ACQUITY UPLC H-Class and H-Class Bio

System Specifications

Revision B

Waters

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Introduction

The system specifications outlined in this document depend on the conditions in individual laboratories. Refer to the *ACQUITY UPLC H-Class Site Preparation Guide*, or contact Waters Technical Service for more information on specifications.

Notes:

- If your system includes an ELS detector, see the *ACQUITY UPLC Evaporative Light Scattering Detector Getting Started Guide* for physical specifications.
- If your system includes a PDA detector, see the *ACQUITY UPLC Photodiode Array Detector Getting Started Guide* for physical specifications.
- If your system includes a PDA Extended λ detector, see the *ACQUITY UPLC Photodiode Array Extended λ Detector Getting Started Guide* for physical specifications.
- If your system includes an FLR detector, see the *ACQUITY UPLC Fluorescence Detector Getting Started Guide* for physical specifications.
- If your system includes a mass spectrometer, see the documentation included with it for specifications.

System features

The following table lists the ACQUITY UPLC® H-Class and H-Class Bio system features.

System features

Item	Specification
Dwell (delay) volume	<400 µL with 100-µL mixer
Integrated leak management	Drip trays direct all leaks to the front of the instrument and then into waste line.
Leak detection	Leak sensors, installed in drip trays.
Quantum sychronization	Injection synchronization between pump and sample manager. Enhances retention time reproducibility.
Settable flow rate range	0.010 to 2.000 mL/min, in 0.001-mL increments
Maximum operating pressure	103,421 kPa (1034 bar, 15,000 psi) to 1 mL/min; 62,053 kPa (621 bar, 9000 psi) to 2 mL/min
pH range	2 to 12
Cycle time	<30 s System cycle time (or overhead) is equal to the chromatographic run time subtracted from the injection-to-injection time. Test conditions: • System: ACQUITY UPLC H-Class quaternary solvent manager (QSM), ACQUITY UPLC H-Class sample manager with flow through needle (SM-FTN), ACQUITY UPLC H-Class column heater with active pre-heater (CH-A), and ACQUITY UPLC TUV detector • Isocratic chromatography • Flow rate: ≥0.4 mL/min • Injection volume: 1 µL • SM-FTN parameters: Default aspiration speeds and wash times

System features (Continued)

Item	Specification
Cycle time (continued)	• Load ahead mode: enabled • Loop offline: 0.2 min • Run time: 2.0 min
Gradient mixers	H-Class QSM: • Standard: stainless steel, 100-µL mixer/filter • Optional: stainless steel, 250-µL mixer/filter H-Class bioQSM: • Standard: titanium, 100-µL mixer/filter • Optional: titanium, 250-µL mixer/filter
Plunger wash feature	Wash pump plungers using seal-wash solvent, can be primed manually or run automatically.
No-flow shutdown feature	Automatically runs the wash plungers function after a user-specified period of idle time.
Column tracking	eCord™ Technology column information management tracks and archives column usage history
Unattended operation	Leak sensors, full 96-hour diagnostic data displayed through ACQUITY UPLC console software
Auto•Blend Plus™	Software with which users can blend liquid mobile phases (acid, base, aqueous, and salt solution) of known composition and concentration. Users select individual steps with a specified pH and/or salt concentration at a particular time and enter one of 11 predefined functions to transition between these times and conditions. The Auto•Blend Plus technology then automatically calculates the percent acid, percent base, percent salt, and percent solvent required to deliver the specified pH and salt conditions at a given time.

Instrument control

The following table lists the mechanisms used to control ACQUITY UPLC H-Class and H-Class Bio system instruments.

Instrument control

Item	Specification
External control	Empower™ software, MassLynx™ software, or standalone, through ACQUITY UPLC Console software
External communications	Ethernet interfacing via RJ45 connection to host PC
Event inputs/outputs	Rear panel contact closure and/or TTL inputs/outputs
Connections INSIGHT®	Provides real-time monitoring and automatic notification of instrument performance and diagnostic information, allowing for quicker problem resolution
Local control	ACQUITY UPLC Local Console Controller (LCC)

Environmental specifications

The following table lists the environmental specifications for the ACQUITY UPLC H-Class and H-Class Bio instruments.

Environmental specifications

Attribute	Specification
Acoustic noise	<65 dBA, system
Operating temperature	4 to 40 °C (39.2 to 104 °F)
Operating humidity	20 to 80%, noncondensing
Shipping and storage temperature	–30 to 60 °C (–22 to 140 °F)
Shipping and storage humidity	20 to 80%, noncondensing

Electrical specifications

The following table lists the electrical specifications for the ACQUITY UPLC H-Class and H-Class Bio instruments.

Electrical specifications

Attribute	Specification
Protection class[1]	Class I
Overvoltage category[2]	II
Pollution degree[3]	2
Moisture protection[4]	Normal (IPXO)
⚠ Line voltages, nominal	Grounded AC
Voltage range	90 to 264 Vac
Frequency	47 to 63 Hz
Maximum power draw	QSM: 360 VA SM-FTN: 400 VA Column manager with active pre-heater (CM-A): 400 VA

1. **Protection Class I** – The insulating scheme used in the instrument to protect from electrical shock. Class I identifies a single level of insulation between live parts (wires) and exposed conductive parts (metal panels), in which the exposed conductive parts are connected to a grounding system. In turn, this grounding system is connected to the third pin (ground pin) on the electrical power cord plug.
2. **Overvoltage Category II** – Pertains to instruments that receive their electrical power from a local level such as an electrical wall outlet.
3. **Pollution Degree 2** – A measure of pollution on electrical circuits that can produce a reduction of dielectric strength or surface resistivity. Degree 2 refers only to normally nonconductive pollution. Occasionally, however, expect a temporary conductivity caused by condensation.
4. **Moisture Protection** – Normal (IPXO) – IPXO means that no Ingress Protection against any type of dripping or sprayed water exists. The "X" is a placeholder that identifies protection against dust, if applicable.

Performance specifications

Quaternary solvent manager

The following table lists the performance specifications for the ACQUITY UPLC H-Class QSM and H-Class bioQSM.

QSM performance specifications

Item	Specification
Number of solvents	One to four (A,B, C, and D), in any combination. Optional 6-position solvent selection valve enables solvent selections D_1 through D_6 on line D, in addition to A, B, and C (a total of nine solvents to select from).
Solvent conditioning	Integrated vacuum degassing, four chambers. One additional for the SM-FTN.
Gradient formation	Low-pressure mixing, quaternary gradient
Gradient profiles	11 gradient curves, including linear, step (2), concave (4), and convex (4)
Primary check valve	Intelligent Intake Valve (*i^2Valve*)
Flow accuracy	±1.0% of set flow at 0.500 to 2.000 mL/min using 100% solvent A. Backpressure 4137 to 6895 kPa (41 to 69 bar, 600 to 1000 psi), with water.
Flow precision	0.075% RSD or ±0.02 min SD, whichever is greater, based on six replicates. Test conditions: • Mobile phase: 60:40 methanol/water pre-mixed • Flow rate: 0.5 mL/min • Sample mix: alkylphenone mix (5.0 µL injection volume)

QSM performance specifications (Continued)

Item	Specification
Flow precision (continued)	• Column: ACQUITY UPLC BEH C_{18}, 1.7 µm, 2.1 × 50 mm. • Column temperature: 35 °C ±0.3 °C • Detector: UV, 254 nm wavelength
Composition ripple (baseline noise)	<1.0 mAU (<0.1 mAU with optional 250-µL mixer) Test conditions: • Mobile phase: A: water + 0.1%, trifluoroacetic acid; B: acetonitrile + 0.1%, trifluoroacetic acid • Flow rate: 0.5 mL/min • Gradient conditions: 1.0 to 33% B in 10 min; time average window, 10 s. Noise range 4.00 to 6.00 min • Column: ACQUITY UPLC BEH C_{18}, 1.7 µm, 2.1 × 50 mm. • Detector: ACQUITY TUV, 214 nm wavelength, 10 Hz sampling rate
Composition accuracy	±0.5% absolute (full scale) from 5 to 90% from 0.500 to 2.000 mL/min Test conditions: • Mobile phase: acetonitrile/water, 10:90; acetonitrile/water, 10:90, with caffeine at 12 mg/L concentration • Backpressure: 13,790 kPa (138 bar, 2000 psi) • Gradient conditions: Step gradient method • Detector: UV, 273 nm wavelength.

QSM performance specifications (Continued)

Item	Specification
Composition precision	<0.15% RSD or ±0.04 min SD, whichever is greater, based on six replicate injections Test conditions: • Mobile phase: 60:40 methanol/water mixed online via the QSM • Flow rate: 0.5 mL/min • Sample mix: alkylphenone mix (5.0 µL injection volume) • Column: ACQUITY UPLC BEH C_{18}, 1.7 µm, 2.1 × 50 mm. • Detector: UV, 254 nm wavelength • Column temperature: 35 °C ±0.3 °C
Compressibility compensation	Automatic and continuous
Priming	Wet priming can run at flow rates up to 4 mL/min
Plunger wash	Equipped with a wash system, to flush the rear of the high pressure seal and the plunger. The interval between seal wash pump activations is: • QSM default: 5.0 min • bioQSM default: 0.1 min (6 s)
Flow ramping	Range: 0.01 to 30.00 min to reach 2.0 mL/min Default: 0.45 min, to reach 2.0 mL/min at 4.44 mL/min/min
Vent valve	Used for priming the pump and automated leak testing. When the column manager switches columns, the vent valve switches to the vent position, to reduce system pressure.

QSM performance specifications (Continued)

Item	Specification
Solvent lines	Set of factory-installed inlet tubing assemblies. Each assembly includes a 10-µm reservoir filter.
Composition range	0.0 to 100.0% settable in 0.1% increments.

Sample manager - FTN

The following table lists the performance specifications for the ACQUITY UPLC H-Class SM-FTN and H-Class bioSM-FTN.

Sample manager - FTN performance specifications

Item	Specification
Injection volume range	0.1 to 10.0 µL as standard. Up to 1000.0 µL with optional extension loops (50, 100, 250, and 1000 µL).
Accuracy (aspiration)	±0.2 µL, measured by fluid weight removed from vial with 10 µL injections averaged over 20 injections using 100 µL syringe.
Linearity	>0.999 (standard needle) Test conditions: • Chromatography: isocratic • Mobile phase: 10:90 acetonitrile/water • Flow rate: 0.6 mL/min • Sample mix: caffeine 0.03 mg/mL (0.2 to 10 µL injection volume) • Column: ACQUITY UPLC BEH C_{18}, 1.7 µm, 2.1 × 50 mm. • Detector: UV, 273 nm wavelength • Column temperature: 40 °C ±0.3 °C

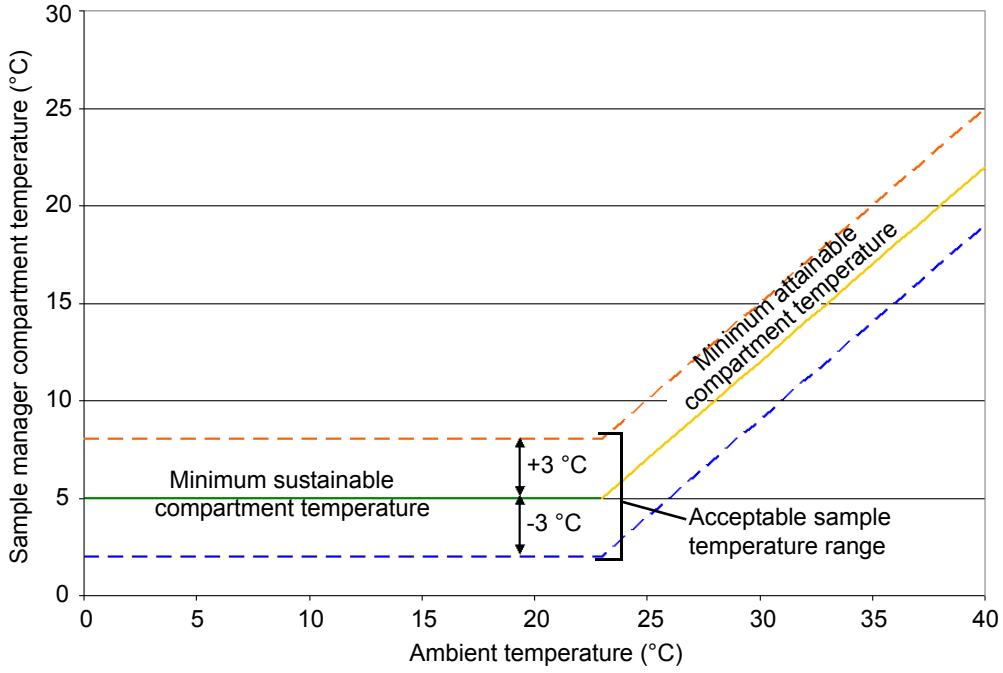
Sample manager - FTN performance specifications (Continued)

Item	Specification
Precision	<1% area RSD, 0.2 µL to 1.9 µL (0.25 to 0.50 mg/mL caffeine), <0.5% area RSD, 2.0 µL to 10.0 µL (0.03 mg/mL caffeine) Test conditions: • Chromatography: isocratic • Replicates: 6 • Mobile phase: 10:90 acetonitrile/water • Flow rate: 0.6 mL/min • Column: ACQUITY UPLC BEH C_{18}, 1.7 µm, 2.1 × 50 mm. • Detector: UV, 273 nm wavelength • Column temperature: 40 °C ±0.3 °C
Number of sample plates	Any combination (two) of the following Waters-certified plates: • 96 round-well, 350-µL • 96 round-well, medium, 1.0-mL • 96 square-well, tall, 2.0 mL • 384-well, 100-µL • 384-well, 250-µL • 96-well with 700-µL glass insert, with plate • 96-well with 1-mL extended glass insert, with plate • 96-well with 700-µL glass insert, insert only • 96-well with 1-mL extended glass insert, insert only For more information, see *Using Plates and Vials with ACQUITY UPLC and ACQUITY UPLC H-Class Systems*.

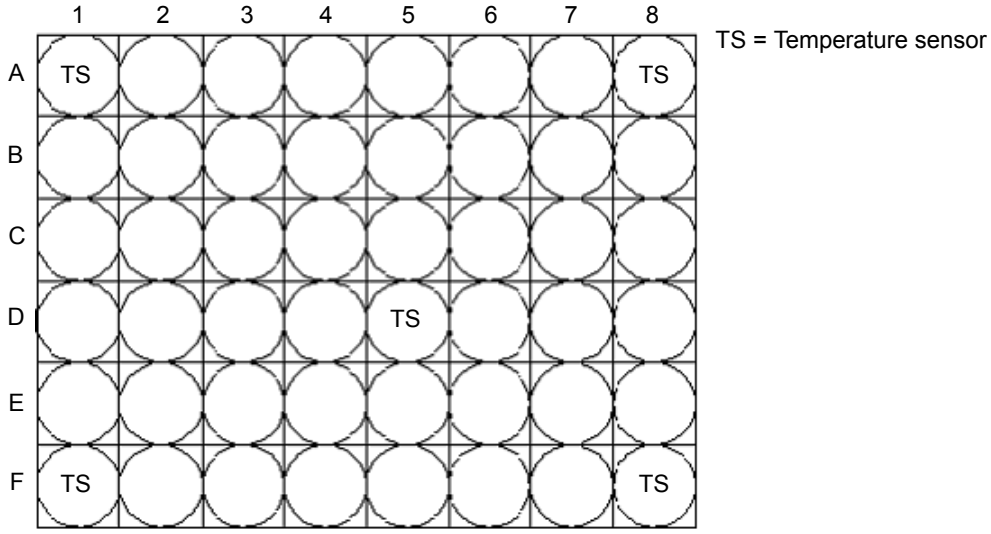
Sample manager - FTN performance specifications (Continued)

Item	Specification
Maximum sample capacity	768 in two, 384-well Waters-certified plates, or 96 in 2-mL vial holders. For more information, see *Using Plates and Vials with ACQUITY UPLC and ACQUITY UPLC H-Class Systems*.
Sample compartment temperature range	4.0 to 40.0 °C, settable in 0.1 °C increments • Sample manager maintains setpoint temperatures from 5 to 40 °C for ambient temperatures up to 23 °C and relative humidity levels up to 80%. Sample temperatures will be within ±3 °C of the setpoint. • At ambient temperatures above 23 °C, the sample manager can maintain an average sample temperature of 18 °C below ambient ±3 °C.

Sample manager - FTN performance specifications (Continued)

Item	Specification
Minimum sample compartment temperature specifications The graph shows achievable sample compartment temperature and expected variation at various sample temperatures.  	

Sample manager - FTN performance specifications (Continued)

Item	Specification
Recommended temperature sensor locations The following diagram shows the recommended temperature sensor locations on the sample tray when validating specifications. 	
Temperature accuracy	No more than a ±0.5 °C in temperature between a traceable external temperature measurement device and instrument temperature measurement device.
Temperature stability	±1.0 °C (at the sensor with sample compartment door closed)
Injection needle wash	Integral, active, and programmable
Minimum sample required	3 µL, residual, using 950-µL Waters Total Recovery Vials (needle placement of 0 mm) in the 48-well vial holder. 7 µL, residual, using Maximum Recovery Vials (needle placement of 2.0 mm) in the 48-well vial holder.

Sample manager - FTN performance specifications (Continued)

Item	Specification
Sample carryover - UV	<0.004% caffeine (UV) Test conditions: • Solvent A: 100% water • Solvent B: 100% acetonitrile • Weak wash: water/acetonitrile, 90/10 • Strong wash: water/acetonitrile, 90/10 • Column: ACQUITY UPLC BEH C_{18} 1.7 µm, 2.1 × 50 mm • Mobile phase: 90% solvent A:10% solvent B • Flow rate: 0.6 mL/min • Sample: caffeine, at 0.16 mg/mL (standard) and 4 mg/mL (challenge) in water/acetonitrile, 90/10, compared to blanks of water/acetonitrile, 90/10 • Injection volume: 5 µL • Column temperature: 40 °C • Detection: UV at 273 nm, sampling rate = 20 points/s, filter time constant = normal (0.2 s) • Run time: 2 min • Data system: Empower or MassLynx software Basis of calculation: Any peak in the blanks following the challenge sample are compared to the known (0.005%) standard. Carryover peak areas below the standard area are within specification.

Sample manager - FTN performance specifications (Continued)

Item	Specification
Sample carryover - MS	<0.005% sulphadimethoxine (MS) Test conditions: • Solvent A: water with 0.1% formic acid • Solvent B: acetonitrile with 0.1% formic acid • Weak wash: water/acetonitrile, 95/5 • Strong wash: water/acetonitrile, 50/50 • Mobile phase: 80% solvent A:20% solvent B • Flow rate: 0.3 mL/min • Sample: sulphadimethoxine at 5 pg/µL (standard) and 1 µg/µL (challenge) in water/acetonitrile, 90/10 +0.1% formic acid, compared to blanks of water/acetonitrile, 90/10 +0.1% formic acid • Injection volume: 5 µL • Column: ACQUITY UPLC BEH C_{18} 1.7 µm, 2.1 × 50 mm • Column temperature: 40 °C • Sample temperature: 10 °C • Detection: MS SIR at 311.3 Da,0.5 s dwell or MRM at 156.0 to 310.0 • Ion mode: ES+ • Run time: 5 min • Data system: Empower or MassLynx software

Sample manager - FTN performance specifications (Continued)

Item	Specification
Sample carryover - MS (continued)	Basis of calculation: Any peak in the blanks following the challenge sample are compared to the known (0.005%) standard. Carryover peak areas below the standard area are within specification.

Column heater

The following table lists the performance specifications for the ACQUITY UPLC H-Class CH-A, H-Class 30-cm column heater with active pre-heater (CH-30A), H-Class bioCH-A, and H-Class bioCH-30A.

Column heater performance specifications

Item	Specification
Column capacity	CH-A: Single column, up to 4.6-mm internal diameter (ID), to 150-mm length, with filter or guard column. Maximum column, outside diameter (OD), is 5/8-inch. CH-30A: Single column, up to 4.6-mm internal diameter (ID), to 300-mm length, with filter or guard column. Maximum column, outside diameter (OD), is 5/8-inch.
Column compartment temperature range	CH-A/CH-30A: 20 to 90 °C, in increments of 0.1 °C (control requires a setpoint of greater than ambient temperature +5 °C)

Column heater performance specifications (Continued)

Item	Specification
Column compartment temperature accuracy	CH-A/CH-30A: Tested to ±0.5 °C Test conditions: • Door closed • No column installed • No flow • Measurement taken with traceable, external temperature measurement device • Measurement taken after 1 hour of thermal equilibration at set point • Measurement taken at column compartment sensor location • Tested at 35 °C, 55 °C, and 85 °C
Column compartment temperature stability	CH-A/CH-30A: Tested to ±0.3 °C Test conditions: • Door closed • No column installed • No flow • Measurement taken with traceable, external temperature measurement device • Measurement taken for 1 hour of thermal equilibration at set point • Measurement taken at column compartment sensor location • Tested at 35 °C, 55 °C, and 85 °C

Column heater performance specifications (Continued)

Item	Specification
Solvent conditioning	CH-A: Active pre-heating is standard. Passive pre-heating is allowed for legacy support. CH-30A: Active pre-heating is standard.

Column manager

The following table lists the performance specifications for the ACQUITY UPLC H-Class CM-A, H-Class auxiliary column manager (CM-Aux), H-Class bioCM-A, and H-Class bioCM-Aux.

Column manager performance specifications

Item	Specification
Columns	Up to 4.6 mm ID; up to 150-mm columns. Up to 30-mm column with guard column or filter. ACQUITY UPLC 30-cm column heater/cooler supports columns with dimensions of up to 7.8 mm diameter.
Number of columns	CM-A: Up to two 150-mm columns (with filters or guard column) or up to four 50-mm columns (with no guard column or filter). CM-Aux: Up to two 150-mm columns (with filters or guard column).
Column compartment temperature range (settable)	4 to 90 °C, in increments of 0.1 °C. Troughs are independently settable. Derating: The minimum achievable column compartment temperature set point must not be greater than 25 °C below ambient temperature.

Column manager performance specifications (Continued)

Item	Specification
Time to temperature, from steady state, after door is open for 30 seconds.	12 minutes maximum Test conditions: • No column installed • No flow • Measurement taken with internal temperature sensor • Measurement taken after 1 hour of thermal equilibration at set point • Door is opened for 30 seconds • Tested at 35 °C, 55 °C, and 85 °C
Column compartment temperature accuracy	Tested to ±0.5 °C Test conditions: • Door closed • No column installed • No flow • Measurement taken with traceable, external temperature measurement device • Measurement taken after 1 hour of thermal equilibration at set point • Measurement taken at column compartment sensor location • Tested at 35 °C, 55 °C, and 90 °C

Column manager performance specifications (Continued)

Item	Specification
Column compartment temperature precision	Tested to ±0.1 °C Test conditions: • Door closed • No column installed • No flow • Measurement taken with traceable, external temperature measurement device • Measurement taken at column compartment sensor location • Temperature is ramped from ambient to 90 °C • Measurement taken after 1 hour of thermal equilibration • Temperature is returned to ambient • Test is repeated four additional cycles
Column compartment temporal temperature stability	Tested to ±0.3 °C Test conditions: • Door closed • No column installed • No flow • Measurement taken with traceable, external temperature measurement device • Measurement taken for 1 hour after thermal equilibration at set point • Measurement taken at column compartment sensor location • Tested at 35 °C, 60 °C, and 90 °C
Ambient temperature stability	Within 2.0 °C/60 minute maximum
Pre-heater temperature (not user-settable)	Defined by set point of the column trough.

Wetted materials of construction

Quaternary solvent manager

The following table lists the wetted materials of construction for the ACQUITY UPLC H-Class QSM and H-Class bioQSM.

QSM wetted materials of construction

Description	Specification
Wetted materials	ACQUITY UPLC H-Class QSM: 316 L stainless steel, DLC, fluoroelastomer, fluoropolymer, Nitronic 60, PEEK™ and PEEK blend, PPS and PPS blend, ruby, sapphire, titanium alloy, UHMWPE blend, zirconia ACQUITY UPLC H-Class bioQSM: DLC, fluoroelastomer, fluoropolymer, Inconel 600, MP35N, PEEK™ and PEEK blend, PPS and PPS blend, ruby, sapphire, titanium, titanium alloy, UHMWPE blend, zirconia

Sample manager - FTN

The following table lists the wetting materials of construction for the sample ACQUITY UPLC H-Class SM-FTN and H-Class bioSM-FTN.

Sample manager - FTN wetted materials of construction

Description	Specification
Wetted materials	ACQUITY UPLC H-Class SM-FTN: 316 stainless steel, 316 stainless steel with DLC, 450-G, borosilicate, EPDM, fluoropolymer, fluoropolymer-coated Neoprene, gold-plated stainless steel, PEEK, PEEK blend, polyethylene, polyimide, PPS ACQUITY UPLC H-Class bioSM-FTN: MP35N, PEEK, titanium alloy with DLC

Column heater

This table lists the wetted materials of construction for the ACQUITY UPLC H-Class CH-A, H-Class CH-30A, H-Class bioCH-A, and H-Class bioCH-30A.

Column heater wetted materials of construction

Description	Specification
Wetted materials	ACQUITY UPLC H-Class CH-A and CH-30A: 316 stainless steel ACQUITY UPLC H-Class bioCH-A and bioCH-30A: MP35N

Column manager

This table lists the wetted materials of construction for the ACQUITY UPLC H-Class CM-A, H-Class CM-Aux, H-Class bioCM-A, and H-Class bioCM-Aux.

Column manager wetted materials of construction

Description	Specification
Wetted materials	ACQUITY UPLC H-Class CM-A and CM-Aux: 316 stainless steel ACQUITY UPLC H-Class bioCM-A and bioCM-Aux: MP35N, titanium