



ACQUITY Arc Systems with LC Detectors

Performance Test

General information

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Technical Inquiry Database/Service Assist Comments or Questions	Service Key Document: Technical Inquiries
Customer Interaction Tracking (CIT)	Service Key Document: Customer Interaction Tracking (CIT)

Performance test safety considerations

Use this performance test in conjunction with the relevant installation guide. All safety-related information within the installation guide remains applicable during the performance testing. See "Safety advisories" within the installation guide for more information.

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1 General test information

This document provides instructions for preparing, running, and evaluating the system performance tests for an ACQUITY Arc System with any LC detector.

! **Notice:** If the customer purchased qualification, see the qualification testing referenced in the [qualification documents](#).

Revision date	March, 2017
Parts	• Cortecs C18 2.7μ 4.6 x 50-mm column, 186007375 (for UV and RI detectors) • IC_PAK Anion HR 4.6 x 75 mm column, WAT026765 (for 2432 detectors)
Sample kits	• ACQUITY Arc UV Absorb Start-up solution, 186008093 • ACQUITY Arc RI Start-up Solution, 186008094 • System Start-up Solution Kit, 186008093 (for 2998 PDA or 2489 UV) or 186008094 (for 2414 RI) • Waters ACQUITY UPLC System FLR Test Solution (2475 FLR), 700003694 • Waters ACQUITY UPLC Systems ELSD Test Solution (2424 ELS), 700002848 • Waters Conductivity Detector OQ/PQ Test Solution, 700002309
Solvents	• LC/MS-grade methanol • LC/MS-grade acetonitrile • LC/MS-grade water • Waters 2432 premixed mobile phase (700002310)
Tools/materials	• 10-mL class A volumetric flask • 20-mL class A graduated measuring cylinder • 100-mL class A graduated measuring cylinder • 250-mL class A graduated measuring cylinder • 1-L reservoir bottle
Documentation	• ACQUITY Arc System Installation Checklist • ACQUITY Arc Installation Manual

Technical support	Global Service and Support (full information) USA phone support: 508-482-8070 or 800-252-4752 x8070 Wilmslow phone support: 44-161-435-4490 or 0800-345-7521 (UK) 800-887-0874 (US)
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2 Preparing for the Tests

2.1 Confirm prerequisites

Confirm that all the prerequisites are met.

Table 2–1: Performance test prerequisites

Prerequisite	Guiding document
Ensure that Waters-recommended solvents and clean glassware are available.	Controlling Contamination in UPC2/MS Systems (715003809)
Ensure that the Arc system is set up, with all optional components prepared.	ACQUITY Arc System Installation Manual
Ensure that the appropriate software, firmware, software change notes (SCNs), and driver packs are installed on the system workstation.	Software Support Key Document
Ensure that the installation checklist sections preceding the test results are completed.	ACQUITY Arc System Installation Checklist

2.2 Installing the project

Alternative: If you are unable to download the project from the Waters portal, create your performance test methods using the method parameter settings provided in the Reference section at the back of this document.

1. From the Waters portal, navigate to the appropriate Empower or MassLynx installation project.
2. Download the appropriate detector-specific project.
3. Rename the project, using the serial number and date of the install.
4. Do one of the following:
 - If using Empower, use the Restore Projects Wizard to restore the project, and then use Empower Pro to create a new system.
 - If using MassLynx, copy the downloaded project file to the MassLynx folder on the C:\ drive.

2.3 Configure the System

- [Configure the Empower system](#)
- [Configure the MassLynx system](#)

Important: If your Empower-controlled system includes a 2432 detector, you need to perform some preliminary steps before you can configure the system through Empower. Follow the steps in [Loading the 2432 ICS](#) before configuring the system in Empower.

2.3.1 Configure the Empower system

This section applies to all system configurations.

1. From the Configuration Manager, click **File > New > Chromatographic System**.
2. In the New Chromatographic System Wizard, select **Create New System**.
3. Follow the on-screen instructions to create a new system, ensuring that the correct detectors and modules are selected, and then click **Next**.
4. Choose the appropriate permissions according to the customer's standard operating practice.

2.3.2 Configure the MassLynx system

Configure system components, chromatographic pumps, events and triggering, and the sample manager.

To configure the system:

1. From the MassLynx Inlet Method window, start the Inlet Configuration Wizard.
2. Select the appropriate pump, sample manager, and detectors (see the following Figures). After each selection, click **Next**.

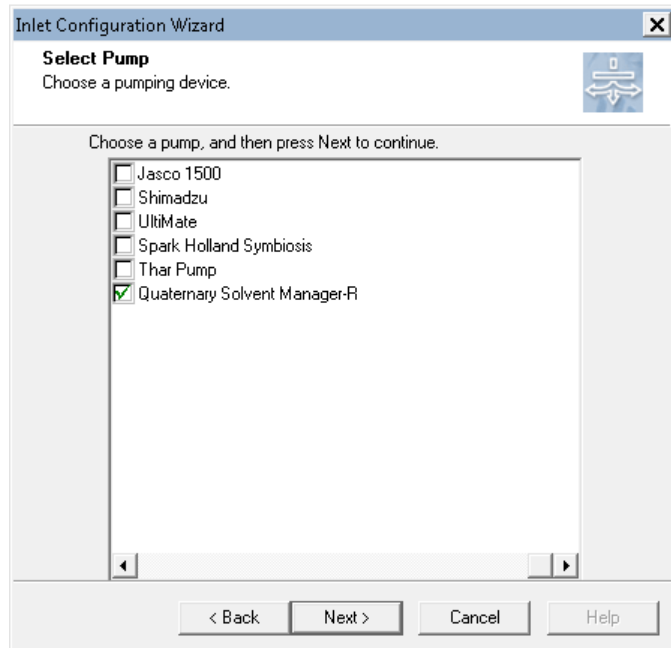
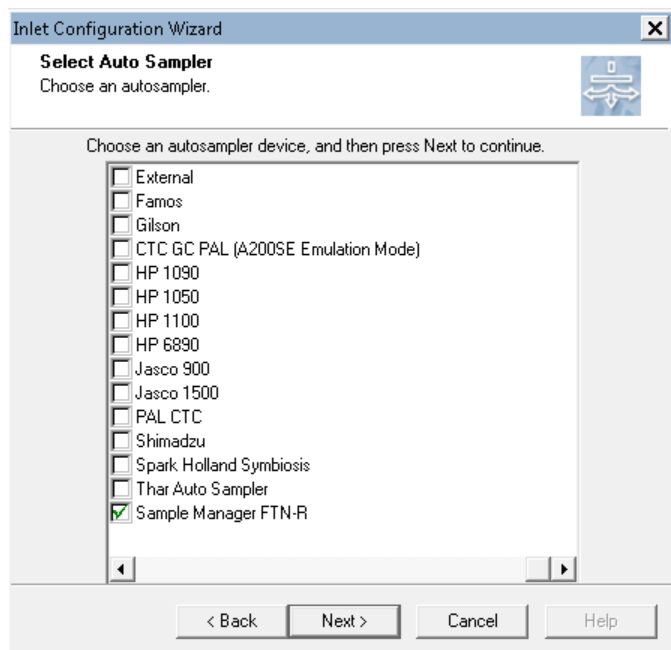
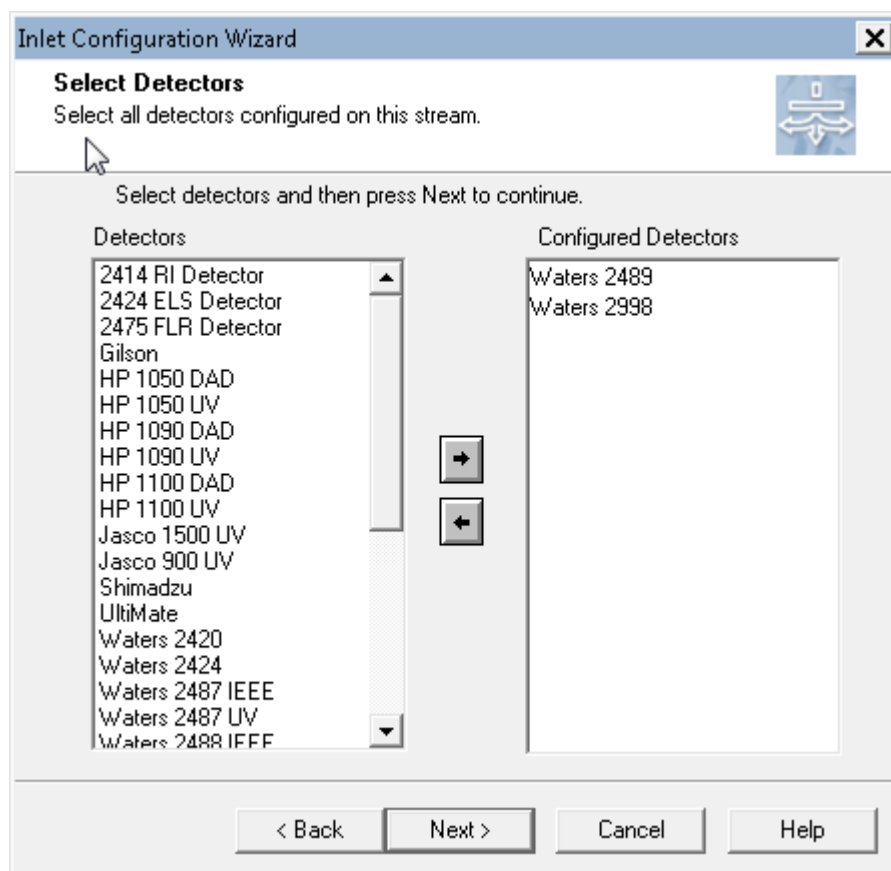
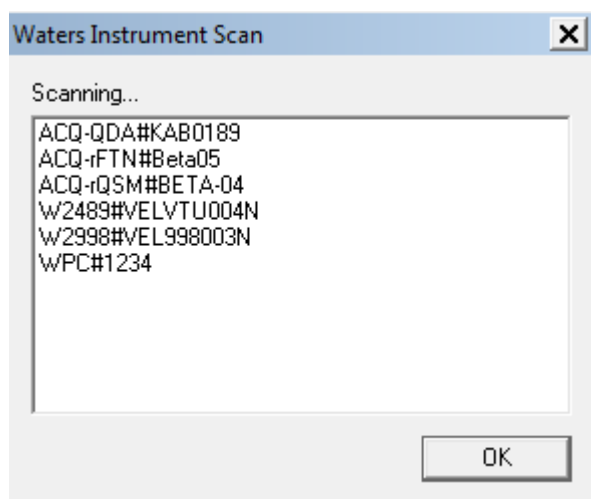
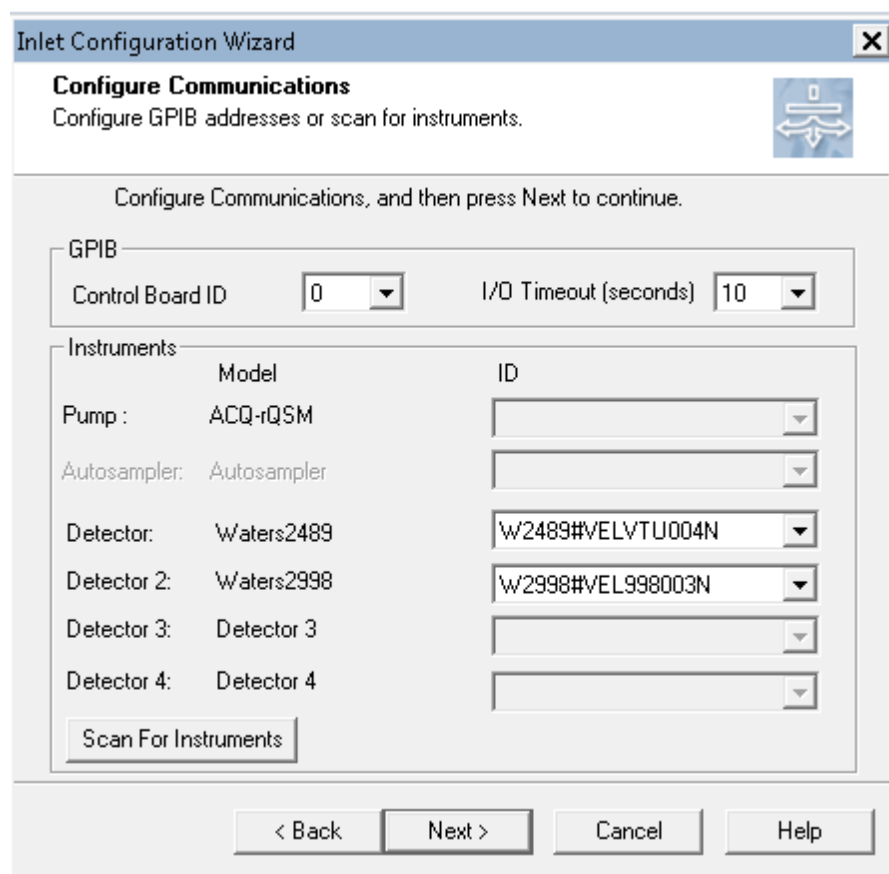
Figure 2–1: Selecting the pump**Figure 2–2: Selecting the sample manager**

Figure 2–3: Selecting the detector

3. When prompted to configure communications, click **Scan for Instruments** (see the following Figure).
4. In the Waters Instrument Scan dialog, confirm that the appropriate instruments are displayed, and then click **OK**.

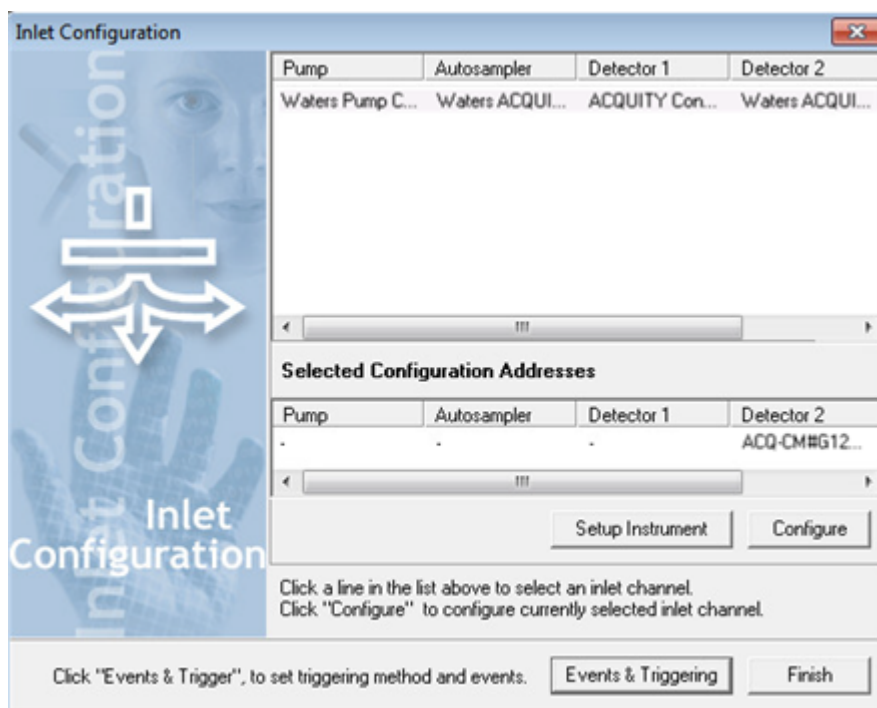
Figure 2–4: Scanned instruments

5. Use the menus to select the instrument IDs (see the following Figure), and then click **Next**.

Figure 2–5: Configure Communications

6. Click **Next** to open the Finished Configuring dialog box, and then click **Finish**.
7. From the Inlet Configuration dialog box (see the following Figure), click **Finish**.

Figure 2–6: Inlet Configuration



2.4 Prepare mobile phases and solvents

2.4.1 Considerations for the preparation of mobile phases and solvents

- ! Notice:** All solvents, including additives, must be of the highest chemical purity; Waters recommends a minimum of LC/MS-grade. Lower-quality solvents can result in signal suppression, high background noise levels, and loss of sensitivity. Water quality alone, before other sources of system contamination or suppression are taken into account, can affect results by an order of magnitude. Waters recommends deionized water from a well-maintained in-house supply (for example, Milli-Q or Elga). Bottled water can be affected by age and the material in which it is stored, as well as the original level of contaminants.
- ! Notice:** Do not wash glassware with detergents or with other general glassware. The glassware must be rinsed with the high-purity solvents before use.
- ! Notice:** Ensure that you have carried out the procedures required to prevent contamination, as detailed in the document [Controlling Contamination in LC/MS Systems](#).

2.4.2 Preparing mobile phases and solvents

Table 2–2: Mobile phases and solvents required for the tests

Solvent	Composition
2489 UV/Vis, 2998 PDA, 2424 ELS, and 2475 FLR detectors	
Mobile phase A and C	100% water
Mobile phase B and D (and wash solvent for the 2475 FLR)	100% acetonitrile
Seal-wash solvent	90:10 water/acetonitrile
Wash solvent	
Purge solvent	
2432 Conductivity detector	
Mobile phase A, B, C, and D (and purge solvent)	Pre-mixed 2432 detector mobile phase
Seal wash solvent	90:10 water/acetonitrile
Wash solvent	
Purge solvent	
2414 RI detector ^a .	
All mobile phases and solvents	87.3:12.7 water/methanol - Weight-to-weight preparation method (w:w)
	84.5:15.5 water/methanol (v:v)

a. There are two methods to make up the RI mobile phase: weight:weight (w:w) or volume:volume (v:v). For the most consistent results, Waters recommends using the w:w method. The alternate v:v method is based on a solvent temperature of 20 °C. The v:v method may require you to adjust volumes if solvent temperatures differ from 20° C

To prepare mobile phases and solvents:

1. Prepare the 100% water (for 2489, 2998, 2424, and 2475 detectors). See [Prepare 100% Water](#).
2. Prepare the 100% acetonitrile (for 2489, 2998, 2424, and 2475 detectors). See [Prepare 100% Acetonitrile](#).
3. Prepare the 90:10 water/acetonitrile (for 2489, 2998, 2424, 2432, and 2475 detectors). See [Prepare 90:10 Water/ACN](#).
4. Prepare the premixed 2432 mobile phase. See [Prepare pre-mix 2432 mobile phase](#).
5. Prepare the 2414 water/methanol mobile phase. See [Prepare 2414 mobile phase](#).

2.4.2.1 Preparing 100% Water

1. Pour approximately 1 L of HPLC-grade water into a 1-L reservoir bottle.
2. Label the reservoir bottle "100% water".

2.4.2.2 Preparing 100% Acetonitrile

1. Pour approximately 1 L of methanol into a 1-L reservoir bottle.
2. Label the reservoir bottle "100% acetonitrile".

2.4.2.3 Preparing 90:10 Water/Acetonitrile

1. Pour 90 mL of filtered HPLC-grade water into a 500-mL reservoir bottle.
2. Pour 10 mL of filtered acetonitrile into the same reservoir bottle.
3. Cap the reservoir bottle and mix well.
4. Label the reservoir bottle "90:10 water/acetonitrile".

2.4.2.4 Preparing Pre-mixed 2432 Mobile Phase

1. Pour approximately 1 L of premixed 2432 detector mobile phase into a 1-L reservoir bottle.
2. Label the reservoir bottle "2432 detector mobile phase".

2.4.2.5 Preparing 2414 Water/Methanol mobile phase

Note: There are two methods to make up the RI mobile phase: weight:weight (w:w) or volume:volume (v:v). For the most consistent results, Waters recommends using the w:w method. The alternate v:v method is based on a solvent temperature of 20 °C. The v:v method may require you to adjust volumes if solvent temperatures differ from 20 °C. Both methods are described below.

Weight:Weight method:

- a. Combine 245.5g of HPLC-grade methanol with 1690g of HPLC-grade water.
- b. Filter the mobile phase through a membrane filter, and then transfer it to a reservoir bottle.
- c. Cap the reservoir bottle and mix well.
- d. Label the reservoir bottle "90:10 water/methanol".

Volume:Volume method:

- a. Separately measure 1690 mL of water and 310 mL of methanol.
- b. Combine the two solvents.
- c. Filter the mobile phase through a membrane filter, and then transfer it to a reservoir bottle.

- d. Cap the reservoir bottle and mix well.
- e. Label the reservoir bottle "84.5:15.5 Water/Methanol".

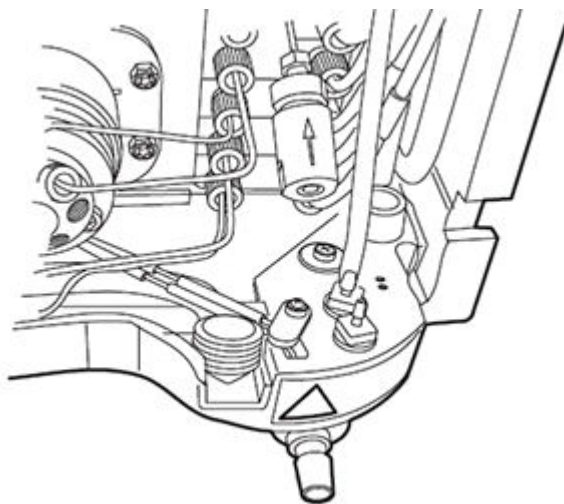
2.5 Priming and flushing the system



Notice: To avoid fluid backup and false leak-sensor alarms, ensure proper drainage of waste:

- Place the waste container below the system stack to permit gravity flow.
 - Ensure that the waste and degasser vent tubes do not crimp or bend. A crimp or bend can impede flow to the waste container.
 - Ensure that the exit of the waste and degasser vent tubes is not immersed in waste solvent.
 - If necessary, shorten each tube so that no portion of it drops below the top of the waste container.
1. Place the solvent and wash lines in their appropriate reservoirs.
 2. Perform a seal-wash prime (from dry):
 - a. Ensure that the seal-wash inlet tubing is immersed in the wash solvent.
 - b. Remove the seal-wash outlet tubing from the seal-wash waste fitting on the right side of the drip tray (see the following figure).

Figure 2–7: Seal-wash waste fitting



- c. Push the syringe plunger fully into the syringe barrel.
- d. Connect the tubing adapter to the syringe, and then connect the syringe assembly to the seal wash outlet tubing.

3. From the system tree in the console, select **ACQUITY UPLC System > Control > Start up system**.
4. From Prime Solvents (**QSM** tab), select all boxes, set the **Duration of Prime** to five minutes, and then click **Start**.
5. Prime the SM-FTN:
 - a. For 2489, 2998, 2424, and 2475 detectors, place the purge solvent line into a reservoir of 100% acetonitrile. For 2414 and 2432 detectors, place the purge solvent line into the appropriate solvent.
 - b. From the Prime Solvents (**SM** tab), enable the **Purge Solvent** check box and set 30 cycles.
 - c. Click **Start**.
 - d. When the initial purge finishes, remove the purge solvent line from the 100% acetonitrile and insert it into the 90:10 water/acetonitrile reservoir (required only for 2498 and 2998 detectors).
 - e. Enable the **Wash Solvent** check box, and then set a time of 15 seconds.
 - f. Set **Purge Solvent** cycles to 50.
 - g. Click **Start**.
6. Flush the system to waste using a 25/25/25/25 mixture of mobile phases A, B, C, and D for 10 minutes at 2 mL/minute.

2.6 Flush and equilibrate the column

Select one of the following:

- [Flushing and equilibrating the column \(no column select valve\)](#)
- [Flushing and equilibrating the column \(systems with a column select valve\)](#)

2.6.1 Flushing and equilibrating the column (no column select valve)

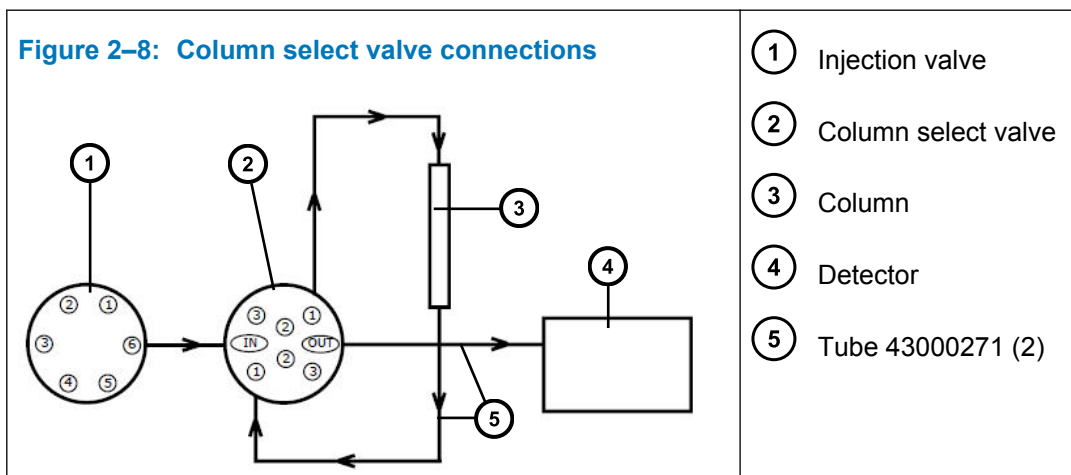
1. Depending on your column manager, connect either the PPH or the APH to the column inlet.
2. Attach a piece of waste tubing to the column outlet.
3. Flush the column to waste with 100% acetonitrile at 0.1 mL/min for at least one hour.
4. Attach the eCord.
5. Remove the waste line and connect the column to the detector.

6. Set the column heater temperature to 40 °C and the sample compartment to 10 °C, and then confirm that the temperatures are regulated.
7. From the Console, set the flow to 90%A:10%B at 1.8 mL/min and equilibrate for at least one hour.

2.6.2 Flushing and equilibrating the column (systems with a column select valve)

1. Using a cut-to-length section of 0.005-inch PEEK tubing (43000271), connect the column 1 outlet to port 1 of the column select valve.

Figure 2–8: Column select valve connections



2. Attach a second section of 0.005-inch PEEK tubing to the OUT port of the column select valve, and then route it to waste.
3. Flush the column to waste with 100% acetonitrile at 0.1 mL/min for at least one hour.
4. After flushing, connect the tubing from the column select valve OUT port to the detector.
5. Attach the eCord.
6. Set the column heater temperature to 40 °C and the sample compartment to 10 °C, and then confirm that the temperatures are regulated.
7. From the Console, set the flow to 90%A:10%B at 1.8 mL/min and equilibrate for at least one hour.
8. While equilibrating, run the Sample Manager - FTN Needle Seal Readiness Test. Ensure that the flow is set to 1.8 mL/min. Confirm that the test passes.

2.7 Running diagnostic tests

Run the instrument- and system-level diagnostic tests.

Sequence	Diagnostic test
1	QSM leak test using 100% acetonitrile (solvent B or D)
2	SM-FTN rotary tray calibration
3	SM-FTN calibrate needle z axis
4	System leak test

1. Run the test sequence above and print the results after each test.
2. When finished, remove the pin plug from port 6 of the SM-FTN.

2.8 Confirming the instrument or inlet method

1. Open the instrument or inlet method and confirm that the inlet settings match those in the project.
2. Refer to the following table for the performance test method names that correspond to the detectors on your system.

Note: If you do not have access to the project, create the instrument/inlet method using the method parameters shown in [Method parameters](#)

Table 2–3: Performance test method names

Detector	System precision test method name	Gradient test method name
2489 TUV	Sys_Prec_TUV_IM	Gradient_TUV_IM
2998 PDA	Sys_Prec_PDA_IM	Gradient_PDA_IM
2424 ELS	Sys_Prec_ELS_IM	N/A
2475 FLR	Sys_Prec_FLR_IM	N/A
RI	Sys_Prec_RI_IM	N/A
2432	Sys_Prec_2432_IM	N/A

2.9 Prepare the test samples

Table 2–4: Required test solutions

Part number	Description	Quantity
2489 UV/Vis and 2998 PDA detectors (use start-up solution 186008093)		
186008093-1	UV System Precision Test Solution (Caffeine), 0.100 mg/mL	1 ampule

Table 2–4: Required test solutions (continued)

Part number	Description	Quantity
186008093-2	Gradient test sample (2-acetylfuran, acetanilide, acetophenone, butylparaben, benzophenone, valerophenone)	1 ampule
2475 FLR detector (use start-up solution 700003694)		
700003694-1	System precision test sample (anthracene, 5 pg/μL)	1 ampule
2424 ELS detector (use start-up solution 700002848)		
700002848-1	System precision test sample (caffeine, 0.16 mg/m)	1 ampule
2414 RI detector (use start-up solution 186008094)		
186008094-1	System precision test sample (caffeine)	1 ampule
2432 Conductivity detector (use Waters Cond Det OQ/PQ Test-up solution 700002309)		
700002309	System precision test sample (chloride/bromide)	1 ampule

Follow the steps in the appropriate procedure to prepare the required test samples:

- [Prepare 2489 and 2998 test samples](#)
- [Prepare the 2475 test samples](#)
- [Prepare the 2424 test samples](#)
- [Prepare the 2414 test samples](#)
- [Prepare the 2432 test samples](#)

2.9.1 Preparing the 2489 and 2998 test samples

Follow the steps below to prepare the 2489 or 2998 detector system precision and gradient test samples.

1. Prepare the system precision sample:
 - a. Fill an appropriately sized sample vial with the caffeine test solution from ampule 186008093-1.
 - b. Label the vial "System Precision Test".
2. Prepare the gradient sample:
 - a. Fill an appropriately sized sample vial with the 6-component test solution from ampule 186008093-2.
 - b. Label the vial "Gradient".
3. Place sample and blank vials into the correct positions in the sample manager, per the following table.

Table 2–5: Sample and blank vial positions

Vial	Positions
System precision	2:A,1
Gradient (2489 and 2998 only)	2:A,2

2.9.2 Preparing the 2475 test sample

1. Fill an appropriately sized sample vial with the anthracene test solution from ampule 700003694-1.
2. Label the vial "System Precision Test".
3. Place the sample vial into position 2:A,1 in the sample manager.

2.9.3 Preparing the 2424 test sample

1. Fill an appropriately sized sample vial with the caffeine test solution from ampule 700002848-1.
2. Label the vial "System Precision Test."
3. Place sample vial into position 2:A,1 in the sample manager.

2.9.4 Preparing the 2414 test sample

1. Fill an appropriately sized sample vial with the caffeine test solution from ampule 186008094-1.
2. Label the vial "System Precision Test".
3. Place the sample vial into position 2:A,1 in the sample manager.

2.9.5 Preparing the 2432 test sample

1. Pipette 1 mL of the chloride/bromide ampule into a 50-mL volumetric flask.
2. Fill the flask to the mark with LC/MS-grade water.
3. Mix well.
4. Label the vial as "System Precision Test".
5. Place sample vial into position 2:A,1 in the sample manager.

3 Running the Tests

3.1 Running the system precision test

1. Open the appropriate sample set method or sample list for the system precision test and confirm the following:

Function	Value
Equilibration step using initial conditions	2.0 minutes
Sample injections	6
Injection volume	• 2998 PDA and 2489 UV/Vis: 14 µL • ELS, RI, and FLR: 5 µL • 2432 detector: 10 µL
Run time	• 2998 PDA and 2489 UV/Vis with 10-mm flow cell: 2.0 minutes • ELS and FLR: 2.0 minutes • RI: 10 µL: 4.0 minutes • 2432 detector: 8.0 minutes

2. Run the samples.
3. When the run finishes, do one of the following:
 - For Empower-based systems, view the reports, and then analyze and verify the results. See [Arc system precision test specifications](#).
 - For MassLynx-based systems, process the samples; verify that the peaks are symmetrical, integrated, and identified correctly; calculate the results for caffeine over six replicate injections; and then verify the results. See [Arc system precision test specifications](#).

3.1.1 Arc system precision test specifications

System precision test	System precision specification
2998 PDA and 2489 UV/Vis	

System precision test	System precision specification
Retention time standard deviation	≤1.0 sec
Peak area %RSD	≤0.5 %
Peak height %RSD	≤1.1 %
2424 ELS	
Retention time standard deviation	≤1.0 sec
Peak area %RSD	≤5.0 %
Peak height %RSD	≤5.0 %
2475 FLR	
Retention time standard deviation	≤2.8 sec
Peak area %RSD	≤3.0 %
Peak height %RSD	≤4.5 %
2414 RI	
Retention time standard deviation	≤1.0 sec
Peak area %RSD	≤1.5 %
2432	
Retention time standard deviation (for chloride and bromide)	≤1.5 sec
Peak area %RSD (for chloride and bromide)	≤2.0 %

3.1.2 System precision results examples

Figure 3–1: Example 2489 system precision chromatogram

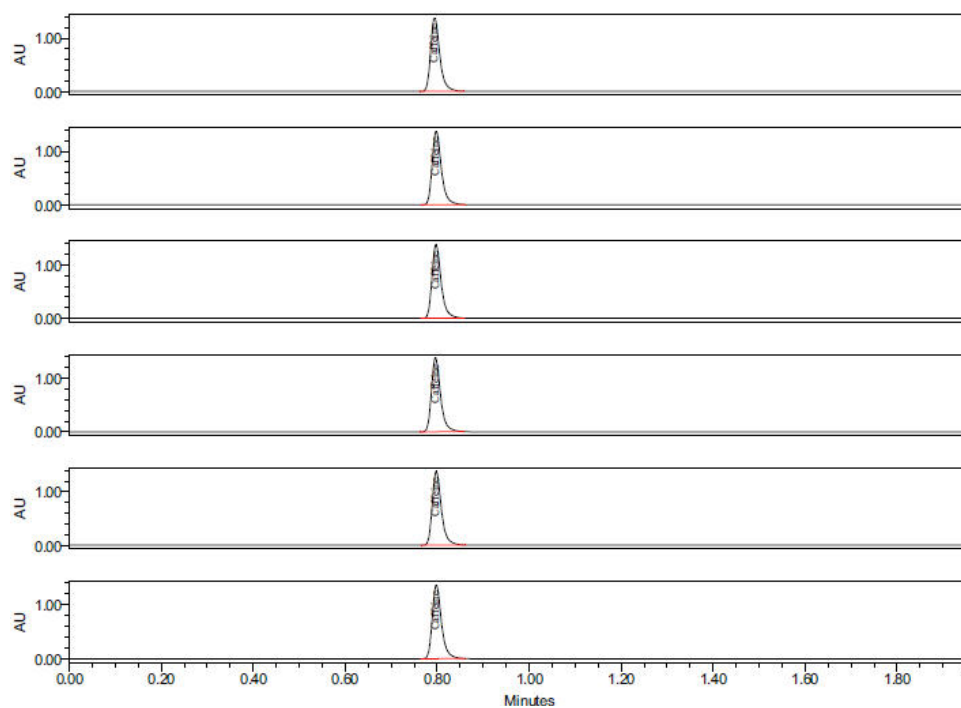


Figure 3–2: Example 2432 system precision chromatogram

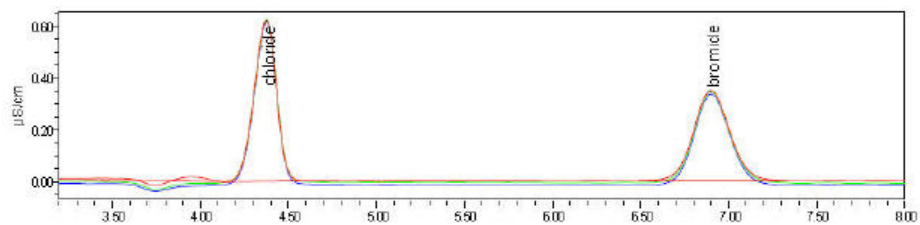
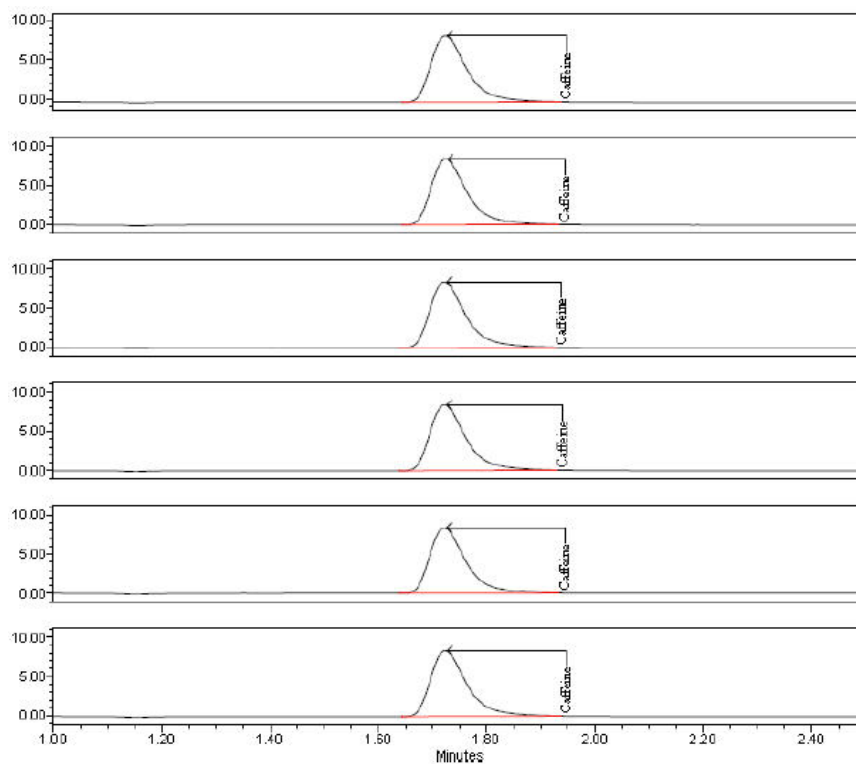


Figure 3–3: Example RI system precision chromatogram

3.2 Running the gradient test

Note: Run the gradient test only for 2998 PDA and 2489 UV/Vis detectors.

1. Open the appropriate sample set method or sample list for the gradient test and confirm the following:

Function	Value
Condition column	Two 6.0-minute steps
Sample injections	Three from solvents A and B
Condition column	Two 6.0-minute steps
Sample injections	Three from solvents A and B
Injection volume	5 μ L
Run time	6.0 minutes using 10-mm flow cell

2. Run the samples.
3. When the run finishes, do one of the following:

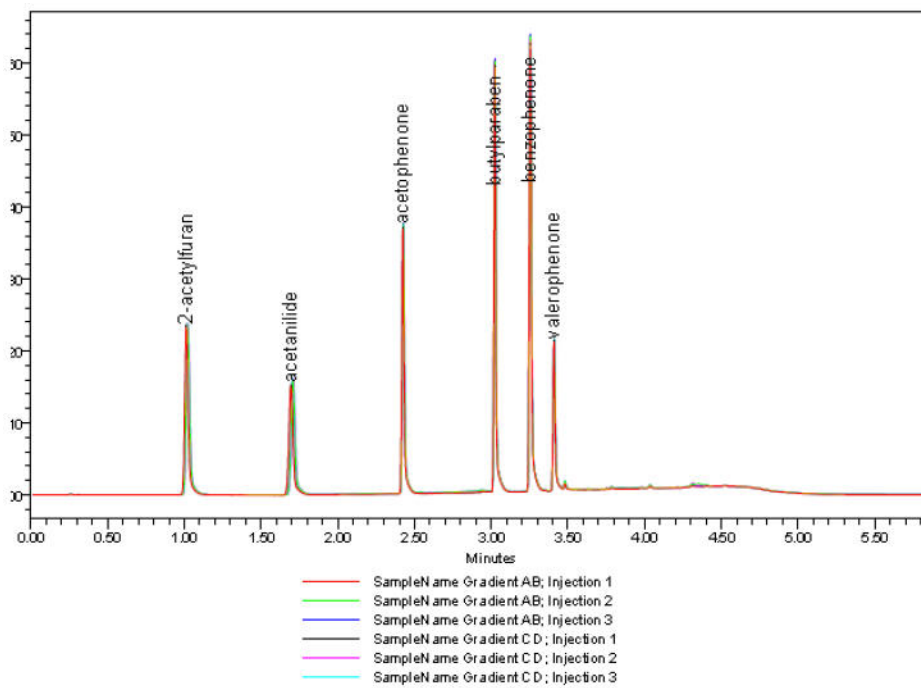
- For Empower-based systems, view the reports, and then analyze and verify the results. See [Arc gradient specifications](#).
- For MassLynx-based systems, process the samples; verify that the peaks are symmetrical, integrated, and identified correctly; calculate the results for each of the six compounds over three replicate injections; and then verify the results. See [Arc gradient specifications](#).

3.2.1 Arc gradient test specifications for 2998 PDA and 2489 UV/Vis detectors

Gradient test compound	Standard deviation specification
Solvents A, B, C, and D	
2-acetylfuran	≤1.5 sec
acetanilide	≤1.5 sec
acetophenone	≤1.5 sec
butylparaben	≤1.5 sec
benzophenone	≤1.5 sec
valerophenone	≤1.5 sec

3.2.2 Gradient test results example

Refer to the 2998 gradient chromatogram example, as needed.

Figure 3–4: Example 2998 gradient chromatogram

3.3 Recording the results

Record the results in the relevant installation checklist and attach any pertinent documentation.

3.4 Completing the installation

1. Complete the installation checklist and leave it with the customer (see appropriate [installation checklist](#)).
2. Attach a copy of the sign-off section to the CIT record.
3. Reset the service interval and record the date of service.
4. Save the performance test data and back up the target registry.

4 Reference Information

4.1 Method parameters

Choose the detector-specific method parameters from the following list:

- [System precision test method parameters for the 2489 UV/Vis](#)
- [Gradient test method parameters for the 2489 UV/Vis](#)
- [System precision test method parameters for the 2998 PDA](#)
- [Gradient test method parameters for the 2998 PDA](#)
- [System precision test method parameters for the 2424 ELS](#)
- [System precision test method parameters for the 2475 FLR](#)
- [System precision test method parameters for the 2414 RI](#)
- [System precision test method parameters for the 2432](#)

4.1.1 Systems with 2489 TUV detectors

4.1.1.1 System precision test method parameters for the 2489 UV/Vis

The following are the method parameters required to run the system precision test using the 2489 UV/Vis detector.

Table 4–1: QSM-R method parameters for the system precision test

Parameter ^a		Value				
General tab						
Solvent A and C		Water				
Solvent B and D		Acetonitrile				
Pressure limits		0-9500 psi				
Position		Path 1				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	1.800	90.0	10.0	0.0	0.0	Initial

Table 4–1: QSM-R method parameters for the system precision test (continued)

Parameter ^a		Value				
30.0	1.800	90.0	10.0	0.0	0.0	6
30.50	0.000	90.0	10.0	0.0	0.0	11

a. All unlisted parameters use default settings.

Table 4–2: QSM-R method parameters for the system precision test

Parameter ^a	Value
Misc tab	
Seal wash frequency	5.00 min
Accelerate to 2 mL/min in	0.45 min
Gradient starts	At injection

a. All unlisted parameters use default settings.

Table 4–3: QSM-R method parameters for the system precision test

Parameter ^a	Value
Data tab	
System pressure (channel)	Enabled
Degasser (channel)	Enabled

a. All unlisted parameters use default settings.

Table 4–4: SM FTN-R parameters for the system precision test

Parameter	Value
General Tab	
Wash solvent	90%Water/10% Acetonitrile
Pre-inject	0 seconds
Post-inject	6 seconds
Purge solvent	90%Water/10% Acetonitrile
Active preheater	Use Console Configuration
Column position	Column 1
Sample temperature set point	Off
Column temperature	40 °C

Table 4–4: SM FTN-R parameters for the system precision test (continued)

Parameter	Value
Advanced Settings	
All parameters	Disabled

Table 4–5: SM FTN-R parameters for the system precision test

Parameter	Value
Data Tab	
Sample pressure (channel)	Enabled
Sample temp (channel)	Enabled
Column temp (channel)	Enabled
Room temp (channel)	Enabled

Table 4–6: 2489 UV/Vis method parameters for the system precision test

Parameter ^a	Values
Channel A tab	
Lamp on	Enabled
Wavelength	273 nm
Sampling rate (points/sec)	20
Filter time constant	Normal
On wavelength changes	Maintain baseline
On inject start	Enabled (Auto-zero)
Data mode	Absorbance
Analog Out 1 tab	
Sensitivity	2.000 AUFS
Polarity	Positive (+)
Voltage offset	0 mV
Options	Enabled (Enable chart marks)

a. All unlisted parameters use default settings.

4.1.1.2 Gradient test method parameters for the 2489 UV/Vis

The following are the method parameters required to run the gradient test using the 2489 UV/Vis detector.

Table 4–7: QSM-R method parameters for the gradient test (solvents A and B)

Parameter ^a		Value				
General tab						
Solvent A		Water				
Solvent B		Acetonitrile				
Pressure limits		0-9500 psi				
Position		Path 1				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	1.800	90.0	10.0	0.0	0.0	Initial
0.70	1.800	90.0	10.0	0.0	0.0	6
3.50	1.800	5.0	95.0	0.0	0.0	6
3.75	1.800	5.0	95.0	0.0	0.0	6
4.25	1.800	90.0	10.0	0.0	0.0	6
30.00	0.000	90.0	10.0	0.0	0.0	11

a. All unlisted parameters use default settings.

Table 4–8: QSM-R method parameters for the gradient test (solvents C and D)

Parameter ^a		Value				
General tab						
Solvent C		Water				
Solvent D		Acetonitrile				
Pressure limits		0-9500 psi				
Position		Path 1				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	1.800	0.0	0.0	90.0	10.0	Initial
0.70	1.800	0.0	0.0	90.0	10.0	6
3.50	1.800	0.0	0.0	5.0	95.0	6
3.75	1.800	0.0	0.0	5.0	95.0	6
4.25	1.800	0.0	0.0	90.0	10.0	6
30.00	0.000	0.0	0.0	90.0	10.0	11

a. All unlisted parameters use default settings.

Table 4–9: QSM-R method parameters for the gradient test

Parameter ^a	Value
Misc tab	
Seal wash frequency	5.00 min
Accelerate to 2 mL/min in	0.45 min
Gradient starts	At injection

a. All unlisted parameters use default settings.

Table 4–10: QSM-R method parameters for the gradient test

Parameter ^a	Value
Data tab	
System pressure (channel)	Enabled
Degasser (channel)	Enabled

a. All unlisted parameters use default settings.

Table 4–11: SM FTN-R parameters for the gradient test

Parameter	Value
General Tab	
Wash solvent	90%Water/10% Acetonitrile
Pre-inject	0 seconds
Post-inject	6 seconds
Purge solvent	90%Water/10% Acetonitrile
Active preheater	Use Console Configuration
Column position	Column 1
Sample temperature set point	Off
Column temperature	40 °C
Advanced Settings	
All parameters	Disabled

Table 4–12: SM FTN-R parameters for the gradient test

Parameter	Value
Data Tab	
Sample pressure (channel)	Enabled

Table 4–12: SM FTN-R parameters for the gradient test (continued)

Parameter	Value
Sample temp (channel)	Enabled
Column temp (channel)	Enabled
Room temp (channel)	Enabled

Table 4–13: 2489 UV/Vis method parameters for the gradient test

Parameter ^a	Values
Channel A tab	
Lamp on	Enabled
Wavelength	254 nm
Sampling rate (points/sec)	20
Filter time constant	Normal
On wavelength changes	Maintain baseline
On inject start	Enabled (Auto-zero)
Data Mode	Absorbance
Analog Out 1 tab	
Sensitivity	2.000 AUFS
Polarity	Positive (+)
Voltage offset	0 mV
Options	Enabled (Enable chart marks)

a. All unlisted parameters use default settings.

4.1.2 Systems with 2998 PDA detectors

4.1.2.1 System precision test method parameters for the 2998 PDA

The following are the method parameters required to run the system precision test using the 2998 PDA.

Table 4–14: QSM-R method parameters for the system precision test

Parameter ^a	Value
General tab	
Solvent A and C	Water

Table 4–14: QSM-R method parameters for the system precision test (continued)

Parameter ^a		Value				
Solvent B and D		Acetonitrile				
Pressure limits		0-9500 psi				
Position		Path 1				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	1.800	90.0	10.0	0.0	0.0	Initial
30.0	1.800	90.0	10.0	0.0	0.0	6
30.50	0.000	90.0	10.0	0.0	0.0	11

a. All unlisted parameters use default settings.

Table 4–15: QSM-R method parameters for the system precision test

Parameter ^a	Value
Misc tab	
Seal wash frequency	5.00 min
Accelerate to 2 mL/min in	0.45 min
Gradient starts	At injection

a. All unlisted parameters use default settings.

Table 4–16: QSM-R method parameters for the system precision test

Parameter ^a	Value
Data tab	
System pressure (channel)	Enabled
Degasser (channel)	Enabled

a. All unlisted parameters use default settings.

Table 4–17: SM FTN-R parameters for the system precision test

Parameter	Value
General Tab	
Wash solvent	90%Water/10% Acetonitrile
Pre-inject	0 seconds

Table 4–17: SM FTN-R parameters for the system precision test (continued)

Parameter	Value
Post-inject	6 seconds
Purge solvent	90%Water/10% Acetonitrile
Active preheater	Use Console Configuration
Column position	Column 1
Sample temperature set point	Off
Column temperature	40 °C
Advanced Settings	
All parameters	Disabled

Table 4–18: SM FTN-R parameters for the system precision test

Parameter	Value
Data Tab	
Sample pressure (channel)	Enabled
Sample temp (channel)	Enabled
Column temp (channel)	Enabled
Room temp (channel)	Enabled

Table 4–19: 2998 PDA method parameters for the system precision test

Parameter ^a	Values
General tab	
Lamp on	Enabled
3D data	Enabled
λ Range	210 to 400 nm
Resolution	1.2 nm
Sampling rate (points/sec)	20
Filter time constant	Normal

a. All unlisted parameters use default settings.

4.1.2.2 Gradient test method parameters for the 2998 PDA

The following are the method parameters required to run the gradient test using the 2998 PDA

Table 4–20: QSM-R method parameters for the gradient test (solvents A and B)

Parameter ^a		Value				
General tab						
Solvent A		Water				
Solvent B		Acetonitrile				
Pressure limits		0-9500 psi				
Position		Path 1				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	1.800	90.0	10.0	0.0	0.0	Initial
0.70	1.800	90.0	10.0	0.0	0.0	6
3.50	1.800	5.0	95.0	0.0	0.0	6
3.75	1.800	5.0	95.0	0.0	0.0	6
4.25	1.800	90.0	10.0	0.0	0.0	6
30.00	0.000	90.0	10.0	0.0	0.0	11

a. All unlisted parameters use default settings.

Table 4–21: QSM-R method parameters for the gradient test (solvents C and D)

Parameter ^a		Value				
General tab						
Solvent C		Water				
Solvent D		Acetonitrile				
Pressure limits		0-9500 psi				
Position		Path 1				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	1.800	0.0	0.0	90.0	10.0	Initial
0.70	1.800	0.0	0.0	90.0	10.0	6
3.50	1.800	0.0	0.0	5.0	95.0	6
3.75	1.800	0.0	0.0	5.0	95.0	6
4.25	1.800	0.0	0.0	90.0	10.0	6
30.00	0.000	0.0	0.0	90.0	10.0	11

a. All unlisted parameters use default settings.

Table 4–22: QSM-R method parameters for the gradient test

Parameter ^a	Value
Misc tab	
Seal wash frequency	5.00 min
Accelerate to 2 mL/min in	0.45 min
Gradient starts	At injection

a. All unlisted parameters use default settings.

Table 4–23: QSM-R method parameters for the gradient test

Parameter ^a	Value
Data tab	
System pressure (channel)	Enabled
Degasser (channel)	Enabled

a. All unlisted parameters use default settings.

Table 4–24: SM FTN-R parameters for the gradient test

Parameter	Value
General Tab	
Wash solvent	90%Water/10% Acetonitrile
Pre-inject	0 seconds
Post-inject	6 seconds
Purge solvent	90%Water/10% Acetonitrile
Active preheater	Use Console Configuration
Column position	Column 1
Sample temperature set point	Off
Column temperature	40 °C
Advanced Settings	
All parameters	Disabled

Table 4–25: SM FTN-R parameters for the gradient test

Parameter	Value
Data Tab	
Sample pressure (channel)	Enabled

Table 4–25: SM FTN-R parameters for the gradient test (continued)

Parameter	Value
Sample temp (channel)	Enabled
Column temp (channel)	Enabled
Room temp (channel)	Enabled

Table 4–26: 2998 PDA method parameters for the gradient test

Parameter ^a	Values
General tab	
Lamp on	Enabled
3D data	Enabled
λ Range	210 to 400 nm
Resolution	1.2 nm
Sampling rate (points/sec)	20
Filter time constant	Normal

a. All unlisted parameters use default settings.

4.1.3 Systems with 2424 ELS detectors

4.1.3.1 System precision test method parameters for the 2424 ELS

The following are the method parameters required to run the system precision test using the 2424 ELS detector.

Table 4–27: QSM-R method parameters for the system precision test

Parameter ^a		Value				
General tab						
Solvent A and C		Water				
Solvent B and D		Acetonitrile				
Pressure limits		0-9500 psi				
Position		Path 1				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	1.500	90.0	10.0	0.0	0.0	Initial

Table 4–27: QSM-R method parameters for the system precision test (continued)

Parameter ^a		Value				
30.0	1.500	90.0	10.0	0.0	0.0	11
30.50	0.000	90.0	10.0	0.0	0.0	6

a. All unlisted parameters use default settings.

Table 4–28: QSM-R method parameters for the system precision test

Parameter ^a	Value
Misc tab	
Seal wash frequency	5.00 min
Accelerate to 2 mL/min in	0.45 min
Gradient starts	At injection

a. All unlisted parameters use default settings.

Table 4–29: QSM-R method parameters for the system precision test

Parameter ^a	Value
Data tab	
System pressure (channel)	Enabled
Degasser (channel)	Enabled

a. All unlisted parameters use default settings.

Table 4–30: SM FTN-R parameters for the system precision test

Parameter	Value
General Tab	
Wash solvent	Water
Purge solvent	Water
Pre-inject	0 sec
Post-inject	6 sec
Column temperature	40.0 °C

Table 4–31: SM FTN-R parameters for the system precision test

Parameter	Value
Data Tab	
Column Temp	Enabled

Table 4–32: 2424 ELSD method parameters for the system precision test

Parameter ^a	Values
General tab	
Detector gain	100
Sampling rate	10 pts/sec
Filter time constant	Other, OK1.0000 sec
Auto-zero	Enabled
Lamp On	Enabled
Gas pressure	40 psi
Nebulizer mode	Cooling
Drift tube set point	50.0
Alarm limit	±25 °C
External column heater	Disabled

a. All unlisted parameters use default settings.

Table 4–33: 2424 ELSD method parameters for the system precision test

Parameter ^a	Values
Data tab	
ELSD Signal	Enabled
ELSD Signal - MBF	Disabled

a. All unlisted parameters use default settings.

Table 4–34: 2424 ELSD method parameters for the system precision test

Parameter ^a	Values
Analog out tab	
Output full scale	2000 mV
LSU full scale	2000 LSU

Table 4–34: 2424 ELSD method parameters for the system precision test (continued)

Parameter ^a	Values
Voltage offset	0.0000 mV
Data channel	Nebulizer temperature
Voltage offset	0.0000 mV

a. All unlisted parameters use default settings.

4.1.4 Systems with 2475 FLR detectors

4.1.4.1 System precision test method parameters for the 2475 FLR

The following are the method parameters required to run the system precision test using the 2475 FLR detector.

Table 4–35: QSM-R method parameters for the system precision test

Parameter ^a		Value				
General tab						
Solvent A and C		Water				
Solvent B and D		Acetonitrile				
Pressure limits		0-9500 psi				
Position		Path 1				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	1.500	30.0	70.0	0.0	0.0	Initial
30.0	1.500	30.0	70.0	0.0	0.0	11
30.50	0.000	30.0	70.0	0.0	0.0	6

a. All unlisted parameters use default settings.

Table 4–36: QSM-R method parameters for the system precision test

Parameter ^a	Value
Misc tab	
Seal wash frequency	5.00 min
Accelerate to 2 mL/min in	0.45 min

Table 4–36: QSM-R method parameters for the system precision test (continued)

Parameter ^a	Value
Gradient starts	At injection

a. All unlisted parameters use default settings.

Table 4–37: QSM-R method parameters for the system precision test

Parameter ^a	Value
Data tab	
System pressure (channel)	Enabled
Degasser (channel)	Enabled

a. All unlisted parameters use default settings.

Table 4–38: SM FTN-R parameters for the system precision test

Parameter	Value
General Tab	
Wash solvent	100%Water
Pre-inject	0 seconds
Post-inject	6 seconds
Purge solvent	90% Water/10% Acetonitrile
Active preheater	Use Console Configuration
Column position	Column 1
Sample temperature set point	10 °C
Column temperature	40 °C
Advanced Settings	
All parameters	Disabled

Table 4–39: 2475 FLR method parameters for the system precision test

Parameter ^a	Values
General tab	
Lamp on	Enabled
λ ex (Channel A)	246
λ em (Channel A)	402

Table 4–39: 2475 FLR method parameters for the system precision test (continued)

Parameter ^a	Values
Data mode	Emission
Data units	Emission
Comment	Channel A
Sampling rate	1 point/sec
PMT gain	1
Noise filter	Hamming 2.0 sec
Auto-zero (On inject)	Enabled
Auto-zero (From keypad or Event In)	Enabled

a. All unlisted parameters use default settings.

Table 4–40: 2475 FLR method parameters for the system precision test

Parameter ^a	Values
Outputs tab	
Output mode	Emission
Sensitivity	10,000 EUFS
Voltage offset	0 mV
Chart marks	Enabled

a. All unlisted parameters use default settings.

4.1.5 Systems with 2414 RI detectors

4.1.5.1 System precision test method parameters for the 2414 RI

The following are the method parameters required to run the system precision test using a 2414 RI detector.

Table 4–41: QSM-R method parameters for the system precision test

Parameter ^a	Value
General tab	
Solvent A , B, C, and D	ACQ RI mobile phase
Pressure limits	0-655 bar
Position	Path 1

Table 4–41: QSM-R method parameters for the system precision test (continued)

Parameter ^a		Value				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	1.400	100.0	0.0	0.0	0.0	Initial
30.0	1.400	100.0	0.0	0.0	0.0	11
30.50	0.000	100.0	0.0	0.0	0.0	11

a. All unlisted parameters use default settings.

Table 4–42: QSM-R method parameters for the system precision test

Parameter ^a	Value
Misc tab	
Seal wash frequency	5.00 min
Accelerate to 2 mL/min in	0.45 min

a. All unlisted parameters use default settings.

Table 4–43: QSM-R method parameters for the system precision test

Parameter ^a	Value
Data tab	
System pressure	Enabled

a. All unlisted parameters use default settings.

Table 4–44: SM FTN-R parameters for the system precision test

Parameter	Value
General Tab	
Wash solvent	90%Water/10% Acetonitrile
Pre-inject	0 seconds
Post-inject	6 seconds
Purge solvent	90%Water/10% Acetonitrile
Active preheater	Use Console Configuration
Column position	Column 1
Sample temperature set point	Off

Table 4–44: SM FTN-R parameters for the system precision test (continued)

Parameter	Value
Column temperature	40 °C
Alarm band	± 5.0 °C
Advanced Settings	
All parameters	Disabled

Table 4–45: SM FTN-R parameters for the system precision test

Parameter	Value
Data Tab	
Sample temp (channel)	Enabled
Column temp (channel)	Enabled
Room temp (channel)	Enabled

Table 4–46: 2414 RI method parameters for the system precision test

Parameter ^a	Values
General tab	
Sampling rate	5 points/sec
Filter time constant	Normal
Polarity	Positive
On inject start	Enabled (Auto-zero)
Flow cell temperature	45 °C
Alarm band	±5.0 °C
Data tab	
W2414 RI	Enabled
W2414 Flow Cell Temperature	Enabled
Analog Out tab	
RIU full scale (RIU Signal Analog Output)	500 µRIU
Output full scale (RIU Signal Analog Output)	2000 mV
Voltage offset (RIU Signal Analog Output)	0 mV
Output type (Auxiliary Analog Output)	Flow cell temperature
Output full scale (Auxiliary Analog Output)	2000 mV

Table 4–46: 2414 RI method parameters for the system precision test (continued)

Parameter ^a	Values
Voltage offset (Auxiliary Analog Output)	0 mV

a. All unlisted parameters use default settings.

4.1.6 Systems with 2432 detectors

4.1.6.1 System precision test method parameters for the 2432

The following are the method parameters required to run the system precision test using the 2432 detector.

Table 4–47: QSM-R method parameters for the system precision test

Parameter ^a		Value				
General tab						
Solvent A, B, C, and D		2432 pre-mix				
Pressure limits		0-9500 psi				
Position		Path 1				
Gradient						
Time (min)	Flow (mL/min)	%A	%B	%C	%D	Curve
Initial	0.900	100.0	0.0	0.0	0.0	Initial
40.0	0.900	100.0	0.0	0.0	0.0	6
41.0	0.000	100.0	0.0	0.0	0.0	6

a. All unlisted parameters use default settings.

Table 4–48: QSM-R method parameters for the system precision test

Parameter ^a	Value
Misc tab	
Seal wash frequency	1.00 min
Accelerate to 2 mL/min in	0.45 min
Gradient starts	At injection

a. All unlisted parameters use default settings.

Table 4–49: SM FTN-R parameters for the system precision test

Parameter	Value
General Tab	
Wash solvent	90%Water/10% Acetonitrile
Pre-inject	0 seconds
Post-inject	6 seconds
Purge solvent	90%Water/10% Acetonitrile
Active preheater	Use Console Configuration
Column position	Column 1
Sample temperature set point	15.0 °C
Column temperature	33 °C
Advanced Settings	
All parameters	Disabled

Table 4–50: 2432 detector method parameters for the system precision test

Parameter ^a	Values
General tab	
Auto-zeroed Conductivity	Enabled
Absolute Conductivity	Disabled
Auto-zero on inject start	Enabled
Cell (Temperature Control)	35 °C
Cell Constant (Advanced)	16.7
Temperature Coefficient (Advanced)	2.7

a. All unlisted parameters use default settings.

4.2 Windows statistical calculator

You can use the Windows statistical calculator to calculate the average and standard deviation, as well as %RSD values.

See also:

- [Calculating the average and standard deviation](#)
- [Calculating the %RSD](#)

4.2.1 Calculating the mean and standard deviation

1. Click **Start > All Programs > Accessories > Calculator**.
2. Click **View > Statistics**.
3. Enter the first value (for example, retention time, signal-to-noise ratio, or peak area/height).
4. In the lower right corner of the calculator, click **Add**.
5. Specify each of the remaining values, clicking **Add** after each to enter it in the statistics box.

6. To calculate the mean value, click .

7. To calculate the standard value, click .

4.2.2 Calculating the %RSD

1. Open a second Windows calculator by clicking **Start > All Programs > Accessories > Calculator**.
2. Calculate the %RSD using the following formula, referring to the other calculator for the average and standard deviation values.

$$\%RSD = \frac{(\text{Standard Deviation} \times 100)}{\text{Average}}$$

4.3 Load the 2432 ICS and configure the DHCP server

4.3.1 Loading the 2432 ICS

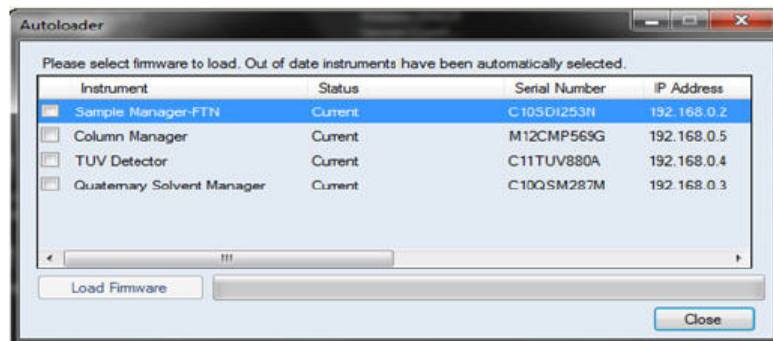
Follow these steps only when installing a new 2432 detector in your system.

Note: If the system workstation's operating software is Windows XP, the Found New Hardware Wizard dialog box appears (see the following figure) when you first power-on a connected 2432 detector. Click **Cancel**.

Figure 4–1: Found New Hardware Wizard

1. Use the deployment manager to install the 2432 ICS (from the CD or from (www.waters.com)).

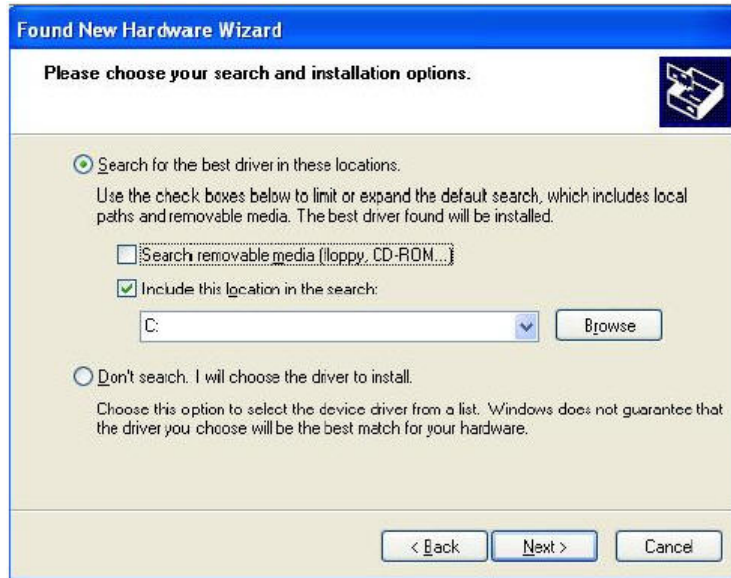
Note: When the ICS install finishes and the Autoloader screen opens (see the following figure), the 2432 is not listed as an instrument (this is expected behavior).

Figure 4–2: Autoloader screen after ICS install (example)

2. Close the Autoloader screen.
3. Restart the workstation.
 - For systems using Windows 7, the 2432 USB driver is automatically installed. No further steps are required.
 - For systems using Windows XP, the Found New Hardware Wizard dialog box appears. Go to step 4 to complete the USB driver install.
4. When the Welcome to the Found New Hardware Wizard page reopens, select No, not this time, and then click **Next**.

- From the Please choose your search and installation options page, make the selections shown in the following figure, click **Browse**, and then navigate to the location shown in step 6.

Figure 4–3: Search and installation options



- Highlight the USBDriver folder, and then click **OK**.

Figure 4–4: Selecting the 2432 USB driver



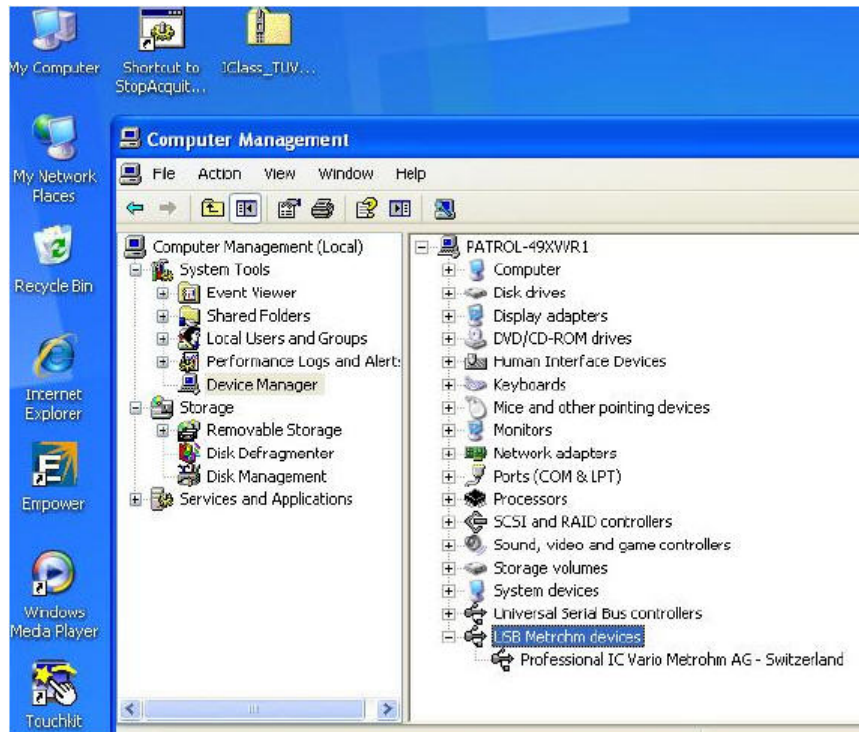
- When the Completing the Found New Hardware Wizard appears, click **Finish**.

Figure 4–5: Completing the 2432 USB driver installation



8. Right-click **My Computer**, and then select **Manage** to open the Computer Management window.
9. Highlight Device Manager, and then confirm that the USB driver is installed (see the following figure).

Figure 4–6: Confirming the 2432 USB driver installation

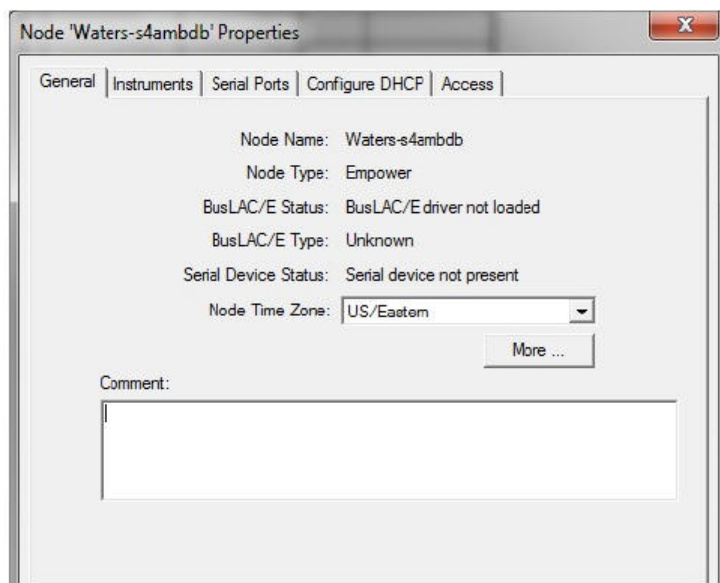


4.3.2 Configuring the DHCP server

Follow these steps to add the 2432 to the Waters DHCP server configuration.

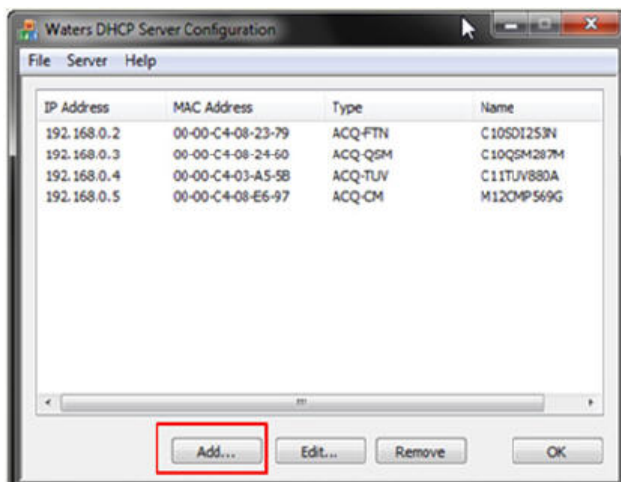
1. In the left pane of the Configuration Manager, right-click on the node where you want to install the 2432 detector, and then select **Properties** to open the Node Properties page.

Figure 4–7: Node Properties page



2. From the **Configure DHCP** tab, click **Configure DHCP**.
3. From the Waters DHCP Server Configuration dialog box, click **Add**.

Figure 4–8: Waters DHCP Server Configuration dialog box



4. From the Add IP Address dialog box (see the following figure):
 - a. Type numbers in each IP Address and MAC Address field. (Note: if you are installing more than one 2432, the numbers must be different.)
 - b. In the Instrument Type drop-down list, select **W2432**.

- c. In the Serial Number/Unique Name field, type the last seven digits of the communication ID from the label on the back of the 2432 (Figure 64).
- d. Click **OK**.

Figure 4–9: Example entries in the Add IP Address dialog box

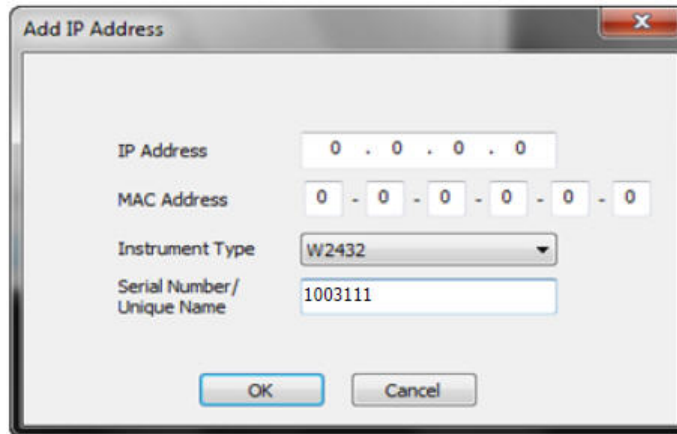
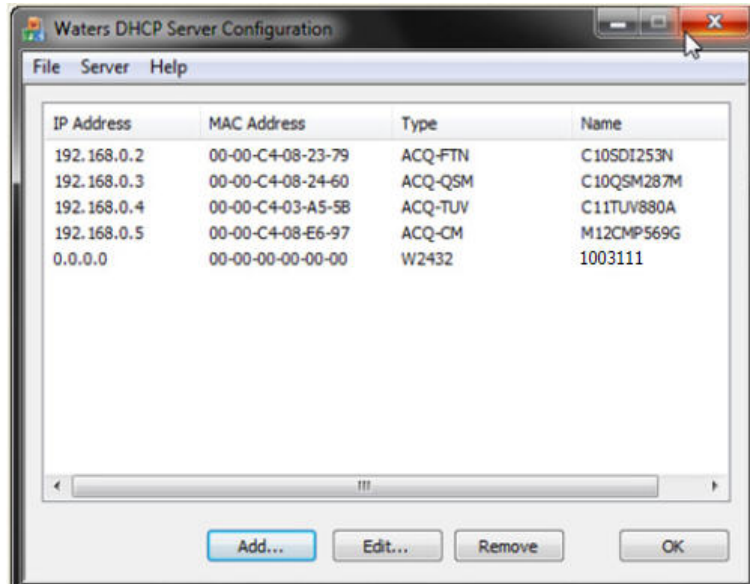


Figure 4–10: Communication ID location



5. When the Waters DHCP Server Configuration dialog box reopens, confirm that the 2432 entries are correct, and then click **OK**.

Figure 4–11: W2432 configuration confirmation

6. Configure the system in Empower as described in [Configure the Empower system](#).