

Waters

Patricia McConville
Manager
Product Positioning Laboratory

Acquity™

Ultra Performance LC

Next Generation Instrument Design



For Complete  Confidence

Next Generation Instrument Design

ACQUITY UPLC™ is a fully integrated modular system which delivers unprecedented uptime, throughput and productivity. The application of advanced system diagnostics, eCord™ technology and Connections® INSIGHT™ remote monitoring capabilities will be discussed.

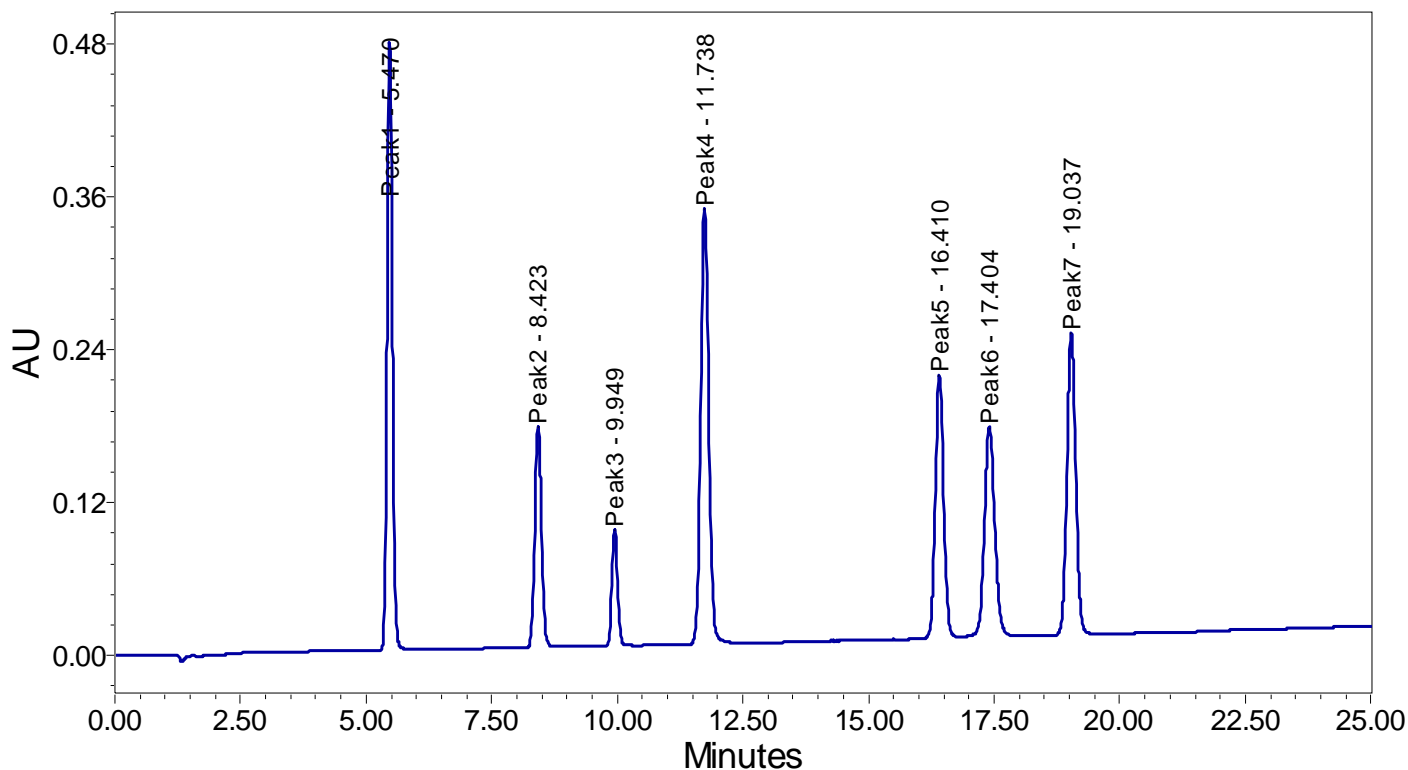
- A new class of separation science
 - Based on chromatography columns with very small particles
 - Based on instruments designed to take advantage of the small particles
- Provides improved resolution, speed, and sensitivity
- Suitable for chromatographic applications in general
 - Appropriate for improving existing methods
 - Appropriate for developing new methods

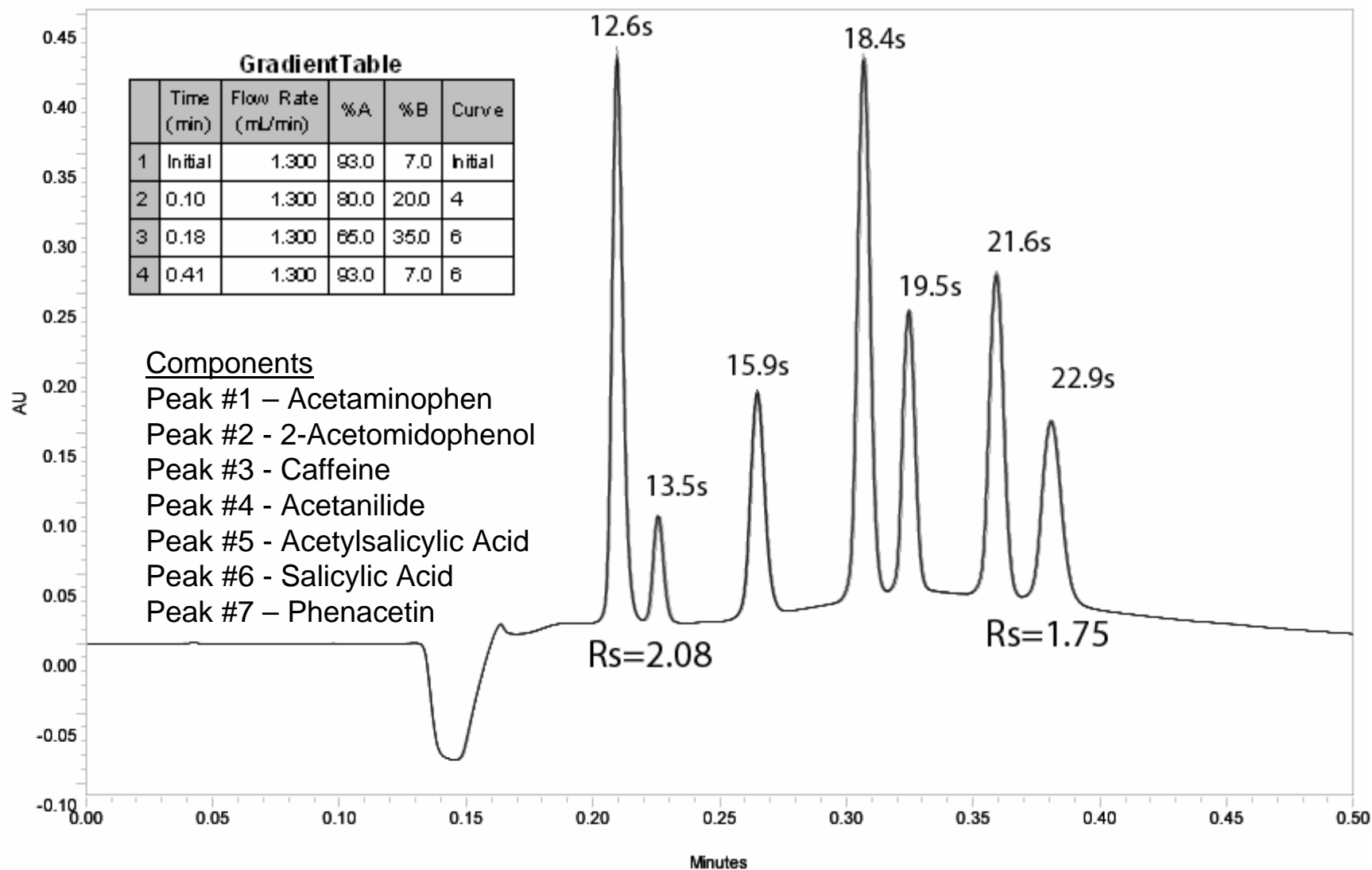
Gradient Table

| Time | Flow | %A | %B | %C | %D | Curve |
|-------|------|------|------|-----|-----|-------|
| | 1.00 | 98.0 | 2.0 | 0.0 | 0.0 | |
| 25.00 | 1.00 | 75.0 | 25.0 | 0.0 | 0.0 | 6 |
| 25.01 | 1.00 | 98.0 | 2.0 | 0.0 | 0.0 | 6 |
| 60.00 | 0.05 | 98.0 | 2.0 | 0.0 | 0.0 | 6 |

Components

- Peak #1 – Acetaminophen
- Peak #2 - 2-Acetamidophenol
- Peak #3 - Caffeine
- Peak #4 - Acetanilide
- Peak #5 - Acetylsalicylic Acid
- Peak #6 - Salicylic Acid
- Peak #7 – Phenacetin



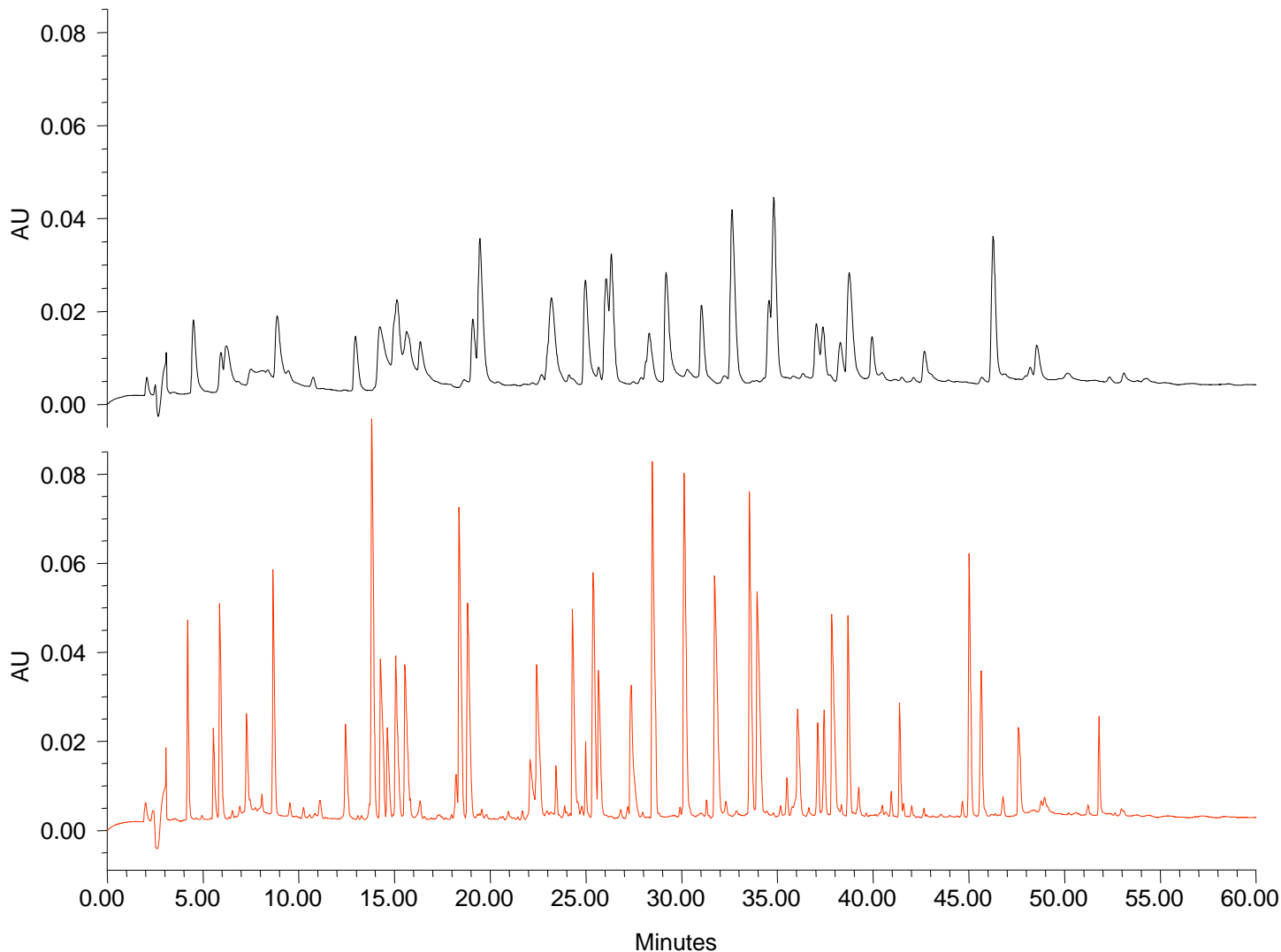


©2005 Waters Corporation

| | | Column Volume (X5) | System Volume (x3) | Re- equili bratio n time (min.) | Total cycle time (min.) | # of injections in 24hours | Solvent consumed per injection |
|---|----------------|--------------------------|--------------------------|---|----------------------------------|-------------------------------------|--------------------------------------|
| HPLC 4.6 x 100 5μ 25 min. run time | 1.0 mL/min. | 1.66mL (8.3mL) | 620uL (1.86mL) | 10.2. | 35.2 | 41 | 35.2mL |
| UPLC™ 2.1 x 50 1.7μ 0.41 min run time | 1.3 mL/min | 0.20mL (1.0mL) | 120uL (0.360mL) | 1.04 | 1.45 | 993 | 1.9mL |

Total Liters of solvent for 1000 injections:
HPLC: 35.2L Vs. UPLC™: 1.9L

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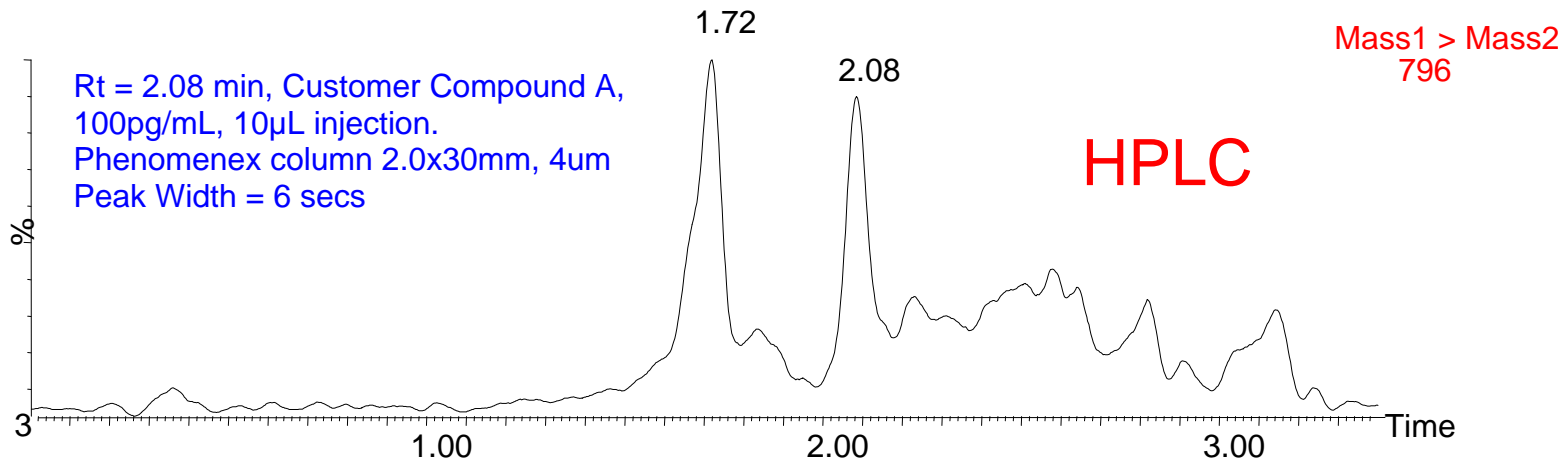
HPLC
4.8 μm
Peaks = 70
 $P_c = 143$

UPLC™
1.7 μm
Peaks = 168
 $P_c = 360$

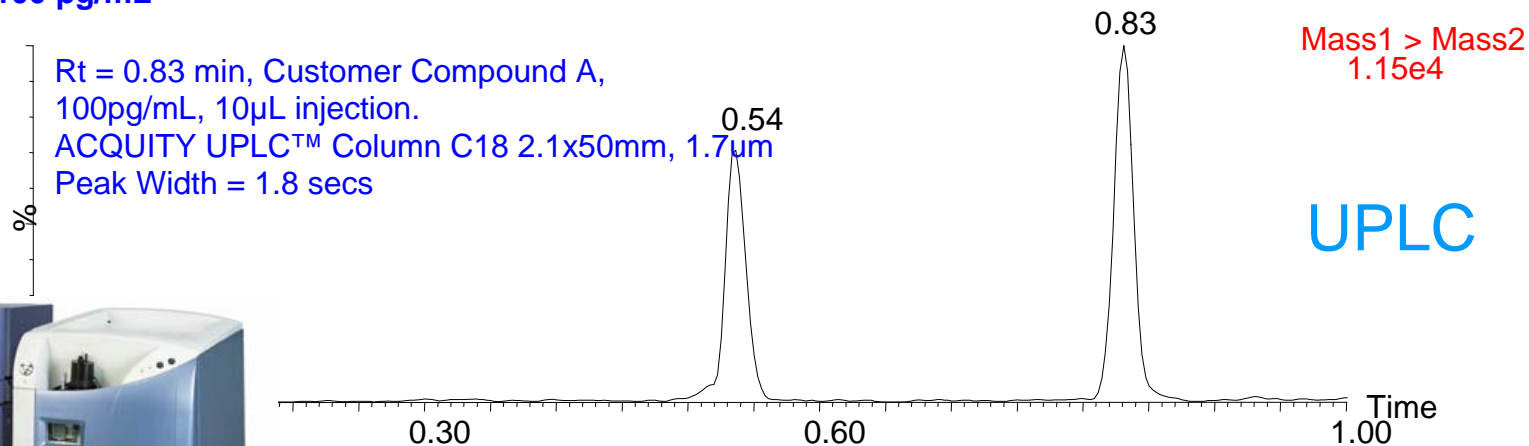
2.5X increase

©2005 Waters Corporation

100 pg/mL



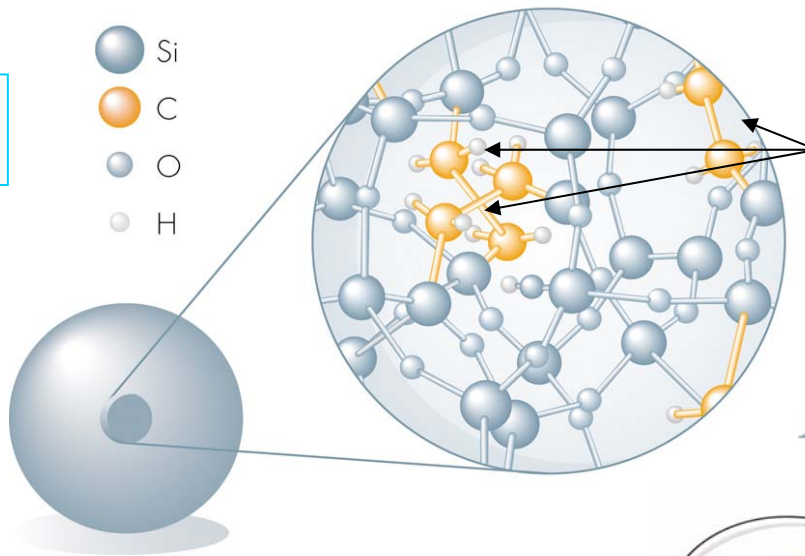
100 pg/mL



Method Comparison 100pg/mL, 10µL injection

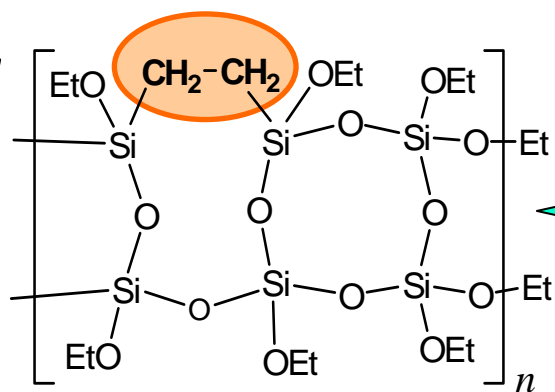
Waters Patented Technology
No. 6,686,035 B2

Si
C
O
H

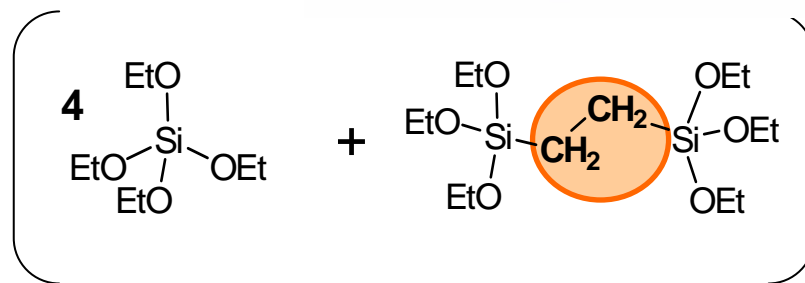


Bridged Ethanes
In Silica Matrix

Acquity™
Ultra Performance LC



Polyethoxysilane
(BPEOS)



Tetraethoxysilane
(TEOS)

Bis(triethoxysilyl)ethane
(BTEE)



Detectors:

- Optical and/or Mass Spec
- Tunable UV or Photodiode Array
- Optimized flow cell for UPLC™
- High speed data sampling for

System Considerations:

- Small Footprint
- Redesigned tubing and fittings
- Consolidated waste management
- Integrated system diagnostics
- Connections Insight™ remote diagnostics

Sample Organizer: (option)

- Expands capacity (22/15/8)
- Shuttles plate feed
- Heated/chilled

Sample Manager:

- Low dispersion XZZZ' Format
- Fast cycle times
- Low carryover
- Plates and/or vials
- Optional Sample Organizer

Column Manager:

- Innovative pivot design
- Positions column to detector
- E-Cord™ connection

Binary Solvent Manager:

- High pressure blending
- Binary gradients
- Four solvent choices
- On-line degassing
- Low dispersion design
- UPLC pressure capabilities

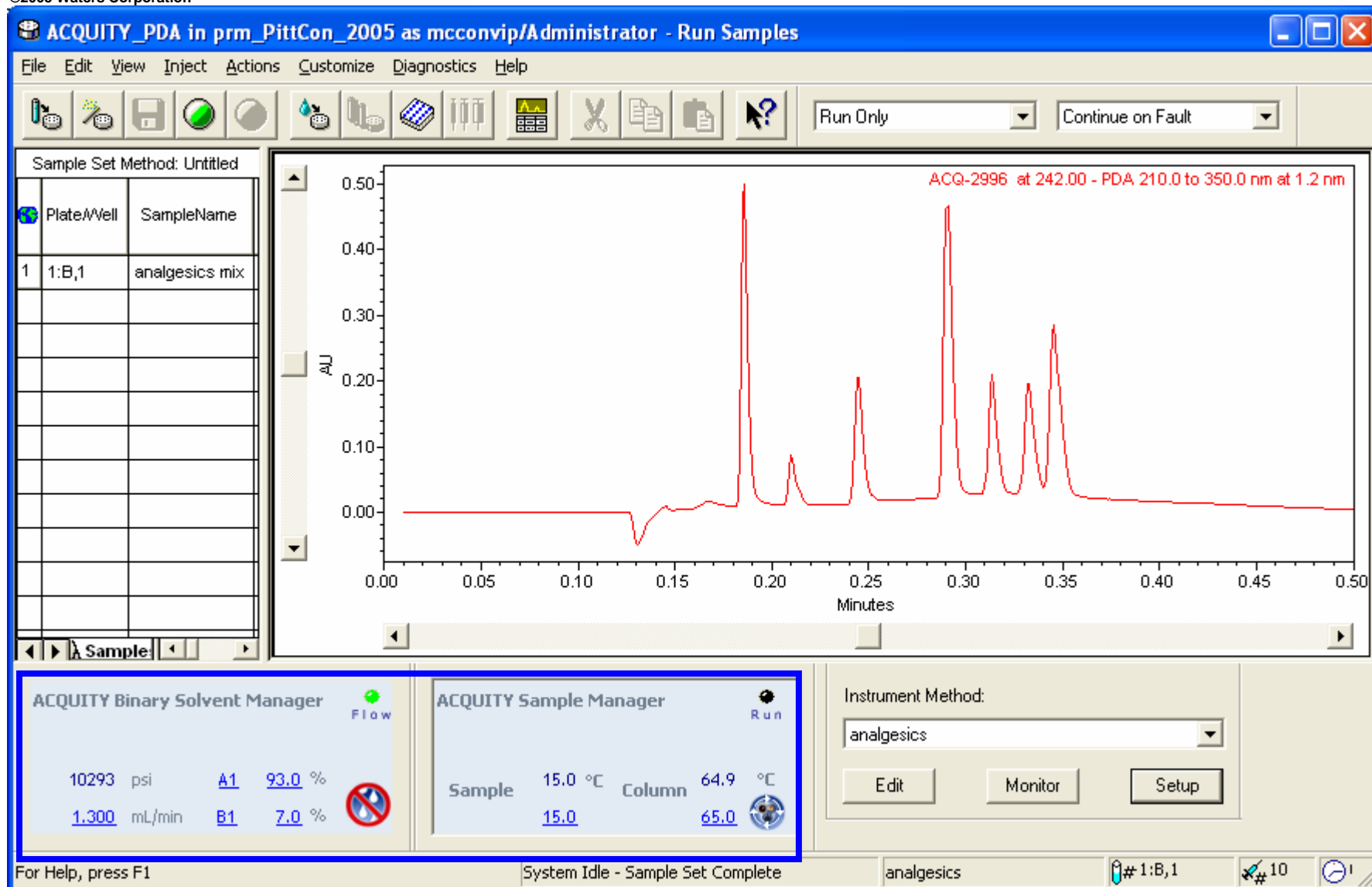


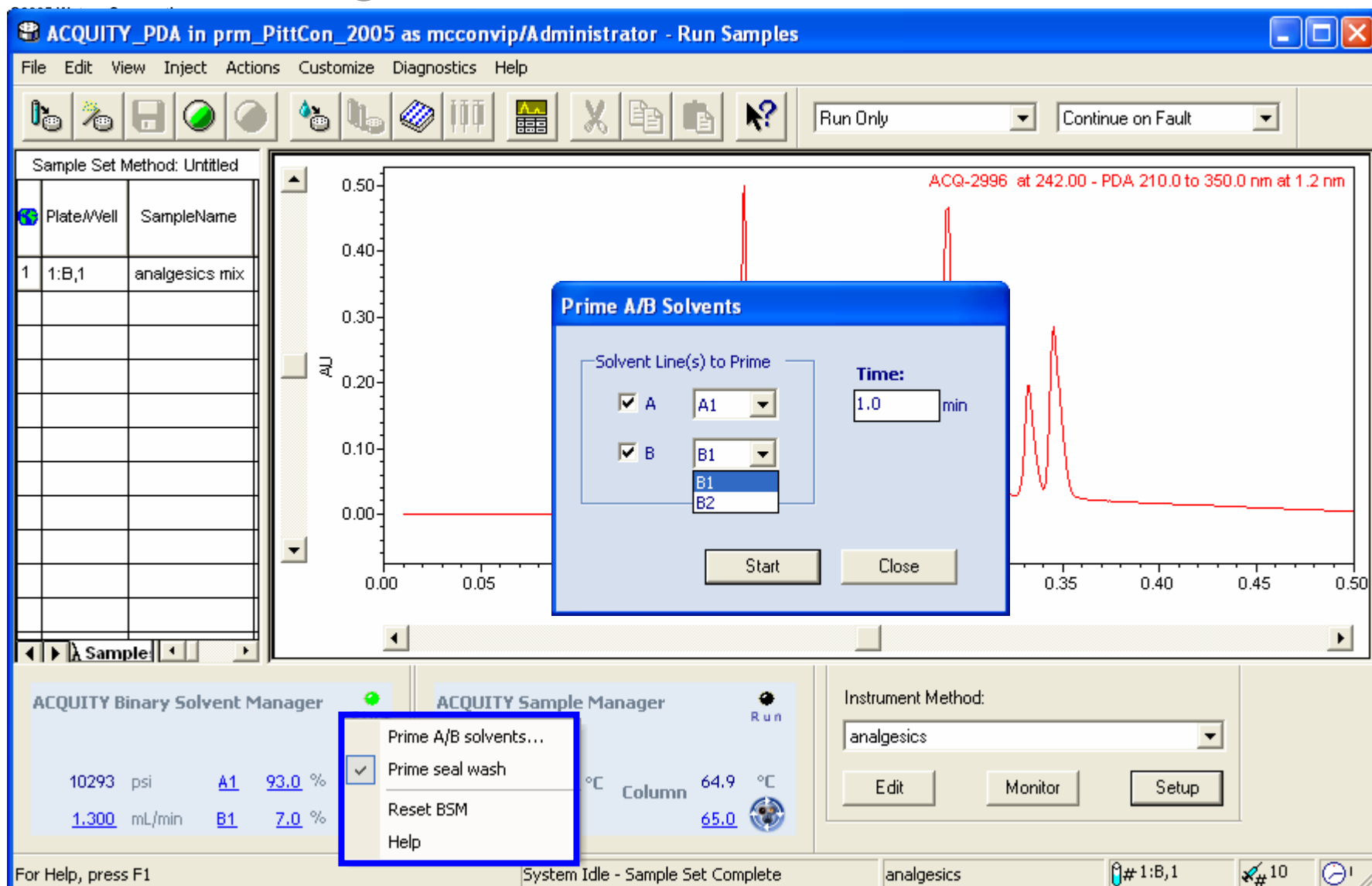
- Integrated hardware and software
 - Visual system status indicators on hardware
 - Instrument Control Panel
- Instrument Console
 - A customizable *Instrument Console* enables operators to easily stay in control of all system functionality including instrument control, interactive system monitoring, status monitoring, and user diagnostic capabilities.
- eCord™ Technology
 - Accurate permanent record of column history
- Connections® INSIGHT™ remote monitoring capabilities

- Front Panel LEDs
 - Power LED (left)
 - **ON GREEN**
 - Instrument is on, has power
 - Flow LED (right)
 - OFF
 - Currently idle, not flowing, appears in good health
 - **ON GREEN**
 - Pump is currently flowing, in good health
 - **FLASHING RED**
 - Pump has stopped on error, no longer flowing
 - **ON RED**
 - Serious system failure prevents further operation



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ACQUITY_PDA in prm_PittCon_2005 as mcconvip/Administrator - Run Samples

File Edit View Inject Actions Customize Diagnostics Help

Run Only Continue on Fault

Sample Set Method: Untitled

| Plate/Well | SampleName |
|------------|----------------|
| 1 1:B,1 | analgesics mix |

ACQ-2996 at 242.00 - PDA 210.0 to 350.0 nm at 1.2 nm

Prime Syringes

☐ Sample syringe only
☒ Sample syringe and wash syringes

Number of cycles: 1

OK Cancel

ACQUITY Binary Solvent Manager

Flow

10295 psi A1 93.0 %
1.300 mL/min B1 7.0 %

ACQUITY Sample Manager

Sample 15.0 °C Column 15.0

Prime syringes...
Wash needle...
Turn lights off
Reset SM
Help

Monitor Setup

For Help, press F1

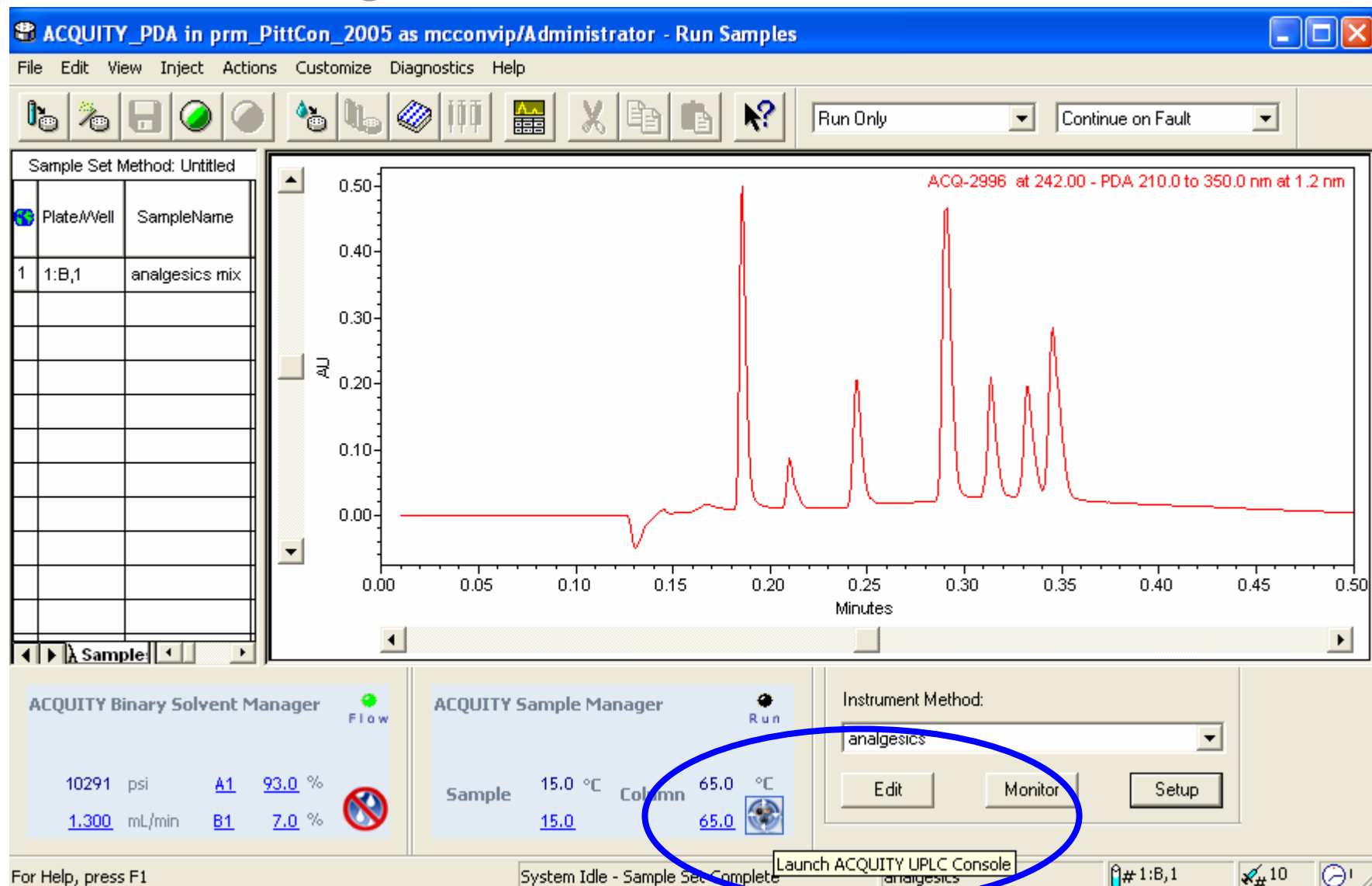
System Idle - Sample Set Complete

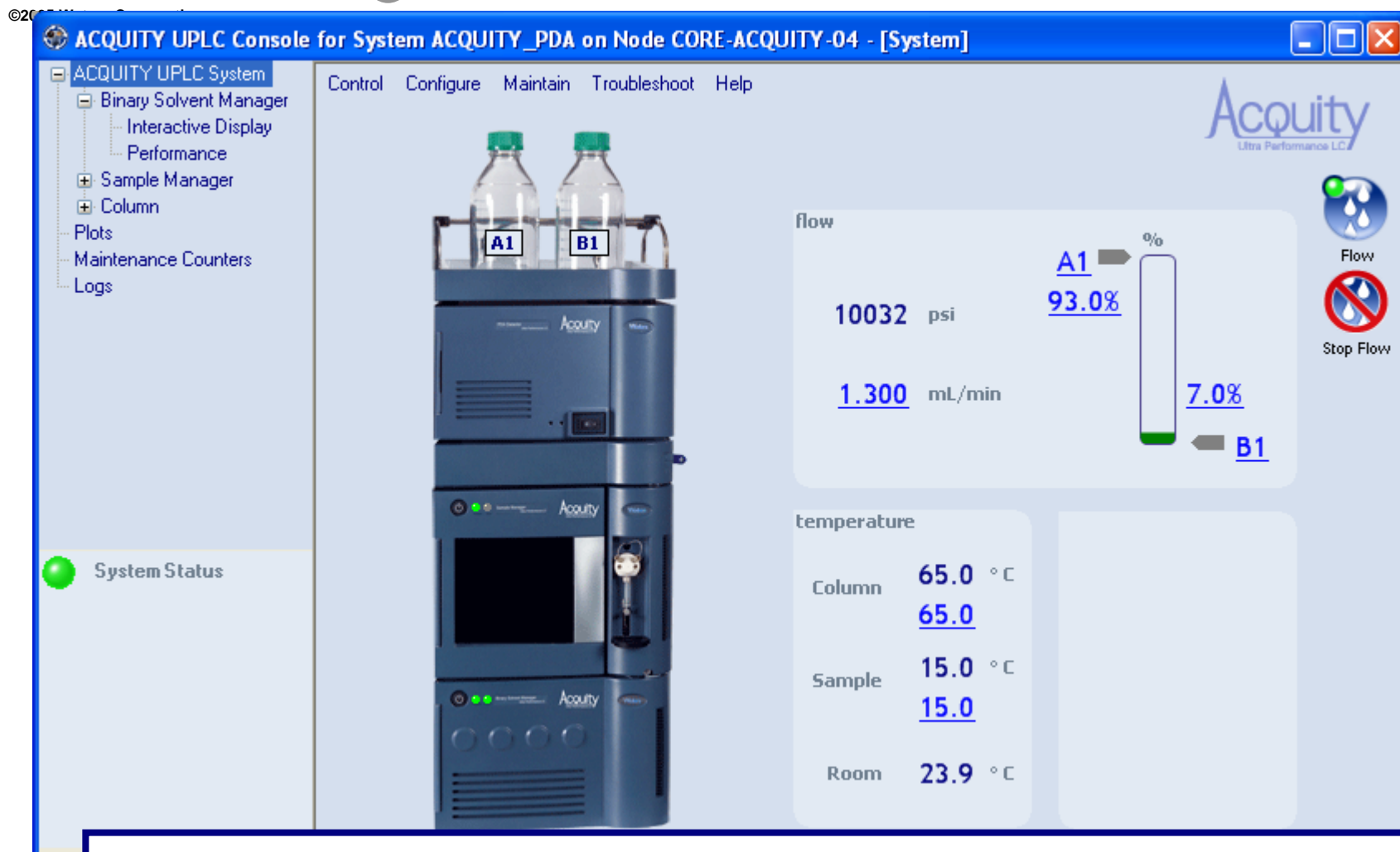
analgesics

1:B,1

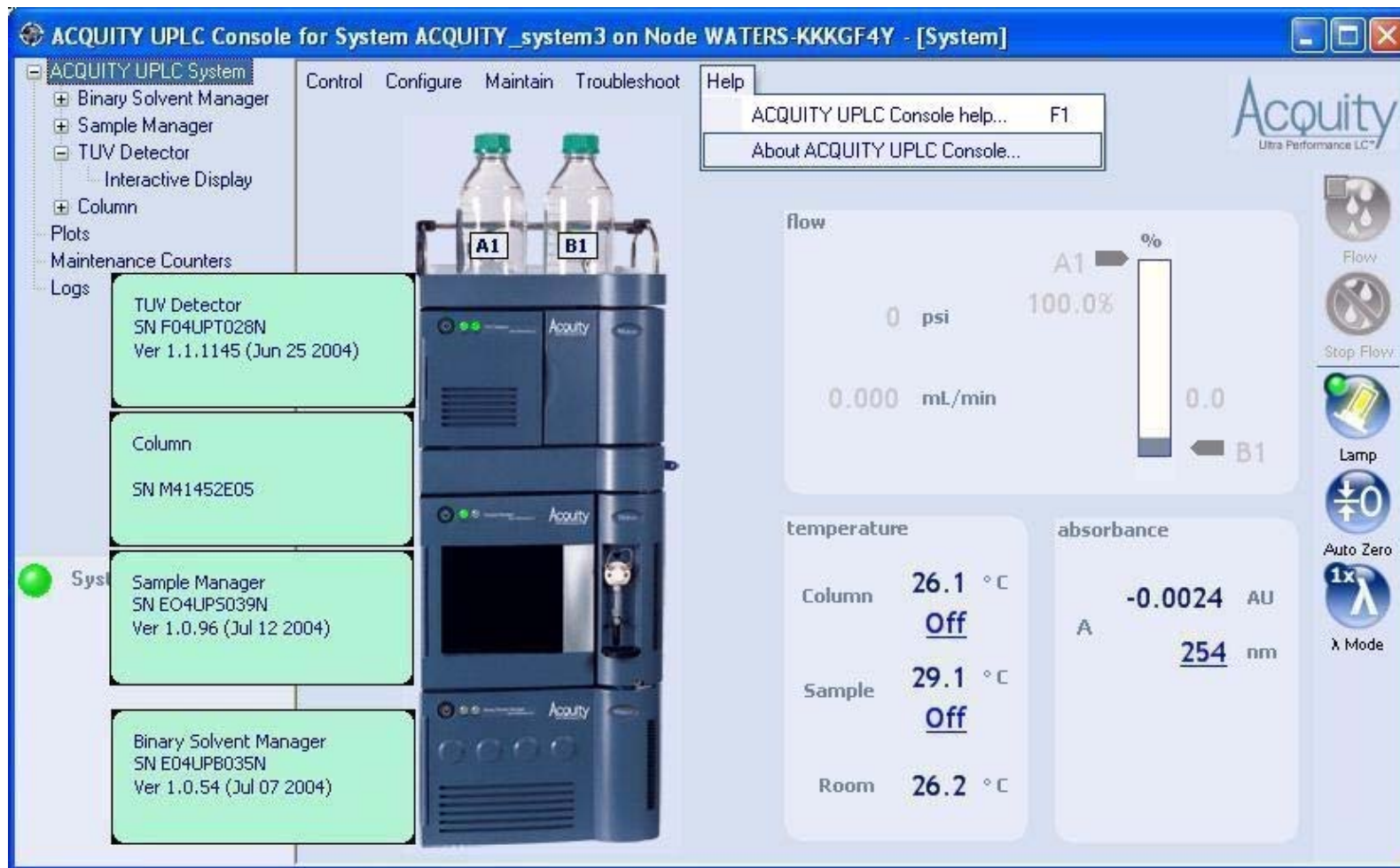
10

- Integrated hardware and software
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ACQUITY UPLC™
Console same in Empower™ and Mass Lynx™



The screenshot displays the ACQUITY UPLC Console software interface. The title bar reads "ACQUITY UPLC Console for System ACQUITY_PDA on Node CORE-ACQUITY-04 - [System]". The interface is divided into several sections:

- Left Panel:** A tree view showing the system hierarchy:
 - ACQUITY UPLC System
 - Binary Solvent Manager
 - Interactive Display
 - Performance
 - Sample Manager
 - Column
 - Plots
 - Maintenance Counters
 - Logs
- System Status:** A green circle icon next to the text "System Status".
- Control Menu:** A dropdown menu with the following options:
 - Set flow...
 - Stop flow
 - Prime A/B solvents...
 - ☒ Prime seal wash
 - Visible system identification
- Flow Section:**
 - Pressure: 10033 psi
 - Flow rate: 1.300 mL/min
 - Flow composition: A1 93.0% (top), B1 7.0% (bottom)
 - Flow status: Flow (green circle icon) and Stop Flow (red circle with a slash icon)
- Temperature Section:**
 - Column: 65.0 °C
 - Sample: 15.0 °C
 - Room: 23.9 °C

The background of the console window features a vertical image of the ACQUITY UPLC system hardware.

The screenshot displays the ACQUITY UPLC Console software interface. The main window title is "ACQUITY UPLC Console for System ACQUITY_PDA on Node CORE-ACQUITY-04 - [System]". The interface includes a sidebar with a tree view containing "ACQUITY UPLC System", "Binary Solvent Manager", "Interactive Display", "Performance", "Sample Manager", "Column", "Plots", "Maintenance Counters", and "Logs". The "System Status" section shows a green indicator light.

The main area features a "Control" tab with sub-tabs: "Configure", "Maintain", "Troubleshoot", and "Help". The "Configure" sub-tab is active, showing "System preferences...". A "System Preferences" dialog box is open, displaying "Units of Pressure" with three radio buttons: "psi" (selected), "bar", and "kPa". The dialog has "OK" and "Cancel" buttons.

The background interface shows a graphical representation of the ACQUITY UPLC system with two solvent bottles labeled "A1" and "B1". To the right, a "flow" section displays a vertical bar chart with "A1" at the top (93.0%) and "B1" at the bottom (7.0%). Below this, a table shows temperatures:

| Component | Temperature (°C) |
|-----------|------------------|
| Column | 65.0 |
| Sample | 15.0 |
| Room | 23.9 |

On the far right, there are icons for "Flow" (a green circle with a drop) and "Stop Flow" (a red circle with a drop and a slash).

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The screenshot displays the ACQUITY UPLC Console for System ACQUITY_PDA on Node CORE-ACQUITY-04. The interface includes a sidebar with a tree view of system components: ACQUITY UPLC System, Binary Solvent Manager, Interactive Display, Performance, Sample Manager, Column, Plots, Maintenance Counters, and Logs. The main area features a menu bar (Control, Configure, Maintain, Troubleshoot, Help) and a 'Create log entry...' button. A 'Create Log Entry' dialog box is open, showing a dropdown menu for 'Applies to:' with options: System, Binary Solvent Manager, Sample Manager, and System. The 'Operator:' field contains 'mcconvip'. The dialog has 'OK' and 'Cancel' buttons. In the background, a 'System Status' section shows a green indicator light. To the right, a 'Flow' control panel includes a 'Flow' icon (green circle with water droplets) and a 'Stop Flow' icon (red circle with a slash and water droplets). A vertical bar chart shows a gradient from green at the bottom to grey at the top, with labels 'A1' and '93.0%' at the top and 'B1' and '7.0%' at the bottom. Below the chart, a 'Sample' temperature of 15.0 °C and a 'Room' temperature of 23.9 °C are displayed.

ACQUITY UPLC Console for System ACQUITY_PDA on Node CORE-ACQUITY-04 - [System]

Control Configure Maintain Troubleshoot Help

Create log entry...

Create Log Entry

Applies to:
 System
 Binary Solvent Manager
 Sample Manager
 System

Operator:
 mcconvip

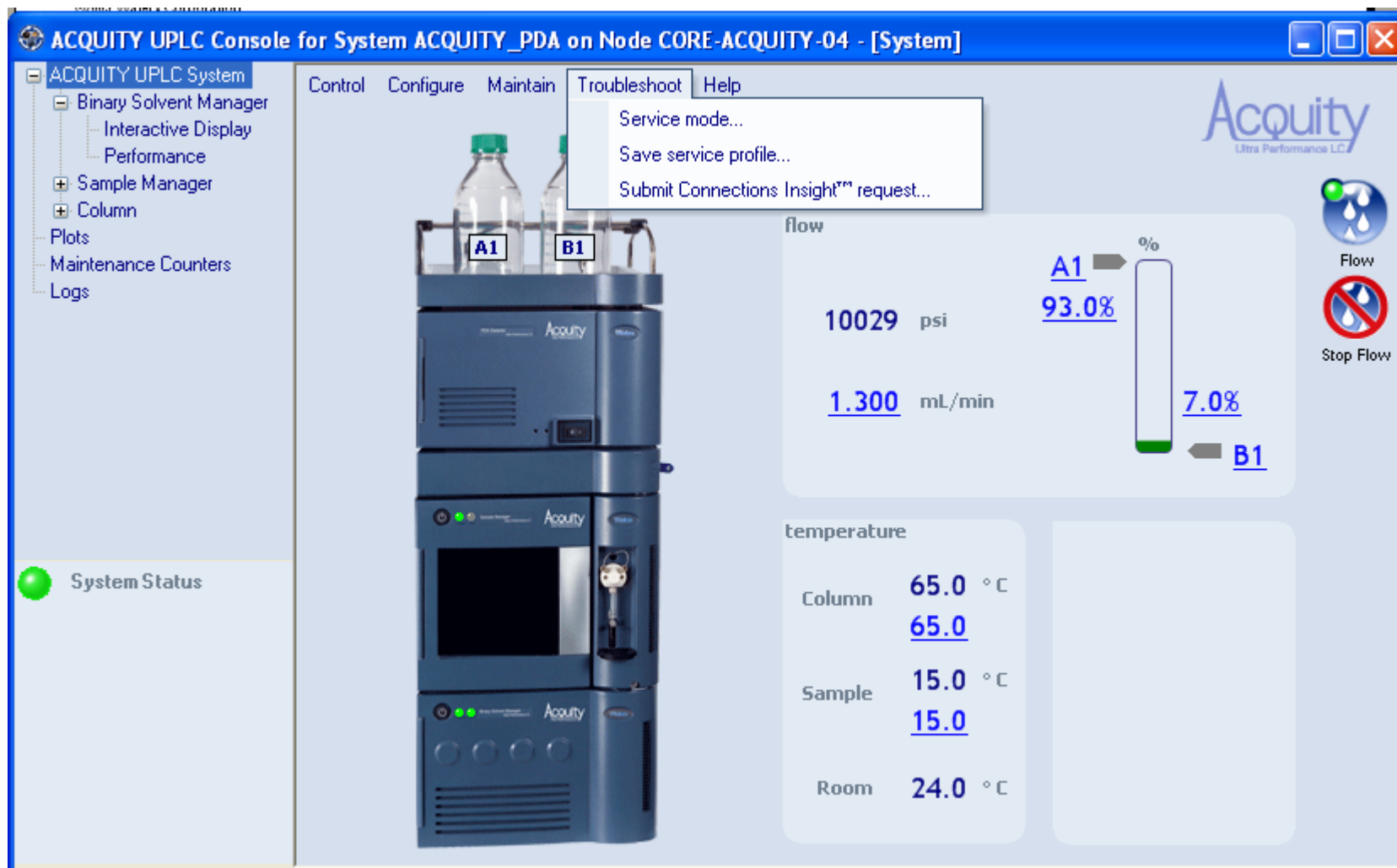
OK Cancel

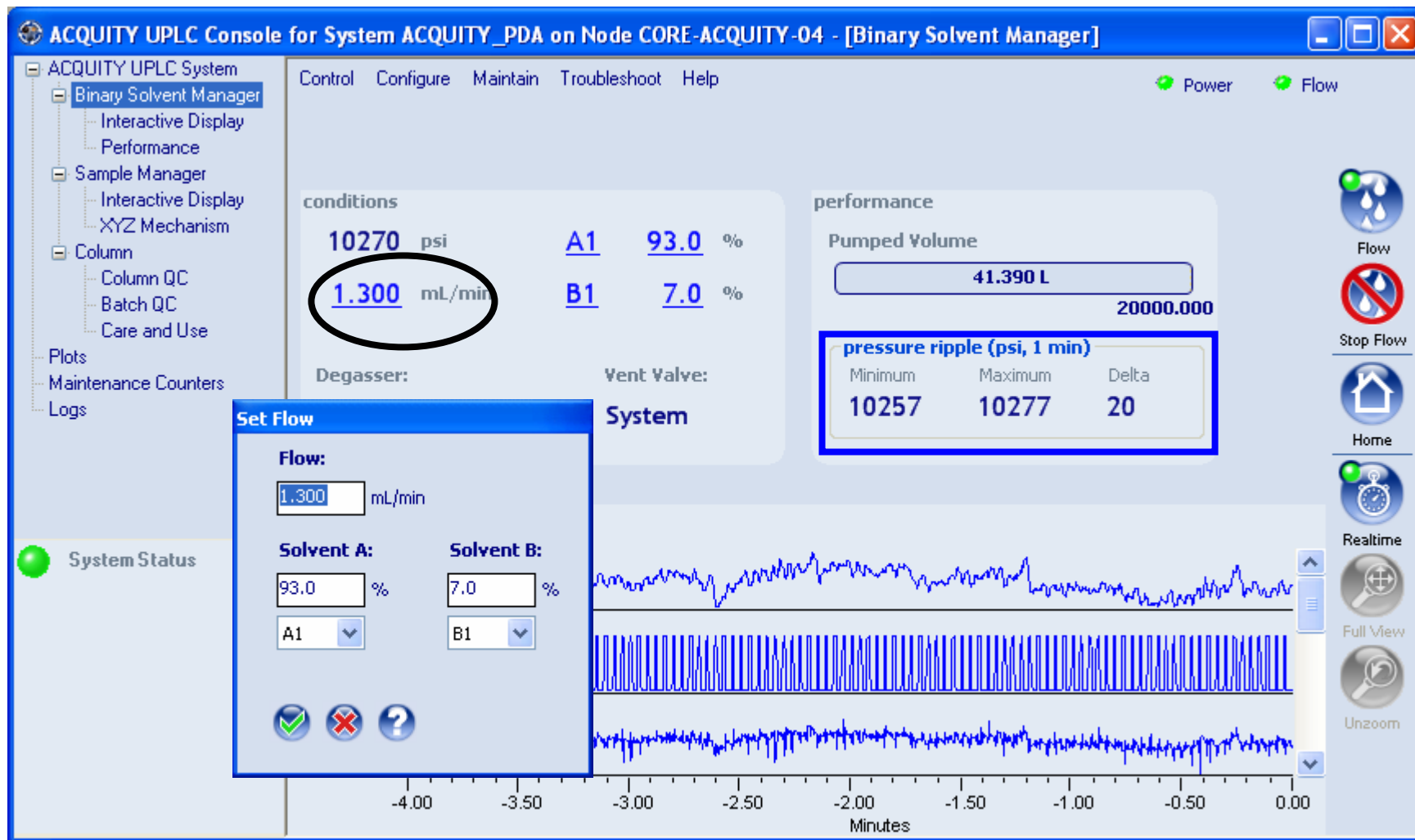
System Status

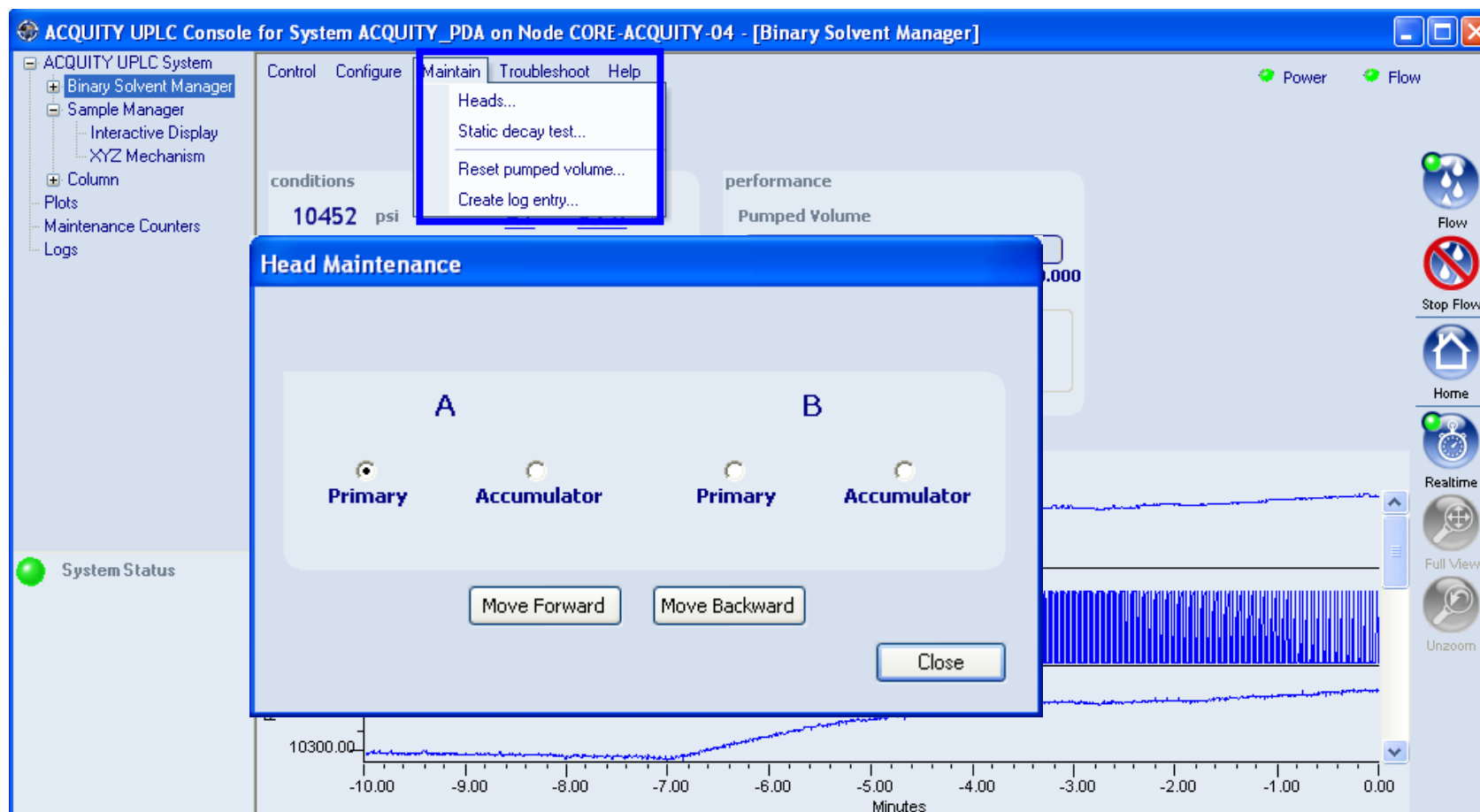
Flow
 Stop Flow

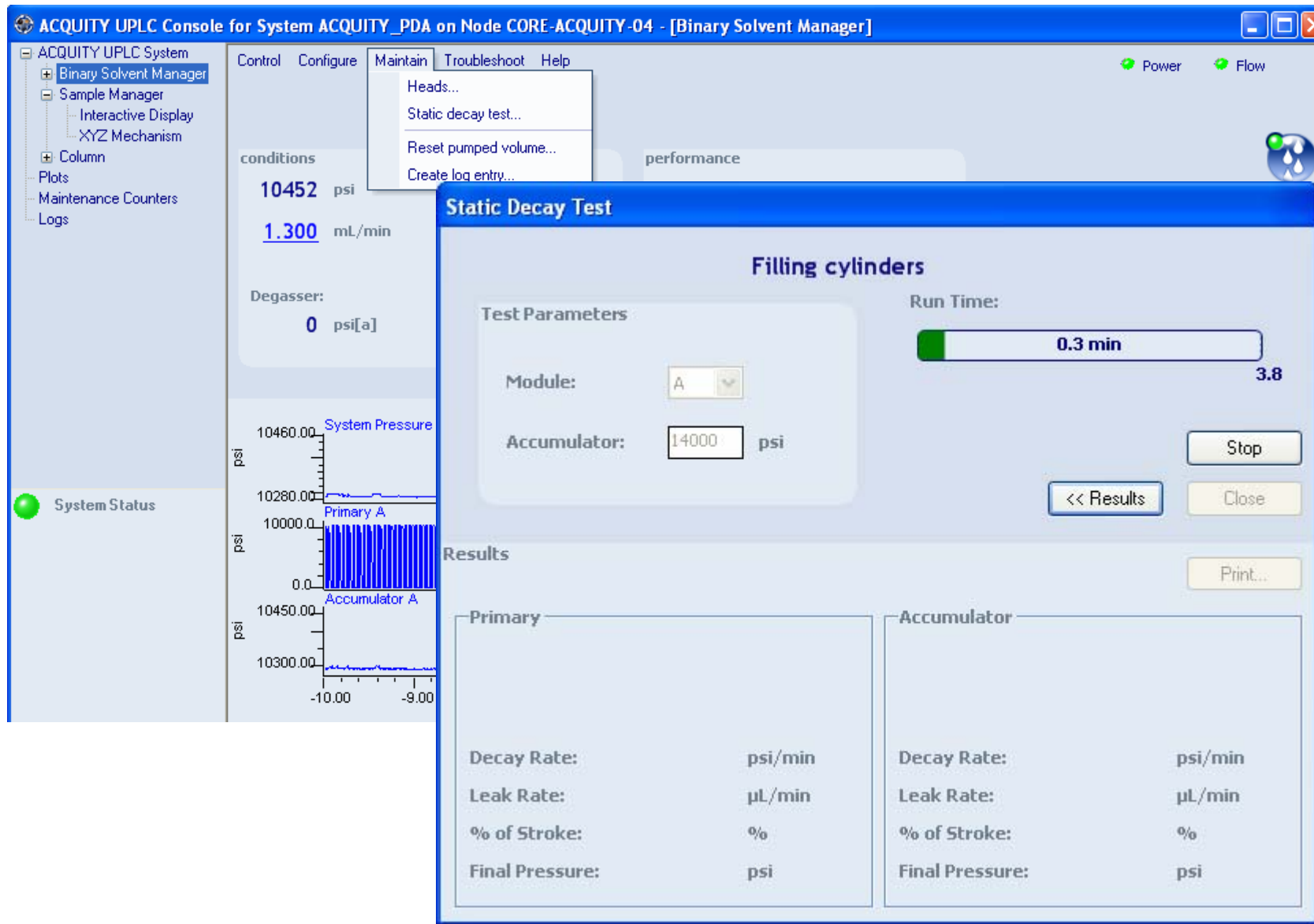
A1 93.0%
 B1 7.0%

Sample 15.0 °C
 15.0
 Room 23.9 °C









Static Decay Test

Test Parameters

Module: A

Accumulator: 14000 psi

Run Time:

0.0 min

4.9

Start

<< Results

Close

Results

Primary

Test Passed

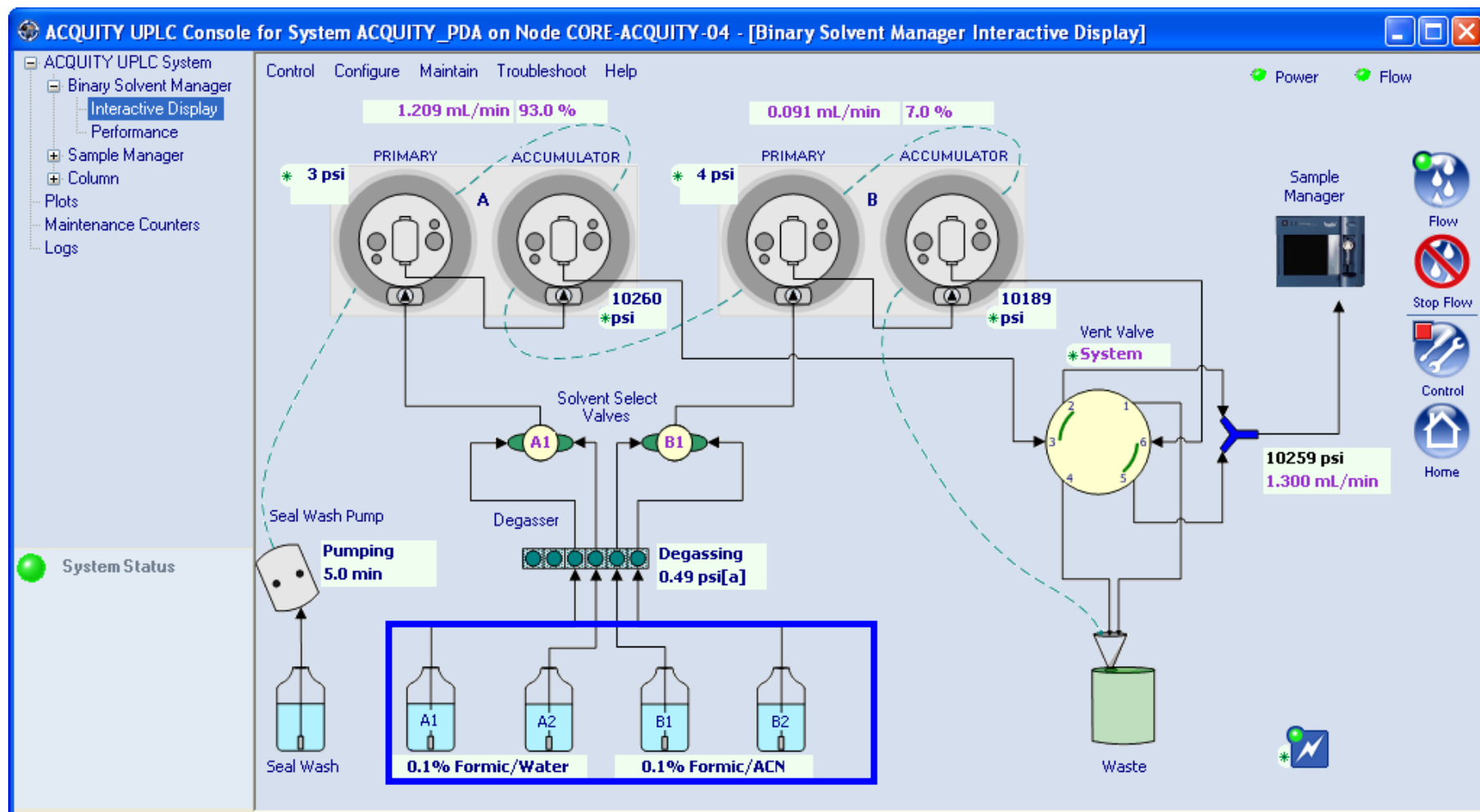
Decay Rate: **87** psi/min
Leak Rate: **0.063** µL/min
% of Stroke: **13.5** %
Final Pressure: **11507** psi

Accumulator

Test Passed

Decay Rate: **92** psi/min
Leak Rate: **0.062** µL/min
% of Stroke: **15.1** %
Final Pressure: **13472** psi

Print...



ACQUITY UPLC Console for System ACQUITY_PDA on Node CORE-ACQUITY-04 - [Binary Solvent Manager Performance]

Control Configure Maintain Troubleshoot Help

Power Flow

ACQUITY UPLC System

- Binary Solvent Manager
 - Interactive Display
 - Performance**
- Sample Manager
- Column
- Plots
- Maintenance Counters
- Logs

System Status

| | A | B |
|--|------|------|
| heads | | |
| Compression- Decompression (C/D) Ratio | 1.28 | 1.39 |
| Compressibility | 0.60 | 0.89 |

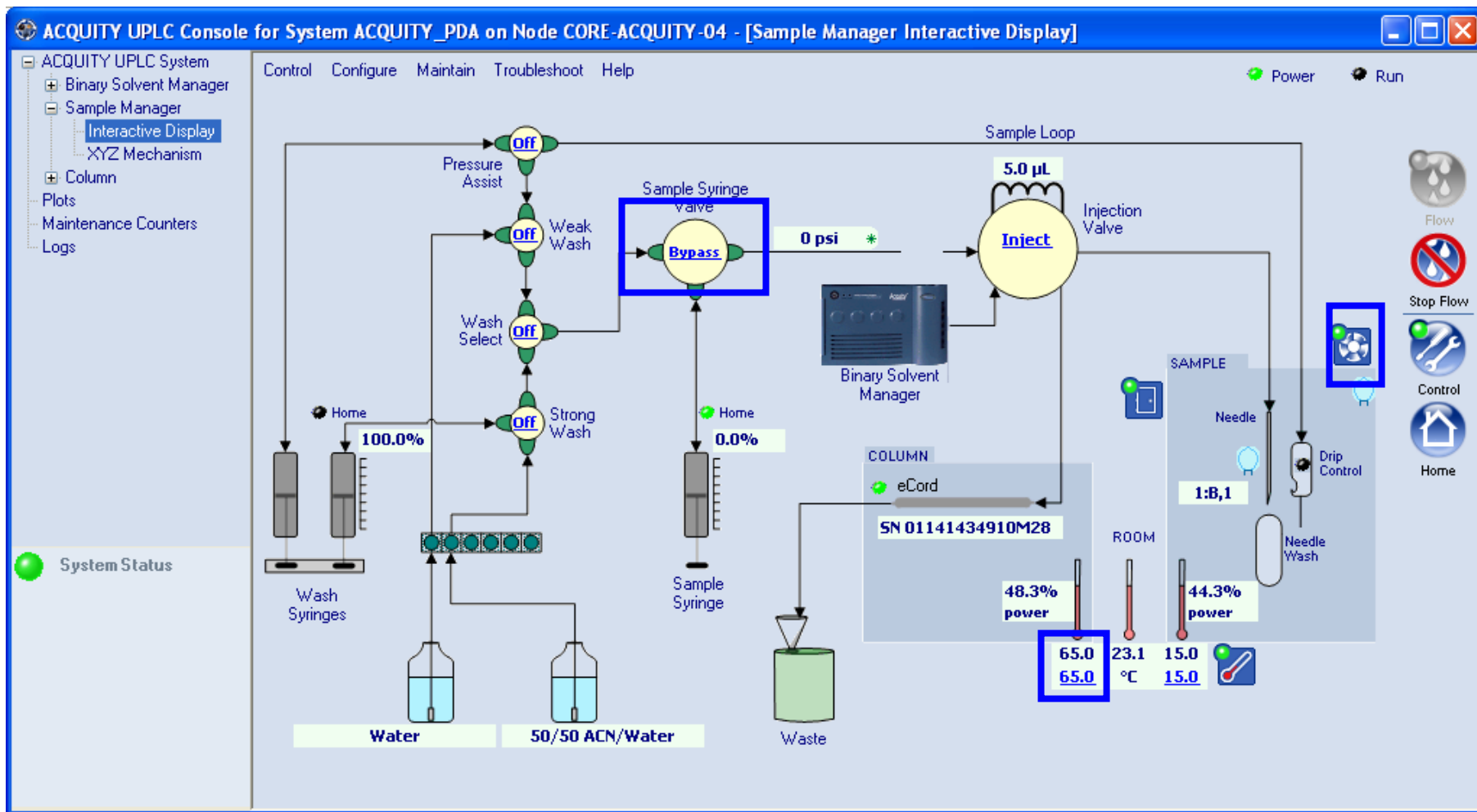
| | A | B |
|------------------------------|-------|-------|
| pressure ripple (psi, 1 min) | | |
| Minimum | 10251 | 10183 |
| Maximum | 10271 | 10198 |
| Delta | 20 | 15 |

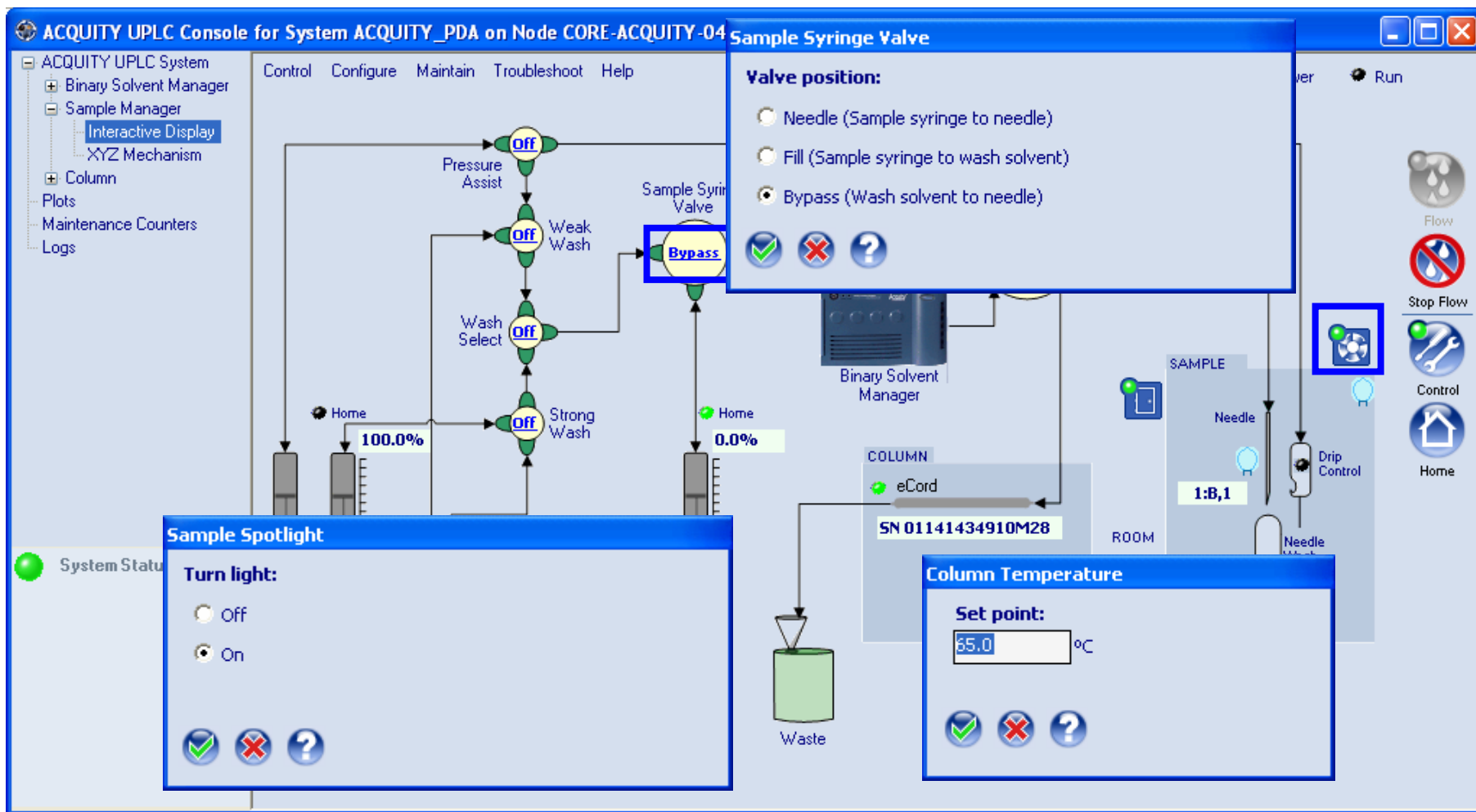
Flow

Stop Flow

Home







The screenshot displays the ACQUITY UPLC Console for System ACQUITY_PDA on Node CORE-ACQUITY-04. The main window is titled "ACQUITY UPLC Console for System ACQUITY_PDA on Node CORE-ACQUITY-04 - [Sample Manager Interactive Display]".

Left Panel (System Tree):

- ACQUITY UPLC System
 - Binary Solvent Manager
 - Interactive Display
 - Performance
 - Sample Manager
 - Interactive Display (Selected)
 - XYZ Mechanism
 - Column
 - Plots
 - Maintenance Counters
 - Logs

Main Panel:

The main panel shows a schematic of the UPLC system. A menu is open over the "Inject" valve, listing the following options:

- Characterize (Selected)
 - Needle and loop volumes...
 - Needle seal...
- Replace
 - Calibrate needle Z axis...
- Leak test
 - Back pressure regulator test...
- Disable motors
- Park injection valve
- Defrost...
- Reset injection count...
- Create log entry...

The background schematic includes components like Wash Syringes, Binary Solvent Manager, Injection Valve, and Needle. Status indicators show "0 psi" and "5.0 µL".

Characterize Needle and Loop Volumes Dialog:

This dialog box is titled "Characterize Needle and Loop Volumes" and is currently in the "Measuring" state.

| Nominal Configuration | |
|-----------------------|--------|
| Loop volume: | 5.0 µL |
| Needle volume: | 30 µL |

Run time: 1.2 min (Progress bar from 0.0 to 1.2 min)

Buttons: Stop, Results >>, Close

ACQUITY UPLC Console for System ACQUITY_PDA on Node CORE-ACQUITY-04 - [Sample Manager Interactive Display]

Control Configure Maintain Troubleshoot Help

ACQUITY UPLC System

- Binary Solvent Manager
 - Interactive Display
 - Performance
- Sample Manager
 - Interactive Display
 - XYZ Mechanism
- Column
- Plots
- Maintenance Counters
- Logs

System Status

Power Run

Flow Stop Flow Control Home

Needle and loop volumes...
Needle seal...

Sample Loop

5.0 µL

Inject

Injection Valve

0 psi *

Syringe

Home

100.0%

Off Strong Wash

Wash Syringes

Sample Syringe

Water 50/50 ACN/Water

Characterize Needle and Loop Volumes

Nominal Configuration

| | | |
|----------------|-----|----|
| Loop volume: | 5.0 | µL |
| Needle volume: | 30 | µL |

Run time: 0.0 min

Start

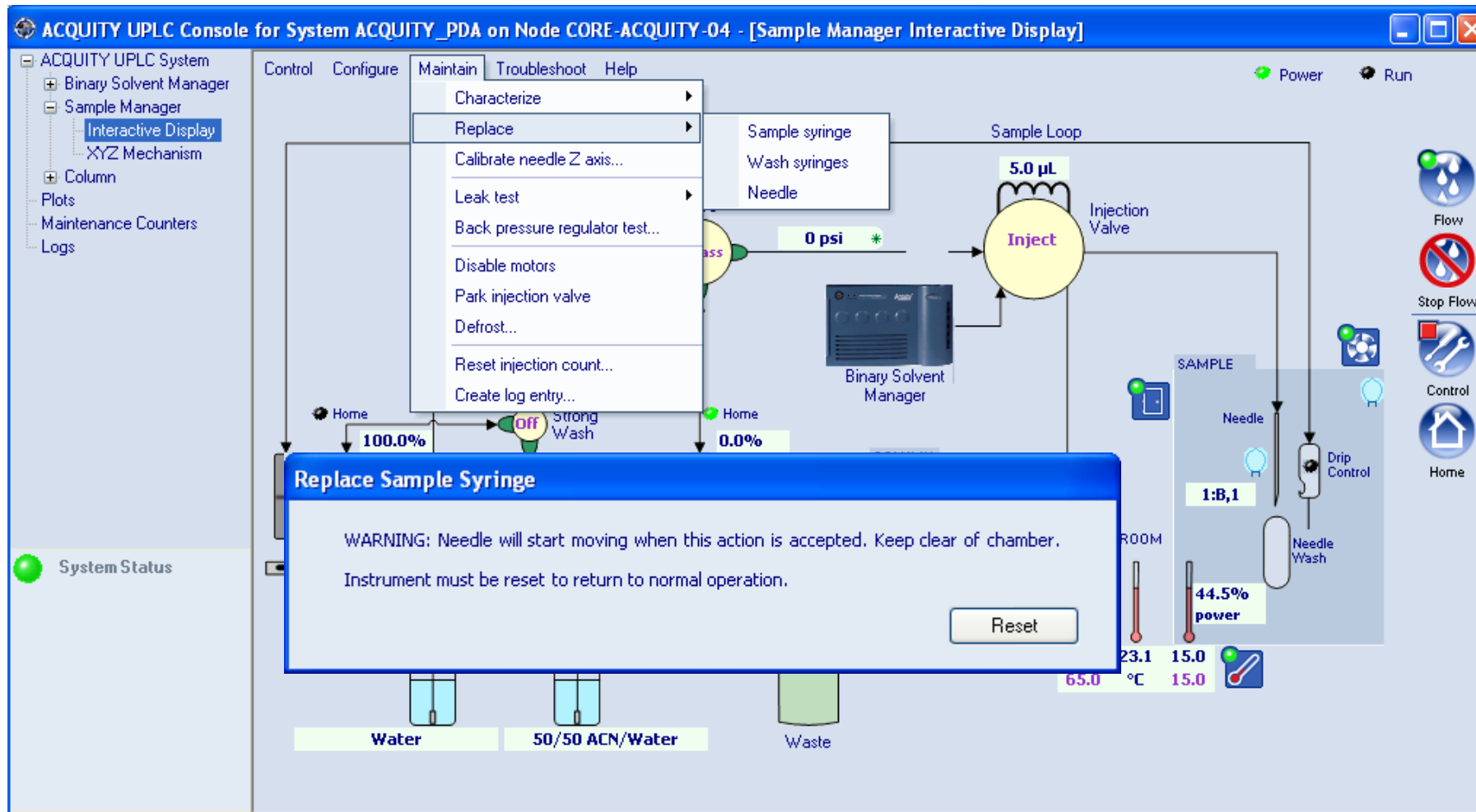
<< Results

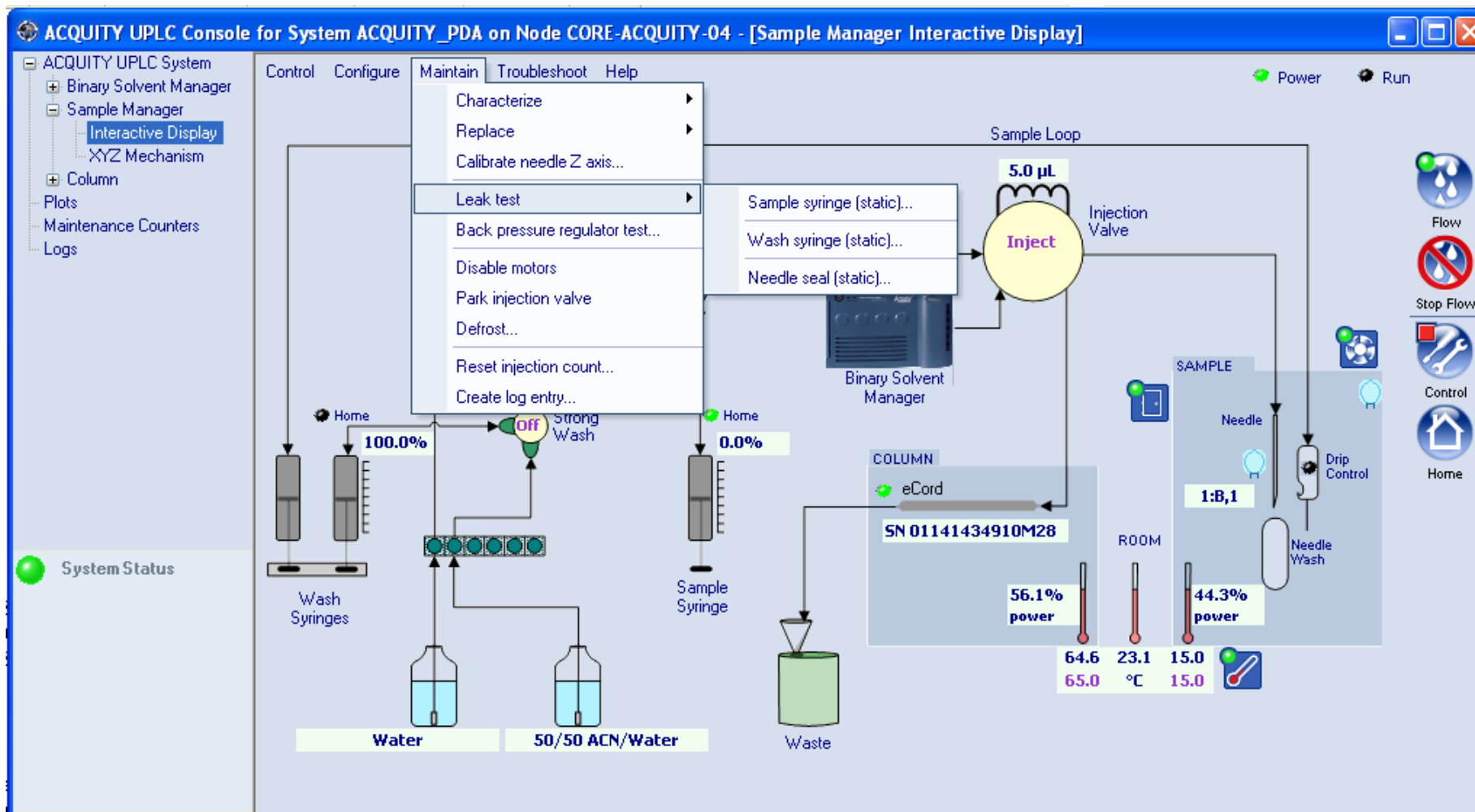
Close

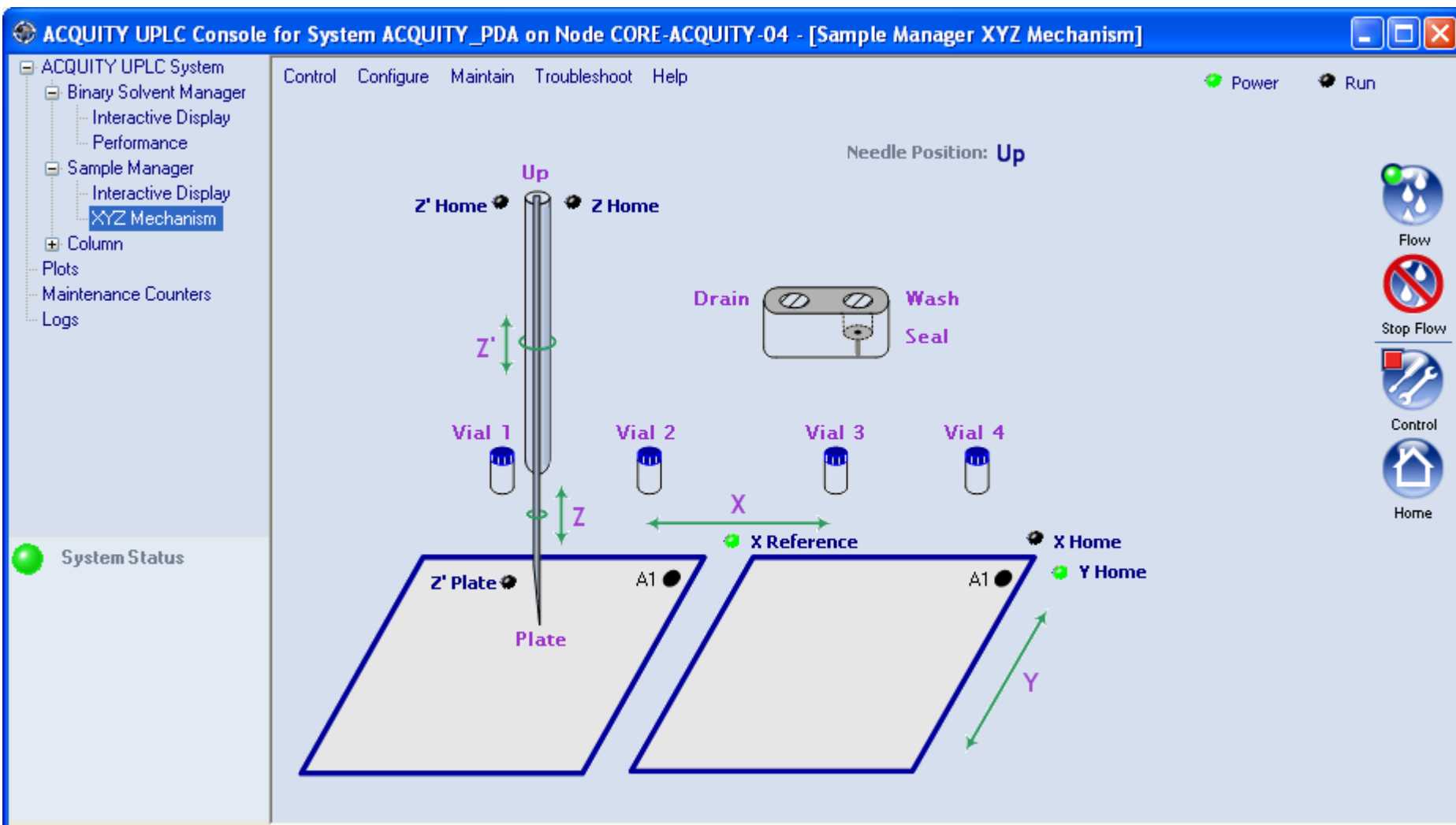
Print...

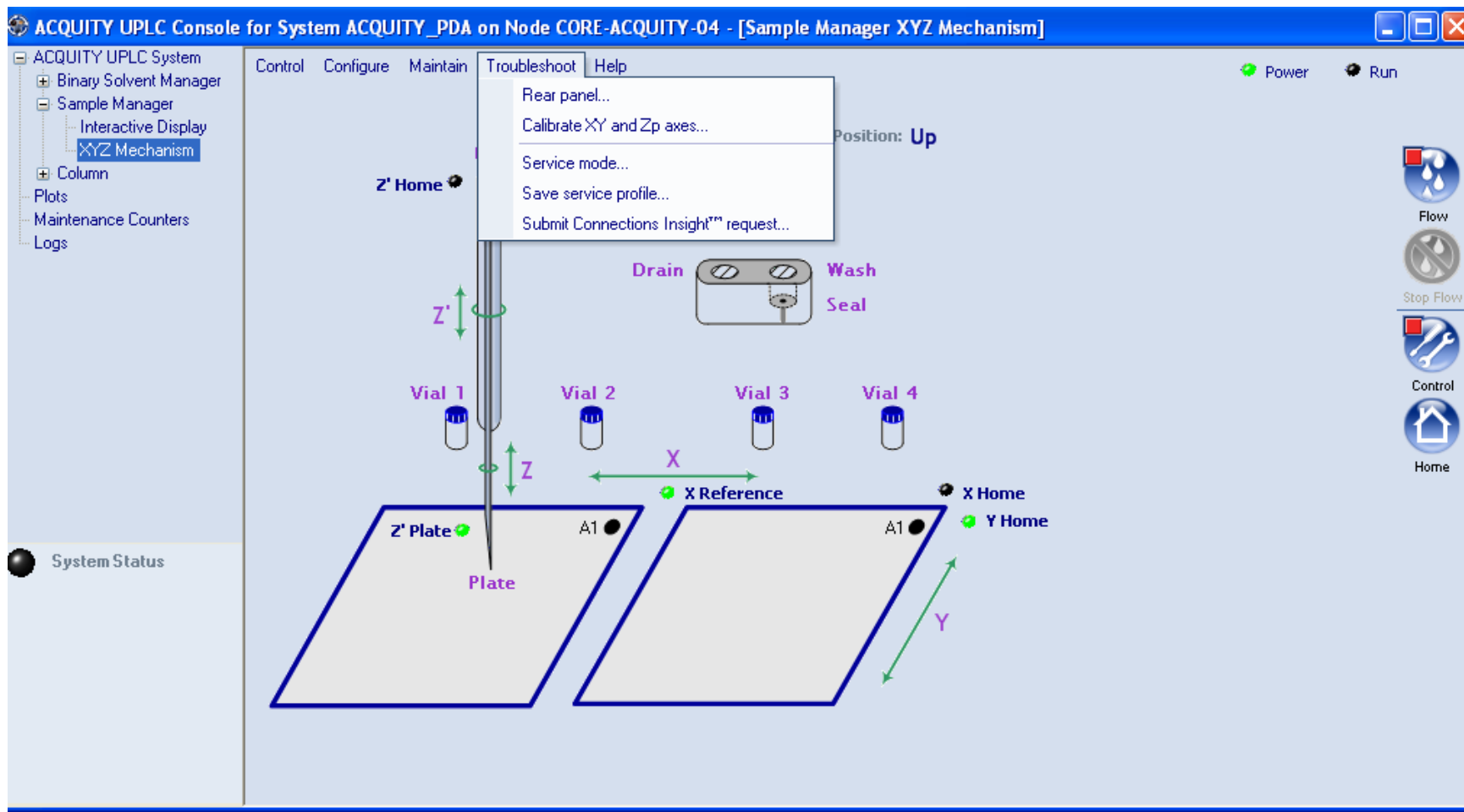
Results

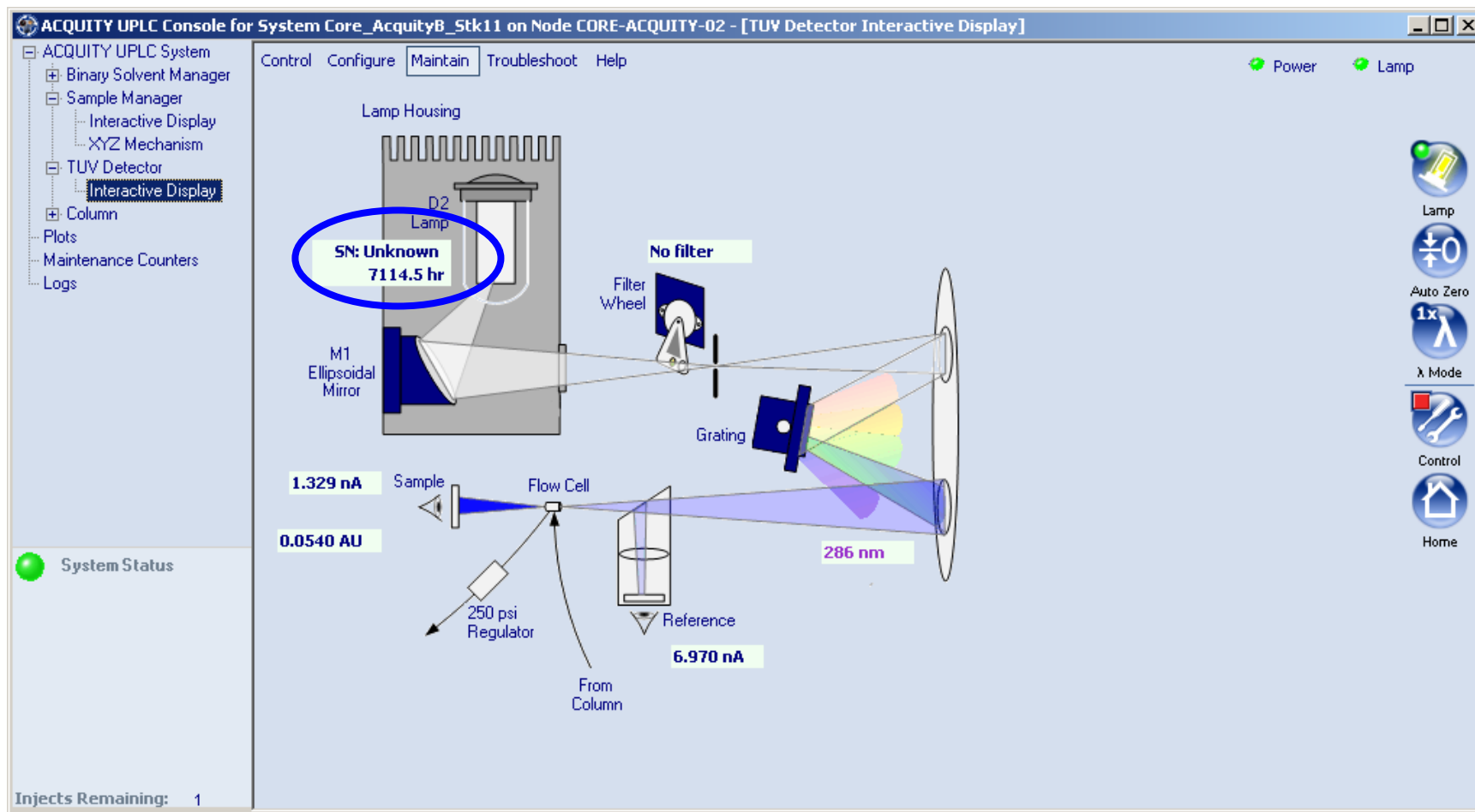
| | Measured volume | |
|-----------------------------|-----------------|---------|
| System volume with loop: | 47.1 | µL |
| System volume without loop: | 41.0 | µL |
| Loop: | Pass | 5.8 µL |
| Needle: | Pass | 33.5 µL |

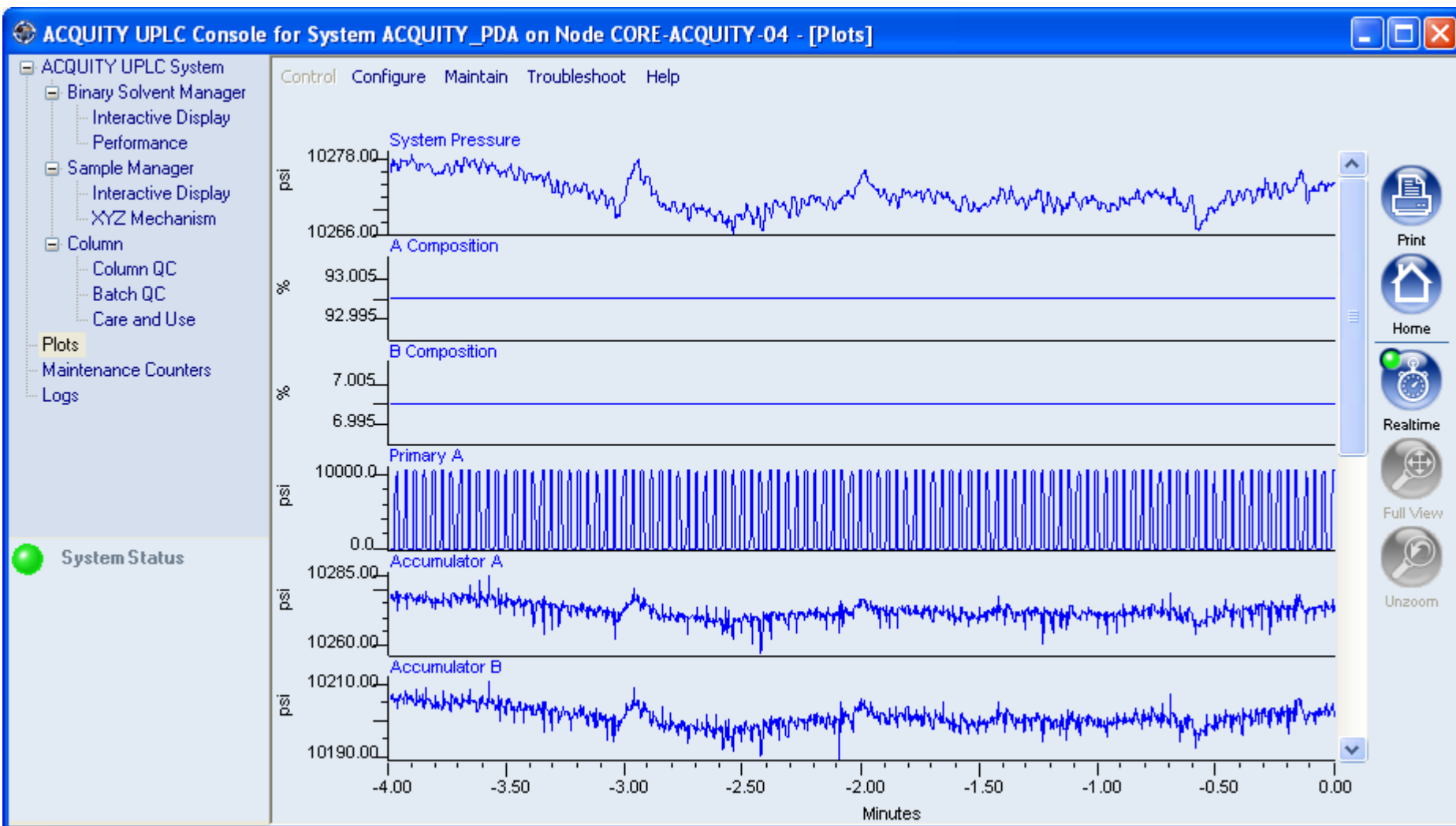


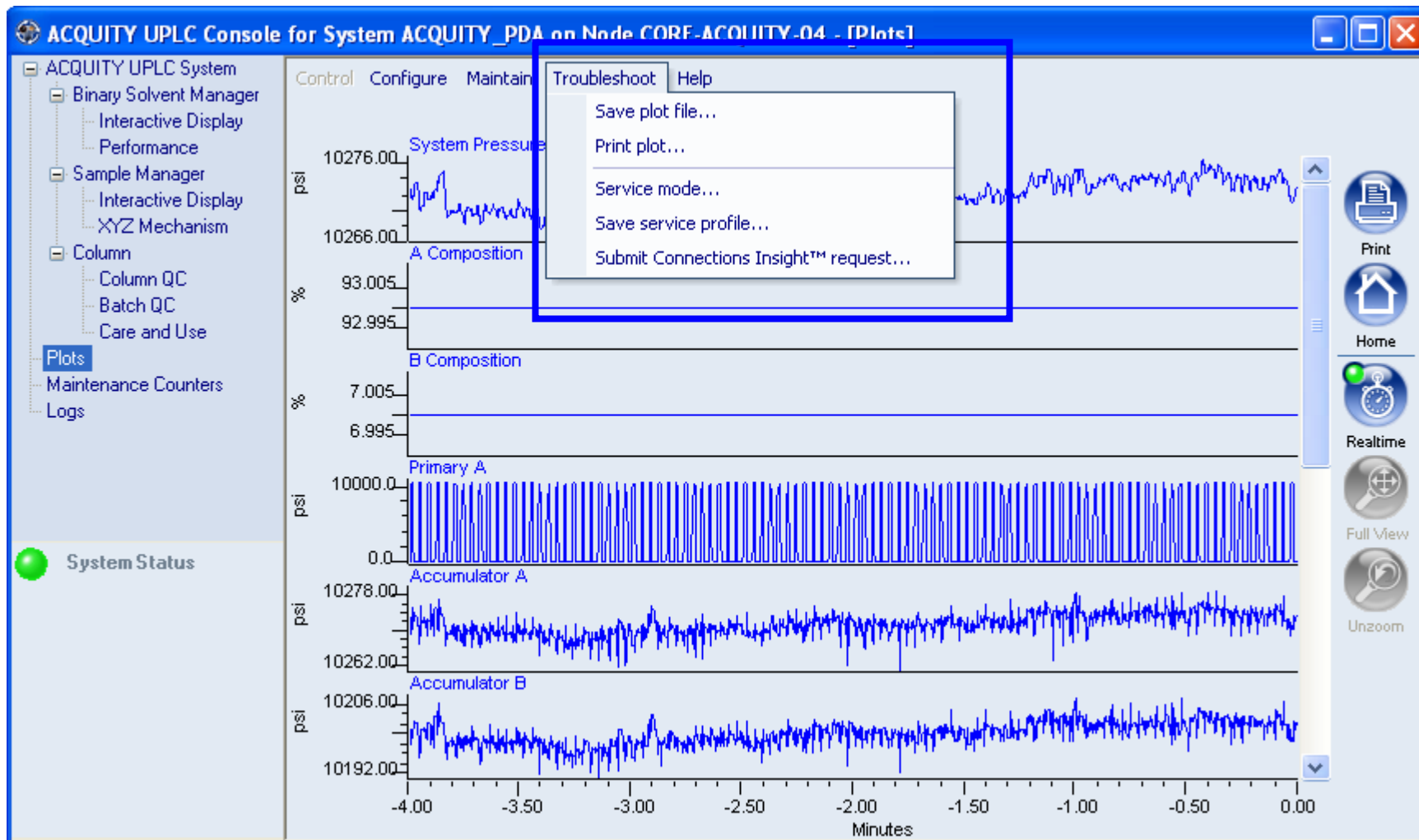












Save Plot File

Include channels:

- ☒ System Pressure
- ☐ Flow Rate
- ☒ A Composition
- ☒ B Composition
- ☒ Primary A
- ☒ Accumulator A
- ☐ Primary B
- ☒ Accumulator B
- ☒ Degasser
- ☐ Measured Flow Rate A

Time Range

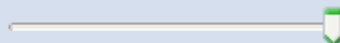
Include points as old as:

February 21 at 5:21:20 PM



...and as recent as:

February 25 at 5:22:02 PM



File location and name:

< Click Browse... to enter a file name and location >

Browse...

OK

Cancel

Connections Insight™ Request

Name:

Patricia McConville

Telephone:

800-252-4752 x2671

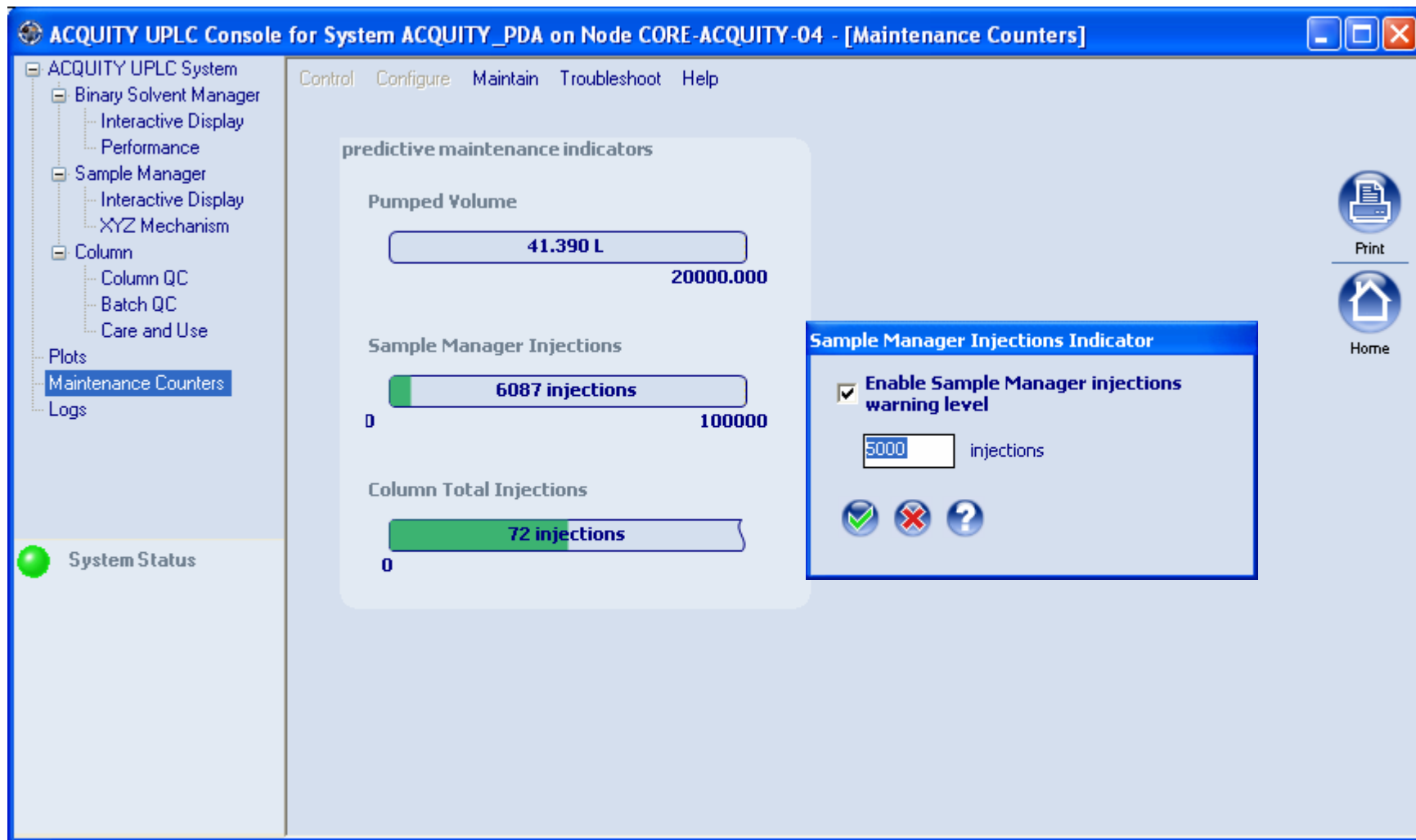
Email:

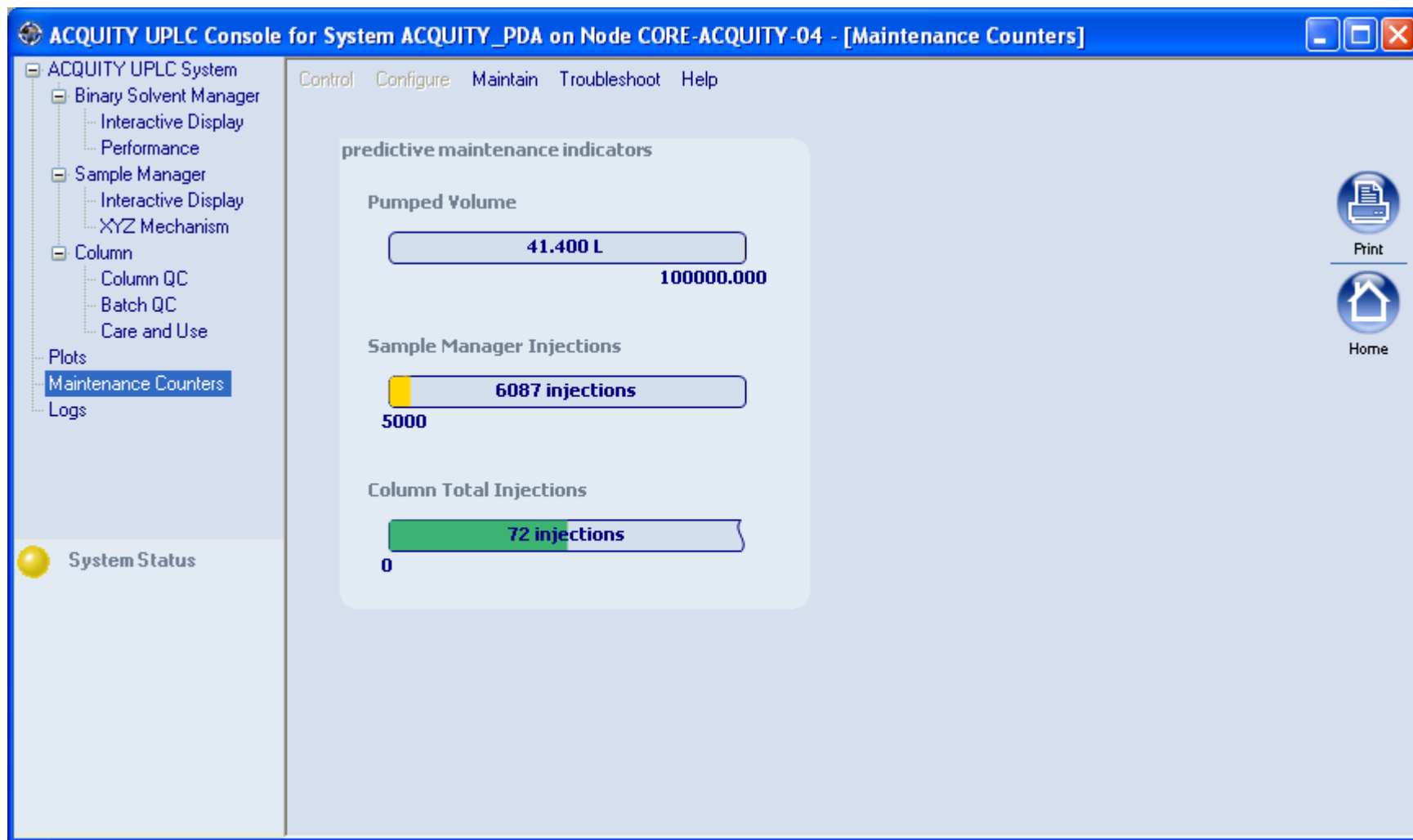
pat_mcconville@waters.com

Description:

Submit

Cancel





ACQUITY UPLC Console for System ACQUITY_PDA on Node CORE-ACQUITY-04 - [Logs]

Control Configure Maintain Troubleshoot Help

Dates: Content: System or Module:

All Errors Current System

Today
Since Yesterday
Past Week
Past Month
Past Year
All

| | Severity | Instrument | Message |
|--------------------|-------------|----------------|--|
| 2/23/2005 3:23 PM | Information | ACQ-SM#C04UPS0 | Injection count exceeded (6087) |
| 2/25/2005 12:59 PM | Error | ACQ-BSM#D04UPB | System: Liters pumped maintenance limit exceeded |
| 2/24/2005 5:01 PM | Error | ACQ-BSM#D04UPB | System: System over pressure. (14959 psi) |
| 2/24/2005 4:59 PM | Error | ACQ-BSM#D04UPB | Pump A: General failure. (Initialization timeout on Pu |
| 2/24/2005 4:59 PM | Error | ACQ-BSM#D04UPB | System: System over pressure. (14108 psi) |
| 2/24/2005 4:57 PM | Information | ACQ-SM#C04UPS0 | eCord connected: Serial Number: 01141434910M28 , |
| 2/24/2005 4:57 PM | Information | ACQ-SM#C04UPS0 | eCord disconnected: Serial Number: 01021502710M2 |
| 2/24/2005 4:44 PM | Error | ACQ-BSM#D04UPB | System: System over pressure. (14110 psi) |
| 2/11/2005 2:59 PM | Information | ACQ-SM#C04UPS0 | eCord connected: Serial Number: 01021502710M20 , |
| 2/11/2005 2:58 PM | Information | ACQ-SM#C04UPS0 | eCord disconnected: Serial Number: M41951C08 , Inj |
| 2/11/2005 2:58 PM | Information | ACQ-SM#C04UPS0 | eCord connected: Serial Number: M41951C08 , Inject |

details of current record

Injection count exceeded (6087)

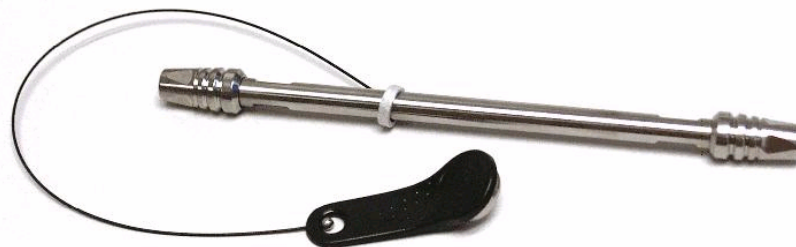
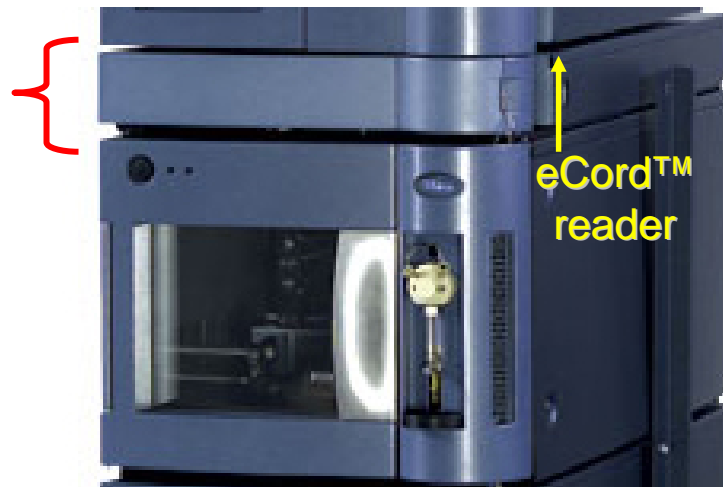
System Status

Refresh
Print
Home

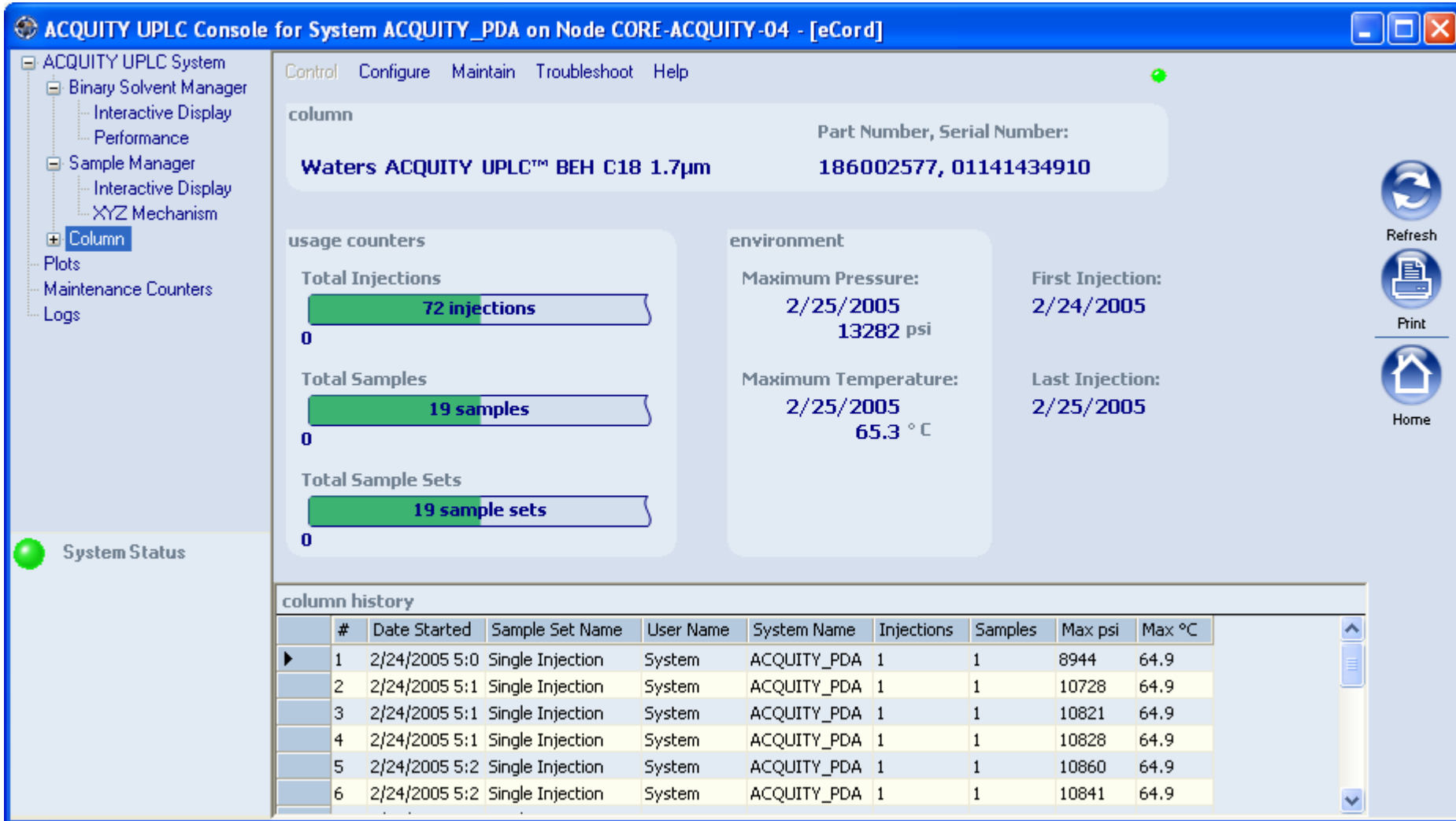
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eCord™ Technology

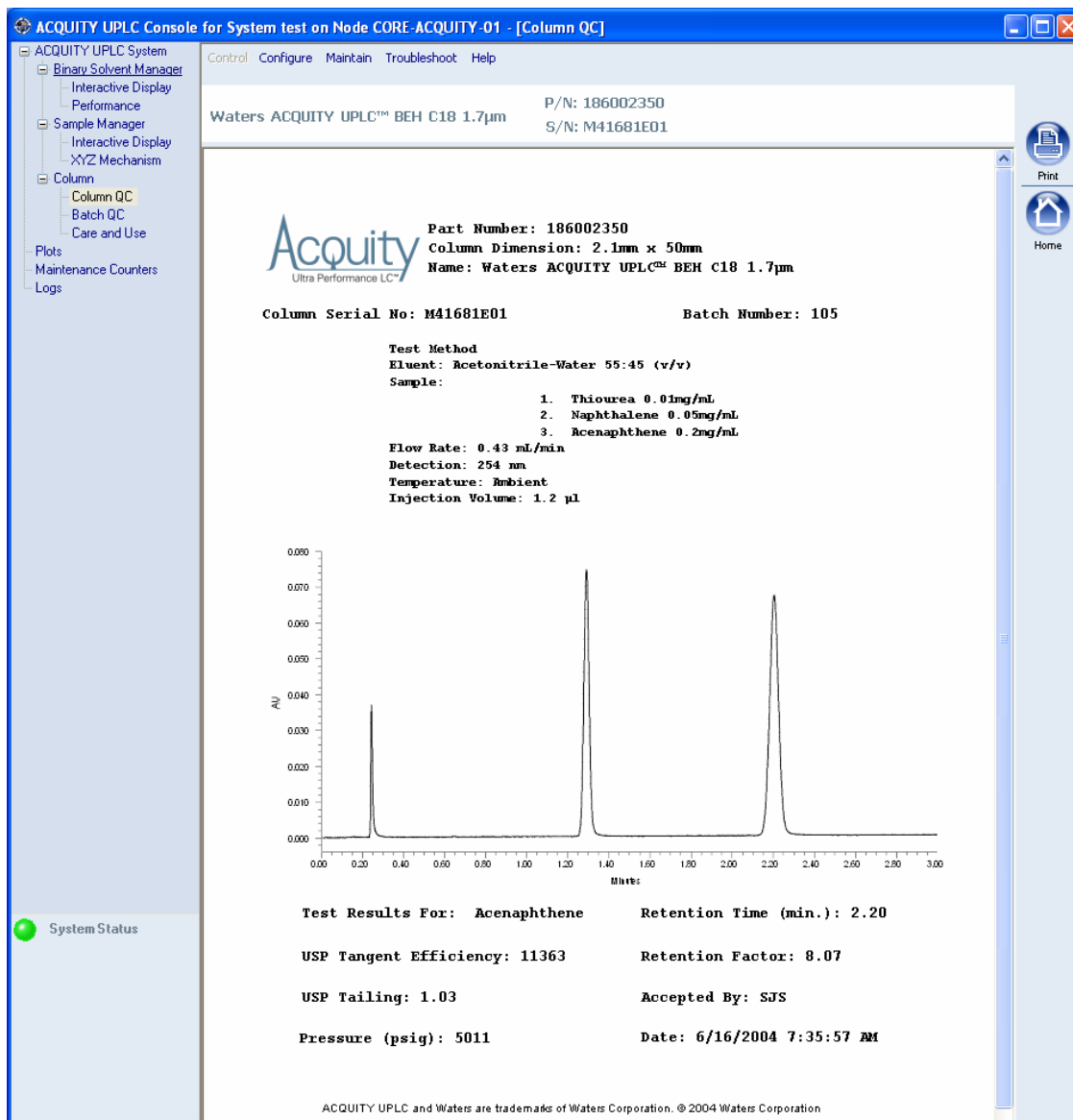
- Column Information
 - Certificate of Analysis
- Column Usage History
 - Total number of samples
 - Injections
 - Pressure/Temperature history
 - And much more...



eCord™



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ACQUITY UPLC Console for System test on Node CORE-ACQUITY-01 - [Column Batch QC]

Control Configure Maintain Troubleshoot Help

ACQUITY UPLC System
Binary Solvent Manager
Interactive Display
Performance
Sample Manager
Interactive Display
XYZ Mechanism
Column
Column QC
Batch QC
Care and Use
Plots
Maintenance Counters
Logs

Waters ACQUITY UPLC™ BEH C18 1.7µm
P/N: 186002350
S/N: M41681E01

Print
Home

Acquity
Ultra Performance LC™

Certificate of Analysis

ACQUITY UPLC™ BEH C₁₈, 1.7 µm

Batch # 105

Analytical Results for ACQUITY UPLC™ BEH C₁₈, 1.7µm

| | Result |
|---|--------------------------|
| Analysis of Unbonded Particles | |
| 90 % / 10 % Diameter Ratio | 1.55 |
| Particle Consistency | Pass |
| Pore Structure | |
| Pore Volume | 0.68 cm ³ /g |
| Average Pore Diameter | 131 Å |
| Surface Area | 184 m ² /g |
| Metal Impurity Concentrations | |
| Na | 5 ppm |
| Al | 4 ppm |
| Fe | 6 ppm |
| Analysis of ACQUITY UPLC™ BEH C₁₈, 1.7 µm | |
| Total Carbon Content | 17.60 % |
| C ₁₈ Surface Coverage | 3.14 µmol/m ² |

System Status

Options ▾ ×

Bookmarks

Signatures

Layers

Pages

Comments

1

2

3

4

5

6

7

8

Waters

ACQUITY UPLC™ BEH Column Care and Use Instructions



Thank you for choosing a Waters ACQUITY UPLC™ BEH column. The ACQUITY UPLC™ BEH packing materials were designed specifically for use with the Waters ACQUITY UPLC™ system and are manufactured in a cGMP, ISO 9002 certified plant using ultra pure reagents. Each batch of ACQUITY UPLC™ BEH material is tested chromatographically with acidic, basic and neutral analytes and the results are held to narrow specification ranges to assure excellent, reproducible performance. Every column is individually tested and a Performance Chromatogram and Certificate of Batch Analysis are provided on the eCord™ intelligent chip.

Contents

- I. Getting Started
 - a. Column Connectors
 - b. Column Installation
 - c. Column Equilibration
 - d. eCord™ Installation
 - e. Initial Column Efficiency Determination
- II. Column Use
 - a. Sample Preparation
 - b. pH Range
 - c. Solvents
 - d. Pressure
 - e. Temperature

Table 2. Buffer Recommendations for Using ACQUITY UPLC™ BEH Columns from pH 1 to 12

| Additive/Buffer | pKa | Buffer range | Volatility (±1 pH unit) | Used for Mass Spec | Comments |
|--|---|--------------|----------------------------|-----------------------|--|
| TFA | 0.3 | | Volatile | Yes | Ion pair additive, can suppress MS signal, used in the 0.02-0.1% range. |
| Acetic Acid | 4.76 | | Volatile | Yes | Maximum buffering obtained when used with ammonium acetate salt. Used in 0.1-1.0% range. |
| Formic Acid | 3.75 | | Volatile | Yes | Maximum buffering obtained when used with ammonium formate salt. Used in 0.1-1.0% range. |
| Acetate (NH ₄ CH ₃ COOH) | 4.76 | 3.76 – 5.76 | Volatile | Yes | Used in the 1-10 mM range. Note that sodium or potassium salts are not volatile. |
| Formate (NH ₄ COOH) | 3.75 | 2.75 – 4.75 | Volatile | Yes | Used in the 1-10 mM range. Note that sodium or potassium salts are not volatile. |
| Phosphate 1 | 2.15 | 1.15 – 3.15 | Non-volatile | No | Traditional low pH buffer, good UV transparency. |
| Phosphate 2 | 7.2 | 6.20 – 8.20 | Non-volatile | No | Above pH 7, reduce temperature/concentration and use a guard column to maximize lifetime. |
| 4-Methylmorpholine | ~8.4 | 7.4 – 9.4 | Volatile | Yes | Generally used at 10 mM or less. |
| Ammonia (NH ₄ OH) | 9.2 | 8.2 – 10.2 | Volatile | Yes | Keep concentration below 10 mM and temperatures below 30 °C. |
| Ammonium Bicarbonate | 10.3 (HCO ₃ ⁻) 9.2 (NH ₄ ⁺) 6.3 (H ₂ CO ₃) | 6.8 – 11.3 | Volatile | Yes | Used in the 5-10 mM range (for MS work keep source >150 °C). Adjust pH with ammonium hydroxide or acetic acid. Good buffering capacity at pH 10. Note: use ammonium bicarbonate (NH ₄ HCO ₃), not ammonium carbonate ((NH ₄) ₂ CO ₃). |
| Ammonium (Acetate) | 9.2 | 8.2 – 10.2 | Volatile | Yes | Used in the 1-10 mM range. |
| Ammonium (Formate) | 9.2 | 8.2 – 10.2 | Volatile | Yes | Used in the 1-10 mM range. |
| Borate | 9.2 | 8.2 – 10.2 | Non-Volatile | No | Reduce temperature/concentration and use a guard column to maximize lifetime. |
| CAPSO | 9.7 | 8.7 – 10.7 | Non-Volatile | No | Zwitterionic buffer, compatible with acetonitrile, used in the 1-10 mM range. Low odor. |
| Glycine | 2.4, 9.8 | 8.8 – 10.8 | Non-Volatile | No | Zwitterionic buffer, can give longer lifetimes than borate buffer. |
| 1-Methylpiperidine | 10.2 | 9.3 – 11.3 | Volatile | Yes | Used in the 1-10 mM range. |
| CAPS | 10.4 | 9.5 – 11.5 | Non-Volatile | No | Zwitterionic buffer, compatible with acetonitrile, used in the 1-10 mM range. Low odor. |
| Triethylamine (as acetate salt) | 10.7 | 9.7 – 11.7 | Volatile | Yes | Used in the 0.1-1.0% range. Volatile only when titrated with acetic acid (not hydrochloric or phosphoric). Used as ion-pair for DNA analysis at pH 7-9. |
| Pyrrolidine | 11.3 | 10.3 – 12.3 | Volatile | Yes | Mild buffer, gives long lifetime. |

c. Solvents

To maintain maximum column performance, use high quality chromatography grade solvents. Filter all aqueous buffers prior to use. Pall Gelman Laboratory Acrodisc® filters are recommended. Solvents containing suspended particulate materials will generally clog the outside surface of the inlet distribution frit of the column. This will result in higher operating pressure and poorer performance.

Degas all solvents thoroughly before use to prevent bubble formation in the pump and detector. The use of an on-line degassing unit is also recommended. This is especially important when running low pressure gradients since bubble formation can occur as a result of aqueous and organic solvent mixing during the gradient.

d. Pressure

ACQUITY UPLC™ BEH columns can tolerate pressures of up to 15,000 psi (1034 bar or 103 Mpa).

III. SCALING UP/DOWN ISOCRATIC METHODS

The following formulas will allow scale up or scale down, while maintaining the same linear velocity, and provide new sample loading values:

If column i.d. and/or length are altered:

$$F_2 = F_1 (r_2/r_1)^2$$

$$\text{Load}_2 = \text{Load}_1 (r_2/r_1)^2 (L_2/L_1)$$

$$\text{Injection volume}_2 = \text{Injection volume}_1 (r_2/r_1)^2 (L_2/L_1)$$

Where:

r = Radius of the column

F = Flow rate

L = Length of column

1 = Original, or reference column

2 = New column

- Integrated hardware and software
 - Visual system status indicators on hardware
 - Instrument Control Panel
- Instrument Console
 - A customizable *Instrument Console* enables operators to easily stay in control of all system functionality including instrument control, interactive system monitoring, status monitoring, and user diagnostic capabilities.
- eCord™ Technology
 - Accurate permanent record of column history
- Connections® INSIGHT™ remote monitoring capabilities

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- Customer calls Waters asking for support
- Customer describes system problem

- Field Engineer is now onsite, but finds a completely different problem, consequently, parts and tools he brought will not work for this repair



Process Results In:

- Increased Repair time
 - Challenges in getting info
 - Difficulties in diagnosing problem
- Increased instrument downtime & lower productivity
- Lower Customer Satisfaction

- Support Engineer asks a series of questions Name, Location, Serial #, Verify entitlement
- Engineer tries to work through the problem



- Support Engineer believes all the information he needs is correct and dispatches Field Engineer to Customer site.

Today's Laboratory Challenges

- Minimize instrument downtime



- Reduce time to assess & diagnose problems

Lab Challenges

- Increase laboratory productivity

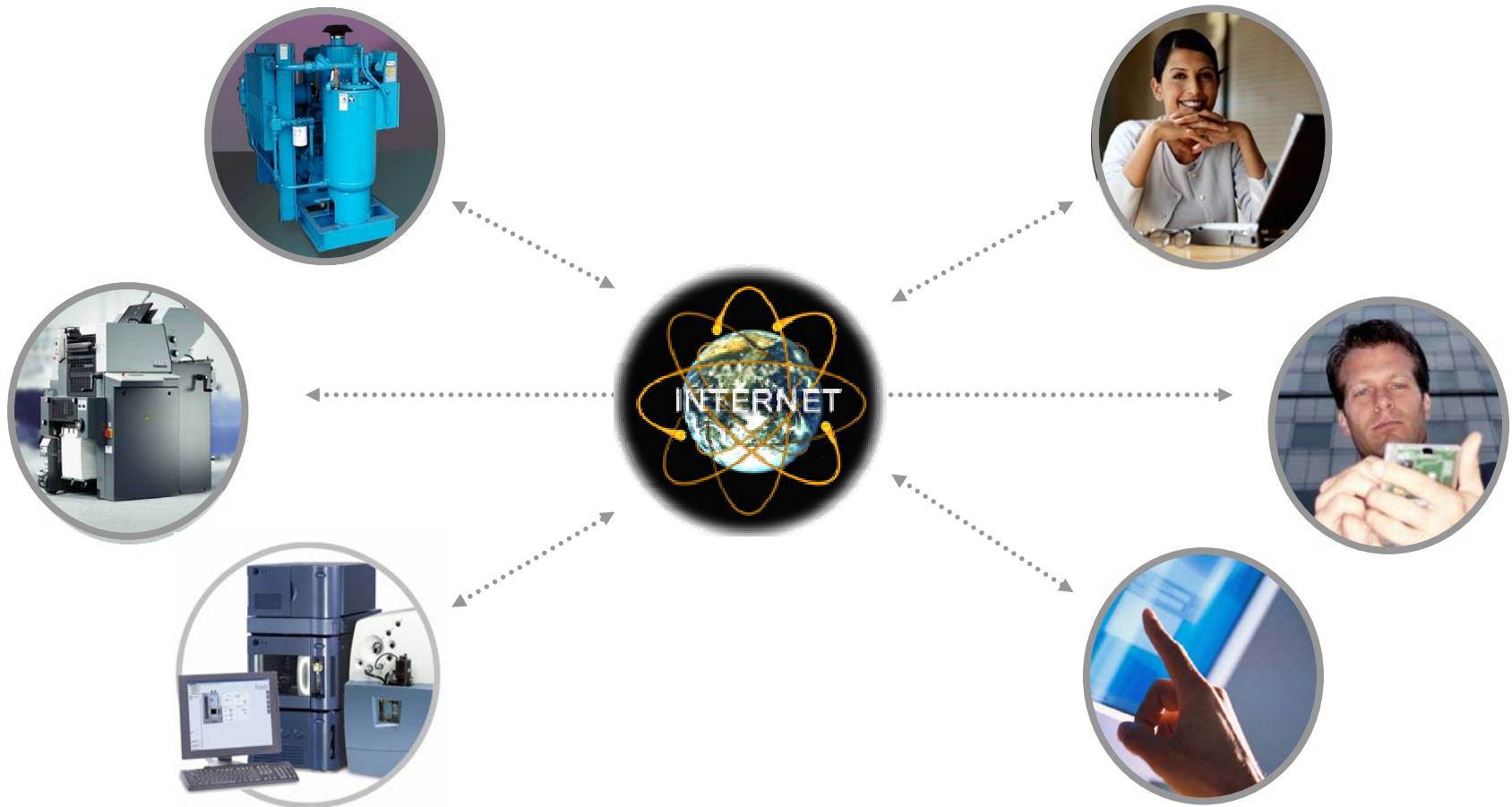


- Lower support costs

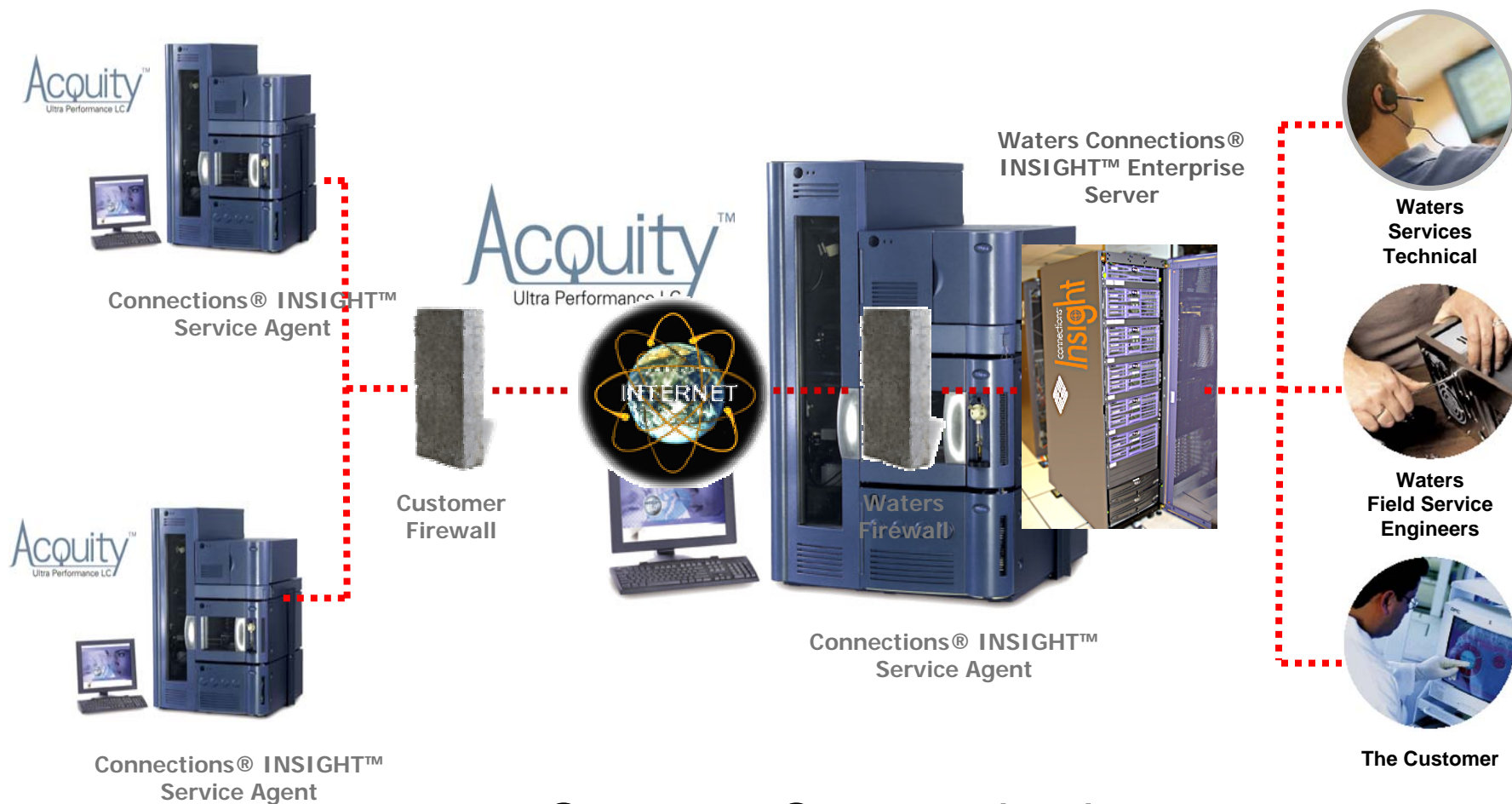
Meeting today's challenges demands proactive and timely service

- Connections® INSIGHT™ uses proven Intelligent Device Management (IDM™) technology that has been successfully implemented in highly regulated, maximum security medical devices and medical records environments
- Connections® INSIGHT™ leverages the Internet to proactively and securely connect the ACQUITY ULPC™ system to Waters' service experts
- Connections® INSIGHT™ creates the “virtual presence” of a service Engineer in the customer lab that monitors the ACQUITY UPLC™ system to ensure its maximum uptime and system performance

What Does Intelligent Device Management™ Do ?



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One-way Communication

.....▶

.....▶

Temperature has exceeded threshold



System Pressure & over Pressure Conditions



Lost remote communication

Operating Performance (Status)

Troubleshooting

Injections Per column

Liters Pumped

Lamp Hours

of Cycles & PM Cycles

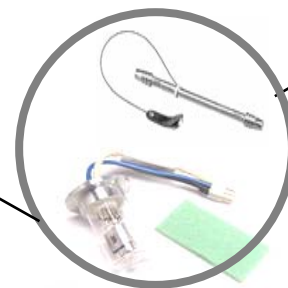
System Injections



Diagnostics

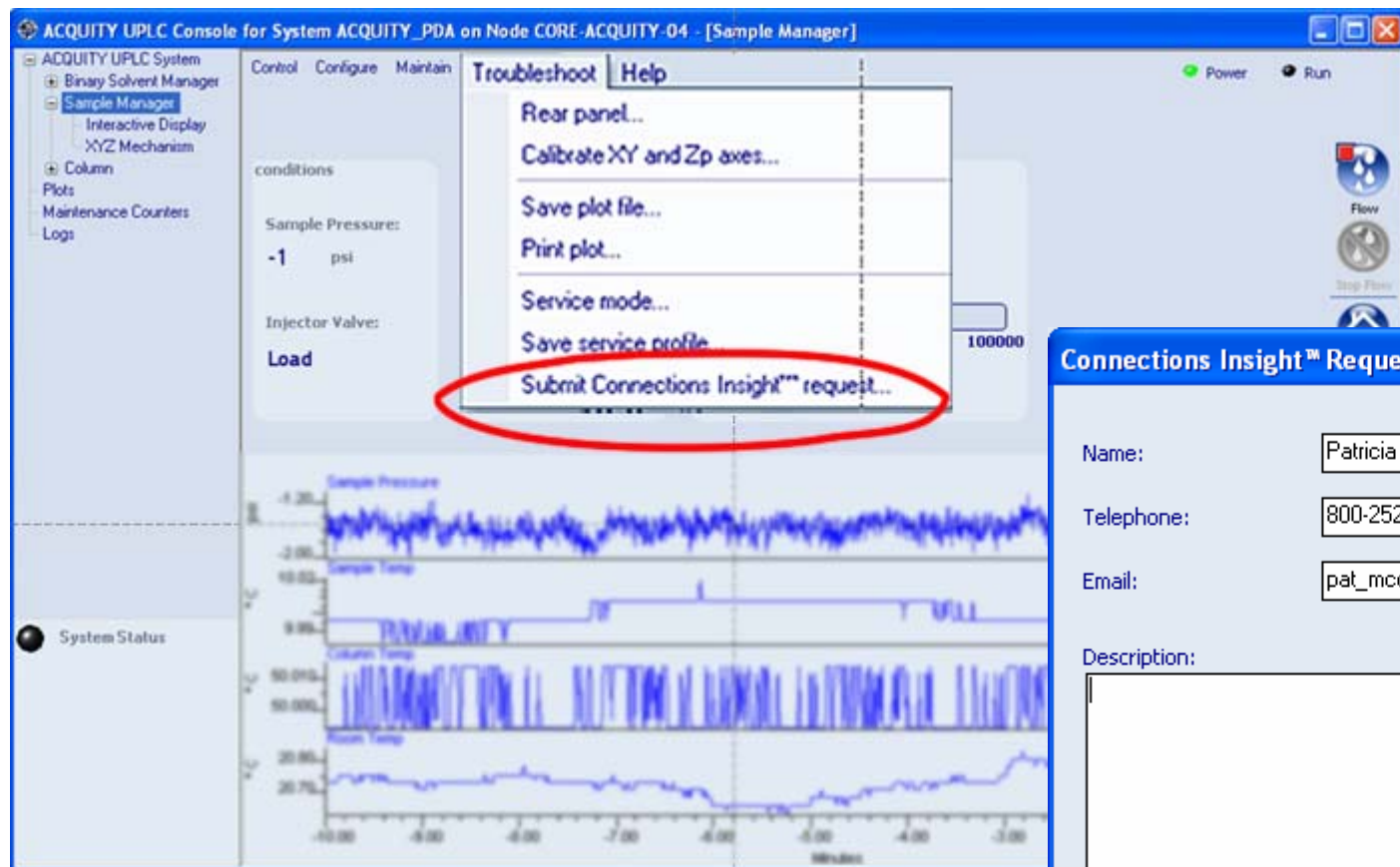
Lamp

Column



Replenishment (parts/consumables)

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Connections Insight™ Request

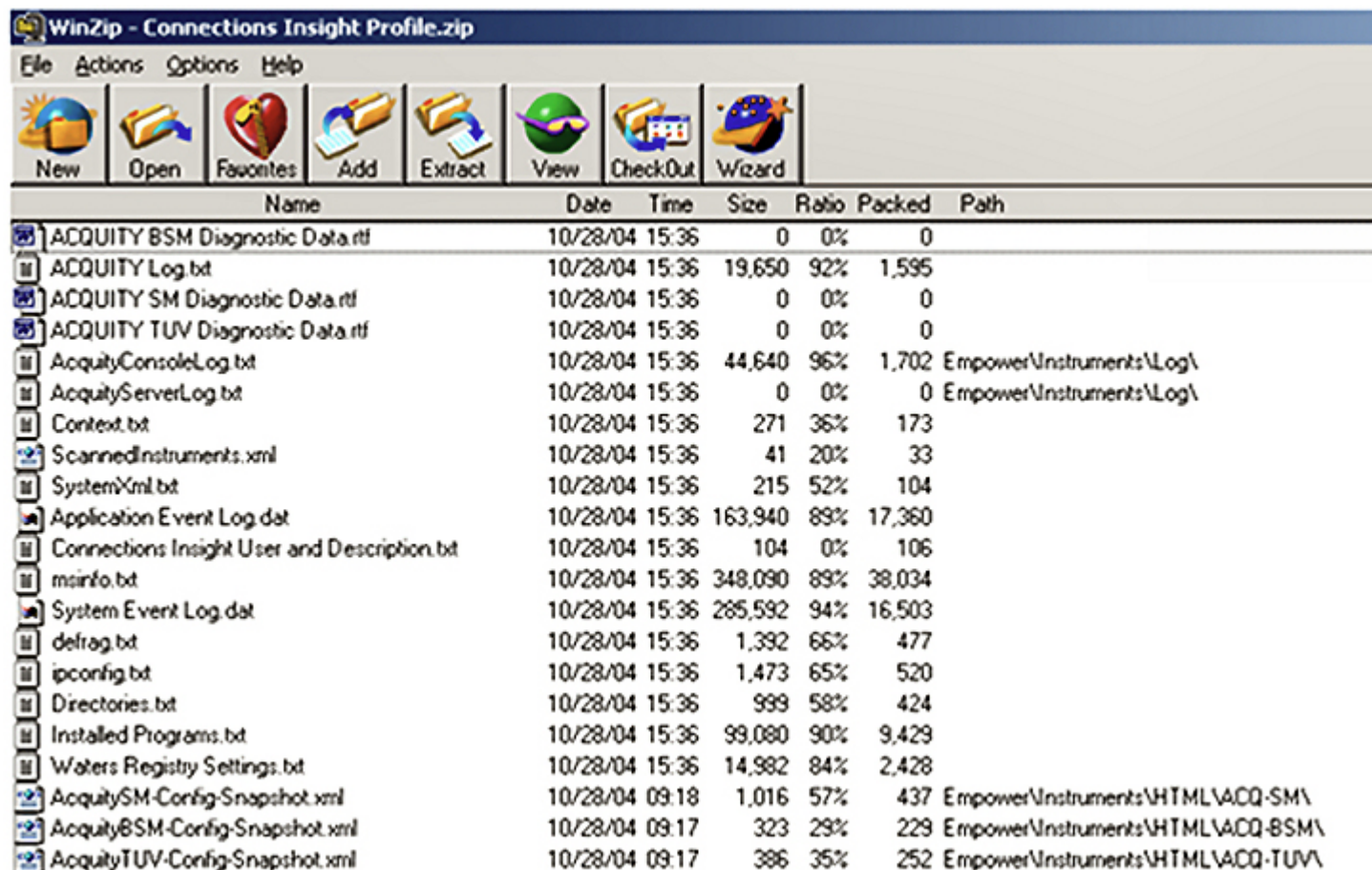
Name:

Telephone:

Email:

Description:

This is a portion of the contents of the “zipped” log file that is received and analyzed in Milford



| Name | Date | Time | Size | Ratio | Packed | Path |
|--|----------|-------|---------|-------|--------|-----------------------------------|
| ACQUITY BSM Diagnostic Data.rtf | 10/28/04 | 15:36 | 0 | 0% | 0 | |
| ACQUITY Log.txt | 10/28/04 | 15:36 | 19,650 | 92% | 1,595 | |
| ACQUITY SM Diagnostic Data.rtf | 10/28/04 | 15:36 | 0 | 0% | 0 | |
| ACQUITY TUV Diagnostic Data.rtf | 10/28/04 | 15:36 | 0 | 0% | 0 | |
| AcquityConsoleLog.txt | 10/28/04 | 15:36 | 44,640 | 96% | 1,702 | Empower\Instruments\Log\ |
| AcquityServerLog.txt | 10/28/04 | 15:36 | 0 | 0% | 0 | Empower\Instruments\Log\ |
| Context.txt | 10/28/04 | 15:36 | 271 | 36% | 173 | |
| ScannedInstruments.xml | 10/28/04 | 15:36 | 41 | 20% | 33 | |
| SystemXml.txt | 10/28/04 | 15:36 | 215 | 52% | 104 | |
| Application Event Log.dat | 10/28/04 | 15:36 | 163,940 | 89% | 17,360 | |
| Connections Insight User and Description.txt | 10/28/04 | 15:36 | 104 | 0% | 106 | |
| msinfo.txt | 10/28/04 | 15:36 | 348,090 | 89% | 38,034 | |
| System Event Log.dat | 10/28/04 | 15:36 | 285,592 | 94% | 16,503 | |
| defrag.txt | 10/28/04 | 15:36 | 1,392 | 66% | 477 | |
| ipconfig.txt | 10/28/04 | 15:36 | 1,473 | 65% | 520 | |
| Directories.txt | 10/28/04 | 15:36 | 999 | 58% | 424 | |
| Installed Programs.txt | 10/28/04 | 15:36 | 99,080 | 90% | 9,429 | |
| Waters Registry Settings.txt | 10/28/04 | 15:36 | 14,982 | 84% | 2,428 | |
| AcquitySM-Config-Snapshot.xml | 10/28/04 | 09:18 | 1,016 | 57% | 437 | Empower\Instruments\HTML\ACQ-SM\ |
| AcquityBSM-Config-Snapshot.xml | 10/28/04 | 09:17 | 323 | 29% | 229 | Empower\Instruments\HTML\ACQ-BSM\ |
| AcquityTUV-Config-Snapshot.xml | 10/28/04 | 09:17 | 386 | 35% | 252 | Empower\Instruments\HTML\ACQ-TUV\ |

Example of an alarm email initiated by customer

This message would be sent to the Engineer monitoring the system

To: john_d_walsh@waters.com
cc:
From: john_d_walsh@waters.com
Date: 10/29/2004 04:26:03 PM AST
Subject: Acquity Request #1395 for asset JohnWalsh_AS01_Z04UPS9999M

Dear walshj,

The following alarm has been generated by asset JohnWalsh_AS01_Z04UPS9999M:

Alarm Name = Fault generated by Asset
Alarm Description = C:\ConnectionsInsight/Connections Insight Profile.zip
Alarm Detail = Uploaded new file: C:\ConnectionsInsight/Connections Insight Profile.zip
Generated At = 2004-10-29T16:26:23 EDT

Alert Name = AcquityAssistance
Asset Name = JohnWalsh_AS01_Z04UPS9999M
Error Code = NEW_FILE
Abstract = FILE_UPLOAD
Alarm Event ID = 1425
Alarm ID = 1
Alarm Extension =
Force Reason =

This message can be customized by adding a content prefix to the associated alert.

=====

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Security at system, network and enterprise server levels...

- Uses SSL (Secure Sockets Layer), a multi-level authentication standard that is the same technology used for credit card transactions
- Only diagnostic parameters are transmitted – Waters has no visibility to customers' data (one-way communication)
- Utilizes customers' existing security infrastructure – no special network requirements needed (VPNs, modem pools)
- Initiates all communications from behind customers' firewall (system contacts us)
- Supports multiple network protocols



Why Would You Want to Implement This?

- Maximizes system uptime and productivity by proactively scheduling maintenance
- Gain confidence in the accuracy and quality of your results
- Predict potential problems by monitoring component and consumable usage
 - Avoid problems
 - Decrease time to repair
- Lower operating expenses through increased instrument utilization

Why Waters Want to Have This Implemented?

- Deliver proactive service to customers
 - Detect or predict problems before they occur or escalate
- Increase instrument uptime
 - Shorten the service response time
- Shorten MTTR (Mean Time to Repair)
 - Arrive on-site with the correct parts the first time
- Highest customer satisfaction

- Connections® INSIGHT™ is available for the Waters' ACQUITY UPLC™ System
- Available at **no additional** charge to customers who are under an ACQUITY UPLC™ warranty during the first year of service
- Value-added feature of ACQUITY UPLC™ Total Assurance Plans and Warranties
- Customer Requirements:
 - ACQUITY UPLC™ must have Empower or Masslynx software installed
 - Customer's PC will need access to the Internet

- Contact –Tina Ferreira, 508.482.3558
 - Questions/issues about Connections® INSIGHT™
 - Coordinate with the appropriate experts to get solutions
 - Arrange customer visits
 - Schedule webcasts

- ACQUITY UPLC™ System is synergistically designed...chemistry, hardware and software developed hand-in-hand to deliver outstanding performance, up-time and ease of use.
- Connections® INSIGHT™ provides remote monitoring and proactive troubleshooting capabilities for fast service and support allowing both Waters Service and our Customers to be always alert to any system issues
- ACQUITY UPLC™ :
 - Taking Liquid Chromatography to a whole new level

AcquityTM
Ultra Performance LC

connections[®]
InsightTM

Thank you for your time.

- Tina Ferreira: Product Manager for Connections Insight
- Elizabeth Robertson: Product Manager for ACQUITY UPLC™
- John Morawski: Project Manager for ACQUITY UPLC™
- Tanya Jenkins: Sr. Applications Chemist
- Eric Grumbach: Sr. Applications Chemist