Introducing new GC Autosampler & Multimode Inlet

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If you could…
Run more samples in your sequence
Improve detection limits
Automate tedious sample and standard preparation steps
Handle active compounds better than before
Get large volume injections without spending a long time on
method development
Get better precision
…wouldn't you be happy!
Two New Products from Agilent to Enhance Lab Productivity

Agilent 7693A Automatic Sampler

Agilent Multimode Inlet

NEW!
Agilent Liquid Sampling Portfolio

7683B ALS

7693A ALS

G2880 ALS

CTC Pal
Upgradeable Platform (7693A) Based on Latest Technology: Grounds-Up Redesign

- New syringe carriage design - rack & pinion drive, stronger motor, no belts
- Smarter instrument with feedback loops
- better motors
- active gripper (additional motor)
- more sophisticated boards (smaller, more reliable, more capabilities)
- physically larger to handle more vials, larger vials
- longer mean-time before first failure
- field supportability
- compatibility with all 6890 GCs
New 7693A Automatic Liquid Sampling System

New Injector with 16 Vial Positions

New Tray with 150 Vial Positions
# New Autosampler versus 7683B

<table>
<thead>
<tr>
<th>Feature</th>
<th>7683B</th>
<th>7693A</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-mL Sample vials, ALS Tower Only</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>2-mL Sample vials with Tray</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Usable solvent capacity</td>
<td>6 x 4mL</td>
<td>10 x 4mL</td>
</tr>
<tr>
<td>Injection volume settings</td>
<td>6</td>
<td>49</td>
</tr>
<tr>
<td>Maximum syringe size</td>
<td>100 µL</td>
<td>500 µL</td>
</tr>
<tr>
<td>Dual simultaneous injection</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bar code reader</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sandwich injections</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Sample prep capabilities</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
7693A Injector & Tray Features

- 16 (Injector) and 150 (Tray), 2-mL samples
- Removable, 50-vial sample trays
- Injections from 1-50% of syringe size in 1% increments
- Modular, field repairable
- Self Calibrating, alignment like 7683B
- LVI (Large Volume Injection to 250 µL per injection)
- Single Sample Heater, Barcode reader/mixer
- Active gripper
- Compatible with all 6890, 7890, 7820 and 6850 (Injector Only for 6850)
- Optional heater/chiller plate (requires circulating bath)

<table>
<thead>
<tr>
<th>Setting (injecting into S/SL inlet)</th>
<th>Precision (% RSD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% to 50%</td>
<td>0.30%</td>
</tr>
<tr>
<td>10%</td>
<td>0.80%</td>
</tr>
<tr>
<td>2%</td>
<td>1-2%</td>
</tr>
<tr>
<td>1%</td>
<td>3-5%</td>
</tr>
</tbody>
</table>
16 Sample Capacity in 7693A Injection Tower

7673 7683 7693
Lifetime and Reliability Testing

- Lifetime before failure – 120,000 injections
New ALS ChemStation Parameter Screen
Sample Prep Programming Flexibility

- Sandwich injections (up to 3 layers with air gap)
- Examples of simple liquid manipulation
  - ISTD addition
  - Reconstitution
  - Mixing (Requires Bar Code Reader / Heater / Mixer option)
- Dilution
- Derivatization
- In Vial Extraction
Manual

7693

% RSDs of RRFs from 7 level calibration

7693A is as good as a skilled chemist when making a 7-level calibration set.

Manual Prep vs 7693A Prep

Compare Manual Prep vs 7693A Prep

Expert Tour 2009
Summary of Key Improvements, 7683B to 7693A

• 100% increased vial capacity on the standard turret
• 50% higher vial capacity of the tray
• Injection volume increments improved from 10% of syringe volume to 1% of syringe volume for greater precision
• 250 µL single stroke injection allowed on 7693A* vs 50 µL on 7683B
• New Heating and Mixing Capability
• Automated Sample Prep

* Requires Enhanced Sample Handling Syringe Carriage
New Multimode Inlet for Gas Chromatography
Agilent’s New Programmable (Multimode) Inlet

7890 standard pneumatics

Air plus liquid CO₂, N₂ cryogenic cooling

7890 turn-top for easy liner exchange

Uses 7890 S/SL liners, septa, ferrules and o-rings

Interchangeable conditions and consumables with current S/SL, while having the ability to do advanced techniques when / if needed
Multimode Inlet Solves Many Problems

Performing large volume injection (LVI) of relatively clean samples?
- programmable injection matches solvent evaporation rate and maximizes analyte transfer into the column/detector
- decrease MDL by injecting more sample

Injecting dirty samples?
- matrix vent, backflush and easy liner changing minimize dirty sample affects

Performing analyses of high molecular weight and/or thermally labile compounds?
- temperature programming of Multimode inlet elutes analytes at the lowest possible temperature, minimizing breakdown and absorption
- discrimination of high molecular weight compounds is minimal
New Multimode Inlet Features

**Hardware**

- Temperature range of -160 °C to 450 °C
- Heating @ 15 °C/sec
- Septum/Liner Easily Exchangeable using Turn-Top Inlet
- Injection Modes: Hot S/SL, Cold S/SL, all in pulsed mode, solvent vent mode, residue removal mode
- Support for single stroke injections from 0.1 µL to 250 µL
- EPC Compatible with Packed Liners
- Compatible with 7890A, 7683, CTC Combi PAL

**Software**

- Ten temperature ramps
- Wizard for setting up large volume injections
- Fully integrated into ChemStation, MSD ChemStation, EZChrom, and MassHunter
Multimode Inlet - Cold Injections

- No syringe-needle discrimination; Minimal inlet discrimination
- No special syringes, liners or consumables
- Large volume injection (5 µL to 250 µL) - lower detection limits
- Solvent vent/matrix vent - decrease interference / maintenance
- Flexibility (hot/cold split/splitless, temperature programmed vaporization)
- Cold trapping in liner - improves chromatographic peak shape, resolution
- Capillary column backflush with Capillary Flow Technology - decreases cycle time, maintenance
Multimode Inlet - Solvent Vent Mode for Large Volume Injection

- Set inlet temperature at or below solvent boiling point
  - But, what Temperature?
- Set high split ratio
  - But, what split ratio?
- Inject sample very slowly into PTV
  - How slowly?
- Solvent evaporates through split vent
  - At what rate?
- Close split vent and ramp PTV temperature
  - When?
- Carry out separation on analytical column
PTV Cold Splitless and SV – Temperature and Flow Programs

Lead-in

Cold Injection

Transfer of sample from inlet to column

GC Separation

Large volume injections used to require a lot of method development

Not Now!

Purge Status

Min 0 0.05 0.6 1.5 2.5 26

Inlet = 11.40 psi

purge flow = 30

Oven = 40

Oven ramps 20 350

PTV cooldown

Inlet = purge off

purge on 26
Built-in Wizard for Solvent Vent Method Development
Solvent Elimination Calculation Wizard

Step 1- Enter Solvent of Choice and Injection Volume

Welcome to the Solvent Elimination Calculator!

Please supply the following information.

If you don't know the first analyte boiling point, leave it at 150 °C.

Solvent:
acetone

Injection Volume (µL)
25 µL

Boiling Point of first eluting analyte (°C)
150 °C
Step 2 - Wizard Calculates the Injection Rate and Vent Time According to the Selected Inlet Temperature and Vent Flow

Solvent Elimination Calculator

Agilent Solvent Elimination Calculation Wizard

Calculated values will change each time an input parameter is modified.

Elimination Rate (µL/min) 149.80  Suggested Injection Rate (µL/min) 74.90  Suggested Vent Time (min) 0.3

Inlet Temperature (°C) 35
Vent Flow (mL/min) 150
Injected Volume (µL) 25.0

Vent Pressure (gauge) 5.000
Outlet Pressure (gauge) 0.000

Solvent acetone

Agilent Technologies
Step 3 - Confirm Values Suggested by the Wizard and Save Parameters to ChemStation Method

All inlet & injection parameters determined for you
Cold Splitless Injection Really Works – Inject up to 10 µL (liner dependent) without Solvent Vent

- Inject up to 10 µL
- 60 °C or lower
- 0.1 min
- 700 °C/min
- 280 °C
- Hold
Multimode Injection LVI of Triazine Herbicides

1 µL Cold Splitless injection

1 µL Hot Splitless injection

1, 2, 3 and 4 µL Cold splitless injections (ethyl acetate)
Compare cold to hot splitless S/N using the new Multimode Inlet on a 7890-5975 GC/MSD system

<table>
<thead>
<tr>
<th>Compound</th>
<th>RT</th>
<th>Mass</th>
<th>Cold S/N : Hot S/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorene</td>
<td>11.152</td>
<td>166</td>
<td>1.36</td>
</tr>
<tr>
<td>Aldrin</td>
<td>15.205</td>
<td>66</td>
<td>1.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>263</td>
<td></td>
</tr>
<tr>
<td>Mevinphos</td>
<td>9.338</td>
<td>127</td>
<td>1.33</td>
</tr>
<tr>
<td>Pentachlorophenol</td>
<td>12.989</td>
<td>266</td>
<td>2.19</td>
</tr>
<tr>
<td>Endrin</td>
<td>17.600</td>
<td>263</td>
<td>1.48</td>
</tr>
<tr>
<td>p,p'-DDT</td>
<td>18.600</td>
<td>235</td>
<td>1.51</td>
</tr>
</tbody>
</table>

Most “active” compound gives largest improvement

Subset of compounds from USEPA Method 525, Semivolatiles in Drinking Water. Used as a test mix and includes non-active and active compounds, all at 1 ppm (1 ng/μL).
25 Pesticide Standards at 40 ppb in Acetone

2-µL Hot Splitless (280°C)
10-µL Cold Splitless (30°C)
25-µL Solvent Vent (35°C)

Fenvalerate
Cypermethrin
Propargite
Hexazinone
Dieldrin
PP-DDE
Heptachlor
Bromacil
Malathion
Chlorpyrifos
Methyl parathion
Chlorpyrifos Methyl
Mirex
Leptophos
Propargite
Linuron
Propanil
Trifluralin
Ethanephirim
Pirimiphos
Mevinphos
Dichlorvos
Methyl parathion
Dieldrin
Bromacil
Malathion
Chlorpyrifos
Methyl parathion
Chlorpyrifos Methyl
Mirex
Leptophos
Propargite
Linuron
Propanil
Trifluralin
Ethanephirim
Pirimiphos
Mevinphos
Dichlorvos
Agilent's New GC Products

• Agilent's New 7693A ALS increases sample throughput
  – Auto-alignment, easy installation
  – 16 position injector and 150 sample tray
  – Removable 50-vial racks for easy sample loading and storage

• Automation of common sample prep steps with the 7693A
  – increases productivity and decreases operator variability

• A new "Multimode" GC inlet provides flexibility:
  – Hot or Cold Split, Splitless or Large Volume injections
  – Facilitates solvent venting, residue venting and backflush
  – Easy method development for large volume injections