash probe (move probe to top sensor while dispensing 1 mL of diluent from diluent pump)
8.57	Dispense 0.5 mL from diluent pump (probe wash), dispense 6 µL from sample pump with check to see if pump is at home sensor (12 µL of sample remains inside the probe), then open cap-pierce door
8.99	De-energize LV10, LV8, and LV12; energize LV11 (WBC bath diluent) and LV15 (RBC bath drain)
9.02	Aspirate air for gap, move probe over the WBC bath, dispense 1.6 mL from diluent pump into WBC bath (prefill)
10.84	Energize LV8 (open path from waste port of probe-wipe housing to VC1 for vent) and delay
12.64	Take “Hgb Blank1” reading, move probe to thief (middle) position in WBC bath, de-energize LV15, de-energize LV6 (turn waste pump OFF), dispense 505.25 µL from sample pump (including the 12 µL of whole-blood) and 500 µL from diluent pump
16.03	De-energize LV8, LV11, and LV2, energize LV3 (WBC bath mix select), use LV5 to create four mix bubbles
16.43	De-energize LV3, then aspirate 100 µL from the WBC bath while dispensing 500 µL into RBC bath (prefill)
17.73	Energize LV8 (open path from waste port of probe-wipe housing to VC1) and LV2 (High Vacuum enable) while moving the probe up to the top sensor (dry wipe)
18.43	De-energize LV8, LV2, move probe over the RBC bath, dispense 800 µL diluent from the diluent pump into the RBC bath, and dispense 325 µL lytic reagent into the WBC bath (while checking the lyse sensor)
19.23	Home lyse pump (dispensing 20 µL), dispense 200 µL diluent to RBC bath, dispense 90 µL lytic reagent
19.64	Energize LV4 (Lyse Mix enable), energize LV5 for two short intervals to create two mixing bubbles through the lyse port **Note:** The stated time assumes an altitude setting at or near sea level. Mix bubble rate is variable according to the altitude setting on the Date/Time screen. As altitude increases, more pump action is required to create a mixing bubble; therefore, LV5 is held open for a longer time.

Table 2.8-8 Closed-Vial Aspirate Cycle - A^{C}•T diff 2 Analyzer, Software Version 1.00 and 2.00

Time	Activity
19.94	De-energize LV4, energize LV3 (WBC bath mix select), move probe down into RBC bath, use LV5 to create three mixing bubbles through the lower WBC bath port **Note:** The stated time assumes an altitude setting at or near sea level. Mix bubble rate is variable according to the altitude setting on the Date/Time screen. As altitude increases, more pump action is required to create a mixing bubble; therefore, LV5 is held open for a longer time.
20.84	De-energize LV3, dispense 550 µL from probe (100 µL WBC dilution + 450 µL diluent from sample pump) and 800 µL from diluent pump into RBC bath
22.18	Energize LV8 (open path from waste port of probe-wipe housing to VC1), move probe up for drying
24.47	De-energize LV8, use LV5 to create 4 mixing bubbles to the bottom of the RBC bath
24.87	Energize LV2 (High Vacuum enable) for 0.5 seconds, then energize LV16, LV17, turn OFF diluent pump and fan
26.37	Acquire data **Note:** The time for acquiring count data depends on the number of extended counts. When Plt data is insufficient, sensing is extended up to eight additional 3.0 second counts in an attempt to acquire sufficient data. Because the time for acquiring data varies, the start time for the next sequence of events also varies.
40.57	Turn ON diluent reservoir pump and fan, de-energize LV16 and LV17, turn ON waste pump, move probe down to middle (thief) position, and take two Hgb Sample readings, about 0.5 seconds apart
41.27	Energize LV12 (WBC bath drain), energize LV4 (Lyse Mix enable to prevent carryover), dispense 50 µL lytic reagent while homing the pump, home the sample pump and analyze CBC data **Note:** The time needed to analyze data depends on the amount of data accumulated during data analysis and the Plt histogram data. A normal blood takes about 6.0 seconds, but can vary from 4.0 to 8.0 seconds. Because the time needed to analyze this data varies, the start time for the next sequence of events also varies.
47.27	Energize LV5 for a short burst, de-energize LV4, LV12, and energize LV15 (RBC bath drain) and LV11 (WBC bath diluent)
47.30	Dispense 0.5 mL diluent to WBC bath, dispense 4.0 mL diluent, dispense 4 µL from sample pump into the RBC bath while homing the pump, and analyze differential data **Note:** The time needed to analyze differential data depends on the amount of data accumulated during data analysis and the differential histogram data. Values for an average normal blood are used in this table. Because the time needed to analyze this data varies, the start time for the next sequence of events also varies.
51.17	De-energize LV15, turn OFF waste pump, energize LV8 (open path from waste port of probe-wipe housing to VC1), move probe to top sensor (out of the RBC bath)
51.87	Increment cycle count, turn waste pump ON, de-energize LV11, energize LV12 (WBC bath drain), dispense about 2.3 mL diluent into the RBC bath (homing the diluent pump), and Show Results **Note:** The time needed to complete the Show Results to the Screen function (which does flagging and clog detect analysis) varies. Values for an average normal blood are used in this table. Because this time varies, the start time for the next sequence of events also varies

Table 2.8-8 Closed-Vial Aspirate Cycle - A^{C}•T diff 2 Analyzer, Software Version 1.00 and 2.00

Time	Activity
53.96	Energize LV3, energize LV5 for a 200 ms burst, de-energize LV3, turn vacuum pump OFF, and dispense from the diluent pump 1.2 mL to the RBC bath, and Print Results **Note:** The time needed to produce print ready results depends on the printer used, the selected print mode, and the presence or absence of graphical data. The time required increases when autoprint is turned on and may increase significantly when automatic host transmission is performed. Graphical printouts also increase print time and depending on the size of the printer buffer, could add a lot of time to a cycle. Because the time needed to print varies, the start time for the next sequence of events also varies.
56.00	De-energize LV12, energize LV11, turn reservoir pump OFF, energize LV7, dispense 0.5 mL from diluent pump to the WBC bath
56.50	Dispense 2.5 mL diluent to the WBC bath, move probe to closed-vial position, zap apertures
60.00	Dispense 1.0 mL diluent (probe wash), de-energize LV13, LV7, LV8, LV11, turn waste pump OFF, and turn reservoir fill OFF

2.9 INSTRUMENT STATES

To save time and reagents whenever power is interrupted, the A^{C}•T Series analyzers record the time of the last sample run and the state of the instrument, or more specifically the diluter, as power is lost. The six instrument states are: busy, ready, sleep, exception, error, and ready-to-ship.

- Busy state - Any time the diluter is in the middle of a cycle performing some operation, the exact fluidic condition is not known and this is considered the “busy” state.
- Ready state - When the instrument is not performing a cycle and is waiting for user input.
- Sleep state - The instrument is put to sleep after two hours without running a sample. To save energy, improve reliability, and force a Prime cycle the Hgb lamp and pneumatic pump are turned off. If the system is in the Sample Results screen, the probe is retracted.

  If the first request, while the instrument is asleep, is to go to the Sample Results screen, the probe retracts immediately, the system awakens, then the probe returns to the aspirate position. Retracting the probe prevents using sample aspiration to awaken the instrument from the sleep state. This is necessary because system vacuum takes time to build up to sufficient levels to perform a probe wash and is also used to force a Prime cycle after two hours.

  Note: If the screen is not touched for 15 minutes, the screen backlighting is turned off (the screen goes blank). This is not considered the “sleep state.” Touch the screen to turn it back on.
- Exception state - When the instrument identifies a situation requiring the user to take some action before the instrument can continue (for example, a reagent is empty).
- Error state - When the instrument identifies a fatal error condition.
- Ready-to-Ship state - When the “prepare-to-ship” sequence of operations has been performed.

The state of the instrument at the time it was powered down is used during powerup to determine what actions to take.

- **If the instrument was in a ready state when powered down**, a Powerup cycle (home all hardware, perform one drain and rinse, extend the probe and check the lytic reagent level) is performed.
- **If the instrument was in a ready state when powered down and over two hours have elapsed since the last Sample cycle**, a Startup cycle is automatically performed after the Powerup cycle is completed.
- **If the instrument was in any other state when powered down**, an extended Cleanup cycle is performed during the Powerup cycle, then a Startup cycle (including a background count) is performed after the Powerup cycle.

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PART A: INSTRUMENT INSTALLATION

3.1 INSTRUMENT INSTALLATION

Complete installation instructions and procedures are available in the customer documents listed in Table 3.1-1.

Table 3.1-1 A^{C}•T Analyzer Installation Documents

Instrument	Document	Language	PN
A^{C}•T 8/10 analyzer	Getting Started	English	4237289
		Chinese	4237355
		French	4237349
		German	4237352
		Italian	4237361
		Japanese	4237358
		Spanish	4237346
	Installation and Training Guide for the A^{C}•T Pak™ Reagent	English	4237414
	Installation and Training Guide for the A^{C}•T Tainer™ Reagent	English	4237413
	Installation Guide	English	4237407
A^{C}•T diff analyzer	Installation and Training Guide for the A^{C}•T Pak™ Reagent	English	4237421
		Chinese	4237444
		French	4237432
		German	4237436
		Italian	4237440
		Spanish	4237428
	Installation and Training Guide for the A^{C}•T Tainer™ Reagent	English	4237417
		Chinese	4237445
		French	4237433
		German	4237437
		Italian	4237441
		Japanese	4237449
		Spanish	4237429
A^{C}•T diff 2 analyzer	Installation and Training Guide for the diff A^{C}•T Pak™ Reagent and the diff A^{C}•T Tainer™ Reagent	English	4237517
		French	4237553
		German	4237544
		Italian	4237561
		Japanese	4237556
		Spanish	4237550
		Portuguese	4237547

PART B: UPGRADE AND OPTION INSTALLATION

3.2 OPTIONAL PRINTERS

Epson TM-290P® and TM-295P® Slip Printers

The Epson TM-290P and TM-290P Slip Printers print numerical results on a ticket, but cannot print histograms. Both models are parallel Printers supported by all A^{C}•T Series instruments and software except the A^{C}•T analyzer Software Version 1.03. Two differences between these printers, however, affect their use and operation.

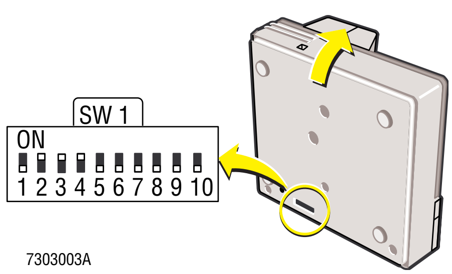
1. The Printers have different power supply connectors, requiring the use of different power supplies. That means that if you replace one model with the other you must also replace the power supply.
2. If the Printer is operating but no ticket is in place, the Epson TM-290P Slip Printer signals the instrument which initiates a printer warning, but the Epson TM-295 Slip Printer does not signal the instrument. It continues printing as if a ticket is in place. If the customer does not notice the missing ticket and cycles the next specimen, the data from the first sample is lost.

For complete information on how to use this Printer, see the COULTER A^{C}•T Series Analyzer Ticket Printer User's Guide. For Printer specifications, see Appendix C, OPTIONAL PRINTERS.

Printer Setup Procedure

1. Unpack the Ticket Printer. Ensure you have the following components:
   - Printer
   - 24-V Printer Power supply
   - Power line cord for the power supply
   - Standard Centronics® data cable
   - Ribbon ink cassette.
2. Locate the DIP switch, SW1, on the bottom of the Printer as shown in Figure 3.2-1. Ensure switch positions 2, 3, and 4 are ON and the rest are OFF. See Table C.1-3 and Table C.1-4 for the complete DIP switch settings including those for international character sets.

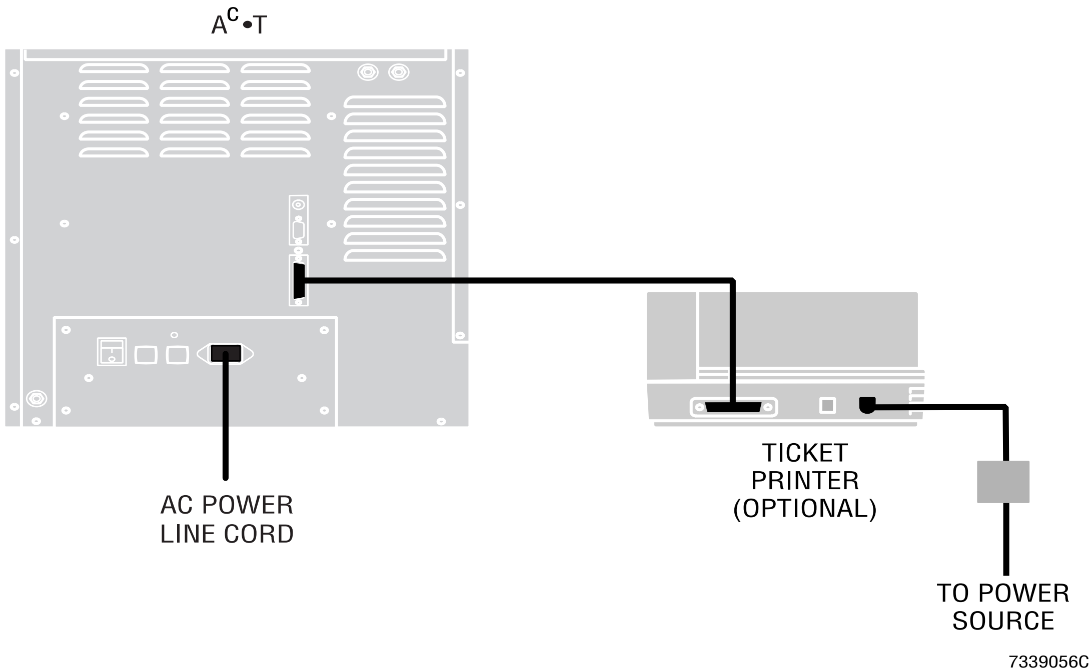
Figure 3.2-1 Epson TM-290P Slip Printer - DIP Switch, SW1, Location



CAUTION Risk of damage to equipment. Turning the instrument's power ON before connecting the Printer to the instrument could damage the instrument. Ensure the instrument's power is OFF before connecting the Printer.

3. Ensure the instrument's power is off.
4. Connect the Printer as shown in Figure 3.2-2 connecting the Printer's power line cord last.

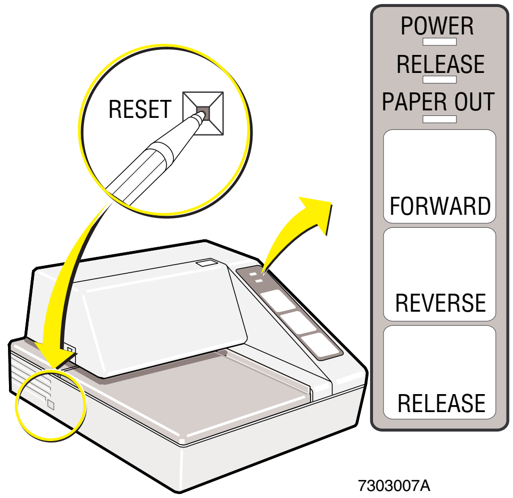
Figure 3.2-2 Connecting Optional Printers



Verification

1. Perform a Printer self-test:
   a. Ensure the instrument's power is on and the Printer's power line cord is plugged in.
   b. Press the **RELEASE** key on the Printer (Figure 3.2-3).
   c. Insert a ticket in the Printer.
   d. Unplug the Printer's power line cord.
   e. Press and hold down the **FORWARD** key (Figure 3.2-3). While holding the **FORWARD** key, plug in the Printer's power line cord to initiate the self-test.
   f. Press the **RESET** button to stop the self-test (Figure 3.2-3). The self-test stops after printing a specific number of lines.
2. Print the calibration factors to verify that the Printer and the instrument are working together properly.

Figure 3.2-3 Epson TM-290P Slip Printer - Location of Controls and Indicators



Canon® BJC-250 Bubble Jet™ Printer

The Canon BJC-250 Bubble Jet Printer is an inkjet Graphics Printer. It is an alternative for the Citizen GSX-190 dot matrix Printer and can be used by all A^C•T Series analyzers. The graphic capability of this Printer, allowing it to print both histograms and numerical data, makes this Printer an attractive choice for the A^C•T diff and A^C•T diff 2 analyzers.

To achieve complete printing results, the A^C•T diff and A^C•T diff 2 analyzers need to be set up for graphic printing.

- To set up the A^C•T diff analyzer properly, refer to Selecting the Printer Type in Chapter 1 of the COULTER A^C•T diff Analyzer Installation and Training Guide.
- To set up the A^C•T diff 2 analyzer properly, refer to Selecting the Printer Type in Chapter 1 of the COULTER A^C•T diff 2 Analyzer Installation and Training Guide.

For complete information regarding this Printer, refer to the COULTER A^C•T diff Analyzer Canon® Bubble Jet™ Printer User's Guide.

Printer Setup Procedure

The Canon BJC-250 Bubble Jet Printer does not have DIP switches or menu settings. Printer settings are changed using the Printer setup from a computer operating system after the appropriate Printer drivers are installed. However, the Printer settings do not need to be changed for use with the A^C•T Series analyzers. The default settings used by this Printer are all that are required.

1. Unpack the Printer removing all items from the box. Ensure you have the following components:
    - Printer
    - 24-V Printer Power supply
    - Power line cord for the power supply
    - Standard Centronics® data cable
    - Black ink cartridge

2. Set the Printer on a flat, stable surface. **Do not use an angled Printer stand**.

CAUTION Risk of damage to equipment. Turning the instrument's power ON before connecting the Printer to the instrument could damage the instrument. Ensure the instrument's power is OFF before connecting the Printer.

3. Ensure the instrument's power is off.
4. Connect the Printer as shown in Figure 3.2-2. Connect the Printer's power line cord last.

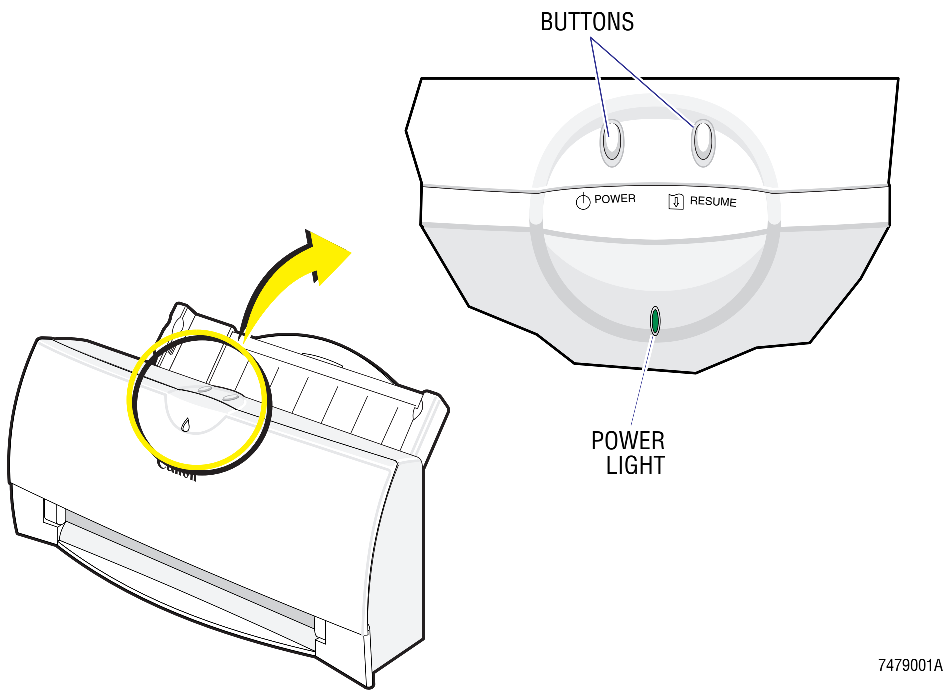
Verification

1. Perform a Printer self-test:
   a. Turn the Printer off.
   b. Ensure that there is paper in the Printer.
   c. To perform the specific tests or gather the information shown in Table 3.2-1, press and hold the **POWER** button (Figure 3.2-4) until you hear the number of audible beeps required, then release the **POWER** button.

Table 3.2-1 Canon BJC-250 Bubble Jet Printer - Available Printer Information/Tests

Printout of the Following Information/Tests	Audible Beeps Required
General Printer Demonstration	1
Printer Status/Status Information	2
Printer Test (A)	3
Print Head Nozzle	4

Figure 3.2-4 Canon BJC-250 Bubble Jet Printer - Power/Resume Controls and Indicators



Ithaca Series 90 Printer

The Ithaca Series 90 Printer (also called the OKIPOS Series 90 Printer in Germany) is supported by the A^{C}•T diff and A^{C}•T diff 2 analyzers' software, but it is not available with the instrument and does not have a Beckman Coulter part number. This Printer must be obtained from the manufacturer or a third party distributor.

The Ithaca Series 90 Printer is a 40 column, fast, dot matrix Printer. It is intended as a "point of sale" Printer and hence is very reliable. This Printer is capable of printing graphics from an Espson graphic driver, just like the Citizen GSX-190 and Canon Bubble Jet BJC-250 Printers. The Model 93 Printer was used in developing software support. When the instrument is setup for this Printer, histograms print vertically, rather than horizontally. In addition to its graphic capability, this Printer can print tickets (slips), and has a journal feature. The journal feature allows one or two backup copies when used as a Roll Printer. The backup copy is automatically spooled in a roll at the back of the Printer, similar to many cash register systems. The other Series 90 models do not have all the printing features, and consequently do not cost as much. This might be a consideration if all features will not be used.

When using the Ithaca Series 90 Printer as a Ticket Printer, you need to consider three main differences between it and the Epson Printers.

1. Settings are not available at the Ithaca Series 90 Printer to select the Ticket mode; the instrument must send a command to put this Printer into the Ticket mode. Consequently the instrument has to be programmed specifically for this Printer and this mode.

   When the proper command is sent, the Ithaca Series 90 Printer accepts a ticket, but as soon as it prints the ticket it automatically defaults to the Roll Paper mode.
2. Standard in-house tickets do not work well with the Ithaca Series 90 Printer; third party tickets are strongly recommended.

   All previous Ticket Printers used advance rollers on the underside of the ticket. The Ithaca Series 90 Printer has its ticket advance rollers on the top of the ticket. The combination of hard back copy and very smooth (slippery) carbon paper causes the front copies of standard Beckman Coulter tickets to bunch up.
3. The Ithaca Series 90 Printer has a standard parallel printer output, but does not use the standard DB25 pin to Centronics 36 pin printer cable. It uses a straight DB25 pin to DB25 pin cable.

OKIPAGE™ 14e LED Printer

The OKIPAGE 14e LED Printer is shipped configured for use with the A^{C}•T Series instruments and cannot be easily reconfigured in the field. In case it does become essential to reconfigure this Printer in the field however, the procedure, Configuring the Printer, and associated tables of settings, are supplied under Heading C.3, OKIPAGE 14e LED PRINTER.

Printer Setup Procedure

1. Remove the Printer from the box and place it on the countertop next to the instrument.
2. Connect the end of the Printer cable labeled P1 (Centronic connector) to the Printer rear parallel port connector and secure the connection using the Printer spring clips.

3. Connect the end of the Printer cable labeled P2 (DB-25 connector) to the back of the instrument (next to the Printer symbol) and secure the connection by tightening the two screws.
4. Press the Printer cover release button and lift the cover.

ATTENTION: For steps 5 through 12, refer to the supplied Quick Start Guide.

5. Lift out the image drum cartridge. Do not touch the drum's green surface or remove the sponge at this time.
6. Without turning the drum cartridge over, remove the protective paper from the image drum.
7. Reinstall the cartridge in the Printer.
8. Remove the sponge.
9. Unwrap the toner cartridge and shake the cartridge to distribute the toner.
10. Peel the tape off of the bottom of the toner cartridge.
11. Grasp the lock lever and place the left side of the toner cartridge under the end tab.
12. Lower the right side of the toner well, aligning the lock lever slot with the ridge in the drum cartridge.
13. When the cartridge is in place, push the lock lever forward until it stops.
14. Lower the Printer cover and press it firmly to close.
15. Remove the protective film from the front operator panel.
16. Slide out the paper tray.
17. Fan a stack of paper and place it in the tray under the tabs.
18. Place the tray in the printer and push closed until the tray locks in place.
19. Connect the power cord to the Printer, then plug the cable into a grounded ac outlet.

ATTENTION: DO NOT press the User Option switch while turning the Printer ON, as that will reset the Printer back to the factory-default settings.

20. Turn the Printer ON. The Printer takes about 10 seconds to warm up. At that time, the "Ready Light" on the operator panel lights, indicating the Printer is ready to receive data.

Verification

1. Print a Demo and Menu page:
   a. Turn the Printer ON.
   b. Set the Printer to off line (the green ready light is off).
   c. Press the User Option switch for 2 seconds, then release it.

      If done correctly, the ready light begins to flash and the Printer prints a Demo page followed by a list of current menu settings.
2. Compare the menu settings to the settings in the User column in Table C.3-2. If any setting needs to be changed, reconfigure the Printer. Refer to Configuring the Printer procedure under Heading C.3, OKIPAGE 14e LED PRINTER.

3.3 VETERINARY SOFTWARE OPTION

Software designed specifically for veterinary specimens is available for the A^{C}•T diff analyzer. This software was introduced with version 1.04 of the A^{C}•T diff analyzer software. It will be maintained with the standard software and kept at the same revision level.

IMPORTANT Risk of inaccurate results due to loss of setup information, such as calibration factors. Setup information may be lost if software version 1.03 and the Veterinary Option software are switched on an A^{C}•T diff analyzer. Although Veterinary Option software is generally intended to be switched back and forth with the clinical version of software, there were CMOS changes from version 1.03 to 1.04. Switching back and forth between revisions of software with different CMOS configurations can corrupt the CMOS data, which forces the instrument to rewrite the CMOS with Default Data. Do not switch between software version 1.03 and Veterinary Option software on an A^{C}•T diff analyzer.

Veterinary Software Installation

1. Turn the instrument off (**0**).
2. Replace the standard system software card with the veterinary software card.
3. Turn the instrument on (**I**).
4. If the instrument has never been used with veterinary software before and the WBC aperture could have been changed since leaving the factory, perform Heading 4.16, APERTURE VERIFICATION - AC•T diff/Veterinary Option ANALYZER, to ensure that the WBC aperture is not too large for veterinary software.

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4.1 GENERAL GUIDELINES

Field Service Engineers can perform the procedures in this section using their standard tool kit. Any special tools, supplies or equipment required are identified at the beginning of the applicable procedure under the Tools/Supplies Needed heading.

Note: When a service/repair procedure requires some type of instrument performance verification upon completion, a Verification heading is provided with the necessary steps that must be performed.

4.2 OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS

Purpose

Use the procedures in this section for Removing the AC•T 8/10 and AC•T diff Analyzers' Top Cover and Rear Panel, Opening the AC•T diff 2 Analyzer's Front Door, or Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover to access the instrument's components.

Removing the AC•T 8/10 and AC•T diff Analyzers' Top Cover and Rear Panel

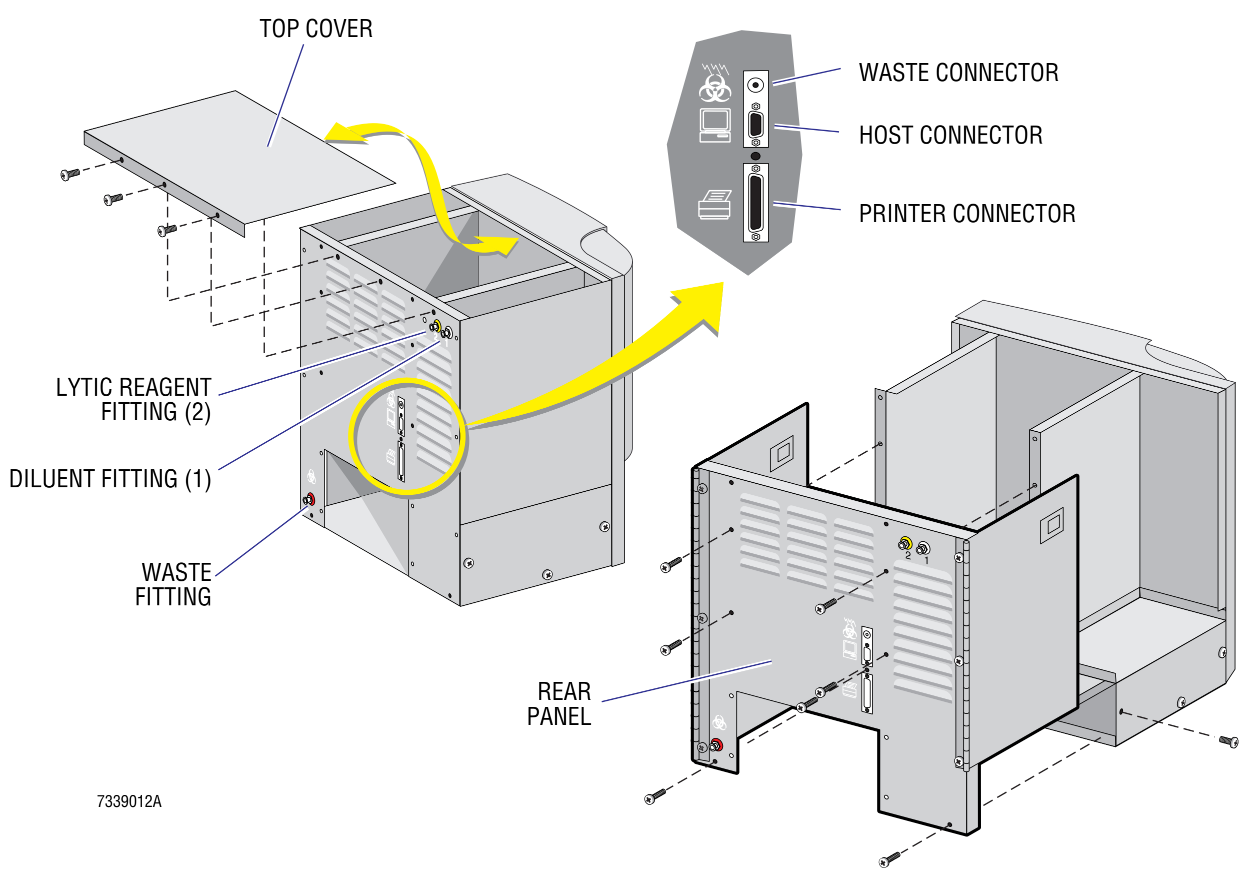
Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver
- ❑ Small-blade screwdriver

Removal (AC•T 8/10 and AC•T diff Analyzers)

1. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
2. From the back of the instrument (Figure 4.2-1), remove the top cover:
   a. Remove the three Phillips-head screws across the back of the instrument.
   b. Unhook (there are no fasteners) the top cover from under the top edge of the front panel and pull the cover off of the instrument (Figure 4.2-1).

Figure 4.2-1 Top Cover and Rear Panel Removal, AC•T 8/10 and AC•T diff Analyzers



3. Remove the Power Supply module as directed under Heading 4.3, POWER SUPPLY MODULE REPLACEMENT.
4. Remove the input/output cables attached to the Analyzer card's rear connectors (Figure 4.2-1):
   - Top (WASTE) connector - round BNC connector used by the waste-full sensor
   - Middle (HOST) connector - 9-pin DB connector used for transmission to a Host computer
   - Bottom (PRINTER) connector - 25-pin DB connector used for a parallel Centronics Printer.

WARNING Risk of personal injury or contamination. Waste can include biohazardous materials. Handle and dispose of waste according to acceptable laboratory standards.

5. Disconnect the reagent tubing from the rear-panel bulkhead Luer fittings (Figure 4.2-1):
   - Waste tubing - red-striped, attaches at the lower left
   - Lytic reagent tubing - translucent EVA, connects to the inner connector labeled 2
   - Diluent tubing - clear-coiled tubing, connects to the outer connector labeled 1.
6. Remove the rear panel. The rear panel is secured with eight Phillips-head screws, seven on the back of the unit and one on the lower right (reagent) side that is used to fasten the vacuum pump cover (Figure 4.2-1).

   Note: Hinged, side-access doors are attached to the rear panel and **do not** have to be removed from the rear panel.

Installation (A^C•T 8/10 and A^C•T diff Analyzers)

1. Attach the rear panel. The rear panel is secured with eight Phillips-head screws, seven on the back of the unit and one on the lower right (reagent) side used to fasten the vacuum pump cover (Figure 4.2-1).
2. Attach the internal reagent tubing to the rear-panel bulkhead Luer fittings (Figure 4.2-1):
   - Waste tubing - red-striped, attaches at the lower left
   - Lytic reagent tubing - translucent EVA, connects to the inner connector labeled 2
   - Diluent tubing - clear-coiled tubing, connects to the outer connector labeled 1.
3. Attach any input/output cables being used, to the Analyzer card's rear connectors (Figure 4.2-1):
   - Top (WASTE) connector - round BNC connector used by the waste-full sensor
   - Middle (HOST) connector - 9-pin DB connector used for transmission to a Host computer
   - Bottom (PRINTER) connector - 25-pin DB connector used for a parallel Centronics Printer.
4. Install the Power Supply module as directed under Installation in Heading 4.3, POWER SUPPLY MODULE REPLACEMENT.

5. From the back of the instrument (Figure 4.2-1), install the top cover:
   a. Hook the top cover under the top edge of the front panel.
   b. Reinstall the three Phillips-head screws across the back of the instrument.
6. Plug the power line cord into an appropriate wall outlet and turn the instrument on (**I**).

Opening the A^{C}•T diff 2 Analyzer's Front Door

Tools/Supplies Needed

- ❑ Large-blade screwdriver

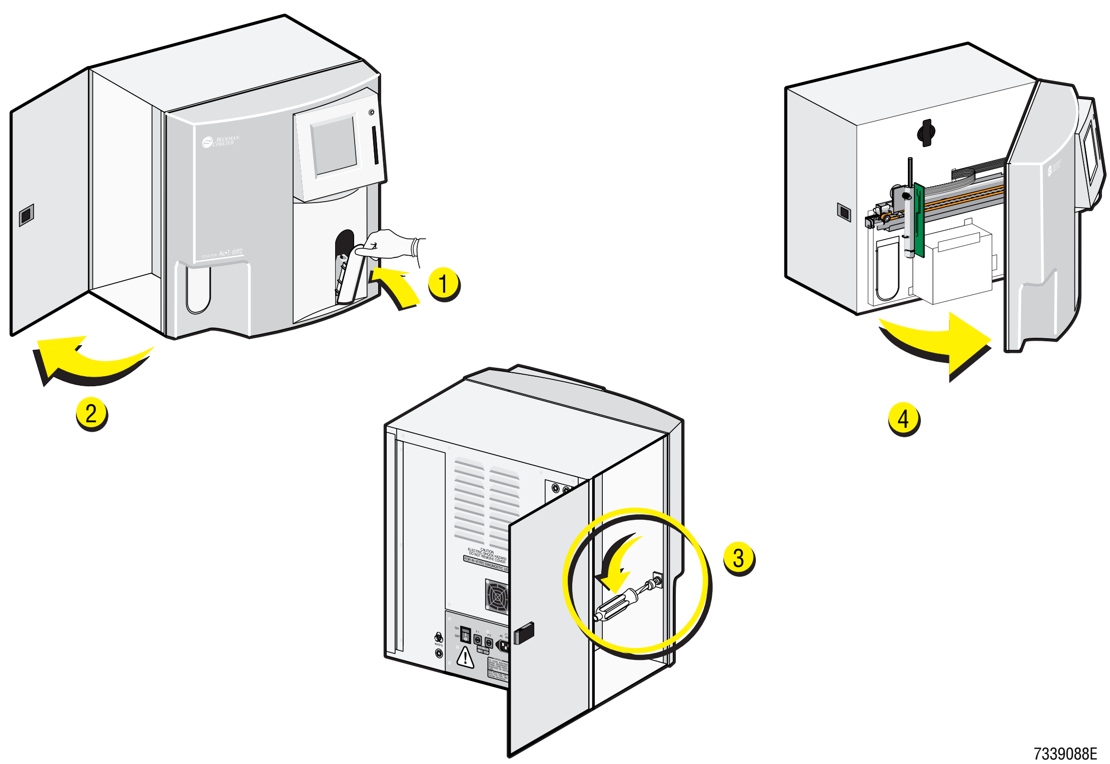
Procedure

1. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.

CAUTION Risk of damage to the analyzer. If you attempt to open the analyzer's front door when the cap-pierce door is open, the Cap-Pierce module or the front door may be damaged. Before opening the analyzer's front door, verify the cap-pierce door is closed.

2. Unlatch and open the front door as shown in Figure 4.2-2.

Figure 4.2-2 Opening the A^{C}•T diff 2 Analyzer's Front Door



Removing the A^C•T diff 2 Analyzer's Top and Rear Center Cover

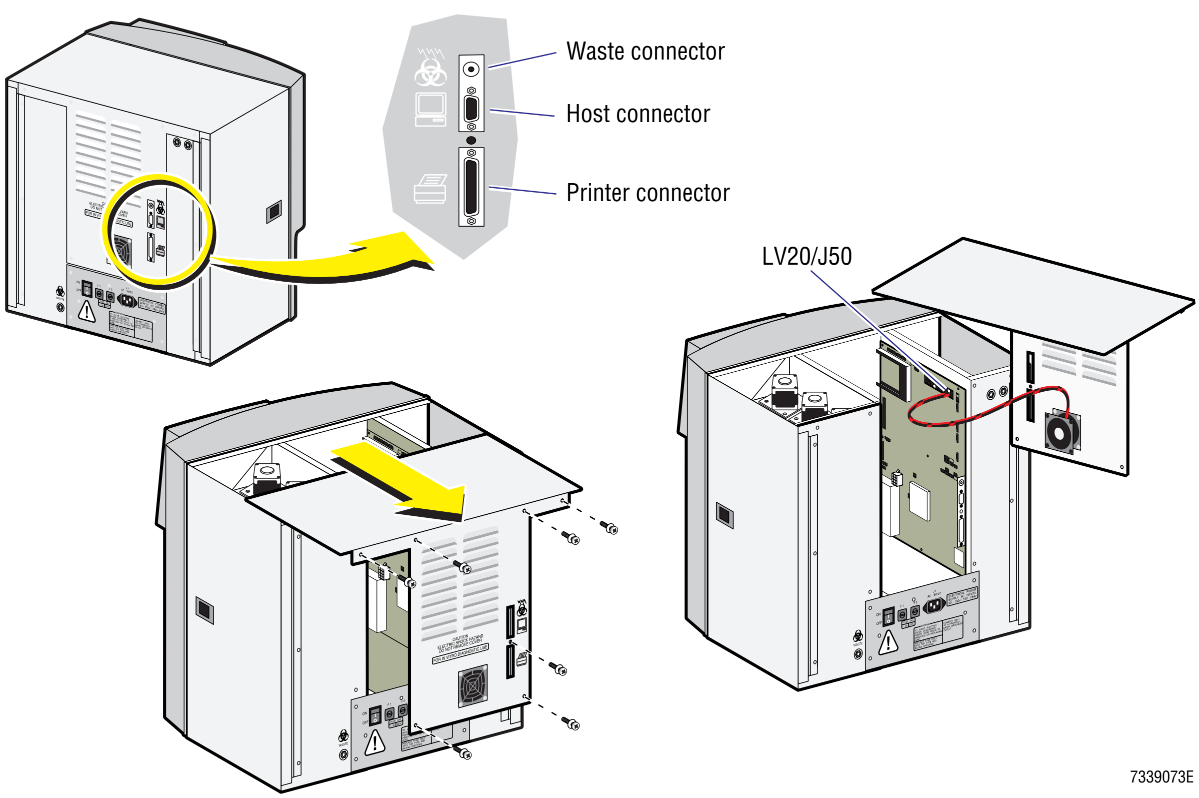
Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver
- ❑ Small-blade screwdriver

Removal (A^C•T diff 2 Analyzer)

1. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
2. Remove the input/output cables attached to the Analyzer card's rear connectors (Figure 4.2-3).
    - Top (WASTE) connector - round BNC connector used by the waste-full sensor
    - Middle (HOST) connector - 9-pin DB connector used for transmission to a Host computer
    - Bottom (PRINTER) connector - 25-pin DB connector used for a parallel Centronics Printer.

Figure 4.2-3 Top and Rear Center Cover Removal, A^C•T diff 2 Analyzer



3. From the back of the instrument (Figure 4.2-3), remove the top and rear center cover:
    a. Remove the seven Phillips-head screws, four from across the back top of the instrument and three from the lower rear center panel.
    b. Unhook (there are no fasteners) the top of the cover from under the top edge of the front panel and pull the cover toward you until the cable for the rear panel fan is accessible. (Figure 4.2-3).
    c. Disconnect the rear panel fan connector LV20/J50 from the Analyzer card and remove the cover.

Installation (A^{C}•T diff 2 Analyzer)

1. From the back of the instrument (Figure 4.2-1), install the top and rear center cover:
    a. Reconnect the rear panel fan connector LV20/J50 to the Analyzer card.
    b. Hook the top of the cover under the top edge of the front panel.
    c. Secure the top and rear center cover with the seven Phillips-head screws, four across the back top of the instrument and three in the lower rear center panel.
2. Reconnect the input/output cables attached to the Analyzer card's rear connectors (Figure 4.2-3).
    - Top (WASTE) connector - round BNC connector used by the waste-full sensor
    - Middle (HOST) connector - 9-pin DB connector used for transmission to a Host computer
    - Bottom (PRINTER) connector - 25-pin DB connector used for a parallel Centronics Printer.
3. Plug the power line cord into an appropriate wall outlet and turn the instrument on (**I**).

4.3 POWER SUPPLY MODULE REPLACEMENT

Purpose

Use this procedure to replace the Power Supply module in any A^{C}•T Series analyzer.

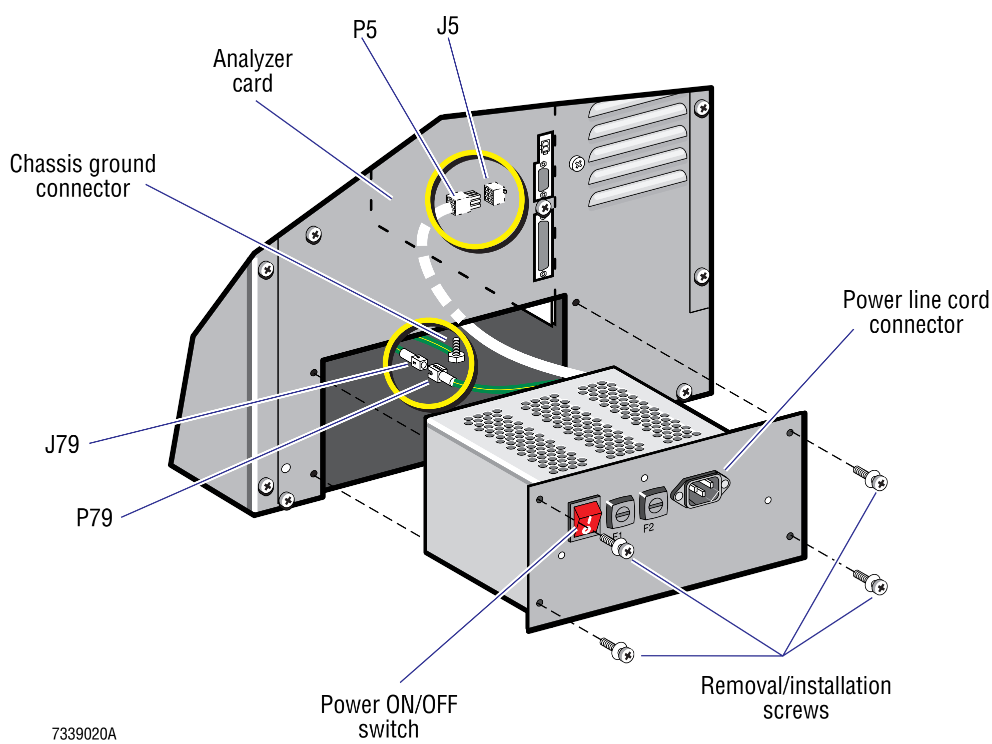
Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver

Removal

1. Turn the instrument off (**0**) and unplug the power line cord from the wall outlet.
2. To access the Power Supply module (Figure 4.3-1), remove the top cover as directed in the procedure for Removing the AC•T 8/10 and AC•T diff Analyzers' Top Cover and Rear Panel or for Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover under Heading 4.2.
3. Remove the four Phillips-head screws attaching the Power Supply module to the instrument (Figure 4.3-1).
4. Pull the Power Supply module out just until you have access to the wiring, and unplug the two Power Supply module connectors (Figure 4.3-1):
   - P5 (9 or 12-pin output connector) - from J5 on the Analyzer card
   - P79 (1-pin chassis ground connector) - attaches to a green/yellow chassis ground wire with connector J79.
5. Remove the Power Supply module.

Figure 4.3-1 Power Supply Module Replacement



Installation

1. Position the new Power Supply module near the back of the instrument.
2. Attach the two Power Supply module connectors (Figure 4.3-1):
   - P5 (9 or 12-pin output connector) - from J5 on the Analyzer card
   - P79 (1-pin chassis ground connector) - attaches to a green/yellow chassis ground wire with connector J79.
3. Slide the Power Supply module in place and fasten it using four Phillips-head screws (Figure 4.3-1).
4. **R**einstall the top cover and rear panel as directed in Installation (AC•T 8/10 and AC•T diff Analyzers) or the top and rear cover as directed in Installation (AC•T diff 2 Analyzer) under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
5. Plug the power line cord into an appropriate wall outlet.

Verification

1. Turn the instrument on (**I**).
2. When the Powerup cycle has completed, select **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Voltages/Sensors** icon.
3. Verify that the voltage supplies on the Voltages/Sensors screen are good:
   - The Power Supply module supplies these direct voltages: +5 Vdc, ±15 Vdc, and +24 Vdc.
   - The A^{C}•T 8/10 analyzer's Voltages/Sensors screen does not display +24 Vdc. A quick check is to verify that the +15 RF voltage is good. It is a 1% precision-regulated voltage derived from the +24 Vdc supply.

     Note: If a more accurate check of the +24 Vdc supply in the A^{C}•T 8/10 analyzer is needed, check TP5 on the Analyzer card or pin P5-1 with a DVM. TP5 is located about 2 cm (0.8 in.) above J5. See Figure A.3-1.

4.4 ANALYZER CARD REPLACEMENT

Purpose

Use this procedure to replace the Analyzer card in any of the AC•T Series instruments.

Tools/Supplies Needed

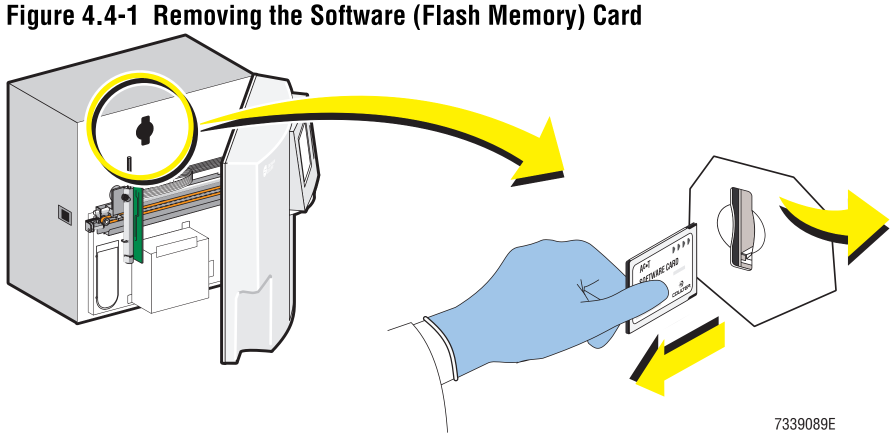
- ❑ #2 Phillips-head screwdriver
- ❑ PC Card Removal tool - AC•T 8/10 analyzer, PN 5450276 (optional)
- ❑ Controls or fresh blood specimens with known values (for Verification)

Removal

CAUTION Risk of damage to electronic components. SMT Analyzer cards are very sensitive to electrostatic discharge (ESD). The surface-mounted components on the top and the bottom of these cards are very sensitive to mechanical and electronic stresses. When removing, installing, or transporting SMT Analyzer cards, ensure that you handle them by the edges; and when transporting SMT Analyzer cards, keep them in their original packaging. The Analyzer cards in the AC•T diff and AC•T diff 2 analyzers are SMT cards.

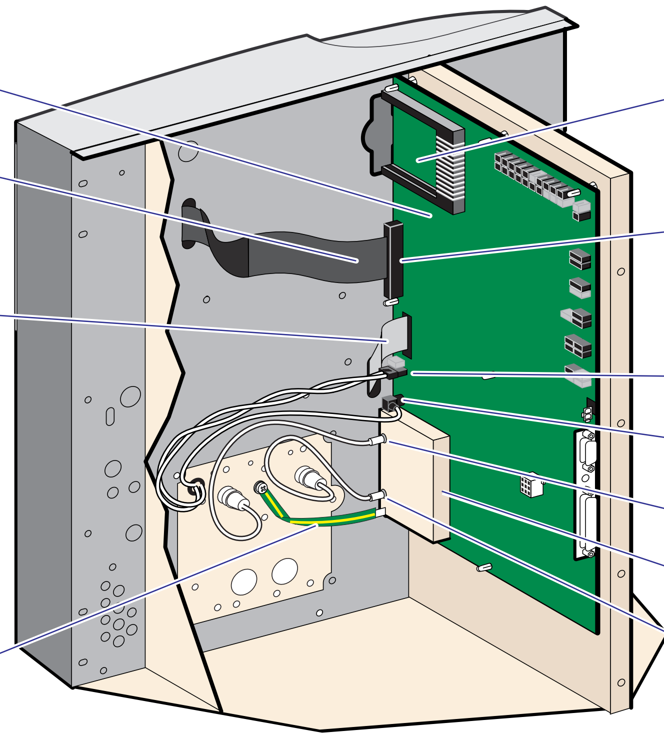
1. Print out or record all the instrument settings, especially the calibration factors, gains, and the Clog Detect parameters. They are stored in the non-volatile CMOS memory chip and must be re-entered when the new Analyzer card is installed.
   - For the AC•T 8/10 analyzer - WPWV RM and AVR RM
   - For the AC•T diff and AC•T diff 2 analyzers - WBC Target, RBC Target, and AVR Target.
2. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
3. Open the front door and remove the software (Flash Memory) card (Figure 4.4-1). To open the front door of the AC•T diff 2 analyzer, see Opening the AC•T diff 2 Analyzer's Front Door under Heading 4.2.

Figure 4.4-1 Removing the Software (Flash Memory) Card



4. To access the Analyzer card (Figure 4.4-2), remove the top cover and rear panel as directed in the procedure for Removing the AC•T 8/10 and AC•T diff Analyzers' Top Cover and Rear Panel or for Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover under Heading 4.2.

Figure 4.4-2 Disconnecting the Analyzer Card



5. Disconnect the cable connectors and the preamp ground from the Analyzer card:

   Note: If any connectors or wires are not labeled (especially solenoid wires) label them before disconnecting them.

   a. At the top right corner of the Analyzer card (Figure 4.4-2), disconnect the solenoid, motor, sensor, dc, and pneumatic pump connectors. For the exact locations of these connectors, refer to Figure A.2-1, Analyzer Card Component Locations - AC•T 8/10 Analyzers; Figure A.2-2, Analyzer Card Component Locations - AC•T diff Analyzer; or Figure A.2-3, Analyzer Card Component Locations - AC•T diff 2 Analyzer.

   b. At the front edge of the card, disconnect the Display assembly ribbon cable and the Traverse module flex cable (Figure 4.4-2).

   c. At the lower front of the card, disconnect the Hgb lamp and detector cables, the WBC and RBC coaxial aperture bath cables, and the preamp ground lug connector (Figure 4.4-2).

CAUTION Risk of damage to electronic components. SMT Analyzer cards are very fragile. Flexing the SMT Analyzer card creates stress on the components. When removing, installing, or transporting SMT Analyzer cards, handle them by the edges and ensure that you do not flex them.

---

6. Remove the Analyzer card from its mounting posts (Figure 4.4-3).

   Note: The number and type of mounting posts may differ from analyzer to analyzer.

   Early A^C•T 8/10 analyzers used nylon snap-on mounting posts. The PC Card Removal tool helps when removing an Analyzer card from nylon mounting posts.

The A^{C}•T diff and A^{C}•T 8/10 analyzers manufactured since the release of the A^{C}•T diff analyzer are mounted with six, pressure-held metal standoffs and a threaded mounting post in the center bottom of the card. See Figure 4.4-3 for the location of these seven mounts.

The Analyzer card on an A^{C}•T diff 2 analyzer is mounted using four, pressure-held metal standoffs and four threaded mounting posts. See Figure 4.4-3 for the location of these eight mounts.

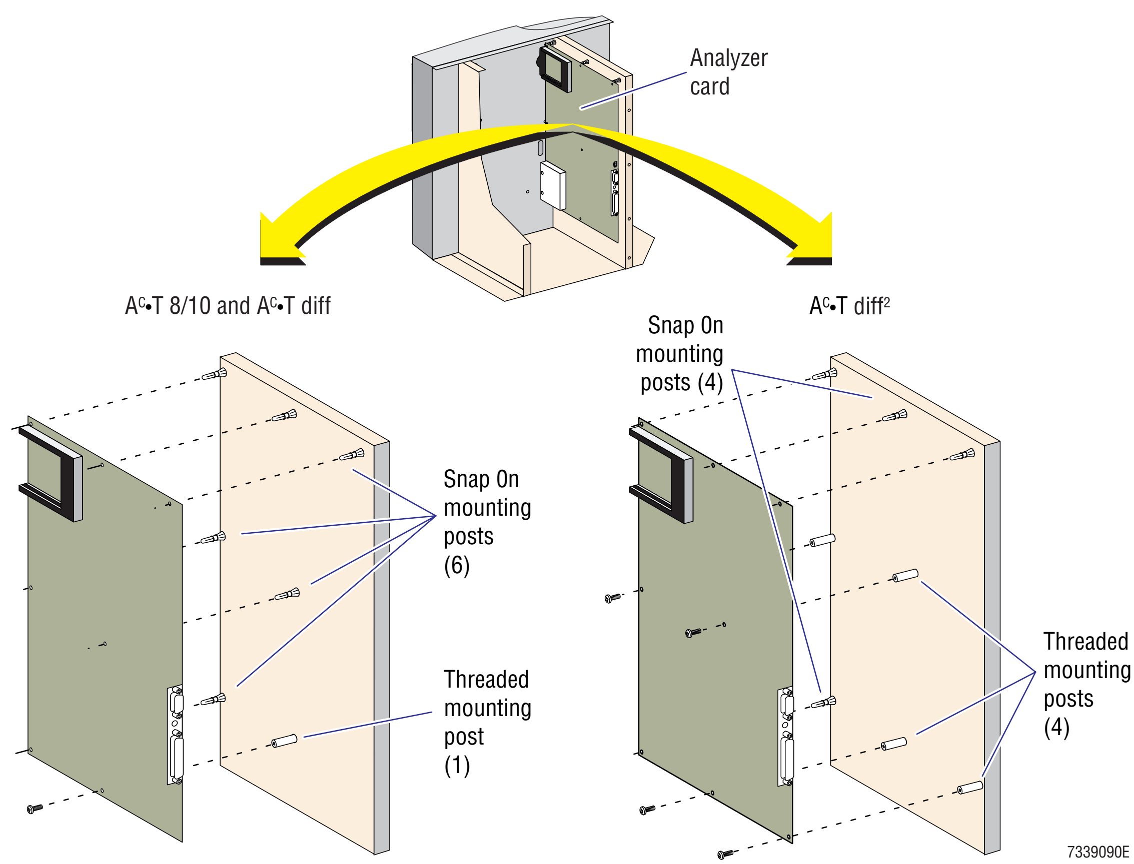
a. If the instrument uses threaded mounting posts, unscrew and remove the fasteners from those posts.

b. Remove the card from the top three mounting posts.

c. Remove the card from the two center posts. The front, center post is located just below connector J30.

d. Remove the card from the bottom posts.The front bottom post is located just below the lower front corner of the preamp shield.

Figure 4.4-3 Disengaging the Analyzer Card from the Mounting Posts



7. While holding the wires and connectors aside with one hand, slowly remove the card from the chassis, through the rear of the instrument.

Installation

1. While holding the wires and connectors aside with one hand, position the Analyzer card inside the instrument's chassis.

CAUTION Risk of damage to electronic components. SMT Analyzer card components are very fragile. Flexing the SMT Analyzer card creates stress on the components. When removing, installing, or transporting SMT Analyzer cards, handle them by the edges and ensure that you do not flex them. The Analyzer cards on the A^{C}•T diff and A^{C}•T diff 2 analyzers are SMT cards.

2. Install the Analyzer card onto its mounting posts (Figure 4.4-3):
   a. Install the card onto the top three posts. This should line up the two center posts and the bottom posts.
   b. Gently push the center and lower portions of the card until the card is completely seated on all the mounting posts.
   c. If the card has threaded-metal, mounting posts, secure the card with the original fasteners.
3. Connect the bath assembly ground wire to the Analyzer card's ground lug connector, located on or near the preamp shield (Figure 4.4-2). If this connection feels loose, gently squeeze the wire lug with pliers to make a tighter connection.

   Note: Electrical noise problems occur, especially for Plt and WBC counts, if the ground lug connection is not firm.
4. Connect the RBC and WBC coaxial aperture bath cables, then the coaxial Hgb connector to J10 and the four-wire Hgb lamp connector, P9, to J9 (Figure 4.4-2).
5. Connect the Traverse module flex cable and the Display assembly ribbon cable (Figure 4.4-2).
6. Connect the solenoid, motor, sensor, dc, and pneumatic pump cables to the Analyzer card. Refer to Figures A.2-1, Analyzer Card Component Locations - AC•T 8/10 Analyzers; A.2-2, Analyzer Card Component Locations - AC•T diff Analyzer; or A.2-3, Analyzer Card Component Locations - AC•T diff 2 Analyzer, for the locations of these connectors.
7. Ensure all the connectors are plugged in.
8. For the A^{C}•T 8/10 and A^{C}•T diff analyzers only, reinstall the rear panel as directed in Installation (AC•T 8/10 and AC•T diff Analyzers) under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
9. Reinstall the software (Flash Memory) card.
10. Plug the power line cord into an appropriate wall outlet.

Verification

1. Turn the instrument on (**I**):
   - If the time and date warning is issued, it means the Analyzer card has new or cleared CMOS and default values were written for all the settings. Press the **Continue** icon.
   - If errors occur, troubleshoot the errors.
   - If the instrument attains a ready state with no errors, the motors and sensors are connected properly and have proper power. Go to step 2.

ATTENTION: Check the instrument settings carefully. If this Analyzer card was installed in another instrument, the settings for that instrument are not automatically written over.

2. When the instrument reaches the “ready” state, select **Main** icon ▸▸ **Settings** icon and check or re-enter the customer’s settings recorded in step 1 of Removal.
3. If the instrument did not perform a Startup on Powerup cycle, or failed background, run a Startup cycle. Rerun as necessary until the backgrounds are acceptable. Depending on the condition of the instrument before the Analyzer card was replaced, this may take several attempts.
4. Select **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Voltages/Sensors** icon. Ensure all the voltages are present and all the sensors indicate their current state correctly.

ATTENTION: To avoid interference from electrical noise during the Pulse test, ensure the bath system is completely primed with diluent and the bath shield is in place.

5. Exit the Voltages/Sensors screen and select the **Pulse** icon.
   a. Use the default values.
   b. Ensure that values other than 0.0 are obtained for all four parameters.
6. Reinstall the top cover as directed in Installation (AC•T 8/10 and AC•T diff Analyzers) or the top and rear cover as directed in Installation (AC•T diff 2 Analyzer) under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
7. Verify the instrument operation by running controls or fresh blood with known values. Run the specimens several times to verify precision as well as accuracy.

4.5 DISPLAY ASSEMBLY - DISASSEMBLING/ASSEMBLING

Purpose

Use the procedure in this section to completely disassemble then reassemble the Display assembly. When replacing the entire Display assembly, only portions of this procedure are required.

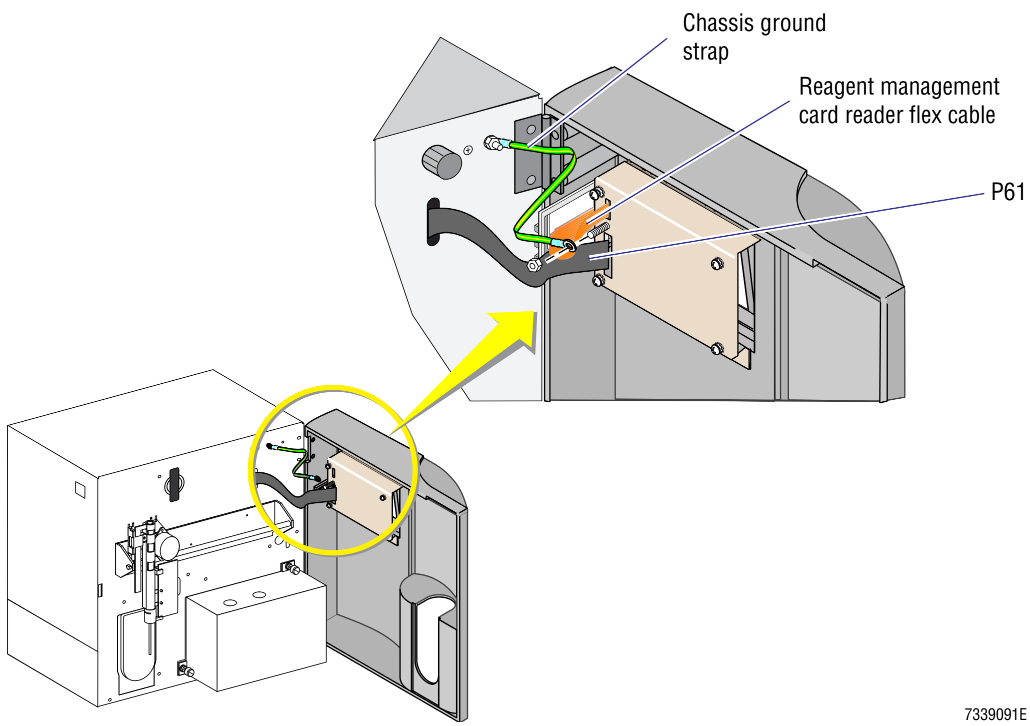
Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver
- ❑ Fine, needle-nose pliers
- ❑ Small flat-blade screwdriver (A^{C}•T diff 2 analyzer only)

Removal

1. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
2. Open the front door. To open the front door of the A^{C}•T diff 2 analyzer, see Opening the A^{C}•T diff 2 Analyzer's Front Door under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
3. At the Display assembly, disconnect P61 (Figure 4.5-1), the main display ribbon cable from the Analyzer card.
4. At the Display assembly, disconnect the reagent management card reader flex cable (Figure 4.5-1). This flex cable pulls out of connector J66, leaving the entire connector on the Display Controller Driver card.
5. Disconnect the chassis ground strap attached to the Display assembly (Figure 4.5-1) by removing a nut at either end of the chassis ground strap.

Figure 4.5-1 Disconnecting the Cables to the Display Assembly

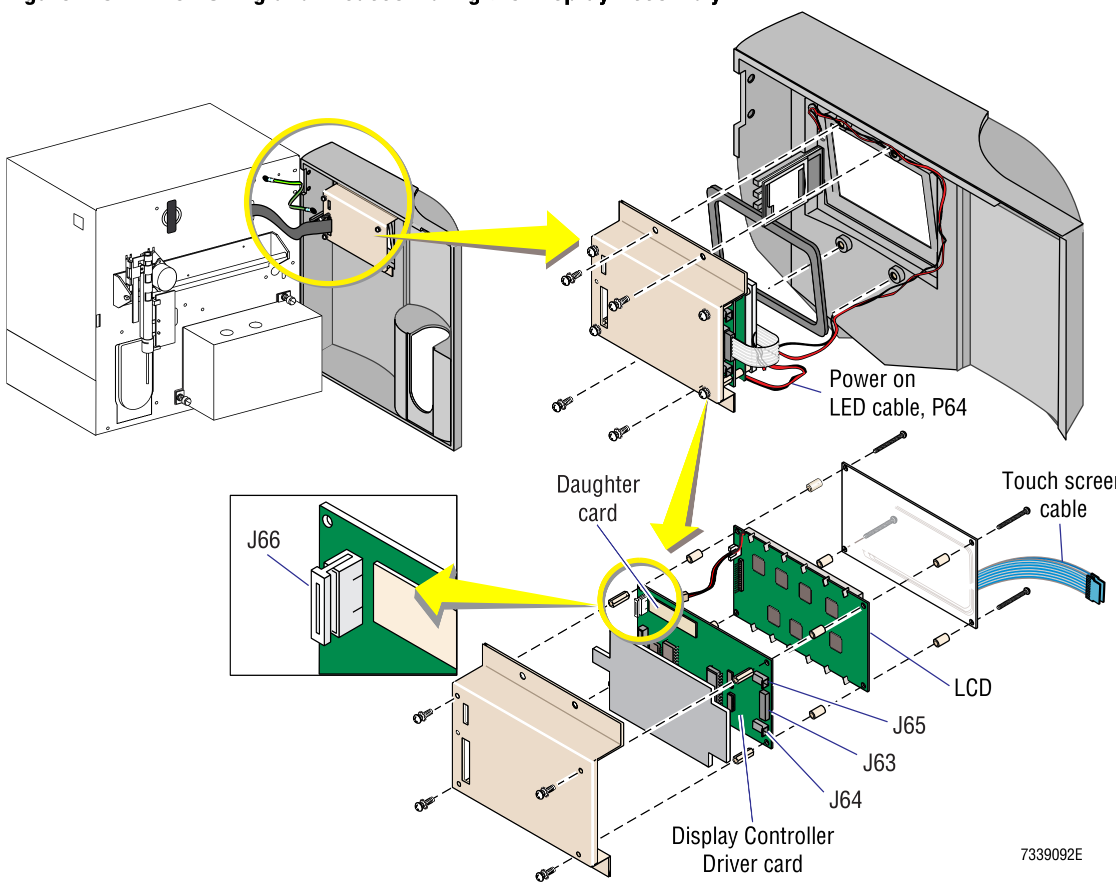


6. To remove an A^{C}•T 8/10 or A^{C}•T diff analyzers' Display assembly from the front door:
   a. Beginning with the top two screws, remove the four outer screws securing the Display assembly to the front door (Figure 4.5-2).

CAUTION On the A^{C}•T 8/10 and A^{C}•T diff analyzers, the power on LED connector, P64, is still attached. If you move the Display assembly completely away from the front door, you could damage the power on LED's connection to the Display assembly. Hold the Display assembly near the front door.

   b. When the Display assembly is free, hold it near the front door.
   c. Disconnect the power on LED connector, P64, from the Display Controller Driver card (Figure 4.5-2).

Figure 4.5-2 Removing and Disassembling the Display Assembly



7. To remove an A^{C}•T diff 2 analyzer's Display assembly from the front door:
   a. Using a small flat-blade screwdriver, remove the power on LED connector, P64, from the Display Controller Driver card.
   b. Beginning with the top two screws, remove the four outer screws securing the Display assembly to the front door (Figure 4.5-2).
8. If replacing the entire Display assembly, go to Installation to install the new assembly. Otherwise go to step 9.
9. Remove the four remaining screws attaching the shield to the rest of the Display assembly and set the shield aside (Figure 4.5-2).

10. Disassemble the Display assembly:
    a. Disconnect the two touch screen flex cables from J63 on the Display Controller Driver card (Figure 4.5-2).
    b. Disconnect the LCD high voltage cable from CN2 on the Display Controller Driver card.
    c. Remove the four Phillips-head screws holding the assembly together (Figure 4.5-2).
        - The Phillips-head screws are accessed on the touch screen side of the assembly and fastened to threaded hex posts on the Display Controller Driver card side.
        - Each screw has two spacers, one separating the touch screen and the LCD, the other separating the LCD and the Display Controller Driver card.
11. Set aside the touch screen.
12. Carefully disconnect the LCD plug from connector J62 on the Display Controller Driver card (Figure 4.5-2).
13. Carefully separate the LCD from the Display Controller Driver card (Figure 4.5-2).

Installation

1. Assemble the Display assembly (Figure 4.5-2):
    a. Plug the LCD cable into J62 on the Display Controller Driver card.
    b. Secure the four Phillips-head screws holding the assembly together.
        - The Phillips-head screws are accessed on the touch screen side of the assembly and fastened to threaded hex posts on the Display Controller Driver card side.
        - Each screw has two spacers, one separating the touch screen and the LCD, the other separating the LCD and the Display Controller Driver card.
    c. Connect the LCD high voltage cable to CN2 on the Display Controller Driver card.
    d. Connect the two touch screen flex cables to J63 on the Display Controller Driver card.
2. If the Display Controller Driver card (Figure 4.5-2) uses the original through-hole technology, ensure the jumpers on the daughter card are set as specified in Table A.2-17, Display Controller Driver Card Jumpers.

    Note: Jumpers are eliminated on the SMT version of the Display Controller Driver card.
3. Locate J66 on the Display Controller Driver card (Figure 4.5-2).

    J66, the reagent card flex cable connector, is a small white assembly made up of two parts. The base of the connector plugs into pins on the Display Controller Driver card. The upper part clips onto the base and slides out about 3 mm (0.01 in.).
4. Slide the upper part of J66 away from the base, leaving the base installed on the Display Controller Driver card. This is the position J66 must be in to accept the flex cable from the reagent management card reader. Once the shield is in place, it is difficult to slide this portion up.
5. On an A^{C}•T 8/10 or A^{C}•T diff analyzer, connect the power on LED connector, P64, to J64 on the Display Controller Driver card (Figure 4.5-2).
6. Attach the four screws installing the shield to the Display assembly. **Do not** tighten the screws.

7. Install the entire Display assembly on the front door:
   a. Position the Display assembly on the door, ensuring that the wiring for the power on LED is not trapped under the shield and is routed around the upper right corner of the Display assembly.
   b. Loosely reinstall the two lower screws.
   c. Reinstall the two upper screws.
   d. From the front of the instrument, center the display and tighten the two upper screws.

      Note: If necessary, you can center the Display assembly more when you tighten the display to the shield in step 8.
   e. Tighten the two lower screws.
8. Tighten the four screws attaching the Display assembly to the shield.
9. On an A^{C}•T diff 2 analyzer, connect the power on LED connector, P64, to J64 on the Display Controller Driver card.
10. Reattach and tighten the chassis ground strap (Figure 4.5-1).
11. Connect the reagent management card reader flex cable to J66 (Figure 4.5-2) on the Display Controller Driver card:
    a. Without pushing in the top portion of J66, insert the reagent management card reader flex cable as far as it will go into the connector slot.
    b. Using needle-nose pliers, apply even force to both ends of the connector, pushing against the top portion of J66 while keeping the reagent management card reader flex cable in place.
    c. Ensure the top portion of J66 is snug against the base of J66.
12. Reconnect P61 (Figure 4.5-1).
13. Plug the power line cord into an appropriate wall outlet.

Verification

1. Turn the instrument on (**I**). Ensure that the green power on LED lights.
2. As the instrument boots up, watch to see if the LCD backlights, and then watch the screen to see if the Beckman Coulter copyright message is displayed.
3. When the instrument status is ready, move through all the menu items, touching each one and ensuring you have full touch-screen control.
   a. Using all numerals in the Sample Results, ID entry screen, will test a large portion of screen.
   b. While using the touch screen, listen for sounds indicating that a touch screen press was received.
4. At the Sample Results screen, make sure the reagent management card reader icon is not displayed in the lower status area of the screen. If the icon is displayed, touch it to remove it. If the instrument cannot read the reagent management card, it cannot run any samples.
5. At the front of the instrument, ensure that the Display assembly is visually centered. **If it is not,** loosen the four shield screws and/or the four Display assembly screws, realign the Display assembly until it appears centered and then tighten the appropriate screws.

4.6 PNEUMATIC PUMP REPLACEMENT - A^{C}•T 8/10 AND A^{C}•T diff ANALYZERS

ATTENTION: Chapter 4 contains two procedures for replacing pneumatic pumps.

- Use this procedure to replace a pneumatic pump in an A^{C}•T 8/10 or A^{C}•T diff analyzer.
- Use the procedure under Heading 4.7, PNEUMATIC PUMP REPLACEMENT - A^{C}•T diff 2 ANALYZER, to replace a pneumatic pump in an A^{C}•T diff 2 analyzer.

Purpose

In the field, three models of pneumatic pumps are currently in use in the A^{C}•T 8/10 and A^{C}•T diff analyzers:

- The Brailsford pump, which is now obsolete. If this pump becomes defective, you can replace it with either an ASF Thomas pump or a KNF dual-head pump.
- The ASF Thomas pump.
- The KNF dual-head pump. This pump is used on new A^{C}•T 8/10 or A^{C}•T diff analyzers and as an upgrade for instruments installed at high altitudes.

  Note: The Brailsford and ASF Thomas pumps cannot build the necessary pressure to produce adequate mixing when installed at high altitudes. For instruments installed at 1524 m (5,000 ft) or above, you must upgrade the pump to a KNF dual-head pump.

  The KNF pump has two pump heads driven by the same motor. One head is used for vacuum. A muffler is connected to its output port. The other head is used for pressure. A choke is connected to its input port to decrease the air pressure at its output.

The following procedure can be used for any of these pneumatic pumps.

Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver
- ❑ Flat-blade screwdriver or needle-nose pliers
- ❑ Wire cutters

For field upgrades to a KNF dual-head pump, you will also need the following:

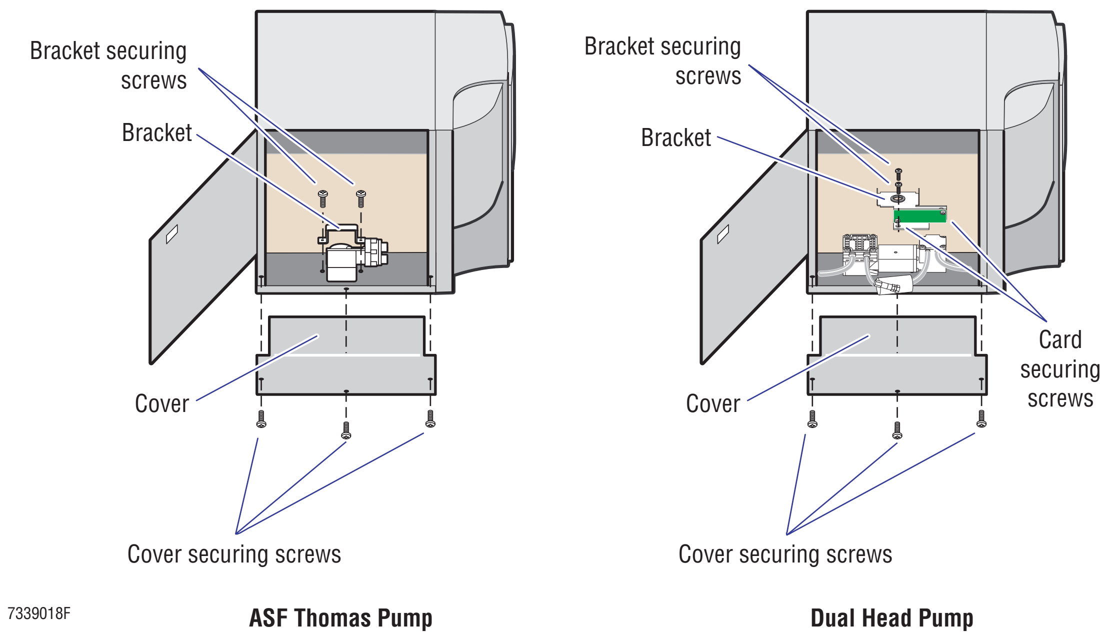
- ❑ KNF dual-head pump, PN 6233071
- ❑ Brown choke, 0.006 i.d. orifice, PN 6213009 (for applications below 1524 m [5,000 ft])
  or
  black choke, 0.010 i.d. orifice, PN 6213011 (for applications at or above 1524 m [5,000 ft])
- ❑ Union fitting, 0.125 x 10-32, PN 6232085
- ❑ O-ring seal, 0.187 i.d. x 0.050 w, PN 2523062
- ❑ 5.08 cm (2 in.) of 0.145 i.d. tubing, PN 3202039
- ❑ Pneumatic pump bracket, PN 6807690
- ❑ Grommet, PN 2830017
- ❑ Pump Motor Filter card, PN 6029207

Removal

1. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
2. Open the left side door of the analyzer and place the internal reagents on the bench.
3. Remove the three Phillips-head screws securing the pneumatic pump cover (Figure 4.6-1).

   Note: The cover forms the platform that the internal reagents are placed on.

Figure 4.6-1 Pneumatic Pump Cover and Bracket Removal AC•T 8/10 and AC•T diff Analyzers



4. If you are removing a Brailsford pump, remove the top cover of the analyzer as directed in Removing the AC•T 8/10 and AC•T diff Analyzers' Top Cover and Rear Panel under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
5. Disconnect the vacuum and pressure output tubes from the pump's fittings using a flat-blade screwdriver or needle-nose pliers.

   If the pump is a KNF dual-head pump with a choke installed on one of its ports, remove that tubing/choke assembly also and set it aside.
6. If the pump is a KNF dual-head pump, remove the two Phillips-head screws securing the Pump Motor Filter card to the pump's bracket (Figure 4.6-2), and set the card aside.
7. Disconnect the pump's electrical connector.
   - If the pump is a Brailsford pump, disconnect its cable from LV3 on the Analyzer card.

     For the location of the connector, refer to Figure A.2-1, Analyzer Card Component Locations - AC•T 8/10 Analyzers, Figure A.2-2, Analyzer Card Component Locations - AC•T diff Analyzer, or Figure A.2-4, Universal AC•T diff/AC•T diff 2 Analyzer Card Component Locations.

- If the pump is an ASF Thomas pump, disconnect the spade lugs from the spade terminals on the pump.
- If the pump is a KNF dual-head pump, disconnect its cable from the cable on the Pump Motor Filter card.

8. Remove the two Phillips-head screws holding the pneumatic pump's bracket in place (Figure 4.6-1).

   Note: If you are replacing a KNF dual-head pump that was installed as a field upgrade, only one Phillips-head screw is securing the bracket.

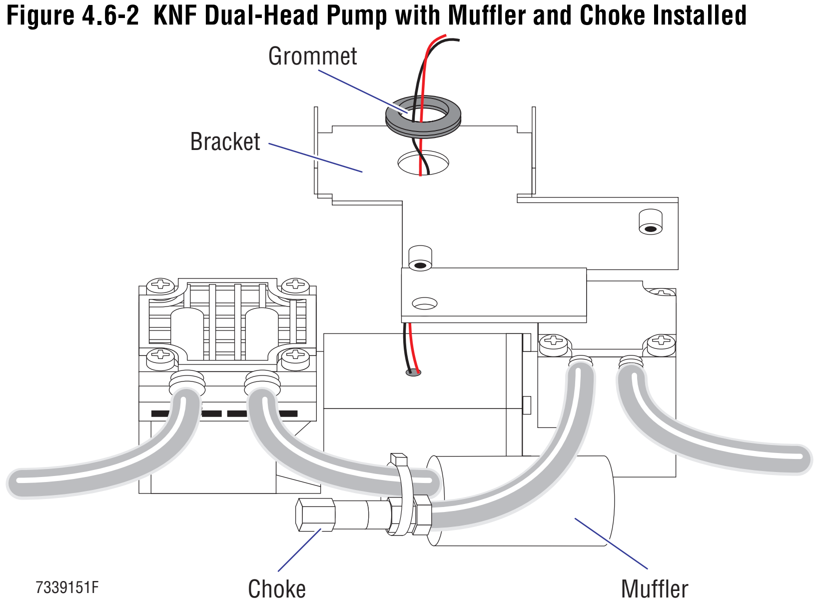
9. Remove the pump from the instrument.

Installation

IMPORTANT Using the incorrect choke will result in improper mixing of the dilutions in the bath. Be sure to use the black (0.010 i.d. orifice) choke for altitudes of 1524 m (5,000 ft) and above, the brown (0.006 i.d. orifice) choke for lower altitudes.

1. If you are installing a KNF dual-head pump, attach a tubing/choke assembly to the IN (∧) port on the pump's pressure head. See Figure 4.6-2.
   a. If a tubing/choke assembly is available from the old pump:
      1) Remove the assembly from the old pump.
      2) Replace the choke in the assembly with a new choke.
      3) Install the tubing/choke assembly on the new pump.
   b. If a tubing/choke assembly is not available:
      1) Place an O-ring over the threaded end of the barb fitting and screw the fitting onto the appropriate choke.
      2) Attach a 5.08 cm (2 in.) piece of the 0.145 i.d. polyurethane tubing to the barb end of the fitting.
      3) Attach the other end of the tubing to the new pump.

Figure 4.6-2 KNF Dual-Head Pump with Muffler and Choke Installed



2. Secure the pneumatic pump to the instrument:
   a. Place the pump in position.
   b. If you are replacing a single-head pump with a KNF dual-head pump, install a grommet in the cable outlet on the top of the new pump's bracket. See Figure 4.6-2.

   ATTENTION: When installing the pump bracket on a KNF dual-head pump, ensure the mounts for the circuit card face outward, toward you.

   c. Secure the pump with its bracket, fastening the bracket with one (for field upgrades) or two Phillips-head screws. See Figure 4.6-1.

      Note: On instruments that are upgraded to a KNF dual-head pump in the field, you can only secure the front of the pump's bracket.
   d. If you are replacing a single-head pump with a KNF dual-head pump, remove and discard the unused spacer for the pump's bracket.
3. If you are installing a KNF dual-head pump, secure the Pump Motor Filter card to the pump's bracket with Phillips-head screws. See Figure 4.6-1.
4. Connect the pump's tubing:
   - The tubing that adapts to the smaller green-stripe tubing is the vacuum line. Connect it to the IN port on the vacuum head.
   - The larger tubing is the pressure tubing. Connect it to the exhaust port on the ASF Thomas pump or the OUT port on the pressure head of the KNF dual-head pump.
5. Connect the pump's electrical connector:
   - If the pump is a KNF dual-head pump, connect the pump's cable to the cable on the Pump Motor Filter card.

   ATTENTION: Polarity is important! When connecting the ASF Thomas pump wires, ensure the red-wire is attached to the (+) terminal.

   - If the pump is an ASF Thomas pump, push the spade lugs onto the spade terminals on the pump, ensuring the red, positive wire is connected to the (+) terminal.
6. On a KNF dual-head pump, bind the choke and muffler lines together with a wire tie.

   Note: Restricting the position of the choke prevents it from being obstructed by the foam on the underside of the pump's cover.
7. **If you have reason to question pump operation**, perform pneumatic pump Verification (next heading) before installing the pump cover.
8. Reinstall the pneumatic pump cover using three Phillips-head screws (Figure 4.6-1).
9. Place the internal reagents back in the reagent compartment and close the left side door.
10. If you removed the top cover over of the analyzer, re-install it.

Verification

1. Plug the power line cord into an appropriate wall outlet.
2. Turn the instrument on (**I**). Listen for the pneumatic pump to turn on during powerup.
3. Press **Main** icon ►► **Diagnostics** icon ►► **Voltages/Sensors** icon. Verify that the pneumatic pump has turned on. If necessary, adjust the low vacuum reading to 6.00.
4. **If you have not done so**, install the pneumatic pump cover and close up the instrument.

4.7 PNEUMATIC PUMP REPLACEMENT - AC•T diff 2 ANALYZER

ATTENTION: Chapter 4 contains two procedures for replacing pneumatic pumps.

- Use these procedures to replace a pneumatic pump in an AC•T diff 2 analyzer.
- Use the procedure under Heading 4.6, PNEUMATIC PUMP REPLACEMENT - AC•T 8/10 AND AC•T diff ANALYZERS, to replace a pneumatic pump in an AC•T 8/10 or AC•T diff analyzer.

Purpose

In the field, two models of pneumatic pumps are currently in use in the AC•T diff 2 analyzers.

- The ASF Thomas pump is used in the original AC•T diff 2 analyzers.
- The KNF dual-head pump is used in the new AC•T diff 2 analyzers.

  Note: The KNF pump has two pump heads driven by the same motor. One head is used for vacuum. A muffler is connected to its output port. The other head is used for pressure. A choke is connected to its input port to decrease the air pressure at its output.

This section contains three procedures.

- Use the ASF Thomas Pump Replacement procedure to replace an ASF Thomas pump with another ASF Thomas pump
- Use the KNF Dual-Head Pump Replacement procedure to replace a KNF dual-head pump with another KNF dual-head pump.
- Use the Pneumatic Pump Upgrade to KNF Dual-Head Pump procedure to upgrade an ASF Thomas pump to a KNF dual-head pump.

  Note: The pneumatic pump compartment for the KNF dual-head pump is larger than the pneumatic pump compartment for the ASF Thomas pump, so the entire compartment is replaced in an upgrade.

ASF Thomas Pump Replacement

Tools/Supplies Needed

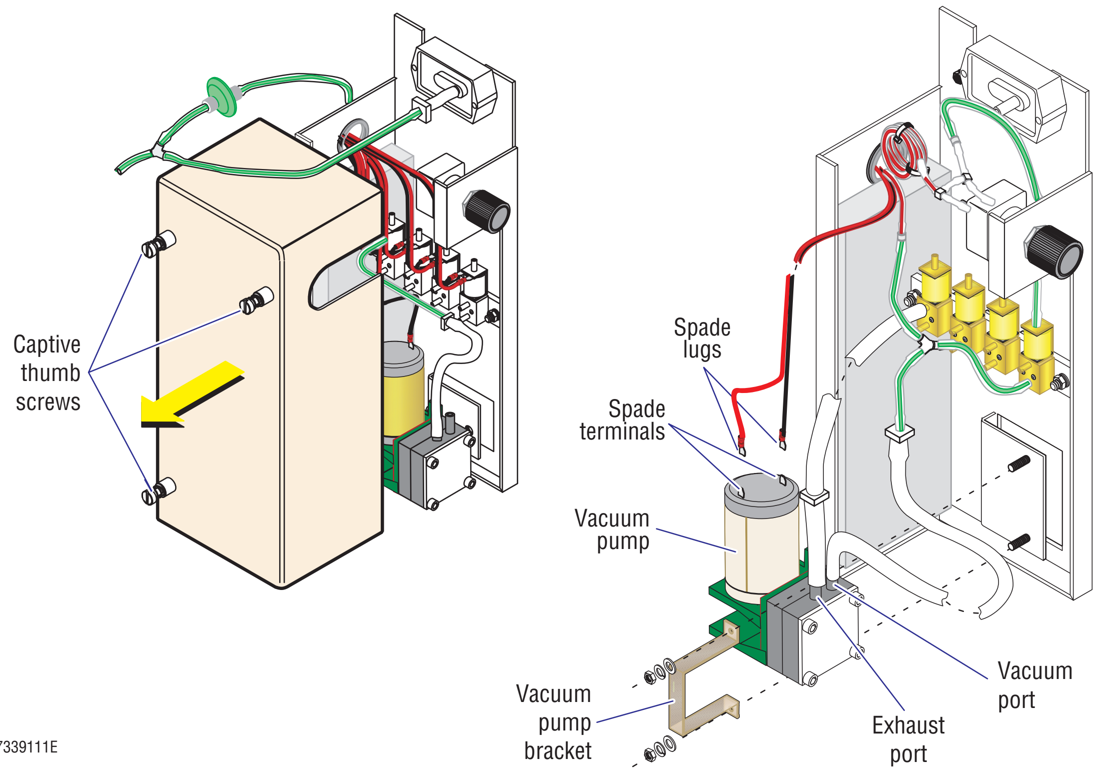
- ❑ Flat-blade screwdriver or needle-nose pliers
- ❑ ¼ in. hex nut driver

Removal

1. Turn the instrument off (**0**) and unplug the power line cord from the wall outlet.
2. Open the right-side instrument door.
3. Unfasten the three captive thumb screws securing the pneumatic pump cover and remove the cover. See Figure 4.7-1.
4. Disconnect the vacuum and pressure output tubes from the pump's fittings using a flat-blade screwdriver or needle-nose pliers.
5. Disconnect the spade lugs from the spade terminals on the pump. See Figure 4.7-1.

6. Remove the two hex nuts holding the pump's bracket in place and remove the bracket. See Figure 4.7-1.
7. Remove the pump from the instrument.

Figure 4.7-1 ASF Thomas Pneumatic Pump Replacement - AC•T diff 2 Analyzer



Installation

1. Connect the pump's tubing:
   - The tubing that adapts to the smaller green-stripe tubing is the vacuum line. Connect it to the IN (∨) port on the vacuum head.
   - The larger tubing is the pressure tubing. Connect it to the exhaust (∧) port on the ASF Thomas pump. Refer to Figure 4.7-1.
2. Secure the pneumatic pump to the instrument:
   a. Place the pump in position.
   b. Secure the pump with its bracket, fastening the bracket to the two captive studs with hex nuts.

ATTENTION: Polarity is important! When connecting the ASF Thomas pump wires, ensure the red-wire is attached to the (+) terminal.

3. Push the spade lugs onto the spade terminals on the pump, ensuring the red, positive wire is connected to the (+) terminal.
4. **If you have reason to question pump operation**, perform pneumatic pump Verification (at the end of this section) before installing the pump cover.
5. Reinstall the pneumatic pump cover, being careful not to pinch any tubing.
6. Go to Verification.

KNF Dual-Head Pump Replacement

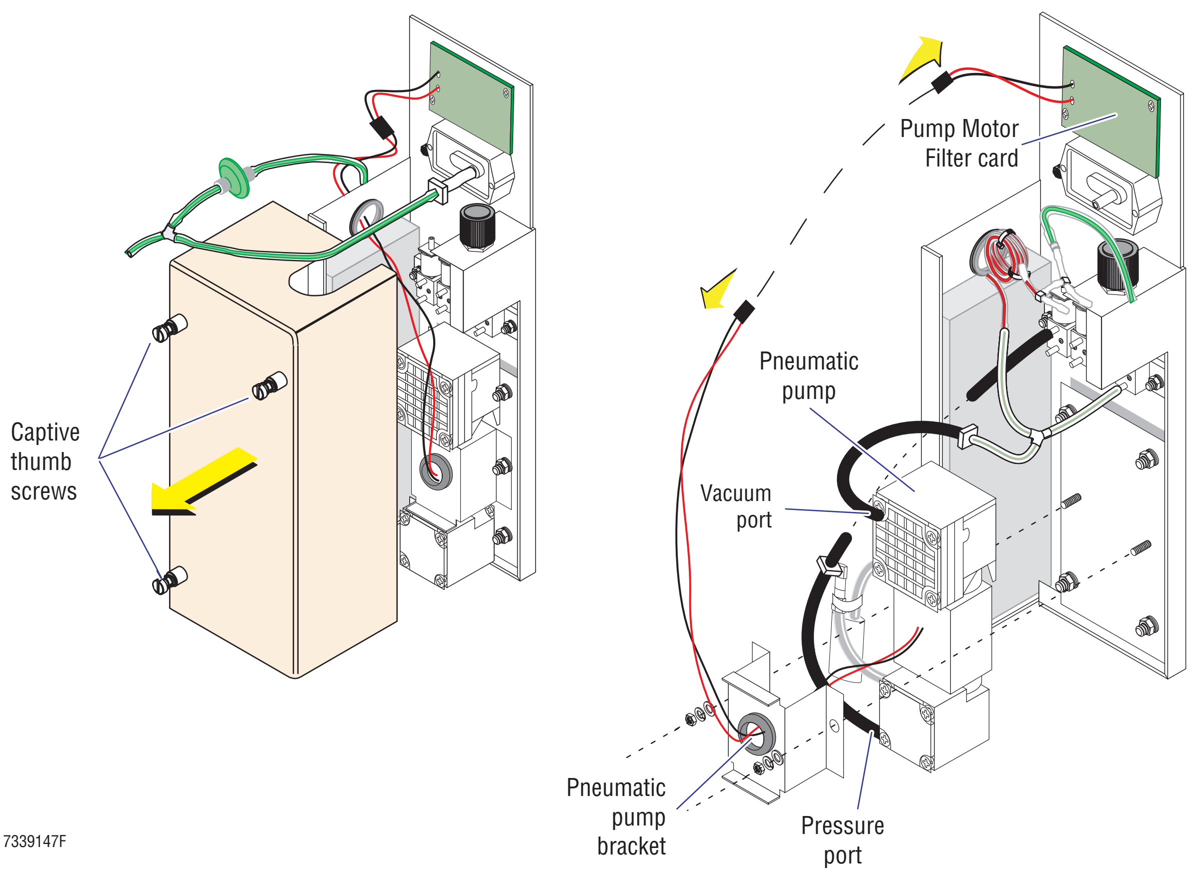
Tools/Supplies Needed

- ❑ Flat-blade screwdriver or needle-nose pliers
- ❑ 3/8 in. hex nut driver
- ❑ Wire cutters

Removal

1. Turn the instrument off (**0**) and unplug the power line cord from the wall outlet.
2. Open the right-side instrument door.
3. Unfasten the three captive thumb screws securing the pneumatic pump cover and remove the cover. See Figure 4.7-2.
4. Disconnect the vacuum and pressure output tubes (Figure 4.7-2) from the pump's fittings using a flat-blade screwdriver or needle-nose pliers.
5. Disconnect the pump's cable from the cable to the Pump Motor Filter card. See Figure 4.7-2.
6. Remove the two hex nuts holding the pump's bracket in place. See Figure 4.7-2.
7. Remove the pump and bracket from the instrument.
8. Remove the bracket from the pump.

Figure 4.7-2 KNF Dual-Head Pneumatic Pump Replacement - AC•T diff 2 Analyzer

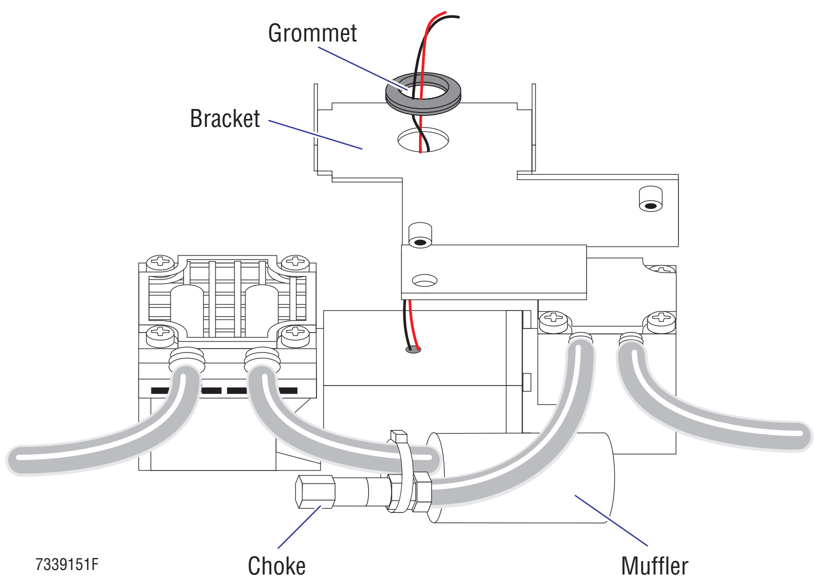


Installation

1. Place the pump bracket on the new pump.
2. Install a tubing/choke assembly on the new pump. See Figure 4.7-3.
   a. Remove the tubing/choke assembly from the defective pump.
   b. Replace the choke in the assembly with a new choke.
   c. Attach the tubing/choke assembly to the IN (∧) port on the pump's pressure head.
   d. Bind the choke and muffler lines together with a tie wrap.

   Note: Restricting the position of the choke prevents it from being obstructed by the foam on the underside of the pump's cover.

Figure 4.7-3 KNF Dual-Head Pump with Muffler and Choke Installed



3. Connect the pump's tubing:
   - The tubing that adapts to the smaller green-stripe tubing is the vacuum line. Connect it to the IN (∧) port on the vacuum head.
   - The larger tubing is the pressure tubing. Connect it to the OUT (∨) port on the pressure head. Refer to Figure 4.7-2.
4. Secure the pneumatic pump to the instrument:
   a. Place the pump in position.
   b. Secure the pump with its bracket, fastening the bracket to the two captive studs with hex nuts.
5. Connect the pump's cable to the cable on the Pump Motor Filter card.
6. **If you have reason to question pump operation**, perform pneumatic pump Verification (at the end of this section) before installing the pump cover.
7. Reinstall the pneumatic pump cover, being careful not to pinch any tubing.
8. Go to Verification.

Pneumatic Pump Upgrade to KNF Dual-Head Pump

Tools/Supplies Needed

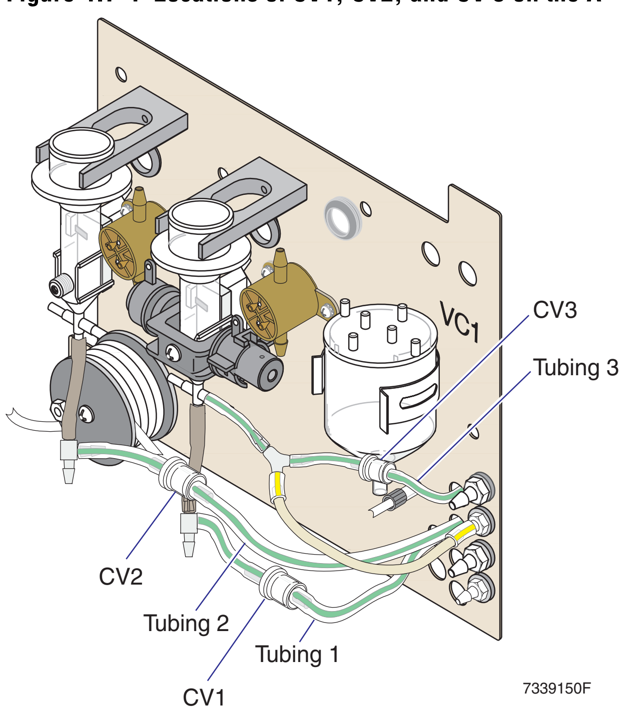
- ❑ Wire cutters
- ❑ Phillips-head screwdriver
- ❑ Flat-blade screwdriver or needle-nose pliers
- ❑ KNF Dual-Head Pump module, PN 6807707
- ❑ Wire tie mount, 0.75 l x 0.75 w, adhesive back, PN 6011015
- ❑ Wire tie, releasable, 4.0 l x 10 w, PN 6028917

Removal of Old Pneumatic Pump Compartment

1. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
2. To access the Analyzer card, remove the top cover of the analyzer as directed in Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
3. Disconnect S10A, LV2, LV3, LV4 and LV5 from the Analyzer card. Free up their associated cables and let them hang loose. You will remove them with the pneumatic pump compartment.

   For the locations of the connectors, refer to Figure A.2-3, Analyzer Card Component Locations - AC•T diff 2 Analyzer, or Figure A.2-4, Universal AC•T diff/AC•T diff 2 Analyzer Card Component Locations.
4. Open the front door of the analyzer and remove the baths' electrical shield.
5. Disconnect the tubings labeled 1, 2, and 3, from the check valves connected to the bottoms of the baths. See Figure 4.7-4.

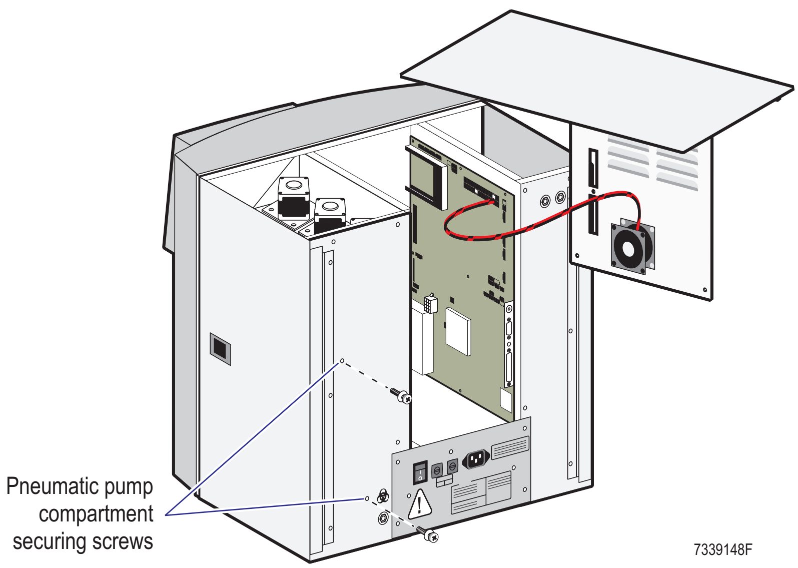
Figure 4.7-4 Locations of CV1, CV2, and CV 3 on the AC•T diff 2 Analyzer



6. Open the left side instrument door.
7. Free up the three tubings disconnected from the front of the instrument in step 5 and let them hang loose. You will remove them with the pneumatic pump compartment.
8. Disconnect the tubing from the vacuum transducer, using a flat-blade screwdriver or needle-nose pliers.
9. Locate the tubing from the pneumatic pump compartment to the fluid barrier and disconnect the female Luer lock from the fluid barrier.
10. If two diluent filters are attached to the pneumatic pump cover, cut the wire tie securing the filters to the cover, and set the filter assembly aside.

    Note: The pair of diluent filters are installed as an assembly and attached to the pneumatic pump cover. This assembly will be reattached to the new pneumatic pump cover, so it is not necessary to disconnect the filters from the Luer locks.
11. From the rear of the instrument, remove the two Phillips-head screws that secure the pneumatic pump compartment. See Figure 4.7-5. Set the screws aside.

Figure 4.7-5 Pneumatic Compartment Securing Screws



12. Remove the pneumatic pump compartment from the instrument.

Installation of New Pneumatic Pump Compartment

1. Place the new pneumatic pump compartment inside the instrument's right compartment and secure it with the two Phillips head screws removed in step 11 of the removal procedure.
2. Route the cables from the new pneumatic pump compartment into the Analyzer card's compartment, and connect them to S10A, LV2, LV3, LV4 and LV5 on the Analyzer card.

   For the locations of the connectors, refer to Figure A.2-3, Analyzer Card Component Locations - AC•T diff 2 Analyzer, or Figure A.2-4, Universal AC•T diff/AC•T diff 2 Analyzer Card Component Locations.
3. Route the tubings labeled 1, 2, and 3 to the aperture baths area and connect them to CV1, CV2, and CV3, respectively, as shown in Figure 4.7-4.

4. Connect the tubing with the female Luer lock to the fluid barrier.
5. Connect the tubing removed from the old vacuum transducer to the new transducer.
6. If the analyzer has diluent filters installed, secure the filter assembly to the pneumatic pump cover using a wire tie mount and wire tie.
7. Go to Verification.

Verification

1. Plug the power line cord into an appropriate wall outlet.
2. Turn the instrument on (**I**). Listen for the vacuum pump to turn on during powerup.
3. Press **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Voltages/Sensors** icon. Verify that the pneumatic pump has turned on. If necessary, adjust the low vacuum reading to 6.00.
4. Cycle a blank and ensure the probe wash is functioning correctly with no dripping.
5. Verify the instrument is set correctly for the altitude. Refer to the procedure, Entering Your Elevation, in Chapter 1 of the Installation and Training Guide.
6. **If you have not done so**, install the pneumatic pump cover and close up the instrument.

4.8 TRAVERSE MODULE DISASSEMBLY/REPLACEMENT - AC•T 8/10 AND AC•T diff ANALYZERS

Purpose

Use the procedure in this section to completely disassemble/reassemble the Traverse module in an AC•T 8/10 or AC•T diff analyzer. Replacing individual parts on the Traverse module requires only portions of the procedure.

Use the TRAVERSE MODULE DISASSEMBLY/REPLACEMENT - AC•T diff 2 ANALYZER procedure under Heading 4.9 to disassemble and reassemble the Traverse module in an AC•T diff 2 analyzer.

Tools/Supplies Needed

- ❑ #1 Phillips-head screwdriver
- ❑ #2 Phillips-head screwdriver
- ❑ Large, flat-blade screwdriver
- ❑ DOW CORNING 33® lubricant, PN 1604007-0

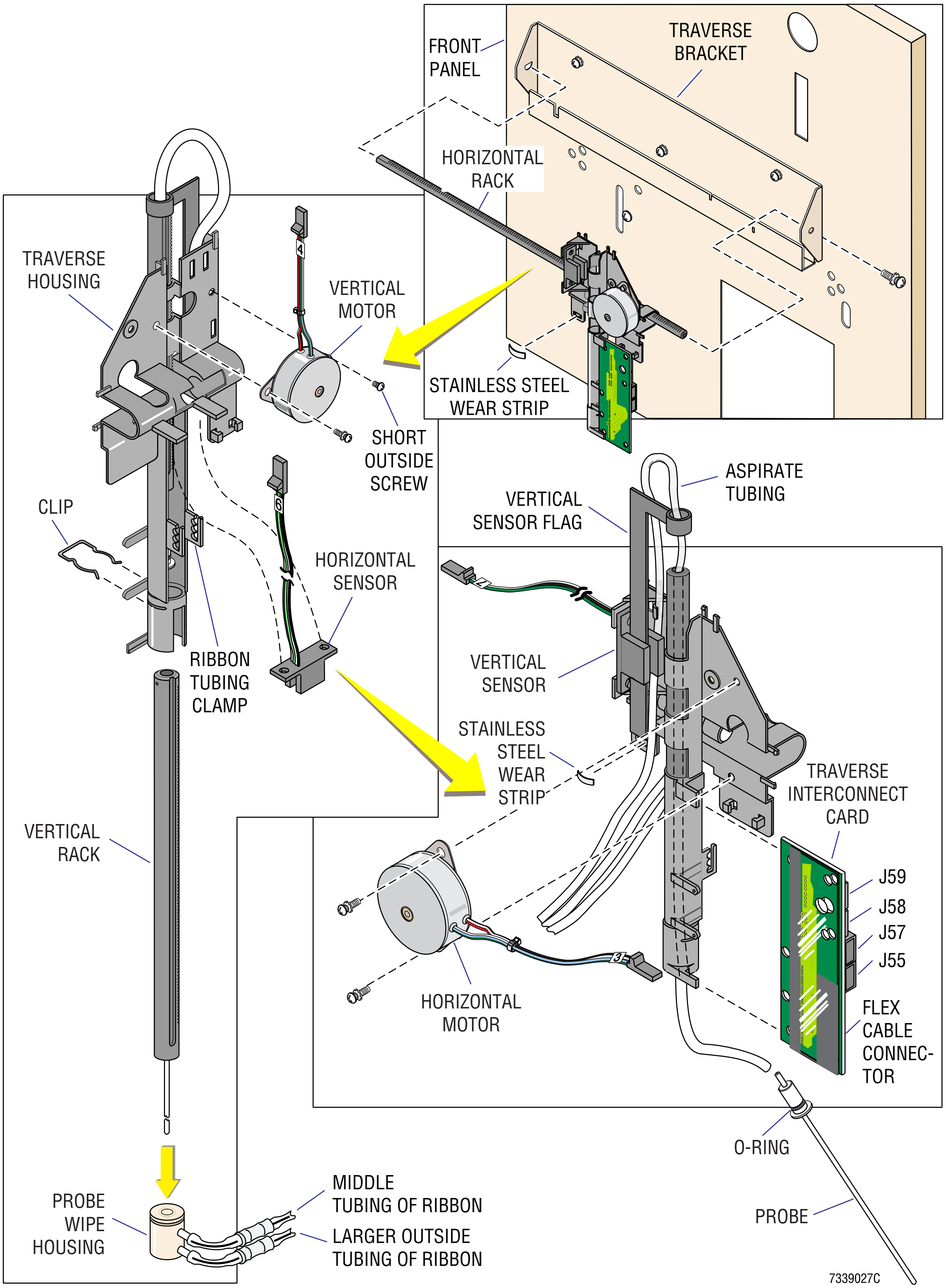
Removal

1. Turn the instrument off (**0**) and unplug the power line cord from the wall outlet.
2. Remove the probe-wipe housing (Figure 4.8-1):
   a. Manually remove the metal clip.
   b. Pull the probe-wipe housing out the bottom of the traverse housing.
   c. Remove the tubing from the probe-wipe housing.
3. Remove the aspirate probe from the traverse housing (see Figure 4.8-1):
   a. Manually move the probe and vertical rack until the bottom of the rack (where the probe is press fit into the vertical rack) is visible through the traverse housing window.
   b. Pry the probe out of the rack using a large, flat-blade screwdriver.
   c. Pull the probe out of the bottom of the traverse housing.
   d. Remove the aspirate tubing from its top fitting.

ATTENTION: Perform the next step **only if the entire Traverse module is to be replaced**.

4. Disconnect the traverse flex cable from the Traverse Interconnect card.
5. Remove the Traverse module from the instrument as a unit, by removing three Phillips-head screws attaching the traverse bracket to the front panel (Figure 4.8-1).
6. Remove the horizontal rack and the traverse housing (Figure 4.8-1):
   a. Unscrew one (the only) Phillips-head screw on the right end of the horizontal rack.
   b. When free, slide the rack right until the left end disengages from the traverse bracket.
   c. Remove the horizontal rack from the traverse bracket.
   d. Remove the traverse housing from the horizontal rack.

Figure 4.8-1 Traverse Module Disassembling/Replacement



7. Disconnect the motor and sensor cables from the Traverse Interconnect card (Figure 4.8-1):
   a. P58 (vertical sensor plug) wiring is routed across the top of the housing and plugs into J58, the second connector from the top.
   b. P59 (horizontal sensor plug) wiring is routed up, then across and down with the other wiring, and plugs into J58, the top connector on the Traverse Interconnect card.
8. Remove the Traverse Interconnect card. It is press fit into the housing and does not use any fasteners (Figure 4.8-1).
9. Remove the horizontal and vertical motors and sensors (Figure 4.8-1):
   - The motors are fastened to the housing with two Phillips-head screws each.
   - The sensors are snap fit onto the traverse housing and can be pulled off by hand.
10. Remove the vertical sensor from the top of the vertical rack. It snaps onto the vertical rack without fasteners (Figure 4.8-1).
11. Remove the vertical rack by sliding it out the bottom of the traverse housing (Figure 4.8-1).

Installation

1. Install the vertical rack into the traverse housing (Figure 4.8-1):
   - The vertical rack slides in from the bottom of the traverse housing.
   - A guide slot in the vertical rack is positioned at the back.
   - The slotted end of the vertical rack (flush to end of rack) is positioned up.
   - The gear teeth are to the left.
2. Attach the vertical sensor flag (Figure 4.8-1). It snaps onto the top of the vertical rack and is positioned in the vertical sensor.
3. Install the vertical and horizontal dual-channel position sensors by snapping them into place on the traverse housing.

ATTENTION: Although the vertical motor is fastened with two Phillips-head screws, it requires that you use one shorter screw in the outer position. This is necessary because a longer screw in the outer position would interfere with the vertical sensor.

4. Secure the vertical and horizontal motors with two Phillips-head screws each (Figure 4.8-1).
5. Install the Traverse Interconnect card. This card is press fit onto the traverse housing using two inner fingers on the back of the card and two outer fingers on the component side of the card (Figure 4.8-1).
6. Connect the vertical and horizontal sensors to the Traverse Interconnect card (Figure 4.8-1):
   a. P58 (vertical sensor plug) wiring routes across the top of the housing and plugs into J58, the second connector from the top.
   b. P59 (horizontal sensor plug) wiring routes up, then across and down with the other wiring, and plugs into J58, the top connector on the Traverse Interconnect card.

ATTENTION: Dress the sensor and motor wires as efficiently as possible and tie wrap them together. These wires move with the traverse housing. Loose wires eventually snag and cause fatal, probe-position errors.

7. Connect the traverse (vertical and horizontal) motors (Figure 4.8-1)
   - Vertical and horizontal connector plugs are P55 and P57 respectively.
   - Wires are routed with vertical sensor wire.
8. Engage the horizontal rack (Figure 4.8-1).
   - The rack teeth are facing up.
   - The right end is threaded.
9. Install the traverse housing onto the traverse bracket (Figure 4.8-1):
   a. Ensure that the two stainless steel wear strips are properly in place in the traverse housing.
   b. From inside, slide the left end of the horizontal rack through the left end of the traverse bracket.
   c. Line up the bottom travel guides.
   d. Lower the traverse housing onto the front guide edge of the traverse bracket just until the Phillips-head screw can be fastened to the right end of the horizontal rack.
10. Install the aspirate tubing (Figure 4.8-1):
    a. Guide the smaller aspirate tubing behind the vertical sensor.
    b. Using a small-blade screwdriver, push the aspirate tubing into the molded tubing clamp just above the vertical sensor. There should be 24 cm (9.5 in.) of tubing protruding above the clamp.
    c. Feed the tubing into the top of the rack and through to the bottom of the traverse housing.
11. Install the aspirate probe (Figure 4.8-1):
    a. Apply a small amount of silicon lubricant onto the probe mounting O-ring.
    b. Attach the probe to the aspirate tubing.
    c. Push the probe up until it pushes the vertical rack up. Holding the vertical rack with one hand and the probe with the other hand, push the probe into the vertical rack.
12. Install the probe-wipe housing (Figure 4.8-1):
    a. Slide the probe-wipe housing onto the bottom of the probe with the slotted end up and the fitting at the back.
    b. Move the probe-wipe housing and the probe, up into the traverse housing.
    c. At the front, fasten the probe-wipe housing in place using the wire clip.
13. Attach the probe-wipe tubing (Figure 4.8-1):
    - The middle tube in the tubing ribbon connects to the top fitting.
    - The larger outside (non-aspirate) tubing connects to the bottom fitting.
14. Place the tubing ribbon into its retaining clamp at the back of the traverse housing. The tubing ribbon runs along the front panel from the right, runs behind the traverse housing, and then loops back to the traverse housing. Slide it down into its retaining clamp near the split of the three tubings.

Verification

1. Manually move the probe up and down, ensuring that it moves smoothly without binding and that nothing interferes with its travel.
2. Manually move the horizontal rack to the WBC bath position and back. Ensuring that the horizontal rack moves smoothly without binding by confirming that:
   - The motor and sensor wires do not snag on anything.
   - The flex cable flows and bends without difficulty.
   - The ribbon tubing has enough play in it for travel to each end of horizontal movement. **If necessary**, adjust the traverse and front-panel tubing clamps.
3. Plug the power line cord into an appropriate wall outlet.
4. Turn the instrument on (**I**). **If the instrument does not perform a startup producing background results**, initiate a startup.
5. If no probe position errors are encountered during startup, the instrument is ready to be used.

4.9 TRAVERSE MODULE DISASSEMBLY/REPLACEMENT - AC•T diff 2 ANALYZER

Purpose

Use the procedures in this section to remove and replace the entire Traverse module in an AC•T diff 2 analyzer, or to disassemble or replace specific components. Always begin by doing the Preliminary Steps.

Use the TRAVERSE MODULE DISASSEMBLY/REPLACEMENT - AC•T 8/10 AND AC•T diff ANALYZERS procedure under Heading 4.8 to disassemble and reassemble the Traverse module in an AC•T 8/10 or AC•T diff analyzer.

Tools/Supplies Needed

- ❑ #1 Phillips-head screwdriver
- ❑ #2 Phillips-head screwdriver
- ❑ Large, flat-blade screwdriver
- ❑ Controls or a specimen with known results (for Verification)

Preliminary Steps

1. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
2. Open the front door. See Opening the AC•T diff 2 Analyzer's Front Door under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
3. If removing the Traverse module, the horizontal motor, or a horizontal sensor, remove the top cover and rear panel to access the connections on the Analyzer card. Refer to Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover under Heading 4.2.
4. To remove the entire Traverse module, go to Traverse Module Removal.
5. To remove the probe, or to access the vertical rack, go to Probe Removal.

   Note: You must remove the probe and the Traverse Interconnect card before you can remove the vertical rack.
6. To remove the horizontal drive belt, or to access the traverse housing or the vertical motor, go to Horizontal Drive Belt Removal.

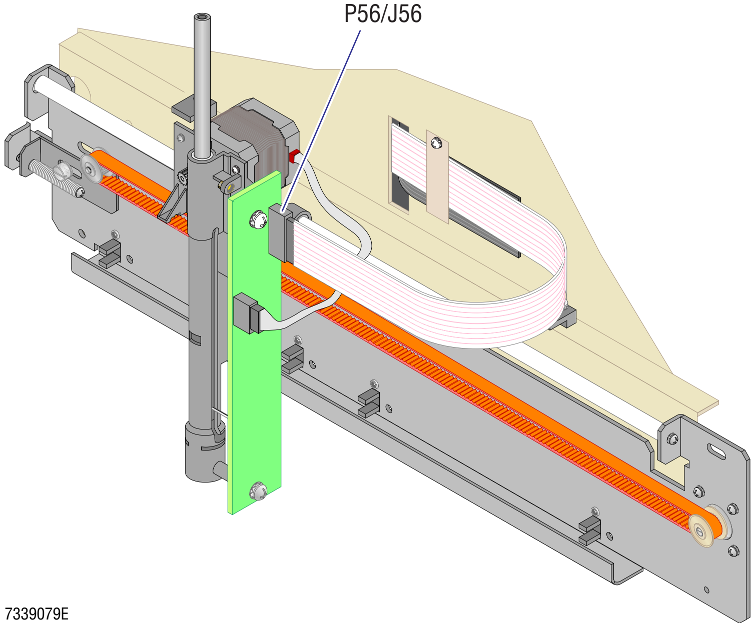
   Note: You must remove the horizontal drive belt before you can remove the traverse housing. You must remove either the traverse housing or the entire Traverse module to make room for removing the vertical motor.
7. To remove the Traverse Interconnect card, go to Traverse Interconnect Card Removal.
8. To remove the horizontal motor, go to Horizontal Motor Removal.
9. To remove a horizontal sensor, go to Horizontal Sensor Removal.

Disassembly and Removal Procedures

Traverse Module Removal

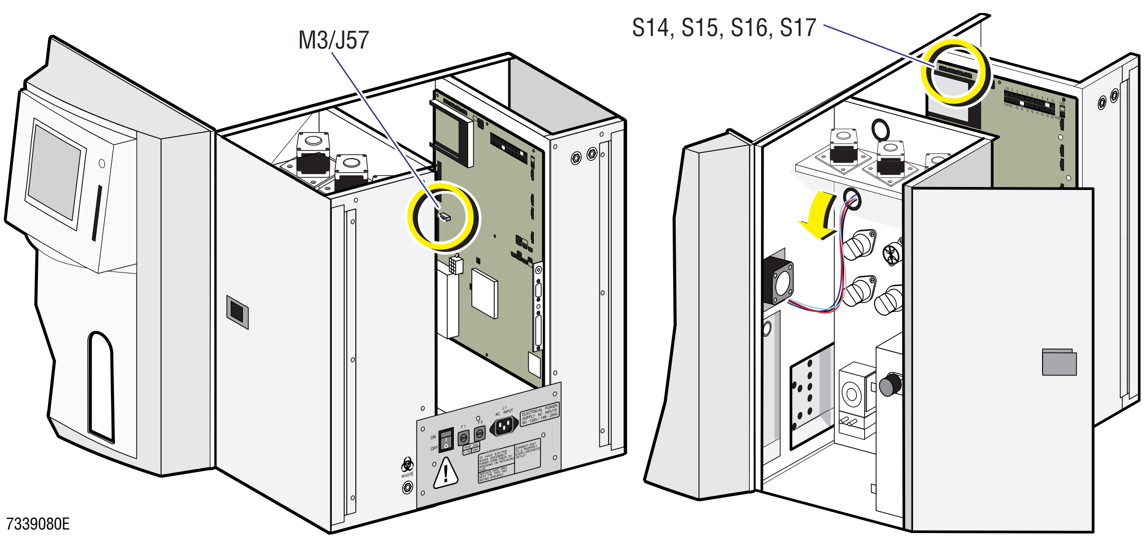
1. Disconnect the Traverse module flex cable, P56, from J56 on the Traverse Interconnect card.

Figure 4.9-1 Disconnecting the Traverse Module Flex Cable



2. Disconnect the horizontal motor cable from M3/J57 on the center front of the Analyzer card and pull the cable through the right bulkhead into the right side compartment (Figure 4.9-2).

Figure 4.9-2 Disconnecting the Horizontal Motor Cable

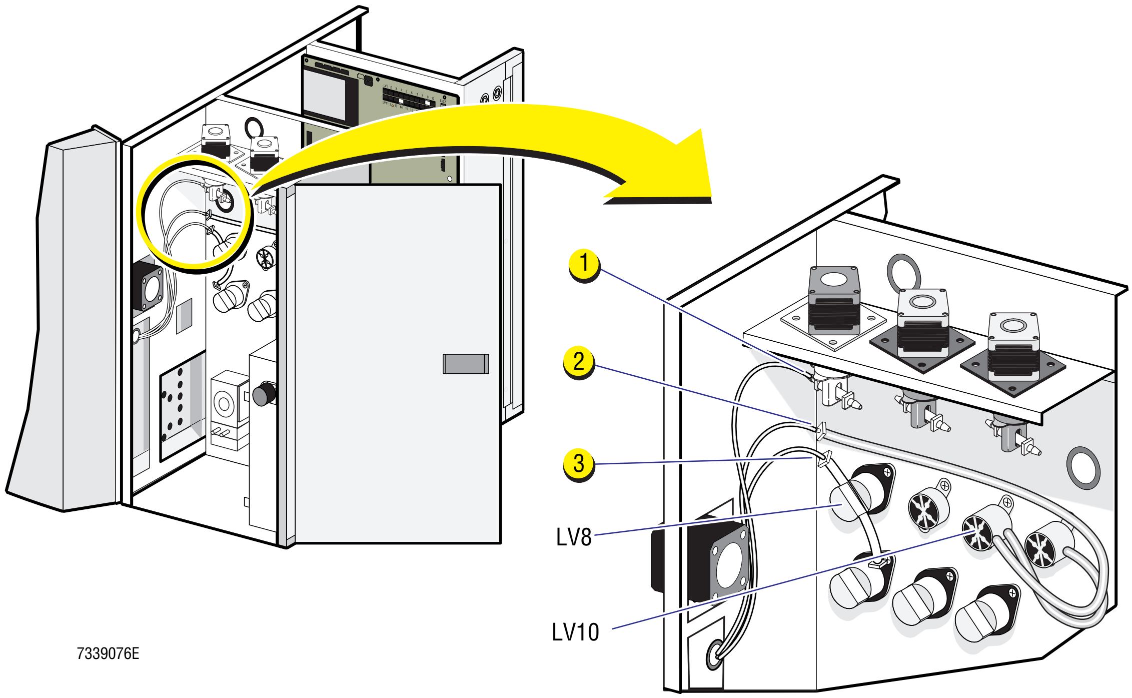


3. Disconnect the four horizontal sensors from connectors S14, S15, S16, and S17 on the top front of the Analyzer card (Figure 4.9-2) and free the wires from the wire harness and cable clamps.
4. In the right side compartment, disconnect the tubing attaching the Traverse module to the instrument.
   a. Disconnect the stiff aspirate tubing from the fitting on the front of the 50 µL sample pump. See Figure 4.9-3, 1.

b. Disconnect the probe-wipe housing top-port tubing from the adapter union fitting between the probe-wipe tubing and the larger tubing in LV10. See Figure 4.9-3, 2.

c. Disconnect the probe-wipe housing bottom-port tubing from the adapter union fitting between the probe-wipe ribbon tubing and the pinch tubing in LV8. See Figure 4.9-3 3.

Figure 4.9-3 Disconnecting the Traverse Module Tubing



5. Remove the six #2 Phillips-head screws securing the Traverse module's main bracket to the instrument front panel (Figure 4.9-4) and remove the module.

Figure 4.9-4 Removing the Traverse Module

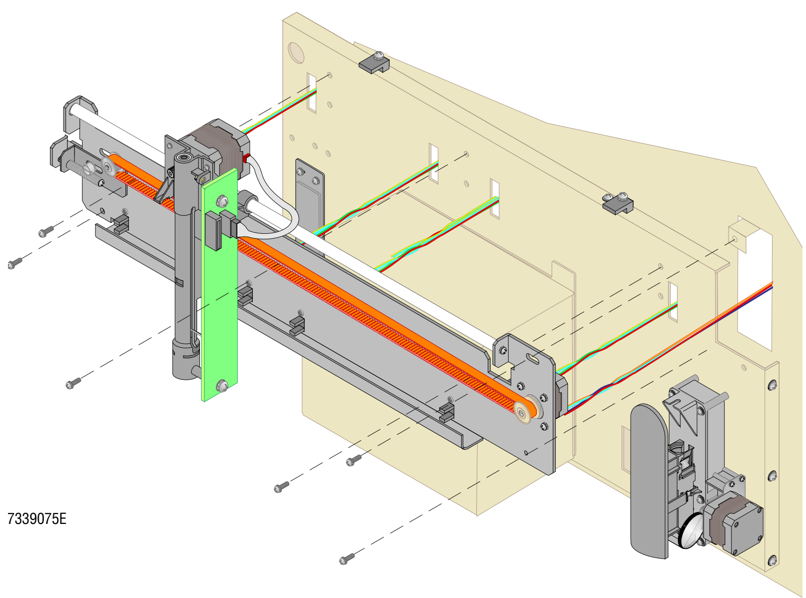


Figure 4.9-5 Removing the Probe-Wipe Housing from the Traverse Housing

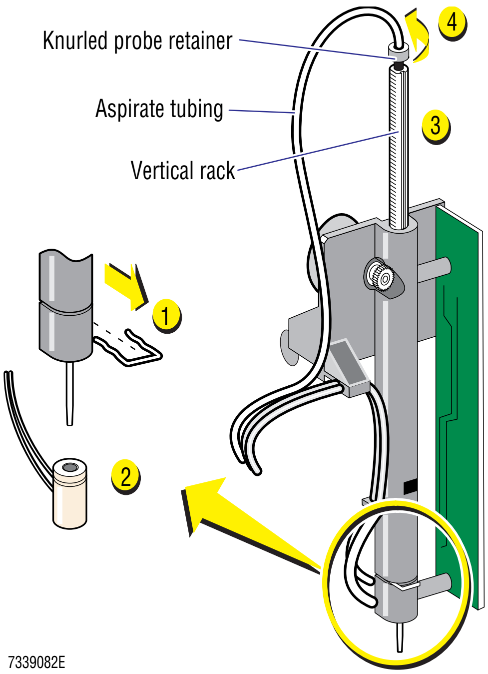
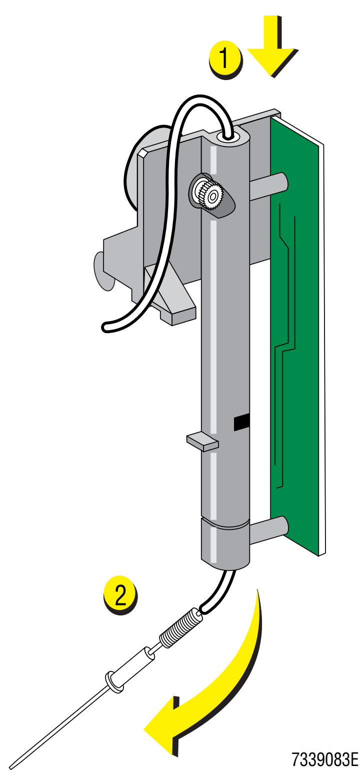


Figure 4.9-6 Removing the Probe from the Traverse Housing



Probe Removal

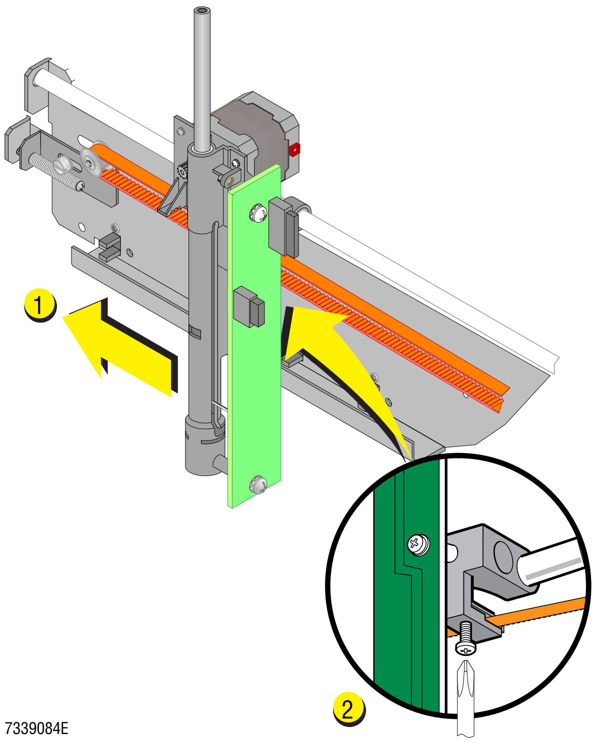
1. Remove the spring clip that retains the probe-wipe housing (Figure 4.9-5, 1).
2. Remove the probe-wipe housing block from the traverse housing and pull it off the probe (Figure 4.9-5, 2).
3. Unscrew the knurled probe retainer from the probe by grasping the vertical rack with one hand and loosening the knurled probe retainer with the other (Figure 4.9-5, 3 and 4).

   Note: The probe retainer is a knurled cylinder at the top of the vertical rack. The aspirate tubing is routed down through the probe retainer for attachment to the probe (Figure 4.9-5, 3 and 4).

4. Remove the probe from the traverse housing by pushing the probe retainer down into the traverse housing and then pulling the probe out the bottom of the housing (Figure 4.9-6).
5. Remove the aspirate tubing from the probe and pull the tubing out of the top of the vertical rack.
6. Remove the probe retainer from the vertical rack.
   - If replacing the probe, go to the Probe Installation procedure.
   - If removing the vertical rack, go to the Traverse Interconnect Card Removal procedure.

     Note: You must remove the Traverse Interconnect card before removing the vertical rack.

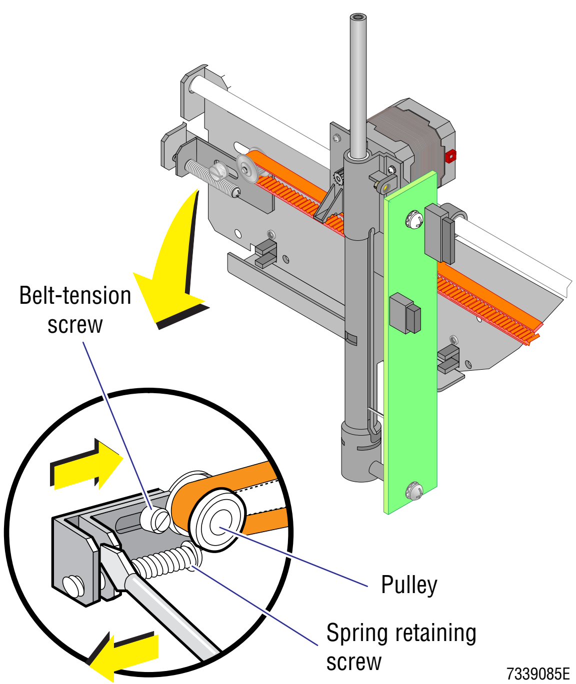
Figure 4.9-7 Removing the Belt Clamp



Horizontal Drive Belt Removal

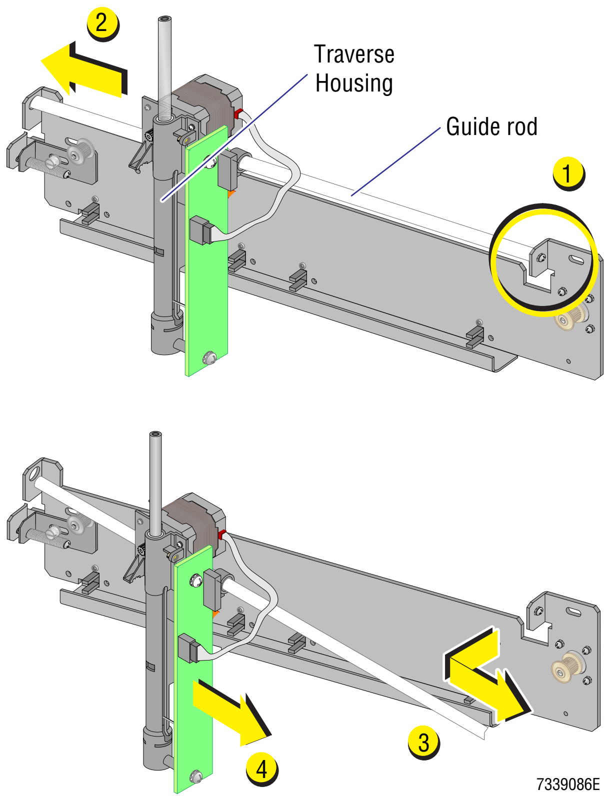
1. Move the traverse housing to the left end of its travel, the Manual-mode position (Figure 4.9-7, 1).
2. Remove the #2 Phillips-head screw securing the belt clamp. You access the belt-clamp screw underneath the belt through an access hole in the Traverse module bracket (Figure 4.9-7, 2).
3. Remove the belt clamp.

Figure 4.9-8 Removing the Belt



4. Loosen the belt-tension shoulder screw that tightens the belt tension bracket to the Traverse module bracket(Figure 4.9-8).
5. Insert a large flathead screwdriver between the Traverse module bracket and the belt tension bracket, and apply force against the spring pressure until you can take the belt off the belt-tension idler pulley (Figure 4.9-8).
6. Remove the belt from the Traverse module.
7. If removing the traverse housing, go to Traverse Housing Removal, step 2.
8. If replacing the horizontal belt drive, go to the Horizontal Drive Belt Installation procedure.

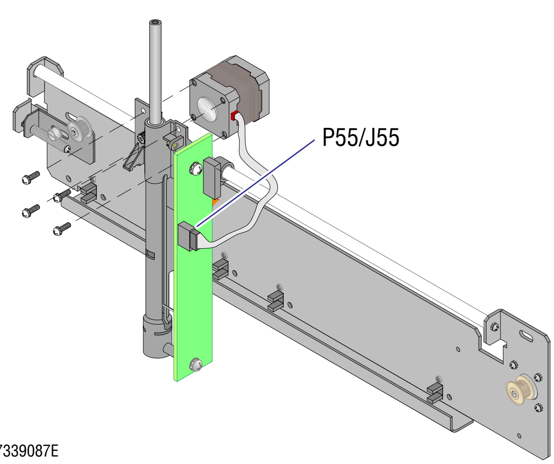
Figure 4.9-9 Removing the Traverse Housing



Traverse Housing Removal

1. Remove the horizontal drive belt as directed under Horizontal Drive Belt Removal.
2. Remove the #2 Phillips-head screw at the right end of the traverse housing guide rod (Figure 4.9-9, 1).
3. Hold the guide rod on either side of the traverse housing and slide the guide rod first to the left to clear the right end of the Traverse module's main bracket, then to the right to remove the rod from the left end of the bracket (Figure 4.9-9, 2 and 3).
4. Slide the traverse housing off the guide rod (Figure 4.9-9, 4).
5. If removing the vertical motor, go to the Vertical Motor Removal procedure, step 2.
6. If replacing the traverse housing, go to the Traverse Housing Installation procedure.

Figure 4.9-10 Removing the Vertical Motor



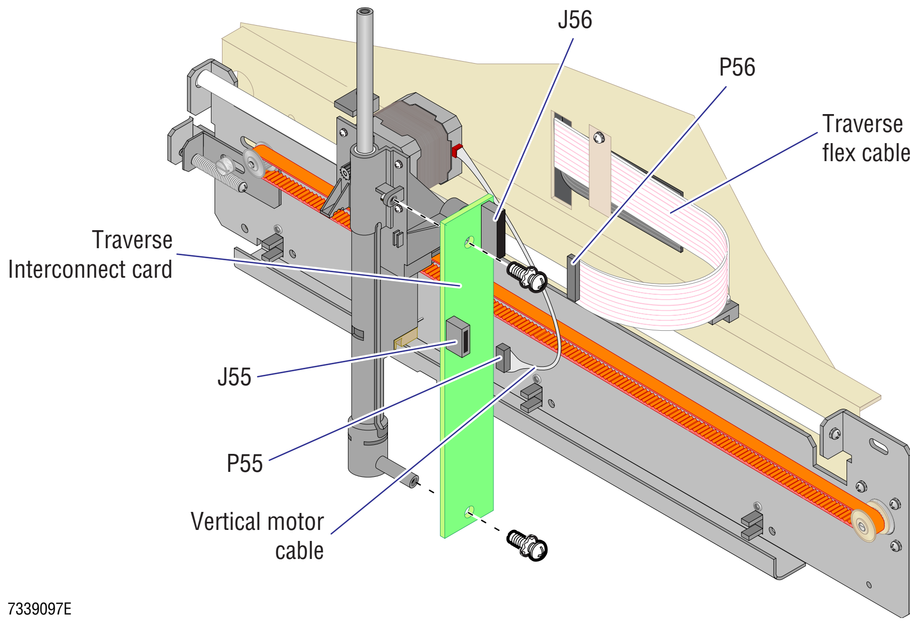
Vertical Motor Removal

1. To make room for removing the vertical motor, do either the Traverse Housing Removal procedure or the Traverse Module Removal procedure.
2. Disconnect the vertical motor cable connector, P55, from J55 on the Traverse Interconnect card (Figure 4.9-10).
3. Remove the four #1 Phillips-head screws securing the vertical motor to the traverse housing (Figure 4.9-10) and remove the motor.
4. To install a vertical motor, go to the Vertical Motor Installation procedure.

Traverse Interconnect Card Removal

1. If the Traverse module is still on the instrument, disconnect the vertical motor cable, P55, and the Traverse module flex cable, P56, from J55 and J56 on the Traverse Interconnect card, respectively (Figure 4.9-11).

Figure 4.9-11 Removing the Traverse Interconnect Card

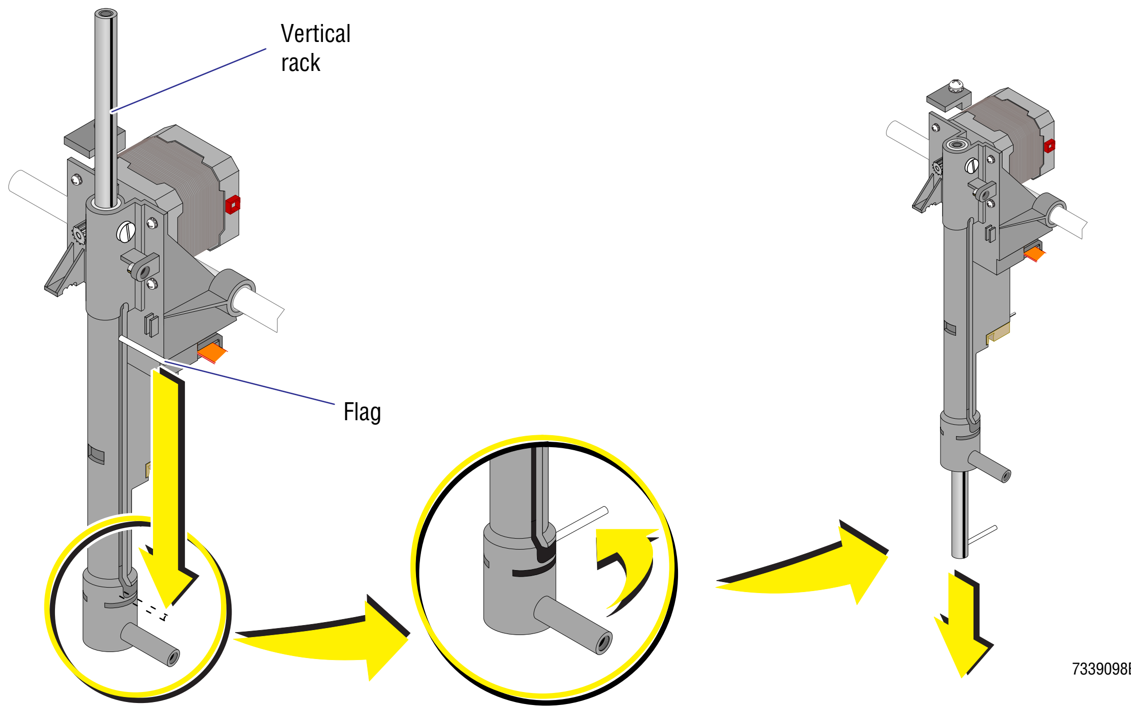


2. Remove the two #1 Phillips-head screws securing the Traverse Interconnect card to the traverse housing (Figure 4.9-11).
3. If removing the vertical rack, go to the Vertical Rack Removal procedure.
4. If replacing the Traverse Interconnect card, go to the Traverse Interconnect Card Installation procedure.

Vertical Rack Removal

1. Remove the probe as directed under Probe Removal.
2. Remove the Traverse Interconnect card as directed under Traverse Interconnect Card Removal.
3. Push the vertical rack down into the traverse housing until the flag stops it (Figure 4.9-12).
4. Rotate the rack 90 degrees counterclockwise (flag moves to back of traverse housing) until the rack comes out the bottom of the traverse housing (Figure 4.9-12).
5. To install a vertical rack, go to the Vertical Rack Installation procedure.

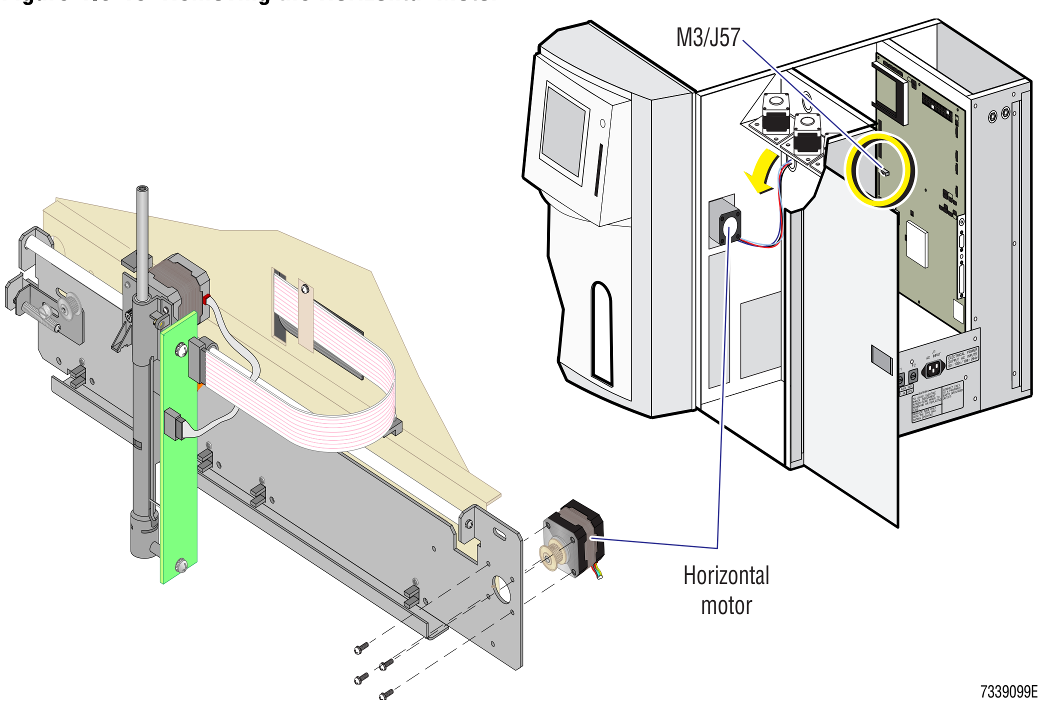
Figure 4.9-12 Removing the Vertical Rack



Horizontal Motor Removal

1. If the Traverse module is still on the instrument, disconnect the motor cable connector from connector M3/J57 on the center front of the Analyzer card and pull the wire harness through to the right hand diluter compartment (Figure 4.9-13).

Figure 4.9-13 Removing the Horizontal Motor

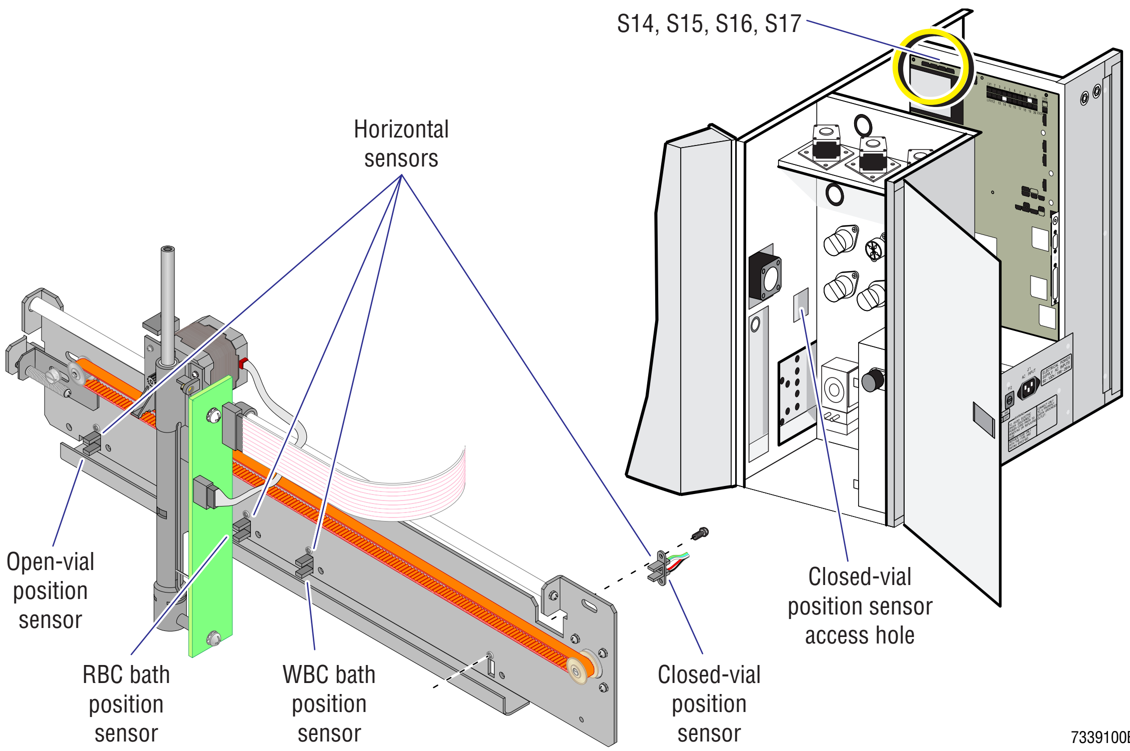


2. Remove the four #1 Phillips-head screws securing the horizontal motor to the Traverse module main bracket (Figure 4.9-13) and remove the motor.
3. To install a horizontal motor, go to the Horizontal Motor Installation procedure.

Horizontal Sensor Removal

1. If the Traverse module is still on the instrument, disconnect the sensor that is being replaced from the top front of the Analyzer card (Figure 4.9-14).
   - The open-vial position (far left) sensor connects to S14.
   - The RBC bath position sensor connects to S16.
   - The WBC bath position sensor connects to S17.
   - The closed-vial position (far right) sensor connects to S15.

Figure 4.9-14 Removing a Horizontal Sensor



2. From the rear of the instrument's front panel, remove the #1 Phillips-head screw securing the sensor to the Traverse module's main bracket (Figure 4.9-14).

   Note: All the horizontal sensors are accessible, even when the Traverse module has not been removed from the instrument.
3. To install a horizontal sensor, go to the Horizontal Sensor Installation procedure.

Installation Procedures

Horizontal Sensor Installation

1. At the rear of the instrument's front panel, secure the sensor to the Traverse module's main bracket with the #1 Phillips-head screw (Figure 4.9-14).
2. Connect the sensor to the Analyzer card connector, upper left corner, as follows:
   - The open-vial position sensor connects to S14
   - The RBC position sensor connects to S16
   - The WBC position sensor connects to S17
   - The closed-vial or cap-pierce sensor connects to S15.
3. Verify the instrument is working correctly. Go to Verification.

Horizontal Motor Installation

1. At the rear of the instrument's front panel, position the horizontal motor assembly on the right end of the Traverse module's main bracket (Figure 4.9-13).
2. At the front of the Traverse module's main bracket, secure the motor to the bracket with four #1 Phillips-head screws (Figure 4.9-13).
3. If the Traverse module is in place on the instrument, feed the horizontal motor cable into the middle compartment and attach its connector to connector M3/J57 on the center front of the Analyzer card.
4. Verify the instrument is working correctly. Go to Verification.

Vertical Rack Installation

1. With the flag at the bottom and pointing to the rear, insert the vertical rack into the bottom of the traverse housing (Figure 4.9-12).
2. Push the vertical rack up into the traverse housing as far as it will go, and then rotate the rack 90 degrees clockwise.

   Note: Rotating the rack positions the flag on the right side of the traverse housing.
3. Reinstall the Traverse Interconnect card. Go to the Traverse Interconnect Card Installation procedure.

Traverse Interconnect Card Installation

1. Slide the Traverse Interconnect card into its guide slots on the right side of the traverse housing and secure the card with two #1 Phillips-head screws (Figure 4.9-11).
2. If the Traverse module is in place on the instrument, connect the following cables to the Traverse Interconnect card (Figure 4.9-11):
   - Connect the vertical motor connector P55 to J55.
   - Connect the traverse flex cable connector P56 to J56.
3. If you removed the probe to access the vertical rack, reinstall the probe. Go to the Probe Installation procedure.
4. If the probe is installed, verify the instrument is working correctly. Go to Verification.

Vertical Motor Installation

1. From the rear of the traverse housing, feed the vertical motor gear through the housing, ensuring the gear meshes with the teeth on the vertical rack (Figure 4.9-10).
2. From the front of the traverse housing, secure the vertical motor to the housing with four #1 Phillips-head screws (Figure 4.9-10).
3. Connect the vertical motor cable connector P55 to J55 on the Traverse Interconnect card.
4. If you removed the traverse housing to access the vertical motor, reinstall the traverse housing. Go to the Traverse Housing Installation procedure.
5. If you removed the entire Traverse module to access the vertical motor, reinstall the Traverse module. Go to the Traverse Module Installation procedure.

Traverse Housing Installation

1. Insert the right (threaded) end of the traverse housing guide rod into the left side of the traverse housing and slide the guide rod through the traverse housing.

   Note: It is preferable to insert the right end of the guide rod into the left side of the traverse housing since that end should have fewer scratches.
2. Insert the left end of the traverse housing guide rod into the left end of the Traverse module's main bracket and slide the rod just far enough so that you can drop the right end of the rod into the right end of the bracket.
3. At the right end of the Traverse module's main bracket, secure the traverse housing guide rod to the bracket with a #2 Phillips-head screw (Figure 4.9-9).
4. Reinstall the horizontal belt drive. Go to the Horizontal Drive Belt Installation procedure.

Horizontal Drive Belt Installation

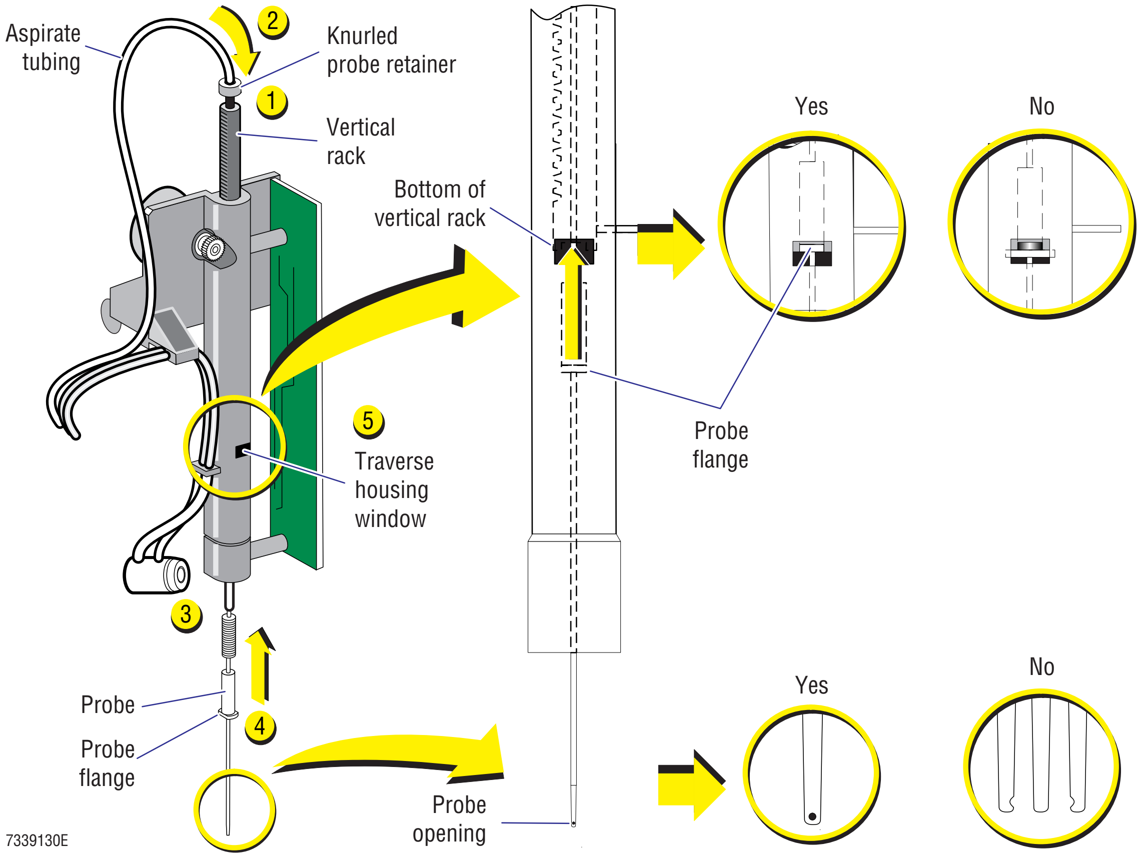
1. Loosen the belt-tension shoulder screw if it is not already loose (Figure 4.9-8).
2. Loop the horizontal drive belt over the right horizontal motor pulley.
3. Insert a large flathead screwdriver between the Traverse module bracket and the belt tension bracket, and apply force against the spring pressure until you loop the other end of the belt over the left belt-tension idler pulley (Figure 4.9-8).
4. Set the belt tension as directed under Belt Tension Adjustment.

Probe Installation

Refer to Figure 4.9-15.

1. With the knurled end of the probe retainer at the top, insert the probe retainer into the top of the vertical rack (1).
2. Feed the aspirate tubing (2) down through the top of the probe retainer/vertical rack until it is accessible at the bottom of the traverse housing.
3. Locate the opening at the tip of the probe and the probe flange (4). Notice the probe flange has two flattened sides. Note the aspirate port is aligned with one of the narrow sides of the probe flange. This side of the flange will act as a marker for positioning the probe. When properly installed, the probe aspirate port and this flange will face outward.

Figure 4.9-15 Probe Installation



4. With the aspirate port facing you, connect the aspirate tubing to the top of the probe, pushing it on ¼ inch.
5. While looking through the traverse housing window (5), push the probe up into the traverse housing until you can see the junction between the probe and the vertical rack.
6. Move the probe up slightly until the flange is clearly visible through the traverse housing window then turn the probe until the narrow side of the flange is centered in the window. The probe's aspirate port should be facing you.
7. While holding the probe in place with one hand, thread the probe retainer onto the probe with the other. When the connection is secured, finger tighten by grasping the vertical rack (1) with one hand and tightening the knurled probe retainer (2) with the other. When complete, the aspirate port should be facing you and the short probe flange should still be visible and centered in the traverse housing window.

   Note: The probe retainer will thread onto the probe even when the probe is not properly fitted into the notch at the bottom of the vertical rack as detailed in step 7, so using the flange and the probe's aspirate port as guides for proper alignment is important to ensure proper operation.

8. Check the tubing attached to the probe-wipe housing ports. If needed,
   - Connect black-striped tubing, which is used to provide diluent from LV10 for the probe wash, to the top port.
   - Connect yellow-striped tubing, which is used to route waste through LV8 to the vacuum isolator chamber, to the bottom port.
9. With the probe-wipe housing retaining groove up and its fittings facing the rear, slide the probe-wipe housing block (3) onto the probe.
10. Secure the probe-wipe housing block by inserting the retaining clip through the side openings near the bottom of the traverse housing. The clip should snap around the retaining groove etched near the top of the probe-wipe housing block (Figure 4.9-5, 1).
11. Verify the instrument is working correctly. Go to Verification.

Traverse Module Installation

1. Feed the horizontal motor wire harness through the large cutout provided in the front panel for the horizontal motor (Figure 4.9-4).
2. Feed the three Traverse module tubings through the round hole just below the right end of the location for the Traverse module.
3. Feed the horizontal sensor wires through the small rectangular cutouts provided in the front panel for the sensors (Figure 4.9-4).
4. Secure the Traverse module's main bracket to the instrument front panel with six #2 Phillips-head screws: three behind the horizontal drive belt, one in each of the lower corners of the bracket, and one in the upper right corner of the bracket (Figure 4.9-4).
5. Connect the tubing from the Traverse module to the instrument:
   a. Connect the stiff aspirate tubing to the fitting on the front of the 50 µL sample pump. See Figure 4.9-3, 1.
   b. Connect the probe-wipe housing top-port tubing to the adapter union fitting between the probe-wipe tubing and the larger tubing in LV10. See Figure 4.9-3, 2.
   c. Connect the probe-wipe housing bottom-port tubing to the adapter union fitting between the probe-wipe ribbon tubing and the pinch tubing in LV8. See Figure 4.9-3 3.
6. Connect the traverse flex cable connector P56 to J56 on the Traverse Interconnect card (Figure 4.9-1).
7. Route the horizontal motor wire harness between the main front panel and the false front to the back of the WBC position sensor.
8. Route the three other sensor wire harnesses to the back of the WBC position sensor. Dress the wires up from this position, making a neat harness.

9. Connect the five wire harnesses to their correct connectors on the front of the Analyzer card.
   - The horizontal motor cable connector P57 connects to M3/J57.
   - The open-vial position sensor connector P21 connects to S14
   - The RBC position sensor connector P23 connects to S16
   - The WBC position sensor connector P81 connects to S17
   - The closed-vial or cap-pierce sensor connector P22 connects to S15.
10. Verify the instrument is working correctly. Go to Verification.

Belt Tension Adjustment

1. Loosen the belt-tension shoulder screw if it is not already loose (Figure 4.9-8).
2. Turn the spring retaining screw (Figure 4.9-8) until one to two threads appear on the back side of the pem nut.
3. Tighten the belt-tension shoulder screw.
4. Verify the instrument is working correctly. Go to Verification.

Verification

1. If you removed the top cover and rear panel, reinstall it. See the Installation (AC•T diff 2 Analyzer) procedure under Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover in Heading 4.2.
2. If you changed the position of the Traverse module as it mounts to the front panel, or if you loosened the traverse housing guide rod and altered its mounting to the Traverse module's main bracket, check the probe alignment. Go to Heading 4.18, CAP-PIERCE PROBE/TUBE ALIGNMENT - AC•T diff 2 ANALYZER.
3. Manually move the probe up and down, and back and forth. Determine that the probe has full motion and that nothing is binding or impeding movement beyond the normal restriction of the motors. If the motion does not feel right, or the range is restricted, troubleshoot this before continuing.
4. Leave the probe near the open-vial position and halfway down its normal vertical travel.
5. Plug the power line cord into an appropriate wall outlet and turn the instrument on (I).
6. Verify the instrument attains the ready state. If it does not, troubleshoot any error that prevents the system from reaching the ready state before continuing.
7. Access the Motors screen. Select **Main** icon ▸▸ **Diagnostics Functions** icon ▸▸ **Motors** icon.
8. Move the probe horizontally verify that all four horizontal sensors, POV, PR, PW, and PCV change their state to (1) when the probe is in that position.
9. Return to the Main screen.
10. Select **Sample Results** icon and cycle a blood specimen. Ensure that the cycle is completed without error.
11. Cycle controls or a specimen with known results to verify that the instrument is aspirating and dispensing correctly.

4.10 APERTURE/BATH ASSEMBLY REPLACEMENT

Purpose

Use this procedure to replace an RBC or WBC aperture/bath assembly that is defective, or that has an aperture too large for use with the A^{C}•T diff/Veterinary Options analyzer software.

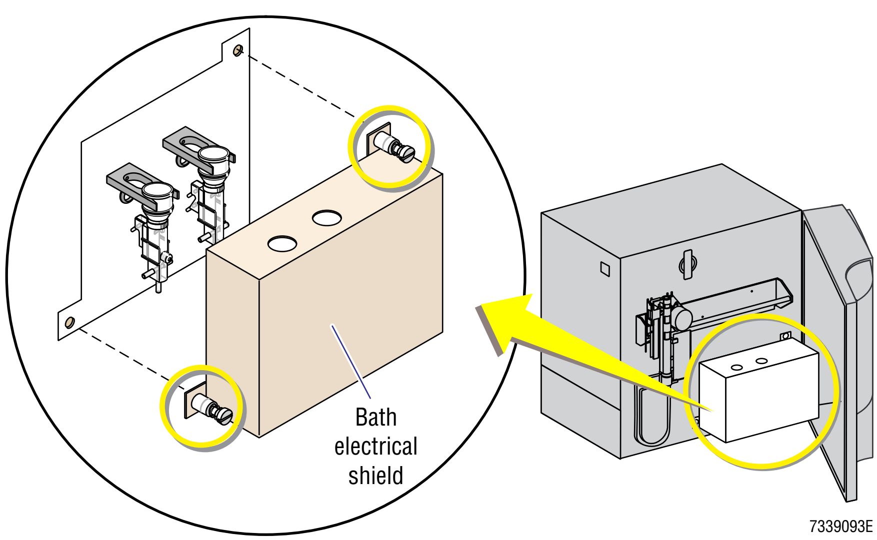
Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver
- ❑ Specimen with known values (for Verification)

Removal

1. Select **Main** icon ▸▸ **Diluter Functions** icon ▸▸ **Drain** icon.
2. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
3. Remove the top cover as directed in the procedures for Removing the AC•T 8/10 and AC•T diff Analyzers' Top Cover and Rear Panel, or Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover, under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
4. Disconnect the aperture (white coaxial) cables plugged into the preamp, a shielded area at the lower front of the Analyzer card:
   - The WBC cable connects through the top hole in the preamp shield.
   - The RBC cable connects through the bottom hole in the preamp shield.
5. Open the front door. To open the front door of the A^{C}•T diff 2 analyzer, see Opening the AC•T diff 2 Analyzer's Front Door under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
6. Unfasten the two thumb screws securing the aperture/bath assembly shield to the front panel (Figure 4.10-1) and remove the shield.

Figure 4.10-1 Removing the Aperture/Bath Assembly Shield



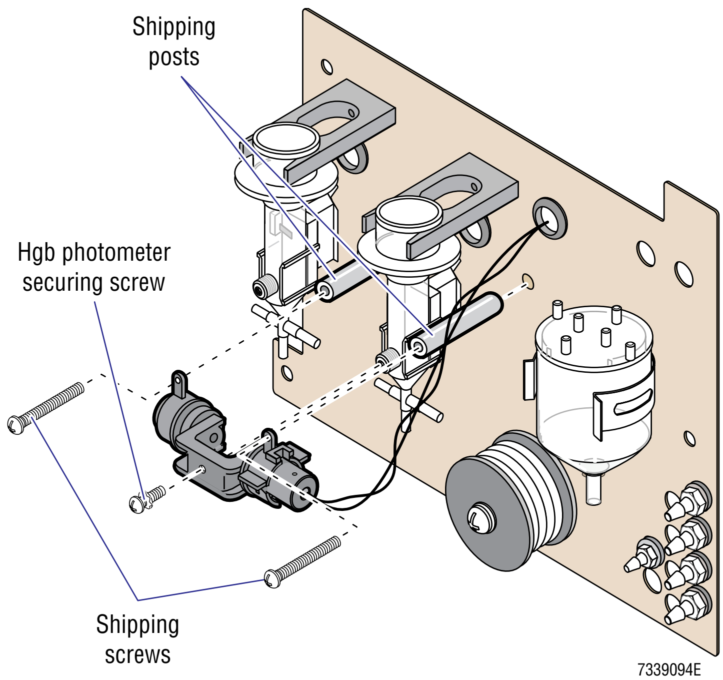
7. Disconnect the three tubes going to the bottom of the aperture/bath assembly being replaced.
8. On the A^{C}•T diff 2 analyzer, disconnect the diluent tube from the fitting at the top of the bath.

WARNING Risk of personal injury. The hemoglobin lamp is hot. You might be burned if you handle the lamp while it is hot. Let the lamp cool before removing the Hgb photometer assembly.

9. **If replacing the WBC aperture/bath assembly**, remove the Hgb photometer assembly.
   a. Remove the Phillips-head screw securing the Hgb photometer assembly to the WBC bath (Figure 4.10-2).
   b. If the two shipping posts are still attached, remove them (Figure 4.10-2).

      Note: The shipping posts, which consist of a screw and a spacer, do **not** have to be installed unless you are shipping the instrument.
   c. Slide the Hgb photometer assembly off the front of the WBC bath.

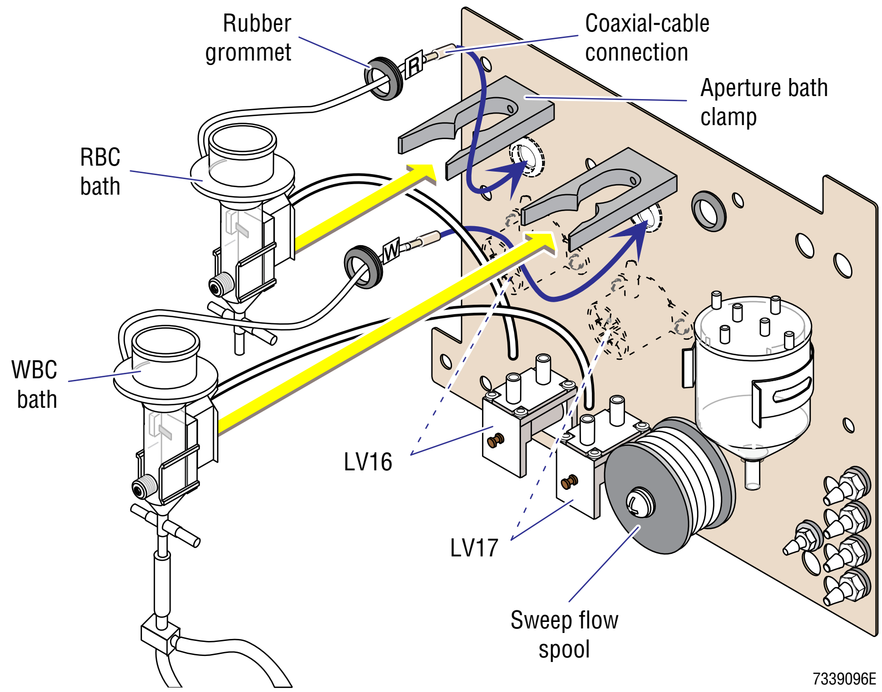
Figure 4.10-2 Removing the Hgb Photometer Assembly



10. Manually remove the aperture/bath assembly from its aperture bath clamp (Figure 4.10-3). It snaps in and out of the clamp.
11. Disconnect the aperture/bath assembly's rear-chamber tubing (Figure 4.10-3):
    - RBC bath
      - Red-striped tubing from LV16 connects to the upper fitting.
      - Sweep-flow tubing attaches to the lower fitting.
    - WBC bath - Red-striped tubing from LV17 connects to the rear chamber fitting

12. Remove the aperture/bath assembly by carefully guiding the coaxial-cable connector of the aperture cable through the opening in the front panel. A rubber grommet comes with the cable. Remove the rubber grommet from the old assembly and use it on the replacement bath.

Figure 4.10-3 Aperture Sensor System Components



Installation

1. Install the aperture/bath assembly by carefully guiding the coaxial-cable connector of the aperture cable through the appropriate opening in the front panel and position the rubber grommet on the front panel.

ATTENTION: If the aperture/bath assembly's rear-chamber tubing is not reconnected properly, the tubes may crimp, and impede flow. Correct routing is from rear chamber fitting, up through the opening in the machined clamp or around the stem of the molded clamp, and then down to LV16 or LV17. This routing ensures a proper loop that will not crimp tubing.

2. Attach the aperture/bath assembly's rear-chamber tubing (Figure 4.10-3):
   - **If the WBC aperture/bath assembly was replaced**, connect the red-striped tubing from LV17 to the bath's rear-chamber fitting.
   - If the RBC aperture/bath assembly was replaced:
     - Connect the red-striped tubing from LV16 to the upper fitting of the bath's rear chamber.
     - Connect the sweep-flow tubing to the lower fitting of the bath's rear chamber.
3. Snap the aperture/bath assembly into the aperture bath clamp, orienting it so that the bath's rear chamber is at the back.

4. **If the WBC aperture/bath assembly was replaced**, install the Hgb photometer assembly.
   a. Slide the Hgb photometer assembly onto the front of the WBC bath.

CAUTION Risk of damage to the WBC bath. When securing the Hgb photometer assembly to the WBC bath, if you use a screw that is too long, the screw can break through the bath wall. Use the correct length screw when securing the Hgb photometer assembly to the WBC bath.

   b. Secure the Hgb photometer assembly using the appropriate length Phillips-head screw (Figure 4.10-2).
   c. **If shipping the instrument**, reinstall the two shipping posts (Figure 4.10-2).
5. Attach the tubings to the bath being replaced.
   a. **For either the RBC or the WBC aperture/bath assemblies**, connect the waste tubing to the bottom fitting of the bath.
   b. **For an RBC aperture/bath assembly**, diluent flow is divided by two Y-fittings into three paths.
      1) Connect the diluent tubing with the small check valve in the line to the top fitting on the bath.
      2) Connect the other two diluent lines to the two lower side fittings of the bath.
   c. **For a WBC aperture/bath assembly**, diluent flow is divided by a Y-fitting into two paths.
      1) Connect the diluent tubing with the small check valve in the line to the top fitting on the bath.
      2) Connect the other diluent line to the lower-left side fitting on the bath.
      3) Connect the lytic reagent line to the lower-right side fitting on the bath.
6. Attach the aperture (white coaxial) cables:
   a. The WBC cable connects through the top hole in the preamp shield.
   b. The RBC cable connects through the bottom hole in the preamp shield.
7. Position the electrode:
   a. Manually move the probe to the bath that was replaced.
   b. Manually move the probe down into the center of the bath.
   c. Shape and position the bath electrode so that the probe does not touch the electrode when it goes down into the center of the bath. This is necessary because the probe thief position is lower than the level of the electrode during a normal cycle.
   d. Ensure that the electrode **does not touch** the side of the bath when it is bent off center.
8. Reinstall the top cover and rear panel as directed in Installation (AC•T 8/10 and AC•T diff Analyzers), or Installation (AC•T diff 2 Analyzer), under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
9. Plug the power line cord into an appropriate wall outlet.

Verification

1. Turn the instrument on (**I**). Observe the baths during power up and ensure that there are no leaks and fluid cycling seems correct. If a Startup cycle is performed, disregard the results.
2. **If a Startup cycle was not performed during power up**, run a cycle and ensure that the electrode is not touched by the probe when the probe is down in the bath.

IMPORTANT Electrical interference occurs when the bath's electrical shield is not covering the aperture/bath assembly. This interference will cause sample results to be unacceptable. Always ensure that the bath's electrical shield is in place before running a sample.

3. Install the aperture/bath assembly shield, being careful not to pinch any tubing, and close the front door. Refer to Figure 4.10-1.
4. Perform a Startup cycle and ensure that the backgrounds are acceptable.
5. **For instruments using the AC•T diff/Veterinary Options analyzer software**, verify the aperture is not too large as directed under Heading 4.16, APERTURE VERIFICATION - AC•T diff/Veterinary Option ANALYZER.
6. **For AC•T diff and AC•T diff 2 analyzers**, check the gain settings as directed under Heading 4.12, LATEX GAIN ADJUSTMENT - AC•T diff AND AC•T diff 2 ANALYZERS.
7. Run a specimen with known values and verify that the results are acceptable.
8. Perform a verification and/or calibration.

   Note: Replacing an aperture often requires calibration which should be performed only by the appropriate personnel according to local regulations and laboratory protocols.

4.11 HGB PHOTOMETER ASSEMBLY - DISASSEMBLY/REPLACEMENT

Purpose

Use this procedure to remove, disassemble and reassemble the Hgb photometer assembly when the Hgb lamp, clear lens, blue heat filter, or O-ring needs replaced.

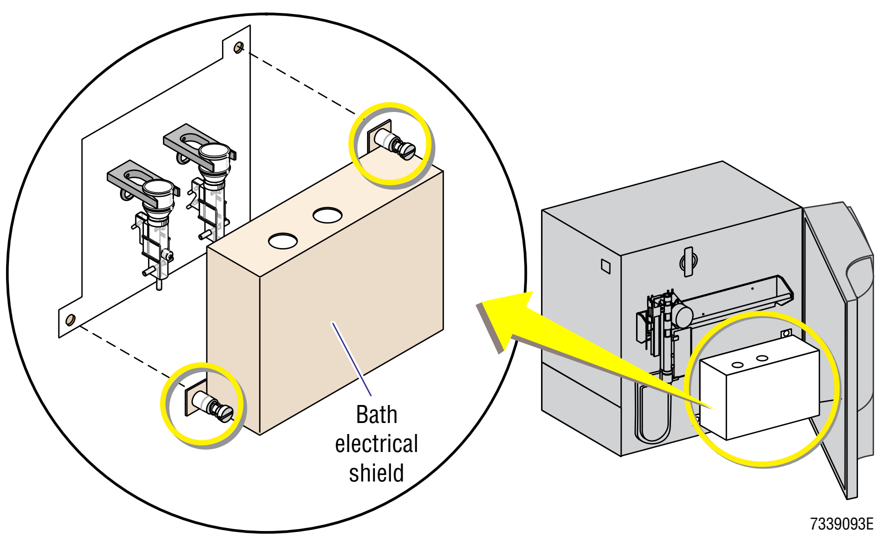
Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver
- ❑ A control or a fresh blood specimen with a known value (for Verification)

Removal

1. Turn the instrument off (**0**) and unplug the power line cord from the wall outlet.
2. Remove the top cover as directed in the procedures for Removing the A^{C}•T 8/10 and A^{C}•T diff Analyzers' Top Cover and Rear Panel, or Removing the A^{C}•T diff 2 Analyzer's Top and Rear Center Cover, under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
3. Open the front door. To open the front door of the A^{C}•T diff 2 analyzer, see Opening the A^{C}•T diff 2 Analyzer's Front Door under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
4. Unfasten the two thumb screws securing the aperture/bath assembly shield to the front panel (Figure 4.11-1) and remove the shield.

Figure 4.11-1 Removing the Aperture/Bath Assembly Shield



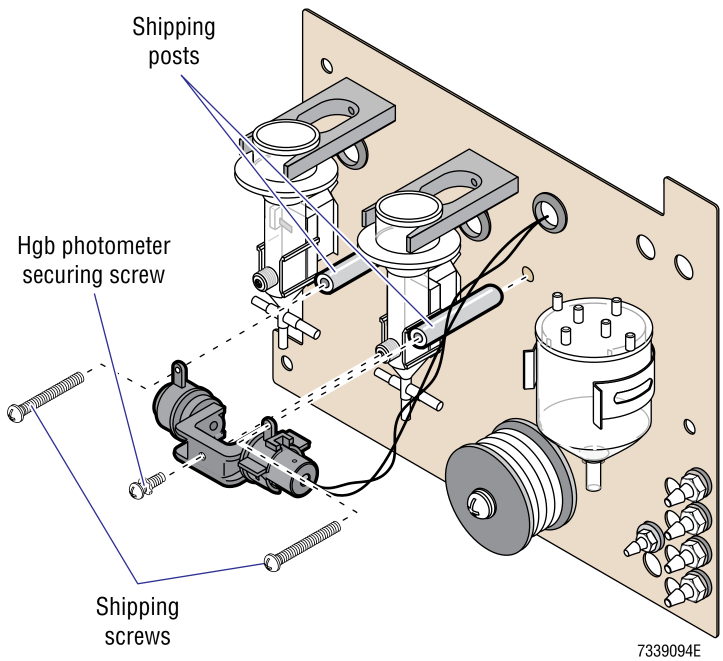
5. Disconnect the Hgb lamp cable, P9, and the Hgb preamp coaxial cable, P10, from the Analyzer card connectors, J9 and J10, respectively. For the locations of the connectors, see Figures A.2-1, Analyzer Card Component Locations - A^{C}•T 8/10 Analyzers, A.2-2, Analyzer Card Component Locations - A^{C}•T diff Analyzer, or A.2-3, Analyzer Card Component Locations - A^{C}•T diff 2 Analyzer.

WARNING Risk of personal injury. The hemoglobin lamp is hot. You might be burned if you handle the lamp while it is hot. Let the lamp cool before removing the Hgb photometer assembly.

6. Remove the Phillips-head screw fastening the Hgb photometer assembly to the WBC bath (Figure 4.11-2).
7. If the two shipping posts are still attached, remove them. (Figure 4.11-2).

   Note: The shipping posts, which consist of a screw and a spacer, do **not** have to be installed unless you are shipping the instrument.

Figure 4.11-2 Removing the Hgb Photometer Assembly



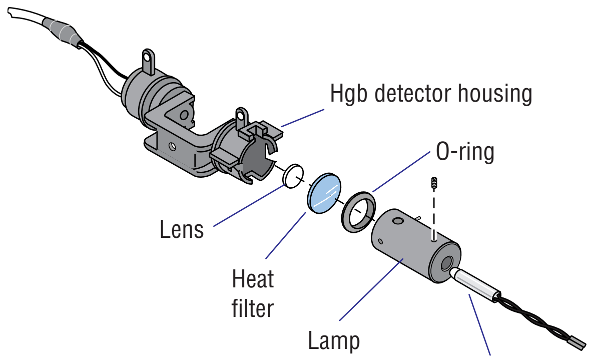
8. Remove the Hgb photometer from the WBC bath, and pull the Hgb preamp and the Hgb lamp cables through the front panel.

   Note: It is often easier to remove the rubber grommet from the panel with the cables, and then take the grommet off the cables.
9. Disassemble the Hgb photometer (Figure 4.11-3) by removing the following components from the Hgb detector housing:

   Note: Disassemble carefully. These components are small and can be easily lost.

   a. Remove the lamp assembly by pushing the assembly into the housing and twisting counterclockwise.
   b. Remove the clear lens.
   c. Remove the blue heat filter.
   d. Remove the compression O-ring.

Figure 4.11-3 Disassembling the Hgb Photometer Assembly



10. Remove the lamp from its heatsink housing by loosening the Allen setscrew and pulling the lamp out. Refer to Figure 4.11-3.

Installation

1. Insert the lamp into the back end of the lamp housing and the heatsink until the back end of the lamp is flush with the back end of the heatsink. Tighten the lamp in place with the Allen setscrew (Figure 4.11-3).
2. Assemble the photometer (Figure 4.11-3) by inserting the following into the Hgb detector housing:
   a. Insert the clear lens.
   b. Insert the blue heat filter.
   c. Insert the compression O-ring.
   d. Push the lamp housing into the Hgb detector housing and twist counterclockwise.

      Note: With a fresh O-ring, the lamp housing pins usually rest in the center notch and provide good tension.

CAUTION Risk of damage to the WBC bath. When securing the Hgb photometer assembly to the WBC bath, if you use a screw that is too long, the screw can break through the bath wall. If you use a screw that is too short, you can cause damage to the plastic threads. Use the correct length screw when securing the Hgb photometer assembly to the WBC bath.

3. Slide the Hgb photometer assembly onto the WBC bath. Tighten in place using the appropriate length Phillips-head screw (Figure 4.11-2).
4. **If shipping the instrument**, install the two shipping posts (Figure 4.11-2).
5. Dress the Hgb preamp and the Hgb lamp cables to the rear of bath. Place a rubber grommet over both cables if they were removed from the panel.
6. Feed both cables through the panel. Install the grommet if it is not in place.
7. Connect cables, P9 and P10, to the Analyzer card connectors, J9 and J10, respectively. For the locations of the connectors, see Figures A.2-1, Analyzer Card Component Locations - A^{C}•T 8/10 Analyzers, A.2-2, Analyzer Card Component Locations - A^{C}•T diff Analyzer, or A.2-3, Analyzer Card Component Locations - A^{C}•T diff 2 Analyzer.

8. Install the aperture/bath assembly shield (Figure 4.11-1).
9. Reinstall the instrument's top cover as directed in Installation (A^{C}•T 8/10 and A^{C}•T diff Analyzers), or Installation (A^{C}•T diff 2 Analyzer), under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
10. Plug the power line cord into an appropriate wall outlet.
11. Verify the instrument is working correctly. Go to Verification.

Verification

1. Turn the instrument on (**I**).
2. When the instrument reaches the "ready" state, select **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Voltages/Sensors** icon.
3. Change the Preamp and/or Hgb Gain adjustment. Verify that the Hgb output moves up/down as you move the gain up/down. Set the Hgb output to3700 ±100 using either the **Preamp Gain** or the **Hgb Gain** controls.

   Note: The Analyzer cards used by the A^{C}•T diff and A^{C}•T diff 2 analyzers have only one amplifier, the Hgb Gain adjustment, for setting the Hgb output.
4. Select the **Save and Exit** icon.
5. Run a control or a fresh blood specimen with a known value and verify that the Hgb parameter is recovered properly.

4.12 LATEX GAIN ADJUSTMENT - AC•T diff AND AC•T diff 2 ANALYZERS

ATTENTION: On instruments using AC•T **diff/Veterinary Option analyzer software**, you **must** verify the apertures are not too large before adjusting the gains. Do the procedure under Heading 4.16, APERTURE VERIFICATION - AC•T diff/Veterinary Option ANALYZER, before doing this gain adjustment procedure.

Purpose

Use this procedure to adjust the gains of the amplifiers for the pulse signals received from the apertures. This procedure compensates for variations in aperture size that could affect size-sensitive parameters derived from histograms like the WBC differential and MCV.

Always perform this procedure after replacing an aperture/bath assembly or replacing an Analyzer card for reasons affecting signal and gain. You do not need to do this procedure, however, if the Analyzer card was changed for an unrelated symptom. Variations in gain from one Analyzer card to another are minimal and do not affect results.

Note: On instruments using both AC•T diff analyzer and AC•T diff/Veterinary Option analyzer software, you can set the gains using either software and no additional adjustments are needed to use the other software. The higher gains needed for the various animal species are accomplished by the software based on the gains set in the LATEX GAIN ADJUSTMENT - AC•T diff AND AC•T diff 2 ANALYZERS procedure for normal laboratory use.

Tools/Supplies Needed

- ❑ Latex particles, PN 6857371-8

Procedure

1. Ensure that the apertures are clean. If protein buildup is suspected, bleach the apertures as directed under Clean the Baths, in the Special Procedures and Troubleshooting manual.
2. Select **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Latex Calibration** icon. An intermediate screen (Figure 4.12-1 for an AC•T diff analyzer or Figure 4.12-2 for an AC•T diff 2 analyzer) is displayed indicating the next action to perform.

Figure 4.12-1 Latex Calibration Screen - AC•T diff Analyzer

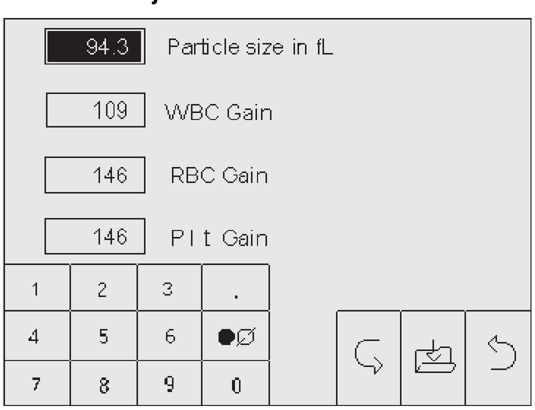


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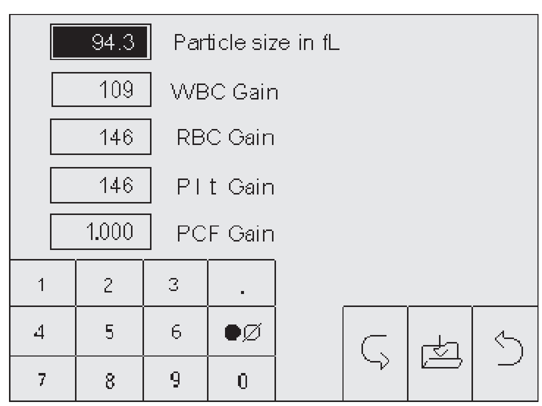
Figure 4.12-2 Latex Calibration Screen - AC•T diff 2 Analyzer



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3. The top numerical entry box is highlighted showing the particle size (default = 94.3 fL). Enter the particle size of the latex particles you are using.

   Note: The **Save** icon is not needed. The **Save** icon is used for the manual entry of the gain values below the particle size.

4. Select **Continue** icon. An icon is displayed indicating that the instrument is ready to aspirate the latex particles.

5. Aspirate the latex particles:

   a. Present the latex particles to the aspirate probe (open-vial position if using an AC•T diff 2 analyzer.)

   b. Press the aspirate switch as you would to run a sample.

6. When the latex cycle is completed, a screen similar to Figure 4.12-3 is displayed. Verify that the WBC and RBC counts and the corresponding CVs displayed on the screen are within the limits shown on Table 4.12-1.

Figure 4.12-3 Latex Results Screen

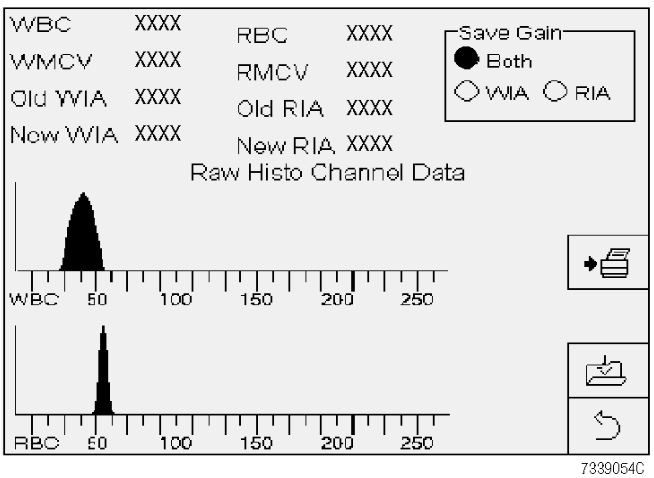


Table 4.12-1 Latex Adjustment Criteria

Parameter	Minimum	Maximum
WBC	1.0	10.0
RBC	0.5	2.5
WBC CV	0.0	15.0
RBC CV	0.0	8.0
WMCV	-1.5	+1.5
RMCV	-1.5	+1.5
WIA	10.0	250.0
RIA	10.0	250.0

7. Check the measured values for WMCV and RMCV:
   - If the measured values are within ±1.5 fL of the latex particle size entered in step 3, no adjustment is necessary.
   - If the measured values are **not** within ±1.5 fL of the latex particle size entered in step 3, adjust the gains and verify that they are within the limits in Table 4.12-1. If the gains are outside the limits, troubleshoot and correct the problem.
8. Select **WIA**, **RIA** or **Both** to select the parameter to change.
   - Select **Save and Exit** icon to save the new gains and exit the program.
   - Select **Exit** icon to exit the program without saving any changes.

Verification

Verify instrument calibration and calibrate if necessary.

Note: MCV and RDW are most affected by a change in RIA gain. The WBC differential is most affected by a change in WIA gain.

4.13 SETTING CLOG DETECTION TARGET VALUES - AC•T diff AND AC•T diff 2 ANALYZERS

Tools/Supplies Needed

- ❑ Ten or five normal, fresh-blood specimens
- ❑ COULTER 4C® PLUS Normal cell control (preferred)

Procedure

ATTENTION: This procedure is more accurate if performed at the normal operating temperature of the instrument. During sample analysis, the Target values are scaled according to the temperature of the reagent in the diluent reservoir.

1. Ensure the apertures are clean. If protein buildup is suspected, bleach the apertures as directed under Clean (Bleach) the Baths, in the Operator's Guide, Section 6, Service and Maintenance.
2. Run the first specimen or the 4C PLUS Normal cell control.
3. Print the Sample Details screen or from the Sample Details screen, record the WBC, RBC, AVR Measured, WBC Measured, and RBC Measured values.
4. Repeat step 3 above until you have ten values.

   Note: If using 4C PLUS Normal cell control, cycle the control ten times. If using five normal fresh blood specimens, cycle each blood twice. If using ten normal fresh blood specimens, cycle each blood once.
5. Calculate the Mean value of the ten runs for WBC, RBC, AVR Measured, WBC Measured, and RBC Measured.
   - If you used normal fresh blood specimens, the Mean values for AVR Measured, WBC Measured, and RBC Measured are the new Target values.
   - If you used 4C PLUS Normal cell control, multiply the Mean values for AVR Measured, WBC Measured, and RBC Measured by the values below to obtain the new Target values:
     - Mean value of AVR Measured x 0.98 = new Target value
     - Mean value of WBC Measured x 1.05 = new Target value
     - Mean value of RBC Measured x 1.02 = new Target value.
6. Calculate the CV for the WBC and RBC parameters.
7. Ensure that the results from steps 5 and 6 meet the criteria in Table 4.13-1.

Table 4.13-1 Target Acceptance Criteria

Parameter	Acceptable Range
WBC count	CV≤3.0%
RBC count	CV≤3.0%
AVR Measured	≥1.4 but ≤2.3
WBC Measured	≥900 but ≤1500
RBC Measured	≥810 but ≤1350

8. Enter the new Target values on the Sample Details screen.

Verification

Run controls and/or blood specimens and verify there are no clog detect problems.

4.14 VERIFY INSTRUMENT OPERATION IN PREDILUTE MODE

Purpose

The purpose of the **Verify Predilute** function is to aid you in troubleshooting the Predilute mode. This function allows you to make prediluted samples more quickly and consistently than manual methods. It also provides a means of determining if a Predilute mode problem is in the instrument or in sample preparation.

DO NOT use this method for normal sample analysis. If enough whole blood is available in the specimen tube for the instrument to make a prediluted sample, then enough blood is available for the instrument to analyze the blood in the Whole-Blood mode and that is how the sample should be analyzed.

Tools/Supplies Needed

- ❑ Empty sample container

Procedure

1. Select **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Verify Predilute** icon. The screen displays the next action to perform.
2. Present a whole blood sample to the aspirate probe.

   Note: If operating an A^{C}•T diff 2 analyzer, the **Verify Predilute** function uses the Open-Vial mode.
3. Press the aspirate switch.
   a. Whole blood is aspirated.
      - If operating an A^{C}•T 8/10 or A^{C}•T diff analyzer, 20 µL of whole-blood is aspirated.
      - If operating an A^{C}•T diff 2 analyzer, 50 µL of whole-blood is aspirated.

   b. The probe is wiped clean.

   c. The probe is presented after being wiped.
4. Present an empty sample container to the aspirate probe.
5. Press the aspirate switch. Diluent is dispensed into the sample container along with the whole blood aspirated earlier.
   - If operating an A^{C}•T 8/10 or A^{C}•T diff analyzer, 1580 µL (1.58 mL) of diluent is dispensed into the sample container along with the 20 µL of whole blood.

     Note: The sample produced has the same dilution as a prediluted fingerstick sample prepared using a 20 µL pipette with the instrument dispensed volume of diluent.
   - If operating an A^{C}•T diff 2 analyzer, 4000 µL (4.0 mL) of diluent is dispensed into the sample container along with the 50 µL of whole blood. The pulsing action of the A^{C}•T diff 2 analyzer is normal.

     Note: The sample produced has the same dilution as a prediluted fingerstick sample prepared using a 50 µL pipette with the instrument dispensed volume of diluent.

6. Identify status then proceed as instructed.
   a. If operating an A^{C}•T 8/10 analyzer with revision 1.03 software, the analyzer has returned to the Diagnostics menu. Press the **Verify Predilute** icon if you want to make another prediluted sample. Repeat this procedure from step 2 until you have prepared the desired number of prediluted samples.
   b. If operating any other A^{C}•T Series analyzer, the instrument is ready to prepare another sample. Repeat this procedure from step 2 until you have prepared the desired number of prediluted samples.
7. If using any A^{C}•T Series analyzers after the A^{C}•T 8/10 analyzer with revision 1.03 software, return to the Main screen (**Exit** icon ▸▸ **Exit** icon).
8. **If not already in the Predilute mode**, select the Predilute mode (**Main** icon ▸▸ **Analyzing Mode** icon. Set to **Predilute Mode**).
9. Select the **Sample Results** icon and run the prediluted samples.

4.15 PREPARING THE INSTRUMENT FOR LONG-TERM SHUTDOWN OR SHIPMENT

Tools/Supplies Needed

- ❑ Empty sample container
- ❑ Bleach solution (one part distilled water and one part bleach from the bleach container)
- ❑ Distilled water
- ❑ 5-mL to 20-mL syringe with attached tubing, optional

Note: In step 2, a silicone tubing (approximately six to eight inch long) works best. In step 13, a polyurethane tubing with an internal diameter large enough to fit securely, but snugly over the pump fitting will maximize the pressure application.

Procedure

1. Remove the pickup tubes from their reagents and place them into an empty container. Leave the waste line in the waste receptacle.
2. **Optional if preparing an AC•T diff 2 analyzer:** Completion of the following steps expedites the removal of diluent from the system which helps prevent salt crystallization within the FMI pumps.
   a. Open the right side door and use Figure A.5-2 to locate the diluent reservoir.
   b. Attach a piece of tubing (preferably silicone) to an empty syringe then insert the tubing through the opening near the top of the diluent reservoir. With the end of the tubing positioned below the diluent level, fill the syringe. When the syringe is full, discard this diluent. Repeat these actions as many times as necessary to empty the reservoir.
   c. Using the same syringe (or squeeze bottle), fill the reservoir with distilled water until it is approximately ½ to ¾ full.
3. Select **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Prepare to Ship** icon.

   The screen opens displaying 1 (indicating the first stage of preparation) and an icon that refers the operator to the manual for instructions if they do not know how to proceed.
4. Press **1**:
   a. The instrument cycles air through the system.
   b. When the system has been purged of reagents, a screen opens displaying **2** (indicating the second stage of preparation) and an icon that refers the operator to the manual for instructions if they do not know how to proceed.
5. Insert the diluent and lytic reagent pickup tubes into a container of distilled water.
6. Insert the cleaning agent pickup tube into a container of bleach solution (one part distilled water and one part bleach from the bleach container).
7. Press **2**:
   a. The instrument cycles the bleach solution through the system and draws it through the apertures.
   b. The instrument enters a 15 minute wait period for the bleaching and decontamination processes to complete. After the wait period, the bleach solution drains and the system is flushed with distilled water.

   c. A screen opens displaying **3** (indicating the third stage of preparation) and an icon that refers the operator to the manual for instructions if they do not know how to proceed.

8. Remove the cleaning agent pickup tube from the bleach container and place it into distilled water.
9. Press **3**:
   a. The instrument cycles the distilled water through the system.
   b. After cycling, a screen opens displaying **4** (indicating the fourth stage of preparation) and an icon that refers the operator to the manual for instructions if they do not know how to proceed.
10. Remove all the pickup tubes from the distilled water and place them into the empty sample container.
11. Press **4** and the instrument clears the distilled water from the system.
12. When the system has been mostly cleared of fluids, the final screen displays a power on/off icon.
13. **Optional if preparing an AC•T diff 2 analyzer:** Flushing the aspiration and diluent FMI pumps with warm or hot tap water helps prevent salt crystallization.
   a. Attach a piece of tubing (preferably polyurethane) to a syringe then fill the syringe with warm or hot tap water.
   b. Open the right side door and use Figure A.5-2 to locate the aspiration and diluent FMI pumps.
   c. At the aspiration FMI pump, remove the tubing from the outboard fitting (the fitting closest to you).
   d. Attach the syringe to the fitting and apply continuous pressure (slight to medium) for two minutes.

      Note: Due to the structure of the FMI pump, there will be no discernible movement of liquid from the syringe into the pump; however, the pressure being applied is forcing the hot water to mix with and dilute any reagent remaining inside the pump.
   e. Detach the syringe and reattach the pump's tubing.
   f. Flush the diluent FMI pump using this same technique.

WARNING Risk of personal injury or contamination. Waste can include biohazardous materials. Handle and dispose of waste according to acceptable laboratory standards.

---

14. Turn the instrument off (**O**), unplug the power line cord from the wall outlet and disconnect the waste tubing from the instrument. The instrument is now in long-term shutdown. If the instrument is to be packed for shipment, go to Preparation for Shipment.

Preparation for Shipment

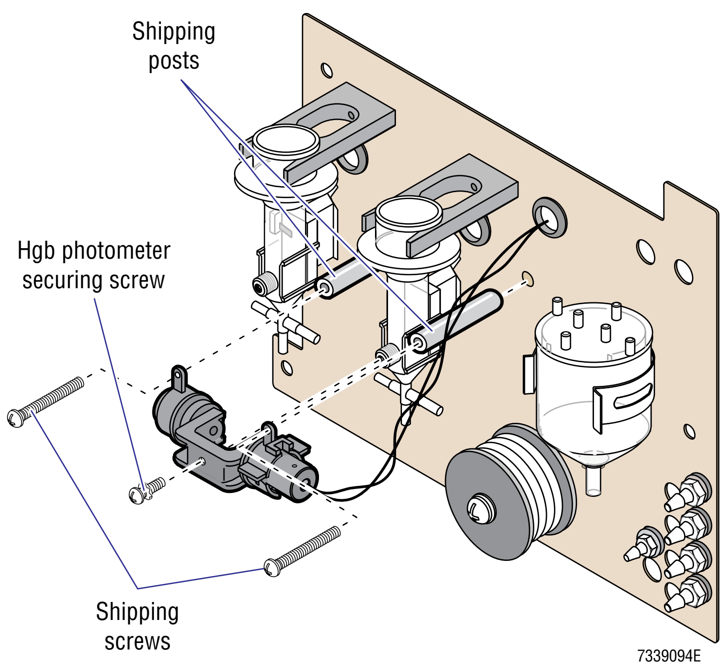
Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver
- ❑ Two shipping posts, PN 2852302, and two shipping screws, PN 2852303, for the Hgb photometer assembly, if not already installed
- ❑ One 3.5-in. shipping screw, PN 2851323, for the Traverse module
- ❑ Pump cushion, PN 8024587, with attached caution tag, PN 4276819

Procedure

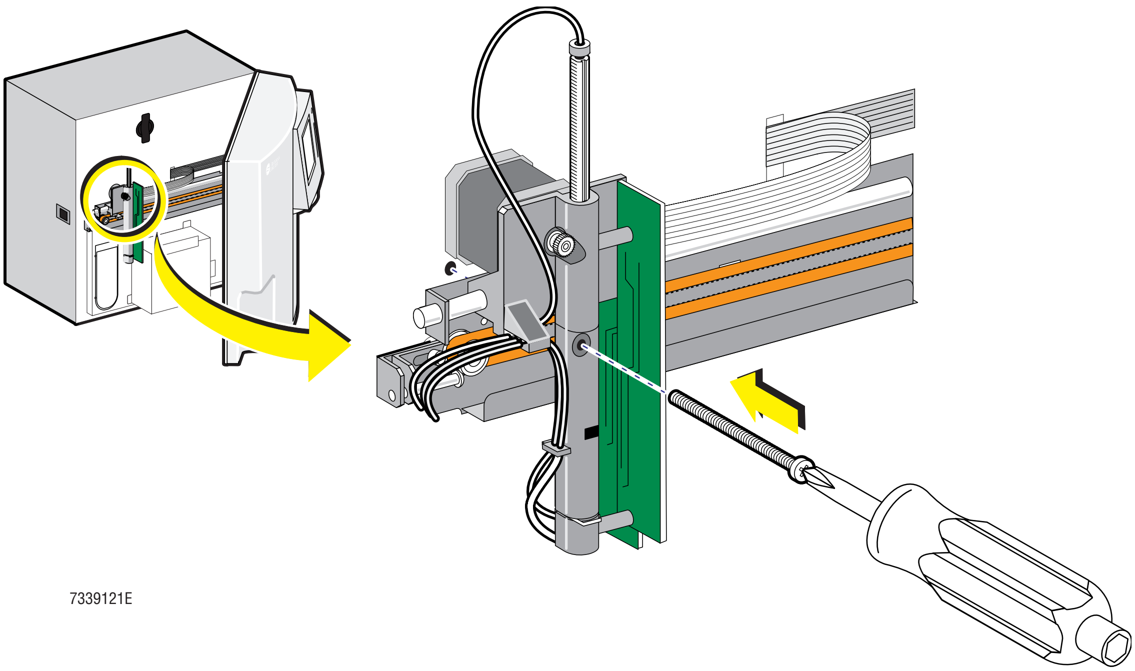
1. Open the front door. To open the front door of an A[C]•T diff 2 analyzer, see Opening the AC•T diff 2 Analyzer's Front Door under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
2. **If not installed**, install the two Hgb photometer assembly shipping posts and screws (Figure 4.15-1).

Figure 4.15-1 Hgb Photometer Shipping Posts



3. Secure the Traverse module with a 3.5-in. Phillips-head shipping screw to prevent movement during shipment (Figure 4.15-2).

Figure 4.15-2 Securing the Traverse Assembly for Shipping

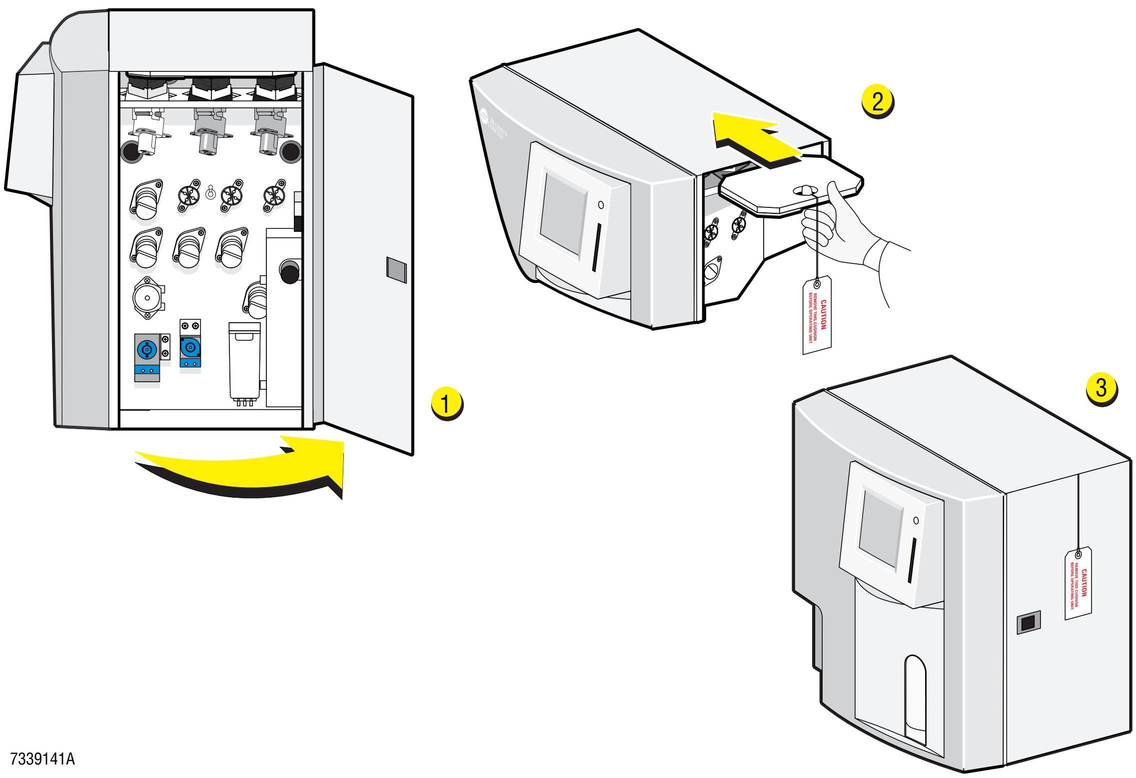


4. Close the front door.
   - If shipping an A^{C}•T 8/10 or A^{C}•T diff analyzer, pack the instrument in its original box, if available.
   - If shipping an A^{C}•T diff 2 analyzer, go to step 5.

For steps 5 through 8, refer to Figure 4.15-3.

5. Open the right-side door (1).
6. Verify the caution tag is attached to the pump cushion (2). If not, attach the tag to the cushion by looping the tag's string through the hole in the pump cushion then pulling the tag through the center of the string.
7. With the cardboard side down (towards the FMI pumps), insert the tagged pump cushion between the FMI pump motors and the top cover of the instrument to prevent movement of the FMI pumps during shipment (2).
8. While holding the caution tag over the top cover, close the right-side door. When you release the caution tag, it should be clearly visible as it hangs against the right-side door (3).

Figure 4.15-3 Preparing FMI Pumps for Shipment



9. Pack the instrument in its original box, if available.

4.16 APERTURE VERIFICATION - A^{C}•T diff/Veterinary Option ANALYZER

Purpose

You must do this procedure on any instrument to be used with the A^{C}•T diff/Veterinary Option analyzer software to verify the apertures are not too large. Because animal samples require very high gain settings, and larger apertures also require high gains settings, it is possible to have an aperture requiring a gain beyond the capabilities of the instrument.

Note: This verification is not required if the instrument is used only with standard A^{C}•T diff analyzer software.

This is only a verification procedure, not an adjustment procedure. To adjust the gains, go to Heading 4.12, LATEX GAIN ADJUSTMENT - AC•T diff AND AC•T diff 2 ANALYZERS.

Tools/Supplies Needed

- ❑ Latex particles, PN 6857371

Procedure

1. Select **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Latex Calibration** icon. A screen displays a default particle size and the current gain settings for the WBC, RBC, and Plt amplifiers.
2. Record the current settings for WBC, RBC, and Plt gains.
3. Enter gain values of 250 for both WBC and RBC.
4. Press the **File Folder** icon to save these values. You are then returned to the Diagnostics menu.
5. Select **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Latex Calibration** icon. Ensure that the Latex particle size is the same as the particle size you will use. If it is not, set it to the correct size.

   Note: The **Save** icon is not needed. The **Save** icon is used for the manual entry of the gain values below the particle size.
6. Select **Continue** icon. An icon is displayed indicating that the instrument is ready to aspirate the latex particles.
7. Aspirate the latex particles:
   a. Present the latex particles to the aspirate probe.
   b. Press the aspirate switch as you would to run a sample.
8. When the cycle is complete, note the values reported for WMCV and RMCV. Values for acceptable apertures are WMCV >165 and RMCV >160.
9. Return to the Latex Gain screen. Enter and **Save** the original gain values for WBC, RBC, and Plt.
10. If an aperture did not meet the criteria in step 8:
    a. Replace the aperture (Heading 4.10, APERTURE/BATH ASSEMBLY REPLACEMENT).
    b. Repeat this procedure to ensure the new aperture is not too large.

11. If you have not adjusted the gains for the apertures currently installed, go to Heading 4.12, LATEX GAIN ADJUSTMENT - AC•T diff AND AC•T diff 2 ANALYZERS.

    Note: If the gains were set using AC•T diff analyzer software, it is not necessary to make further adjustments to use AC•T diff/Veterinary Option analyzer software. The higher gains needed for the various animal species are accomplished by the software based on the gains set in the LATEX GAIN ADJUSTMENT - AC•T diff AND AC•T diff 2 ANALYZERS procedure for normal laboratory use.

4.17 CAP-PIERCE MODULE DISASSEMBLY AND REPLACEMENT – AC•T diff 2 ANALYZER

Purpose

Use the procedures in this section to remove and replace the entire Cap-Pierce module, or to disassemble or replace specific components. Always begin by doing the Preliminary Steps.

Tools/Supplies Needed

- ❑ #1 Phillips-head screwdriver
- ❑ #2 Phillips-head screwdriver
- ❑ Pliers
- ❑ Whole-blood specimen in a capped specimen tube (for Verification)
- ❑ Controls (for Verification)

Preliminary Steps

1. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
2. Open the front door. See Opening the AC•T diff 2 Analyzer's Front Door under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.

CAUTION Risk of contamination. Biohazardous contamination could occur from contact with Cap-Pierce module components. Handle with care and avoid skin contact.

3. To remove the entire Cap-Pierce module, go to the Cap-Pierce Module Removal procedure.
4. To remove the cap-pierce motor, or to disassemble the cap-pierce door, go to the Cap-Pierce Motor Removal procedure.

   Note: Before disassembling the cap-pierce door, you must remove the cap-pierce motor and the front door safety latch.
5. To remove the front door safety latch, go to the Front Door Safety Latch Removal procedure.
6. To remove the door-closed position sensor, S25, or the tube bottom seeking sensor, S24, go to the Optical Sensor Removal procedure.

Disassembly and Removal Procedures

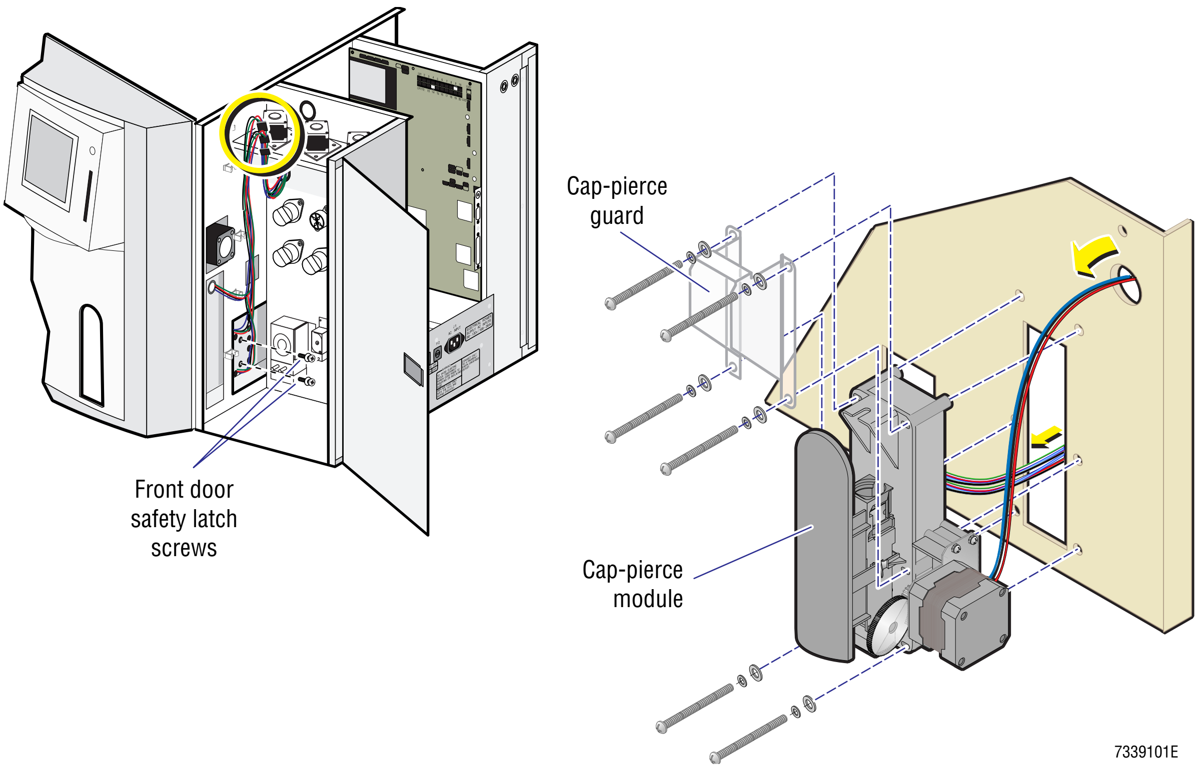
Cap-Pierce Module Removal

1. Open the right-side door of the instrument.
2. In the right compartment:
   a. Disconnect the cap-pierce door motor cable connector, P25, from the inline connector, J25, and free the cable from any cable clamps.

      Note: The wiring for the cap-pierce motor, the door-closed position optical sensor, and the tube bottom seeking optical sensor are attached to the same wire harness (Figure 4.17-1).

b. Disconnect the door-closed position and tube bottom seeking optical sensors and free their wiring from any cable clamps.

Figure 4.17-1 Removing the Cap-Pierce Module



c. Remove the two screws securing the front door safety latch to the front panel (Figure 4.17-1).

Note: The front door safety latch is the "hook" type latch on the lower left of the Cap-Pierce module that prevents the front door of the instrument from opening when the cap-pierce door is open.

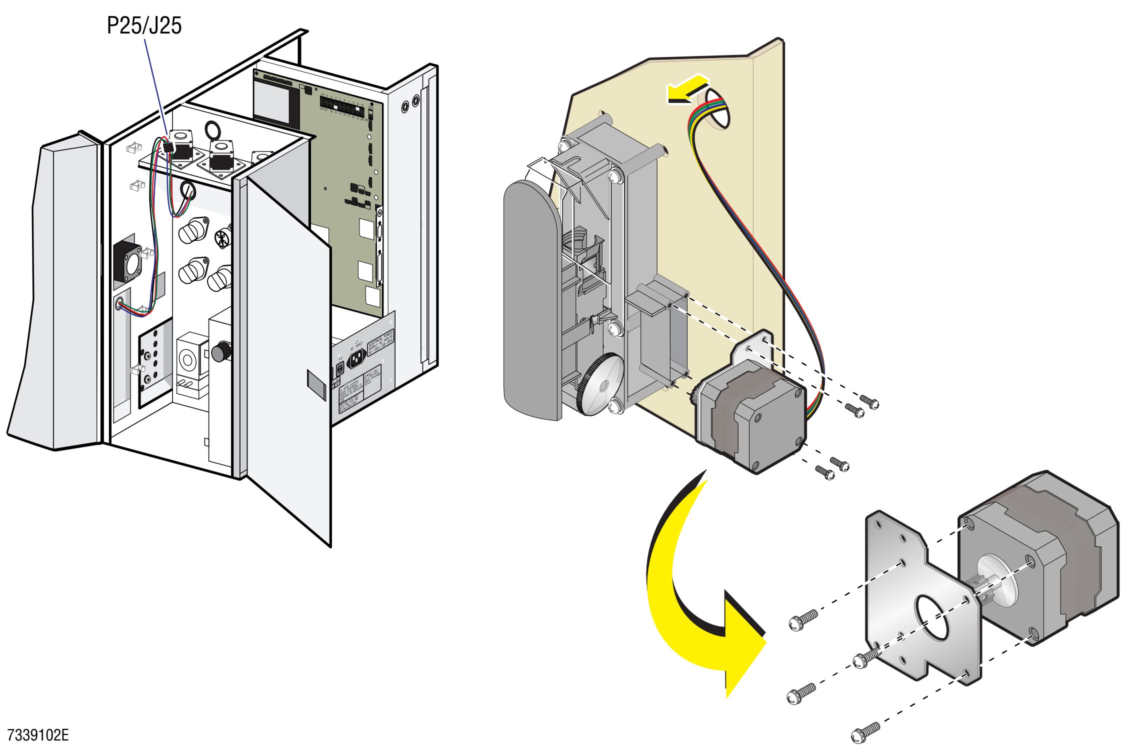
3. Remove the six screws securing the Cap-Pierce module base bracket to the front panel (Figure 4.17-1). This frees both the Cap-Pierce module and the protective finger guard which is held in place by the top four screws.
4. Remove the Cap-Pierce module.
5. If replacing the entire Cap-Pierce module, go to the Cap-Pierce Module Installation procedure.
6. If disassembling and removing a component from the Cap-Pierce module:
   - To replace the motor or disassemble the cap-pierce door, go to the Cap-Pierce Motor Removal procedure.
   - To replace the front door safety latch, go to the Front Door Safety Latch Removal procedure.

Cap-Pierce Motor Removal

Note: You can remove the cap-pierce motor without removing the Cap-Pierce module.

1. If the Cap-Pierce module is still on the instrument, disconnect the cap-pierce motor:
   a. Open the right-side door of the instrument.
   b. In the right compartment, disconnect the cap-pierce door motor cable connector, P25, from the inline connector, J25, and free the cable from any cable clamps (Figure 4.17-2).
2. Remove the four screws that attach the cap-pierce motor bracket to the Cap-Pierce module base bracket (Figure 4.17-2).
3. Remove the four screws that attach the cap-pierce motor to its bracket (Figure 4.17-2).

Figure 4.17-2 Removing the Cap-Pierce Motor



4. Remove the cap-pierce motor.
5. If replacing the cap-pierce motor, go to the Cap-Pierce Motor Installation procedure.
6. If disassembling the cap-pierce door, go to the Front Door Safety Latch Removal procedure.

   Note: Before disassembling the cap-pierce door, you must remove the front door safety latch.

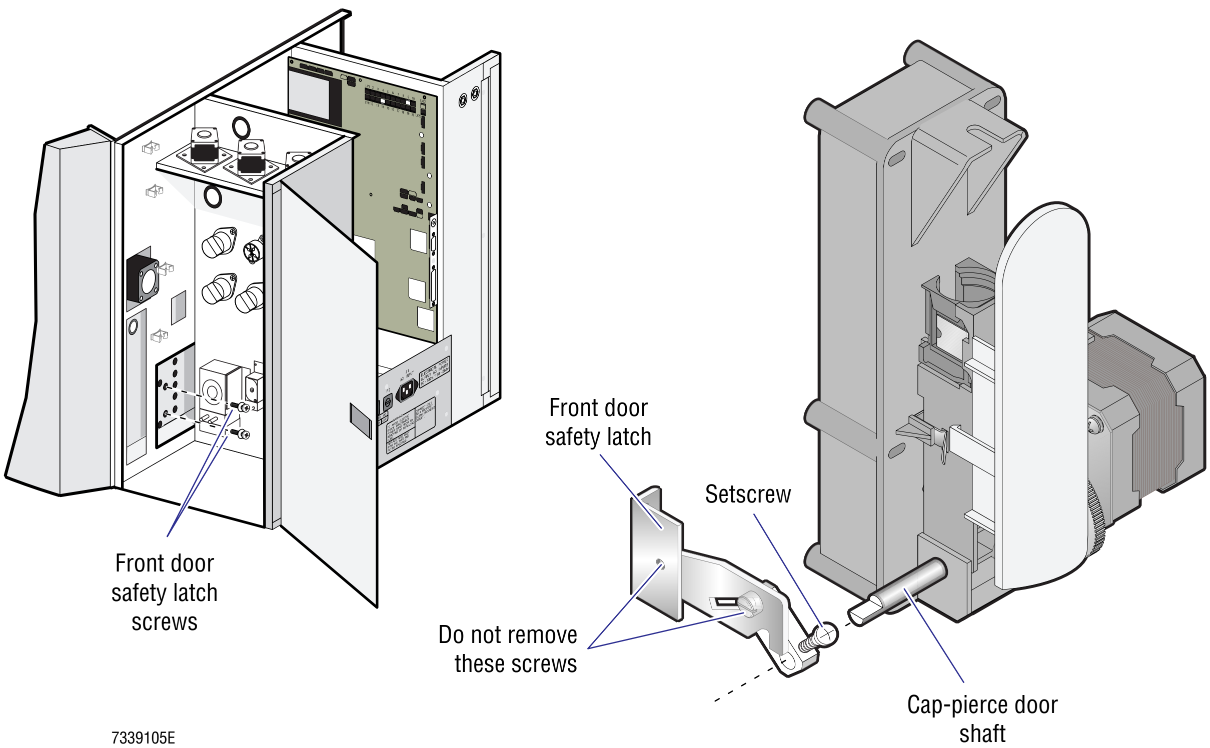
Front Door Safety Latch Removal

The front door safety latch is the "hook" type latch on the lower left of the Cap-Pierce module that prevents the front door of the instrument from opening when the cap-pierce door is open.

Note: You can remove the front door safety latch without removing the Cap-Pierce module.

1. If the Cap-Pierce module is still on the instrument:
   a. Open the right-side door of the instrument.
   b. In the right compartment, remove the two screws securing the front door safety latch to the front panel (Figure 4.17-3).

Figure 4.17-3 Front Door Safety Latch Removal



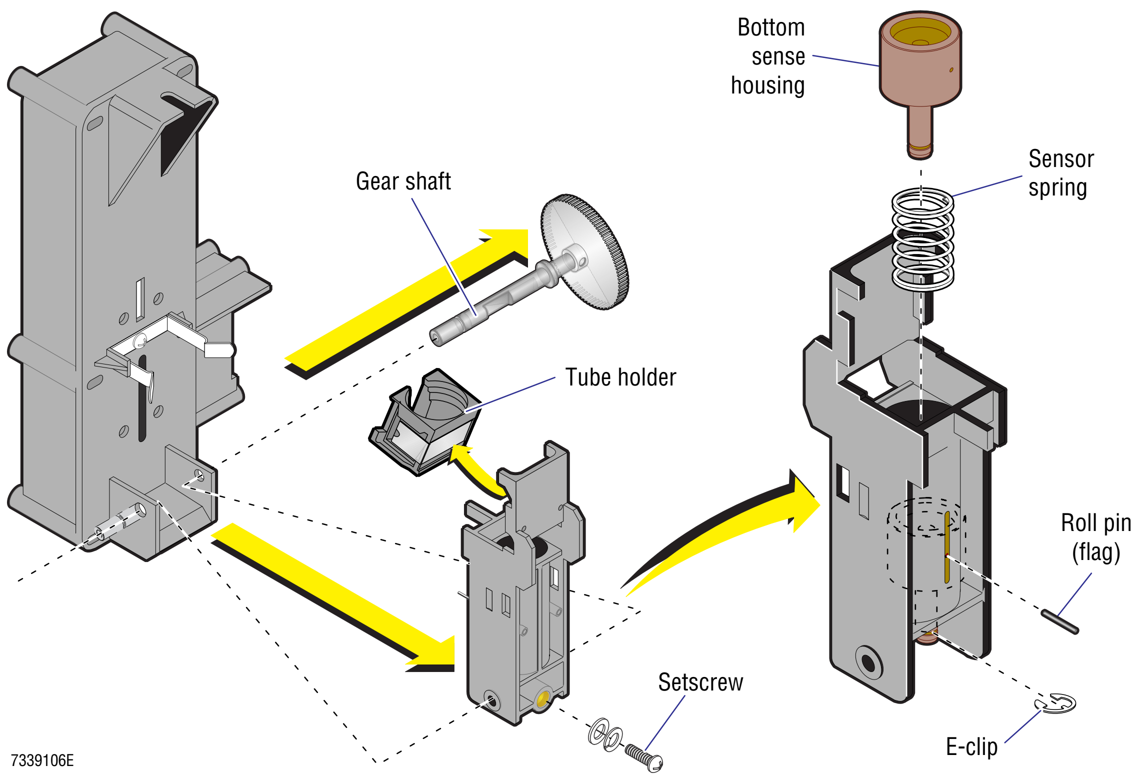
2. At the front door safety latch, loosen the Phillips-head setscrew securing the cam bracket to the cap-pierce door shaft (Figure 4.17-3).
3. Slide the entire safety latch assembly off the cap-pierce door shaft.

   Note: Unless it is necessary, DO NOT remove the two shoulder screws that hold the pieces of the safety latch together. These screws have a strong thread-lock compound on their threads and will fall out during normal instrument operation if the thread-lock compound is not intact.
4. If replacing the front door safety latch, go to the Front Door Safety Latch Installation procedure.
5. If disassembling the cap-pierce door, go to the Cap-Pierce Door Disassembly procedure.

Cap-Pierce Door Disassembly

1. Remove the motor as directed under Cap-Pierce Motor Removal.
2. Remove the front door safety latch as directed under Front Door Safety Latch Removal.
3. At the bottom front of the cap-pierce door, loosen the Phillips-head setscrew tightening the cap-pierce door to the gear shaft (Figure 4.17-4).
4. Slide the gear and shaft to the right to free the cap-pierce door from the Cap-Pierce module base bracket (Figure 4.17-4).

Figure 4.17-4 Disassembling the Cap-Pierce Door Assembly



5. Remove the tube holder from the top of the cap-pierce door assembly by sliding the lower end back and pivoting it on the top, front edge.
6. Using pliers, pull the roll pin, or flag, from the bottom sense housing (Figure 4.17-4).
7. Remove the E-clip from the bottom sense housing shaft through an opening in the bottom of the cap-pierce door assembly.
8. Remove the bottom sense housing and the sensor spring.
9. To reassemble the cap-pierce door, go to the Cap-Pierce Door Reassembly procedure.

Optical Sensor Removal

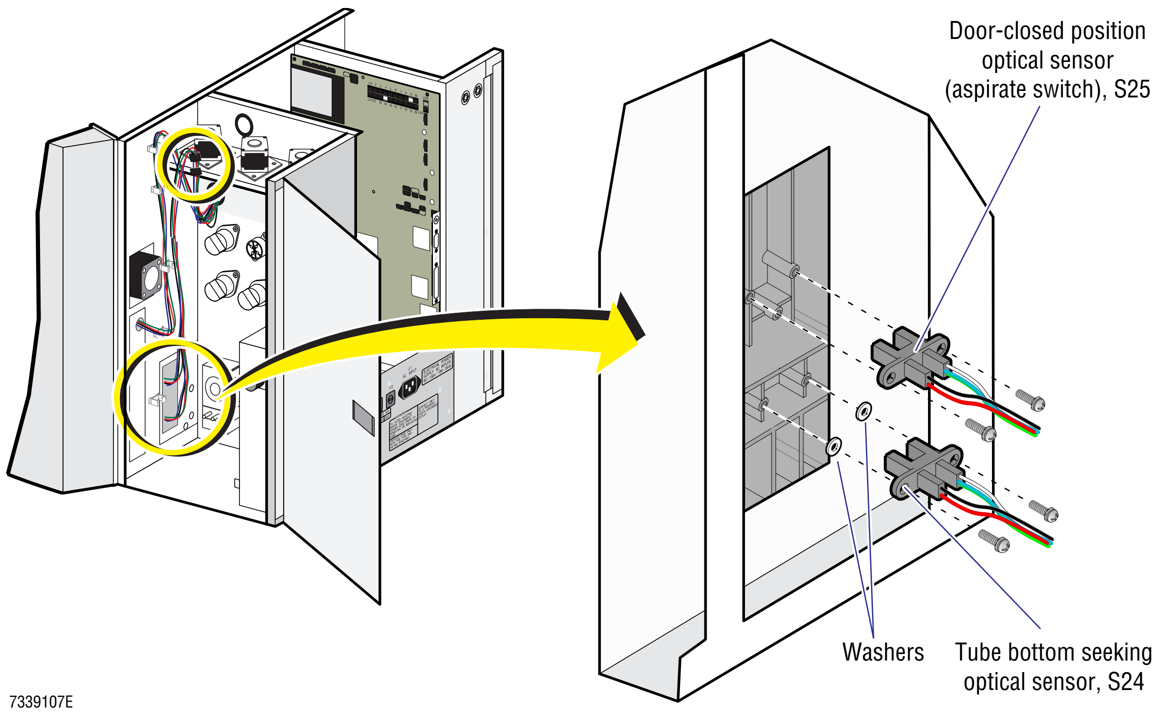
Note: You can remove the optical sensors without removing the Cap-Pierce module.

1. If the Cap-Pierce module has not been removed,
   a. Open the right-side door of the instrument.
   b. In the right compartment, disconnect the sensor to be replaced and free its wiring from any cable clamps (Figure 4.17-5).

      Note: The door-closed position and tube bottom seeking optical sensors are attached to the same wire harness as the cap-pierce door motor.

      - For the door-closed position optical sensor, S25, disconnect P25 from J25.
      - For the tube bottom seeking optical sensor, S24, disconnect P24 from J24.

Figure 4.17-5 Removing the Optical Sensors in the Cap-Pierce Module



2. Remove the two Phillips-head screws holding the sensor in place and remove the sensor (Figure 4.17-5).
3. To install the replacement sensor, go to the Optical Sensor Installation procedure.

Reassembly and Installation Procedures

Cap-Pierce Door Reassembly

1. In the tube holder opening in the cap-pierce door:
   a. Insert the sensor spring (Figure 4.17-4).
   b. Insert the bottom sense housing, ensuring the shaft end is down and the hole provided in the housing for the roll-pin flag is facing the slot in the cap-pierce door (Figure 4.17-4).
   c. While pushing the bottom sense housing down slightly against the spring tension, install the E-clip on the housing (Figure 4.17-4).
2. Insert the roll-pin flag through the slot in the cap-pierce door and into its hole in the bottom sense housing. This pin fits tightly and may need to be hammered completely into the housing.
3. If the cap-pierce door-spring clip is not installed, install the clip onto the front center of the base bracket with one Phillips-head screw.
4. Install the cap-pierce door onto the Cap-Pierce module base bracket:
   a. Line up the holes at the bottom of the cap-pierce door with the holes in the base bracket (Figure 4.17-4).
   b. Insert the gear and shaft from the right hand side until stopped by the E-clip on the shaft near the gear (Figure 4.17-4).
   c. Tighten the setscrew at the bottom front of the cap-pierce door against the flat of the gear shaft. This setscrew forces the cap-pierce door to move with the shaft and gear.
5. Install the tube holder in the top of the cap-pierce door. This piece clips into the top with a metal spring clip facing front (Figure 4.17-4).
6. Reinstall the cap-pierce motor and the front door safety latch. Go to the Cap-Pierce Motor Installation procedure.

Optical Sensor Installation

1. Position the replacement optical sensor and secure it with two Phillips-head screws (Figure 4.17-5).

   Note: If replacing the tube bottom seeking optical sensor (the lower sensor), make sure you also replace the washers. These washers are needed as spacers and must be positioned between the sensor and the instrument panel, **not** between the screw and the sensor (see Figure 4.17-5).
2. If the Cap-Pierce module is already installed on the instrument
   a. Connect the sensor to the wire harness in the right compartment (Figure 4.17-5)
      - For the tube bottom seeking optical sensor, connect P80 to J80.
      - For the door-closed position optical sensor, connect P98 to J98.
   b. Ensure the instrument is working correctly. Go to Verification.
3. If the Cap-Pierce module is not installed in the instrument, go to the Cap-Pierce Module Installation procedure.

Cap-Pierce Motor Installation

1. Fasten the replacement cap-pierce motor to its bracket with four screws (Figure 4.17-2).
2. Fasten the cap-pierce motor bracket to the Cap-Pierce module base bracket with four screws (Figure 4.17-2).
3. If the Cap-Pierce module is already installed on the instrument, connect the cap-pierce door motor cable connector, P25, to the inline connector, J25, in the wire harness in the right compartment (Figure 4.17-2).
4. If the front door safety latch and the Cap-Pierce module are both installed, ensure the instrument is working correctly. Go to Verification.
5. If the front door safety latch is not installed, go to the Front Door Safety Latch Installation procedure.
6. If the front door safety latch is installed but the Cap-Pierce module is not, go to the Cap-Pierce Module Installation procedure.

Front Door Safety Latch Installation

1. Slide the cam bracket onto the end of the cap-pierce door shaft.
2. In the right side compartment, fasten the latch mounting bracket to the front panel with two screws.
3. Tighten the setscrew that fastens the cam bracket to the cap-pierce door shaft.
4. If the Cap-Pierce module is installed, ensure the instrument is working correctly. Go to Verification.
5. If the Cap-Pierce module is not installed, go to the Cap-Pierce Module Installation procedure.

Cap-Pierce Module Installation

1. Fasten the base bracket to the instrument front panel with the bottom two screws. Do not fully tighten screws at this time (Figure 4.17-1).
2. Hold the finger guard in place and fasten the finger guard and the base bracket to the instrument front panel with four screws, two at the center of the bracket and two at the top. Snug, but do not fully tighten the screws at this time.
3. If you are replacing the entire Cap-Pierce module, in the right compartment:
   a. Fasten the front door safety latch mounting bracket to the front panel with two screws (Figure 4.17-1).
   b. Connect the cap-pierce door motor cable connector, P25, to the inline connector, J25, in the wire harness.

      Note: The wiring for the cap-pierce motor and the door-closed position and tube bottom seeking optical sensors are attached to the same wire harness (Figure 4.17-1).
   c. Connect the optical sensors to the wire harness:
      - For the tube bottom seeking optical sensor, connect P80 to J80.
      - For the door-closed position sensor, connect P98 to J98.

4. Verify the alignment of the cap-pierce probe and the tube. Go to Heading 4.18, CAP-PIERCE PROBE/TUBE ALIGNMENT - AC•T diff 2 ANALYZER.

Verification

1. Plug the power line cord into an appropriate wall outlet and turn the instrument on (**I**).
2. Ensure that the instrument attains a ready state. Troubleshoot any errors before continuing.
3. Verify the alignment of the probe and tube.
   - If you changed the position of the Cap-Pierce module base bracket, go to Heading 4.18, CAP-PIERCE PROBE/TUBE ALIGNMENT - AC•T diff 2 ANALYZER.
   - If you did not change the position of the Cap-Pierce module base bracket, go to step 4.
4. Access the Motors screen. Select **Main** icon ▸▸ **Diagnostics Functions** icon ▸▸ **Motors** icon.
5. Manually move the probe housing up and to the left.
6. Ensure the probe is not in any vertical sensor, that is that PV, PT, and PD are OFF.
7. Verify that the tube bottom seeking optical sensor is working. With the cap-pierce door still closed, push down on the specimen tube until PD indicates ON.
8. Exit the Diagnostics Functions screen.
9. If a startup cycle was not done automatically when you turned on the power, do a startup cycle.
10. Close the front door.
11. Cycle a capped specimen in the Closed-Vial mode to ensure proper mechanical operation.
12. Verify, or have the customer verify, the instrument's performance by running the appropriate control materials in the Closed-Vial mode.

4.18 CAP-PIERCE PROBE/TUBE ALIGNMENT - AC•T diff 2 ANALYZER

Purpose

Use this procedure to ensure that the probe pierces the specimen tube caps in the center. This is particularly important if small volume tubes are being used. Do this procedure whenever:

- You have loosened or removed the
  - Cap-Pierce module
  - Traverse module
  - Traverse housing guide rod
- The probe is visibly piercing off-center.

Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver
- ❑ A specimen tube with a clearly delineated center on the cap, or a control vial

  Note: You can use the circular hole in the plastic portion of a control-vial cap to visually center the probe.
- ❑ Whole-blood specimen in a capped specimen tube

Front to Back Alignment

1. Turn the instrument off (**O**) and unplug the power line cord from the wall outlet.
2. Open the front door. See Opening the AC•T diff 2 Analyzer's Front Door under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
3. Insert a specimen tube with a clearly delineated center, or a control vial, in the cap-pierce assembly tube holder.
4. Manually move the probe housing until the probe is laterally centered above the specimen tube, then move the probe down until it is near the cap.

   Note: Positioning the probe close to the cap makes it easier to see when the probe is centered.
5. Loosen the screw at the right end of the traverse bracket that fastens the traverse housing guide rod to the traverse bracket.
6. Move the traverse guide bar in or out until the probe is centered on the tube cap, from front to back. Tighten the bar in this position.
7. Manually move the probe up and then move the probe housing to a central location between the open-vial and closed-vial positions.
8. Plug the power line cord into an appropriate wall outlet and turn the instrument on (**I**).
9. Verify the probe is centered with the tube from side to side. Go to Side to Side Alignment.

Side to Side Alignment

1. Access the Motors screen. Select **Main** icon ▸▸ **Diagnostics Functions** icon ▸▸ **Motors** icon.
2. Locate the status field for sensor PCV (probe closed vial).

3. With the specimen tube used for centering the probe from front to back still in the tube holder, close the cap-pierce door.
4. Loosen, but do not remove, the six screws securing the Cap-Pierce module to the instrument front panel.
5. Manually move the probe housing to a central location on the traverse. The PCV sensor should be OFF.
6. Ensure the probe is up, then press motor function M6-PCV to move the probe housing to the closed-vial position. The PCV sensor should be ON.
7. Manually move the probe down until it is close to the specimen tube cap.

   Note: Positioning the probe close to the cap makes it easier to see when the probe is centered.
8. Move the entire Cap-Pierce module until the probe is centered on the cap, from left to right. Tighten the module in this position.
9. If you are unable to center the probe with the cap:
   a. Loosen, but do not remove, the screws securing the Traverse module.
   b. Move the entire Traverse module until you can center the probe.
   c. Tighten the Traverse module and repeat step 8 as necessary.
   d. Verify the Closed-Vial mode is working correctly. Go to Verification.

Verification

1. Move the probe housing up and to the left.
2. Press motor function M9-PUP (probe up position) to move the probe to the up position. (PV should be ON).
3. Press motor function M6-PCV to move the probe to the closed-vial position. Sensor PCV should be ON.

CAUTION Motor functions M10-PDHC and M20-DCHC leave holding current applied to the motor after motion has stopped. Doing motor functions M10-PDHC or M20-DCHC without doing the opposite function within 1 minute can damage the driver circuit on the Analyzer card or the stepper motors. Do motor function M9-PUP within 1 minute of doing M10-PDHC. Do motor function M21-DOPN within 1 minute of doing M20-DCHC.

4. Press motor function M20-DCHC (door closed holding current) to apply holding current to keep the cap-pierce door closed.
5. Press motor function M10-PDHC (probe down holding current) to move the probe to the down position, piercing the tube cap on the way, and to apply holding current to keep the probe down.
6. Ensure the probe pierced the tube in the center of the cap.
7. Press M9-PUP to move the probe up and M21-DOPN (door open) to open the cap-pierce door.
8. Exit the Motor Functions screen.
9. Run a sample from a capped specimen tube in the Closed-Vial mode and verify the tube is pierced correctly.

4.19 PUMP CORRECTION FACTOR (PCF) DETERMINATION

Purpose

The sample pump uses a partial revolution to aspirate sample from a specimen tube. Accuracy of the aspirated sample volume depends on proper positioning of the sample pump's home sensor.

Setting the home sensor position in a sample pump to an exact location consistently is difficult from pump to pump. A pump correction factor (PCF) is used by the instrument to offset these possible inaccuracies.

Use this procedure to determine the PCF for a sample pump:

- After installing a new sample pump.
- If the PCF is lost and must be determined again; however, this procedure should not need to be repeated until another pump is installed.

Tools/Supplies Needed

- ❑ Normal whole-blood specimen or COULTER 4C PLUS Normal cell control

Procedure

1. Select **Verify Predilute** (**Main** icon ▸▸ **Diagnostics** icon ▸▸ **Verify Predilute** icon).
2. Make two dilutions of the same specimen in one container to provide sufficient prediluted specimen for 11 cycles.
3. Select the **Predilute Mode** icon from the Main screen.
4. Select the **Reproducibility** icon (**Main** icon ▸▸ **QA Functions** icon ▸▸ **Reproducibility** icon).
5. Run the prediluted specimen 11 times and record the results.
6. Calculate the WBC, RBC, and Hgb mean values obtained using the prediluted specimen.
7. Exit to the Main screen and select the **Whole Blood, Closed Vial Mode** icon.
8. Select the **Reproducibility** icon (**Main** icon ▸▸ **QA Functions** icon ▸▸ **Reproducibility** icon).
9. Run the original whole-blood specimen 11 times in the Closed-Vial mode and record the results.
10. Calculate the WBC, RBC, and Hgb mean values obtained using whole-blood.
11. Calculate the PCF by dividing the whole-blood Hgb mean by the predilute Hgb mean.

$$\text{PCF} = \frac{\text{Whole-Blood Hgb Mean}}{\text{Predilute Hgb Mean}}$$

12. Verify the PCF value meets the following criteria.
    - PCF must be within the range 0.85 to 1.15.
    - Divide the whole-blood WBC mean by the predilute WBC mean. The result must be within 0.07 of the PCF.
    - Divide the whole-blood RBC mean by the predilute RBC mean. The result must be within 0.07 of the PCF.

13. If the results are acceptable, enter the pump correction factor in the instrument.
    a. Select **Latex Calibration** (**Main** icon ▸▸ **Diagnostics** icon ▸▸ **Latex Calibration** icon). This factor is located on the first Latex Procedure screen with the amplifier gains.
    b. Enter the PCF value calculated in step 11.
    c. Select **Save and Exit** to save the PCF value and return to the Main screen. It is not necessary to perform a latex procedure at this time.
14. Verify the instrument is working correctly. Go to Verification.

Verification

1. Select **Verify Predilute** (**Main** icon ▸▸ **Diagnostics** icon ▸▸ **Verify Predilute** icon).
2. Make a dilution of the whole blood specimen or control.
3. Select the **Predilute Mode** icon from the Main screen.
4. Select the **Reproducibility** icon (**Main** icon ▸▸ **QA Functions** icon ▸▸ **Reproducibility** icon).

IMPORTANT Risk of compromised results possible due to short sample on the fifth run. Ensure the aspirate probe is completely submerged before initiating the fifth cycle.

5. Run the prediluted specimen five times and record the results.
6. Calculate the RBC and Hgb mean values obtained using the prediluted specimen.
7. Exit to the Main screen and select the **Whole Blood, Closed Vial Mode** icon.
8. Select the **Reproducibility** icon (**Main** icon ▸▸ **QA Functions** icon ▸▸ **Reproducibility** icon).
9. Run the original whole blood or control specimen five times in the Closed-Vial mode and record the results.
10. Calculate the RBC and Hgb mean values obtained using whole-blood.
11. Verify that the RBC and Hgb mean values for the Predilute and Closed-Vial modes compare within 5%.

4.20 FMI PUMP DECRYSTALLIZATION

Purpose

FMI pumps can dry out. If salt crystallizes within the tight seal between the ceramic piston and the liner, it will seize the assembly which will inhibit reagent delivery. Of the three FMI pumps, the diluent FMI pump is the pump most likely to dry out. Use this procedure to dissolve the crystallized salt bond.

Tools/Supplies Needed

- ❑ Syringe with attached tubing

  Note: Use of polyurethane tubing with an internal diameter large enough to fit securely, but snugly over the pump fitting will maximize the pressure application.

- ❑ Control or a specimen with known values (for verification purposes)

Procedure

1. Fill a syringe with warm or hot tap water.
2. Open the right side door and use Figure A.5-2 to locate the suspect FMI pump.
3. At the pump, remove the tubing from the outboard fitting (the fitting closest to you).
4. Attach the syringe to the fitting and apply pressure (slight to medium) for one to two minutes.

   Note: Due to the structure of the FMI pump, there will be no discernible movement of liquid from the syringe into the pump; however, the pressure being applied is forcing the hot water to mix with the reagent inside the pump. The hot water acts as a solvent and dissolves the salt crystals binding the ceramic piston to the liner.

5. Detach the syringe and reattach the pump's tubing.
6. Cycle the instrument to confirm proper reagent delivery.
   a. If reagent delivery appears normal, run a control or a fresh blood specimen with a known value and verify the proper parameter results are being recovered.
   b. If reagent delivery is still compromised, either repeat steps 1 through 6 or proceed to Soaking the Pump Head.

Soaking the Pump Head

ATTENTION: Only in extreme cases should it be necessary to soak the pump head to dissolve the salt bond.

Tools/Supplies Needed

- ❑ #2 Phillips-head screwdriver
- ❑ Sturdy container such as a tri-pour or glass beaker
- ❑ Control or a specimen with known values (for verification purposes)

FMI Pump Removal

1. Turn the instrument off (**0**) and unplug the power line cord from the wall outlet.

2. Remove the top cover and rear panel to access the FMI pump. Refer to Removal (AC•T diff 2 Analyzer) under the Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover portion of Heading 4.2.
3. At the pump, remove the tubing from the inboard fitting (near the inner panel) as well as the outboard fitting.
4. At the motor end of the pump, gently disconnect the white plug from the motor.

   Note: The sample pump does not have a removable plug at the motor. To disconnect this pump's plug, locate M5 in the upper right section of the Analyzer card. Disconnect WM5 from M5 and free the wiring for removal with the pump. If needed, see Figure A.2-3, Analyzer Card Component Locations - AC•T diff 2 Analyzer to locate this connection.
5. Remove the two #2 Phillips-head screws that mount the pump to the shock absorbers.
6. Remove the pump from the instrument.

CAUTION Risk of damage to the FMI pump. Exposure to water may damage the metal and/or electronic portions of the FMI pump. Make sure water contact is limited to the pump's side fittings and the housing below these side fittings. The water level for soaking the pump head must fall below the aluminum retainer that surrounds the pump's housing just above its side fittings.

7. Submerge the pump's fittings in a container of hot water that is positioned such that the container will not tip over due to the heavy top weight of the pump.
8. Allow the pump to soak for several hours to dissolve the salt bond.
9. Remove the pump head from the water and carefully wipe it dry using lint free tissues.

Reinstalling the FMI Pump

1. Insert the pump through the panel opening. With the motor's plug oriented towards the front of the instrument, line up two of the four mounting holes with the shock absorbers.
2. Secure the FMI pump mount to the shock absorbers using two #2 Phillips-head screws.
3. Reconnect the plug to the motor.
4. Carefully reattach each tubing to its proper fitting.
5. Replace the top cover and real panel. Refer to Installation (AC•T diff 2 Analyzer) under the Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover portion of Heading 4.2.
6. Plug the power line cord into an appropriate wall outlet and turn the instrument on (**I**).

Verification

1. As the Powerup cycle progresses, verify reagent delivery appears normal.
2. When the Powerup and Startup cycles are complete, verify the background results are acceptable.
   a. If operation appears normal, run a control or a fresh blood specimen with a known value and verify the proper parameter results are being recovered.
   b. If reagent delivery is still compromised, the pump may need to be replaced.

4.21 INSTRUMENT DECONTAMINATION

Purpose

Use this procedure to decontaminate the instrument's diluent delivery system whenever you suspect contamination is the cause of elevated background counts.

ATTENTION: Throughout this decontamination procedure, handle the pickup tubes carefully to avoid recontaminating the system. To avoid contamination in the future, always place the pickup tubes on a known clean surface or material when changing the reagents and stress this action to the operator.

Tools/Supplies Needed

- ❑ One diluent pickup tube, PN 6805685 for the A^C•T Pak reagent, or PN 6805771 for the A^C•T Tainer reagent
- ❑ One diluent reservoir with float, PN 6806261
- ❑ Two liters 5% acetic acid (white distilled vinegar)
- ❑ One empty reagent container (for waste)
- ❑ Two liter distilled water
- ❑ Two 20 mL syringes
- ❑ One fresh reagent supply (Pak or Tainer)

Procedure

WARNING Failure to adhere to the following procedure could mix reagents with acetic acid, exposing you and your customer to hazardous chemicals. Follow the procedure exactly as written.

Flushing Out the Old Reagents

1. Turn the instrument off (**O**).
2. Manually drain the diluent reservoir with a 20 mL syringe.
3. Remove and discard the old diluent (reagent 1) pickup tube.
4. Install a new diluent pickup tube, placing the pickup end in a small container of distilled water.
5. Remove the lytic reagent (reagent 2) and cleaning agent (reagent 3) pickup tubes from their reagent containers and place them in the container of distilled water.
6. Turn the instrument on (**I**) and wait until the instrument status returns to ready or the Main screen.

   Note: Correct any reagent low error messages.
7. Do the dry lytic reagent function four times. (On the Main screen, press **Diluter Functions** icon ▸▸ **Dry Prime Lytic Reagent** icon.)
8. Do two Shutdown cycles. (On the Main screen, press **Shutdown** icon.)

   Note: Each Shutdown cycle includes a Startup cycle.
9. Turn the instrument off (**O**).
10. Manually drain the diluent reservoir with a 20 mL syringe.

11. Remove and discard the diluent reservoir.
12. Install the new diluent reservoir.

WARNING Mixing reagents with acetic acid, could expose you and your customer to hazardous chemicals. Do not allow waste containing acetic acid to be routed into a waste container containing lytic reagent, nor into a sink or open drain. Remove any waste container containing lytic reagent from the instrument.

13. Remove the instrument waste line from its waste container or drain (whichever is applicable) and route it to an empty (lytic reagent free) waste container.
14. Go to Decontaminating with Acetic Acid.

Decontaminating with Acetic Acid

1. Place the diluent pickup tube in a container of acetic acid. Leave the lytic reagent and cleaning agent pickup tubes submerged in distilled water.
2. Turn the instrument on (**I**) and wait until the instrument status returns to ready or the Main screen.

   Note: Correct any reagent low error messages.
3. Do the sweep-flow prime function four times. (On the Main screen, press **Diluter Functions** icon ▸▸ **Sweep Flow** icon.)
4. Do four Startup cycles to completely flush the system with acetic acid. (On the Main screen, press **Startup** icon.)
5. Turn the instrument off (**O**).
6. Allow acetic acid to remain in the system for 1 hour.
7. Go to Flushing Out the Acetic Acid.

Flushing Out the Acetic Acid

1. Manually drain the diluent reservoir with the 20 mL syringe.
2. Discard the used syringe, and obtain a fresh, clean 20 mL syringe.
3. Rinse the diluent reservoir twice with distilled water using the clean 20 mL syringe. Leave the reservoir empty.
4. Place the syringe and tubing on a clean surface to avoid contaminating them.
5. Remove the diluent pickup tube from the acetic acid and rinse it with distilled water.
6. Place the diluent pickup tube back in the container of distilled water with the lytic reagent and cleaning agent pickup tubes.
7. Turn the instrument on (**I**) and wait until the instrument status returns to ready or the Main screen.

   Note: Correct any reagent low error messages.
8. Do the sweep-flow prime function six times. (On the Main screen, press **Diluter Functions** icon ▸▸ **Sweep Flow** icon.)
9. Do two Shutdown cycles. (On the Main screen, press **Shutdown** icon.)

   Note: Each Shutdown cycle includes a Startup cycle.

10. Do six Startup cycles to completely flush out the distilled water. (On the Main screen, press the **Startup** icon.)
11. Turn the instrument off (**O**).
12. Manually drain the diluent reservoir with the 20 mL syringe.
13. Remove the waste container used to collect the acetic acid solution and reinstall the original waste container or return the waste line to the sink drain (whichever is applicable).
14. Go to Installing New Reagents and Checking the Instrument.

Installing New Reagents and Checking the Instrument

1. Remove all the pickup tubes from the distilled water, being careful not to contaminate them, and install them into a fresh reagent container (A^{C}•T Pak or A^{C}•T Tainer reagents).
2. Turn the instrument on (**I**) and wait until the instrument status returns to ready or the Main screen.

   Note: Correct any reagent low error messages.
3. Do the sweep-flow prime function four times. (On the Main screen, press **Diluter Functions** icon ►► **Sweep Flow** icon.)
4. Do three Shutdown cycles. (On the Main screen, press **Shutdown** icon.)

   Note: Each Shutdown cycle includes a Startup cycle.
5. Do two Startup cycles. (On the Main screen, press **Startup** icon.)
6. On the final startup cycle, verify the background counts are within limits.
7. Do Heading 4.12, LATEX GAIN ADJUSTMENT - AC•T diff AND AC•T diff 2 ANALYZERS, and make adjustments if necessary.
8. Do Heading 4.13, SETTING CLOG DETECTION TARGET VALUES - AC•T diff AND AC•T diff 2 ANALYZERS, and make adjustments if necessary.
9. Do a Reproducibility run and verify all the results are within specifications.
10. Cycle patient samples and verify the results and the histogram (if applicable) are acceptable.

4.22 PREAMP DUMMY LOAD TEST

Purpose

Use this procedure as a troubleshooting tool to help determine if problems affecting the test results are in the pneumatic/hydraulic system or in the electronic system.

Tools/Supplies Needed

- ❑ Two Coax Load Cable Assemblies (dummy loads), PN 6029105

Procedure

1. Turn the instrument off (**0**) and unplug the power line cord from the wall outlet.
2. To access the Analyzer card (Figure 4.4-2), remove the top cover and rear panel as directed in the procedure for Removing the AC•T 8/10 and AC•T diff Analyzers' Top Cover and Rear Panel or for Removing the AC•T diff 2 Analyzer's Top and Rear Center Cover under Heading 4.2.
3. On the Analyzer card, disconnect the RBC and WBC aperture cables from J7 and J8, respectively.

   For the exact locations of these connectors, refer to Figure A.2-1, Analyzer Card Component Locations - AC•T 8/10 Analyzers; Figure A.2-2, Analyzer Card Component Locations - AC•T diff Analyzer; or Figure A.2-3, Analyzer Card Component Locations - AC•T diff 2 Analyzer.
4. Connect the Coax Load Cable Assemblies to J7 and J8 on the Analyzer card.
5. Reinstall the top cover and rear panel as directed in Installation (AC•T 8/10 and AC•T diff Analyzers) or Installation (AC•T diff 2 Analyzer) under Heading 4.2, OPENING OR REMOVING INSTRUMENT DOORS, PANELS, AND COVERS.
6. Plug the power line cord into the ac wall outlet and turn the instrument on (**I**).
7. Cycle a sample of air and verify the directly measured parameter results are zero and the histograms on the A^{C}•T diff and A^{C}•T diff 2 analyzers have no populations or "spikes".
   - If the test passed, the problem is probably in the pneumatic/hydraulic system.
   - If the test failed, the problem is probably in the electronic system, possibly a malfunction of the Analyzer card or the Power Supply module.
8. Turn the instrument off (**0**) and unplug the power line cord from the wall outlet.
9. Remove the top cover and rear panel to access the Analyzer card.
10. On the Analyzer card:
    a. Disconnect the Coax Load Cable Assemblies from J7 and J8.
    b. Reconnect the RBC and WBC aperture cables to J7 and J8, respectively.
11. Troubleshoot and correct the problem. When you are finished:
    a. Reinstall the top cover and rear panel.
    b. Plug the power line cord into the ac wall outlet and turn the instrument on (**I**).

5 MAINTENANCE PROCEDURES, 5.1-1

5.1 RECOMMENDED MAINTENANCE SCHEDULE, 5.1-1

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5.1-2 Recommended Maintenance Schedule - A[C]•T diff 2 Analyzers, 5.1-1

5.1 RECOMMENDED MAINTENANCE SCHEDULE

Perform maintenance for the A^{C}•T 8/10 and A^{C}•T diff analyzers according to the schedule in Table 5.1-1. Perform maintenance for the A^{C}•T diff 2 analyzers according to the schedule in Table 5.1-2.

Table 5.1-1 Recommended Maintenance Schedule - A^{C}•T 8/10 and A^{C}•T diff Analyzers

Component	Replacement Interval	Person Responsible for Replacement
Aperture/bath assembly	Every 3 years	Service personnel
Dual diluent filters	Every 6 months **or** every 5,000 cycles	Customer
Hgb lamp	Every 3 years	Service personnel
Pump filter (FLS1, FLS3) - blue fluid diluent (2)	Every 12,000 cycles **or** when replacing associated tubing	Customer
Pump filter (FLS2) - blue fluid shutdown diluent	Every year	Customer
Tubing	Every 3 years	Service personnel
Peristaltic tubing	Every 12,000 cycles	Customer
Syringe piston seals	Every 12,000 cycles	Customer

Table 5.1-2 Recommended Maintenance Schedule - A^{C}•T diff 2 Analyzers

Component	Replacement Interval	Person Responsible for Replacement
Aperture/bath assembly	Every 3 years	Service personnel
Dual diluent filters	Every 6 months **or** every 5,000 cycles	Customer
Hgb lamp	Every 3 years	Service personnel
Waste filter	As required	Customer

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6.1 SCHEMATICS REQUIRED, 6.1-1

6.1 SCHEMATICS REQUIRED

The following is a list of the engineering schematics you need for troubleshooting the A^{C}•T Series instruments. Two tubing lists (production tubing instructions) are also included.

Name	**PN**
Pneumatic/Hydraulic, A^{C}•T 8/10 and A^{C}•T diff Analyzers HYDRO-PNEU, Ac.T SERIES	6323083
Pneumatic/Hydraulic, A^{C}•T diff 2 Analyzers CB8 - HYDRO-PNEU, Ac.T SERIES	6323266
System Interconnect, A^{C}•T 8/10 Analyzer INTERCON. DIAG. SYS. ELECT. CB1	6323157
System Interconnect, A^{C}•T diff Analyzer INTERCON. DIAG. SYS. ELECT. CB2	6323257
System Interconnect, A^{C}•T diff 2 Analyzer INTERCON. DIAG. SYS. ELECT. CB8	6323521
Power Supply, A^{C}•T 8/10 Analyzer UNIVERSAL ELECTRICAL PWR SUPPLY	6322902
Power Supply, A^{C}•T diff Analyzer UNIVER. ELECT. PWR SUPPLY CB2	6323265
Analyzer Card Schematic, A^{C}•T 8/10 Analyzer ANALYZER	6322891
Display Controller Driver, A^{C}•T Series Analyzers (old) KEYPAD/DISPLAY	6322910
Analyzer Card Schematic, A^{C}•T diff analyzer ANALYZER SMT CARD*	6323022
Analyzer Card Schematic, A^{C}•T diff 2 analyzer ANALYZER SMT CARD*	6323409
Tubing List, A^{C}•T 8/10 and A^{C}•T diff analyzers	6323129
Tubing List, A^{C}•T diff 2 analyzers	6323548

* **Note:** These are surface-mount boards and cannot be repaired in the field.

Electronic (.pdf) files of these schematics are available on a separate CD-ROM in the Service Resource Kit (SRK) and in a Lotus Notes® database. The schematics in the SRK are the latest revisions available at the time the SRK is released. For copies of schematics released between revisions of the SRK, check the Lotus Notes database. It will always have the most current revisions.

Note: Depending on the configurations of this instrument in the field, more than one revision of a schematic can be valid.

If you want to include schematics in the printed version of this manual, make printouts of the electronic files and insert them at the end of this chapter.

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7.1 DIAGNOSTICS MENU

The Diagnostics menu (Figure 7.1-1 for the A^{C}•T 8/10 analyzer, Figure 7.1-2 for the A^{C}•T diff/Veterinary option analyzer, and Figure 7.1-3 for the A^{C}•T diff and A^{C}•T diff 2 analyzers) provides information and manual control of many instrument functions that are needed to adjust or troubleshoot the instrument.

Figure 7.1-1 Diagnostics Menu, A^{C}•T 8/10 Analyzer

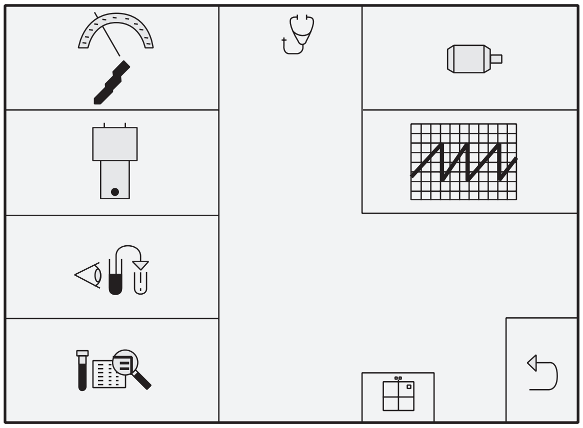

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Figure 7.1-2 Diagnostics Menu, A^{C}•T diff/Veterinary Option Analyzer

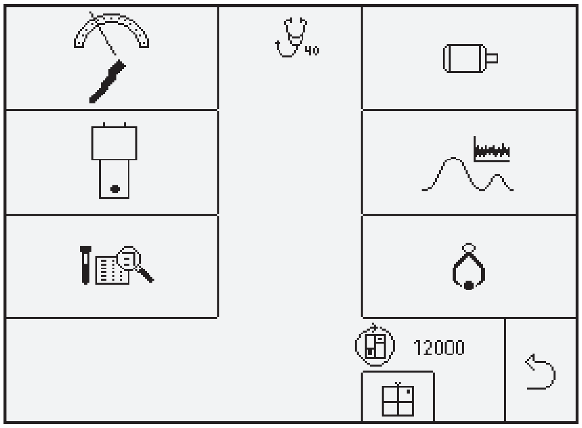

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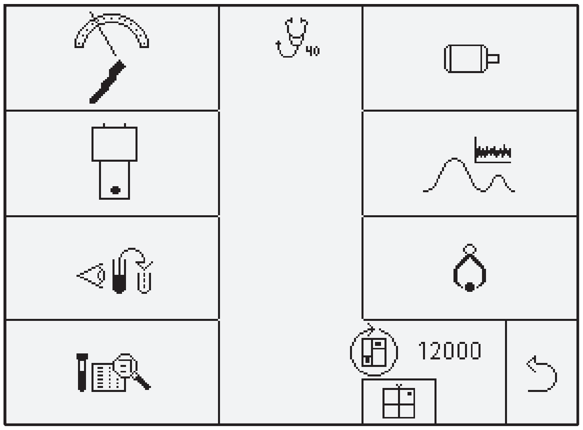
Figure 7.1-3 Diagnostics Menu, A^{C}•T diff and A^{C}•T diff 2 Analyzers



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Individual control of instrument components is possible from the Solenoids screen and the Motors screen. If any instrument functions are used, the instrument state is unknown. To ensure that the instrument is ready to run a cycle, the Powerup cycle is automatically performed when leaving the Diagnostics menu.

Voltages/Sensors Screen

The Voltages/Sensors screen (Figure 7.1-4 for the AC•T 8/10 analyzer, Figure 7.1-5 for the AC•T diff analyzer, and Figure 7.1-6 for the AC•T diff 2 analyzer) provides information about the instrument state that can be used for troubleshooting. Voltages, sensors, Hgb amplifier gain, and vacuum are displayed on this screen. The reagent temperature in the diluent reservoir is also indicated. This value is not currently used by the AC•T 8/10 analyzer's software but it is used by the clog detection algorithm on the AC•T diff and AC•T diff 2 analyzer. A description of each screen item by its screen name follows Figure 7.1-6.

Figure 7.1-4 Voltages/Sensors Screen - AC•T 8/10 Analyzer

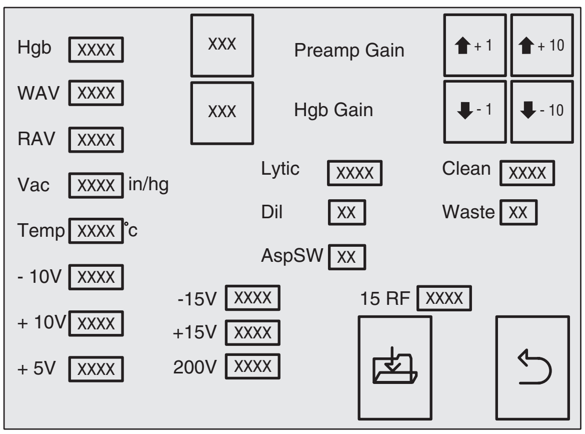

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Figure 7.1-5 Voltages/Sensors Screen - AC•T diff Analyzer

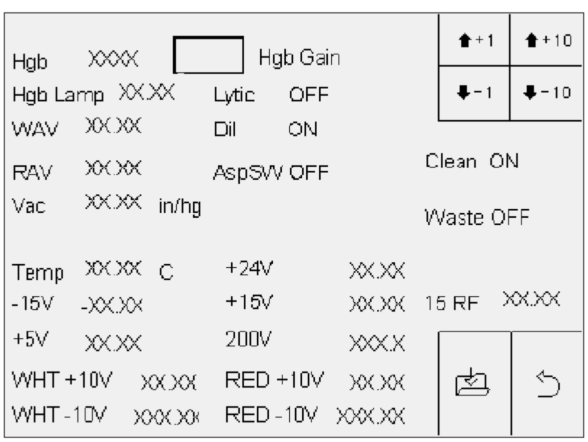

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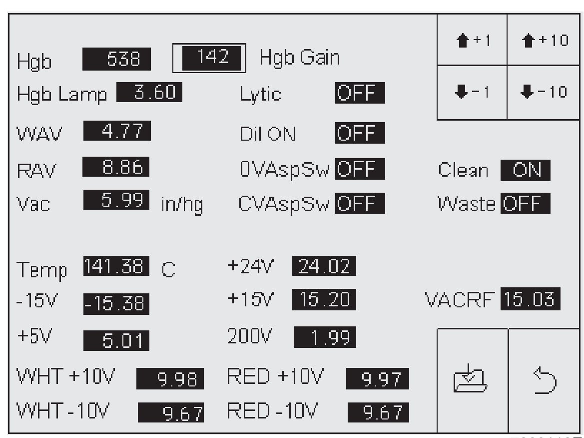
Figure 7.1-6 Voltages/Sensors Screen - AC•T diff 2 Analyzer



7339113E

Hgb

This value represents the Hgb amplifier output or "Amp Out." It is given in A/D units rather than voltage. For a rough conversion to mV, consider that 5.0 V is represented by 4095 A/D units, the highest possible output from the A/D chip. While in the Voltages/Sensors screen, you can adjust and save the Hgb value. Adjust the gain so that the output with clean diluent in the WBC bath is 3700 ±100. This represents the Hgb blank reading. Although the gain can be set manually while in the Voltages/Sensors screen, it is adjusted automatically during the Startup cycle when it is outside the range of 2867 to 4090 A/D units. This ensures that the Hgb blank level is checked at least once a day when the instrument is in use and is adjusted automatically when required.

Preamp Gain and Hgb Gain - A^{C}•T 8/10 Analyzer

The Hgb amplifier is a two-stage amplifier. Adjustment has been provided for both amplifier stages, one called the preamp gain, the other called the Hgb gain. The numbers displayed on the Voltages/Sensors screen are indicators of the gain for that amplifier, with a higher number indicating a higher gain. Set the amplifiers so that the Hgb blank output is near 3700 ±100. Any combination of the two amplifier gains may be used.

To the right of the *Preamp Gain* and the *Hgb Gain* screen labels are up/down arrows used to adjust Hgb gain. To adjust either gain, first select that gain by touching the gain number. This highlights the gain and it can then be adjusted by touching the up/down arrow boxes. The +1 and -1 boxes move the selected gain up or down by one unit respectively, while the +10 and -10 boxes move the gain up or down by ten units respectively. When adjustment is completed, use the **Save and Exit** icon to save the new value and exit the screen. Using the **Exit** icon alone does **not** save results. Using the **Exit** icon allows the screen to revert to the gain data the instrument housed before you entered the screen.

Hgb Gain - A^{C}•T diff and A^{C}•T diff 2 Analyzers

The Analyzer cards used by the A^{C}•T diff and A^{C}•T diff 2 analyzers provide only one Hgb amplifier. This gain is labeled *Hgb Gain* on the Voltages/Sensors screen. Adjusting the *Hgb Gain* on the A^{C}•T diff and A^{C}•T diff 2 analyzers is the same as described under Preamp Gain and Hgb Gain - A^{C}•T 8/10 Analyzer for adjusting the Preamp Gain and the Hgb Gain on the A^{C}•T 8/10 analyzer, except that there is only one gain to adjust.

WAV and RAV

The red and white aperture voltages are measured voltages across the external and internal electrodes. They indicate aperture impedance for their respective aperture. An aperture voltage reading varies with the volume of electrolyte through the aperture. Decreases from the normal reading for that aperture could indicate a cracked aperture. An increased reading could indicate a partial plug or an aperture with severe protein buildup. Typical readings are 5 V to 6 V for WAV and 10 to 11.5 V for RAV. Readings vary depending on the aperture size.

Note: The A^{C}•T diff and A^{C}•T diff 2 analyzers tends to give slightly lower readings. For example, it is common to get readings in the 9 to 10 V range for RAV, while the A^{C}•T 8/10 analyzer rarely gives a reading <10.0 V.

Vac

Vac is the count or low vacuum reading given in inches of mercury. The instrument has no indicator for the unregulated pump vacuum.

To adjust the low vacuum, you watch the low vacuum reading as you turn the regulator adjustment knob.

- On the A^{C}•T 8/10 and A^{C}•T diff analyzers, the regulator adjustment knob is located on the upper right front panel behind the Display assembly.
- On the A^{C}•T diff 2 analyzer, the regulator adjustment knob is located on the vacuum pump enclosure in the right side compartment.

The vacuum regulator is a mechanical device, so the adjustment does not have to be saved before leaving the Voltages/Sensors screen.

The vacuum transducer used to obtain a vacuum reading on the A^{C}•T 8/10 and A^{C}•T diff analyzers has a small range of measurement for maximum resolution. Any vacuum under the minimum reading shows the minimum reading and any vacuum over the maximum reading shows the maximum reading. Current hardware gives a minimum reading of 5.36 in. Hg and a maximum reading of 6.5 in. Hg. These numbers may vary slightly with different hardware implementations, but should not change significantly.

The transducer and formula used on the A^{C}•T diff 2 analyzer does not have a limited range.Readings can go as low as zero and higher than 10 in. of Hg.

Temp

Temp is a temperature reading in degrees Celsius. A temperature sensor is housed in the lower portion of the diluent reservoir to measure the diluent temperature. The diluent temperature should be very close to the temperature at the aperture during sample analysis.

Note: Current A^{C}•T 8/10 analyzer's software does not use this temperature reading. The A^{C}•T diff and A^{C}•T diff 2 analyzer's clog detection analysis use temperature compensation for AVR, WPWV, and RPWV.

Voltages

The A^{C}•T series analyzers monitor several of the system voltages. The Voltages/Sensors screen is an active display providing a full DVM function for these system voltages.

On the A^{C}•T 8/10 Analyzer:

- The +5 V, +15 V, and -15 V are supplied directly from the Power Supply module to the Analyzer card. (The +24 V is also supplied directly from the Power Supply module, but it is not monitored by the A^{C}•T 8/10 analyzer).
- The -10, +10, and 15 RF are reference voltages developed on the Analyzer card using 2% precision regulators.

- The aperture current and burn circuit supply, +200 Vdc, is also developed on the Analyzer card. On the AC•T 8/10 analyzer the full range of the 200 V supply is not displayed. Only a range from 180 V to 220 V is displayed, providing better resolution around the target voltage. A reading of 180 V could be anywhere from 0 to 180 Vdc.

On the AC•T diff and AC•T diff 2 analyzers:

- The +5 V, +15 V, -15 V and +24 V are supplied directly from the Power Supply module to the Analyzer card. All other voltage supplies are created on the Analyzer card from these voltages.
- The 15 RF voltage is a precision-regulated voltage used as a reference voltage by the A/D converter for vacuum transducer translation. On the AC•T diff 2 analyzer, this voltage is labeled VACRF because the voltage used for reference may be 8 V or 15 V, depending on the vacuum transducer used.
- The 200 Vdc supply on the AC•T diff and the AC•T diff 2 analyzers provide a lower resolution to the voltage display than the AC•T 8/10 analyzer does. The lower resolution allows a display of the full voltage range from 0 V to about 242.5 V, instead of the narrow 80 V to 220 V range displayed on the AC•T 8/10 analyzer.
- Separate ±10 V RBC and WBC circuit supplies are created and indicated on this screen.
- Hgb lamp is the Hgb lamp supply voltage reading for the Analyzer card. On the AC•T diff and AC•T diff 2 analyzers, the Hgb lamp supply voltage should be 3.6 V. The Hgb lamp supply on the AC•T 8/10 analyzer is 3.18 V.

Lytic and Clean

On the AC•T 8/10 analyzer, Lytic and Clean readings are analog sensor readings from the optical sensors in the lytic reagent and instrument rinse lines. The numbers displayed are low when reagent is present and high when no reagent (air) is present. The cutpoint is 820, meaning that readings >820 trigger a “no reagent” reading. Typically, when reagent is present, the reading is <100 and when no reagent is present, the reading is >1500.

On the AC•T diff and AC•T diff 2 analyzers, the signals from the optical sensors in the lytic reagent and instrument rinse lines are routed to digital drivers on the Analyzer card. Instead of indicating an analog value, Lytic and Clean indicate *ON* when reagent is present and *OFF* when reagent is **not** present

Dil, Waste, and AspSW (OVAsp and CVAsp on the AC•T diff 2 Analyzer)

These are digital sensor indicators on the Voltages/Sensors screen for the diluent reservoir sensor (Dil), the waste container sensor (Waste), and the aspirate switch (AspSW)

- Dil displays *ON* when diluent is high or trips the sensor in the diluent reservoir.
- Waste is *ON* when the two waste sensor electrodes are shorted.
- AspSW is *ON* when the aspirate switch is pressed or closed. The AC•T diff 2 analyzer has two aspirate switches, one for the open-vial position (OVAsp) and the other for the closed-vial position (CVAsp).

For all other conditions, these sensors display *OFF*.

Exit Icons

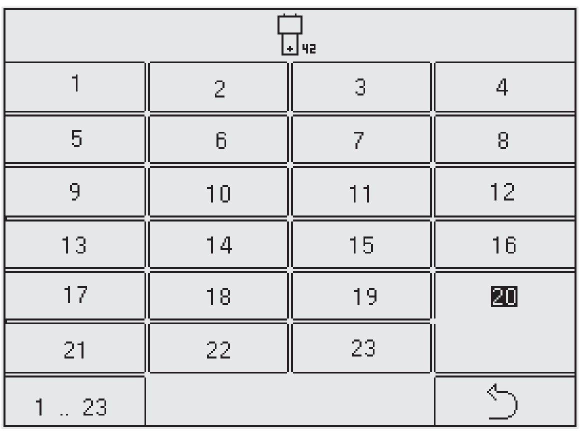
The two icons in the lower right corner are the exit icons. The icon on the left, resembling a file folder, is the **Save and Exit** icon. When you press the **Save and Exit** icon the current preamp gain and Hgb gain settings are saved and then the screen is exited. The icon on the right, the return arrow icon, is the **Exit** icon and pressing it returns you to the Diagnostics menu **without** saving the gain settings.

Solenoids Screen

The Solenoids screen is used to energize up to six solenoids simultaneously. Solenoids are designated by their number. A solenoid that is energized is shown with inverse characters. See Figure 7.1-7.

On the AC•T 8/10 and AC•T diff analyzers, numbered keys represent solenoid drivers 1 through 17 and 23. On the AC•T diff 2 analyzer, numbered keys represent solenoid drivers 1 through 23.

Figure 7.1-7 Solenoid Screen, AC•T diff 2 Analyzer



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The key labeled **1 .. 23** briefly energizes each solenoid driver in sequence. Solenoids that are energized stay on until that solenoid number is pressed again or the Diagnostics menu, not the Solenoids screen, is exited. This makes it possible to exit the Solenoids screen and move to another Diagnostics menu item, such as the Motors screen, while keeping up to six solenoids energized.

Although the numbers on the Solenoids screen represent solenoid drivers, and most drivers are connected to solenoids of the same number, several solenoid drivers drive dc motors. Table 7.1-1 summarizes the solenoid drivers and their related components.

Table 7.1-1 Solenoid Drivers and Related Components

Solenoid Driver No.	AC•T 8/10 and AC•T diff Analyzer		AC•T diff 2 Analyzer	
	Component	Function	Component	Function
1	LV1	VIC vent select	Rinse pump motor	
2	LV2	High vacuum enable	LV2	High vacuum enable
3	LV3	WBC air mix select	LV3	WBC air mix select
4	LV4	Lytic reagent air mix select	LV4	Lytic reagent air mix select
5	LV5	Air mix enable	LV5	Air mix enable
6	Spare		Waste pump motor	
7	LV7	RBC bath diluent select	LV7	VIC drain enable
8	LV8	Probe-wipe waste select	LV8	Probe-wipe waste select
9	LV9	Lytic reagent dispense enable	LV9*	Not connected - ghost LV5
10	LV10	Probe-wash diluent select	LV10	Probe-wash diluent select
11	LV11	Bath diluent select	LV11	WBC bath diluent select
12	LV12	Syringe diluent select	LV12	WBC bath drain select
13	LV13	Cleaner select	LV13	Diluent reservoir fill select
14	LV14	WBC bath drain select	LV14	Spare
15	LV15	VIC drain select	LV15	RBC bath drain select
16	LV16	RBC count	LV16	RBC count
17	LV17	WBC count	LV17	WBC count
18	N/A		LV18	Cleaner select
19	N/A		Diluent pump motor	
20	N/A		Rear panel fan motor	
21	N/A		N/A	
22	N/A		LV22	Spare
23	Vacuum pump motor		Vacuum pump motor	

*Solenoid LV9 is not connected in the system; however, LV9 is used as a software switch in the Closed-Vial, Open-Vial, Predilute, and Startup Diluter Tables. As altitude increases, more pump action is required to create mixing bubbles. LV9 informs the software to increase mix bubble pump time when the altitude setting requires it. LV5 still creates the mixing bubbles but is held open for a longer time.

Verify Predilute Screen

Many problems encountered using the Predilute mode are sample or dilution-technique related, rather than instrument related. This function is used to verify instrument operation in the Predilute mode.

To verify instrument operation, obtain a whole-blood specimen or whole-blood control and use the Verify Predilute function to create one or more prediluted samples.

Using blood collected in a tube eliminates many sample problems such as tissue debris. Using the instrument to make dilutions, rather than capillary fingerstick pipettes, provides consistent and accurate dilutions from sample to sample. Refer to Heading 4.12, LATEX GAIN ADJUSTMENT - A^{C}•T diff AND A^{C}•T diff 2 ANALYZERS.

When the Verify Predilute function is entered, a cleanup cycle is performed to ensure that the instrument is ready to make a dilution. Software Version 1.03 for the A^{C}•T 8 analyzer allows only one dilution to be made. Software Version 1.04 for the A^{C}•T 8/10 analyzer and the software for the A^{C}•T diff and A^{C}•T diff 2 analyzers allow many dilutions to be made before exiting the Verify Predilute function.

Sample Details Screen - A^{C}•T 8/10 Analyzer

IMPORTANT Reporting results from the Sample Details screen can cause inaccurate patient diagnosis. The Sample Results screen and printout suppresses results when a problem is detected during data accumulation. Results suppressed on the Sample Results screen and printout are presented on the Sample Details screen as an aid in troubleshooting problems and are not for patient diagnosis.

The Sample Details screen is a diagnostic screen for troubleshooting clog detection and Hgb incomplete problems (Figure 7.1-8). The Sample Results screen suppresses results for both of these conditions. The Sample Details screen:

- Displays parameter data that is suppressed on the Sample Results screen.
- Displays Hgb Voltage readings from which the Hgb result is determined.
- Displays the clog detection criteria parameters. Failure of some tests results in the display of only an asterisk (*) flag while a clog determination suppresses results.
- Displays pass/fail criteria in the form of 0.0 for results that pass and 1.0 for results that fail. This applies to most criteria except AVR and WPWV AVG/RM/LTVAR.
- Allows the editing of two running mean (RM) parameters, WPWV RM and AVR RM. This is useful when it takes many samples yielding no results to alter an RM value that is too far from nominal.
- Gives the option of printing the data that is displayed on the screen.

When considering clog detection analysis, it is important to remember how the A^{C}•T Series collects data and under what conditions clog detection analysis occurs.

- The instrument collects data in 1-second count periods. The system uses 12, 1-second count periods. Plt data however, may require additional count time for low counts. The system also uses any extended count periods needed for Plts. Clog detection analysis relies on the availability of 12 pieces of data for many of the clog detect parameters.
- Clog detection analysis is invoked **only** for cycles where:
  - **Hgb ≥2.0 g/dL**
  - If the Hgb result is incomplete the RBC must be:

    >0.50 x 10^6 µL.

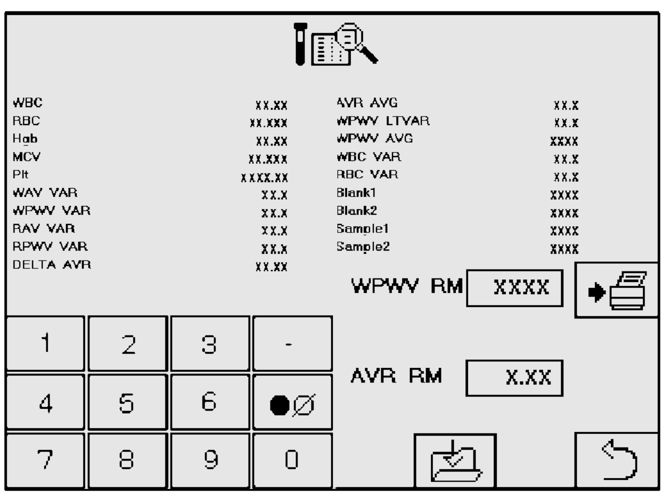
Sample Results

Sample results (not reported on the Sample Results screen) are composed of WBC, RBC, Hgb, MCV, and Plt results. When a clog detect is generated, asterisks are reported **instead of results**. Generated clog detects affect the following:

- A WBC clog-detect parameter inhibits the WBC result.
- An RBC clog-detect parameter inhibits RBC, MCV, Hct, MCH, MCHC, and Plt results.
- An AVR clog-detect parameter inhibits WBC or RBC results depending on which direction the ratio changes.

To troubleshoot clog detection problems, it is sometimes useful to know what the measured results would have been. Use the Sample Details screen (Figure 7.1-8) to find the WBC, RBC, Hgb, MCV, and Plt parameters.

Figure 7.1-8 Sample Details Screen Example - A^{C}•T 8/10 Analyzer



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WAV/RAV VAR

The white aperture voltage (WAV) and red aperture voltage (RAV) are measured directly across the aperture, similar to the voltages displayed on the Voltages/Sensors screen. A running average of WAV and RAV is determined for each 1-second count period. The coefficient of variation (VAR) is calculated for the 12 WAV and 12 RAV readings. Interpret the results according to the following:

- 0.0 = CVs pass.
- 1.0 = CVs fail. Failure criteria:
  - 2% <WAV CV <5% and **no other criteria failure**, results in asterisk (*) flags displaying for WBC.
  - 2% <WAV CV <5% and **another criteria failure**, results in a clog being generated for WBC.
  - WAV CV $\geq$5.0% results in a clog in the WBC aperture.
  - RAV CV >6.0% results in a clog in the RBC aperture.

WPWV/RPWV VAR

The white pulse width voltage (WPWV) and the red pulse width voltage (RPWV) are measurements of the width of pulses from each aperture made at a threshold just above the lower threshold for WBC and RBC. At the end of sample data accumulation, a running average for the pulses in each 1-second count period is determined, resulting in 12 pulse-width readings per aperture. The CV is calculated using these 12 readings per aperture. This test is applied only when the raw count of the pulses in each 1-second count period is high enough. If applied when lower, the CV calculation is **not** statistically valid. There is no exact correspondence between the raw counts used and the final WBC or RBC count. If however, the WBC count is 1.7×10^3 µL or lower or the RBC count is 0.20×10^6 µL or lower, then the corresponding pulse-width parameter was probably not used for clog determination.

- 0.0 = CVs pass.
- 1.0 = CVs fail. Failure criteria:
  - WPWV CV >12.0% results in a clog in the WBC aperture.
  - RPWV CV >5.0% results in a clog in the RBC aperture.

AVR VAR/AVG/RM/DELTA

The aperture voltage ratio (AVR) is based on the idea that if neither aperture has a problem, then the ratio of the voltages across each aperture should be constant. The average RAV and WAV are calculated, and then the RAV average is divided by the WAV average to get AVR AVG for the last result. It is displayed as the calculated ratio. This ratio is then compared to AVR RM, which is a running mean of the AVR ratios of previous samples.

There is editing capability for AVR RM. If circumstances, such as installing a new aperture, give an unacceptable value, the correct value can be entered without the need to run many bloods. DELTA AVR is the comparison between AVR AVG and AVR RM. It is a percentage difference expressed as a ratio. For instance, a +3.0% difference is indicated as 0.03. The following applies:

- DELTA AVR >5% (0.05) results in a clog in the RBC aperture.

- -2 <DELTA AVR ≤-5 and **no other WBC criteria failure**, results in asterisk (*) flags displaying for WBC.
- -2 <DELTA AVR ≤-5 and **another WBC criteria failure**, results in a clog being generated for WBC.
- DELTA AVR > -5% (-0.05) results in a clog in the WBC aperture.
- **If AVR AVG for the current result = 1.75 ±25% (1.21 to 2.19)**, AVR RM is updated using the formula:

  AVR RM(new) = 0.8 × AVR RM(old) + 0.2 × AVR AVG
- **If the CMOS is new or corrupted**, a default value of 1.75 is used for AVR RM to start a new running mean.

WPWV AVG/RM/LTVAR

This clog-detect criteria differs from most of the other clog detection criteria in that a failure of this test alone **does not** suppress the WBC result. An asterisk flag (*) displays beside the WBC result if this test fails.

Two values are used to perform this test:

- The white pulse width voltage average (WPWV AVG) is the average of the 12 count-period values. This is the average pulse width for the sample and is given in A/D measurement units.
- The WPWV RM is the running mean of all previous samples. It is given in A/D measurement units and can be edited. If for some reason, like changing an aperture, the RM is not matching current samples, it can be edited immediately, rather than forcing the user to run many samples until it is acceptable.

The WPWV long-term variance (LTVAR) is a comparison of WPWV AVG and WPWV RM.

The following applies:

- **If WPWV AVG for the current result >10% difference from WPWV RM**, WPWV LTVAR = 1.0 (fail - a clog detect is generated).
- **If WPWV AVG for the current result = 10% or less**, WPWV LTVAR = 0.0 (pass).
- WPWV RM is updated using the formula:

  WPWV RM(new) = 0.8 x WPWV RM(old) + 0.2 x WPWV AVG(current).
- WPWV AVG **must be** = 410 to 2460 A/D units or WPWV RM will not be updated.
- **If the CMOS is new or corrupted**, a default value of 1400 A/D units is used to start a new RM.
- For statistical validity, this test is not applied for a WBC count of approximately 1.7 x 10^3 µL or lower.

WBC/RBC VAR

The WBC and RBC variance (VAR) parameters deal with aperture voteouts. As with other single-aperture COULTER COUNTER® instruments, voting is done based on a three-aperture system where the first four 1-second count periods comprise aperture 1, the second four 1-second count periods are aperture 2, and the last four 1-second count periods are aperture 3. When a single aperture voteout occurs, the aperture that voted out is compared to the average of the other two apertures. If the resulting percent difference >7%, a clog is generated for that aperture. The system displays:

- 1.0 = fail (a clog detect is generated)
- 0.0 = pass.

Hgb Readings

Hgb measurements are obtained by measuring the amount of 525-nm light transmitted through a sample and comparing that result to the amount of 525-nm light transmitted through a blank solution. To ensure the integrity of the readings, the takes two blank readings and two Hgb sample readings when determining the Hgb result: Blank1, Blank2, Sample1 and Sample2.

When troubleshooting Hgb problems on the A^{C}•T 8/10 analyzer, especially Hgb incomplete results, it is necessary to know what the Hgb blank and sample readings were. These four readings are in the Sample Details report. When using these readings, consider the following:

- Hgb Blank2 is taken on the blank diluent in the bath when the aspirate switch is pressed to initiate a cycle.
- Hgb Blank1 is taken on the rinse after the sample is drained from the WBC bath.
- Hgb Sample1 is taken 1 second before the WBC sample is drained from the WBC bath.
- Hgb Sample2 is taken 1/2 second before the WBC sample is drained from the WBC bath.

See Tables 2.8-3 through 2.8-8 for the times the readings are taken.

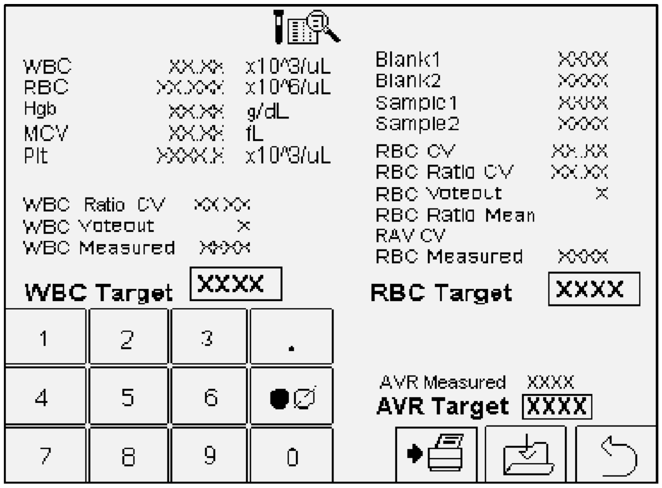
Sample Details Screen - A^{C}•T diff and A^{C}•T diff 2 Analyzers

With the addition of editors to the Analyzer card, a different scheme is used for clog detection that is very similar to the scheme used in the MD II analyzer. Figure 7.1-9 shows the Sample Details screen. This screen displays data from the last sample, control, or Startup cycle that can be used to troubleshoot clog detect and instrument problems.

Sample Results

IMPORTANT Reporting results from the Sample Details screen can cause inaccurate patient diagnosis. The Sample Results screen and printout suppresses results when a problem is detected during data accumulation. Results suppressed on the Sample Results screen and printout are presented on the Sample Details screen as an aid in troubleshooting problems and are not for patient diagnosis.

Figure 7.1-9 Sample Details Screen Example - AC•T diff Analyzer



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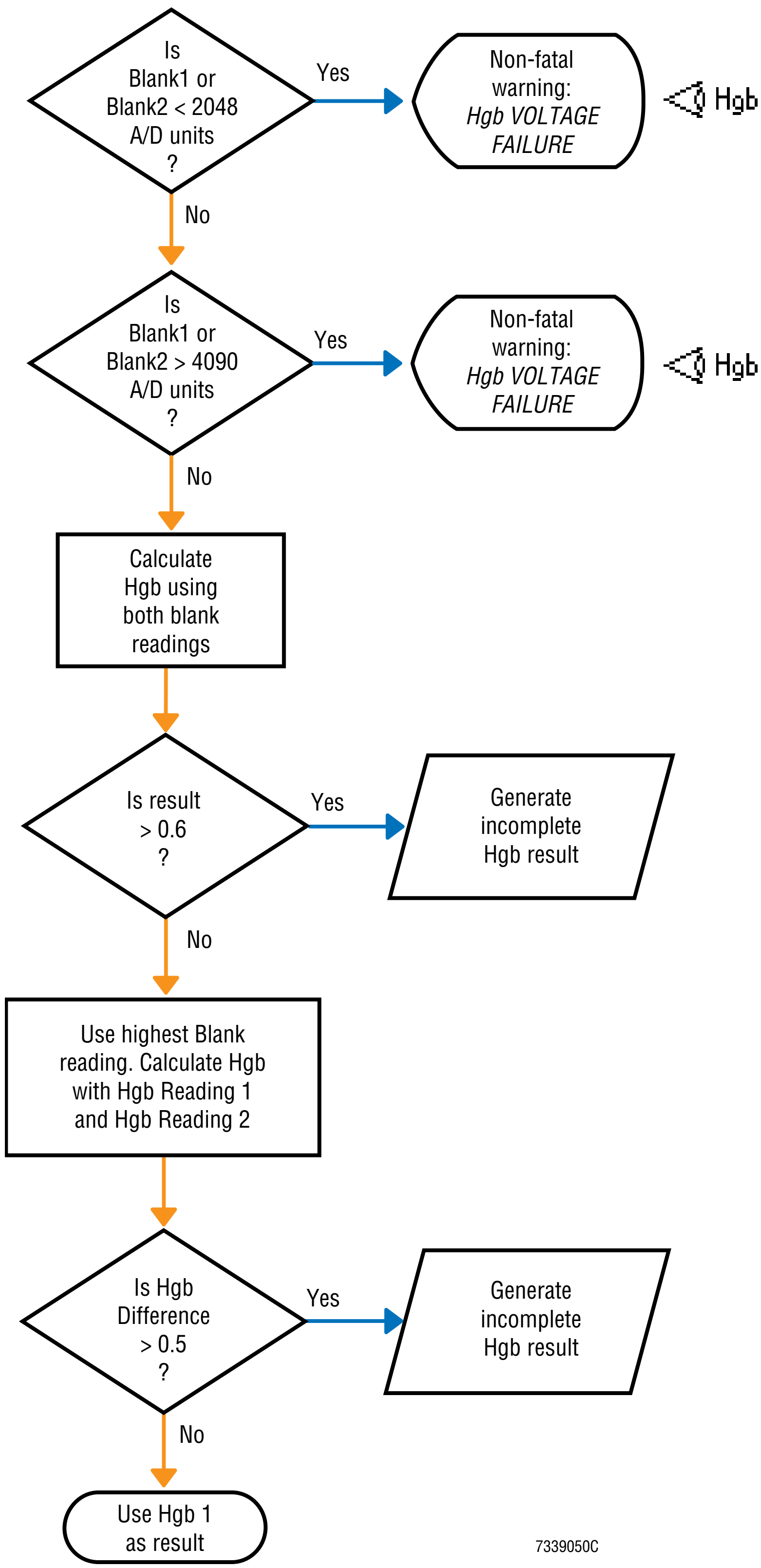
When a clog is detected, sample results are suppressed on the Sample Results screen. Instead of the measured value, Xs (XXXXX) are displayed, printed, and transmitted. To troubleshoot a clog detection, or a problem generating a clog detect, it is useful to have the measured value of the parameter or parameters that were suppressed. This information is reported on the Sample Details screen for WBC, RBC, Hgb, MCV, and Plt.

Hgb Readings

Hgb measurements are obtained by measuring the amount of 525-nm light transmitted through a sample and comparing that result to the amount of 525-nm light transmitted through a blank solution. To ensure the integrity of the readings, the instrument takes two Hgb blank readings and two sample readings are taken. These four readings are displayed on the Sample Details screen. The instrument verifies the integrity of the readings by using the process shown in Figure 7.1-10.

Figure 7.1-10 Hgb Results Analysis



When troubleshooting Hgb problems on the A^{C}•T diff or A^{C}•T diff 2 analyzers, consider the following:

- On the A^{C}•T diff 2 analyzer, Hgb Blank2 is taken soon after the aspirate switch is pressed, on the rinse that is in the bath at the beginning of a cycle. A drain and rinse follows, but a Hgb Blank reading **is not** taken on this rinse.
- On the A^{C}•T diff analyzer, Hgb Blank2 is taken on the WBC bath rinse. After the aspirate switch is pressed, the WBC bath is drained and rinsed. The Hgb Blank2 reading **is** taken on this rinse.
- On both the A^{C}•T diff and A^{C}•T diff 2 analyzers, Hgb Blank1 is taken on the 1.5 mL sample prefill that enters the WBC bath through the lower port This is the first phase of the sample dilution, the rest of the diluent is dispensed through the probe with the sample.
- Hgb Sample1 is taken one second before the WBC sample is drained from the WBC bath.
- Hgb Sample2 is taken 1/2 second after the Hgb Sample1.

WBC/RBC Measured

These parameters are 26-percentile values representing pulse width. A 26-percentile value is determined by the Editor circuit for each one-second count period. Twelve values are recorded during sample data accumulation, and these twelve values are averaged to produce the reported measured value. The measured value is then compared to the Target value to determine if this clog test passes.

The limits for the measured values generating clogs are as follows:

$$\text{WBC Target value} \times 0.88 \le \text{WBC Measured} \le \text{WBC Target value} \times 1.12$$

$$\text{RBC Target value} \times 0.87 \le \text{RBC Measured} \le \text{RBC Target value} \times 1.15$$

RBC CV

The CV is calculated using the 12 measured, 26-percentile values determined during sample data collection. This test fails if the calculated CV is **not** within the following range:

$$0.5\% \le \text{RBC CV} \le 5.0\%$$

WBC/RBC Ratio CVs

The ratio is the ratio of "good" pulses to total pulses. Pulses are processed to determine a proper size and width. Pulses having the proper size and width are "good" pulses. The editor receives pulses one-by-one. When it is processing a pulse, it ignores any other pulses that may come along. "Good" pulses are those that are processed and accepted as good by the editor. Total pulses are the total pulses counted by the counter circuit, not the total pulses processed by the editor. A ratio value is determined for each one-second count period.

When sample data accumulation is complete, there are 12 ratio values for WBC and RBC. The CV of these values is calculated and used for clog detection. The idea behind this criteria is based on consistency. The ratio of good pulses may vary for a particular sample because of cell size, shape, elasticity, or concentration. It may even vary with the concentration of other cells or interfering particles or substances. Once a sample dilution is made however, whatever the ratio is, it should be consistent through the 12 count periods.

This test fails if the Ratio CV is outside the following limits:

WBC Ratio CV ≤ 8.0%

RBC Ratio CV ≤ 7.5%

RBC Ratio Mean

The 12 RBC Ratio values are averaged. If this average is <0.2, this clog test fails.

WBC/RBC Voteout

When there is a single aperture count voteout, WBC or RBC, the count from that aperture is compared to the average count of the other two apertures. If this count is >7.0% higher than the average of the other two apertures, the voteout test fails.

RAV CV

An RBC Aperture Voltage (RAV) reading is taken for each one-second count period. The CV is calculated for the 12 readings. If the resulting CV is >5.0%, this clog test fails.

AVR Measured

The 12 readings for RBC Aperture Voltage (RAV) and WBC Aperture Voltage (WAV) are averaged. The RAV average is then divided by the WAV average to obtain the Aperture Voltage Ratio (AVR) Measured. This test fails if:

AVR (average) > AVR Target × 1.09 ; this condition generates an RBC failure.

AVR (average) < AVR Target × 0.97; this condition generates a WBC failure.

WBC/RBC/AVR Target

WBC and RBC Target are target 26-percentile values used for comparison with the WBC and RBC Measured values during sample analysis. AVR Target is the target Aperture Voltage Ratio used for comparison with the AVR Measured clog detection test. They are determined by averaging the value obtained when running several normal samples. See Heading 4.13, SETTING CLOG DETECTION TARGET VALUES - AC•T diff AND AC•T diff 2 ANALYZERS, for the procedure to determine these values.

Note: The numeric keypad and **Save and Exit** icon are used to enter the Target values.

RBC Clog Detection Criteria

The above tests are used to determine whether a clog has occurred and whether results should be suppressed with XXXXX or whether the result will be given with a single X flag. These tests **are not performed** if:

- A total RBC voteout has occurred.
- Hgb <2.0 g/dL (or Hgb is incomplete and RBC <0.5 x 10^6 cells/µL).
- RBC count < ≈ 0.20 x 10^6 cells/µL then RBC Measured is not calculated or used.
- RBC count < ≈ 0.12 x 10^6 cells/µL then RBC Ratio and RBC Ratio CV are not calculated or used.

When clog tests are performed, flagging is accomplished according to Table 7.1-2.

Table 7.1-2 RBC Clog Test Results

Condition	Status	Effect on Results
No tests fail	No clog	None
1 test fails	Maybe clog	X flag
>1 test fails	Clog	Suppressed

WBC Clog Detection Criteria

The above tests are used to determine whether a clog has occurred and whether results should be suppressed with XXXXX or whether the result will be given with a single X flag. These tests **are not performed** if:

- A total WBC voteout has occurred.
- Hgb <2.0 g/dL (or Hgb is incomplete and WBC <0.5 x 10^6 cells/µL).
- WBC count < ≈ 1.7 x 13^3 cells/µL then WBC Measured is not calculated or used.
- WBC count < ≈ 1.0 x 10^3 cells/µL then WBC Ratio is not calculated so WBC Ratio CV is not used.

When clog tests are performed, flagging is accomplished according to Table 7.1-3.

Table 7.1-3 WBC Clog Test Results

Condition	Status	Effect on Results
No tests fail	No clog	None
1 test fails	Maybe clog	X flag
1 test fails (WBC Ratio is not performed)	Clog	Suppressed
>1 test fails	Clog	Suppressed

Motors Screen

The Motors screen allows you to individually operate the stepper motors used by the A^C•T series analyzers. Beginning with the A^C•T 8/10 analyzer, Software Version 1.04, and in all the A^C•T diff and A^C•T diff 2 analyzers' software, the Motors screen also displays the state of the sensors associated with the stepper motors. See Figures 7.1-11 and 7.1-12.

Pressing a Motors key performs the diluter table default action for the selected motor. On the A^C•T 8/10 and A^C•T diff analyzers, 15 different motor actions are required during instrument operation, so five motor functions are available on the Motors screen (Table 7.1-4). The A^C•T diff analyzer uses 24 different motor functions (Table 7.1-5).

Many of the motor functions appear similar. For example in Table 7.1-4, **M0 - ASF** operates the aspirate syringe to aspirate a sample and **M2-DSF** operates the diluent syringe to recharge the syringe, but both functions move the syringe pistons down.

Figure 7.1-11 Motors Screen, AC•T 8/10 and AC•T diff Analyzers

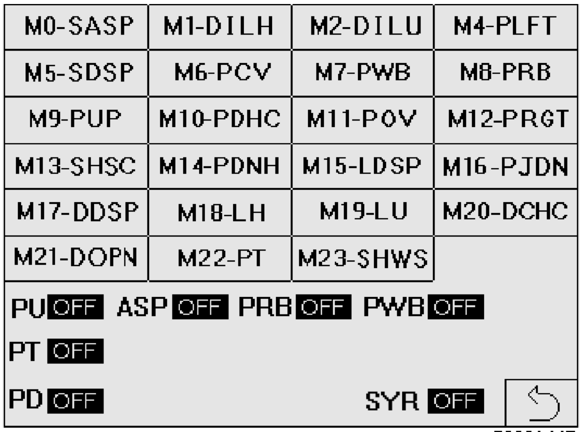


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Figure 7.1-12 Motors Screen, AC•T diff 2 Analyzer

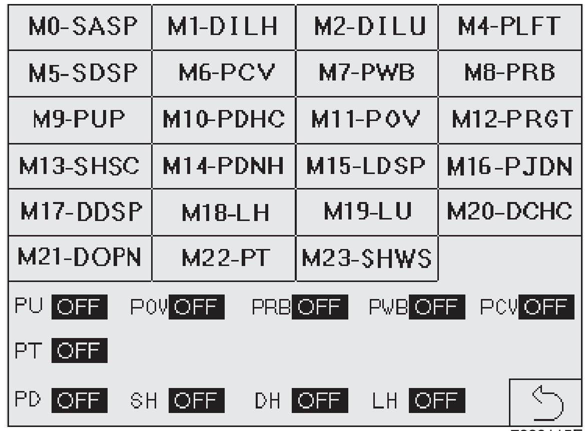

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Table 7.1-4 Motors - Function, Action and Description, AC•T 8/10 and AC•T diff Analyzers

Motor Function	Motor Action	Description
M0 - ASF	**Asp**irate syringe fill	Moves aspirate syringe **down** 0.25 mL
M1 - DSDWS	**D**iluent **s**yringe **d**ischarge **w**ith **s**ensor	Moves syringe 30.3 mL, stops on sensor
M2 - DSF	**D**iluent **s**yringe **f**ill	Moves diluent syringe **down** 0.60 mL
M3 - DSDNS	**D**iluent **s**yringe **d**ischarge **n**o **s**ensor	Moves diluent syringe **up** 20.0 mL, does not stop on sensor
M4 - LSF	**L**ytic reagent **s**yringe **f**ill	Moves lytic reagent syringe **down** 0.1 mL
M5 - LSD	**L**ytic reagent **s**yringe **d**ispense	Moves lytic reagent syringe **up** 0.1 mL
M6 - PA	**P**robe **a**spirate	Moves probe **left** to aspirate position
M7 - PWB	**P**robe **WB**C	Moves probe **right** to WBC position
M8 - PRB	**P**robe **RB**C	Moves probe **left** to RBC position
M9 - PU	**P**robe **up**	Moves probe **up** to top position
M10 - PD	**P**robe **d**own	Moves probe **down** to bottom position
M11 - PT	**P**robe **t**hief	Moves probe **down** to thief position (probe height used in WBC bath to aspirate RBC dilution)
M12 - DRN	**Dr**ai**n**	Moves PM1 **clockwise** 2.5 turns, drains RBC bath
M13 - DRF	**D**iluent **r**eservoir **f**ill	Moves PM2 **clockwise**, fills diluent reservoir to sensor or 4.6 turns, whichever occurs first
M14 - DO	**D**iluent **o**verfill	Rotates PM2 **clockwise** 4.6 turns, fills diluent reservoir without regard to sensor
M15 - CF	**C**leaner **f**ill	Rotates PM1 **counterclockwise** 2.5 turns, fills RBC bath with waste

Table 7.1-5 Motors - Function, Action and Description, A^C•T diff 2 Analyzer

Motor Function	Motor Action	Description
M0 - SASF	**S**ample **asp**iration	Moves sample pump counterclockwise to aspirate
M1 - DILH	**Dil**uent pump **h**ome	Moves diluent pump clockwise to sensor
M2 - DILU	**Dil**uent pump **u**nblock	Moves diluent pump clockwise just out of sensor
M3 -		
M4 - PLFT	**P**robe jog **left**	Moves probe to left, out of sensor
M5 - SDSP	**S**ample **disp**ense	Moves sample pump clockwise to dispense
M6 - PCV	**P**robe to **c**losed **v**ial	Moves probe right to closed-vial position
M7 - PWB	**P**robe to **w**hite **b**ath	Moves probe left to WBC bath position
M8 - PRB	**P**robe to **r**ed **b**ath	Moves probe left to RBC bath position
M9 - PUP	**P**robe **up**	Moves probe up to upper sensor
M10 - PDHC	**P**robe **d**own **h**olding **c**urrent	Moves probe down to down sensor and applies holding current.
M11 - POV	**P**robe **o**pen **v**ial	Moves probe left to open-vial position
M12 - PRGT	**P**robe jog **rig**h**t**	Moves probe right, out of sensor
M13 - SHSC	**S**ample **h**ome **c**heck	Moves sample pump "12 µL", checks for sensor
M14 - PDNH	**P**robe **d**own, **n**o **h**olding current	Moves probe down, does not apply holding current when down
M15 - LDSP	**L**yse **disp**ense	Moves lyse pump clockwise to dispense
M16 - PJDN	**P**robe **j**og **d**ow**n**	Moves probe down, out of sensor
M17 - DDSP	**D**iluent **disp**ense	Moves diluent pump clockwise to dispense
M18 - LH	**L**yse pump **h**ome	Moves lyse pump clockwise to sensor
M19 - LU	**L**yse pump **u**nlock	Moves lyse pump clockwise, just out of sensor
M20 - DCHC	**D**oor **c**losed **h**olding **c**urrent	Applies holding current when cap-pierce door is closed
M21 - DOPN	**D**oor **open**	Moves cap-pierce counterclockwise to open
M22 - PT	**P**robe to **t**hief position	Moves probe down to thief position
M23 - SHWS	**S**ample **h**ome with **s**ensor	Moves sample pump clockwise to sensor

When using motor functions, you are in control of the instrument. Normal system safeguards used by system cycles are bypassed, and must be observed. Most notable, solenoid functions are separate from motor functions. During an instrument cycle, the proper solenoids are energized before doing a motor function. Entering this screen without first energizing the appropriate solenoids from the Solenoids screen may enable fluidic pathways that are not desirable.

For example, the function **M15 - CF** (Table 7.1-4) rotates PM1, the waste peristaltic pump, counterclockwise, against the waste flow.

- During a normal Shutdown cycle, LV13 is energized before calling function **M15 - CF**, changing the hydraulic path from the waste container to the shutdown diluent container. Then, without energizing any other solenoid, performing **M15 - CF** fills the RBC bath with shutdown diluent.
- Performing the **M15 - CF** function from the Motors screen **does not** energize LV13, so the RBC bath fills with waste from the waste system. Furthermore, since draining waste is also a separate function, the RBC bath overflows if you repeatedly perform this function without draining the RBC bath. To duplicate the Shutdown cycle, you must energize the appropriate solenoids from the Solenoids screen first, before entering the Motors screen.

CAUTION Risk of damage to mechanical components. Using fill functions repeatedly can drive the syringe pistons down and out of the glass syringe barrels. Subsequent upward movement of the syringe without manually placing the pistons back into the glass barrels may cause the syringe barrels to break. Always open the right side door and observe the syringe assembly when using syringe motor functions. If the pistons are pulled out of the syringe barrels, manually guide them back in while using the thumbscrew at the bottom of the syringe assembly.

CAUTION Motor functions M10-PDHC and M20-DCHC leave holding current applied to the motor after motion has stopped. Doing motor functions M10-PDHC or M20-DCHC without doing the opposite function within 1 minute can damage the driver circuit on the Analyzer card or the stepper motors. Do motor function M9-PUP within 1 minute of doing M10-PDHC. Do motor function M21-DOPN within 1 minute of doing M20-DCHC.

If you are using probe functions, direction of travel is determined by the needs of the system during normal instrument cycles. Some functions may generate error messages if the position of the probe before initiating the function is ignored. For example, during a normal instrument cycle the probe always goes to the RBC bath position from the WBC bath, never from the aspirate position. The direction of travel is left. If you initiate function **M8-PRB** while at the aspirate position, the probe moves left. Since the probe is already at its left-most position, and the RBC bath position is to the right, you drive the traverse housing against the left mechanical stop, never get to the RBC bath, and generate fatal error *11*.

Starting with A^{C}•T 8/10 analyzer, Software Version 1.04 the Motors screen also displays the states of the sensors associated with the stepper motors. This allows you to move a motor and check the sensor state without going back to the Voltages/Sensors screen.

On the A^{C}•T 8/10 and A^{C}•T diff analyzers, the syringe sensor is the simplest. It is a single sensor that displays *ON* when the syringe is at the top position and displays *OFF* when the syringe is **not at the top position**.

The horizontal and vertical traverse sensors are actually double sensors where the binary state is used to determine a horizontal or vertical position. The Motors screen displays the probe position rather than the individual sensor state.

On the A^C•T 8/10 and A^C•T diff analyzers:

- The three horizontal positions and their designators are:
  - PA - probe at the aspirate position
  - PR - probe at the RBC bath position
  - PW - probe at the WBC bath position.
- The three vertical positions and their designators are:
  - PU - probe at the top (up) position
  - PT - probe in the bath (thief) position
  - PD - probe at the lower-aspirate (down) position.

When the probe is at one of the indicated positions, that position is *ON*, otherwise it is *OFF*. This means that all six positions can indicate *OFF* but no more than one horizontal and one vertical position should indicate *ON* at one time.

On the A^C•T diff 2 analyzer, the Motors screen displays the ON/OFF state for ten sensors.

- The four horizontal position sensors are:
  - POV - Probe at the open-vial position
  - PRB - Probe at the red bath position
  - PWB - Probe at the white bath position
  - PCV - Probe at the closed-vial or cap-pierce position
- The three vertical position sensors are:
  - PV - Probe at the top of travel
  - PT - Probe at the thief position (down position when in the baths)
  - PD - Probe down.

    The probe-down position is unique in that two different sensors can indicate the probe is down: the vertical sensor on the Traverse Interconnect card and the tube bottom seeking optical sensor, S24, in the Cap-Pierce module. S24 is triggered by pushing a tube against the bottom of the tube holder in the Cap-Pierce module.

    The probe-down position is not indicated correctly unless both PV and PT indicate OFF, which is the case in normal operation.
- The remaining three position sensors are the homing sensors within each FMI pump:
  - SH - Sample pump-home position
  - DH - Diluent pump-home position
  - LH - Lyse pump-home position

Pulse Test - AC•T 8/10 Analyzer

An electronic pulse test is provided to verify operation of the Analyzer card's signal processing capability. Pulses are input into the signal path where the aperture electrode cables enter. This means that the resistance at the aperture and any noise picked up by the aperture system affects the pulse test results. If the pulse test is performed with the aperture cables in place, ensure that there is reagent in the bath and rear chamber and that the bath shield is in place. Aperture size and environmental conditions may still affect the results to some extent. For a true baseline, disconnect the aperture cables before doing the pulse test. This provides stable results.

When the **Pulse** icon is pressed, a screen is presented to allow entry of a minimum and maximum voltage. The pulse test is a series of pulses that ramp from a minimum to maximum voltage. Changing these voltages affects which channel the pulses start and end in. The only channelizing circuit in the AC•T 8/10 analyzer is for the Plt parameter, so this test is only useful when troubleshooting Plt problems. Generally, the minimum and maximum should be left at default values of 1 and 50 respectively, while doing the pulse test.

Pulse Test - AC•T diff and AC•T diff 2 Analyzers

Unlike the AC•T 8/10 analyzer's pulse test, the pulses are input into the peak detector input signal path where the aperture electrode cables enter. The aperture and bath system are not involved; therefore, any noise pulses picked up by the bath system are not counted in the pulse test. Because the AC•T diff and AC•T diff 2 analyzers have histograms for WBC and RBC as well as for Plt, the pulse test must provide pulses for a 256-channel histogram.

When the **Pulse** icon is pressed, a screen is presented to allow entry of a minimum and maximum voltage Values can range from 0 to 255. The minimum and maximum defaults are 1 and 255, respectively.

Latex Calibration

With the introduction of histograms and the differential parameters, greater control of amplifier gain is required. The amplifiers are adjustable and a latex calibration function is provided for gain adjustment. See Heading 4.12, LATEX GAIN ADJUSTMENT - AC•T diff AND AC•T diff 2 ANALYZERS, for the procedure to adjust the amplifier gain using latex particles.

Selecting **Main** icon ▸▸ **Diagnostics** icon ▸▸ **Latex Calibration** icon displays the Latex Calibration screen (Figure 7.1-13) for an AC•T diff analyzer or Figure 7.1-14 for an AC•T diff 2 analyzer).

Figure 7.1-13 Latex Calibration Screen - AC•T diff Analyzer

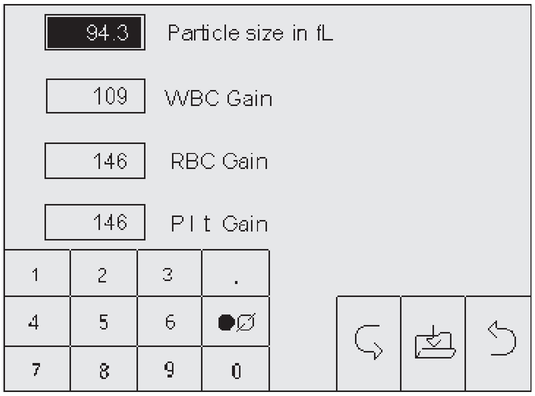

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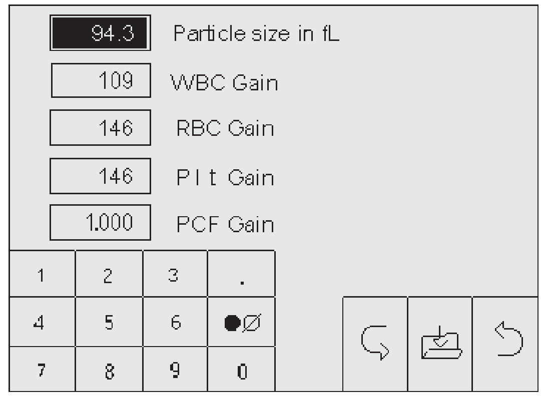
Figure 7.1-14 Latex Calibration Screen - AC•T diff 2 Analyzer



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The top item on the Latex Calibration screen is the latex particle size. If the instrument's power has been off since the last time the latex particle size was used, this value defaults to a particle size of 94.3 fL.

The next three fields on the Latex Calibration screen display values representing the amplifier gains for WBC, RBC, and Plt gain. If you know what the gains should be, you can enter them here without performing the Latex Gain Adjustment procedure. Note that the Plt gain should be set to the same value as the RBC gain for normal operation.

During the automatic adjustment procedure, prompts to change gains only mention WBC and RBC gains. Any requested change to the RBC automatically produces the same change in the Plt value. If however, you manually enter the RBC gain, the Plt gain is **not** automatically entered. You **must** manually enter the same value that was entered for the RBC gain.

The Latex Calibration screen on the AC•T diff 2 analyzer also provides a field for entering the pump correction factor for the sample pump, the PCF Gain field. To determine the pump calibration factor, see Heading 4.19, PUMP CORRECTION FACTOR (PCF) DETERMINATION.

The Latex Calibration screen also displays the following icons at its bottom:

- A numeric entry keypad for entering values
- A **Continue** icon to perform a Latex Gain Adjustment procedure
- A **Save and Exit** icon to save gains that were manually entered.
- An **Exit** or **Return** icon, to exit the latex calibration function.

Cycle Counter

The instrument's cycle counter is incremented during each aspirate cycle, whether Whole Blood, Predilute, Control or Reproducibility mode. On the A^{C}•T 8/10 analyzer the cycle counter icon appears on the Time/Date Setup screen. On the A^{C}•T diff and A^{C}•T diff 2 analyzers, the cycle counter icon appears on the Startup screen. The Startup screen is a more practical location for customer use but requires running the Startup cycle to get the cycle count. For service use, the cycle counter icon appears on the Diagnostics menu on the A^{C}•T diff analyzer, Software Version 1.04 and later, and on the A^{C}•T diff 2 analyzer.

Prepare to Ship

This function is used to prepare an instrument for shipment or for long-term shutdown. There are four stages to preparing an instrument for shipment. By the end of the procedure, the instrument has been decontaminated, flushed with distilled water and dried. For procedures, refer to Heading 4.15, PREPARING THE INSTRUMENT FOR LONG-TERM SHUTDOWN OR SHIPMENT.

7.2 TROUBLESHOOTING ERROR MESSAGES

The system displays two types of error messages, warning (non-fatal) and fatal error messages.

Warning (Non-Fatal) Error Messages (Icons)

Warning messages indicate an instrument condition that could affect operation, such as low reagents or a Printer that is off line. A warning message is indicated by the "yield sign" warning icon, a message specific icon, and a continuation icon. Pressing the **Continue** icon allows the user to continue operation and correct the condition where applicable. Table 7.2-1 shows the icons that identify warning (non-fatal) errors.

Table 7.2-1 Warning (Non-Fatal) Error Messages (Icons)

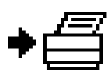
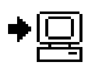
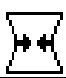
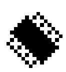
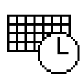
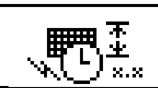
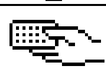
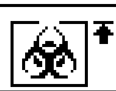
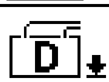
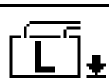
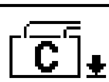
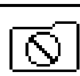
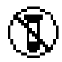
Error Message Icons	Description
	Check printer
	Transmission incomplete
	Vacuum out of range during count
	Hgb voltage failure - Hgb Blank or Sample reading outside range 2048 to 4095 A/D units
	Channelizing buffer overflow error - usually indicates an overflow in one of the Plt channels
	Timekeeper failure
	CMOS PD (persistent data) failure
	Check Reagent Management card
	Waste full
	Diluent empty
	Lytic reagent empty
	AC•T Rinse shutdown diluent empty
	Patient storage data corrupt, AC•T diff and AC•T diff 2 analyzers

Table 7.2-1 Warning (Non-Fatal) Error Messages (Icons) ***(Continued)***

Error Message Icons	Description
	Control expired, AC•T diff and AC•T diff 2 analyzers
	Control file full, AC•T diff and AC•T diff 2 analyzers

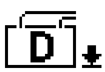
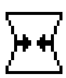
Fatal Error Messages (Numbers)

Fatal error messages (Table 7.2-2) are indicated by an **Error** icon and an **Error Message** icon or number. Fatal error messages do not have a **Continue** icon available. The instrument must be turned OFF then ON to continue operation. The **Error** icon is displayed until the fatal error is resolved.

Table 7.2-2 Fatal Error Messages (Numbers)

Error No./Icon	Instrument	Description
1	All	PCMCIA. For details, see PCMCIA Error 1.
3	All	DVM. For details, see DVM Error 3.
4	All	Unexpected software condition.
6	All	Probe did not reach up position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
7	All	Probe did not reach down position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
8	All	Measured thief position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
9	AC•T 8/10 and AC•T diff analyzers	Probe did not reach aspirate position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
	AC•T diff 2 analyzer	Probe did not reach closed-vial position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
10	All	Probe did not reach WBC position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
11	All	Probe did not reach RBC position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
12	AC•T 8/10 and AC•T diff analyzers	Syringe did not reach up position. For details, see Syringe Did Not Reach/Leave Up Position Errors 12 and 13, AC•T 8/10 and AC•T diff Analyzers.
	AC•T diff 2 analyzer	Diluent pump did not see home sensor. For details, see Diluent, Sample, and Lyse Pump Not Home Errors 12, 20, and 21, AC•T diff 2 Analyzer.

Table 7.2-2 Fatal Error Messages (Numbers) *(Continued)*

Error No./Icon	Instrument	Description
13	AC•T 8/10 and AC•T diff analyzers	Syringe did not leave up position. For details, see Syringe Did Not Reach/Leave Up Position Errors 12 and 13, AC•T 8/10 and AC•T diff Analyzers.
14	AC•T 8 analyzers, Software Version 1.03	Valve error. For details, see Valve Error 14.
16	All	I^{2}C communication failure. For details, see I^{2}C Communication Failure Error 16.
17	AC•T 8/10 and AC•T diff analyzers	Steps missing (syringe motor). For details, see Steps Missing (Syringe Motor) Error 17, AC•T 8/10 and AC•T diff Analyzers.
19	AC•T diff 2 analyzer	Probe did not reach open-vial position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
20	AC•T diff 2 analyzer	Sample pump did not see home sensor. For details, see Diluent, Sample, and Lyse Pump Not Home Errors 12, 20, and 21, AC•T diff 2 Analyzer.
21	AC•T diff 2 analyzer	Lyse pump did not see home sensor. For details, see Diluent, Sample, and Lyse Pump Not Home Errors 12, 20, and 21, AC•T diff 2 Analyzer.
	AC•T 8/10 and AC•T diff analyzers	Diluent level error during Powerup table execution. For details, see Diluent Level Error During Powerup.
	All	Vacuum <6 in. Hg before probe wipe. For details, see Vacuum Error.

Service Bypass

An error that occurs during powerup creates a loop and consequently the instrument cannot be used. For troubleshooting a powerup problem, a “service bypass” function is provided to get past the powerup fatal error message. To initiate the service bypass:

1. Hold down the aspirate switch and turn ON the instrument.
2. Release the aspirate switch when the Powerup (title) screen is displayed.

This procedure bypasses most normal powerup operations and displays the Main screen.

- All cycles and menus, including the Diagnostic menu are active.
- When running cycles, such as the Aspirate cycle, any error encountered is reported as a fatal error and forces a power off.
- When using the Solenoids screen or the Motors screen, any error encountered is reported as a warning, using the error number as the message icon. Pressing the **Continue** icon returns control to the Solenoids or the Motors screen.
- System states are ignored and normal instrument operation could be affected.

When the instrument is again ready for normal operation, always power up without using the aspirate switch. If the instrument is ON and was turned ON using the aspirate switch, you must turn the instrument OFF, and then back ON again **without using** the aspirate switch.

Note: The A^{C}•T diff 2 analyzer uses four optical sensors to vertically position the probe. Three of these optical sensors (top, middle, bottom) are located on the Traverse Interconnect card. The fourth optical sensor for controlling vertical positioning of the probe is the tube bottom seeking (or alternate bottom) sensor located inside the cap-pierce housing. At any given time, only one of these four sensors should be blocked. However, if one of the optical sensors is defective or occluded so that two sensors are activated at the same time, a Vertical Sensor Error will occur when the Vertical Sensor Check is performed. Since the software performs a Vertical Sensor Check before the bypass function, the service bypass function cannot be initiated in this situation. If a Vertical Sensor Error does occur, check the tube bottom seeking sensor first. Because this sensor is located in the cap-pierce module where it is exposed to aerosol during the piercing process, occlusion of the tube bottom seeking sensor is the most likely problem.

Extended Fatal Error Descriptions

The following sections describe the most complex fatal errors with emphasis on what the instrument is looking for when it generates a particular fatal error message.

PCMCIA Error 1

Error *1* is generated when the system fails to verify a checksum of the PCMCIA code. All program code is contained in Flash Memory. Major problems with reading the Flash Memory or corruption of Flash Memory data prevents the checksum verification from occurring or the display from being used. As a result, this error should be very rare, but if it occurs, the most likely problem is the Flash Memory (software) card itself.

DVM Error 3

A DVM check is made during powerup and during a menu-selected startup. System voltages are checked to see if they are within allowable ranges. If any of these voltages are outside their allowable range (shown in Table 7.2-3 for the A^{C}•T 8/10 analyzer, in Table 7.2-4 for the A^{C}•T diff analyzer, and in Table 7.2-5 for the A^{C}•T diff 2 analyzer), error *3* is displayed on the screen. The A/D converter has an input range of 0 to 10 Vdc, so voltages are converted to this range before presentation to the A/D converter. The test points given in the table are before the conversion, representing the actual voltage.

The POWER GOOD/POWER FAIL signal from the Power Supply module is also monitored. A POWER GOOD/POWER FAIL signal also triggers error *3*.

If a DVM failure occurs, there may be a problem with the Power Supply module or the Analyzer card, or poor line voltage may be triggering the POWER GOOD/POWER FAIL signal.

Table 7.2-3 Allowable Voltage Ranges - AC•T 8/10 Analyzer

Voltage	Range	Analyzer Card Test Point
+5	±5%	TP12 or P5-4
+10	±2%	TP27
-10	±2%	TP26
+15	±5%	TP14 or P5-7
-15	±5%	TP4 or P5-9
(+)15 RF	±2%	Positive lead C66

Table 7.2-4 Allowable Voltage Ranges - AC•T diff Analyzer

Voltage	Range	Analyzer Card Test Point
+5	±6%	TP5
+15	±6%	TP8
(+)15 RF	±3%	TP25

Table 7.2-5 Allowable Voltage Ranges - AC•T diff 2 Analyzer

Voltage		Acceptable Range	Analyzer Card Test Point
+5		±6%	TP5
+15		±6%	TP8
VACRF	If +8 V reference (X4 OFF = new vacuum transducer)	±3%	S10A (J18A), Pin 1
	If +15 V reference (X4 ON = old vacuum transducer)	±3%	S10A (J18A), Pin 1

Probe Did Not Reach Position Errors 6 through 11 and 19

The Traverse module is responsible for moving the aspirate probe to different horizontal and vertical positions.

- The AC•T 8/10 and AC•T diff analyzers use two dual-channel optical sensors to identify position, one for vertical and one for horizontal movement. Vertical positions are determined by holes in a flag that snaps onto the top of the vertical rack and rides through the vertical sensor. Horizontal positions are determined by cutouts in the front portion of the main traverse mounting bracket.
- The AC•T diff 2 analyzer uses single optical sensors at each station, four horizontal sensors mounted on the main bracket of the Traverse module, and three vertical sensors mounted on the Traverse Interconnect card. Roll pins mounted on the probe mechanism move and interrupt the stationary sensors.

During system operation, the probe is sent enough steps to go slightly beyond the sensor read position. If the probe does not get to the position, horizontal or vertical, that it is sent to, a corresponding error message is generated. See Table 7.2-2, Fatal Error Messages (Numbers), for specific messages.

Mechanical and electrical problems that can cause errors 6 through 11 and 19 include:

- Obstruction or resistance to probe movement that causes the stepper motor to miss steps.
- Obstructions in the optical sensor path that cause incorrect sensor reads.
- Poor electrical connections to the motors and sensors, the responsibility of the Traverse Interconnect card and the flex cable.
- Problems with the Power Supply module, since the DVM check is made only during powerup. This is especially true on the A^{C}•T 8/10 analyzer, since the DVM does not check the +24 Vdc supply.
- Failure of any of the following components: motors, sensors, Traverse Interconnect card, flex cable, and Analyzer card.

Syringe Did Not Reach/Leave Up Position Errors 12 and 13, A^{C}•T 8/10 and A^{C}•T diff Analyzers

The syringe assembly only uses one sensor and it is at the top position. At various times, the syringe is homed, sent to the top position. When the syringe is not detected at the home position after it is sent there, a Syringe Did Not Reach Up Position (error *12*) message is generated.

Syringe movement is complex as many up/down movements can occur before the syringe is sent back to the home position. It is not practical to track this movement and determine exactly when the syringe should be back at the home position. Instead, the syringe is sent to the home sensor after a period of activity to start once again from a known position. Though movement is not tracked precisely, the syringe should never be at the home sensor after a downward move. If this is detected, a Syringe Did Not Leave Up Position (error *13*) message is generated.

Mechanical and hydraulic problems that can produce error *12* or *13* include:

- A problem with the motor and lead screw of the syringe mechanism
- Dislodged syringe pistons
- A damaged, obstructed, or out of position syringe sensor
- Deteriorating piston seals that result in too much friction
- Broken syringe bodies
- Plugs in hydraulic tubing or solenoid valves that cause syringe deadheading.

Electrical problems that can produce error *12* or *13* include:

- A defective syringe motor or sensor
- A defective solenoid valve that causes a deadhead pathway
- Poor electrical connections to a solenoid, syringe motor, or sensor
- A problem with the Analyzer card which drives the solenoids, motors, and sensors
- Problems with the Power Supply module, since the DVM check is made only during powerup. This is especially true on the A^{C}•T 8/10 analyzer, since the DVM does not check the +24 Vdc supply.

Valve Error 14

Note: Error *14* applies only to the A^{C}•T 8/10, Software Version 1.03.

The driver output of each solenoid valve, LV1 to LV20, and the vacuum pump, LV23, is monitored. The monitoring system can detect if current is flowing, so if a valve is turned on and the monitoring system does not detect current flow, indicating something is wrong with the valve circuit, it generates an error *14*.

Error *14* does not indicate which valve is in error, but you can determine the valve by using the service bypass function and then using the Solenoids screen to turn on each valve individually.

The most likely source of solenoid errors is an open circuit, whether it is caused by an open coil in the device, or by a break in the connection from the circuit on the Analyzer card to the device.

Two reasons for a vacuum pump causing error *14* are:

- The vacuum pump does not turn on if it is deadheaded, so plugs in the input and output lines can turn it off.
- An internal thermal switch inhibits the vacuum pump from turning on if the pump is too hot.

I^{2}C Communication Failure Error 16

Motor movement is provided by individual driver microprocessors for each motor. The main microprocessor on the Analyzer card merely sends messages to these motor drivers with specific parameters. Information like how many steps to move and whether to stop on sensor or on step count is relayed in these messages. The protocol used to send and receive messages between the motor driver processors and the main Analyzer card processor is called I-Squared-C, or I^{2}C for short. If a problem is detected with this message protocol, error *16* is generated.

Since all the components involved in error *16* are located on the Analyzer card, any time error *16* is generated there is a problem on the Analyzer card.

Steps Missing (Syringe Motor) Error 17, A^{C}•T 8/10 and A^{C}•T diff Analyzers

Error *17* indicates something is wrong with syringe movement. The syringe assembly has one sensor, located at the top of stroke. The syringe is sent to this sensor near the beginning of a cycle so that it has a known starting point. Because there are three syringes for one motor, many upward and downward moves are made before the syringe may be sent back to the sensor. The system keeps track of the number of steps for each move. When the syringe is finally sent back to the sensor, the number of downward steps should equal the number of upward steps, leaving a difference of 0. Error *17* is generated if the difference is not near 0. A margin of error is given, since normal stopping and directional changes can produce small step errors.

Note that when using the Motors screen, a default number is used to generate error *17* when the syringe is sent to the sensor using the M1 motor function. If you are not at the correct position (within the limits for error) before this function is used, error *17* is generated. This does not however, mean that there is a problem with the syringe.

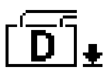
Diluent, Sample, and Lyse Pump Not Home Errors 12, 20, and 21, AC•T diff 2 Analyzer

The AC•T diff 2 analyzer uses FMI pumps for precision hydraulic movement. These pumps are rotary style pumps with input and output actions during each motor revolution. These pumps do not pump liquid in a constant flow during a revolution, so it is important to have a consistent starting point for each use of the pump. To establish a known starting point, an optical sensor is interrupted at one position during a revolution. This sensor would also be used to count steps for a dc motor, but that is not necessary for the stepper motors used in the AC•T diff 2 analyzer.

The system homes these pumps at various times during a cycle. To home the pump, the system moves the pump clockwise until it interrupts the sensor, then moves the pump to the edge of the sensor or just out of the sensor. If the sensor is not interrupted when it should be, the system generates an error *12*, *20* or *21* for the diluent, sample, or lyse pumps, respectively.

Problems with a motor driver, motor, or sensor can cause an error *12*, *20* or *21*.

Diluent Level Error During Powerup



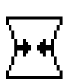
During the Powerup cycle, the diluent level sensor is checked twice. It is checked after a large amount of diluent is used by the system, which should indicate that the diluent level is low, not at the sensor. It is checked again after the reservoir is intentionally overfilled, which should indicate that diluent is at sensor. If the sensor reading is not what it should be at either check, a fatal diluent error is generated.

This routine is used to check the operation of the diluent sensor, not to check the diluent level, but a problem with the diluent reagent delivery system can cause the fatal version of the diluent error to occur. For instance, if there is a leak in the diluent input that does not allow the reservoir to fill, the sensor never sees diluent on the second check.

The most common problem with the diluent level sensor is bubbles, a film, or a droplet of diluent developing on the surface of the sensor.

Chronic diluent errors during powerup can also be caused by clogged diluent filters.

Vacuum Error



More than 6-in. Hg is needed to do a probe wipe. The vacuum is checked before probe wipe and if the vacuum is less than 6-in. Hg this error is generated. This check ensures there is no vacuum leak and that the vacuum can build to this level quickly.

7.3 TROUBLESHOOTING CLOG DETECTION PROBLEMS

Purpose

This section provides an in-depth discussion of the parameters used for clog detection and why they are used. A greater knowledge of these parameters and what can cause them to vary should make troubleshooting clog detection problems simpler.

Flow Voltage (Pulse Width)

Description

The basic parameter used for clog detection is pulse width. This is an important parameter because it represents the time it takes a particle or cell to travel through a sensitive area of the aperture. Since the instrument applies a constant fixed vacuum to draw cells through a fixed aperture, the time of travel or pulse width should be constant. The time of travel and pulse width do vary some, however, because not all particles take a straight path through the aperture. A cell passing straight along the center axis of the aperture achieves the shortest time and the narrowest pulse width. A cell approaching the aperture from the side takes an angular path through the sensing zone and aperture and consequently takes longer to clear the sensing zone and produces a wider pulse width. A wider pulse width means that the cell was in the sensing zone for a longer time and that it took longer to travel through the sensing zone.

Measuring Pulse Widths, AC•T 8/10 Analyzer

The most obvious method of measuring pulse width is to measure the width of each pulse at a fixed height or voltage. The AC•T 8/10 analyzer uses this method by measuring the pulse width at a voltage just above the count-threshold voltage. At the end of each one-second count period, an average of the widths of the pulses counted during the period is determined. This is the basis of the WPWV and RPWV parameters.

Measuring Pulse Widths, AC•T diff and AC•T diff 2 Analyzers

The AC•T diff and AC•T diff 2 analyzers use a very different method from the AC•T 8/10 analyzer to measure the pulse width. The AC•T diff and AC•T diff 2 analyzers use a method that produces a value called the 26-percentile. The 26-percentile value is reported on the Sample Details screen in the WBC Measured or RBC Measured field.

The 26-percentile value is based on readings taken at the ½ height width and ¾ height width. To understand a ½ height width, first consider a triangular pulse. If you were to draw a horizontal line at ½ the height of the triangle, and measure the length between the points where the line intersects the two vertical sides of the triangle, this measurement would be the ½ height width of the triangle or the pulse width.

The reason this method of measuring the pulse width is better than the method used by the AC•T 8/10 analyzer is that this value is independent of height. This can be illustrated by considering another triangle with exactly the same base width, but with a different height. This triangle represents a particle of a different size, but taking exactly the same path and time through the aperture. Measuring the ½ height width gives the same value as was obtained for the first triangle. Measuring the width at a fixed threshold gives a wider pulse width for a taller triangle and a narrower pulse width for a shorter triangle.

After measuring the pulse widths, the instrument must determine a value representing all the pulses passing through the Editor circuit during a count period. The first value to consider is an average, but an average value might not be the best choice. If all the pulse widths during a count period were plotted, with the vertical axis representing the number of pulses and the horizontal axis representing increasing width, the resulting distribution would be similar to a normal Plt distribution curve. It would show a fast rise on the left of the peak, and a more gradual drop on the right of the peak. The average width would be on the right, but fairly close to the peak. The average width would represent the 50 percentile, since 50% of the pulses would be on the left of this point, and 50% would be on the right. The 26 percentile is a point on the curve where 26% of the pulses are on the right of that point and 74% are on the left. The 26 percentile point is well to the right of the peak, where the curve is approaching the baseline.

Keeping this normal distribution in mind, consider what happens if a clog occurs. Pulse widths increase because there is no optimal path through the center axis of the aperture. Pulses no longer fall on the left end of the curve and the drop on the right side of the peak is more gradual as pulses are added. The average, and possibly the peak, move slowly to the right. The 26 percentile also moves to the right, since more pulses were being plotted on the right end of the curve. The 26 percentile is more sensitive to a change in wider pulse widths, which is what a clog produces, than the 50 percentile or a 74 percentile.

Factors Affecting Pulse Widths

With the knowledge of how the pulse-width parameters are derived, it is easier to understand what can affect pulse width.

- A partial clog affects pulse width in two ways.
    - Since the aperture is effectively smaller with the same vacuum applied, less dilution travels through the aperture. Though the speed at the aperture center does not decrease, cells entering the sensing zone take more time before they actually travel through the aperture.This extra time entering and exiting the aperture creates a wider pulse width.
    - In addition, flow patterns are disrupted and chaotic. This results in angular paths rather than the fast, straight path down the axis of the aperture, also resulting in wider pulse widths.
- A change in the vacuum is the most direct factor that can change pulse width, since the flow through the aperture is accomplished by vacuum. Decreased vacuum slows the flow through the aperture and therefore increases pulse width.
- The temperature of the dilution also alters flow rate. As the dilution temperature rises, it becomes less viscous and can travel through the aperture more readily. This decreases pulse width.
- Cell elasticity is a less obvious factor affecting pulse width. Cells are very elastic in nature, being essentially a “bag of fluid.” A red cell, for instance, elongates as it passes through the aperture, creating a length five to ten times its normal diameter. This process of elongation seems to slow the travel through the aperture, causing wider pulse widths. The length of the cell in itself causes the cell to be in the sensing zone for a longer period as it travels.

When a cell is fixed, as cells are for controls and calibrators, some of the elasticity is lost. Consequently, the cell travels through the aperture faster, creating a narrower pulse width. This is why there is a difference in the 26-percentile value between fresh bloods and controls. This is also why sickle cells produce a narrow pulse width. Sickle cells have rigid cell walls which means they do not have the same elasticity as normal cells and travel through the aperture much faster.

WBC/RBC Ratios and WBC/RBC Ratio CVs

The WBC and RBC Ratio CVs, like the 26-percentile value, are derived from data obtained from the Editor circuit. These parameters are only available for clog detection on the A^{C}•T diff analyzer, not the A^{C}•T 8 or 10 analyzer.

The primary purpose of the Editor circuit in deriving the WBC and RBC Ratios is to screen the pulse train for well-shaped pulses and channelize only well-shaped pulses for constructing histograms. The aperture signal is applied to the editor and the rising edge of a pulse triggers the processing of that pulse. No other pulses are processed until processing is completed for the previous pulse. This means that only a percentage of pulses are even looked at by the editor. This is further complicated for the RBC editor because Plts are taken from the same signal, and Plt pulse processing is given a higher priority because of the smaller number of Plts generally available. If the Plt count is high, the number of pulses looked at by the RBC editor decreases. Pulses processed and rejected by the editor are not counted, so the WBC/RBC Ratio is a ratio of the channelized pulses (well-shaped pulses) to the raw count from the counter (total pulses at the aperture).

The ratio of well-shaped pulses may be very low, but still acceptable. For this reason, the actual ratio is not used for RBC clog detection, and the ratio has a wide limit for WBC clog detection. More useful information is gained from the CV of the ratio values. A ratio is calculated for each count period yielding 12 readings for RBC and WBC. A CV of the 12 values is calculated and limits placed on the result. The assumption is that the ratio should not change. Samples with ratios of 75% and 20% should remain at 75% and 20% for all 12 count-periods. Factors such as vacuum, cell concentration, and physical cell characteristics may determine the ratio, but remain constant for count duration.

A clogged aperture affects flow patterns and in turn affects the ratio. Cells with an irregular path through the aperture are rejected by the editor, decreasing the ratio. If the clog is severe, the pulse rate is reduced and may allow a higher percentage of cells to be processed, increasing the ratio.

Changes in flow rate caused by temperature or vacuum have no affect until they cause the pulses to be so wide that they get rejected by the editor. This triggers vacuum alarms and the 26-percentile check.

The Ratio CV is affected when a temporary clog is present long enough to significantly change one or more count periods. If a sample yields a low ratio, the Ratio CV calculation is higher for mathematical reasons alone.

WAV/RAV/AVR

WAV and RAV are the voltages measured across the WBC and RBC apertures, respectively. AVR is the ratio of the RAV to WAV, which should be constant for a given set of apertures.

Since the voltage across the aperture is directly proportional to resistance at the aperture, this is the most obvious form of clog detection. This is also why the voltage reading for the WBC aperture is about half the voltage reading for the RBC aperture. Resistance is lower for the larger WBC aperture, so voltage is lower. An obstruction in the aperture causes an increase in resistance which causes an increase in voltage. A cracked aperture is larger, with less resistance, so the voltage across the aperture decreases.

The WAV, RAV and AVR are affected directly by aperture size, temperature of the reagents, resistive properties of the reagents (electrolytes), and any bubbles in the aperture's path. The instrument software compensates to some degree for temperature changes and using the AVR Ratio also minimizes the affects of temperature.

7.4 TROUBLESHOOTING AC•T 8/10 AND AC•T diff ANALYZER SPECIFIC PROBLEMS

The causes of several problems on the AC•T 8/10 or AC•T diff analyzers may not be immediately obvious. Table 7.4-1 describes some of these problems and their causes/solutions, including solutions that may be different from those used for other Beckman Coulter instruments.

Table 7.4-1 Specific AC•T 8/10 and AC•T diff Analyzer Problems/Solutions

Symptom	Possible Problem	Causes/Solutions
Counts, Hgb high and/or erratic AC•T diff analyzer only - low Hgb Blank1 giving Hgb incomplete computations	Poor probe wipe	Poor diluent delivery due to: • Diluent line too long • Diluent height too great relative to instrument • Diluent line restricted • Diluent peristaltic pump tubing worn • Diluent fluid filters plugged • Solenoid LV10 problems • Probe wash restricted.
		Poor probe wipe evacuation due to: • Probe wipe housing restricted • Path from probe wipe housing to VC1 restricted • Solenoid LV8 problems. Insufficient high vacuum caused by slight leak, restriction, or weak vacuum pump diaphragm. High vacuum at VC1 should be >15 in. Hg. If not, replace pump diaphragm (see Heading 4.6, PNEUMATIC PUMP REPLACEMENT - AC•T 8/10 AND AC•T diff ANALYZERS).
Counts, Hgb low and/or erratic	Poor bath drain	Restriction in one of solenoids LV13, LV14, or LV15. Usually requires dislodging of large particle. Manual purging of solenoid using Diagnostics menu usually clears problem. If not, using syringe to flush solenoid and/or bleaching waste path may prevent solenoid replacements.
High WBC, Plt counts and background	Interference	Ground path between bath panel and Analyzer card uses a lug connector on preamp shield. If lug connector becomes loose from being reconnected several times, or oxidized, interference results. Ensure a good connection at this ground point.
	Cross talk	Shunt paths between the two apertures or from one aperture to the bottom waste port in VC1.

8 PARTS LISTS, 8.1-1

8.1 MASTER PARTS LIST, 8.1-1

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ILLUSTRATIONS

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8.1 MASTER PARTS LIST

The parts are listed in alphabetic order within the following categories:

- Components (Table 8.1-1)
- Fasteners, Fittings, and Miscellaneous Hardware (Table 8.1-2)
- Optional Items and Supplies (Table 8.1-3)

Table 8.1-1 Components

Description	Part Number	Figure	Item
Aperture, RBC and bath assembly	6806442	8.2-14 8.2-15	24 26
Aperture, WBC and bath assembly	6806443	8.2-14 8.2-15	23 25
Belt, traverse horizontal drive, AC•T diff 2 analyzer	2527827	8.2-11	5
Board, switching supply, Power Supply module	4004097	8.2-9	9
Cable for adapting the AC•T diff analyzer Power Supply module for use on an AC•T 8/10 analyzer	6028918		
Cable, a/c power line cord, 115 Vac, US	6027225		
Cable, bath assembly, ground	6028719		
Cable, black ribbon cable to Display assembly, AC•T diff 2 analyzer	6002021	8.2-3 8.2-4	4 17
Cable, chassis ground, connects to Power Supply module	6028708	8.2-9	7
Cable, ground strap for Display assembly, AC•T 8/10 and AC•T diff analyzers	6028264	8.2-4	4
Cable, ground strap for Display assembly, AC•T diff 2 analyzer	6028879	8.2-4	4
Cable, harness, ASF Thomas vacuum pump	6028893	8.2-8 8.2-13	20 7
Cable, ribbon cable to Display assembly, AC•T 8/10 and AC•T diff analyzers	6028704	8.2-4	17
Cable, syringe module to Analyzer card	6028703		
Cable, Traverse module, flex, AC•T 8/10 and AC•T diff analyzers	6028676	8.2-2	9
Cable, Traverse module, flex, AC•T diff 2 analyzer	6002022	8.2-3 8.2-11	8 4
Cable, waste-level sensor, for two-piece assembly	6028783		
Cam, safety latch, AC•T diff 2 analyzer	1024560	8.2-12	16
Card reader, reagent smart card, AC•T 8/10 and AC•T diff analyzers	2121950	8.2-4	1
Card reader, reagent smart card, AC•T diff 2 analyzer	2122060	8.2-4	1
Card, Analyzer, AC•T 8/10 analyzer (new number) **Note:** This card is functionally the same as PN 6706332; it was assigned a new part number because its layout is different.	6706541	8.2-13	4
Card, Analyzer, AC•T 8/10 analyzer (old number)	6706332	8.2-13	4
Card, Analyzer, AC•T diff 2 analyzer	6706802	8.2-13	4
Card, Analyzer, AC•T diff analyzer	6706442	8.2-13	4

Table 8.1-1 Components *(Continued)*

Description	Part Number	Figure	Item
Card, Analyzer, Universal (for AC•T diff and AC•T diff 2 analyzers only)	6707111	8.2-13	4
Card, Display Controller Driver, SMT	6706703	8.2-4	15
Card, Display Controller Driver, through hole	6706342	8.2-4	15
Card, Pump Motor Filter	6029207	8.2-8 8.2-13	21 12
Card, Transient Suppressor, Power Supply module	6705663	8.2-9	11
Card, Traverse Interconnect, AC•T 8/10 and AC•T diff analyzers	6706334	8.2-10	4
Card, Traverse Interconnect, AC•T diff 2 analyzer	6706753	8.2-11	3
Chamber, vacuum isolator and waste assembly, molded	6805032	8.2-14 8.2-15	14 14
Choke, 0.010 orifice, black	6213011	8.2-13	11
Choke. 0.006 orifice, brown	6213009	8.2-13	11
Cover, cap-pierce door, AC•T diff 2 analyzer	1024537	8.2-12	15
Cover, front, AC•T diff 2 analyzer	6806393	8.2-4	6
Cover, front, with partial label, AC•T 8/10 and AC•T diff analyzers	6805673	8.2-4	6
Cover, pneumatic pump compartment, AC•T diff 2 analyzer, ASF Thomas pump	6806364	8.2-8	1
Cover, pneumatic pump compartment, AC•T diff 2 analyzer, KNF dual-head pump	6807605	8.2-8	26
Display, graphic LCD screen	4837341	8.2-4	19
Display, LCD and keypad assembly with SMT, AC•T 8/10 and AC•T diff analyzers	7000580	8.2-4	5
Display, LCD and keypad assembly with SMT, AC•T diff 2 analyzer	7000623	8.2-4	5
Door, left side with hinge, no latch, AC•T 8/10 and AC•T diff analyzers	6805316	8.2-13	15
Door, right side with hinge, no latch, AC•T 8/10 and AC•T diff analyzers	6805672	8.2-6	20
Fan, 24 Vdc, mounts on rear of panel of the AC•T diff 2 analyzer	6806535		
Fan, filter and cage assembly, for rear panel of the AC•T diff 2 analyzer	2603078		
Filter, fluid barrier, 0.45 micron, green	6232803	8.2-6 8.2-8	22 18
Filter, for 24 Vdc fan, AC•T diff 2 analyzer	2603081		
Filter, waste particle, basket type, 149 micron mesh, double-barb, AC•T diff 2 analyzer **Note:** Position filter with the arrow pointing towards the waste pump.	6233045	8.2-7	22
Filter, water, hydrophilc, 5 μ, with male Luer fitting, AC•T 8/10 and AC•T diff analyzers	6233052	8.2-6	1
Filter, water, hydrophilic, 0.45 μ, replacement kit (two filters in kit), AC•T 8/10 and AC•T diff analyzers **Note**: These filters are mounted on the inside surface of the right-side door.	6915577		
Filter, water, hydrophilic, 0.45 μ, replacement kit (two filters in kit), AC•T diff 2 analyzer **Note**: These filters are mounted inside the right compartment on the pneumatic pump cover.	6915526	8.2-7	10

Table 8.1-1 Components *(Continued)*

Description	Part Number	Figure	Item
Flag, vertical position, for optical sensor, AC•T 8/10 and AC•T diff analyzers	1023357	8.2-10	11
Foam trap, glassware and stopper assembly	6806764	8.2-7	20
Fuse, 1.5 A SLO BLO, F1 and F2 on Power Supply module, AC•T 8/10 and AC•T diff analyzers	5102029	8.2-9	14
Fuse, 2.5 A SLO BLO, F1 and F2 on Power Supply module, AC•T diff 2 analyzer	5120184	8.2-9	14
Gear, cap-pierce door, with setscrew, AC•T diff 2 analyzer	2527842	8.2-12	10
Gear, traverse belt tensioner, AC•T diff 2 analyzer	2527743	8.2-11	21
Guard, cap-pierce probe, AC•T diff 2 analyzer	1024587	8.2-12	22
Holder, tube, AC•T diff 2 analyzer	6806615	8.2-12	2
Holder, tube, door assembly, AC•T diff 2 analyzer	6806616	8.2-12	9
Housing, cap pierce, AC•T diff 2 analyzer	6806481	8.2-12	1
Housing, lamp holder and heatsink, molded	6805691	8.2-14 8.2-15	3 3
Housing, probe-wipe, AC•T 8/10 and AC•T diff analyzers	6859716	8.2-10	14
Housing, probe-wipe, AC•T diff 2 analyzer	6807013	8.2-11	12
Housing, traverse guide, AC•T diff 2 analyzer	6706321	8.2-11	10
Housing, traverse, molded, AC•T 8/10 and AC•T diff analyzers	6805479	8.2-10	17
Housing, traverse, molded, AC•T diff 2 analyzer	6806502	8.2-11	15
Insulation, vacuum pump cover, side, AC•T diff 2 analyzer	1024433	8.2-8	15
Insulation, vacuum pump cover, top and bottom, AC•T diff 2 analyzer	1024434	8.2-8	14
Insulation, vacuum pump cover, top, AC•T diff 2 analyzer	1024432	8.2-8	16
Insulation, vacuum pump, bracket side, AC•T diff 2 analyzer	1024435	8.2-8	8
Insulator, display fish paper, AC•T 8/10 or AC•T diff analyzer with original through-hole Display Controller Driver card	1023501		
Insulator, display fish paper, AC•T analyzer with SMT Display Controller Driver card	1024137		
Keyboard, touch screen	2016703	8.2-4	20
Knob, vacuum regulator	9908180	8.2-2 8.2-8	2 5
Lamp, Hgb Photometer assembly	6805344	8.2-14 8.2-15	2 2
LED, power indicator assembly, AC•T 8/10 and AC•T diff analyzers	6805394	8.2-4	23
LED, power indicator assembly, AC•T diff 2 analyzer	6806620	8.2-4	23
Lens, Hgb lamp	1023237	8.2-14 8.2-15	6 6
Lens, Hgb lamp, heat filter, blue	6102189	8.2-14 8.2-15	5 5

Table 8.1-1 Components *(Continued)*

Description	Part Number	Figure	Item
Memory, CMOS, non-volatile Dallas® chip	4837242		
Module, Pneumatic Pump, KNF dual-head (includes the pneumatic pump compartment with all the internal components shown in Figure 8.2-8, the pneumatic pump cover, and the following components external to the compartment: the EMC Motor Filter 2 card, PN 6707140; the vacuum transducer, PN 2302008; the vacuum regulator knob, PN 9908180; and the female Luer lock fitting, PN 6232801. **Note:** Only order this complete module if you are upgrading a single-head pump to a KNF dual-head pump. If you are simply replacing a defective KNF dual-head pump, order the pump, PN 6233071.	6807707	8.2-8	27
Module, Traverse, AC•T 8/10 and AC•T diff analyzers	7000558	8.2-2	8
Motor, cap-pierce door, AC•T diff 2 analyzer	6806575	8.2-12	8
Motor, peristaltic pump, assembly with connector, AC•T 8/10 and AC•T diff analyzers	6805708	8.2-5	2
Motor, peristaltic pump, assembly with connector (half winding, use with new Analyzer card, PN 6707111), AC•T 8/10 and AC•T diff analyzers	6807092	8.2-5	2
Motor, probe vertical movement, AC•T diff 2 analyzer	6806490	8.2-11	1
Motor, traverse horizontal motion, AC•T diff 2 analyzer	6806491	8.2-11	6
Motor, traverse travel, with connector, AC•T 8/10 and AC•T diff analyzers	6805555	8.2-10	8
Photodiode, Hgb preamp and housing, molded	6805357	8.2-14 8.2-15	10 10
Plate, aspirate switch, black molded, AC•T 8/10 and AC•T diff analyzers	1023491	8.2-2	12
Plate, aspirate switch, grey molded, AC•T diff 2 analyzer	10244871	8.2-3	16
Plate, bath assembly mounting and isolation, AC•T 8/10 and AC•T diff analyzers	6805559	8.2-16	3
Plate, bath assembly mounting and isolation, AC•T diff 2 analyzer	6806092	8.2-16	3
Power Supply, main power module, AC•T 8/10 analyzer	7000556	8.2-9	16
Power Supply, main power module, AC•T diff 2 analyzer	7000626	8.2-9	16
Power Supply, main power module, AC•T diff analyzer	7000573	8.2-9	16
Probe, aspirate probe without O-ring, AC•T 8/10 and AC•T diff analyzers	6805125	8.2-10	6
Probe, aspirate, AC•T diff 2 analyzer	6805948	8.2-11	13
Pump, ASF Thomas vacuum, 24 Vdc brush type (new style)	6232880	8.2-8 8.2-13	12 8
Pump, cleaning agent (shutdown diluent), AC•T diff 2 analyzer	6806489	8.2-7	21
Pump, diluent reservoir fill, AC•T diff 2 analyzer	6806580	8.2-7	16
Pump, FMI, 100 µL, diluent/lyse, AC•T diff 2 analyzer	6806493	8.2-7	28
Pump, FMI, 50 µL, sample (aspiration), AC•T diff 2 analyzer	6806492	8.2-7	27
Pump, FMI, 50 µL, sample (aspiration) (half winding, use with new Analyzer card, PN 6707111), AC•T diff 2 analyzer	6807001	8.2-7	27

Table 8.1-1 Components *(Continued)*

Description	Part Number	Figure	Item
Pump, KNF dual-head, vacuum/pressure, 24-Vdc, brushless	6233071	8.2-8 8.2-13	23 10
Pump, Triple Syringe module, with boot seal on diluent syringe only	6707085	8.2-1	1
Pump, waste, KNF, AC•T diff 2 analyzer	6806494	8.2-7	19
Rack, traverse, horizontal motion, AC•T 8/10 and AC•T diff analyzers	1023360	8.2-10	3
Rack, traverse, horizontal motion, AC•T diff 2 analyzer	1024022	8.2-11	22
Rack, traverse, vertical drive, AC•T diff 2 analyzer	6806614	8.2-11	11
Rack, traverse, vertical motion, AC•T 8/10 and AC•T diff analyzers	1023359	8.2-10	15
Regulator, vacuum	6232628	8.2-8 8.2-13	4 18
Reservoir, subassembly, with float sensor (replaces PN 6805906)	6806261	8.2-5 8.2-7	11 6
Retainer, probe, AC•T diff 2 analyzer	1024158	8.2-11	23
Sensor, dual channel, optical, AC•T 8/10 and AC•T diff analyzers	4837317	8.2-10	10
Sensor, inline optical fluid, cleaning and lytic reagent	6706483	8.2-6	14
Sensor, optical diluent level sense, with fuse	5120246	8.2-5	11
Sensor, optical, position, AC•T diff 2 analyzer **Note:** The four horizontal position sensors on the Traverse module and the door-closed position and tube bottom seeking sensors in the Cap-Pierce module are identical sensors.	6806496	8.2-11 8.2-12	18 4
Sensor, thermistor temperature assembly, AC•T 8/10 and AC•T diff analyzers	2306100	8.2-5	10
Sensor, vacuum transducer, 15 V reference, AC•T 8/10 and AC•T diff analyzers	2306099	8.2-6 8.2-13	8 18
Sensor, vacuum transducer, 8 V reference, AC•T diff 2 analyzer	2302008	8.2-8 8.2-13	2 18
Sensor, waste assembly, with cable and tubing	6805741		
Sensor, waste, sensor only	6705981		
Shaft, cap-pierce door gear, AC•T diff 2 analyzer	1024428	8.2-12	14
Shield, bath assembly, electrical, AC•T 8/10 and AC•T diff analyzers	6805331	8.2-16	1
Shield, bath assembly, electrical, AC•T diff 2 analyzer	6806555	8.2-16	1
Shield, electromagnetic for Display assembly, AC•T 8/10 and AC•T diff analyzers with original through-hole Display Controller Driver card	6805136	8.2-4	18
Shield, electromagnetic for Display assembly, AC•T 8/10 and AC•T diff analyzers with SMT Display Controller Driver card	6806205	8.2-4	18
Shield, electromagnetic for Display assembly, AC•T diff 2 analyzer	6806601	8.2-4	18
Shield, EMI/EMC, gasket, V-form, AC•T 8/10 and AC•T diff analyzers	5704057	8.2-2	5
Shield, EMI/EMC, gasket, V-form, AC•T diff 2 analyzer	5703007	8.2-3	15

Table 8.1-1 Components *(Continued)*

Description	Part Number	Figure	Item
Shield, plastic, splash guard, AC•T 8/10 and AC•T diff analyzers	6805734	8.2-10	5
Software, AC•T 10 analyzer, Version 1.04	6706655	8.2-2	1
Software, AC•T 8 analyzer, Version 1.04	6706654	8.2-2	1
Software, AC•T diff 2 analyzer, Spanish Version 1.00	6915345	8.2-3	1
Software, AC•T diff 2 analyzer, Version 1.00	6915288	8.2-3	1
Software, AC•T diff analyzer, English, Version 1.06, card only	6915355	8.2-2	1
Software, AC•T diff analyzer, English, Version 1.06, upgrade kit, mailable	6915356	8.2-2	1
Software, AC•T diff analyzer, Spanish, Version 1.06, card only	6915347	8.2-2	1
Software, AC•T diff/Veterinary Option analyzer, Version 1.06, kit with manual	6915366	8.2-2	1
Software, AC•T diff/Veterinary Option analyzer, Version 1.06, kit without manual	6915367	8.2-2	1
Spool, peristaltic pump, AC•T 8/10 and AC•T diff analyzers	6859650	8.2-5	3
Spool, peristaltic pump, new molded version, AC•T 8/10 and AC•T diff analyzers	6706686	8.2-5	3
Spool, sweep-flow, assembly (includes 13 ft. of EVA tubing, PN 3202284, and two flangeless fittings, PN 6233080)	6807701	8.2-14 8.2-15	17 20
Switch, aspirate, with cable and connector	6805396	8.2-13	5
Switch, Power Supply module and instrument ON/OFF	5120214	8.2-9	10
Syringe, assembly, 1 mL, without barrel boot seal	6707095	8.2-1	5
Syringe, glass barrel assembly, with boot and plunger, 250 µL	6706808	8.2-1	4
Syringe, glass barrel assembly, with boot and plunger, 5 mL	6706809	8.2-1	3
Syringe, glass barrel assembly, with boot and plunger, without boot seal, 250 µL	6707087	8.2-1	4
Syringe, glass barrel with Luer fitting, 1 mL (replaces PN 2527682)	6706652	8.2-1	6
Syringe, glass barrel with Luer fitting, 250 µL (replaces PN 2527683)	6706653	8.2-1	13
Syringe, glass barrel with Luer fitting, 5 mL (replaces PN 2527680)	6706651	8.2-1	7
Syringe, piston, 1 mL	2527677	8.2-1	5
Syringe, piston, 250 µL	2527678	8.2-1	11
Syringe, piston, 5 mL	2527679	8.2-1	8
Traverse, probe traverse module, AC•T 8/10 and AC•T diff analyzers	7000558	8.2-2	8
Tubing, 0.082 i.d., polyurethane, clear	3202036		
Tubing, 0.082 i.d., polyurethane, green striped	3202208		
Tubing, 0.082 i.d., polyurethane, red striped	3202205	8.2-8	7
Tubing, 0.082 i.d., polyurethane, blue striped	3202209		
Tubing, 0.082 i.d., polyurethane, yellow striped	3202207		
Tubing, 0.145 i.d., polyurethane, clear	3202039	8.2-14 8.2-15	19 22
Tubing, coiled reagent	1023593		

Table 8.1-1 Components *(Continued)*

Description	Part Number	Figure	Item
Tubing, coiled reagent with blue stripe	1023592		
Tubing, EVA, for lytic reagent pickup	3202221		
Tubing, for large Bio-Chem solenoid pinch valve 6232869	3230084		
Tubing, for small Bio-Chem solenoid pinch valve 6232867	3230085		
Tubing, peristaltic pump, AC•T 8/10 and AC•T diff analyzers	3213214	8.2-5	4
Tubing, polyurethane, special three-tube ribbon, AC•T 8/10 and AC•T diff analyzers	3230066	8.2-2	6
Tubing, silicone pinch tubing, black striped	3203015		
Valve, check, medium (0.125 i.d. fitting)	6214107	8.2-6	6
Valve, check, small (0.062 i.d. fitting)	6214108	8.2-6 8.2-14 8.2-15	4 20 23
Valve, large Bio-Chem solenoid pinch, AC•T diff 2 analyzer	6232869	8.2-7	23
Valve, large Bio-Chem solenoid pinch, AC•T diff 2 analyzer	3230084	8.2-7	21
Valve, Pneutronics® solenoid, AC•T 8/10 and AC•T diff analyzers	6232777	8.2-5	14
Valve, small Bio-Chem solenoid pinch, AC•T 8/10 and AC•T diff analyzers	6232867	8.2-6	13
Valve, solenoid, Angar® fluidic, 2 way, AC•T 8/10 and AC•T diff analyzers	6232780	8.2-14	21
Valve, solenoid, Angar® fluidic, 3 way	6232779	8.2-6	18
Valve, solenoid, bank of four, pneumatic, 3 way, AC•T diff 2 analyzer	6232930	8.2-8	11
Valve, solenoid, fluidic, 2 way, AC•T diff 2 analyzer	6232933	8.2-7	4
Valve, solenoid, fluidic, 3 way, AC•T diff 2 analyzer	6232931	8.2-7	2
Valve, solenoid, pinch, 3 way, AC•T diff 2 analyzer	6232870	8.2-7	5
Valve, solenoid, pneumatic, 3 way, AC•T diff 2 analyzer	6232929	8.2-8	9
Valve, solenoid, Pneutronics® module with manifold, AC•T 8/10 and AC•T diff analyzers	6232776	8.2-5	12
Valve, solenoid, Takasago fluidic, 2-way, AC•T diff 2 analyzer	6232932	8.2-15	17
Wear strip, stainless steel, traverse guide, AC•T 8/10 and AC•T diff analyzers	1023611	8.2-10	2

Table 8.1-2 Fasteners, Fittings, and Miscellaneous Hardware

Description	Part Number	Figure	Item
Base, pneumatic pump, KNF dual head	6807604	8.2-8	22
Bracket, ASF Thomas vacuum pump	1023939	8.2-8 8.2-13	13 9
Bracket, aspirate switch	6805332	8.2-13	6
Bracket, cap-pierce door motor, A^{C}•T diff 2 analyzer	1024495	8.2-12	6
Bracket, diluent reservoir fill pump	1024549	8.2-7	14
Bracket, KNF dual-head pump	6807690	8.2-8 8.2-13	24 13
Bracket, mounting catch	6805716		
Bracket, safety latch hook, A^{C}•T diff 2 analyzer	1024562	8.2-12	18
Bracket, safety latch mount, A^{C}•T diff 2 analyzer	1024561	8.2-12	20
Bracket, safety latch-catch plate, front door, A^{C}•T diff 2 analyzer	1024601	8.2-3	14
Bracket, screw mounting (part of latching mechanism on current A^{C}•T diff 2 analyzers)	6806844	8.2-3	18
Bracket, waste pump, A^{C}•T diff 2 analyzer	6806480	8.2-7	17
Clamp, bath-mounting post, molded	6805773	8.2-14 8.2-15	26 27
Clamp, cable and tubing, front panel, molded, A^{C}•T 8/10 and A^{C}•T diff analyzers	1023434	8.2-2	11
Clamp, cable bundle, 0.35 diameter, harness mount, nylon	6027786	8.2-13	1
Clamp, cable bundle, 0.47 diameter, panel mount, snap lock, A^{C}•T diff 2 analyzer (Clamp is used throughout this analyzer.)	6028999	8.2-13	17
Clamp, cable bundle, 0.73 diameter, panel mount, snap lock, A^{C}•T 8/10 and A^{C}•T diff analyzers (Clamp is used throughout these analyzers. This clamp replaces PN 6028809 and, in some cases, PN 6028810.)	6028995	8.2-13	17
Clamp, cable bundle, snap mount to panel, 0.515 x 0.410 in. bundle (Clamp is used throughout the analyzer and may be replaced with cable bundle clamp PN 6028995.)	6028809	8.2-6	17
Clamp, cable bundle, snap mount to panel, 0.875 x 0.437 in. bundle, A^{C}•T 8/10 and A^{C}•T diff analyzers (Clamp is used in several places throughout these analyzers. In some cases, PN 6028995 may replace this clamp.)	6028810	8.2-6 8.2-13	11 17
Clamp, cable, front panel, A^{C}•T diff 2 analyzer	1024447	8.2-3	7
Clamp, cable, front panel, molded, A^{C}•T diff 2 analyzer	1024447	8.2-2	11
Clamp, cap-pierce door, A^{C}•T diff 2 analyzer	1024496	8.2-12	7
Clamp, ribbon cable, Display assembly, A^{C}•T 8/10 and A^{C}•T diff analyzers	6027373	8.2-2	3
Clamp, tie wrap, releasable, 4.0 l x 10 w (for fastening foam trap to mount, A^{C}•T diff 2 analyzer)	6028917		
Clamp, tie wrap, releaseable (for fastening vacuum chamber to mount)	6029001	8.2-14 8.2-15	12 12
Clamp, tubing, front panel, A^{C}•T diff 2 analyzer	6806595	8.2-3	3

Table 8.1-2 Fasteners, Fittings, and Miscellaneous Hardware *(Continued)*

Description	Part Number	Figure	Item
Clamp, tubing, traverse, A^{C}•T diff 2 analyzer	6859756	8.2-11	2
Clip, probe-wipe housing	1022827	8.2-10 8.2-11	16 14
Connector, 12-pin, P5 on Power Supply module, A^{C}•T diff analyzer	2121892	8.2-9	12
Connector, 1-pin	2121410	8.2-9	8
Connector, 9-pin, P5 on Power Supply module, A^{C}•T 8/10 analyzer	2121695	8.2-9	12
Connector, card reader flex cable, part of Display Controller Driver card	2121952	8.2-4	21
Fastener, adhesive back cable clamp, 0.375 x 0.500 in.	6027571		
Fastener, barbed, for vacuum transducer, push in fastener	2851884		
Fastener, LED panel mount, A^{C}•T 8/10 and A^{C}•T diff analyzers	2838063	8.2-4	22
Fastener, nut, for bulkhead Luer fitting	6232382	8.2-9	1
Fastener, nylon panel mount, cable clamp	6028781		
Fastener, nylon retaining post to mount Analyzer card (old mount style)	2851601	8.2-13	2
Fitting, adapter, 1/4-28 ext to 3/32 i.d. tubing	6232962	8.2-7	1
Fitting, adapter, 1/8 i.d. to, 1/4-28 male thd	6232951	8.2-7	25
Fitting, feed-thru, 1/4 x 28 flat bottom, stainless steel, CP	1025523	8.2-14 8.2-15	15 15
Fitting, feed-thru, bulkhead, 0.062 i.d. to 0.093 i.d., A^{C}•T diff 2 analyzer	6216353	8.2-15	16
Fitting, feed-thru, bulkhead, 0.07 i.d., A^{C}•T 8/10 and A^{C}•T diff analyzers	1017458	8.2-14	16
Fitting, Luer, bulkhead, to barbed hose fitting	6232503	8.2-9	3
Fitting, Luer, female, to 0.094 barbed hose	6232801	8.2-6 8.2-8	2 19
Fitting, Luer, male, to 0.094 barbed hose fitting	6232502	8.2-1 8.2-6 8.2-8 8.2-9	2 5 17 5
Fitting, Luer, male, to barbed hose fitting	6232846	8.2-9	4
Fitting, T, 0.062 legs	6226008		
Fitting, T, 0.094 i.d.	6232051	8.2-14 8.2-15	22 24
Fitting, union, 1/4-28 female to 0.093 barb, CP	1025566	8.2-14 8.2-15	18 21
Fitting, union, 0.062 i.d. to 0.093 i.d.	6232352	8.2-2 8.2-8	4 6
Fitting, union, 0.093 to 0.093 **Note:** Also used to join tubing 3230085 to polyurethane tubing	9908083	8.2-10	13
Fitting, union, barb, 0.062 to 0.062	6232109		
Fitting, union, barb, 0.125 x 10-32	6232085		

Table 8.1-2 Fasteners, Fittings, and Miscellaneous Hardware *(Continued)*

Description	Part Number	Figure	Item
Fitting, union, polypropylene, 0.093 i.d to 0.125 i.d.	6232246	8.2-5 8.2-6 8.2-8	5 21 3
Fitting, union, polypropylene, 0.125 i.d. to 0.125 i.d.	6232198		
Fitting, Y, 0.085 i.d. to 0.172 o.d.	1018245		
Fitting, Y, 0.093 i.d. to 0.093 i.d.	6232259	8.2-6 8.2-8	3 10
Flange, Bio-Chem™ pinch valve mount, AC•T 8/10 and AC•T diff analyzers	6232940	8.2-6	12
Flange, mounting for valves 6232870 and 6232869	6232905	8.2-7	24
Foot, plastic, with fastener	2851898		
Fuse holder, Power Supply module	9921373	8.2-9	13
Gasket, display cover seal	1023435	8.2-4	2
Grommet, panel tubing throughway (0.250 i.d. x 0.562 o.d. x 0.250 thick), AC•T 8/10 and AC•T diff analyzers	2830013	8.2-6	15
Grommet, 0.375 i.d. x 0.625 o.d. x 0.250 thick (panel tubing throughway)	2830014	8.2-6 8.2-14	10 25
Grommet, 0.500 i.d. x0.813 o.d. x 0.281 thick (panel tubing throughway)	2830016	8.2-6 8.2-15	9 18
Grommet, 0.562 i.d. x 0.875 o.d. x 0.218 thick, rubber (used in KNF dual-head pump bracket)	2830017	8.2-8 8.2-13	25 14
Hinge, front cover mount, AC•T 8/10 and AC•T diff analyzers	6805138	8.2-4	10
Hinge, front cover mount, AC•T diff 2 analyzer	6806604	8.2-4	10
Latch, catch, front door, AC•T 8/10 and AC•T diff analyzers (for latch keeper PN 2852271)	2852272	8.2-4	7
Latch, keeper bracket, front door (used on original AC•T diff 2 analyzers, for latch keeper PN 2852413)	1024624	8.2-3	10
Latch, keeper, front door, AC•T 8/10 and AC•T diff analyzers (for latch catch PN 2852272)	2852271	8.2-2	15
Latch, keeper, front door (used on original AC•T diff 2 analyzers, for latch PN 2852412)	2852413	8.2-3 8.2-4	11 7
Latch, lever arm, CP (part of latching mechanism on current AC•T diff 2 analyzers)	1024875	8.2-3	19
Latch, receiver, front door, hidden (replaces PN 1024624 and PN 2852413 on current AC•T diff 2 analyzers) **Note:** This latch receiver is used with a latching mechanism comprised of a mounting bracket, PN 6806844; lever arm, PN 1024875; shoulder screw, PN 1024876, retaining ring, PN 2852417, and setscrew, PN 2807020.	2852440	8.2-3	9
Latch, screw lock, front door (used on original AC•T diff 2 analyzers, for latch keeper PN 2852413)	2852412	8.2-3	23
Latch, side door, black, AC•T 8/10 and AC•T diff analyzers	2851605	8.2-6 8.2-13	19 16

Table 8.1-2 Fasteners, Fittings, and Miscellaneous Hardware *(Continued)*

Description	Part Number	Figure	Item
Latch, side door, grey, AC•T diff 2 analyzer	2852403	8.2-6 8.2-13	19 16
Mount, wire tie, 0.75 l x 0.75 w, adhesive back	6011015	8.2-14 8.2-15	11 11
Mount, shock absorbing, AC•T diff 2 analyzer	2527770	8.2-7	26
Nut, hex, #6-32	2822008	8.2-5 8.2-7	9 9
Nut, SEMS, #6-32	2821010	8.2-6	7
O-ring, 0.187 i.d. x 0.050 w	2523062		
O-ring, 0.364 in. i.d.	2523689	8.2-14 8.2-15	4 4
Pin, socket for Power Supply module, 9-pin connector	2121692		
Ring, retainer, 0.125 diameter groove x 0.029 wide, crescent (part of latching mechanism on current AC•T diff 2 analyzers)	2852417	8.2-3	21
Screw, countersink, #6-32 x 0.25 in.	2806104	8.2-3 8.2-4	13 8
Screw, flat head, #6-32 x 0.38 in., black	2806137	8.2-3 8.2-4 8.2-4	12 8 11
Screw, hex post, #4-40 for Analyzer card mount, AC•T diff 2 analyzer	1024645		
Screw, latch shoulder, CP (part of latching mechanism on current AC•T diff 2 analyzers)	1024876	8.2-3	20
Screw, pan head, #4-40 x 0.25 in.	2852223	8.2-11	8
Screw, pan head, #4-40 x 0.25 in., traverse motor mount, AC•T 8/10 and AC•T diff analyzers	2804005	8.2-10	12
Screw, pan head, #4-40 x 1.25 in.	2804036	8.2-4	13
Screw, pan head, #4-40 x 1.50 in.	2804082	8.2-7	18
Screw, pan head, #4-40 x 1.75 in.	2852303	8.2-14 8.2-15	7 7
Screw, pan head, #6-32 x 0.19 in.	2806005	8.2-12	17
Screw, pan head, #6-32 x 1.0 in.	2806117	8.2-5 8.2-6	13 16
Screw, pan head, #8-32 x 0.50 in.	2808038	8.2-12	13
Screw, pan head, #8-32 x 1.50 in.	2808072	8.2-11	16
Screw, pan head, SEMS, #4-40 x 0.31 in.	2852224	8.2-7 8.2-11 8.2-12 8.2-14 8.2-15	3 9 3 8 8

Table 8.1-2 Fasteners, Fittings, and Miscellaneous Hardware *(Continued)*

Description	Part Number	Figure	Item
Screw, pan head, SEMS, #4-40 x 0.38 in.	2852218	8.2-2 8.2-4 8.2-10	14 9 9
Screw, pan head, SEMS, #6-32 x 0.38 in., black	2852300	8.2-2 8.2-3 8.2-9	13 17 15
Screw, pan head, SEMS, #6-32 x 0.50 in.	2852095	8.2-2 8.2-3 8.2-5 8.2-14 8.2-15	10 2 6 27 28
Screw, self tap, #4-24 x 0.312 in., pan head	2851663	8.2-7	11
Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.	2852093	8.2-2 8.2-3 8.2-4 8.2-7 8.2-10 8.2-11 8.2-12 8.2-14 8.2-15 8.2-16	7 5 3 15 1 7 21 13 13 4
Screw, self-tapping flat head, #6-32 x 0.38 in. (for old mount style)	2852306	8.2-13	3
Screw, setscrew, Allen, #4-40 x 0.38 in.	2807048	8.2-14 8.2-15	1 1
Screw, setscrew, Allen, #6-32 x 0.375 in., A^{C}•T 8/10 and A^{C}•T diff analyzers	2807024	8.2-5	1
Screw, setscrew, 6-32 x 0.187, hex (part of latching mechanism on current A^{C}•T diff 2 analyzers)	2807020	8.2-3	22
Screw, shoulder, #8-32 x 0.188 in., A^{C}•T diff 2 analyzer	2852100	8.2-11 8.2-12	19 19
Screw, thumb, #4-40 x 0.38 in., nylon (mounting for Analyzer card)	2852358		
Screw, Traverse module shipping, #6-32 x 3.5 in., A^{C}•T diff 2 analyzer	2851323		
Seal, O-ring, to retain aspirate probe, A^{C}•T 8/10 and A^{C}•T diff analyzers	2512120	8.2-10	7
Seal, syringe barrel boot, 250 µL	1023877	8.2-1	12
Seal, syringe barrel boot, 5 mL	1023828	8.2-1	9
Shield, EMI/EMC, gasket, V-form, A^{C}•T diff 2 analyzer	5703007	8.2-3	15
Spacer, #4, 0.375 in. long x 0.250 in. o.d.	2852289	8.2-4	14
Spacer, #4, 1.5 in. long	2852302	8.2-14 8.2-15	9 9
Spacer, hinge, A^{C}•T 8/10 and A^{C}•T diff analyzers	1023618	8.2-4	12
Spacer, nylon, bath assembly, isolation	2527699	8.2-16	2

Table 8.1-2 Fasteners, Fittings, and Miscellaneous Hardware *(Continued)*

Description	Part Number	Figure	Item
Spacer, threaded, #4-40, 0.56 in. length	2852288	8.2-4	16
Spring, traverse belt tensioner, AC•T diff 2 analyzer	2523815	8.2-11	17
Syringe, collar, boot retainer	1024163	8.2-1	10
Washer, flat, #4, 0.125 i.d. x 0.250 o.d. x 0.031 thick	2827045	8.2-7 8.2-12	13 5
Washer, flat, #6, 0.156 i.d. x 0.375 o.d. x 0.046 thick	2827134	8.2-5 8.2-7	7 7
Washer, flat, #6, 0.177 i.d. x 0.408 o.d. x 0.062 thick, nylon	2852281	8.2-16	5
Washer, flat, #8, 0.188 i.d. x 0.375 o.d. x 0.045 thick	2827148	8.2-11 8.2-12	20 11
Washer, red lock ring, for bulkhead Luer fitting	6232497	8.2-9	17
Washer, split lock, #4	2826002	8.2-7	12
Washer, split lock, #6	2826035	8.2-5 8.2-7	8 8
Washer, split lock, #8	2826048	8.2-12	12
Washer, white lock ring, for bulkhead Luer fitting	6232498	8.2-9	2
Washer, yellow lock ring, for bulkhead Luer fitting	6232670	8.2-9	6

Table 8.1-3 Optional Items and Supplies

Description	Part Number	Figure	Item
Adapter, narrow tube, cap-pierce	1020854		
Cable, Centronics, 10 ft, for parallel Printer	6028504		
Cushion, FMI Pump (packing material)	8024587		
Paper, roll, for Printer	2016740		
Particles, latex, for latex gain adjustment	6857371		
Pickup tube, A^{C}•T Rinse shutdown diluent, A^{C}•T PAK reagent, machined	6805687		
Pickup tube, A^{C}•T Rinse shutdown diluent, A^{C}•T Tainer reagent	6805770		
Pickup tube, diluent, A^{C}•T Tainer reagent	6805771		
Pickup tube, diluent, A^{C}•T Pak reagent	6805685		
Pickup tube, lytic reagent, A^{C}•T Pak reagent, machined	6805686		
Pickup tube, lytic reagent, A^{C}•T Tainer reagent	6805769		
Printer, ac adapter, 13.5 Vdc, for Canon BJC-250 Bubble Jet Printer, 110 V	2016814		
Printer, Citizen®, GSX-190, 80 column, 115 Vac	2016583		
Printer, Citizen, GSX-190, 80 column, 230 Vac	2016584		
Printer, Citizen, iDP 3110, 40 column, 115 Vac	2016730		
Printer, Citizen, iDP 3110, 40 column, 230 Vac	2016800		
Printer, Epson, TM290P, MAXM tickets, no power supply	2016671		
Printer, OKIPAGE 14e LED Printer, parallel, 115 Vac	2016932		
Printer, OKIPAGE 14e LED Printer, parallel, 230 Vac	2016933		
Printer, ink cartridge, black, for Canon BJC-250 Bubble Jet Printer	2016812		
Printer, ink cassette, for Citizen GSX-190 Printer	2016511		
Printer, ink cassette, for Epson TM290P Slip Printer	2016717		
Printer, toner cartridge, for OKIPAGE 10e LED Printer	2016900		
Printer, universal power supply, for Epson TM290P Slip Printer	4004103		
Ribbon cartridge, purple ink, for Citizen iDP 3110 Printer	2016739		
Silicone grease, DOW CORNING 33 Lubricant	1604007		
Tag, caution for use with FMI pump cushion 8024587	4276819		
Tool, for PC card removal, nylon mounting posts	5450276		
Tool, Coax Load Cable Assembly (dummy load)	6029105		

8.2 ILLUSTRATED PARTS

Figure 8.2-1 Triple Syringe Module Components, AC•T 8/10 and AC•T diff Analyzers (See Table 8.2-1)

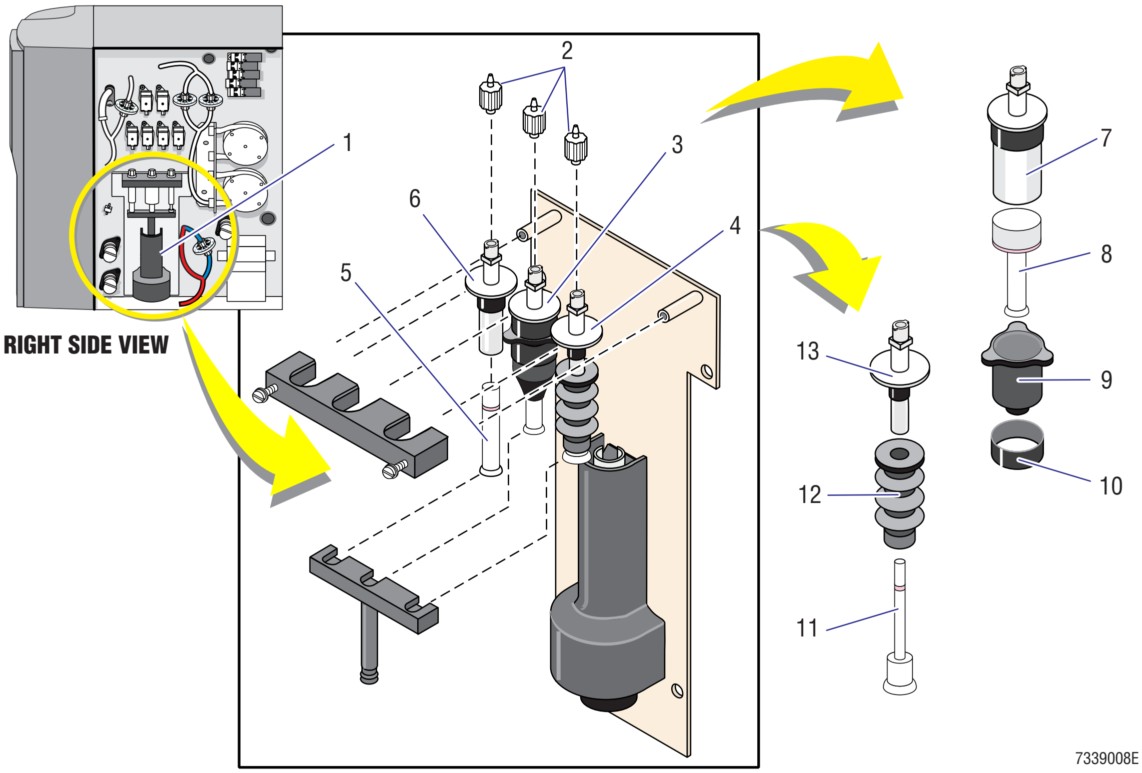

Table 8.2-1 Triple Syringe Module Components, AC•T 8/10 and AC•T diff Analyzers (See Figure 8.2-1)

Item	Part Number	Description
1	6707085	Pump, Triple Syringe module, with boot seal on diluent syringe only
2	6232502	Fitting, Luer, male, to 0.094 barbed hose fitting
3	6706809	Syringe, glass barrel assembly, with boot and plunger, 5 mL
4	6706808 6707087	Syringe, glass barrel assembly, with boot and plunger, 250 µL Syringe, glass barrel assembly, with boot and plunger, without boot seal, 250 µL
5	2527677 6707095	Syringe, piston, 1 mL Syringe, assembly, 1 mL, without boot seal
6	6706652	Syringe, glass barrel with Luer fitting, 1 mL (replaces PN 2527682)
7	6706651	Syringe, glass barrel with Luer fitting, 5 mL (replaces PN 2527680)
8	2527679	Syringe, piston, 5 mL
9	1023828	Seal, syringe barrel boot, 5 mL
10	1024163	Syringe, collar, boot retainer
11	2527678	Syringe, piston, 250 µL
12	1023877	Seal, syringe barrel boot, 250 µL
13	6706653	Syringe, glass barrel with Luer fitting, 250 µL (replaces PN 2527683)

Figure 8.2-2 Front Panel Components, A[C]•T 8/10 and A[C]•T diff Analyzers (See Table 8.2-2)

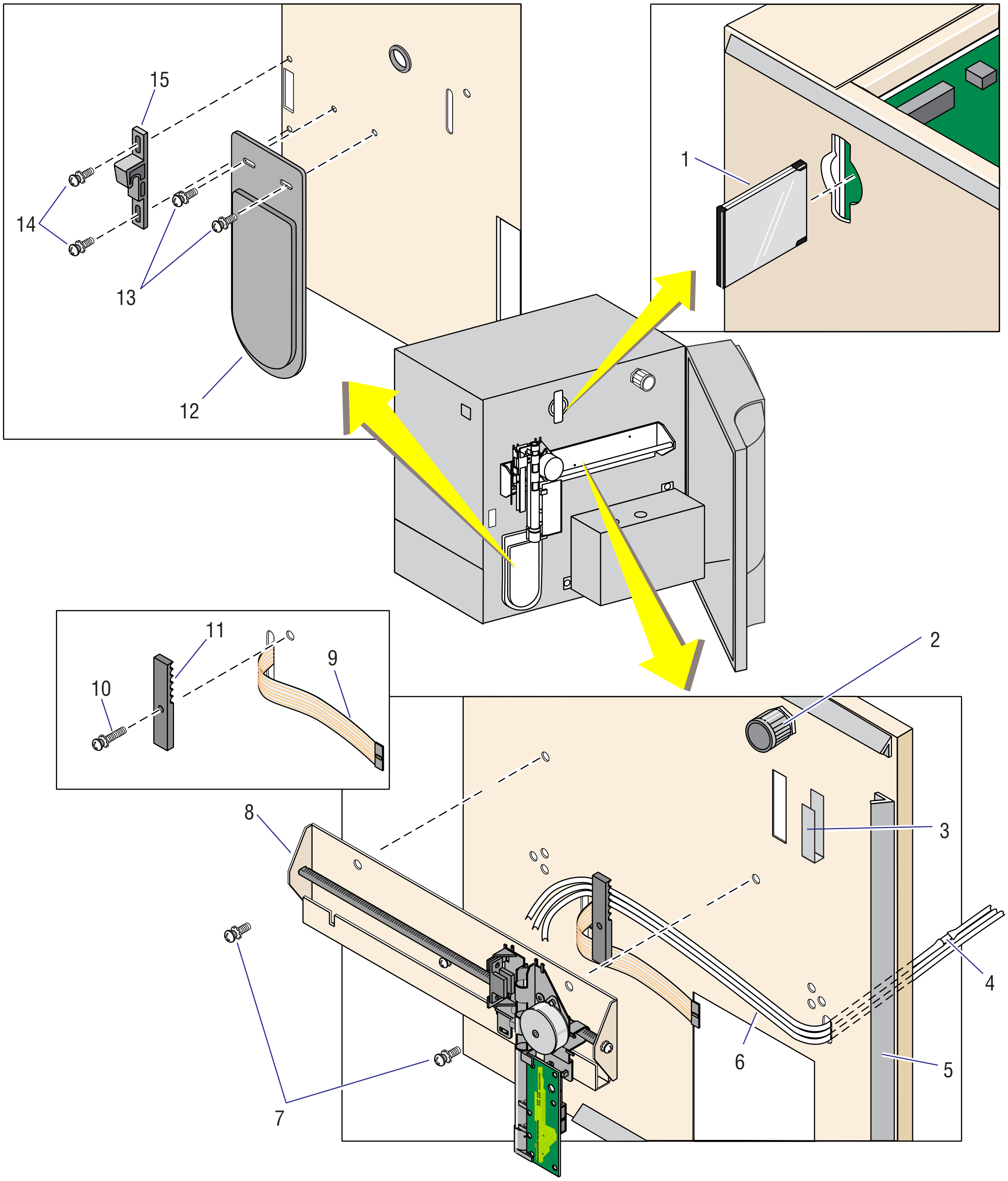

Table 8.2-2 Front Panel Components, A^C•T 8/10 and A^C•T diff Analyzers (See Figure 8.2-2)

Item	Part Number	Description
1	6706654	Software, A^C•T 8 analyzer, Version 1.04
	6706655	Software, A^C•T 10 analyzer, Version 1.04
	6915355	Software, A^C•T diff analyzer, English, Version 1.06, card only
	6915356	Software, A^C•T diff analyzer, English, Version 1.06, upgrade kit, mailable
	6915347	Software, A^C•T diff analyzer, Spanish, Version 1.06, card only
	6915366	Software, A^C•T diff/Veterinary Option analyzer, Version 1.06, kit with manual
	6915367	Software, A^C•T diff/Veterinary Option analyzer, Version 1.06, kit without manual
2	9908180	Knob, vacuum regulator
3	6027373	Clamp, ribbon cable, Display assembly
4	6232352	Fitting, union, 0.062 i.d. to 0.093 i.d.
5	5704057	Shield, EMI/EMC, gasket, V-form
6	3230066	Tubing, polyurethane, special three-tube ribbon
7	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.
8	7000558	Traverse, probe traverse module
9	6028676	Cable, Traverse module, flex
10	2852095	Screw, pan head, SEMS, #6-32 x 0.50 in.
11	1023434	Clamp, cable and tubing, front panel, molded
12	1023491	Plate, aspirate switch, black molded
13	2852300	Screw, pan head, SEMS, #6-32 x 0.38 in., black
14	2852218	Screw, pan head, SEMS, #4-40 x 0.38 in.
15	2852271	Latch, keeper, front door (for latch catch 2852272)

Figure 8.2-3 Front Panel Components, A^{C}•T diff 2 Analyzers (See Table 8.2-3)

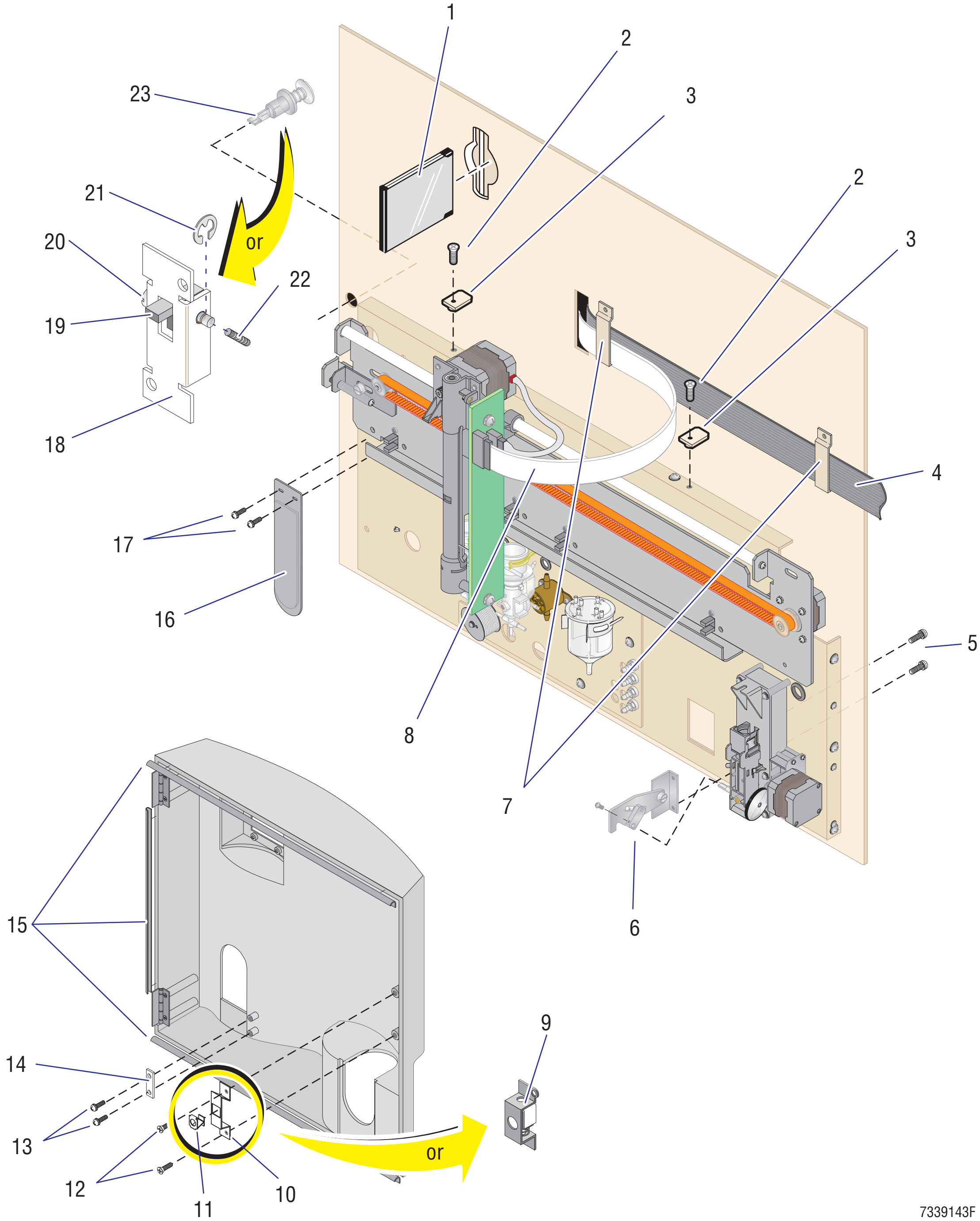

Table 8.2-3 Front Panel Components, A^{C}•T diff 2 Analyzers (See Figure 8.2-3)

Item	Part Number	Description
1	6915288 6915345	Software, A^{C}•T diff 2 analyzer, Version 1.00 Software, A^{C}•T diff 2 analyzer, Spanish Version 1.00
2	2852095	Screw, pan head, #6-32 x 0.50 in. L
3	6806595	Clamp, tubing, front panel
4	6002021	Cable, black ribbon cable to Display assembly
5	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.
6		Safety latch bracket assembly, see Figure 8.2-12, items 16 through 21.
7	1024447	Clamp, cable, front panel
8	6002022	Cable, Traverse module, flex
9	2852440	Latch, receiver, front door, hidden (replaces PN 1024624 and PN 2852413 on current A^{C}•T diff 2 analyzers,) **Note:** This latch receiver is used with a latching mechanism comprised of a mounting bracket, PN 6806844; lever arm, PN 1024875; shoulder screw, PN 1024876, retaining ring, PN 2852417, and setscrew, PN 2807020.
10	1024624	Latch, front door, keeper bracket (used on original A^{C}•T diff 2 analyzers with latch keeper PN 2852413)
11	2852413	Latch, front door, keeper (used on original A^{C}•T diff 2 analyzers, for latch PN 2852412)
12	2806137	Screw, flat head, #6-32 x 0.38 in., black
13	2806104	Screw, countersink, #6-32 x 0.25 in.
14	1024601	Bracket, safety latch-catch plate, front door
15	5703007	Shield, EMI/EMC, gasket, V-form
16	1024487	Plate, aspirate switch, grey molded
17	2852300	Screw, pan head, SEMS, #6-32 x 0.38 in., black
18	6806844	Bracket, screw mounting (part of latching mechanism on current A^{C}•T diff 2 analyzers)
19	1024875	Latch, lever arm, CP (part of latching mechanism on current A^{C}•T diff 2 analyzers)
20	1024876	Screw, latch shoulder (part of latching mechanism on current A^{C}•T diff 2 analyzers)
21	2852417	Ring, retainer, 0.125 diameter groove x 0.029 wide, crescent (part of latching mechanism on current A^{C}•T diff 2 analyzers)
22	2807020	Screw, setscrew, 6-32 x 0.187, hex (part of latching mechanism on current A^{C}•T diff 2 analyzers)
23	2852412	Latch, screw lock, front door (used on original A^{C}•T diff 2 analyzers, for latch keeper PN 2852413)

Figure 8.2-4 Front Door Components (See Table 8.2-4)

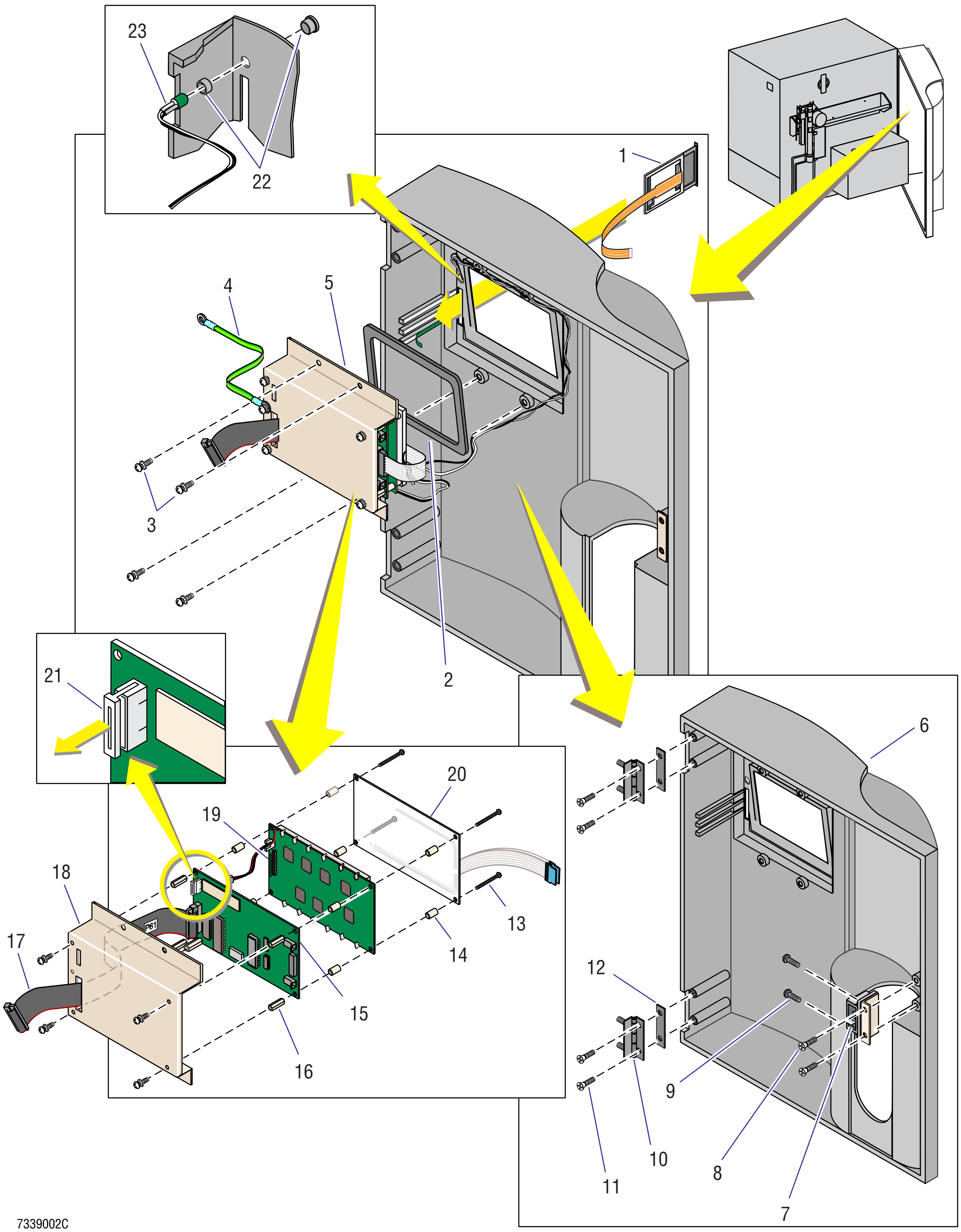

Table 8.2-4 Front Door Components (See Figure 8.2-4)

Item	Part Number	Description
1	2121950 2122060	Card reader, reagent smart card, AC•T 8/10 and AC•T diff analyzers Card reader, reagent smart card, AC•T diff 2 analyzer
2	1023435	Gasket, display cover seal
3	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in. L
4	6028264 6028879	Cable, ground strap for Display assembly, AC•T 8/10 and AC•T diff analyzers Cable, ground strap for Display assembly, AC•T diff 2 analyzer
5	7000580 7000623	Display, LCD and keypad assembly with SMT, AC•T 8/10 and AC•T diff analyzers Display, LCD and keypad assembly with SMT, AC•T diff 2 analyzer
6	6805673 6806393	Cover, front, with partial label, AC•T 8/10 and AC•T diff analyzers Cover, front, AC•T diff 2 analyzer
7	2852272	Latch, catch, front door, AC•T 8/10 and AC•T diff analyzers (for latch keeper PN 2852271)
8	2806104 2806137	Screw, countersink, #6-32 x 0.25 in., for AC•T 8/10 and AC•T diff analyzers Screw, flat head, #6-32 x 0.38 in., black, AC•T diff 2 analyzer
9	2852218	Screw, pan head, SEMS, #4-40 x 0.38 in.
10	6805138 6806604	Hinge, front cover mount, AC•T 8/10 and AC•T diff analyzers Hinge, front cover mount, AC•T diff 2 analyzer
11	2806137	Screw, flat head, #6-32 x 0.38 in., black
12	1023618	Spacer, hinge, AC•T 8/10 and AC•T diff analyzers
13	2804036	Screw, pan head, #4-40 x 1.25 in.
14	2852289	Spacer, #4, 0.375 in. long x 0.250 in. o.d.
15	6706342 6706703	Card, Display Controller Driver, through hole Card, Display Controller Driver, SM
16	2852288	Spacer, threaded, #4-40, 0.56-in. length
17	6028704 6002021	Cable, ribbon cable to Display assembly, AC•T 8/10 and AC•T diff analyzers Cable, black ribbon cable to Display assembly, AC•T diff 2 analyzer
18	6805136 6806205 6806601	Shield, electromagnetic for Display assembly, AC•T 8/10 or AC•T diff analyzer with original through-hole Display Controller Driver card Shield, electromagnetic for Display assembly, AC•T 8/10 or AC•T diff analyzer with SMT Display Controller Driver card Shield, electromagnetic for Display assembly, AC•T diff 2 analyzer
19	4837341	Display, graphic LCD screen
20	2016703	Keyboard, touch screen
21	2121952	Connector, card reader flex cable, part of Display Controller Driver card
22	2838063	Fastener, LED panel mount, AC•T 8/10 and AC•T diff analyzers
23	6805394 6806620	LED, power indicator assembly, AC•T 8/10 and AC•T diff analyzers LED, power indicator assembly, AC•T diff 2 analyzer
Not shown	1023501	Insulator, display fish paper, AC•T 8/10 or AC•T diff analyzer with original through-hole Display Controller Driver card
Not shown	1024137	Insulator, display fish paper, AC•T analyzer with SMT Display Controller Driver card

Figure 8.2-5 Right-Side Compartment, Reservoir Components, A^C•T 8/10 and A^C•T diff Analyzers (See Table 8.2-5)

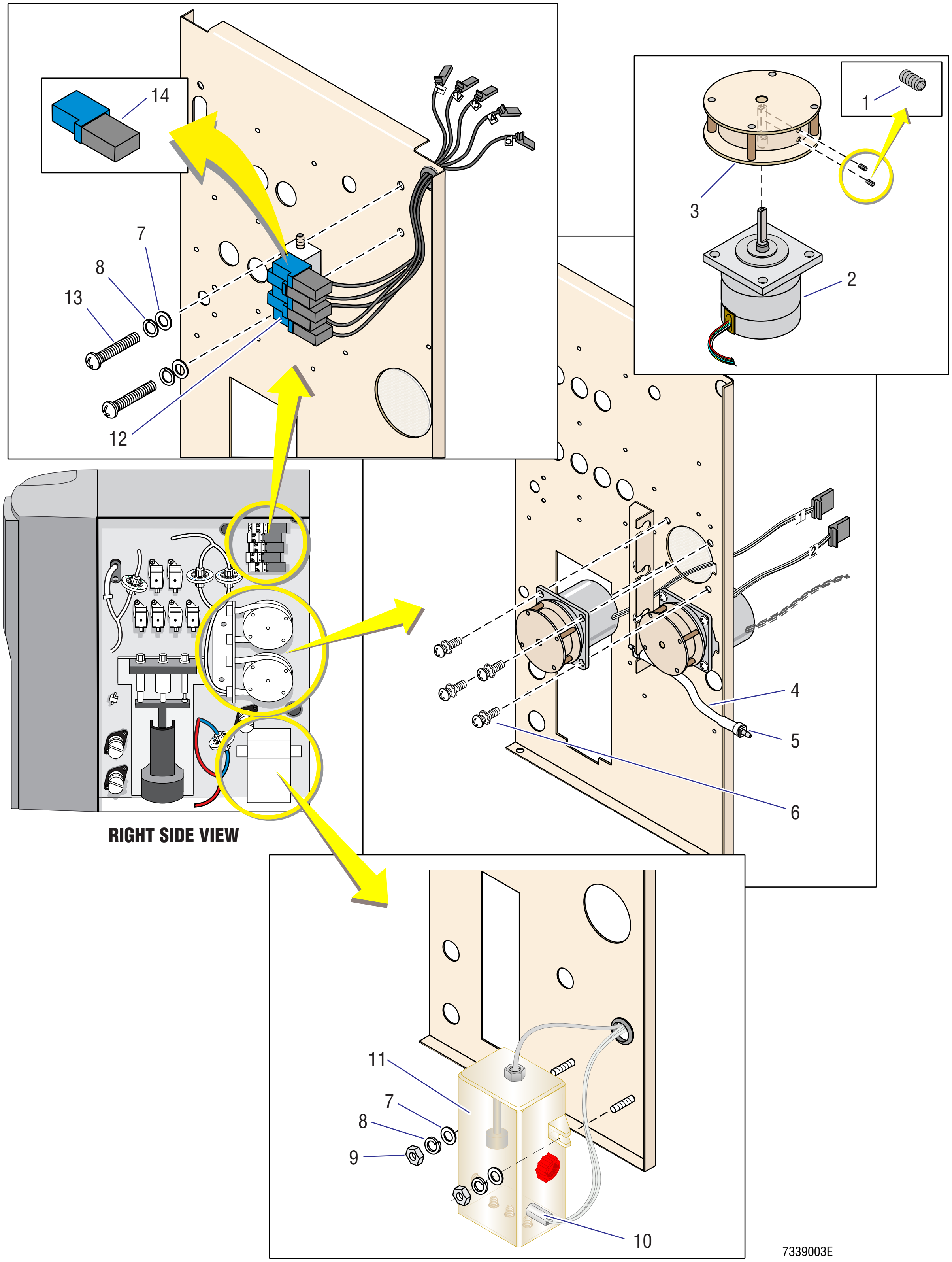

Table 8.2-5 Right-Side Compartment, Reservoir Components, A^{C}•T 8/10 and A^{C}•T diff Analyzers (See Figure 8.2-5)

Item	Part Number	Description
1	2807024	Setscrew, Allen, #6-32 x 0.375 in.
2	6805708 6807092	Motor, peristaltic pump, assembly with connector Motor, peristaltic pump, assembly with connector (half winding, use with new Analyzer card, PN 6707111)
3	6859650 6706686	Spool, peristaltic pump Spool, peristaltic pump, new molded version
4	3213214	Tubing, peristaltic pump
5	6232246	Fitting, union, polypropylene, 0.093 i.d. to 0.125 i.d.
6	2852095	Screw, pan head, SEMS, #6-32 x 0.50 in.
7	2827134	Washer, flat, #6 (0.156 i.d. x 0.375 o.d. x 0.046 thick)
8	2826035	Washer, splitlock, #6
9	2822008	Nut, hex, #6-32
10	2306100	Sensor, thermistor temperature assembly
11	6806261	Reservoir, subassembly, with float sensor (replaces PN 6805906)
12	6232776	Valve, solenoid, Pneutronics® module, with manifold
13	2806117	Screw, pan head, #6-32 x 1.0 in.
14	6232777	Valve, Pneutronics® solenoid

Figure 8.2-6 Right-Side Compartment, Transducer Components, A^C•T 8/10 and A^C•T diff Analyzers (See Table 8.2-6)

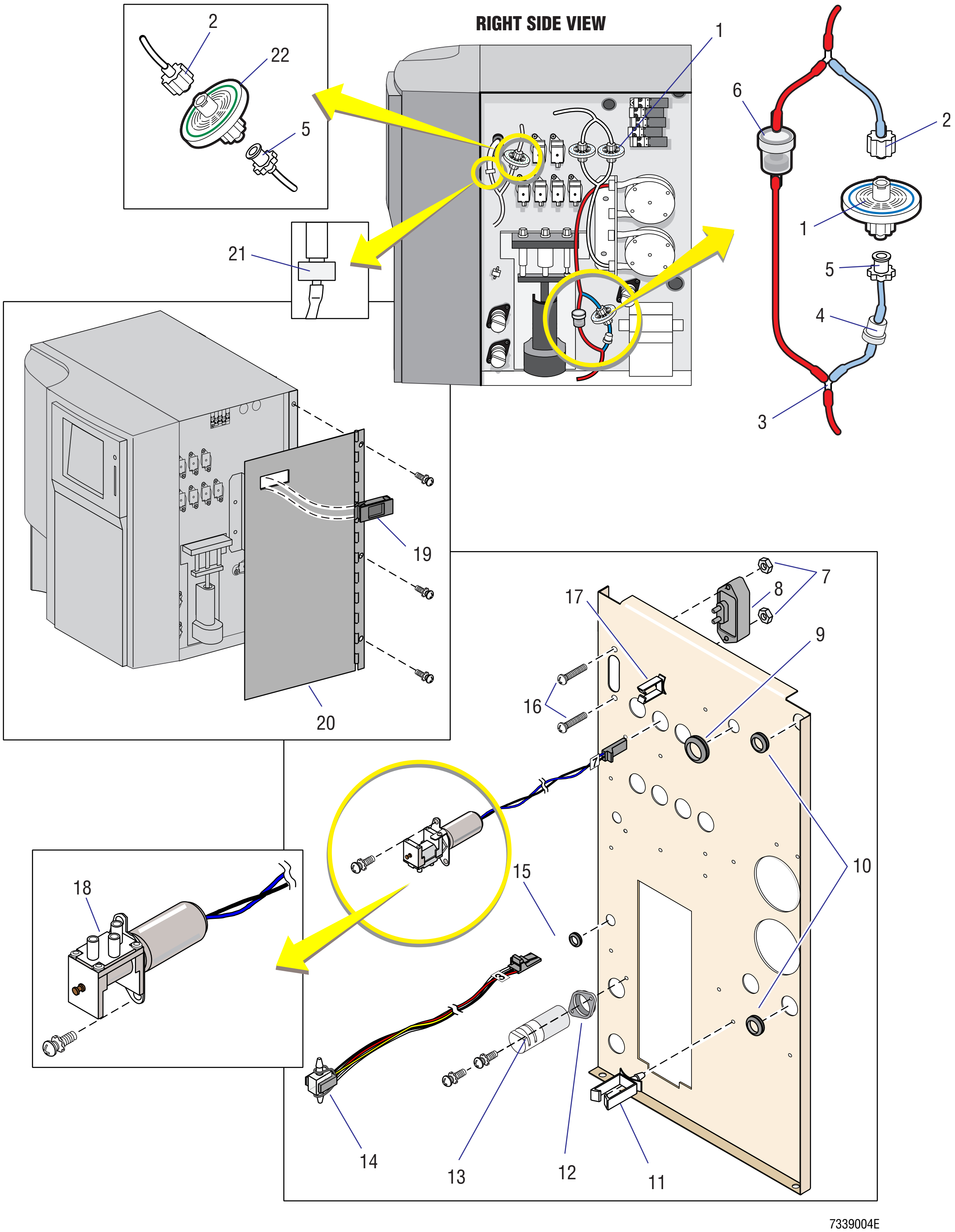

Table 8.2-6 Right-Side Compartment, Transducer Components, A[C]•T 8/10 and A[C]•T diff Analyzers (See Figure 8.2-6)

Item	Part Number	Description
1	6233052	Filter, water, hydrophilc, 5 µ, with male Luer fitting
2	6232801	Fitting, Luer, female, to 0.094 barbed hose
3	6232259	Fitting, Y, 0.093 i.d. to 0.093 i.d.
4	6214108	Valve, check, small (0.062 i.d. fitting)
5	6232502	Fitting, Luer, male, to 0.094 barbed hose fitting
6	6214107	Valve, check, medium (0.125 i.d. fitting)
7	2821010	Nut, SEMS, #6-32
8	2306099	Sensor, vacuum transducer, 15 V
9	2830016	Grommet, panel tubing throughway (0.500 i.d. x0.813 o.d. x 0.281 thick)
10	2830014	Grommet, panel tubing throughway (0.375 i.d. x 0.625 o.d. x 0.250 thick)
11	6028810	Clamp, cable bundle, snap mount to panel, 0.875 x 0.437 in. bundle
12	6232940	Flange, Bio-Chem pinch valve mount
13	6232867	Valve, small Bio-Chem solenoid pinch
14	6706483	Sensor, inline optical fluid, cleaning and lytic reagent
15	2830013	Grommet, panel tubing throughway (0.250 i.d. x 0.562 o.d. x 0.250 thick)
16	2806117	Screw, pan head, #6-32 x 1.0 in.
17	6028809	Clamp, cable bundle, snap mount to panel, 0.515 x 0.410 in. bundle (may also use cable bundle clamp PN 6028995)
18	6232779	Valve, solenoid, Angar fluidic, 3-way
19	2851605 2852403	Latch, side door, black, A[C]•T 8/10 and A[C]•T diff analyzers Latch, side door, grey, A[C]•T diff 2 analyzer
20	6805672	Door, right side, with hinge, no latch
21	6232246	Fitting, union, polypropylene, 0.093 i.d. to 0.125 i.d.
22	6232803	Filter, fluid barrier, 0.45 micron, green
Not shown	3230085	Tubing, for small Bio-Chem solenoid pinch valve 6232867
Not shown	9908083	Fitting, union, 0.093 to 0.093 (used to join tubing 3230085 to polyurethane tubing)

Figure 8.2-7 Right-Side Compartment, Reservoir and Reagent Pump Components, AC•T diff 2 Analyzers (See Table 8.2-7)

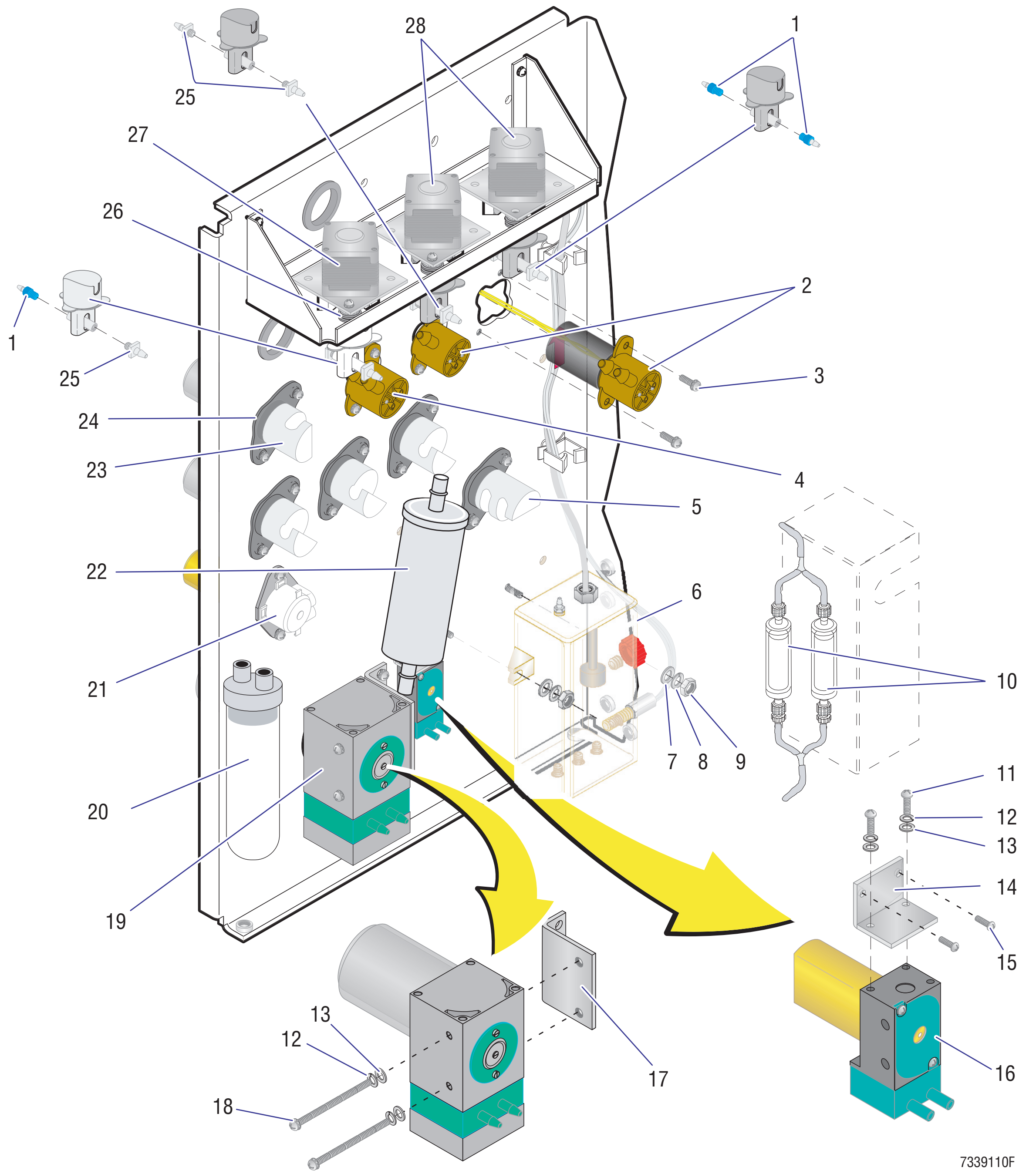

Table 8.2-7 Right-Side Compartment, Reservoir and Reagent Pump Components, A^{C}•T diff 2 Analyzers (See Figure 8.2-7)

Item	Part Number	Description
1	6232962	Fitting, adapter, 1/4-28 ext to 3/32 i.d. tubing
2	6232931	Valve, solenoid, fluidic, 3 way
3	2852224	Screw, pan head, SEMS, #4-40 x 0.31 in.
4	6232933	Valve, solenoid, fluidic, 2 way
5	6232870	Valve, solenoid, pinch, 3 way
6	6806261	Reservoir, subassembly, with float sensor
7	2827134	Washer, flat, #6 (0.156 i.d. x 0.375 o.d. x 0.046 thick)
8	2826035	Washer, split lock #6
9	2822008	Nut, hex, #6-32
10	6915526	Filter, water, hydrophilic, 0.45 µ, replacement kit (two filters in kit)
11	2851663	Screw, self tap, #4-24 x 0.312, pan head
12	2826002	Washer, split lock, #4
13	2827045	Washer, flat, #4 (0.125 i.d. x 0.250 o.d. x 0.031 thick)
14	1024549	Bracket, diluent reservoir fill pump
15	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.
16	6806580	Pump, diluent reservoir fill
17	6806480	Bracket, waste pump
18	2804082	Screw, pan head, #4-40 x 1.50 in.
19	6806494	Pump, waste, KNF
20	6806764	Foam trap, glassware and stopper assembly
21	6806489	Pump, cleaning agent (shutdown diluent)
22	6233045	Filter, waste particle, basket type, 149 micron mesh, double-barb **Note:** Position the filter with the arrow pointing towards the waste pump.
23	6232869	Valve, large Bio-Chem solenoid pinch
24	6232905	Flange, mounting, for valves 6232870 and 6232869
25	6232951	Fitting, adapter, 1/8 i.d. to, 1/4-28 male thd
26	2527770	Mount, shock absorbing
27	6806492	Pump, FMI, 50 µL, sample (aspiration)
	6807001	Pump, FMI, 50 µL, sample (aspiration) (half winding, use with Analyzer card, PN 6707111)
28	6806493	Pump, FMI, 100 µL, diluent/lyse
Not shown	1018245	Fitting, Y, 0.0851 i.d. x 0.172 o.d.
Not shown	2852403	Latch, side door, grey
Not shown	3230084	Tubing, for large Bio-Chem solenoid pinch valve 6232869
Not shown	6011015	Mount, adhesive back, for foam trap, VC2
Not shown	6028917	Clamp, tie wrap for fastening foam trap to mount, releaseable
Not shown	6232198	Fitting, union, polypropylene, 0.125 i.d. to 0.125 i.d.
Not shown	6232246	Fitting, union, polypropylene, 0.093 i.d. to 0.125 i.d.
Not shown	6706483	Sensor, fluid optical, rinse and lytic reagent

Figure 8.2-8 Right-Side Compartment, Pneumatic Pump Components, A^C•T diff 2 Analyzers (See Table 8.2-8)

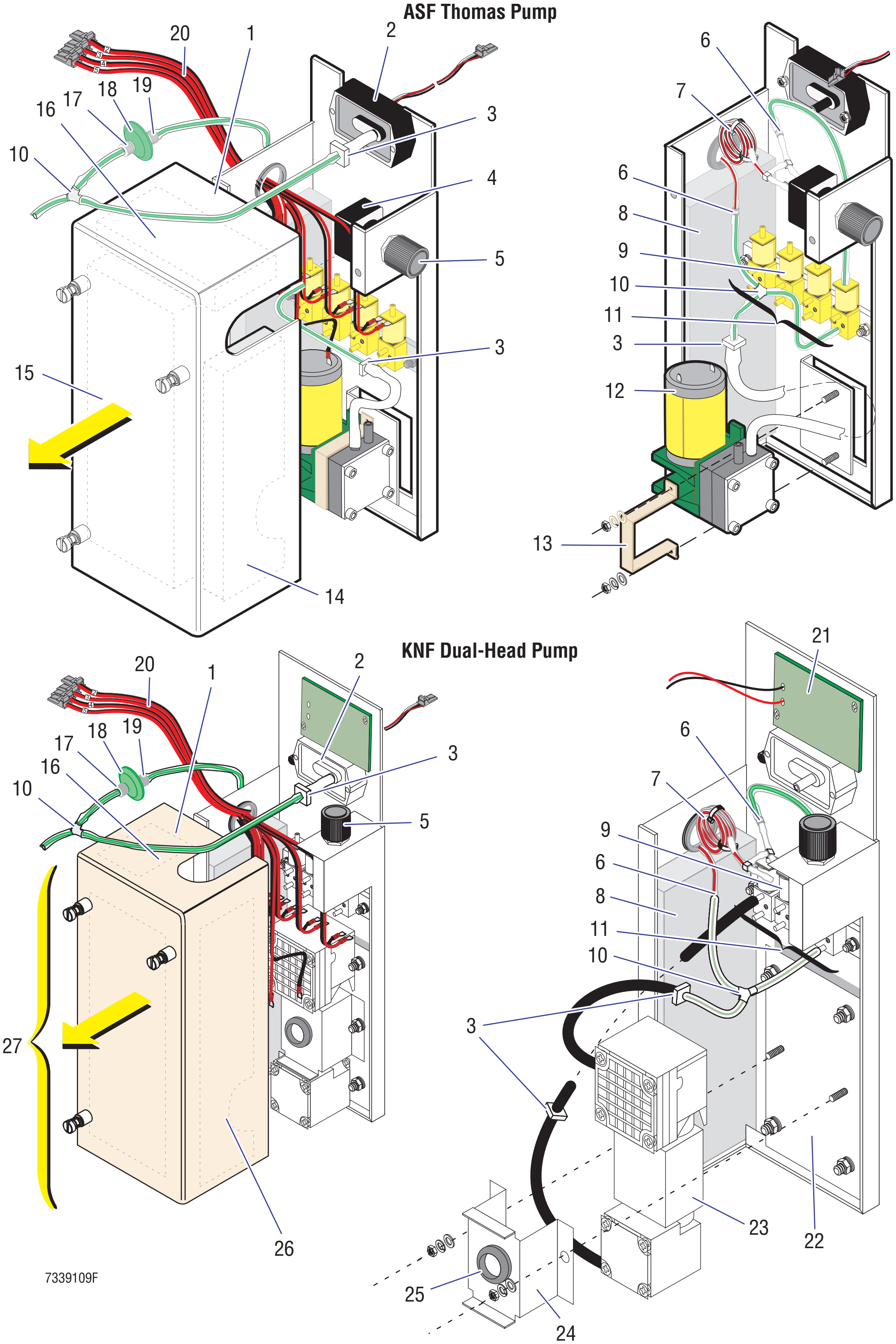

Table 8.2-8 Right-Side Compartment, Vacuum Pump Components, A^{C}•T diff 2 Analyzers (See Figure 8.2-8)

Item	Part Number	Description
1	6806364	Cover, pneumatic pump compartment, ASF Thomas pump
2	2302008	Sensor, vacuum transducer, 8 V
3	6232246	Fitting, union, polypropylene, 0.093 i.d. to 0.125 i.d.
4	6232628	Regulator, vacuum
5	9908180	Knob, vacuum regulator
6	6232352	Fitting, union, 0.062 i.d. to 0.093 i.d.
7	3202205	Tubing, 0.082 polyurethane, 12 inches red-striped
8	1024435	Insulation, vacuum pump, bracket side
9	6232929	Valve, solenoid, pneumatic, 3-way
10	6232259	Fitting, Y, 0.093 i.d. to 0.093 i.d.
11	6232930	Valve, solenoid, bank of four, pneumatic, 3-way
12	6232880	Pump, ASF Thomas vacuum, 24-Vdc brush type
13	1023939	Bracket, ASF Thomas vacuum pump
14	1024434	Insulation, vacuum pump cover, top and bottom
15	1024433	Insulation, vacuum pump cover, side
16	1024432	Insulation, vacuum pump cover, top
17	6232502	Fitting, Luer, male, to 0.094 barbed hose fitting
18	6232803	Filter, fluid barrier, 0.45 micron, green
19	6232801	Fitting, Luer, female, to 0.094 barbed hose
20	6028893	Cable, harness, ASF Thomas vacuum pump
21	6029207	Card, Pump Motor Filter
22	6807604	Base, pneumatic pump, KNF dual head
23	6233071	Pump, KNF dual-head vacuum/pressure, 24 Vdc, brushless
24	6807690	Bracket, pneumatic pump, KNF dual-head
25	2830017	Grommet, 0.562 i.d. x 0.875 o.d. x 0.218 thick, rubber
26	6807605	Cover, pneumatic pump, for dual-head pump
27	6807707	Module, Pneumatic Pump, KNF dual-head (includes the pneumatic pump compartment with all the internal components shown in Figure 8.2-8, the pneumatic pump cover, and the following components external to the compartment: the EMC Motor Filter 2 card, PN 6707140; the vacuum transducer, PN 2302008; the vacuum regulator knob, PN 9908180; and the female Luer lock fitting, PN 6232801. **Note:** Only order this complete module if you are upgrading a single-head pump to a KNF dual-head pump. If you are simply replacing a defective KNF dual-head pump, order the pump, PN 6233071.

Figure 8.2-9 Rear View Showing Components (See Table 8.2-9)

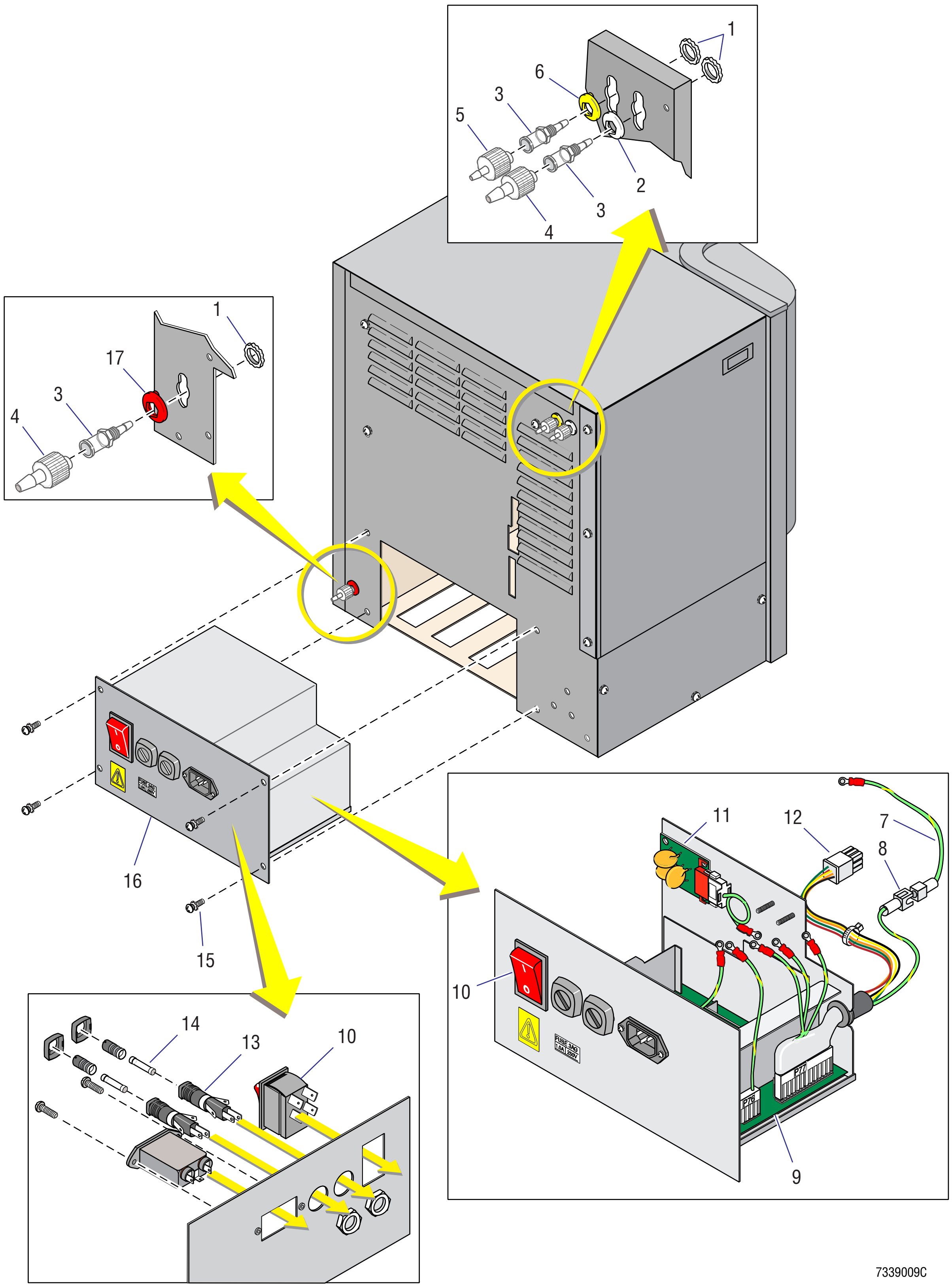

Table 8.2-9 Rear View Showing Components (See Figure 8.2-9)

Item	Part Number	Description
1	6232382	Fastener, nut, for bulkhead Luer fitting
2	6232498	Washer, white lock ring, for bulkhead Luer fitting
3	6232503	Fitting, bulkhead, Luer to barbed hose fitting
4	6232846	Fitting, Luer, male to barbed hose fitting
5	6232502	Fitting, Luer, male, to 0.094 barbed hose fitting
6	6232670	Washer, yellow lock ring, for bulkhead Luer fitting
7	6028708	Cable, chassis ground, connects to Power Supply module
8	2121410	Connector, 1-pin
9	4004097	Board, switching supply, Power Supply module
10	5120214	Switch, Power Supply module and instrument ON/OFF
11	6705663	Card, Transient Suppressor, Power Supply module
12	2121695 2121892	Connector, 9 pin, P5 on Power Supply module, AC•T 8/10 analyzer Connector, 12 pin, P5 on Power Supply module, AC•T diff analyzer
13	9921373	Fuse holder, Power Supply module
14	5102029 5120184	Fuse, 1.5 A SLO BLO, F1 and F2 on Power Supply module, AC•T 8/10 and AC•T diff analyzers Fuse, 2.5 A SLO BLO, F1 and F2 on Power Supply module, AC•T diff 2 analyzer
15	2852300	Screw, pan head, SEMS, #6-32 x 0.38 in., black
16	7000556 7000573 7000626	Power Supply, main power module, AC•T 8/10 analyzer Power Supply, main power module, AC•T diff analyzer Power Supply, main power module, AC•T diff 2 analyzer
17	6232497	Washer, red lock ring, for bulkhead Luer fitting
Not shown	2121692	Pin, socket for Power Supply module, 9-pin connector
Not shown	2603078	Fan, filter and cage assembly, for rear panel of the AC•T diff 2 analyzer
Not shown	6028918	Cable (adapts AC•T diff analyzer Power Supply module for use on AC•T 8/10 analyzer)
Not shown	6806535	Fan, 24 Vdc, mounts on rear of panel of the AC•T diff 2 analyzer
Not shown	2603081	Filter, for 24 Vdc fan, AC•T diff 2 analyzer

Figure 8.2-10 Traverse Module Components, A^C•T 8/10 and A^C•T diff Analyzers (See Table 8.2-10)

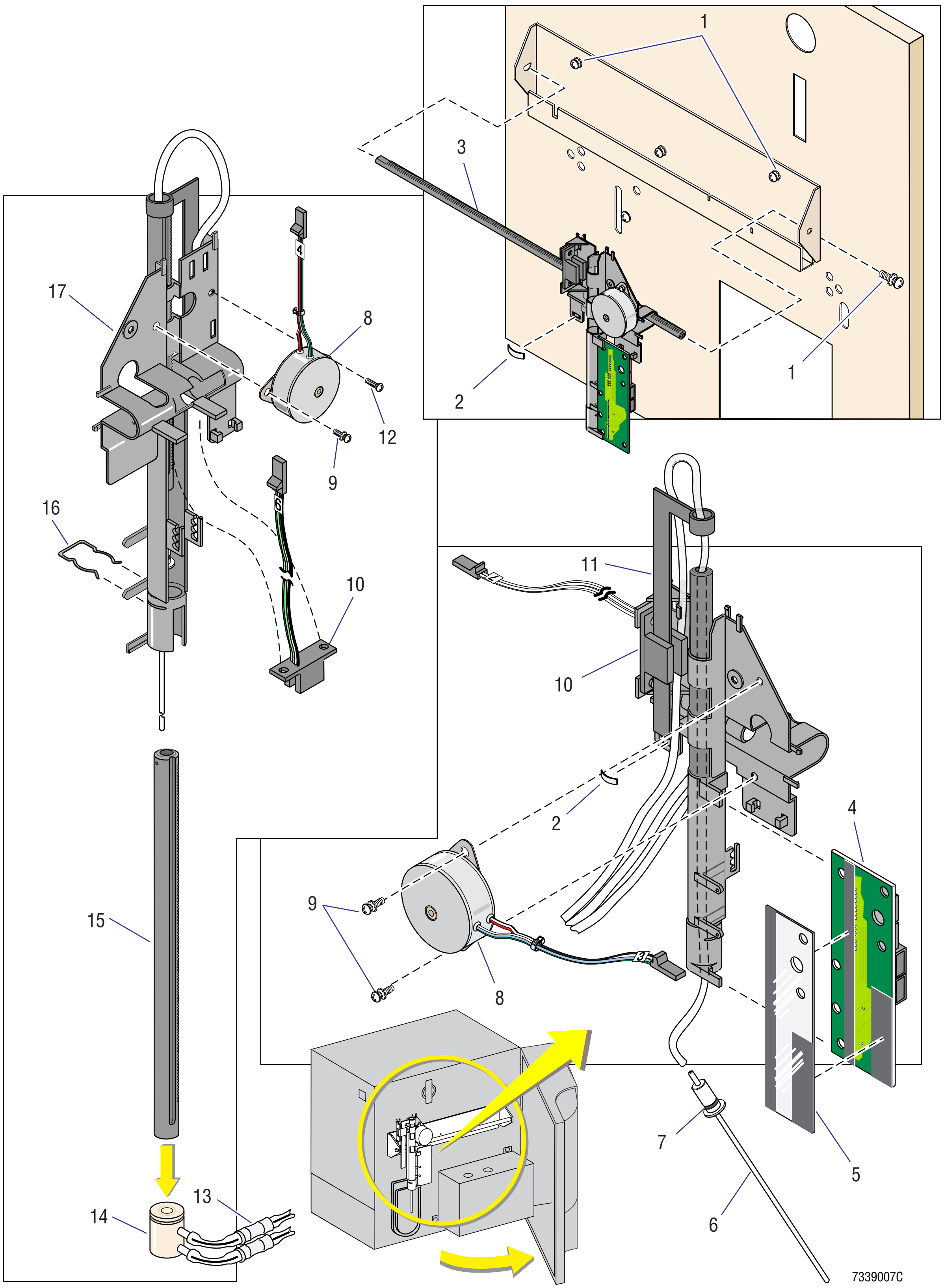

Table 8.2-10 Traverse Module Components, A^{C}•T 8/10 and A^{C}•T diff Analyzers (See Figure 8.2-10)

Item	Part Number	Description
1	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.
2	1023611	Wear strip, stainless steel, traverse guide
3	1023360	Rack, traverse, horizontal motion
4	6706334	Card, Traverse Interconnect
5	6805734	Shield, plastic, splash guard
6	6805125	Probe, aspirate probe without O-ring
7	2512120	Seal, O-ring, to retain aspirate probe
8	6805555	Motor, traverse travel, with connector
9	2852218	Screw, pan head, SEMS, #4-40 x 0.38 in.
10	4837317	Sensor, dual channel, optical
11	1023357	Flag, vertical position, for optical sensor
12	2804005	Screw, pan head, #4-40 x 0.25 in., traverse motor mount
13	9908083	Fitting, union, 0.093 to 0.093 in.
14	6859716	Housing, probe wipe
15	1023359	Rack, traverse, vertical motion
16	1022827	Clip, probe-wipe housing
17	6805479	Housing, traverse, molded

Figure 8.2-11 Traverse Module Components, A[C]•T diff 2 Analyzers (See Table 8.2-11)

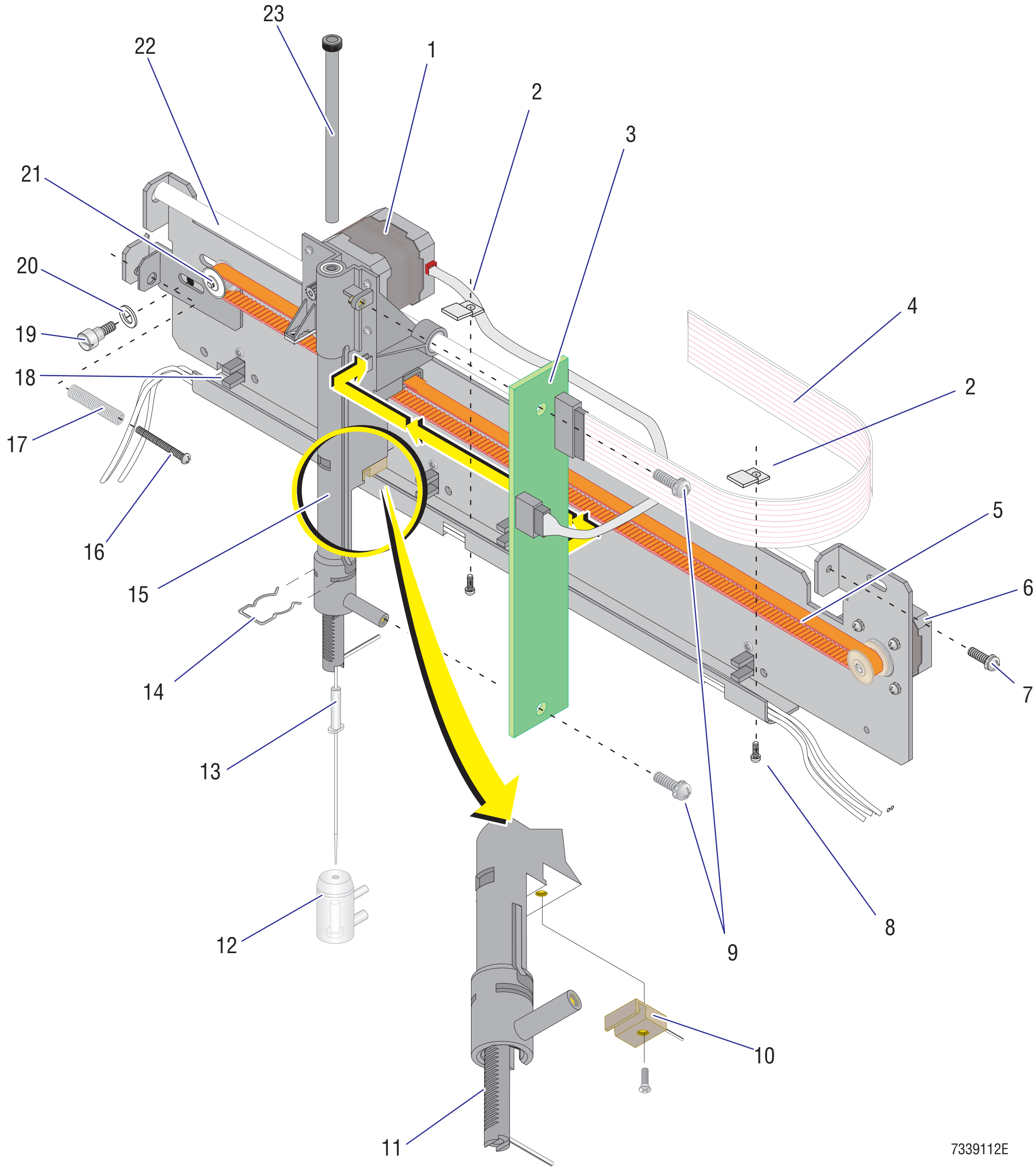

Table 8.2-11 Traverse Module Components, A^{C}•T diff 2 Analyzers (See Figure 8.2-11)

Item	Part Number	Description
1	6806490	Motor, probe vertical movement
2	6859756	Clamp, tubing, traverse
3	6706753	Card, Traverse Interconnect
4	6002022	Cable, Traverse module, flex
5	2527827	Belt, traverse horizontal drive
6	6806491	Motor, traverse horizontal motion
7	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.
8	2852223	Screw, pan head, #4-40 x 0.25 in., for clamp 6859756
9	2852224	Screw, pan head, SEMS, #4-40 x 0.31 in.
10	6706321	Housing, traverse guide
11	6806614	Rack, traverse, vertical drive
12	6807013	Housing, probe-wipe
13	6805948	Probe, aspirate
14	1022827	Clip, probe-wipe housing
15	6806502	Housing, traverse, molded
16	2808072	Screw, pan head, #8-32 x 1.50 in.
17	2523815	Spring, traverse belt tensioner
18	6806496	Sensor, optical, (horizontal) position
19	2852100	Screw, shoulder, #8-32 x 0.188 in.
20	2827148	Washer, flat, #8
21	2527743	Gear, traverse belt tensioner
22	1024022	Rack, traverse, horizontal motion
23	1024158	Retainer, probe

Figure 8.2-12 Cap-Pierce Module Components, A^{C}•T diff 2 Analyzers (See Table 8.2-12)

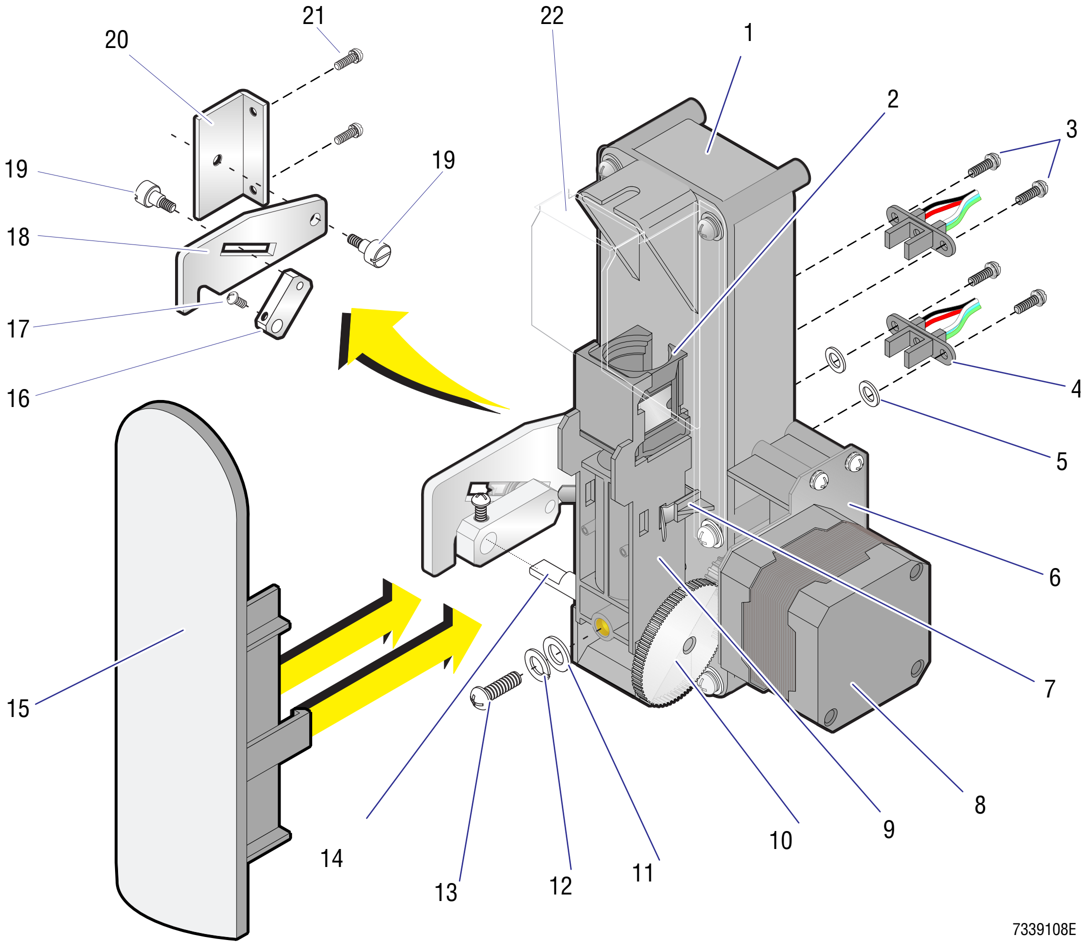

Table 8.2-12 Cap-Pierce Module Components, A^{C}•T diff 2 Analyzers (See Figure 8.2-12)

Item	Part Number	Description
1	6806481	Housing, cap pierce
2	6806615	Holder, tube
3	2852224	Screw, pan head, SEMS, #4-40 x 0.31 in.
4	6806496	Sensor, optical, door-closed position (upper sensor mounted inside cap-pierce housing) **or** sensor, optical, tube bottom seeking (lower sensor mounted inside cap-pierce housing)
5	2827045	Washer, flat, #4 (0.125 i.d. x 0.250 o.d. x 0.031 thick)
6	1024495	Bracket, cap-pierce door motor
7	1024496	Clamp, cap-pierce door
8	6806575	Motor, cap-pierce door
9	6806616	Holder, tube, door assembly
10	2527842	Gear, cap-pierce door, with setscrew
11	2827148	Washer, flat, #8
12	2826048	Washer, split lock, #8
13	2808038	Screw, pan head, #8-32 x 0.50 in.
14	1024428	Shaft, cap-pierce door gear
15	1024537	Cover, cap-pierce door **Note:** The cap-pierce door cover is glued to the tube holder door assembly (9) to ensure the door remains securely attached.
16	1024560	Cam, safety latch
17	2806005	Screw, pan head, #6-32 x 0.19 in.
18	1024562	Bracket, safety latch hook
19	2852100	Screw, shoulder, #8-32 x 0.188 in.
20	1024561	Bracket, safety latch mount
21	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.
22	1024587	Guard, cap-pierce probe
Not shown	1024601	Bracket, safety latch-catch plate, front door (See Figure 8.2-3, item 13.)

Figure 8.2-13 Left Side and Top Views (See Table 8.2-13)

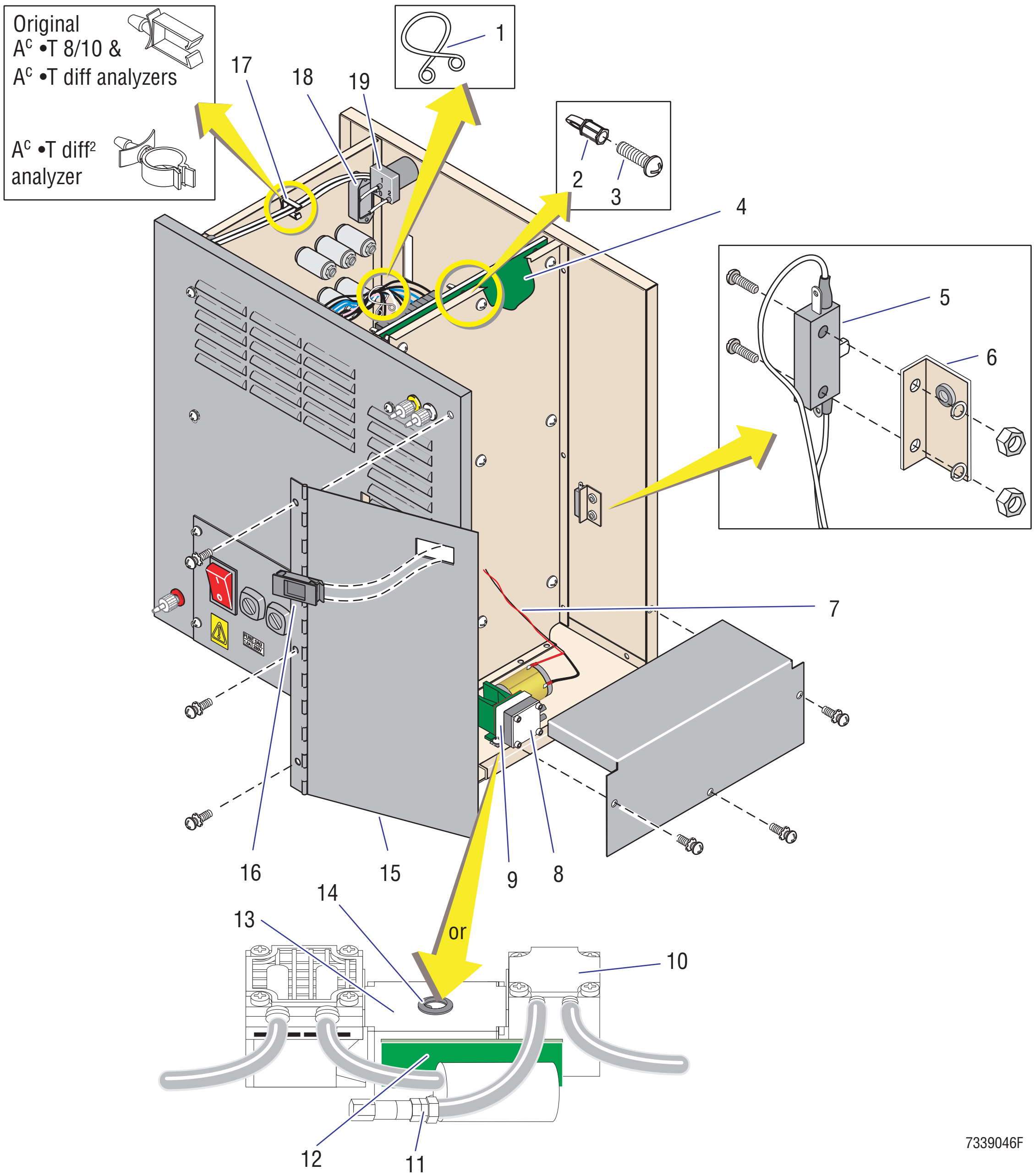

Table 8.2-13 Left Side and Top Views (See Figure 8.2-13)

Item	Part Number	Description
1	6027786	Clamp, cable bundle
2	2851601	Fastener, nylon retaining post to mount Analyzer card (old mount style)
3	2852306	Screw, self-tapping flathead, #6-32 x 0.38 in. (for old mount style)
4	6706332	Card, Analyzer, AC•T 8/10 analyzer (old number)
	6706541	Card, Analyzer, AC•T 8/10 analyzer (new number) **Note:** This card is functionally the same as PN 6706332; it was assigned a new part number because its layout is different.
	6706442	Card, Analyzer, AC•T diff analyzer
	6706802	Card, Analyzer, AC•T diff 2 analyzer
	6707111	Card, Analyzer, Universal (for AC•T diff and AC•T diff 2 analyzers only)
5	6805396	Switch, aspirate, with cable and connector
6	6805332	Bracket, aspirate switch
7	6028893	Cable harness, ASF Thomas vacuum pump
8	6232880	Pump, ASF Thomas vacuum, 24 Vdc brush type (new style)*
9	1023939	Bracket, ASF vacuum pump
10	6233071	Pump, dual-head vacuum/pressure, 24 Vdc, brushless*
11	6213009	Choke. 0.006 orifice, brown (for applications up to 1524 m [5,000 ft.])
	6213011	Choke, 0.010 orifice, black (for applications at 1524 m [5,000 ft.] and above)
12	6029207	Card, Pump Motor Filter
13	6807690	Bracket, pneumatic pump, dual head
14	2830017	Grommet, 0.562 i.d. x 0.875 o.d. x 0.218 thick, rubber
15	6805316	Door, left side with hinge, no latch, AC•T 8/10 and AC•T diff analyzers
16	2851605	Latch, side door, black, AC•T 8/10 and AC•T diff analyzers
	2852403	Latch, side door, grey, AC•T diff 2 analyzer
17		**Note:** The following cable bundle clamps are used throughout the specified analyzer.
	6028810	Clamp, cable bundle, snap mount to panel, 0.875 x 0.437 in. bundle, AC•T 8/10 and AC•T diff analyzers (In some cases, PN 6028995 may replace this clamp.)
	6028995	Clamp, cable bundle, 0.73 diameter, panel mount, snap lock, AC•T 8/10 and AC•T diff analyzers (This cable bundle clamp replaces PN 6028809 and, in some cases, PN 6028810.)
	6028999	Clamp, cable bundle, 0.47 diameter, panel mount, snap lock, AC•T diff 2 analyzer
18	2306099	Sensor, vacuum transducer, 15 V, AC•T 8/10 and AC•T diff analyzers
	2302008	Sensor, vacuum transducer, 8 V, AC•T diff 2 analyzer.
18	6232628	Regulator, vacuum*
Not shown	1024645	Screw, hex post, #4-40, used for Analyzer card mount, AC•T diff 2 analyzer

*In the AC•T diff 2 analyzer, the pneumatic pump and vacuum regulator are located inside a covered compartment in the analyzer's right-side compartment. See Figure 8.2-8.

Figure 8.2-14 Aperture/Bath Assembly Components on Mounting Plate, A^{C}•T 8/10 and A^{C}•T diff Analyzers (See Table 8.2-14)

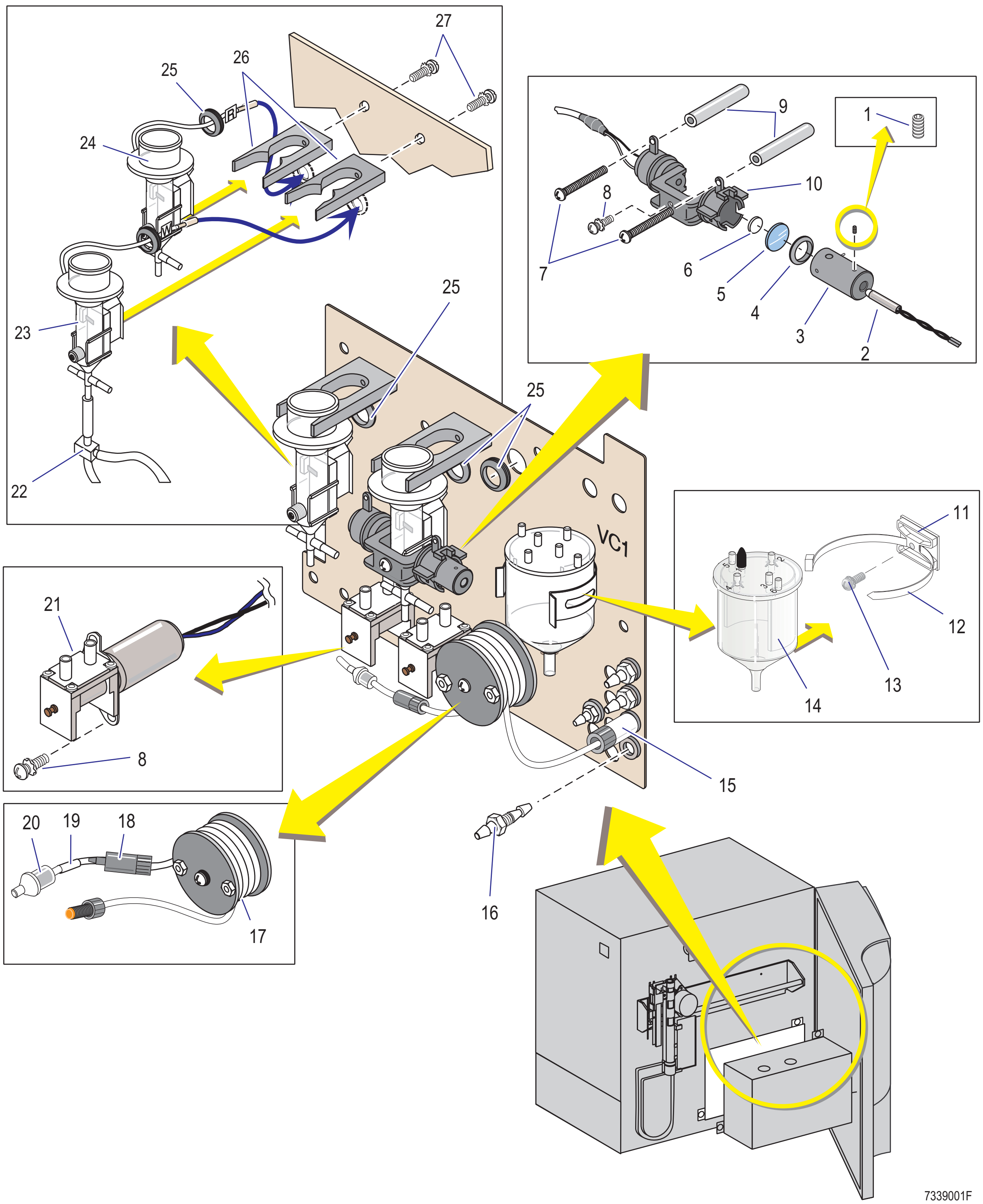

Table 8.2-14 Aperture/Bath Assembly Components on Mounting Plate, A^{C}•T 8/10 and A^{C}•T diff Analyzers (See Figure 8.2-14)

Item	Part Number	Description
1	2807048	Setscrew, Allen, #4-40 x 0.38 in.
2	6805344	Lamp, Hgb photometer assembly
3	6805691	Housing, lamp holder and heatsink, molded
4	2523689	O-ring, 0.364 in. i.d.
5	6102189	Lens, Hgb lamp, heat filter, blue
6	1023237	Lens, Hgb lamp
7	2852303	Screw, pan head, #4-40 x 1.75 in.
8	2852224	Screw, pan head, SEMS, #4-40 x 0.31 in.
9	2852302	Spacer, #4, 1.5 in. long
10	6805357	Photodiode, Hgb preamp and housing, molded
11	6011015	Mount, wire tie, 0.75 l x 0.75 w, adhesive back (for vacuum chamber)
12	6029001	Clamp, wire tie, releasable (for fastening vacuum chamber to mount)
13	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.
14	6805032	Chamber, vacuum isolator and waste assembly, molded
15	1025523	Fitting, feed-thru, 1/4 x 28 flat bottom, stainless steel, CP
16	1017458	Fitting, bulkhead feedthru, 0.07 i.d., A^{C}•T 8/10 and A^{C}•T diff analyzers
17	6807701	Spool, sweep-flow, assembly (includes 13 ft. of EVA tubing, PN 3202284, and two flangeless fittings, PN 6233080)
18	1025566	Fitting, union, 1/4-28 female to 0.093 barb, CP
19	3202039	Tubing, 0.145 i.d., polyurethane, clear
20	6214108	Valve, check, small, 0.062 i.d. fitting, for sweep flow
21	6232780	Valve, solenoid, Angar® fluidic, 2-way, A^{C}•T 8/10 and A^{C}•T diff analyzers
22	6232051	Fitting, T, 0.094 i.d.
23	6806443	Aperture, WBC and bath assembly
24	6806442	Aperture, RBC and bath assembly
25	2830014	Grommet, panel tubing throughway (0.375 i.d. x 0.625 o.d. x 0.250 thick), A^{C}•T 8/10 and A^{C}•T diff analyzers
26	6805773	Clamp, bath-mounting post, molded
27	2852095	Screw, pan head, SEMS, #6-32 x 0.50 in.
Not shown	6232259	Fitting, Y, 0.093 i.d. to 0.093 i.d.

Figure 8.2-15 Aperture/Bath Assembly Components on Mounting Plate, AC•T diff 2 Analyzers (See Table 8.2-15)

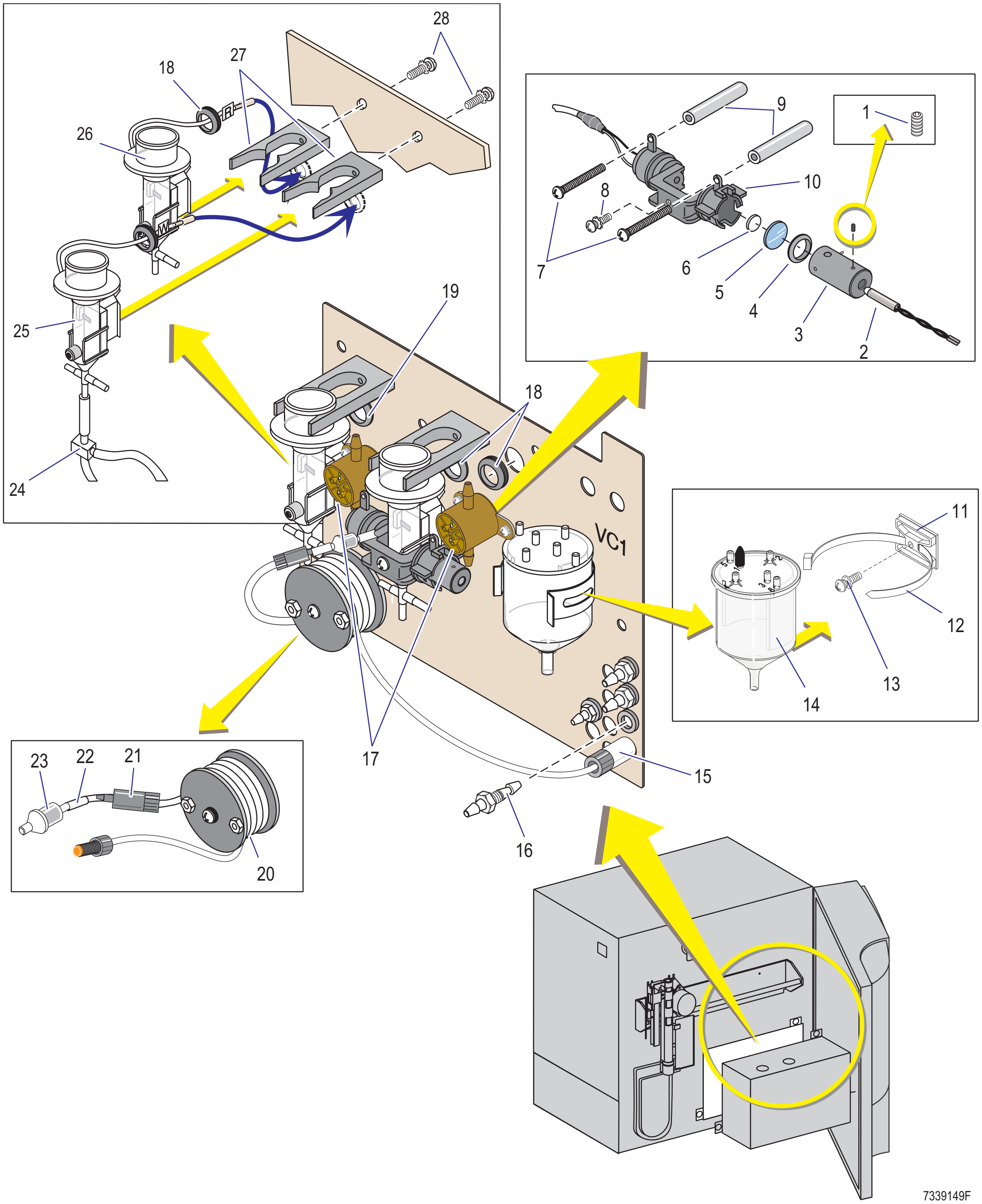

Table 8.2-15 Aperture/Bath Assembly Components on Mounting Plate, A^C•T diff 2 Analyzers (See Figure 8.2-15)

Item	Part Number	Description
1	2807048	Setscrew, Allen, #4-40 x 0.38 in.
2	6805344	Lamp, Hgb photometer assembly
3	6805691	Housing, lamp holder and heatsink, molded
4	2523689	O-ring, 0.364 in. i.d.
5	6102189	Lens, Hgb lamp, heat filter, blue
6	1023237	Lens, Hgb lamp
7	2852303	Screw, pan head, #4-40 x 1.75 in.
8	2852224	Screw, pan head, SEMS, #4-40 x 0.31 in.
9	2852302	Spacer, #4, 1.5 in. long
10	6805357	Photodiode, Hgb preamp and housing, molded
11	6011015	Mount, adhesive back, for vacuum chamber
12	6029001	Clamp, wire tie for fastening vacuum chamber to mount
13	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.
14	6805032	Chamber, vacuum isolator and waste assembly, molded
15	1025523	Fitting, feed-thru, 1/4 x 28 flat bottom, stainless steel, CP
16	6216353	Fitting, feed-thru, bulkhead 0.062 i.d. to 0.093 i.d., A^C•T diff 2 analyzer
17	6232932	Valve, solenoid Takasago fluidic, 2-way, A^C•T diff 2 analyzer
18	2830016	Grommet, panel tubing throughway (0.500 i.d x 0.813 o.d. x 0.281 thick), A^C•T diff 2 analyzer
19	2830014	Grommet, panel tubing throughway (0.375 i.d. x 0.625 o.d. x 0.250 thick)
20	6807701	Spool, sweep-flow, assembly (includes 13 ft. of EVA tubing, PN 3202284, and two flangeless fittings, PN 6233080)
21	1025566	Fitting, union, 1/4-28 female to 0.093 barb, CP
22	3202039	Tubing, 0.145 i.d., polyurethane, clear
23	6214108	Valve, check, small, 0.062 i.d. fitting, for sweep flow
24	6232051	Fitting, T, 0.094 i.d.
25	6806443	Aperture, WBC and bath assembly
26	6806442	Aperture, RBC and bath assembly
27	6805773	Clamp, bath-mounting post, molded
28	2852095	Screw, pan head, SEMS, #6-32 x 0.50 in.
Not shown	6232259	Fitting, Y, 0.093 i.d. to 0.093 i.d.

Figure 8.2-16 Aperture/Bath Assembly Shield and Mounting Plate (See Table 8.2-16)

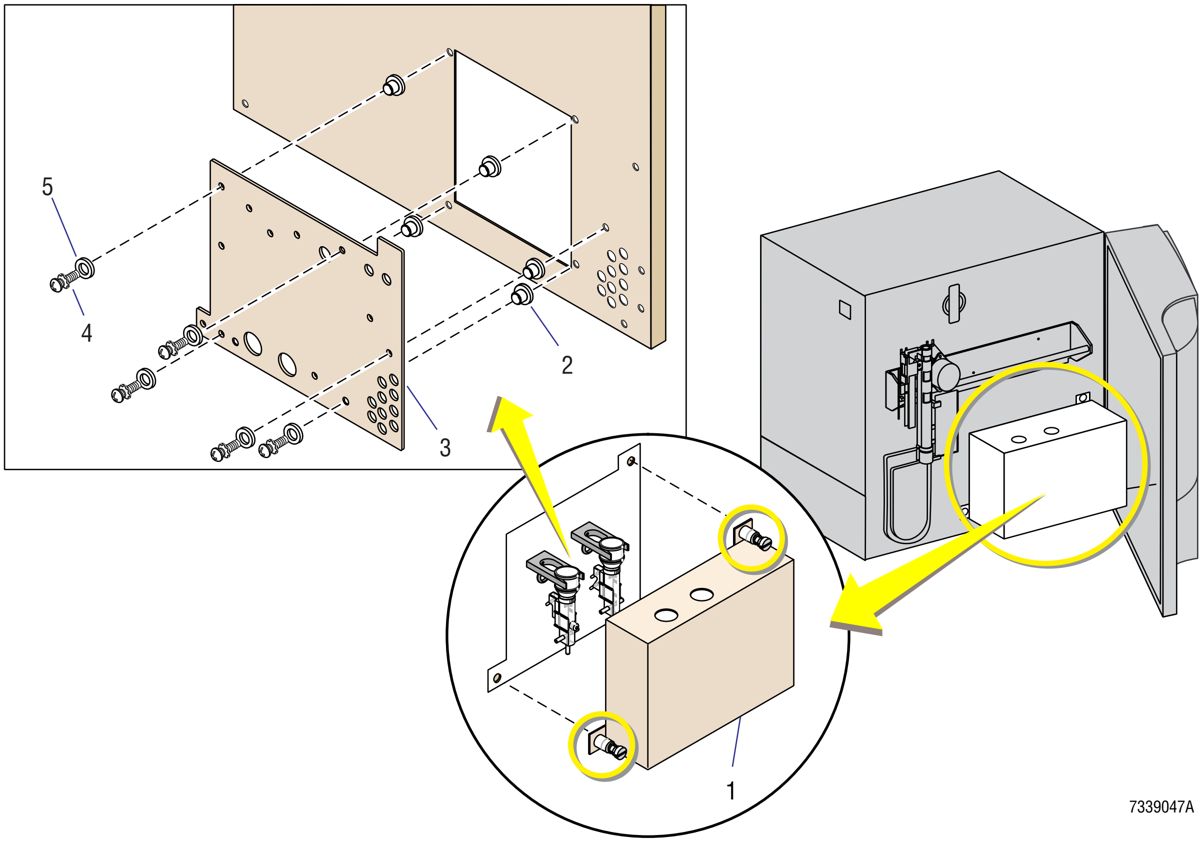

Table 8.2-16 Aperture/Bath Assembly Shield and Mounting Plate (See Figure 8.2-16)

Item	Part Number	Description
1	6805331 6806555	Shield, bath assembly, electrical, AC•T 8/10 and AC•T diff analyzers Shield, bath assembly, electrical, AC•T diff 2 analyzer
2	2527699	Spacer, nylon, bath assembly, isolation
3	6805559 6806092	Plate, bath assembly mounting and isolation, AC•T 8/10 and AC•T diff analyzers Plate, bath assembly mounting and isolation, AC•T diff 2 analyzer
4	2852093	Screw, self-lock, pan head, SEMS, #6-32 x 0.38 in.
5	2852281	Washer, flat, #6, nylon (0.177 i.d. x 0.408 o.d. x 0.062 thick)

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A.1 TOLERANCES AND LIMITS

Analyzer Card Voltage Limits

Table A.1-1 Analyzer Card - AC•T 8/10 Analyzer, Voltage Limits

Voltage	Acceptable Range	Test Point
+5	±5%	TP12 or P5-4
+10	±2%	TP27
-10	±2%	TP26
+15	±5%	TP14 or P5-7
-15	±5%	TP4 or P5-9
(+)15 RF	±2%	Positive lead C66

Table A.1-2 Analyzer Card - AC•T diff Analyzer, Voltage Limits

Voltage	Acceptable Range	Test Point
+5	±6%	TP5
+15	±6%	TP8
(+)15 RF	±3%	TP25

Table A.1-3 Analyzer Card - AC•T diff 2 Analyzer, Voltage Limits

Voltage		Acceptable Range	Test Point
+5		±6%	TP5
+15		±6%	TP8
VACRF	If +8 V reference (X4 OFF = new vacuum transducer)	±3%	S10A (J18A), Pin 1
	If +15 V reference (X4 ON = old vacuum transducer)	±3%	S10A (J18A), Pin 1

Clog Detection Target Value

Table A.1-4 Target Acceptance Criteria

Parameter	Acceptable Range
WBC count	CV ≤ 3.0%
RBC count	CV ≤ 3.0%
AVR Measured	Š1.4 but ≤ 2.3
WBC Measured	Š900 but ≤1500
RBC Measured	Š810 but ≤1350

Hgb Amplifier Output

3700 ±100 (after adjustment)

Latex Adjustment Criteria

Table A.1-5 Latex Adjustment Criteria

Parameter	Minimum	Maximum
WBC	1.0	10.0
RBC	0.5	2.5
WBC CV	0.0	15.0
RBC CV	0.0	8.0
WMCV	-1.5	+1.5
RMCV	-1.5	+1.5
WIA	10.0	250.0
RIA	10.0	250.0

Power Supply Module Output - Connector P5

Table A.1-6 Power Supply Module Output, Connector P5 - A^{C}•T 8/10 Analyzer

Pin	Description	Color
1	+24 Vdc	Brown
2	Digital ground 1	Black
3	Chassis ground	Green/yellow
4	+5 Vdc	Yellow
5	Digital ground	Black
6	POWER GOOD signal	White/blue
7	+15 Vdc	Orange
8	Analog ground	Black
9	-15 Vdc	Green

Table A.1-7 Power Supply Module Output, Connector P5 - A^{C}•T diff and A^{C}•T diff 2 Analyzers

Pin	Description	Color
1	+24 Vdc	Brown
2	+24 Vdc	Brown
3	EGND (chassis ground)	Green/yellow
4	SGND (solenoid ground)	Black
5	MGND (motor ground)	Black
6	+5 Vdc	Yellow
7	DGND (digital ground)	Black
8	+5 Vdc Sense	White/yellow
9	POWER GOOD signal	White/blue
10	+15 Vdc	Orange
11	AGND (analog ground)	Black
12	-15 Vdc	Green

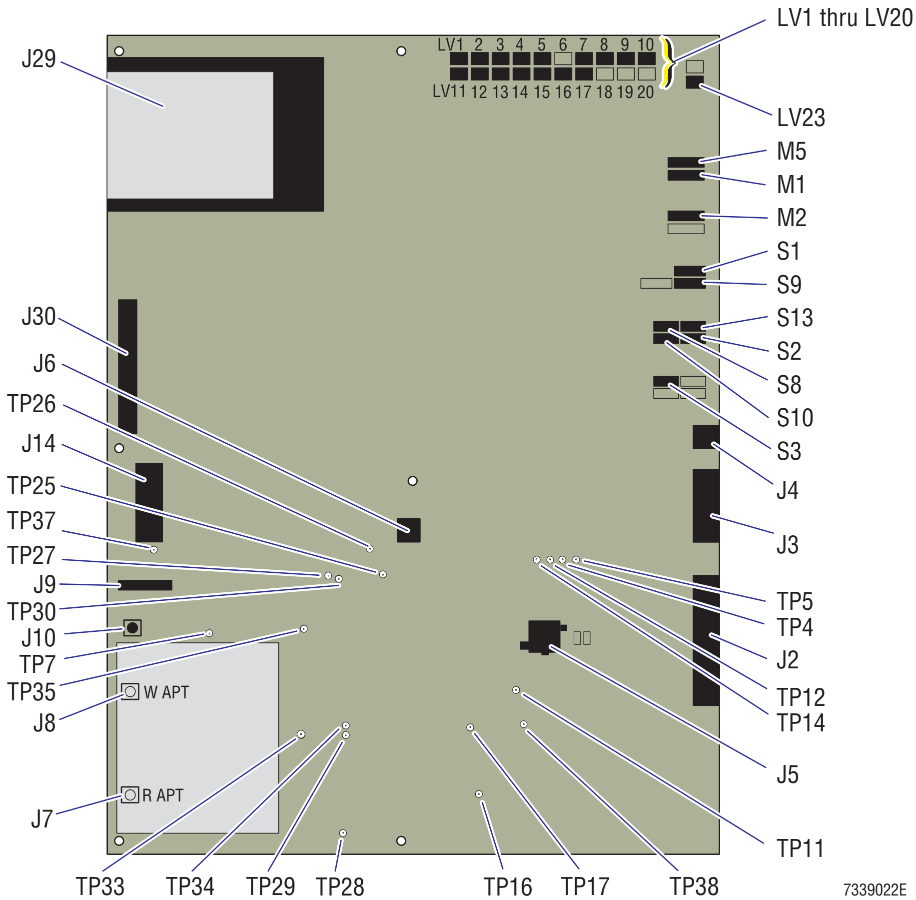
A.2 CIRCUIT CARD CONNECTORS, JUMPERS, AND TEST POINTS

Analyzer Card - AC•T 8/10 Analyzers

- For component locations, refer to Figure A.2-1.
- For details concerning a specific connector, refer to Table A.2-1.
- For details concerning a specific test point, refer to Table A.2-2.

Component Locations

Figure A.2-1 Analyzer Card Component Locations - AC•T 8/10 Analyzers



Connectors

Table A.2-1 Analyzer Card Connectors - A^{C}•T 8/10 Analyzers (See Figure A.2-1)

Reference Designator DCN 6322891	Card Label	Plug	Location	Description
J2	J2	P2	Lower rear	Parallel Printer, rear panel interface, 25 conductor
J3	J3	P3	Center rear	Serial out, rear panel interface, 9 conductor
J4	J4	P4	Center rear	Waste sensor, rear panel interface, BNC connector
J5	J5	P5	Lower rear	Power in, from Power Supply module, 9 conductor
J6	J6	P6	Top center	Cover interlock, currently just jumpered, 2 conductor
J7	J7	P7-R	Lower front	Red aperture cable, coaxial
J8	J8	P8-W	Lower front	White aperture cable, coaxial
J9	J9	P9	Lower front	Hgb lamp, 4 conductor
J10	J10	P10	Lower front	Hgb sensor (preamp), coaxial
J11	LV22	Unused	Top rear	Spare, solenoid 22, dc motor, 2 conductor
J12	LV23	WM23	Top rear	Solenoid 23, vacuum pump, 2 conductor
J13	S13	WM13	Center rear	Sensor 13, diluent reservoir thermistor sensor, 3 conductor
J14	J14	P14	Center front	Traverse module, flex-connect cable, 20 conductor
J15	S1	WM1	Top rear	Diluent reservoir sensor, 4 conductor
J16	S12	Unused	Top rear	Spare sensor for M6, 4 conductor
J17	S9	WM9	Top rear	Syringe motor sensor, 4 conductor
J18	S10	WM10	Center rear	Sensor 10, vacuum transducer, 3 conductor
J19	S2	WM2	Center rear	Sensor 2, lytic reagent optical-fluid sensor, 3 conductor
J20	S3	WM3	Center rear	Sensor 3, A^{C}•T Rinse, optical-fluid sensor, 3 conductor
J21	S14	Unused	Center rear	Spare, sensor 14, 3 conductor
J22	S15	Unused	Center rear	Spare, sensor 15, 3 conductor
J23	S16	Unused	Center rear	Spare, sensor 16, 3 conductor
J24	M5	WM5	Top rear	Motor 5, syringe-assembly motor, 5 conductor
J25	M6	Unused	Top rear	Spare, motor 6, spare sensor motor, 5 conductor
J26	M1	WM1	Top rear	Motor 1, waste peristaltic pump motor, 5 conductor
J27	M2	WM2	Top rear	Motor 2, diluent peristaltic pump motor, 5 conductor
J28	S8	WM8	Center rear	Sensor 8, aspirate switch, 3 conductor
J29	J29	P29	Top front	Flash Memory card, 68 conductor
J30	J30	P30	Center front	Display assembly ribbon cable, 26 conductor
J31	LV1	WM1	Top rear, upper row	Solenoid 1, 2 conductor
J32	LV2	WM2	Top rear, upper row	Solenoid 2, 2 conductor
J33	LV3	WM3	Top rear, upper row	Solenoid 3, 2 conductor

Table A.2-1 Analyzer Card Connectors - A^{C}•T 8/10 Analyzers (See Figure A.2-1) *(Continued)*

Reference Designator DCN 6322891	Card Label	Plug	Location	Description
J34	LV4	WM4	Top rear, upper row	Solenoid 4, 2 conductor
J35	LV5	WM5	Top rear, upper row	Solenoid 5, 2 conductor
J36	LV6	WM6	Top rear, upper row	Spare, solenoid 6, 2 conductor
J37	LV7	WM7	Top rear, upper row	Solenoid 7, 2 conductor
J38	LV8	WM8	Top rear, upper row	Solenoid 8, 2 conductor
J39	LV9	WM9	Top rear, upper row	Solenoid 9, 2 conductor
J40	LV10	WM10	Top rear, upper row	Solenoid 10, 2 conductor
J41	LV11	WM11	Top rear, lower row	Solenoid 11, 2 conductor
J42	LV12	WM12	Top rear, lower row	Solenoid 12, 2 conductor
J43	LV13	WM13	Top rear, lower row	Solenoid 13, 2 conductor
J44	LV14	WM14	Top rear, lower row	Solenoid 14, 2 conductor
J45	LV15	WM15	Top rear, lower row	Solenoid 15, 2 conductor
J46	LV16	WM16	Top rear, lower row	Solenoid 16, 2 conductor
J47	LV17	WM17	Top rear, lower row	Solenoid 17, 2 conductor
J48	LV18	Unused	Top rear, lower row	Spare, solenoid 18, 2 conductor
J49	LV19	Unused	Top rear, lower row	Spare, solenoid 19, 2 conductor
J50	LV20	Unused	Top rear, lower row	Spare, solenoid 20, 2 conductor
J51	J51	Unused	Lower front	Spare, Hgb lamp, 3 conductor

Test Points

Table A.2-2 Analyzer Card Test Points - A^C•T 8/10 Analyzers (See Figure A.2-1)

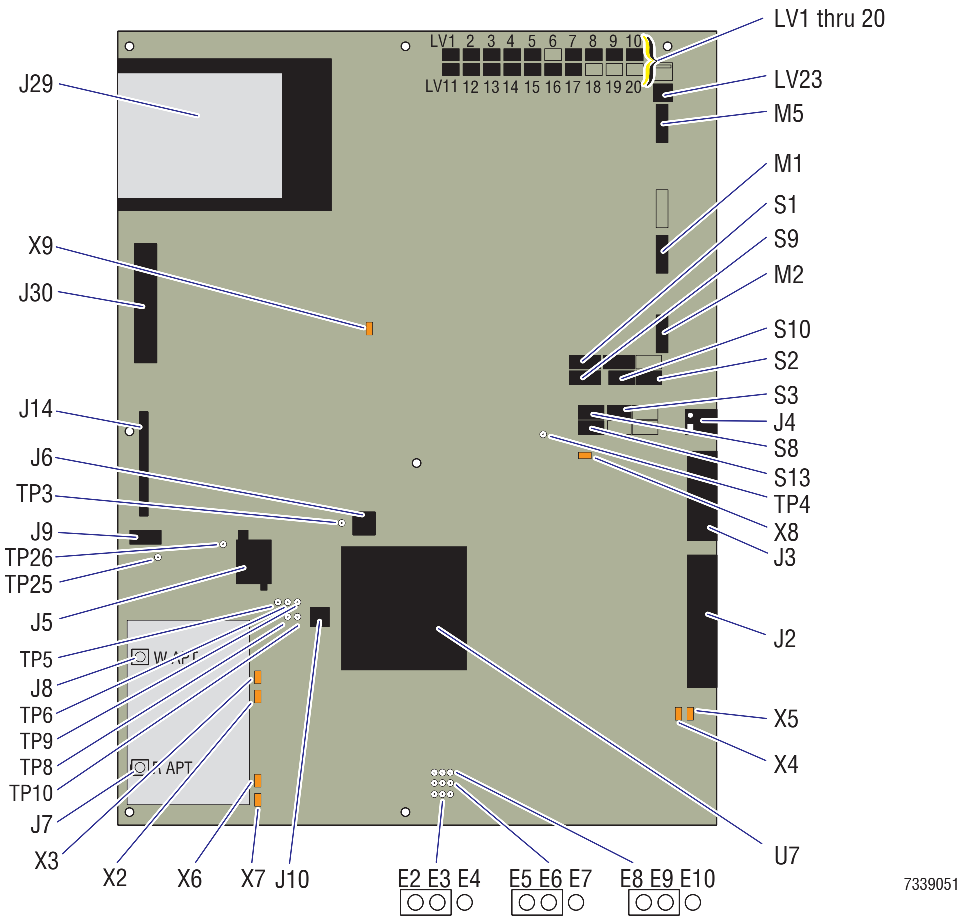
Test Point	Description	Circuit
TP4	-15 Vdc	From the Power Supply
TP5	+24 Vdc	From the Power Supply
TP7	Hgb preamp output	Hgb Support
TP11	A/D BOUND signal	Plt Processor
TP12	+5 Vdc	From the Power Supply
TP14	+15 Vdc	From the Power Supply
TP16	Output	Peak Detector
TP17	Integrator output	Inverter
TP25	Lower Plt threshold	Plt Window Comparator
TP26	-10 Vdc	Supply generated on card
TP27	+10 Vdc	Supply generated on card
TP28	Operation amplifier output	RBC Processor
TP29	Operation amplifier output	WBC Processor
TP30	Upper Plt threshold	Plt Window Comparator
TP33	Preamplifier output	RBC Processor
TP34	Comparator output	WBC Processor
TP35	Preamplifier output	WBC Processor
TP37	Hgb lamp voltage	Hgb Support
TP38	Plt amplifier output	Plt Processor

Analyzer Card - A[C]•T diff Analyzers

- For component locations, refer to Figure A.2-2.
- For details concerning a specific connector, refer to Table A.2-3.
- For details concerning a specific jumper, refer to Table A.2-4.
- For details concerning a specific test point, refer to Table A.2-5.

Component Locations

Figure A.2-2 Analyzer Card Component Locations - A[C]•T diff Analyzer



Connectors

Table A.2-3 Analyzer Card Connectors - A[C]•T diff Analyzer (See Figure A.2-2)

Reference Designator DCN 6323022	Card Label	Plug	Location	Description
J2	J2	P2	Lower rear	Parallel Printer, rear panel interface, 25 conductor
J3	J3	P3	Center rear	Serial out, rear panel interface, 9 conductor
J4	J4	P4	Center rear	Waste sensor, rear panel interface, BNC connector
J5	J5	P5	Lower rear	Power in, from Power Supply module, 9 conductor
J6	J6	P6	Top center	Cover interlock, currently just jumpered, 2 conductor
J7	J7	P7-R	Lower front	Red aperture cable, coaxial
J8	J8	P8-W	Lower front	White aperture cable, coaxial
J9	J9	P9	Lower front	Hgb lamp, 4 conductor
J10	J10	P10	Lower front	Hgb sensor (preamp), coaxial
J11	LV22	Unused	Top rear	Spare, solenoid 22, dc motor, 2 conductor
J12	LV23	WM23	Top rear	Solenoid 23, vacuum pump, 2 conductor
J13	S13	WM13	Center rear	Sensor 13, diluent reservoir thermistor sensor, 3 conductor
J14	J14	P14	Center front	Traverse module, flex-connect cable, 20 conductor
J15	S1	WM1	Top rear	Diluent reservoir sensor, 4 conductor
J16	S12	Unused	Top rear	Spare sensor for M6, 4 conductor
J17	S9	WM9	Top rear	Syringe motor sensor, 4 conductor
J18	S10	WM10	Center rear	Sensor 10, vacuum transducer, 3 conductor
J19	S2	WM2	Center rear	Sensor 2, lytic reagent optical-fluid sensor, 3 conductor
J20	S3	WM3	Center rear	Sensor 3, A[C]•T Rinse, optical-fluid sensor, 3 conductor
J21	S14	Unused	Center rear	Spare, sensor 14, 3 conductor
J22	S15	Unused	Center rear	Spare, sensor 15, 3 conductor
J23	S16	Unused	Center rear	Spare, sensor 16, 3 conductor
J24	M5	WM5	Top rear	Motor 5, syringe-assembly motor, 5 conductor
J25	M6	Unused	Top rear	Spare, motor 6, spare sensor motor, 5 conductor
J26	M1	WM1	Top rear	Motor 1, waste peristaltic pump motor, 5 conductor
J27	M2	WM2	Top rear	Motor 2, diluent peristaltic pump motor, 5 conductor
J28	S8	WM8	Center rear	Sensor 8, aspirate switch, 3 conductor
J29	J29	P29	Top front	Flash Memory card, 68 conductor
J30	J30	P30	Center front	Display assembly ribbon cable, 26 conductor
J31	LV1	WM1	Top rear, upper row	Solenoid 1, 2 conductor
J32	LV2	WM2	Top rear, upper row	Solenoid 2, 2 conductor
J33	LV3	WM3	Top rear, upper row	Solenoid 3, 2 conductor

Table A.2-3 Analyzer Card Connectors - A^{C}•T diff Analyzer (See Figure A.2-2) *(Continued)*

Reference Designator DCN 6323022	Card Label	Plug	Location	Description
J34	LV4	WM4	Top rear, upper row	Solenoid 4, 2 conductor
J35	LV5	WM5	Top rear, upper row	Solenoid 5, 2 conductor
J36	LV6	WM6	Top rear, upper row	Spare, solenoid 6, 2 conductor
J37	LV7	WM7	Top rear, upper row	Solenoid 7, 2 conductor
J38	LV8	WM8	Top rear, upper row	Solenoid 8, 2 conductor
J39	LV9	WM9	Top rear, upper row	Solenoid 9, 2 conductor
J40	LV10	WM10	Top rear, upper row	Solenoid 10, 2 conductor
J41	LV11	WM11	Top rear, lower row	Solenoid 11, 2 conductor
J42	LV12	WM12	Top rear, lower row	Solenoid 12, 2 conductor
J43	LV13	WM13	Top rear, lower row	Solenoid 13, 2 conductor
J44	LV14	WM14	Top rear, lower row	Solenoid 14, 2 conductor
J45	LV15	WM15	Top rear, lower row	Solenoid 15, 2 conductor
J46	LV16	WM16	Top rear, lower row	Solenoid 16, 2 conductor
J47	LV17	WM17	Top rear, lower row	Solenoid 17, 2 conductor
J48	LV18	Unused	Top rear, lower row	Spare, solenoid 18, 2 conductor
J49	LV19	Unused	Top rear, lower row	Spare, solenoid 19, 2 conductor
J50	LV20	Unused	Top rear, lower row	Spare, solenoid 20, 2 conductor

Jumpers

Table A.2-4 Analyzer Card Jumpers - A^{C}•T diff Analyzer (See Figure A.2-2)

Jumper	Analyzer Card - A^{C}•T diff Analyzer
X1	Not present
X2	OFF
X3	ON
X4	OFF
X5	OFF
X6	ON
X7	OFF
X8	ON
X9	ON
E2/E3/E4	ON E2/E3
E5/E6/E7	ON E5/E6
E8/E9/E10	ON E8/E9

Test Points

Table A.2-5 Analyzer Card Test Points - A^C•T diff Analyzer (See Figure A.2-2)

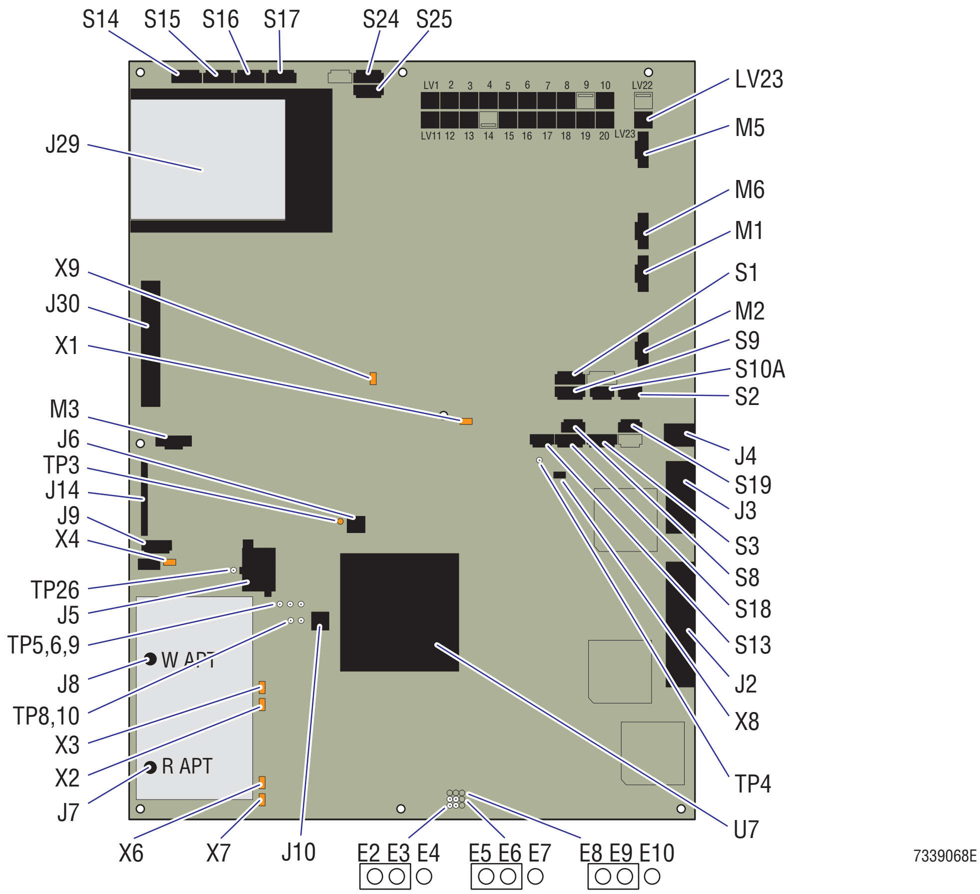
Test Point	Description	Circuit
TP3	+24 Vdc	From the Power Supply
TP4	+200 Vdc	From U7 (dc/dc converter)
TP5	+5 Vdc	From the Power Supply
TP6	DGND	Digital ground
TP8	+15 Vdc	From the Power Supply
TP9	AGND	Analog ground
TP10	-15 Vdc	From the Power Supply
TP25	+15 VRF (vacuum reference)	Generated on the card
TP26	+3.6 Vdc	Hgb lamp supply voltage

Analyzer Card - AC•T diff 2 Analyzers

- For component locations, refer to Figure A.2-3.
- For details concerning a specific connector, refer to Table A.2-6.
- For details concerning a specific jumper, refer to Table A.2-7.
- For details concerning a specific test point, refer to Table A.2-8.

Component Locations

Figure A.2-3 Analyzer Card Component Locations - AC•T diff 2 Analyzer



Connectors

Table A.2-6 Analyzer Card Connectors - A[C]•T diff 2 Analyzer (See Figure A.2-3)

Reference Designator DCN 6323409	Card Label	Plug	Location	Description
J2	J2	P2	Lower rear	Parallel Printer, rear panel interface, 25 conductor
J3	J3	P3	Center rear	Serial out, rear panel interface, 9 conductor
J4	J4	P4	Center rear	Waste sensor, rear panel interface, BNC connector
J5	J5	P5	Lower rear	Power in, 200 Vdc from Power Supply module, 9 conductor
J6	J6	P6	Top center	Cover interlock, currently just jumpered, 2 conductor
J7	J7	P7-R	Lower front	Red aperture cable, coaxial
J8	J8	P8-W	Lower front	White aperture cable, coaxial
J9	J9	P9	Lower front	Hgb lamp, 4 conductor
J10	J10	P10	Lower front	Hgb sensor (preamp), coaxial
J11	LV22	Unused	Top rear	Spare, solenoid 22, dc motor, 2 conductor
J12	LV23	WM23	Top rear	Vacuum pump, 2 conductor
J13	S13	WM13	Center rear	Sensor 13, diluent reservoir thermistor sensor, 3 conductor
J14	J14	P14	Center front	Traverse module, flex-connect cable, 20 conductor
J15	S1	WM1	Top rear	Diluent reservoir sensor, float, 4 conductor
J16	S12	Unused	Top rear	Spare sensor for M6, 4 conductor
J17	S9	WM9	Top rear	Sensor 9, sample pump home sensor, 4 conductor
J18A	S10A	WM10	Center rear	Sensor 10A, vacuum transducer, 3 conductor
J19	S2	WM2	Center rear	Sensor 2, lytic reagent optical-fluid sensor, 3 conductor
J20	S3	WM3	Center rear	Sensor 3, A[C]•T Rinse, optical-fluid sensor, 3 conductor
J21	S14	WM14	Center rear	Sensor 14, open-vial horizontal position sensor, 3 conductor
J22	S15	WM15	Center rear	Sensor 15, closed-vial horizontal position sensor, 3 conductor
J23	S16	WM16	Center rear	Sensor 16, RBC bath horizontal position sensor, 3 conductor
J24	M5	WM5	Top rear	Motor 5, sample FMI pump, 5 conductor
J25	M6	WM25	Top rear	Motor 6, closed-vial station door motor, 5 conductor
J26	M1	WM1	Top rear	Motor 1, lyse FMI pump motor, 5 conductor
J27	M2	WM2	Top rear	Motor 2, diluent FMI pump motor, 5 conductor
J28	S8	WM8	Center rear	Sensor 8, open-vial station aspirate switch, 3 conductor
J29	J29	P29	Top front	Flash Memory card, 68 conductor
J30	J30	P30	Center front	Display assembly ribbon cable, 26 conductor

Table A.2-6 Analyzer Card Connectors - A^{C}•T diff 2 Analyzer (See Figure A.2-3) *(Continued)*

Reference Designator DCN 6323409	Card Label	Plug	Location	Description
J31	LV1	WM1	Top rear, upper row	Rinse pump
J32	LV2	WM2	Top rear, upper row	Solenoid 2, 2 conductor
J33	LV3	WM3	Top rear, upper row	Solenoid 3, 2 conductor
J34	LV4	WM4	Top rear, upper row	Solenoid 4, 2 conductor
J35	LV5	WM5	Top rear, upper row	Solenoid 5, 2 conductor
J36	LV6	WM6	Top rear, upper row	Waste pump
J37	LV7	WM7	Top rear, upper row	Solenoid 7, 2 conductor
J38	LV8	WM8	Top rear, upper row	Solenoid 8, 2 conductor
J39	LV9	WM9	Top rear, upper row	Spare, solenoid 9, 2 conductor
J40	LV10	WM10	Top rear, upper row	Solenoid 10, 2 conductor
J41	LV11	WM11	Top rear, lower row	Solenoid 11, 2 conductor
J42	LV12	WM12	Top rear, lower row	Solenoid 12, 2 conductor
J43	LV13	WM13	Top rear, lower row	Solenoid 13, 2 conductor
J44	LV14	WM14	Top rear, lower row	Spare, solenoid 14, 2 conductor
J45	LV15	WM15	Top rear, lower row	Solenoid 15, 2 conductor
J46	LV16	WM16	Top rear, lower row	Solenoid 16, 2 conductor
J47	LV17	WM17	Top rear, lower row	Solenoid 17, 2 conductor
J48	LV18	Unused	Top rear, lower row	Waste/cleaner select
J49	LV19	WM19	Top rear, lower row	Diluent reservoir pump
J50	LV20	Unused	Top rear, lower row	Fan, back panel
J57	M3	WM3	Center front	Motor 3, traverse horizontal motor
J80	S24	WM24	Top center	Sensor 24, specimen tube bottom seeking sensor
J81	S17	WM17	Top center	Sensor 17, WBC bath horizontal position sensor
J82	S18	WM18	Center rear	Sensor 18, lyse pump home sensor
J83	S19	WM19	Center rear	Sensor 19, diluent pump home sensor
J98	S25	WM25	Top center	Sensor 25, closed-vial aspirate sensor (door-closed position sensor)

Jumpers

Table A.2-7 Analyzer Card Jumpers - AC•T diff 2 Analyzer (See Figure A.2-3)

Jumper	Analyzer Card - AC•T diff 2 Analyzer
X1	ON - AC•T diff 2 Analyzer* OFF - AC•T diff Analyzer*
X2	OFF
X3	ON
X4	ON - Old vacuum transducer† OFF - New vacuum transducer
X5	Not present
X6	ON
X7	OFF
X8	ON
X9	ON
E2/E3/E4	ON E2/E3
E5/E6/E7	ON E5/E6
E8/E9/E10	ON E8/E9

* For possible future use. Currently this card is only used on the AC•T diff 2 analyzer.

† Tells software which vacuum transducer is in use. The old vacuum transducer used on the AC•T 8/10 and AC•T diff analyzers is being discontinued.

Test Points

Table A.2-8 Analyzer Card Test Points - AC•T diff 2 Analyzer (See Figure A.2-3)

Test Point	Description	Circuit
TP3	+24 Vdc	From the Power Supply
TP4	+200 Vdc	From U7 (dc/dc converter)
TP5	+5 Vdc	From the Power Supply
TP6	DGND	Digital ground
TP8	+15 Vdc	From the Power Supply
TP9	AGND	Analog ground
TP10	-15 Vdc	From the Power Supply
TP26	+3.6 Vdc	Hgb lamp supply voltage

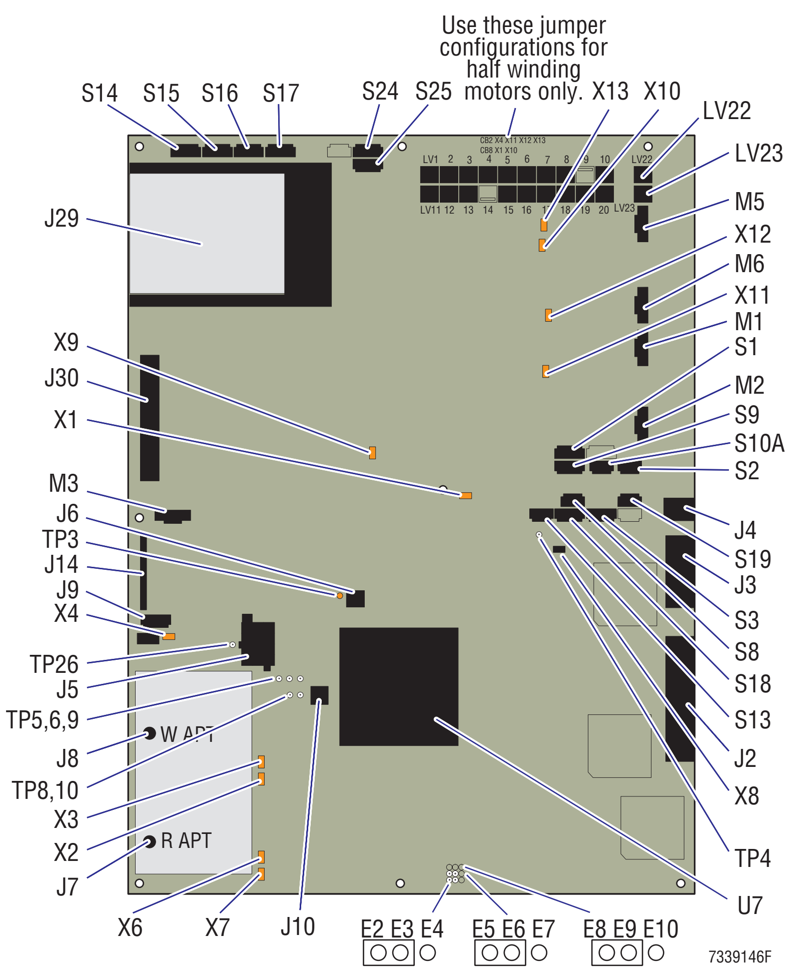
Analyzer Card - Universal A^C•T diff/A^C•T diff 2 Analyzers

- For component locations, refer to Figure A.2-4.
- For details concerning a specific connector, refer to Table A.2-10.
- For details concerning a specific jumper, refer to Table A.2-10.

  Note: The jumpers on the Universal A^C•T diff/A^C•T diff 2 Analyzer card configure the card for the model of the instrument and for the type of peristaltic or FMI sample pump (full or half winding) currently in use on the instrument. Table A.2-11 lists both the wire colors for pump motor connectors J26, J27, and J24 to help you determine if the pump is full or half winding, and the corresponding jumper settings.
- For details concerning a specific test point, refer to Table A.2-11.

Component Locations

Figure A.2-4 Universal A^C•T diff/A^C•T diff 2 Analyzer Card Component Locations



Connectors

Table A.2-9 Universal AC•T diff/AC•T diff 2Analyzer Card Connectors (See Figure A.2-4)

Reference Designator DCN 6323409	Card Label	Plug	Location	Description
J2	J2	P2	Lower rear	Parallel Printer, rear panel interface, 25 conductor
J3	J3	P3	Center rear	Serial out, rear panel interface, 9 conductor
J4	J4	P4	Center rear	Waste sensor, rear panel interface, BNC connector
J5	J5	P5	Lower rear	Power in, 200 Vdc from Power Supply module, 9 conductor
J6	J6	P6	Top center	Cover interlock, currently just jumped, 2 conductor
J7	J7	P7-R	Lower front	Red aperture cable, coaxial
J8	J8	P8-W	Lower front	White aperture cable, coaxial
J9	J9	P9	Lower front	Hgb lamp, 4 conductor
J10	J10	P10	Lower front	Hgb sensor (preamp), coaxial
J11	LV22	Unused	Top rear	Spare, solenoid 22, dc motor, 2 conductor
J12	LV23	WM23	Top rear	Vacuum pump, 2 conductor
J13	S13	WM13	Center rear	Sensor 13, diluent reservoir thermistor sensor, 3 conductor
J14	J14	P14	Center front	Traverse module, flex-connect cable, 20 conductor
J15	S1	WM1	Top rear	Diluent reservoir sensor, float, 4 conductor
J16	S12	Unused	Top rear	Spare sensor for M6, 4 conductor
J17	S9	WM9	Top rear	**AC•T diff analyzer:** Syringe motor sensor, 4 conductor **AC•T diff 2 analyzer:** Sensor 9, sample pump home sensor, 4 conductor
J18A	S10A	WM10	Center rear	Sensor 10A, vacuum transducer, 3 conductor
J19	S2	WM2	Center rear	Sensor 2, lytic reagent optical-fluid sensor, 3 conductor
J20	S3	WM3	Center rear	Sensor 3, AC•T Rinse, optical-fluid sensor, 3 conductor
J21	S14	WM14	Center rear	**AC•T diff analyzer:** Not used. **AC•T diff 2 analyzer:** Sensor 14, open-vial horizontal position sensor, 3 conductor
J22	S15	WM15	Center rear	**AC•T diff analyzer:** Not used. **AC•T diff 2 analyzer:** Sensor 15, closed-vial horizontal position sensor, 3 conductor
J23	S16	WM16	Center rear	**AC•T diff analyzer:** Not used. **AC•T diff 2 analyzer:** Sensor 16, RBC bath horizontal position sensor, 3 conductor
J24	M5	WM5	Top rear	**AC•T diff analyzer:** Motor 5, syringe-assembly motor, 5 conductor **AC•T diff 2 analyzer:** Motor 5, sample FMI pump, 5 conductor

Table A.2-9 Universal A[C]•T diff/A[C]•T diff 2Analyzer Card Connectors (See Figure A.2-4) *(Continued)*

Reference Designator DCN 6323409	Card Label	Plug	Location	Description
J25	M6	WM25	Top rear	**A[C]•T diff analyzer:** Not used. **A[C]•T diff 2 analyzer:** Motor 6, closed-vial station door motor, 5 conductor
J26	M1	WM1	Top rear	**A[C]•T diff analyzer:** Motor 1, waste peristaltic pump motor, 5 conductor **A[C]•T diff 2 analyzer:** Motor 1, lyse FMI pump motor, 5 conductor
J27	M2	WM2	Top rear	**A[C]•T diff analyzer:** Motor 2, diluent peristaltic pump motor, 5 conductor **A[C]•T diff 2 analyzer:** Motor 2, diluent FMI pump motor, 5 conductor
J28	S8	WM8	Center rear	**A[C]•T diff analyzer:** Sensor 8, aspirate switch, 3 conductor **A[C]•T diff 2 analyzer:** Sensor 8, open-vial station aspirate switch, 3 conductor
J29	J29	P29	Top front	Flash Memory card, 68 conductor
J30	J30	P30	Center front	Display assembly ribbon cable, 26 conductor
J31	LV1	WM1	Top rear, upper row	**A[C]•T diff analyzer:** Solenoid 1, 2 conductor **A[C]•T diff 2 analyzer:** Rinse pump
J32	LV2	WM2	Top rear, upper row	Solenoid 2, 2 conductor
J33	LV3	WM3	Top rear, upper row	Solenoid 3, 2 conductor
J34	LV4	WM4	Top rear, upper row	Solenoid 4, 2 conductor
J35	LV5	WM5	Top rear, upper row	Solenoid 5, 2 conductor
J36	LV6	WM6	Top rear, upper row	**A[C]•T diff analyzer:** Not used. **A[C]•T diff 2 analyzer:** Waste pump
J37	LV7	WM7	Top rear, upper row	Solenoid 7, 2 conductor
J38	LV8	WM8	Top rear, upper row	Solenoid 8, 2 conductor
J39	LV9	WM9	Top rear, upper row	Spare, solenoid 9, 2 conductor
J40	LV10	WM10	Top rear, upper row	Solenoid 10, 2 conductor
J41	LV11	WM11	Top rear, lower row	Solenoid 11, 2 conductor
J42	LV12	WM12	Top rear, lower row	Solenoid 12, 2 conductor
J43	LV13	WM13	Top rear, lower row	Solenoid 13, 2 conductor
J44	LV14	WM14	Top rear, lower row	Spare, solenoid 14, 2 conductor
J45	LV15	WM15	Top rear, lower row	Solenoid 15, 2 conductor
J46	LV16	WM16	Top rear, lower row	Solenoid 16, 2 conductor
J47	LV17	WM17	Top rear, lower row	Solenoid 17, 2 conductor

Table A.2-9 Universal A^{C}•T diff/A^{C}•T diff 2Analyzer Card Connectors (See Figure A.2-4) *(Continued)*

Reference Designator DCN 6323409	Card Label	Plug	Location	Description
J48	LV18	Unused	Top rear, lower row	**A^{C}•T diff analyzer:** Not used **A^{C}•T diff 2 analyzer:** Waste/cleaner select
J49	LV19	WM19	Top rear, lower row	**A^{C}•T diff analyzer:** Not used **A^{C}•T diff 2 analyzer:** Diluent reservoir pump
J50	LV20	Unused	Top rear, lower row	**A^{C}•T diff analyzer:** Not used **A^{C}•T diff 2 analyzer:** Fan, back panel
J57	M3	WM3	Center front	Motor 3, traverse horizontal motor
J80	S24	WM24	Top center	Sensor 24, specimen tube bottom seeking sensor
J81	S17	WM17	Top center	Sensor 17, WBC bath horizontal position sensor
J82	S18	WM18	Center rear	Sensor 18, lyse pump home sensor
J83	S19	WM19	Center rear	Sensor 19, diluent pump home sensor
J98	S25	WM25	Top center	Sensor 25, closed-vial aspirate sensor (door-closed position sensor)

Jumpers

The jumpers on the Universal A^{C}•T diff/A^{C}•T diff 2 Analyzer card configure the card for the model of the instrument and for the type of peristaltic or FMI sample pump (full or half winding) currently in use on the instrument. Table A.2-11 lists both the wire colors for pump motor connectors J26, J27, and J24 to help you determine if the pump is full or half winding, and the corresponding jumper settings.

Table A.2-10 Universal AC•T diff/AC•T diff 2 Analyzer Card Jumper Settings (See Figure A.2-4)

	AC•T diff Analyzer Peristaltic Pumps (J26 and J27)		AC•T diff 2 Analyzer FMI Sample Pump (J24)		Function
Pin No.	**Half Winding Wire Colors**	**Full Winding Wire Colors**	**Half Winding Wire Colors**	**Full Winding Wire Colors**	
1	Open	Open	Open	Open	
2	Red	Red	Yellow	Black	
3	White	Blue	Green	Green	
4	Yellow	Green	White	Red	
5	Black	Black	Blue	Blue	
X*	Green	Yellow	Black	Yellow	
X*	Blue	White	Red	White	
Jumpers	**Half Winding Settings**	**Full Winding Settings**	**Half Winding Settings**	**Full Winding Settings**	
X1	Always OFF	Always OFF	Always ON	Always ON	Number of traverse mechanism positions.
X2	Always OFF	Always OFF	Always OFF	Always OFF	Factory use only.
X3	Always ON	Always ON	Always ON	Always ON	Factory use only.
X4	ON	ON	OFF	OFF	†Vacuum transducer reference voltage. 4X ON = 15 V; 4X OFF = 8 V.
X6	Always ON	Always ON	Always ON	Always ON	Factory use only.
X7	Always OFF	Always OFF	Always OFF	Always OFF	Factory use only.
X8	Always ON	Always ON	Always ON	Always ON	RS 232 serial port clock
X9	Always ON	Always ON	Always ON	Always ON	Microprocessor clock
X10	Always OFF	Always OFF	ON	OFF	Changes current for the Triple Syringe module/FMI pump motors.
X11	ON	OFF	Always OFF	Always OFF	M2 current
X12	ON	OFF	Always OFF	Always OFF	M1 current
X13	ON	ON	OFF	OFF	Changes current for the Triple Syringe module/FMI pump motors.
J6	Always ON	Always ON	Always ON	Always ON	High voltage. OFF disconnects high voltage.
E2 -E3	Always ON	Always ON	Always ON	Always ON	Factory set. Connects RBC amplifier to signal processor.
E5 - E6	Always ON	Always ON	Always ON	Always ON	Factory set. Connects PLT amplifier to signal processor
E8 - E9	Always ON	Always ON	Always ON	Always ON	Factory set. Connects WBC amplifier to signal processor

* These wires are not used and are cut near the motor.
† Two vacuum transducers are currently in use. One has a single port (P1) and uses an 8 V reference voltage. The other has two ports (P1 is NOT used) and uses a 15 V reference voltage. Their performance is the same.

Test Points

Table A.2-11 Universal AC•T diff/AC•T diff 2Analyzer Card Test Points (See Figure A.2-4)

Test Point	Description	Circuit
TP3	+24 Vdc	From the Power Supply
TP4	+200 Vdc	From U7 (dc/dc converter)
TP5	+5 Vdc	From the Power Supply
TP6	DGND	Digital ground
TP8	+15 Vdc	From the Power Supply
TP9	AGND	Analog ground
TP10	-15 Vdc	From the Power Supply
TP26	+3.6 Vdc	Hgb lamp supply voltage

Display Controller Driver Card

- For component locations on the circuit card using through-hole design, refer to Figure A.2-5.
- For component locations on the circuit card using surface-mount design, refer to Figure A.2-6.
- For details concerning a specific connector, refer to Table A.2-12.
- For J61 pinout details, refer to Table A.2-13.
- For J62 pinout details, refer to Table A.2-14.
- For J63 pinout details, refer to Table A.2-15.
- For J65 pinout details, refer to Table A.2-16.
- For details concerning a specific jumper on the circuit card using through-hole design, refer to Table A.2-17.

  Note: The circuit card using surface-mount design has no jumpers.
- For details concerning a specific test point, refer to Table A.2-18.

Component Locations

Figure A.2-5 Display Controller Driver Card Component Locations - (Through-Hole Design)

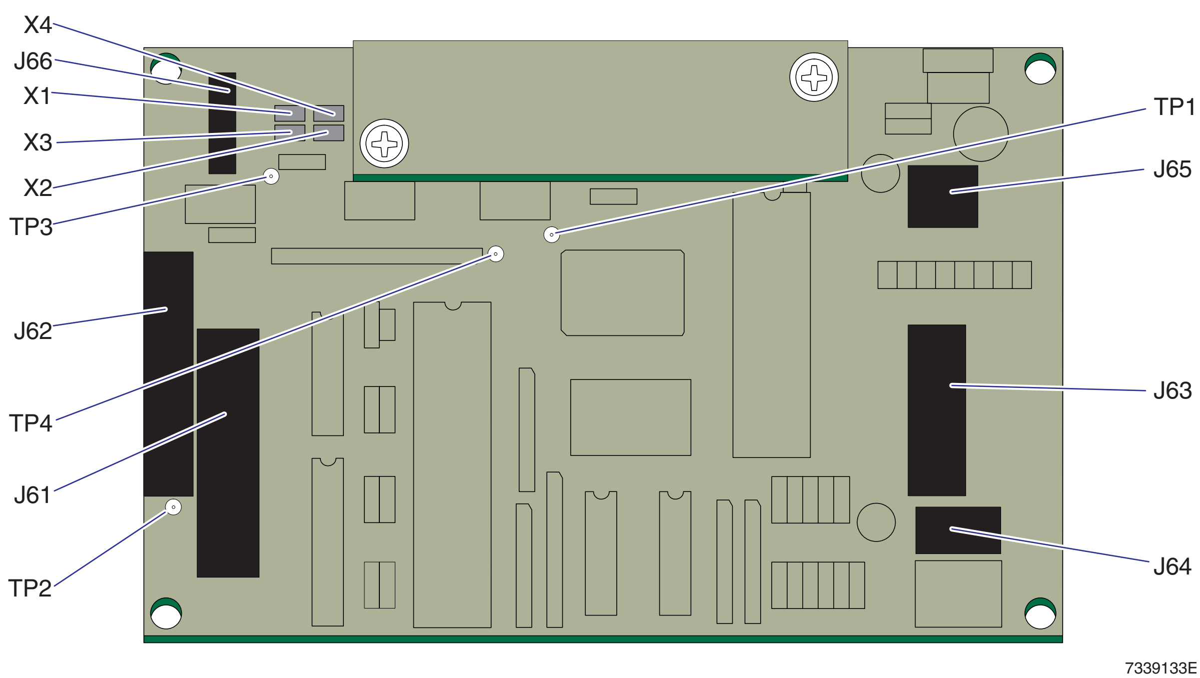
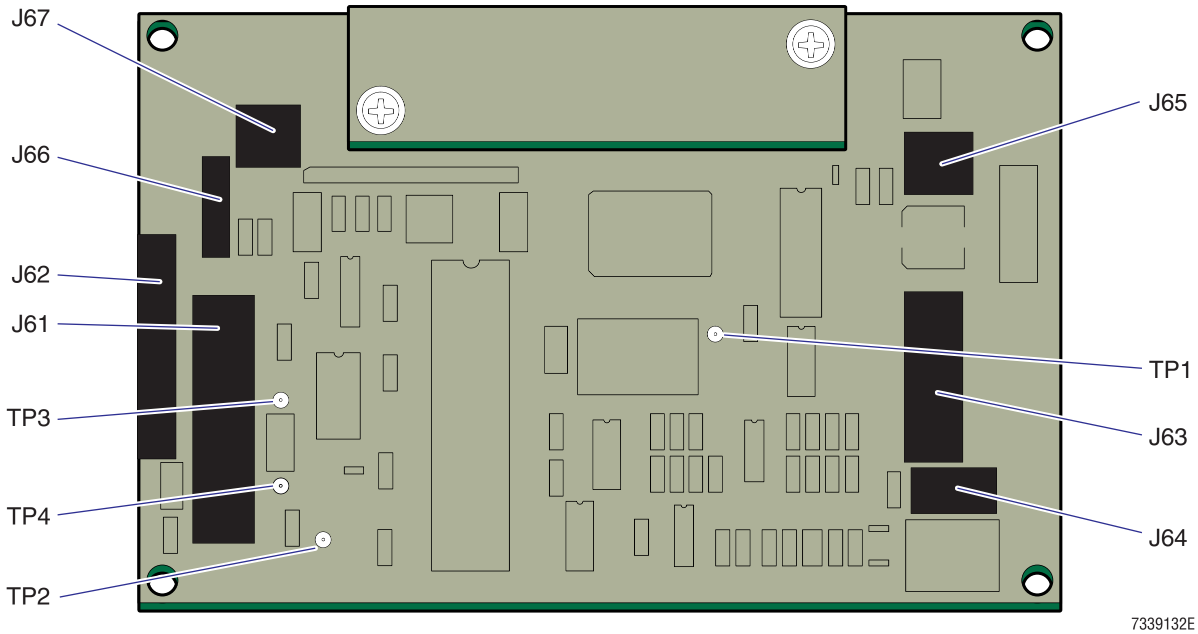


Figure A.2-6 Display Controller Driver Card Component Locations - (Surface-Mount Design)



Connectors and Pinouts

Table A.2-12 Display Controller Driver Card Connectors

J No.	Description (Through-Hole Design)	Description (Surface-Mount Design)
J61	Analyzer card	Analyzer card
J62	LCD	LCD
J63	Touchscreen keypad	Touch keypad
J64	Power LED	Power LED
J65	Backlight Power Daughter card	Backlight Power Daughter card
J66	Smart card reader	Reagent Management card reader
J67	N/A	Reagent Management card reader - subassembly testing

Table A.2-13 Display Controller Driver Card - J61 Pinouts

Pin	Signal	Description
1	DD0	Data bit to/from Analyzer card
2	DGND1	Motor and solenoid ground
3	DD1	Data bit to/from Analyzer card
4	+24 Vdc	
5	DD2	Data bit to/from Analyzer card
6	LCD CONTRAST VOLTAGE	Data bit to/from Analyzer card
7	DD3	
8	+5 Vdc	
9	DD4	Data bit to/from Analyzer card
10	+5 Vdc	
11	DD5	Data bit to/from Analyzer card
12	DGND	Digital ground
13	DD6	Data bit to/from Analyzer card
14	EGND	Earth ground
15	DD7	Data bit to/from Analyzer card
16	Not used	Connects to address bit A16 of display memory (U7)
17	RESET	Reset signal for reagent card reader
18		Production instruments do not use
19	/RD	Read enable for display controller chip U6, active low
20	/LEDPWR	Power source for power on LED
21	/WR	Write enable for display controller chip U6, active low
22	SCLK	Clock signal for reagent card reader
23	/CS	Chip select signal for display controller chip U6, active low
24	KINT	Keyboard interrupt signal from U5, keyboard controller
25	/KWR	Write control signal for U5 (keyboard controller) active low
26	/KWD	Read control signal for U5 (keyboard controller) active low

Table A.2-14 Display Controller Driver Card, J62 Pinouts

Pin	Signal	Function
1	YD (FRAME STARTUP)	Signals start of each screen frame
2	WF (LIQUID CRYSTAL AC)	Provides ac polarity in each display frame
3	LP (DISPLAY DATA LATCH)	Latches data in each common line
4	XSCL (DISPLAY DATA SHIFT)	Shifts data in 4-bit increments to display
5	INHX (DISPLAY ON/OFF)	H=ON
		L=OFF
6	XD0	Data bit 0
7	XD1	Data bit 1
8	XD2	Data bit 2
9	XD3	Data bit 3
10	+5 V	Power supply voltage for logic at +5 Vdc
11	DGND	Digital ground
12	-22 V	Power supply for LCD at -22 Vdc
13		Voltage for LCD contrast adjustment
14	EGND	Chassis (earth) ground

Table A.2-15 Display Controller Driver Card, J63 Pinouts

Pin	Columns: Front Flex Cable	Destination Pin (J63)	Rows: Back Flex Cable	Destination Pin (J63)
1	4	9	1	1
2	3	10	2	2
3	2	11	3	3
4	1	12	4	4
5	5	13	5	5
6	6	14	6	6
7	7	15	7	7
8	8	16	8	8

Table A.2-16 Display Controller Driver Card, J65 Pinouts

Pin	Signal	Function
1	AC IN	Ac backlight supply - 1000 V
2		Not connected
3	AC IN	Ac backlight supply - 1000 V

Jumpers

Table A.2-17 Display Controller Driver Card Jumpers

X No.	Description (Through-Hole Design)	Description (Surface-Mount Design)
X1	ON	N/A
X2	OFF	N/A
X3	ON	N/A
X4	OFF	N/A

Test Points

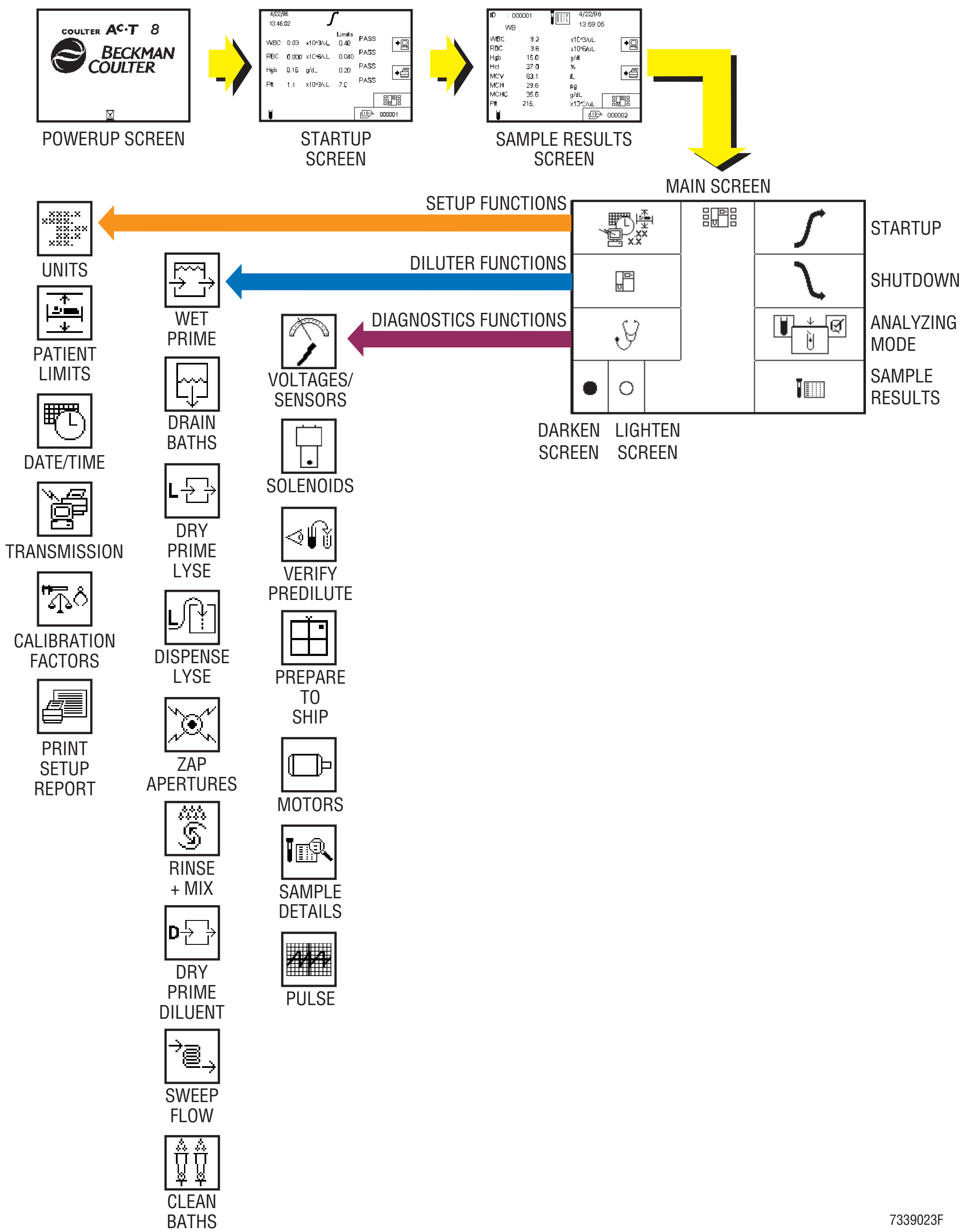
Table A.2-18 Display Controller Driver Card Test Points

TP No.	Description (Through-Hole Design)	Description (Surface-Mount Design)
TP1	Oscillator output	Oscillator output
TP2	-22 Vdc	-22 Vdc
TP3	Digital ground	Digital ground
TP4	+5 Vdc	+5 Vdc

A.3 SOFTWARE MENU TREES

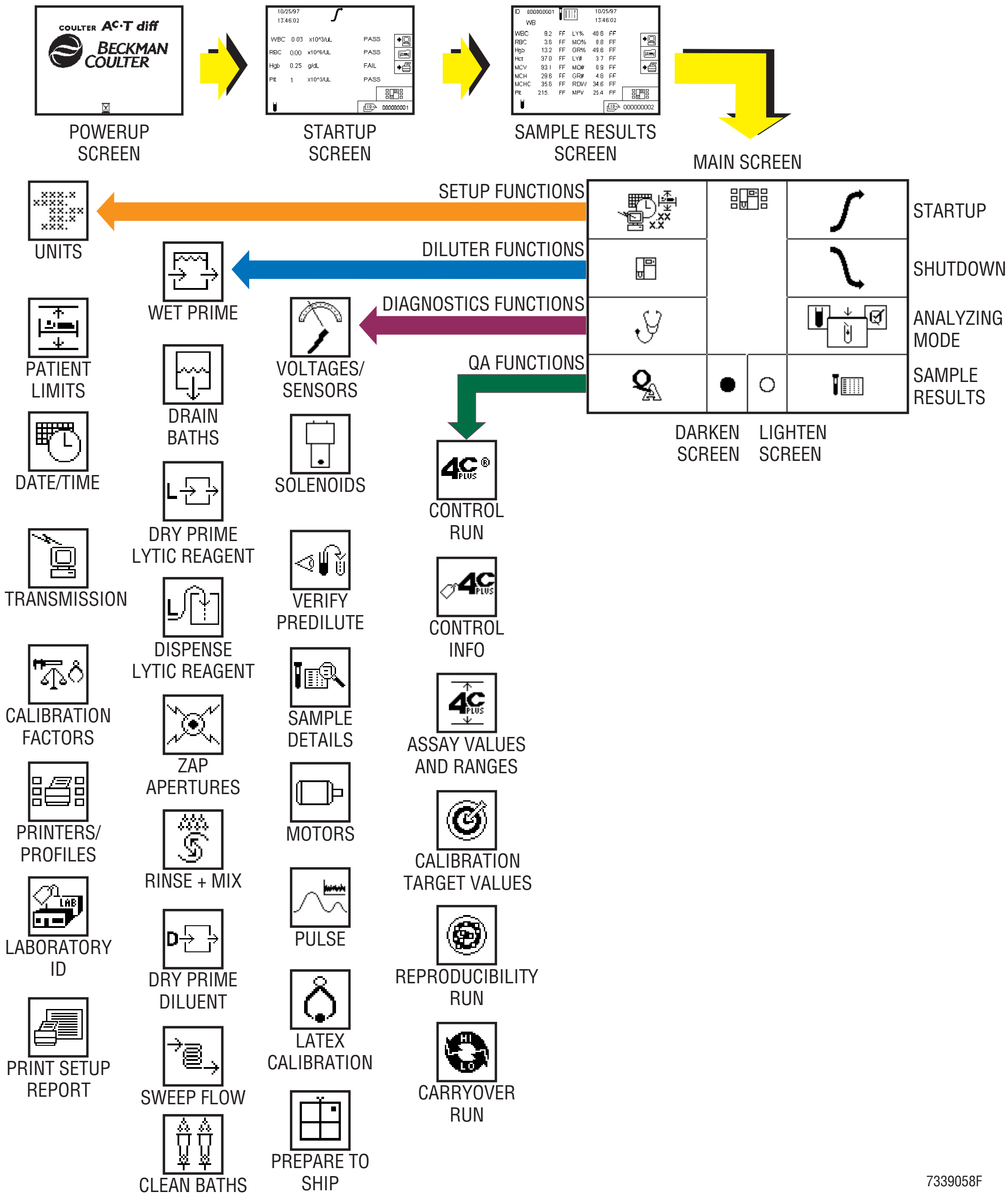
AC•T 8/10 Analyzer

Figure A.3-1 Software Menu Tree - AC•T 8/10 Analyzer



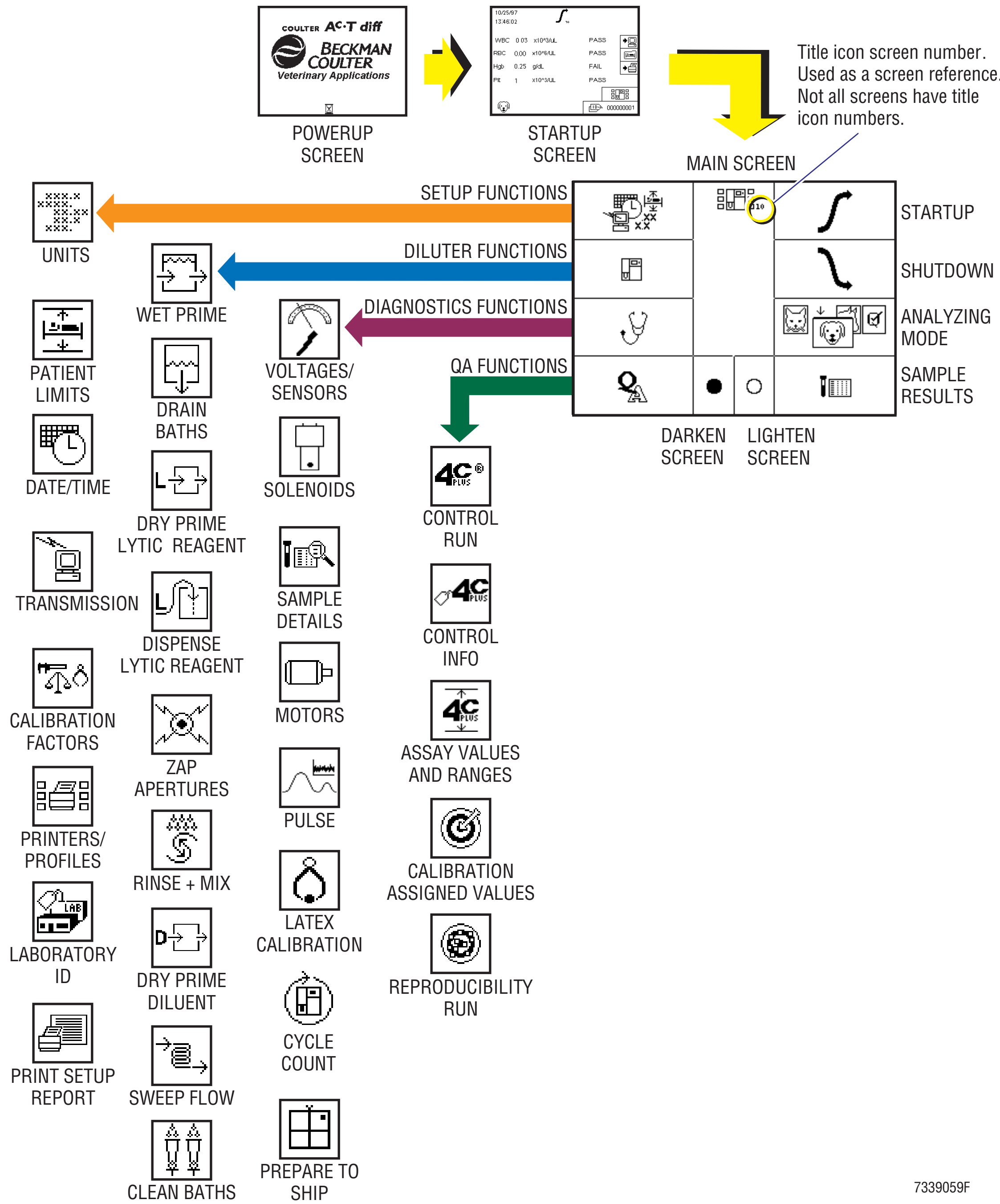
AC•T diff Analyzer

Figure A.3-2 Software Menu Tree - AC•T diff Analyzer



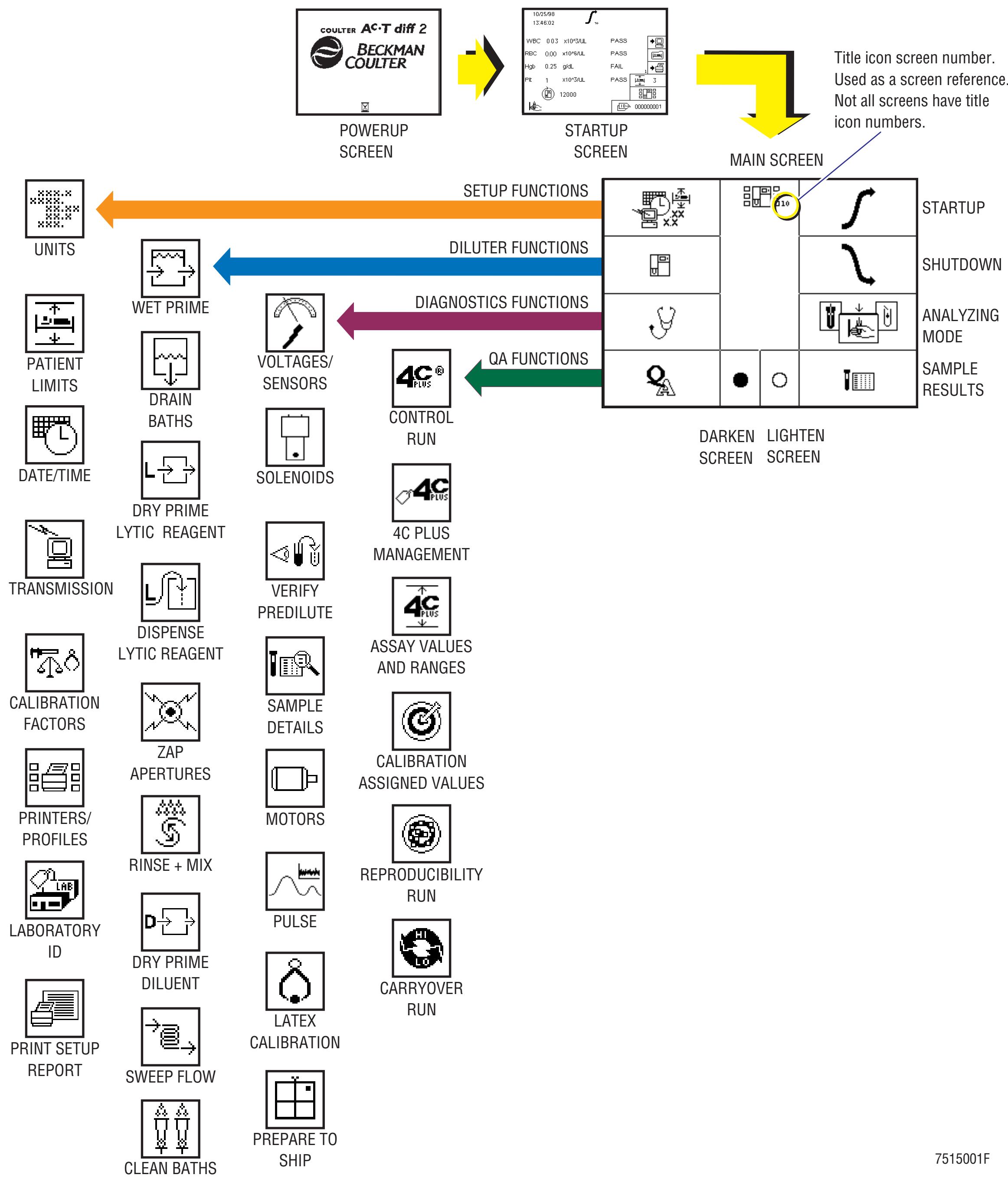
A^{C}•T diff/Veterinary Option Analyzer

Figure A.3-3 Software Menu Tree - A^{C}•T diff/Veterinary Option Analyzer



AC•T diff 2 Analyzer

Figure A.3-4 Software Menu Tree - AC•T diff 2 Analyzer



A.4 A^C•T 8/10 and A^C•T diff COMPONENT LOCATIONS AND FUNCTIONS

Summary

Most Diluter 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.

Solenoids

Solenoids are electronic valves that are energized or de-energized to perform a function or to activate other components in the Diluter. Table A.4-1 identifies the function of each solenoid used in the A^C•T 8/10 and A^C•T diff analyzers. Solenoids LV7, LV8, LV9, LV10, LV11, and LV12 are attached to and control the operation of ASCO® Angar™ valves. Solenoids LV13, LV14, and LV15 are attached to and control the operation of small Bio-Chem™ pinch valves. Use the Pneumatic/Hydraulic Schematic or the figures referenced in Table A.4-1 to locate these solenoids. (For the part number and location of the Pneumatic/Hydraulic Schematics schematic file, see Chapter 6.)

Table A.4-1 Solenoid Functions - A^C•T 8/10 or A^C•T diff Analyzers

Solenoid Number	Function	Figure Reference
LV1	VIC vent select	A.4-2, 7
LV2	High vacuum enable	A.4-2, 8
LV3	WBC air mix select	A.4-2, 9
LV4	Lytic reagent air mix select	A.4-2, 10
LV5	Air mix enable	A.4-2, 11
LV6	Spare	
LV7*	RBC bath diluent select	A.4-2, 3
LV8*	Probe-wipe waste select	A.4-2, 4
LV9*	Lytic reagent dispense enable	A.4-2, 1
LV10*	Probe-wipe diluent select	A.4-2, 2
LV11*	Bath diluent select	A.4-2, 5
LV12*	Syringe diluent select	A.4-2, 6
LV13†	Cleaner select	A.4-2, 14
LV14†	WBC bath drain select	A.4-2, 21
LV15†	VC1 drain select	A.4-2, 20
LV16	RBC count	A.4-1, 8
LV17	WBC count	A.4-1, 7
LV23	Pneumatic pump motor	A.4-3, 4

Note: Solenoids LV18 through LV22 are not used on the A^C•T 8/10 and A^C•T diff analyzers.

* Solenoid is attached to and controls the operation of an Angar valve.

† Solenoid is attached to and controls the operation of a small Bio-Chem pinch valve.

Main Analyzer Components

The main Diluter components comprising the AC•T 8/10 and AC•T diff analyzers are identified and described in the following tables. Each table also includes the reference designator for the component, where applicable, and a figure reference for locating the component.

- Table A.4-2 describes the main components behind the front door. Use Figure A.4-1 to locate these components.
- Table A.4-3 describes the main components inside the right compartment. Use Figure A.4-2 to locate these components.
- Table A.4-4 describes the main components inside the left compartment. Use Figure A.4-3 to locate these components.

Components Located Behind the Front Door of an AC•T 8/10 or AC•T diff Analyzer

Figure A.4-1 View of an AC•T 8/10 or AC•T diff Analyzer with the Front Door Open

1. Software card slot
2. Vacuum adjust knob
3. Vacuum chamber
4. Hgb assembly
5. Sweep-flow spool
6. WBC bath
7. VL17
8. VL16
9. RBC bath
10. Aspirate switch
11. Probe
12. Probe-wipe housing
13. Traverse module

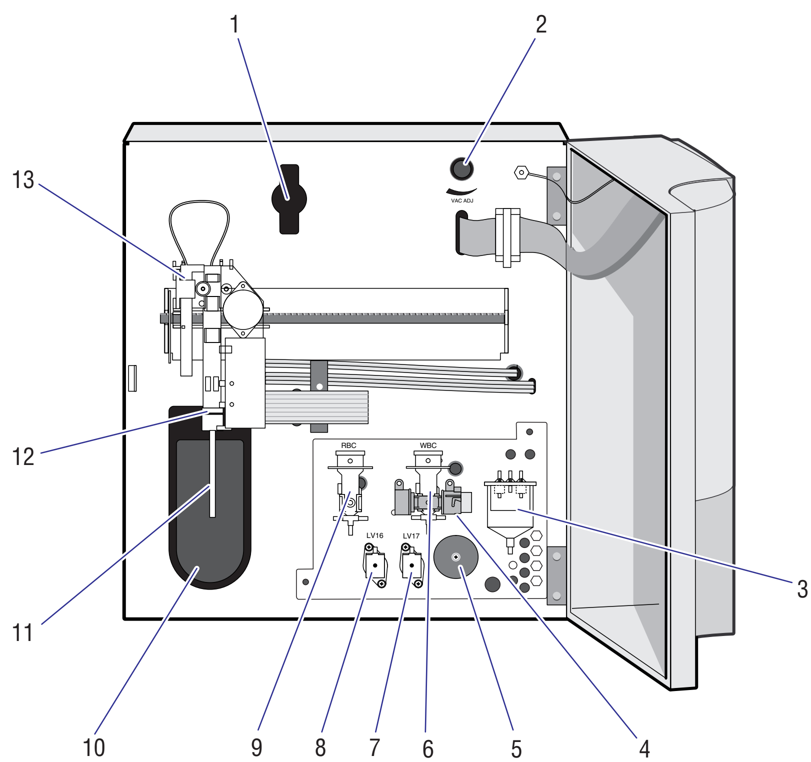


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Table A.4-2 Components behind the Front Door of an A^C•T 8/10 or A^C•T diff Analyzer

Figure Reference	Component	Function	Reference Designator DCN 6323083
A.4-1, 1	Software card slot	Opening for inserting the metallic software card. This software card must be firmly seated into the track of the slot; otherwise, the card could fall inside the analyzer.	
A.4-1, 2	Vacuum adjust knob	Knob used to the adjust the vacuum regulator (RG1) which regulates the low (6-in. Hg) vacuum used to pull the dilution through the WBC and RBC aperture and sweep-flow diluent behind the RBC aperture.	VAC RGL TR
A.4-1, 3	Vacuum chamber	Distributes low vacuum (6-in. Hg) to pull dilution through the aperture in both baths and sweep-flow diluent through the sweep-flow line behind the RBC aperture. Also provides the high vacuum needed for scavenging the sweep-flow line behind the RBC bath, and for cleansing and drying the probe inside the probe-wipe housing. Also acts as a holding chamber for the waste that accumulates during these count, scavenge, and cleaning functions. May also be referred to as a vacuum isolator chamber.	VC1 or VAC ISLR CHMBR
A.4-1, 4	Hgb assembly	Hgb lamp and preamp provide the hemoglobin blank and sample readings needed to calculate the Hgb result.	
A.4-1, 5	Sweep-flow spool	Tubing wound around a spool that acts as a choke to regulate diluent delivery through the sweep-flow line behind the RBC aperture.	CK2
A.4-1, 6	WBC bath	Holds the WBC dilution for mixing and for collecting WBC and Hgb data, including differential data if the analyzer is an A^C•T diff analyzer. May also be referred to as the WBC aperture/bath assembly.	WBC
A.4-1, 7	LV17	Angar two-way solenoid valve used to apply the low vacuum (6-in. Hg) in the vacuum chamber (VC1) to the WBC aperture for accumulating count and size data. *De-energized* - the pathway from VC1 to the WBC aperture is closed. *Energized* - the pathway from VC1 to the WBC aperture is open. As low vacuum is applied to the WBC aperture, dilution is pulled from the WBC bath through the WBC aperture via LV17 and enters the VC1 as a stream of droplets.	LV17

Table A.4-2 Components behind the Front Door of an A^C•T 8/10 or A^C•T diff Analyzer *(Continued)*

Figure Reference	Component	Function	Reference Designator DCN 6323083
A.4-1, 8	LV16	Angar two-way solenoid valve used to apply the low vacuum (6-in. Hg) in the vacuum chamber (VC1) to the RBC aperture for accumulating count and size data. *De-energized* - the pathway from VC1 to the RBC aperture is closed. *Energized* - the pathway from VC1 to the RBC aperture is open. As low vacuum is applied to the RBC aperture, dilution is pulled from the RBC bath through the RBC aperture via LV16 and enters the VC1 as a stream of droplets. Vacuum applied to the RBC aperture is simultaneously applied to the sweep-flow system.	LV16
A.4-1, 9	RBC bath	Holds the RBC dilution for mixing and for collecting RBC and Plt data. May also be referred to as the RBC aperture/bath assembly.	RBC
A.4-1, 10	Aspirate switch	When pressed by the operator, initiates a cycle in the selected mode of operation - either the Whole-Blood mode or Predilute mode.	
A.4-1, 11	Probe	Input pathway for sample aspiration in the Whole-Blood and Predilute modes. Also the input pathway for aspirating a portion of the WBC dilution from the WBC bath for transfer to the RBC bath. May also be referred to as the aspirate probe.	ASP PROBE
A.4-1, 12	Probe-wipe housing	Housing has an internal spiral configuration that allows diluent entering the top port to clean the outside of the probe as the diluent spirals downward and exits through the bottom port to the vacuum chamber (VC1). May also be referred to as the probe-wipe block.	
A.4-1, 13	Traverse module	Encases and protects the probe. Controls horizontal and vertical positioning of the probe using stepper motors, direct drive gear systems, and dual-channel opto sensors. Also cleanses the probe after aspiration. Figure 2.2-1 illustrates the main components.	

Components Inside the Right Compartment of an A^C•T 8/10 or A^C•T diff Analyzer

Figure A.4-2 View Inside the Right Compartment of an A^C•T 8/10 or A^C•T diff Analyzer

1. LV9
2. LV10
3. LV7
4. LV8
5. LV11
6. LV12
7. LV1
8. LV2
9. LV3
10. LV4
11. LV5
12. Waste/rinse pump (PM1)
13. Diluent pump (PM2)
14. LV13
15. Diluent reservoir
16. Aspiration syringe (250 µL)
17. Diluent syringe (5 mL)
18. Syringe module
19. Lytic reagent syringe (1 mL)
20. LV15
21. LV14
22. Rinse (cleaner) optical sensor
23. Vacuum transducer

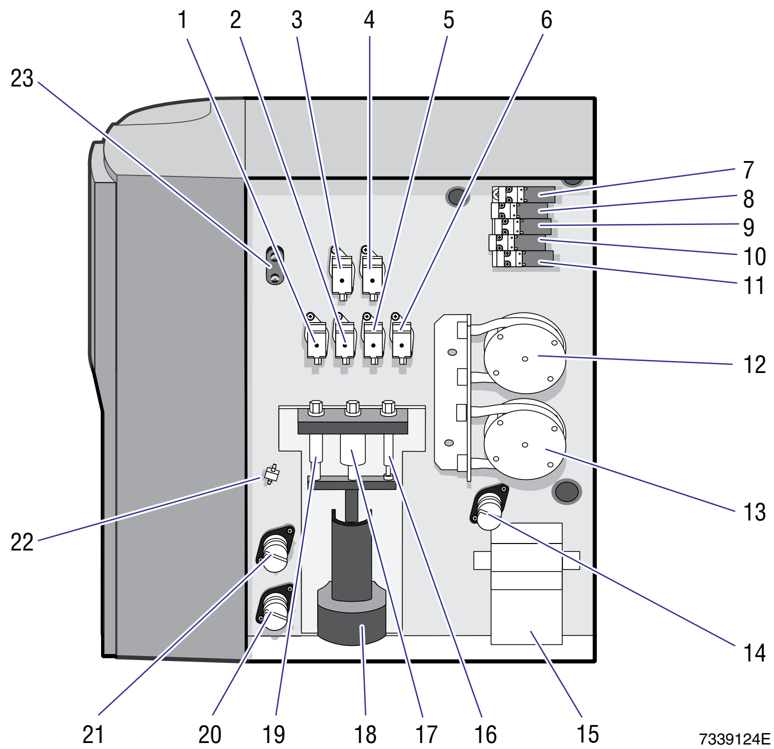


Table A.4-3 Components Inside the Right Compartment of an A[C]•T 8/10 or A[C]•T diff Analyzer

Figure Reference	Component	Function	Reference Designator DCN 6323083
A.4-2, 1	LV9	Angar three-way solenoid valve used to control lytic reagent usage. *De-energized* - provides a bidirectional pathway between the lytic reagent source and the 1-mL lytic reagent syringe. *Energized* - provides a pathway between the 1-mL lyse syringe and the left-side port of the WBC bath.	LV9
A.4-2, 2	LV10	Angar three-way solenoid valve used to control diluent movement. *De-energized* - provides a pathway from the diluent source to the reservoir for diluent being pumped by peristaltic pump PM2. *Energized* - provides a pathway from the diluent source to the top port of the probe-wipe housing for diluent being pumped by peristaltic pump PM2.	LV10
A.4-2, 3	LV7	Angar three-way solenoid valve used to route diluent dispensed by the sample syringe via LV11 to the lower-side ports of the baths. *De-energized* - routes diluent to the right-side port of the WBC bath to prefill the bath. *Energized* - routes diluent through a Y-connector (FY8) to both the left- and right-side ports of the RBC bath to prefill the bath.	LV7
A.4-2, 4	LV8	Angar two-way solenoid valve used to connect the vacuum chamber (VC1) to the bottom port of the probe-wipe housing. *De-energized* - the pathway from the bottom port of the probe-wipe housing to VC1 is closed. *Energized* - the pathway from the bottom port of the probe-wipe housing to the VC1 is open to allow high vacuum to either pull diluent through the housing to clean the outside of the probe or function as a source of air for drying the outside of the probe.	LV8
A.4-2, 5	LV11	Angar three-way solenoid valve used to control diluent output from the sample syringe. *De-energized* - top of the probe is connected to the sample syringe for aspiration or diluent dispense. *Energized* - routes diluent from the sample syringe to LV7 for bath prefill.	LV11
A.4-2, 6	LV12	Angar three-way solenoid valve used to control the routing of diluent. *De-energized* - provides a bidirectional pathway between the diluent reservoir and the 5-mL diluent syringe. *Energized* - provides a unidirectional pathway from the 5-mL diluent syringe to the 250-µL sample syringe and LV11.	LV12

Table A.4-3 Components Inside the Right Compartment of an AC•T 8/10 or AC•T diff Analyzer *(Continued)*

Figure Reference	Component	Function	Reference Designator DCN 6323083
A.4-2, 7	LV1	Two-way solenoid valve used to control venting of the vacuum chamber (VC1). *De-energized* - atmospheric vent closed. *Energized* - vents the top of VC1 to atmosphere when the chamber is draining or during a high vacuum/low vacuum transition.	LV1
A.4-2, 8	LV2	Three-way solenoid valve used to control the vacuum level going through port 1 to the vacuum chamber (VC1). *De-energized* - low vacuum (6-in. Hg) is available at LV2, port 1. *Energized* - high vacuum is available at LV2, port 1.	LV2
A.4-2, 9	LV3	Three-way solenoid valve used to switch the mixing bubbles between the bottom port of the RBC and WBC baths. *De-energized* - supplies mixing bubbles to the RBC bath. *Energized* - supplies mixing bubbles to the WBC bath.	LV3
A.4-2, 10	LV4	Three-way solenoid valve used to switch pressure between the WBC bath and LV3. *De-energized* - pressure is routed to LV3. *Energized* - pressure is routed to the WBC bath lytic reagent port (left-side port).	LV4
A.4-2, 11	LV5	Three-way solenoid valve used to switch the pressure from the pneumatic pump between atmosphere and LV4. *De-energized* - pressure from the pneumatic pump is vented to atmosphere (necessary for proper operation of a single-head pump when vacuum is being used in the system). *Energized* - pressure from pneumatic pump routed to LV4 for creating mixing bubbles.	LV5
A.4-2, 12	Waste/rinse pump	This peristaltic pump functions as either a waste pump or a rinse pump, depending on its rotation. • As a waste pump, PM1 rotates clockwise and drains the WBC bath, the RBC bath, and the vacuum chamber (VC1). • As a rinse pump, PM1 rotates counterclockwise and pumps AC•T Rinse shutdown diluent (cleaner) into the system filling both baths through their respective waste ports.	PM1
A.4-2, 13	Diluent pump	Peristaltic pump used to pull diluent from the diluent container into the diluent reservoir.	PM2

Table A.4-3 Components Inside the Right Compartment of an A^{C}•T 8/10 or A^{C}•T diff Analyzer *(Continued)*

Figure Reference	Component	Function	Reference Designator DCN 6323083
A.4-2, 14	LV13	Small Bio-Chem solenoid pinch valve directs the flow of liquid being moved by peristaltic pump PM1. *De-energized* - peristaltic pump PM1 is connected to the waste system for draining the WBC bath, the RBC bath, and the vacuum chamber (VC1). *Energized* - peristaltic pump PM1 is connected to the A^{C}•T Rinse shutdown diluent (cleaner) supply for input of cleaning agent during the Shutdown routine.	LV13
A.4-2, 15	Diluent reservoir	Distribution chamber for supplying diluent to the diluent syringe. Diluent flow between the reservoir and diluent syringe is bidirectional to allow diluent flow back into the reservoir when the Triple Syringe module is energized but diluent supplied by the diluent syringe is not required. Also supplies diluent through the sweep-flow line behind the RBC aperture.	RSD
A.4-2, 16	Aspiration syringe (250 µL)	Syringe is capable of aspirating different volumes depending on the mode of operation: • 12 µL of whole-blood is aspirated when using the Whole-Blood mode of operation. • 20 µL of whole-blood is aspirated when using the Predilute mode of operation. May also be referred to as the sample or aspirate syringe.	SAMPLE SRNG
A.4-2, 17	Diluent syringe (5 mL)	Syringe is capable of dispensing different volumes as required in the cycle for prefilling the baths and then providing the proper volume of diluent for making the final WBC and RBC dilutions. The diluent syringe also provides the diluent needed for rinsing the WBC and RBC baths.	DILUENT SRNG
A.4-2, 18	Syringe module	Module used to control fluidic movement. From right to left, consists of a 250-µL sample syringe, a 5-mL diluent syringe, and 1-mL lytic reagent syringe. One motor simultaneously drives all three volume syringes. May also be referred to as the Triple Syringe module.	
A.4-2, 19	Lytic reagent syringe (1 mL)	Delivers lytic reagent to the WBC bath to lyse RBCs and react with the hemoglobin. Syringe is capable of delivering different volumes of lytic reagent depending on the cycle: • Dispenses 415 µL during a Whole-Blood mode cycle. • Dispenses 313 µL during a Predilute mode cycle. • Dispenses 1 mL several times during the Lyse Prime cycle. May also be referred to as the lyse syringe.	LYSE SRNG

Table A.4-3 Components Inside the Right Compartment of an A^{C}•T 8/10 or A^{C}•T diff Analyzer *(Continued)*

Figure Reference	Component	Function	Reference Designator DCN 6323083
A.4-2, 20	LV15	Small Bio-Chem solenoid pinch valve used to route the flow of waste or shutdown reagent (cleaner). *De-energized* - connects peristaltic pump PM1 to LV14. Depending on the state of LV13, either drains the bath or fills the bath with shutdown diluent (cleaner) as specified by the de-energized or energized state of LV14. *Energized* - connects peristaltic pump PM1 to the bottom port of the vacuum chamber (VC1) for draining.	LV15
A.4-2, 21	LV14	Small Bio-Chem solenoid pinch valve used to control the flow of waste from the baths or the flow of shutdown diluent (cleaner) to the baths. *De-energized* - depending on the state of LV13 and LV15, connects either the waste system or the shutdown diluent (cleaner) system to the bottom port of the RBC bath. *Energized* - depending on the state of LV13 and LV15, connects either the waste system or the shutdown diluent (cleaner) system to the bottom port of the WBC bath.	LV14
A.4-2, 22	Rinse (cleaner) optical sensor	An inline fluid sensor placed in the tubing from the cleaning reagent source to ensure cleaning reagent is present.	FS3
A.4-2, 23	Vacuum transducer	Monitors the low vacuum supply in VC1, prior to energizing count solenoids VL16 and VL17, to verify the proper level of low vacuum (6-in. Hg) is available for collecting count data. May also be referred to as the vacuum sensor.	VAC XDCR

Components Inside the Left Compartment of an A^{C}•T 8/10 or A^{C}•T diff Analyzer

Figure A.4-3 View Inside the Left Compartment of an A^{C}•T 8/10 or A^{C}•T diff Analyzer

1. Connection for reagent pickup tube 1
2. Connection for reagent pickup tube 2
3. Connection for reagent pickup tube 3
4. Pneumatic pump

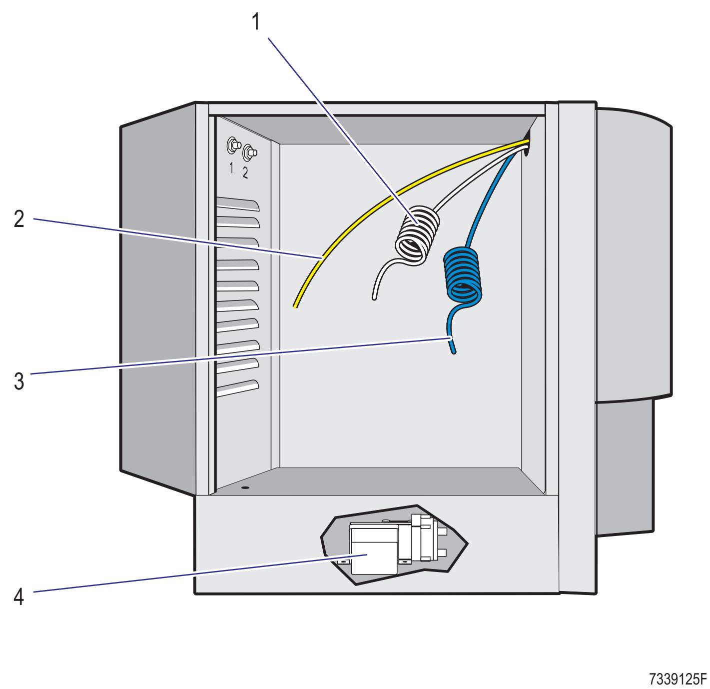


Table A.4-4 Components Inside the Left Compartment of an A^{C}•T 8/10 or A^{C}•T diff Analyzer

Figure Reference	Component	Function	Reference Designator DCN 6323083
A.4-3, 1	Connection for reagent pickup tube 1	Connects the diluent reagent supply to the analyzer. • Reagent 1 of the A^{C}•T Tainer or diff A^{C}•T Tainer reagents. • Reagent 1 of the A^{C}•T Pak reagents.	
A.4-3, 2	Connection for reagent pickup tube 2	Connects the lytic reagent supply to the analyzer. • Reagent 2 of the A^{C}•T Tainer or diff A^{C}•T Tainer reagents. • Reagent 2 of the A^{C}•T Pak reagents.	
A.4-3, 3	Connection for reagent pickup tube 3	Connects the cleaning agent supply to the analyzer. • Reagent 3 of the A^{C}•T Tainer or diff A^{C}•T Tainer reagents. • Use this connection for the A^{C}•T Rinse shutdown diluent supply.	

Table A.4-4 Components Inside the Left Compartment of an A^C•T 8/10 or A^C•T diff Analyzer *(Continued)*

Figure Reference	Component	Function	Reference Designator DCN 6323083
A.4-3, 4	Pneumatic pump	Located underneath the panel floor of the on-board reagent compartment. All three types of 24-Vdc pneumatic pumps currently in use, the Brailsford brushless-type vacuum pump, the ASF Thomas brush-type, diaphragm vacuum pump, and the KNF brushless-type, dual-head pump, provide the vacuum and pressure needed by the system. For details, see Pneumatic System under Heading 2.2, DILUTER SYSTEM - A^C•T 8/10 AND A^C•T diff™ ANALYZERS. **Note:** The ASF Thomas vacuum pump diaphragm and motor are a single assembly.	PM3

A.5 AC•T diff 2 COMPONENT LOCATIONS AND FUNCTIONS

Summary

Most Diluter 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.

Solenoids

Solenoids are electronic valves that are energized or de-energized to perform a function or to activate other components in the Diluter. Table A.5-1 identifies the function of each solenoid used in the AC•T diff 2 analyzer. Solenoids LV7, LV8, LV12, LV15, and LV18 are attached to and control the operation of large Bio-Chem valves. Use the Pneumatic/Hydraulic Schematic, DCN 6323266, in Chapter 6 or the figures referenced in Table A.5-1 to locate these solenoids.

Table A.5-1 Solenoid Functions - AC•T diff 2 Analyzers

Solenoid Number	Function	Figure Reference
LV1	Rinse pump motor	
LV2	High vacuum enable	A.5-3, 10
LV3	WBC air mix select	A.5-3, 9
LV4	Lytic reagent air mix select	A.5-3, 8
LV5	Air mix enable	A.5-3, 7
LV6	Waste pump motor	
LV7	Vacuum chamber drain enable	A.5-2, 16
LV8	Probe-wipe waste select	A.5-2, 18
LV9	Not connected - ghost LV5 **Note:** Solenoid LV9 is not connected in the system; however, LV9 is used as a software switch in the Closed-Vial, Open-Vial, Predilute, and Startup Diluter Tables. As altitude increases, more pump action is required to create mixing bubbles. LV9 informs the software to increase mix bubble pump time when the altitude setting requires it. LV5 still creates the mixing bubbles but is held open for a longer time.	
LV10	Probe-wipe diluent select	A.5-2, 5
LV11	WBC bath diluent select	A.5-2, 6
LV12	WBC bath drain select	A.5-2, 8
LV13	Diluent reservoir fill select	A.5-2, 4
LV14	Spare	
LV15	RBC bath drain select	A.5-2, 17
LV16	RBC count	A.5-1, 9
LV17	WBC count	A.5-1, 7
LV18	Cleaner select	A.5-2, 10
LV19	Diluent pump motor	

Table A.5-1 Solenoid Functions - A^{C}•T diff 2 Analyzers *(Continued)*

Solenoid Number	Function	Figure Reference
LV20	Rear panel fan motor	
LV21	Not used	
LV22	Spare	
LV23	Pneumatic pump motor	A.5-3, 13

Main Analyzer Components

The main Diluter components comprising the A^{C}•T diff 2 analyzers are identified and described in the following tables. Each table also includes the reference designator for the component, where applicable, and a figure reference for locating the component.

- Table A.5-2 describes the main components behind the front door. Use Figure A.5-1 to locate these components.
- Table A.5-3 describes the main components inside the right compartment. Use Figure A.5-2 to locate these components.
- Table A.5-4 describes the main components inside the pneumatic pump compartment. Use Figure A.5-3 to locate these components.
- Table A.5-5 describes the main components inside the left compartment. Use Figure A.5-4 to locate these components.

Components Located Behind the Front Door of an A^C•T diff 2 Analyzer

Figure A.5-1 View of an A^C•T diff 2 Analyzer with the Front Door Open

1. Software card slot
2. Cap-pierce door motor
3. Cap-Pierce module
4. Vacuum chamber
5. Hgb assembly
6. LV17
7. WBC bath
8. LV16
9. Sweep-flow spool
10. RBC bath
11. Aspirate switch
12. Probe
13. Probe-wipe housing
14. Traverse module

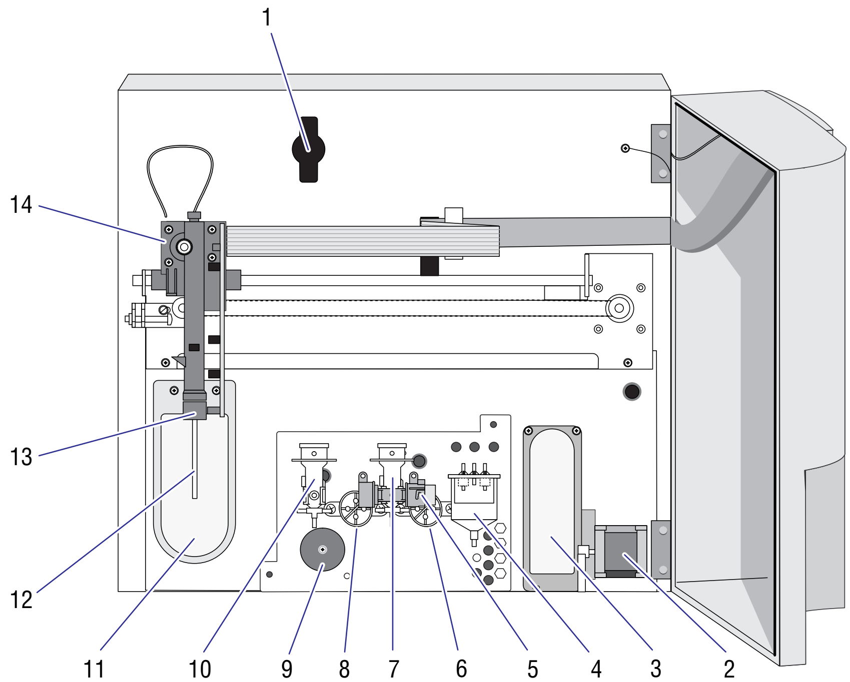


Table A.5-2 Components behind the Front Door of an A^C•T diff 2 Analyzer

Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-1, 1	Software card slot	Opening for inserting the metallic A^C•T diff 2 software card. This software card must be firmly seated into the track of the slot; otherwise, the card could fall inside the analyzer.	
A.5-1, 2	Cap-pierce door motor	Stepper motor opens the cap-pierce door when aspiration in the closed-vial mode is complete.	
A.5-1, 3	Cap-Pierce module	Module that provides the capability for closed-vial sampling. Accepts one specimen tube at a time in a spring-loaded holder that is capable of clamping a variety of tubes with different diameters. Tubes too small for this holder can be accommodated using an adapter. Figure 2.3-3 illustrates the main components.	

Table A.5-2 Components behind the Front Door of an A^{C}•T diff 2 Analyzer *(Continued)*

Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-1, 4	Vacuum chamber	Distributes low vacuum (6-in. Hg) to pull dilution through the aperture in both baths and sweep-flow diluent through the sweep-flow line behind the RBC aperture. Also provides the high vacuum needed for scavenging the sweep-flow line behind the RBC bath, and for cleansing and drying the probe inside the probe-wipe housing. Also acts as a holding chamber for the waste that accumulates during these count, scavenge, and cleaning functions. May also be referred to as a vacuum isolator chamber.	VC1 or VAC ISLR CHMBR
A.5-1, 5	Hgb assembly	Hgb lamp and preamp provide the hemoglobin blank and sample readings needed to calculate the Hgb result.	
A.5-1, 6	LV17	Two-way solenoid valve used to apply the low vacuum (6-in. Hg) in the vacuum chamber (VC1) to the WBC aperture for accumulating count and size data. *De-energized* - the pathway from VC1 to the WBC aperture is closed. *Energized* - the pathway from VC1 to the WBC aperture is open. As low vacuum is applied to the WBC aperture, dilution is pulled from the WBC bath through the WBC aperture via LV17 and enters the VC1 as a stream of droplets.	LV17
A.5-1, 7	WBC bath	Holds the WBC dilution for mixing and for collecting WBC and Hgb data, including differential data. May also be referred to as the WBC aperture/bath assembly.	WBC
A.5-1, 8	LV16	Two-way solenoid valve used to apply the low vacuum (6-in. Hg) in the vacuum chamber (VC1) to the RBC aperture for accumulating count and size data. *De-energized* - the pathway from VC1 to the RBC aperture is closed. *Energized* - the pathway from VC1 to the RBC aperture is open. As low vacuum is applied to the RBC aperture, dilution is pulled from the RBC bath through the RBC aperture via LV16 and enters the VC1 as a stream of droplets. Vacuum applied to the RBC aperture is simultaneously applied to the sweep-flow system.	LV16
A.5-1, 9	Sweep-flow spool	Tubing wound around a spool that acts as a choke to regulate diluent delivery through the sweep-flow line behind the RBC aperture.	CK2
A.5-1, 10	RBC bath	Holds the RBC dilution for mixing and for collecting RBC and Plt data. May also be referred to as the RBC aperture/bath assembly.	RBC
A.5-1, 11	Aspirate switch	When pressed by the operator, initiates a cycle in the either the Open-Vial Whole-Blood mode or Predilute mode, determined by the selection made at the Main Screen.	

Table A.5-2 Components behind the Front Door of an A^{C}•T diff 2 Analyzer *(Continued)*

Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-1, 12	Probe	Input pathway for sample aspiration in the Whole-Blood and Predilute modes. Also the input pathway for aspirating a portion of the WBC dilution from the WBC bath for transfer to the RBC bath. May also be referred to as the aspirate probe.	ASP PROBE
A.5-1, 13	Probe-wipe housing	Housing has an internal spiral configuration that allows diluent entering the top port to clean the outside of the probe as the diluent spirals downward and exits through the bottom port to the vacuum chamber (VC1). May also be referred to as the probe-wipe block.	
A.5-1, 14	Traverse module	Encases and protects the probe. Controls horizontal and vertical positioning of the probe using two stepper motors and a series of optical sensors. Also cleanses the probe after aspiration. Figure 2.3-1 illustrates the main components.	

Components Inside the Right Compartment of an A^{C}•T diff 2 Analyzer

Figure A.5-2 View Inside the Right Compartment of an A^{C}•T diff 2 Analyzer

1. Sample pump (50 µL)
2. Diluent pump (100 µL)
3. Lyse pump (100 µL)
4. LV13
5. LV10
6. LV11
7. Vacuum sensor
8. LV12
9. Vacuum adjust knob
10. LV18
11. Vacuum pump compartment
12. Diluent reservoir
13. Diluent pump (reservoir fill)
14. Waste pump
15. Foam trap
16. Rinse pump
17. LV7
18. LV15
19. LV8

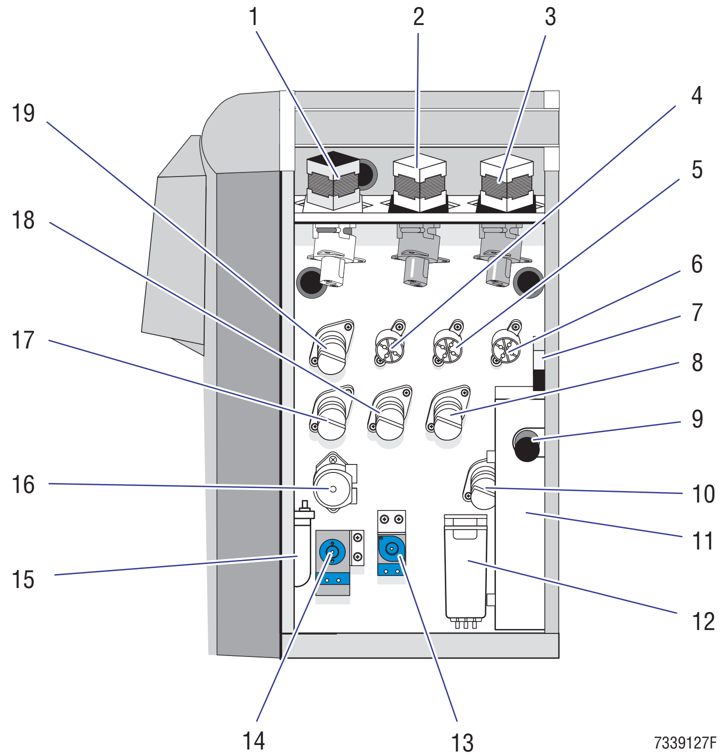


Table A.5-3 Components Inside the Right Compartment of an A^{C}•T diff 2 Analyzer

Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-2, 1	Sample pump (50 µL)	FMI pump is capable of aspirating different volumes depending on the mode of operation: • 18 µL of whole-blood is aspirated when using the Whole-Blood mode of operation. • 50 µL of whole-blood is aspirated when using the Predilute mode of operation. • Used to deliver diluent as well as sample through the probe. May also be referred to as the aspirate pump.	SAMPLE (and pump symbol)
A.5-2, 2	Diluent pump (100 µL)	FMI pump dispenses different volumes of diluent as required in the cycle for prefilling the baths and then providing the proper volume of diluent for making the final WBC and RBC dilutions. This pump also provides the diluent needed for rinsing the WBC and RBC baths and for washing the outside of the probe.	DILUENT (and pump symbol)

Table A.5-3 Components Inside the Right Compartment of an A^{C}•T diff 2 Analyzer *(Continued)*

Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-2, 3	Lyse pump (100 µL)	FMI pump dispenses lytic reagent. Both volume and flow rate are controlled by software, eliminating variables that require lyse/diluent timing adjustments.	LYSE (and pump symbol)
A.5-2, 4	LV13	Two-way solenoid valve used to open or close the reagent pathway between the diluent supply and the reservoir fill pump. *De-energized* - the pathway between the diluent supply and the reservoir fill pump is closed. *Energized* - the pathway between the diluent supply and the reservoir fill pump is open so that when the reservoir fill pump is turned on, diluent is pumped from the supply container into the diluent reservoir.	LV13
A.5-2, 5	LV10	Three-way solenoid valve used to control diluent movement. *De-energized* - routes diluent from the diluent reservoir to LV11 when the FMI diluent pump is turned on. *Energized* - routes diluent from the diluent reservoir to the top port of the probe-wipe housing when the FMI diluent pump is turned on.	LV10
A.5-2, 6	LV11	Three-way solenoid valve used to control diluent movement. *De-energized* - routes diluent from LV10 to the upper left and the two lower side ports of the RBC bath when the FMI diluent pump is turned on. *Energized* - routes diluent from LV10 to the upper and lower right side ports of the WBC bath when the FMI diluent pump is turned on.	LV11
A.5-2, 7	Vacuum sensor	Monitors the low vacuum supply in VC1 prior to energizing count solenoids VL16 and VL17 to verify the proper level of low vacuum (6-in. Hg) is available for collecting count data. May also be referred to as the vacuum transducer.	VAC XDCR
A.5-2, 8	LV12	Large Bio-Chem two-way solenoid pinch valve used to control the flow of waste from the WBC bath or the flow of shutdown diluent (cleaner) to the WBC bath. *De-energized* - closes the pathway between the bottom port of the WBC bath and LV18. *Energized* - depending on the state of LV18, connects either the waste system or the shutdown diluent (cleaner) system to the bottom port of the WBC bath.	LV12
A.5-2, 9	Vacuum adjust knob	Knob used to the adjust the vacuum regulator (RG1) which regulates the low (6-inches Hg) vacuum used to pull the dilution through the WBC and RBC aperture and sweep-flow diluent behind the RBC aperture.	VAC RGL TR

Table A.5-3 Components Inside the Right Compartment of an AC•T diff 2 Analyzer *(Continued)*

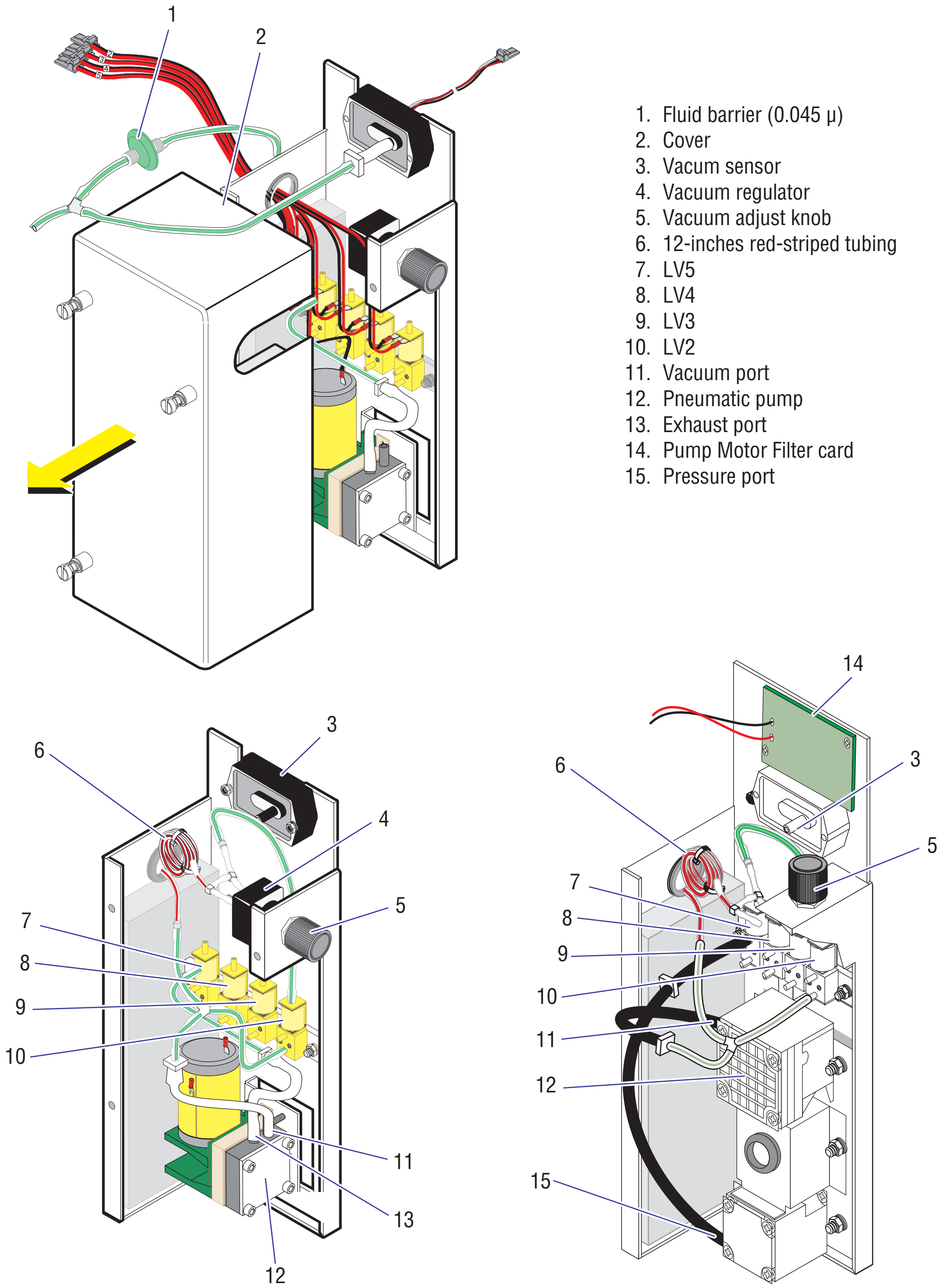
Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-2, 10	LV18	Large Bio-Chem three-way solenoid pinch valve directs the flow of liquid being moved by the waste/rinse pump. *De-energized* - the pump is connected to the waste system for draining the WBC bath, the RBC bath, and the vacuum chamber (VC1). *Energized* - the pump is connected to the AC•T Rinse shutdown diluent (cleaner) supply for input of cleaning agent during the Shutdown routine.	LV18
A.5-2, 11	Pneumatic pump compartment	With the exception of the vacuum sensor, this compartment contains the main components associated with the development of high vacuum and its regulation to low vacuum.	
A.5-2, 12	Diluent reservoir	Distribution chamber for supplying diluent to the sample and diluent FMI pumps. Also supplies diluent through the sweep-flow line behind the RBC aperture.	RSD
A.5-2, 13	Diluent pump (reservoir fill)	24-Vdc brush type motor driven diaphragm liquid pump used to fill the diluent reservoir from the diluent supply when LV13 is energized.	RESERVOIR FILL (and pump symbol)
A.5-2, 14	Waste pump	This dc motor-driven diaphragm pump drains the WBC bath, the RBC bath, and the vacuum chamber (VC1) when the respective solenoid (LV12 for the WBC bath, LV15 for the RBC bath, or LV7 for VC1) is energized.	WASTE (and pump symbol)
A.5-2, 15	Foam trap	Collects foam overflow from the vacuum isolator chamber, preventing it from entering the vacuum system.	VC2
A.5-2, 16	Rinse pump	When LV18 is energized and the rinse pump is turned on, this dc motor-driven peristaltic pump moves AC•T Rinse shutdown diluent (cleaner) into the WBC bath, the RBC bath, and the vacuum chamber (VC1) through the component's waste port when the respective solenoid (LV12 for the WBC bath, LV15 for the RBC bath, or LV7 for VC1) is energized.	CLENZ* (and pump symbol) *COULTER CLENZ® cleaning agent
A.5-2, 17	LV7	Large Bio-Chem two-way solenoid pinch valve used to control the flow of waste from the vacuum chamber (VC1) or the flow of shutdown diluent (cleaner) to VC1. *De-energized* - closes the pathway between the bottom port of VC1 and LV18. *Energized* - depending on the state of LV18, connects either the waste system or the shutdown diluent (cleaner) system to the bottom port of VC1.	LV7

Table A.5-3 Components Inside the Right Compartment of an AC•T diff 2 Analyzer *(Continued)*

Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-2, 18	LV15	Large Bio-Chem two-way solenoid pinch valve used to control the flow of waste from the RBC bath or the flow of shutdown diluent (cleaner) to the RBC bath. *De-energized* - closes the pathway between the bottom port of the RBC bath and LV18. *Energized* - depending on the state of LV18, connects either the waste system or the shutdown diluent (cleaner) system to the bottom port of the RBC bath.	LV15
A.5-2, 19	LV8	Large Bio-Chem two-way solenoid pinch valve used to connect the vacuum chamber (VC1) to the bottom port of the probe-wipe housing. *De-energized* - the pathway from the bottom port of the probe-wipe housing to VC1 is closed. *Energized* - the pathway from the bottom port of the probe-wipe housing to the VC1 is open to allow high vacuum to either pull diluent through the housing to clean the outside of the probe or function as a source of air for drying the outside of the probe. Also used to vent the top of VC1 to atmosphere when the chamber is draining or during a high vacuum/low vacuum transition.	LV8

Components Inside the Pneumatic Compartment of an A^{C}•T diff 2 Analyzer

Figure A.5-3 View Inside the Pneumatic Pump Compartment of an A^{C}•T diff 2 Analyzer



1. Fluid barrier (0.045 µ)
2. Cover
3. Vacum sensor
4. Vacuum regulator
5. Vacuum adjust knob
6. 12-inches red-striped tubing
7. LV5
8. LV4
9. LV3
10. LV2
11. Vacuum port
12. Pneumatic pump
13. Exhaust port
14. Pump Motor Filter card
15. Pressure port

7339129F

ASF Thomas Pump **KNF Dual-Head Pump**

Table A.5-4 Components Inside the Pneumatic Pump Compartment of an A^{C}•T diff 2 Analyzer

Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-3, 1	Fluid barrier	0.045-µ filter barrier, placed between the vacuum chamber (VC1) and LV2, protects the vacuum components from fluid exposure.	FB1
A.5-3, 2	Cover	With the exception of the vacuum sensor, encases the main components associated with the development of high vacuum and its regulation to low vacuum in one compartment.	
A.5-3, 3	Vacuum sensor	Monitors the low vacuum supply in VC1 prior to energizing count solenoids VL16 and VL17 to verify the proper level of low vacuum (6-in. Hg) is available for collecting count data. May also be referred to as the vacuum transducer.	VAC XDCR
A.5-3, 4	Vacuum regulator	Solid state regulator adjusts the high vacuum supplied at port 2 to low vacuum (6-in. Hg) which is applied through port 1 to the vacuum chamber (VC1) via LV2, port 2. During the sensing portion of the cycle, the pathway from VC1 to the WBC aperture and the pathway from VC1 to the RBC aperture is opened and the low vacuum in VC1 is applied to the back of each aperture and to the sweep-flow line behind the RBC aperture.	RG1
A.5-3, 5	Vacuum adjust knob	Knob used to adjust the vacuum regulator (RG1) which regulates the low (6-inches Hg) vacuum used to pull the dilution through the WBC and RBC aperture and sweep-flow diluent behind the RBC aperture.	VAC RGL TR
A.5-3, 6	12-inches red-striped tubing	0.082 polyurethane tubing. Length of tubing combined with its small internal diameter allows this tubing to act as a choke to control the flow of high vacuum supplied to the vacuum regulator for regulation to 6-in. Hg. Also acts as a buffer during high vacuum/low vacuum transitions.	
A.5-3, 7	LV5	Three-way solenoid valve used to switch the pressure from the pneumatic pump between atmosphere and LV4. *De-energized* - pressure from the pneumatic pump is vented to atmosphere (necessary for proper operation of a single-head pump when vacuum is being used in the system). *Energized* - pressure from vacuum pump routed to LV4 for creating mixing bubbles.	LV5
A.5-3, 8	LV4	Three-way solenoid valve used to switch pressure between the WBC bath and LV3. *De-energized* - pressure is routed to LV3. *Energized* - pressure is routed to the WBC bath lytic reagent port (left-side port).	LV4

Table A.5-4 Components Inside the Pneumatic Pump Compartment of an A^{C}•T diff 2 Analyzer

Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-3, 9	LV3	Three-way solenoid valve used to switch the mixing bubbles between the bottom port of the RBC and WBC baths. *De-energized* - supplies mixing bubbles to the RBC bath. *Energized* - supplies mixing bubbles to the WBC bath.	LV3
A.5-3, 10	LV2	Three-way solenoid valve used to control the vacuum level going through port 1 to the vacuum chamber (VC1). *De-energized* - low vacuum (6-in. Hg) is available at LV2, port 1. *Energized* - high vacuum is available at LV2, port 1.	LV2
A.5-3, 11	Vacuum port	Supplies high vacuum to LV2, port 3. May be referred to as raw vacuum.	
A.5-3, 12	Pneumatic pump	Both types of 24-Vdc pneumatic pumps currently in use, the ASF Thomas brush-type, diaphragm vacuum pump and the KNF brushless-type, dual-head pump, provide the vacuum and pressure needed by the system. For details, see Pneumatic System under Heading 2.3, DILUTER SYSTEM - A^{C}•T diff 2™ ANALYZERS. LV23 supplies power to turn on the pneumatic pump motor. **Note:** The ASF Thomas vacuum pump diaphragm and motor are a single assembly.	VACUUM (and pump symbol)
A.5-3, 13	Exhaust port	Supplies pressure from the vacuum pump to LV5.	
A.5-3, 14	Pump Motor Filter card	???	
A.5-3, 15	Pressure port	Supplies pressure from the dual-head pump to LV5	

Components Inside the Left Compartment of an AC•T diff 2 Analyzer

Figure A.5-4 View Inside the Left Compartment of an AC•T diff 2 Analyzer

1. Connection for reagent pickup tube 1
2. Connection for reagent pickup tube 2
3. Connection for reagent pickup tube 3

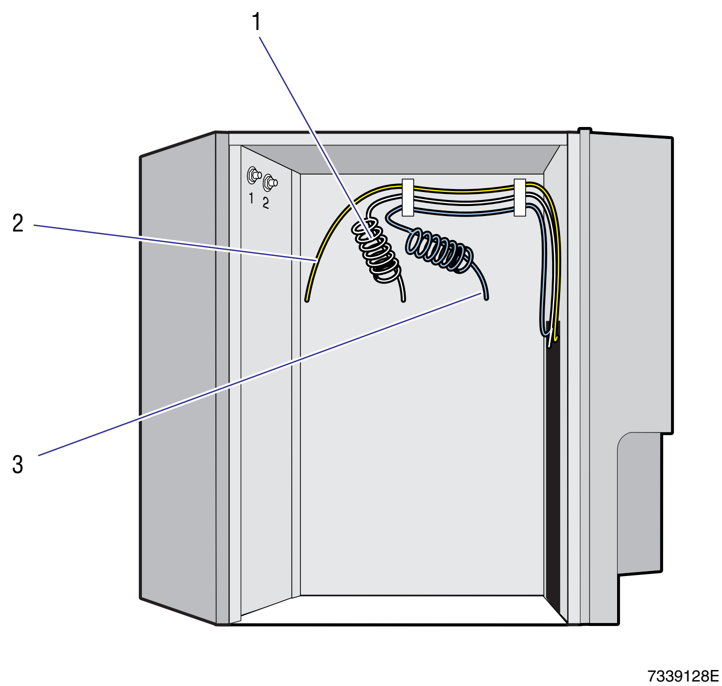


Table A.5-5 Components Inside the Left Compartment of an AC•T diff 2 Analyzer

Figure Reference	Component	Function	Reference Designator DCN 6323266
A.5-4, 1	Connection for reagent pickup tube 1	Connects the diluent reagent supply to the analyzer. • Reagent 1 of the AC•T Tainer or diff AC•T Tainer reagents. • Reagent 1 of the AC•T Pak reagents.	
A.5-4, 2	Connection for reagent pickup tube 2	Connects the lytic reagent supply to the analyzer. • Reagent 2 of the AC•T Tainer or diff AC•T Tainer reagents. • Reagent 2 of the AC•T Pak reagents.	
A.5-4, 3	Connection for reagent pickup tube 3	Connects the cleaning agent supply to the analyzer. • Reagent 3 of the AC•T Tainer or diff AC•T Tainer reagents. • Use this connection for the AC•T Rinse shutdown diluent supply.	

B.1 WARNING AND FATAL ERROR MESSAGE TABLES

Table B.1-1 Warning (Non-Fatal) Error Messages (Icons)

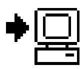
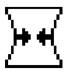
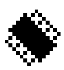
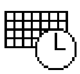
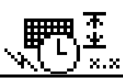
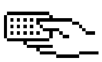
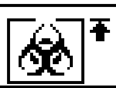
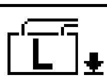
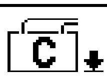
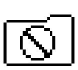
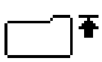
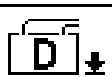
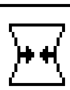
Error Message Icons	Description
	Check printer
	Transmission incomplete
	Vacuum out of range during count
	Hgb voltage failure - Hgb Blank or Sample reading outside range 2048 to 4095 A/D units
	Channelizing buffer overflow error - usually indicates an overflow in one of the Plt channels
	Timekeeper failure
	CMOS PD (persistent data) failure
	Check Reagent Management card
	Waste full
	Diluent empty
	Lytic reagent empty
	AC•T Rinse shutdown diluent empty
	Patient storage data corrupt, AC•T diff and AC•T diff 2 analyzers
	Control expired, AC•T diff and AC•T diff 2 analyzers
	Control file full, AC•T diff and AC•T diff 2 analyzers

Table B.1-2 Fatal Error Messages (Numbers)

Error No./Icon	Instrument	Description
1	All	PCMCIA. For details, see PCMCIA Error 1.
3	All	DVM. For details, see DVM Error 3.
4	All	Unexpected software condition.
6	All	Probe did not reach up position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.

Table B.1-2 Fatal Error Messages (Numbers) ***(Continued)***

Error No./Icon	Instrument	Description
7	All	Probe did not reach down position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
8	All	Measured thief position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
9	AC•T 8/10 and AC•T diff analyzers	Probe did not reach aspirate position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
	AC•T diff 2 analyzer	Probe did not reach closed-vial position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
10	All	Probe did not reach WBC position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
11	All	Probe did not reach RBC position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
12	AC•T 8/10 and AC•T diff analyzers	Syringe did not reach up position. For details, see Syringe Did Not Reach/Leave Up Position Errors 12 and 13, AC•T 8/10 and AC•T diff Analyzers.
	AC•T diff 2 analyzer	Diluent pump did not see home sensor. For details, see Diluent, Sample, and Lyse Pump Not Home Errors 12, 20, and 21, AC•T diff 2 Analyzer.
13	AC•T 8/10 and AC•T diff analyzers	Syringe did not leave up position. For details, see Syringe Did Not Reach/Leave Up Position Errors 12 and 13, AC•T 8/10 and AC•T diff Analyzers.
14	AC•T 8 analyzers, Software Version 1.03	Valve error. For details, see Valve Error 14.
16	All	I²C communication failure. For details, see I2C Communication Failure Error 16.
17	AC•T 8/10 and AC•T diff analyzers	Steps missing (syringe motor). For details, see Steps Missing (Syringe Motor) Error 17, AC•T 8/10 and AC•T diff Analyzers.
19	AC•T diff 2 analyzer	Probe did not reach open-vial position. For details, see Probe Did Not Reach Position Errors 6 through 11 and 19.
20	AC•T diff 2 analyzer	Sample pump did not see home sensor. For details, see Diluent, Sample, and Lyse Pump Not Home Errors 12, 20, and 21, AC•T diff 2 Analyzer.
21	AC•T diff 2 analyzer	Lyse pump did not see home sensor. For details, see Diluent, Sample, and Lyse Pump Not Home Errors 12, 20, and 21, AC•T diff 2 Analyzer.
	AC•T 8/10 and AC•T diff analyzers	Diluent level error during Powerup table execution. For details see Diluent Level Error During Powerup.
	All	Vacuum <6 in. Hg before probe wipe. For details. see Vacuum Error.

C.1 EPSON TM-290P SLIP PRINTER

Specifications

Table C.1-1 Epson TM-290P Slip Printer - Specifications

Item	Specification
Print method	Impact dot matrix
	Shuttle-type, 7-pin head
	Unidirectional printing
	Use 0.63 mm column spacing
	Use 4.23 mm (1/6 in.) line spacing
Ribbon	Exclusive ribbon cassette
	Type ERC-27
	Purple ink
	Life expectancy about 1,500,000 characters
Paper	Types: • Normal (high quality) • Pressure sensitive.
	Carbon copy
	Total thickness: • Single-ply paper (no copy) - 0.09 to 0.25 mm (135 kg paper) • Copy paper - 0.09 to 0.35 mm.
	Maximum copies - 1 original and 2 copies
Interface	Uses parallel interface (Centronics compatible)

Operator Controls and Indicators

See Figure C.1-1 for the location of the controls and indicators and Table C.1-2 for their function.

Figure C.1-1 Epson TM-290P Slip Printer - Location of Controls and Indicators

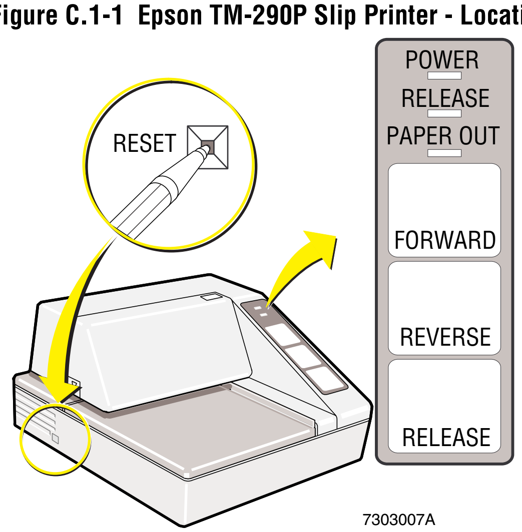


Table C.1-2 Epson TM-290P Slip Printer - Function of Controls and Indicators

Control/Indicator	Function
RESET button	Starts Printer as if power was just turned on
POWER LED (green indicator)	Lights when power is on
RELEASE LED (green indicator)	Lights when Printer is in release state
	Blinks when Printer is in error state
PAPER OUT LED (red indicator)	Lights when paper is out
FORWARD key	Feeds paper forward
REVERSE key	Feeds paper backward
RELEASE key	Releases paper

DIP Switch SW1 Settings

See Table C.1-3 for the DIP switch settings and Table C.1-4 for the DIP switch settings for international character sets.

Table C.1-3 Epson TM-290P Slip Printer - DIP Switch Settings for SW1

Positions/Settings									
1 **OFF**	**2** **ON**	**3** **ON**	**4** **ON**	**5** **OFF**	**6** **OFF**	**7** **OFF**	**8** **OFF**	**9** **OFF**	**10** **OFF**
ON = Autofeed	Used only for International Character Sets (Table C.1-4).			Not Used					

Table C.1-4 Epson TM-290P Slip Printer - International Character Sets - DIP Switch Settings for SW1-2 through SW1-4

Country	Positions/Settings		
	SW1-2	**SW1-3**	**SW1-4**
U.S.A.	ON	ON	ON
France	OFF	ON	ON
Germany	ON	OFF	ON
U.K.	OFF	OFF	ON
Denmark	ON	ON	OFF
Sweden	OFF	ON	OFF
Italy	ON	OFF	OFF
Spain	OFF	OFF	OFF

C.2 CANON BJC-250 BUBBLE JET PRINTER

Specifications

Table C.2-1 Canon BJC-250 Bubble Jet Printer - Specifications

Item	Specification
Print method	Bubble jet ink
Ribbon	BC-02 black cartridge: • Life - 500 pages (5% coverage) • Throughput - 3.1 ppm (standard), 4 ppm (draft)
Paper	Weight (auto feeder) - 64 to 105 g/m^2 (17 to 28 lb)
	Sheet feed capacity (auto feeder): • 0.4 in. • 100 sheets • 75g/m^2 (20 lb) paper.
Interface	IEEE 1284 with parallel Centronics connector
Noise Level	Approximately 43 dB (per ISO 9296)
Operating Temperature	32°F to 95°F (0°C to 35°C)
Power Consumption	20 W (5 W in idle mode)

Operator Controls and Indicators

Figure C.2-1 Canon BJC-250 Bubble Jet Printer - Power/Resume Controls and Indicators

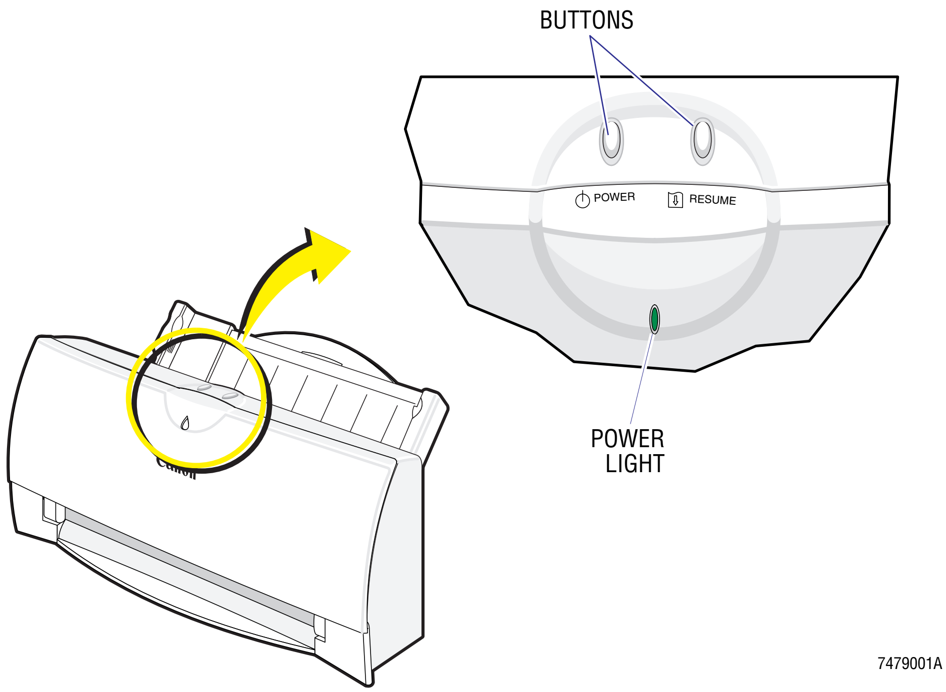


Figure C.2-2 Canon BJC-250 Bubble Jet Printer - Cartridge Lock and Paper Thickness Levers

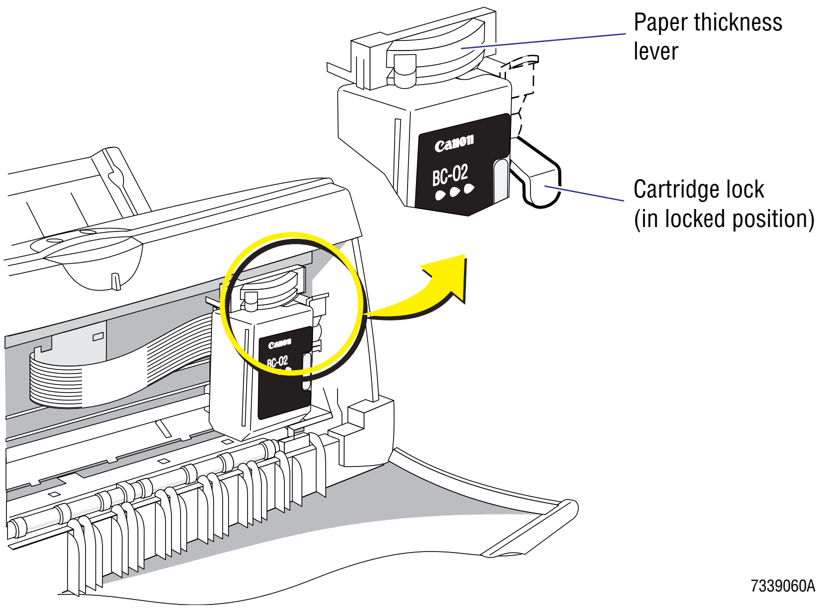


Table C.2-2 Canon BJC-250 Bubble Jet Printer - Function/Status of Controls and Indicators

Control/Indicator	Condition	Function/Status
POWER button	Pressed briefly	Press to turn power on/off
	Pressed until 1 beep heard	Press to print demonstration
	Pressed until 2 beeps heard	Press for Printer status/Printer settings
	Pressed until 3 beeps heard	Press to perform Printer Test (A)
	Pressed until 4 beeps heard	Press to perform Print Head Nozzle Test
RESUME button	Pressed briefly	Press for form feed
	Pressed for 2 seconds or more	Press for head cleaning
POWER LED	Off	Unlit when Printer off
	Yellow	Lights when system initializing
	Green	Lights when power ON
	Flashing green	Flashes when Printer busy/cartridge not present
	Orange	Lights when paper out/Printer offline
Cartridge lock lever	Up	Allows removal/replacement of cartridge
	Down	Locks cartridge in position
Paper thickness lever	Left	For thin paper
	Right	For thick paper

C.3 OKIPAGE 14e LED PRINTER

Specifications

Table C.3-1 OKIPAGE14e LED Printer - Specifications

Item	Specification
Performance	14 ppm, < 8 seconds to first page 600 dpi output quality
Technology	Digital LED print head Epson "FX 9-pin dot matrix compatible
Paper handling	
Paper input	250 sheet letter tray Manual feed
Paper output	200 sheets face down 50 sheets face up (straight through paper path)
Paper quality (recommended)	Tray: 16 to 28 lb Recycled paper must be specified or guaranteed for use with laser printers.
Size (W x D x H)	33.0 cm (13 in.) x 39.6 cm (15.6 in.) x 20.0 cm (7.9 in.)

Configuring the Printer

ATTENTION: Only reconfigure this Printer if the Menu printout indicates the Printer is not configured correctly.

1. Connect the OKIPAGE 14e LED Printer to the parallel printer port of a stand-alone computer equipped with a CD-ROM reader.
2. Insert the OKIPAGE 14e Installation software (CD) provided with the Printer into the computer's CD drive and run the installation program.

   Note: Installing the software in the computer only takes a few minutes and is necessary to configure the Printer. You can uninstall it when you are finished.
3. Follow the screen instructions to install the program.
4. Access the OKIPAGE 14e Status Monitor and using the various menu tabs, modify the settings identified in the Menu printout.
5. Select **Printer Menu ▸▸ Test Printer ▸▸ Menu Print.**
6. Compare the printout to the settings in the User column in Table C.3-3 to determine if the Printer is configured correctly.

Table C.3-2 Approved Menu Settings Printed Using the Front Panel

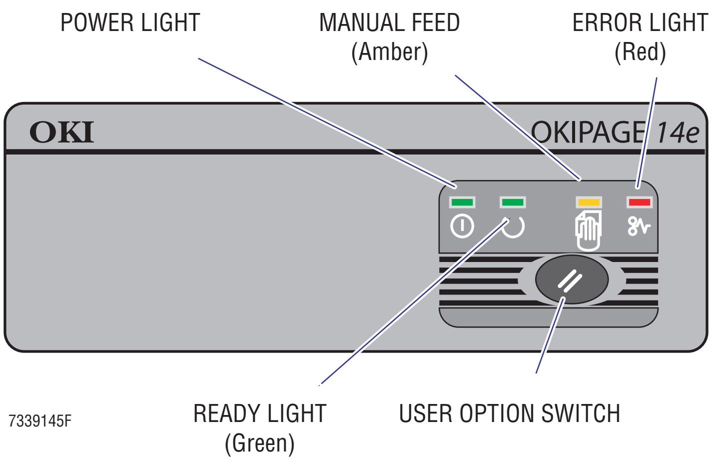
Level 1	Category	Item	Factory	*User*
Common	Personality	Emulation	Auto	*Epson FX*
	Tray Select	Manual Feed	OFF	*OFF*
		Paper Feed	Tray 1	*Tray 1*
	Edit Size	Edit Size	Cassette Size	*Cassette Size*
	Paper Size	Tray1	Letter	*Letter*
		Manual	Letter	*Letter*
	Media Type	Tray 1	Medium	*Medium*
		Manual	Medium	*Medium*
	Paper Size Check	Paper Size Check	Enable	*Enable*
	Copies	Copies	1	*1*
	Euro Sign	Euro Sign	Disable	*Disable*
HP Laser Jet 6P Emulation	Fonts and Symbols	Font Source	Resident	*Resident*
		Font No.	I000	*I000*
		Font Pitch	10.00 CPI	*10.00 CPI*
		Symbol Set	PC-8	*PC-8*
	Page Layout 1	A4 Print Width	78 Column	*78 Column*
		White Page Skip	OFF	*OFF*
		CR Function	CR	*CR*
		LF Function	LF	*LF*
Common	Page Layout 2	Orientation	Portrait	*Portrait*
		Lines per Page	60 Lines	*60 Lines*
	Host Interface	Parallel	Enable	*Enable*
		RS232C	Enable	*Enable*
		USB	Enable	*Enable*
Level – 2	Print Mode	Resolution	600 dpi	*300 dpi*
	Memory Usage	Font Protection	Auto	*Auto (0 KB)*
	Auto Operation	Auto Continue	OFF	*OFF*
		Wait Timeout	90 Seconds	*90 Seconds*
	Darkness Control	Darkness	0	*0*
	Power Saving	Power Saving	15 Min	*15 Min*
	Low Toner	Low Toner	ON	*ON*
	Toner Saving	Toner Saving	Disable	*Disable*
	Clearance Warnings	Clearance Warnings	ON	*ON*
	Error Report	Error Report	OFF	*OFF*
	Parallel I/F	Parallel Speed	High	*High*
		Bi-Direction	Enable	*Enable*
		I-Prime	OFF	*OFF*
	RS232C Serial	Flow Control	DTR Hi Polarity	*DTR Hi Polarity*
		Baud Rate	9600 Baud	*9600 Baud*
		Data Bits	8 Bits	*8 Bits*
		Parity	None	*None*
		Min. Busy Time	200 mSec	*200 mSec*
	Language	Language	English	*English*

Table C.3-3 Approved Menu Settings Printed from the Installation Software Print Menu

Level 1	**Category**	**Item**	**Factory**	***User***
Common	Personality	Emulation	Auto	*Epson FX*
	Tray Select	Manual Feed	OFF	*OFF*
		Paper Feed	Tray 1	*Tray 1*
	Edit Size	Edit Size	Cassette Size	*Cassette Size*
	Paper Size	Tray1	Letter	*Letter*
		Manual	Letter	*Letter*
	Media Type	Tray 1	Medium	*Medium*
		Manual	Medium	*Medium*
	Paper Size Check	Paper Size Check	Enable	*Enable*
	Copies	Copies	1	*1*
	Euro Sign	Euro Sign	Disable	*Disable*
HP Laser Jet 6P Emulation	Fonts and Symbols	Font Source	Resident	*Resident*
		Font No.	I000	*I000*
		Font Pitch	10.00 CPI	*10.00 CPI*
		Symbol Set	PC-8	*PC-8*
	Page Layout 1	A4 Print Width	78 Column	*78 Column*
		White Page Skip	OFF	*OFF*
		CR Function	CR	*CR*
		LF Function	LF	*LF*
Common	Page Layout 2	Orientation	Portrait	*Portrait*
		Lines per Page	60 Lines	*60 Lines*
	Host Interface	Parallel	Enable	*Enable*
		RS232C	Enable	*Enable*
		USB	Enable	*Enable*
Level – 2	Print Mode	Resolution	600 dpi	*300 dpi*
	Memory Usage	Font Protection	Auto	*Auto (0 KB)*
	Auto Operation	Auto Continue	OFF	*OFF*
		Wait Timeout	90 Seconds	*90 Seconds*
	Darkness Control	Darkness	0	*0*
	Power Saving	Power Saving	15 Min	*15 Min*
	Low Toner	Low Toner	ON	*ON*
	Toner Saving	Toner Saving	Disable	*Disable*
	Clearance Warnings	Clearance Warnings	ON	*ON*
	Error Report	Error Report	OFF	*OFF*
	Parallel I/F	Parallel Speed	High	*High*
		Bi-Direction	Enable	*Enable*
		I-Prime	OFF	*OFF*
	RS232C Serial	Flow Control	DTR Hi Polarity	*DTR Hi Polarity*
		Baud Rate	9600 Baud	*9600 Baud*
		Data Bits	8 Bits	*8 Bits*
		Parity	None	*None*
		Min. Busy Time	200 mSec	*200 mSec*
	Language	Language	English	*English*

Controls and Indicators

Figure C.3-1 OKIPAGE 14e LED Printer Front Operator Panel



See Figure C.3-1 for the locations of the controls and indicators on the operator front panel, Table C.3-4 for their functions.

Table C.3-4 OKIPAGE 14e LED Printer - Operator Panel Lights - Reference

Ready Light (Green)*	Manual Feed (Amber)*	Error (Red)*	Meaning	User Option Switch Function
ON	Off	Off	Ready	**Quick Press**: Takes printer off line
Off	Off	Off	Off line	**Quick Press**: Ready **2 Second Press**: Prints Demo and Menu pages. **5 Second Press**: Prints Cleaning page.
Blinking	Off	Off	Processing/receiving data	**Quick Press:** Pauses Printer.
Slow blink	Off	Off	Printing paused	**Quick Press**: Resumes printing. **2 Second Press**: Prints buffer contents. **5 Second Press**: Clears buffer and resets Printer.
Off	Off	Blink	• Paper out • Paper jam • Cover open • Printing error	**Quick Press:** Resumes printing.
Blink or Fast blink	Blink or Fast blink	Blink or Fast blink	Hardware error	Turn Printer OFF and ON. If problem persists, call service.
		Slow blink	• Warning • Change image drum • Toner Low • Toner sensor	
Off	Blink	Off	Ready for manual feed	Place sheet in manual feeder.

*Blink = one blink/second; Slow blink = one blink/4 seconds; Fast blink = several blinks/second

ABBREVIATIONS, ABBREVIATIONS-1

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, separated by semicolons.

SYMBOLS

°C - degrees Celsius

°F - degrees Fahrenheit

> - greater than

≥ - greater than or equal to

< - less than

≤ - less than or equal to

µA - micro amperes

µL - microliter

µs - microsecond

- - minus

% - percent

+ - plus

± - plus or minus

A

A - amperes

ac - alternating current

A/D - analog to digital

AG - automotive glass

AGND - analog ground

APT - aperture

AspSW - aspirate switch

ASTM - American Society for Testing Materials

ATM - atmosphere

AVG - average

AVR - aperture voltage ratio

B

BNC - bayonet Neil-Concelman connector

C

C - capacitor

CD-ROM - compact disc-read only memory

cm - centimeters

CV - check valve

CMOS - complementary metal oxide semiconductor

CN - connector

CPU - central processing unit

CV - coefficient of variant; check valve

D

dB - decibels

dc - direct current

DCHC - door closed holding current

DCN - document control number

DGND - digital ground

Dil - diluent

DIP switch - dual in-line package switch

DMA - direct memory access

DOPN - door open

DUART - dual universal asynchronous receiver transmitter

DVM - digital voltmeter

E

EGND - earth (chassis) ground

EPLD - electronically programmable logic device

ESD - electrostatic discharge

F

F - fuse

FB - fluid barrier

FET - field effect transistor

fL - femtoliters

FLS - hydraulic filter

FMI - logo of Fluid Metering, Inc.

FS - optical liquid sensor

ft - feet

G

g - grams

g/dL - grams per deciliter

H

Hct - hematocrit

Hg - mercury

Hgb -hemoglobin

Hz - hertz

I

i.d. - internal diameter

IEEE - Institute of Electrical Engineers

in. - inches

in. Hg - inches of mercury

I/O - input/output

ISO - International Organization for Standardization

J

J - receptacle connector

K

K - kilos

KΩ - kilohms

KHz - kilohertz

KNF -

L

l - long

L - coil

LCD - liquid crystal display

LED - light emitting diode

LTVAR - long term variance

LV - solenoid

M

MΩ - megohms

M - motor

mA - milli-amperes

max - maximum

MB - megabytes

MCH - mean cell hemoglobin

MCHC - mean cell hemoglobin concentration

MCV - mean corpuscle volume

MGND - motor ground

MHz - megahertz

mL - milliliters

mm - millimeters

N

nm - nanometers

O

o.d. - outside diameter

OP - output port

P

P - plug connector

PC - printed circuit

PCF - pump correction factor

PCMCIA - Personal Computer Memory Card International Association

PCV - probe closed vial

PD - persistent data

Plt - platelet count

PM - pump

PN - part number

p-p - peak-to-peak

ppm - pages per minute

PUP - probe up position

Q

Q - transistor

QA - quality assurance

R

R - resistor

RAM - random access memory

RAV - red aperture voltage

RBC - red blood cell count

RDW - red cell distribution width

RF - reference

RH - relative humidity

RIA - red aperture current

RM - running mean

RMCV - red mean corpuscle value

RN - resistor

ROM - read only memory

RPWV - red pulse-width value

RS-232 - Electronic Industries Association standard governing interface between data processing and data communications equipment.

RV - varistor

S

S - switch; solenoid

SEMS -

SGND - solenoid ground

SLO-BLO - slow blow

SMT - surface mount technology

SW - switch

T

Temp - temperature

thd - thread

TP - test point

U

U - integrated circuit

V

V - volts

Vac - vacuum; volts alternating current

VAR - variance

VC - vacuum isolator chamber

Vdc - volts direct current

VRF - vacuum reference

W

w - wide

W - watt

WAV - white aperture voltage

WBC - white blood cell count

WHT - white

WIA - white aperture current

WM - wire marker

WMCV - white mean corpuscle value

WPWV - white pulse-width voltage

X

X - jumper; plugged

x - times

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