The original capability for the patented modular ultrafast GC column modules using commercially available resistively heated stainless steel capillary columns was truly an advancement in GC technology. Elimination of the air bath oven made revolutionary speed and precision from 2 meter column modules as just discussed possible. Applications expanded rapidly as the technology developed. Ultimately, demand for more separation drove continued development up to the current capability at 16 meters per module. Several applications will be discussed including petroleum condensate, gasoline speciation, and pesticide residue analysis.
2 Meter Columns – D7798

- Calidus 101 with μFID Detector (One 2m Column Module)
- <5m Cycle times
- Process, Laboratory, Transportable
- ASTM D7798 is a newer “Ultrafast GC method”, and is based upon “directly heating the column” at rates 10-15 times that of conventional GC resulting in analysis times much faster than D2887.
- Precision of D7798 is 2-3 times better than D2887
- Greater product throughput for increased revenues and higher profits.

200 seconds
• Calidus 101 with µFID detector
• <3min Cycle time (~30s isothermal, column ramp during backflush)
• Applicable for use in the laboratory and in a transportable platform
  • Fleet Management
  • Higher sample throughput
• Using same parameters as ASTM D7798
• Fast online petroleum characterization
• True power comes when combined with chemometrics software
  • Simulated distillation boiling point curves
  • PCA scores plotting
• Can be used in multiple environments
• Process, laboratory, transportable
• Ability to differentiate multiple hydrocarbon streams
• Calidus MT with 2 μFID Detectors
• Two 4m column modules and column switching valve
• < 5min Cycle times
• Transportable or laboratory
• Simple user interface
  • Used by fuel inspectors, not chemists
  • 55 units total

Dow Accutrace
UK (HMRC) & Republic of Ireland

280 seconds

0.5ppm Marker

0.28 ppm Marker
4 Meter Columns – Extended Natural Gas

- Calidus CS with μFID and μTCD detectors
- Two 4m column modules and column switching valve
- <6 min Cycle times
- In the Natural Gas industry, price is dictated by the energy content; therefore, the ability to determine the energy content within the sample stream is of utmost importance.

Graphs showing gas chromatograms with peaks labeled: CH4, CO2, N2, C2H2, C2H6, etc.
• Calidus MT with 2 μFID detectors
• Two 8m column modules and column switching valve
• <10 min Cycle times
• Transportable or laboratory
• Simple user interface
• Used by fuel inspectors, not chemists

0.1ppm Marker Trace

8 Meter Columns -
Fuel Fraud Detection – aka Marker Trace
BPE
8 Meter Columns – BTEX in Air

- One 8m column module, trap module, and column switching valve
- Calidus GS-T with one μFID detector
- <7min Cycle time (including 100s sampling time)
- Laboratory or transportable
- Excellent DLs (1ppb) and repeatability
- Active ambient air sampling

### Run Number benzene toluene ethylbenzene m+p-xylene o-xylene

<table>
<thead>
<tr>
<th></th>
<th>benzene</th>
<th>toluene</th>
<th>ethylbenzene</th>
<th>m+p-xylene</th>
<th>o-xylene</th>
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<td>230</td>
<td>264</td>
<td>143</td>
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<td>223</td>
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<tr>
<td>Average</td>
<td>220</td>
<td>261</td>
<td>146</td>
<td>506</td>
<td>117</td>
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<td>Std. Dev.</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>13</td>
<td>4</td>
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<tr>
<td>%RSD</td>
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<td>2.64</td>
<td>4.13</td>
<td>2.67</td>
<td>3.34</td>
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</tbody>
</table>
- Calidus CS with 2 µFIDs
- Two 8m column modules with column switching valve
- <13min Cycle time (Including headspace sampling procedure)
  - 430s Run time
- Process or laboratory
- Speciation of components from C₁-C₁₀
- Resolution improved from previous method, half the cycle time
- Previously unidentified contaminants found
• Calidus 101 with 1 μFID detector
• One 16m column module
• <20min Cycle times
• Speciation of terpenes in hops and essential oils
• 31 Individual terpenes, all but two resolved.
16 Meter Columns – Pesticides (Organochlorine)

- Calidus 101 With 1 μFID Detector
- One 16m column module
- <15min Cycle times
- Excellent inertness per EPA 8081B
• EPA Method 8140/8141
  • µFID used, instead of NPD or FPD
  • 27 Compounds across 2 standards
• 47 Compounds
• Optimized for a GC/MS user, better columns available if more resolution required for µFID
  • Coelutions easily resolved via SIR/SIM MS
32 Meter Columns – Pesticides (Organochlorine)

- Calidus 201 With 1 µFID
- Two 16m column modules, in series
- <23min Cycle time
- Excellent inertness
• EPA Method 8140/8141
  • μFID used, instead of NPD or FPD
• 27 Compounds across 2 standards
32 Meter Columns – Pesticides
OC and OP Combined

- 47 Compounds
- Optimized for a GC/MS user, better columns available if more resolution required for μFID
  - Coelutions easily resolved via SIR/SIM MS
- Calidus 201 with 1 μFID Detector
- Two 16m column modules, in series
- <18min Cycle time
- Local gasoline source
- Provides fast gasoline characterization
- Developing chemometric models

670 seconds
32 Meter Columns - DHA

- 300+ Labeled Compounds
- Room for Improvement
Conclusion

• Vast array of options
• Each column module can support 2-16 meter columns
  • 32 Meter columns available with 2 column modules in series
• Can be tailored to fit the specific application
• Liquid injection, headspace injection, SPME injection, active ambient air sampling, gas sample valve, and liquid sample valve available
Any Questions?

Derrick Saul
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Falcon Analytical Systems and Technology