

WATERS CORPORATION

PERFORMANCE SPECIFICATION

TYPE OF SPECIFICATION (check one):



SYSTEM (*SIGNATURE REQUIRED)



SUB ASSEMBLY (✓ SIGNATURE REQUIRED)

PRODUCT: 2690 Separations Module

DOCUMENT NUMBER: WAT270645

ASSEMBLY NAME: 2690 (Models with Vacuum Degasser)

REVISION: A

PART NUMBERS AFFECTED:
270006,270007,270008,270009,290010
270011,270886,270887,270888,270889
270890,270891

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ACKNOWLEDGMENT/DATE:

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JOB TITLE (print)

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REVISION HISTORY

<u>REV.</u>	<u>DWO/ECO NUMBER</u>	<u>DATE</u>	<u>ORIGINATOR</u>
A	DWO-2188	6/10/96	Joe Luongo
0	ECO-3620	6/10/98	Mark Moeller

1. Scope

The purpose of this document is to detail the system level performance specifications for the 2690 Separations Module, all models with vacuum degasser. This includes the 2690XE Model, which is the fully loaded version with seal wash, sample heater/cooler, and column heater.

This information is used by Test Engineering for developing the test equipment for the product, Field Support for developing Validation Protocols, and various test labs to measure performance against. It also provides information for future reference for development, operations and marketing.

The 2690 is not tested with the column heater, but the column heater documentation is referenced in this document as a matter of convenience.

1.1 Description

The 2690 Separations Module combines the functions traditionally performed by separate pump, autosampler, and vacuum degasser modules. The functions of the pump and vacuum degasser are now identified as the solvent delivery and solvent conditioning systems (known collectively as the solvent management system), while the injector and vial positioning systems are called the sample management system.

Solvent Management Main Features:

Solvent Conditioning (Vacuum Degasser):

- Replaces the traditional sparge degassing system, incorporates the same basic components as the Waters In Line Degasser module, the electronics are designed to interface with the 2690 electronics

Solvent Delivery:

- New 2 head serial flow design that uses a separate drive motor for each plunger
- Digital Signal Processor that coordinates the motion of the 2 plungers
- Two pressure transducers (one for each head), and 2 check valves
- Rotary motion of the motors is converted to linear motion using ball screw mechanisms
- Heads are designed to be removed without breaking tubing connections, for servicing.
- Seal wash system (included with XE) provides an active fluid flow to wash the back of the plunger seals to reduce buildup of precipitated salts from buffered mobile phases
- Solvent blending using an upgraded GPV with built in, low volume accumulators

Sample Management Main Features:

Vial Positioning:

- New 5 carousel vial positioning system that provides a 120 sample capacity

Injection System:

- Similar to a 717, the high pressure valves (V1, V2) are identical
- Injector has a more easily serviceable seal pack and some mounting differences
- The V3 valve is a slightly different configuration from 717
- Needle wash pump and V4 valve are identical to the 717

Options

- Sample heater/cooler (included with XE)
- Column heater (included with XE)

More details on all of the major components are in the subassembly performance specifications listed in section 2.0.

2. Applicable documents

<i>Document</i>	<i>Document Number</i>
Spec.,Perf.,PCB,2690/690 CPU	270777
Spec.,Perf.,PCB,2690/690 Front Panel	270778
Keypad,Supermodule	270133
Display,LCD,Sanyo,LCM-5520-24	270208
Spec.,Perf.,Pump Driver PCB, 2690/690	270704
Spec.,Perf.,Fluidics Driver PCB, 2690/690	270696
Spec.,Perf.,Vacuum Degass PCB, 2690/690	270703
Spec.,Perf.,Heater Cooler PCB, 2690/690	270697
Spec.,Perf.,Sensor PCB, 2690/690	270705
Spec.,Perf.,Column Heater PCB, 2690/690 (reference)	270706
Alliance 2690 & 690 400W Pwr Sply Elect Spec	270742
Alliance 2690 & 690 600W Pwr Sply Elect Spec	270743
Spec.,Perf.,Vacuum Degasser, 2690/690	270700
GPV Performance Spec.	270624
Spec.,Perf.,Check Valve, 2690/690	270699
Spec.,Perf.,Pump Mechanics/Fluidics, 2690/690	270698
Subassembly Performance Specification, Pressure Transducer Model JL	270607
Spec.,Perf.,Sample Mech.	270780
Spec.,Perf.,Injector,2690	270694
Spec.,Performance, HPMV	045344
Valve,2-way,2 port,V3,FM	270567
Assy, Wash Pump	078540
Pump, Solenoid	270594
Assy Valve Biochem (V4)	078800
Spec.,Perf,Mech.,Samp. Drive	270693
Spec., Syringe Drive	045346
Spec.,Perf.,Heater/Cooler	270801
Spec.,Perf.,Column Heater, 2690/690 (reference)	271079
Product Packaging Specification	056529
Standard Practice...Shipping...Systems	ASTM D 4169-90
Diagram, Interconnect, 2690	270331
Fluidics Diagram, 2690	270572

3. Specifications

3.1 Physical

<i>Item</i>	<i>Specification</i>
Height	22.5 inches
Depth	21.5 inches (with heater/cooler)
Width	23.0 inches (with column heater)
Weight	130 lbf

3.2 Materials of Construction (Wetted, in contact with mobile phase or wash solutions)

<i>Item</i>	<i>Specification</i>
Solvent Conditioning System-degasser, solvent inlet lines, GPV	ETFE, UHMWPE, PEEK (ferrule), PTFE, 316 Stainless Steel
Solvent Delivery System (except GPV)	Ruby, Sapphire, 316 Stainless Steel, UHMWPE, Flouroloy-G, GFP, Hastelloy, ETFE, Elgiloy [®]
Solvent Delivery System-seal wash system	ETFE, PTFE, UHMWPE, 300 series SST
Sample Management System-injector, HPMV, V3	Zirconia ceramic, 316 Stainless Steel, Flouroloy-08, PTFE, Elgiloy [®]
Sample Management System-needle wash, seal pack	PTFE, UHMWPE, 316 Stainless Steel, Porex, 300 series SST
Column Heater (reference)	316 Stainless Steel

3.3 Materials of Construction (other structural)

<i>Item</i>	<i>Specification</i>
Chassis sheet metal	5051-T52 aluminum, finished per MIL-C-5514, class 3
Front panels	Lexan [®] Structural Foam Polymer

3.4 Interface Definition

3.4.1 Electrical Power

<i>Item</i>	<i>Specification</i>
Line Voltage	85 to 132 and 180 264 VAC (see also 270742/743)
Frequency	47 to 63 Hz (see also 270742/743)
Current requirements, fusing	120 VAC nominal: 10A 240 VAC nominal: 6.3A (see also 270742/743)

3.4.2 Interface (Electrical, rear panel, operator accessible)

<i>Item</i>	<i>Specification</i>
IEEE-488 (1)	For detector and Millennium Control (see 270777)
RS-232 (2)	For output to a Waters 746 Integrator, printer, dissolution control (see 270777)
Event out (6), SW1-SW4, Run Stopped, Inject Start	see 270777
Event in (3), Stop Flow, Hold Inject 1, Hold Inject 2	see 270777
Chart Out (1)	see 270777
Column Heater (1)	QSPI (see 270777) and 24 volt power @ 2 amps for the column heater, connector type 26 pin D subminiature female.
BCD Output	3 digits for vial position using optional box connected to one of the two RS232 ports, BCD format (parallel), positive/negative logic switchable on the box, for interfacing with LIMS systems

3.4.3 Interface (Electrical, direct connect to CPU board, non-operator accessible)

<i>Item</i>	<i>Specification</i>
RS-232 (development and manufacturing test)	see 270777
Pressure Transducer signal (primary, accumulator, sample loop), development and manufacturing test	see 270777

3.4.4 Interface (Mechanical)

<i>Item</i>	<i>Specification</i>
Internal cooling	Provided by brushless DC fans. Power supply fan cools upper compartment. Heater/cooler fans cool lower compartment if installed, otherwise a separate fan cools the lower compartment.
Airflow requirements (installation)	2 inch airspace around the sides and back of the system

3.5 Environmental (Operating)

<i>Item</i>	<i>Specification</i>
Temperature	4 to 40 °C
Humidity	20 to 80% noncondensing
Acoustic Noise (instrument generated)	<65 dBA

3.6 Enviroment (Shipping, packaged, Reference 056529)

<i>Item</i>	<i>Specification</i>
Temperature	-40 to 70 °C
Relative humidity	10% to 90%
Shock (drop)	per ASTM D 4169-90
Vibration	per ASTM D 4169-90

3.7 Safety, Regulatory

<i>Item</i>	<i>Specification</i>
EMI (CE Mark)	EN50081-1
EMC (CE Mark)	EN50082-1
European Union Safety (CE Mark)	EN61010
US Safety (US ETL Mark)	UL 3101
Canadian Safety (ETL Mark)	CSA 1010

3.8 Design Life/Reliability

<i>Item</i>	<i>Specification</i>
Pump Drive Mechanism	5 years (40 hours/week) @ 1.0 mL/min, 4000 psig backpressure
GPV	5 years (40 hours/week) @ 1.0 mL/min
Sample Drive Mechanism	5 years (400,000 vial to vial moves)
Injector Mechanism	5 years
Plunger seal (typical)	6 months (40 hours/week) @ 1.0 mL/min
Injector seal (typical)	1 year (15,000 injections)
Heater/Cooler	5 years
Power Supplies	5 years
Column Heater (reference)	5 years

3.9 Performance

3.9.1 System

<i>Item</i>	<i>Specification</i>
Number of solvents	One to four
Flow rate, pressure operating envelope	see Figure 1
Flow rate increment: range	0.001 mL/min: 0.000 and 0.010 to 10.000 mL/min
Flow rate ramping	Time (0-30 minutes in 0.01minute increments) to reach maximum, when not in gradient table. In gradient table, same as gradient curves.
Delay volume	<650 uliters @ 1.0 mL/min, MeOH/MeOH parabens, independent of back pressure, measured @ liftoff, from the Inject Start Output at the rear panel

3.9.2 Solvent Management

Item	Specification
Degasser vacuum decay, fluid pressure drop, control modes	see 270700 and 270703
System Static Leak rate:	To be less than 1 microliter/minute with 100% Methanol which correlates to a 160 psi/minute leak rate. To be measured at a pressure of 5,000 psi from 60-90 seconds. Fluidics to include the accumulator pump, the restrictor loop, the sample loop, and the red line.
Pump Tray Static leak Rate:	To be less than .44 microliters/minute with 100% Methanol which correlates to a 200 psi/minute leak rate. The accumulator to be measured at a pressure of 5,000 psi and the primary to be measured at 4,000 psi from 60-90 seconds. The primary pump fluidics to include the transducer, the accumulator pump fluidics to include the transducer, the vent valve and the in-line filter.
Note: Leak rates were obtained experimentally	
Flow Accuracy	±1.0% or 10 uL per minute whichever is greater, from 0.200 to 5.000 mL/min, degassed MeOH, 600 psig backpressure
Flow Precision	0.075% RSD or 0.02 minutes SD, for 0.200 to 1.0 mL/min with degassed 60/40 MeOH/Water, isocratic (pre-mixed mobile phase), using alkyphenones, at a column temperature of 30±0.5°C, N≥6 Alternative method is multiple flow accuracy measurements, volumetric or mass, with degassed MeOH
Pressure Ripple	≤2.5% peak-to-peak, 1.0 mL/min, degassed MeOH, at 1700±100 psig backpressure
Composition increment: range	0.1%: 0.0 to 100.0%
Composition Accuracy	±0.50% absolute, 0.2 and 1.0 mL/min using degassed MeOH/MeOH parabens, measured using step gradients.
Composition Precision	0.15% RSD or 0.02 minutes SD, for 0.200 to 1.0 mL/min with degassed 60/40 MeOH/Water, dial-a-mix, using alkyphenones, at a column temperature of 30±0.5°C, N≥6. Alternate definition: ±0.15% SD absolute, 5 to 95%, 0.2 and 1.0 mL/min using degassed MeOH/MeOH parabens, measured using multiple runs of step gradients.
Composition Ripple	±0.1% absolute at 0.200 mL/min and 0.4% absolute at 1.0 mL/min, 5 to 95% using degassed MeOH/MeOH parabens, measured using step gradients.
Seal wash flow rate	≥2.0 mL/min @ priming rate (1 pulse/second)
Seal wash leak rate (pressure test)	see 270698
Gradient Composition Curves	Eleven (11) gradient curves (including linear, step [2], concave [4], convex [4])
Gradient Flow Curves (Gradient Table)	Eleven (11) gradient curves (including linear, step [2], concave [4], convex [4])
Linearity of Linear Gradient	0.5% per minute to 20% per minute linear gradients: correlation coefficient 0.99, Slope Error 1.0%, measured using degassed MeOH/MeOH parabens, from 5 to 95%

	at 0.200 and 1.0 mL/min.
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3.9.3 Sample Management

<i>Item</i>	<i>Specification</i>
Number of sample vials	120 vials, configured in 5 carousels of 24 vials each
Number of sample injections per vial	1-99 injections per sample vial
Sample Vial	Standard 2 mL vial, minimum useable volume is 1 mL without inserts, 10 uL with inserts
Sample Loop Leak Rate (compression test)	≤50 psig decay over 1 minute after pressurizing to 300 psig, maximum compressed volume 20 uL, with 100 uL sample loop and 250 uL syringe
Injector seal adjustment parameters (manufacturing)	Top: 40±10 steps Width: 80±10 steps Bottom (=Top+Width): 100-140 steps
Injection Volume Range	0.1 to 100 uL with standard loop, 0.1 to 2000 uL with optional loop
Injection Accuracy	±1.0 uL @ 50 uL injection volume, with 100 uL sample loop, at 2.5 uL/sec sample draw rate, with 250 uL syringe
Injection Precision	≤0.50% RSD for 20 uL, @ 1.0 mL/min with degassed 60/40 MeOH/Water, dial-a-mix, using alkyphenones, at a column temperature of 30±0.5°C, N≥6 0.50% RSD for 5 uL, @ above conditions, for 1 SD of a sample of systems (Note: this is a statement that not all systems will meet the precision at 5 uL)
Injection Linearity	≥0.999 correlation coefficient, 1 to 100 uL
Needle wash flow rate	≥0.6 mL per injection
Sample carryover	≤0.1% measured using a caffeine standard, 20 uL injection, followed by 20 uL injection of mobile phase, ratio of peak areas, @ 1.0 mL/min, 60/40 MeOH/Water
Sample Compartment Temperature resolution (settability), precision (repeatability), accuracy, spatial distribution	see 270697 and 270801

3.9.4 Column (Reference)

<i>Item</i>	<i>Specification</i>
Column Heater Compartment Temperature resolution, precision, accuracy, spatial distribution	see 270706 and 271079

4. Recommended Test Matrix (Mfg and Validation)

<i>Specification</i>	<i>Manufacturing Test</i>	<i>Validation Test (OQ and PQ)</i>
Degasser vacuum decay	subassembly level	front panel diag
Pump static leak test	front panel diag	no
Seal wash flow rate	check function only	check function only
Sample Loop Leak Rate	front panel diag	no

(compression test)		
Injector seal adjustment parameters	front panel diag	no
Needle wash flow rate	check function only	check function only
Injection Accuracy	@ 50 ul	@ 50 ul
Flow Accuracy	@ 1.0 mL/min	@ 1.0 mL/min, also 0.25, 0.5, 5.0 optional
Delay Volume	@ 1.0 mL/min	no
Composition Precision	PQ twice to test all 4 channels (added cost), may replace with valve pair test at later date	PQ
Injection Precision	PQ (added cost)	PQ
Sample carryover	yes for first 100 units	no
Sample Compartment Temperature	subassembly level	yes (use temperature probe)
Column Temperature (reference)	subassembly level	yes (use temperature probe)
Other Tests		
GPV equivalency and accuracy test (valve pair test)	no, but may replace PQ later	yes
Carousel and vial positioning test	subassembly level	yes

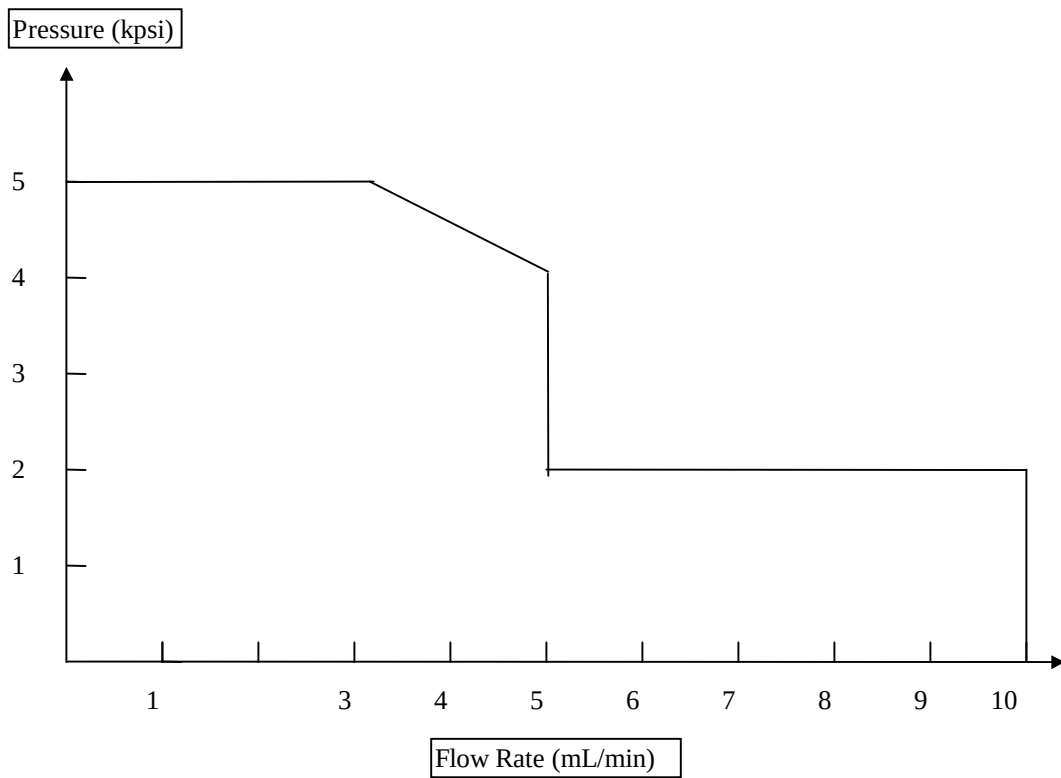


Figure 1