Jet Fuel Contamination, Measurement, Control and Monitoring

Field Data

Presented by Matt Fielder

ENGINEERING YOUR SUCCESS.
Field Sampling Equipment

ACM20
Out of Storage, London Gatwick

ACM20
Dispenser, Dubai Airport
Field Sampling Equipment

ATEX (Zone 2) Version

ACM20-Z2
Field Sampling Equipment

**IcountPD**

- On-line particle detector
- Permanent installation, constant testing
- Indicates ISO codes to aviation standards
- Test results downloaded automatically to PLC or data logger
- Contamination limit set by customer (one off programming)
- Warning LED’s show excess contaminant levels.
Field Sampling Equipment

The Icount Aviation in use on Royal Air Force Dispenser
Laboratory Sampling Equipment
IP PM DK 07B
Gravimetric Review - Field

<table>
<thead>
<tr>
<th>Sample</th>
<th>&gt;4µ</th>
<th>&gt;6µ</th>
<th>&gt;14µ</th>
<th>&gt;21µ</th>
<th>&gt;25µ</th>
<th>&gt;30µ</th>
<th>ISO Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample</td>
<td>1414.5</td>
<td>313.7</td>
<td>10.6</td>
<td>2.5</td>
<td>1.1</td>
<td>0.6</td>
<td>18:15:11</td>
</tr>
<tr>
<td>2</td>
<td>8523.6</td>
<td>1091.6</td>
<td>9.5</td>
<td>2.0</td>
<td>1.0</td>
<td>0.4</td>
<td>20:17:10</td>
</tr>
</tbody>
</table>

Sample 1 – Gravimetric Measured at 0.29 mg/lt
Sample 2 – Gravimetric Measured at 0.23 mg/lt
Field Data – Jet Test Rig, UK

![Graph showing particle count per ml across different test conditions.]

- **24 - 25 Clean, 27 - 31 Dirt, 32 - 38 Dirt Off, 41 - 44 Water On, 45 - 46 Water Off**

- **Particulate counts** for various particle sizes are depicted.

- **Clean Fuel** and **Dirt**

- **Pump On/Off**

- **Water Off**
Field Data

Major International European Airport Fuel Farm

Before Hydrant FWS

After Hydrant FWS

Particle Count per ml

Time of Test

- >4µ
- >6µ
- >14µ
- >21µ
- >25µ
- >30µ
Field Data

Major International European Airport Fuel Farm
- Replaced Filter Elements, New Tank

Particle Count Per/ml

Into A-5

Out A-5

Into A-4

Out A-4

Test Number

7 8 9 10 11 12 13 15 16 17 18 19 20 21 22 23
Field Data

Major International Middle East Fuel Depot
Supply line filtration to Airport

BF Micronic - BF Coalescer - AF Coalescer

Test Number

Particulate Count

Indicates Micronic not working
Indicates FWS not working

Test No

>4µ (c)
>6µ (c)
>14µ (c)
>21µ (c)
>25µ (c)
>30µ (c)
Field Data
Major International Middle East Fuel Depot
Supply line filtration to Airport

Ruptured Microfilter Element

Damaged Downstream Coalescer Element
# Field Data – Filter Performance

## Middle East - Micro Filtration - Fuel Oil for Gas Turbine

<table>
<thead>
<tr>
<th>Micron Size</th>
<th>Influent Counts</th>
<th>Effluent Counts</th>
<th>Beta Ratio</th>
<th>% Effcy</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;4µ (c)</td>
<td>34,770</td>
<td>1774</td>
<td>19.6</td>
<td>94.90</td>
</tr>
<tr>
<td>&gt;6µ (c)</td>
<td>10841</td>
<td>400</td>
<td>27.1</td>
<td>96.31</td>
</tr>
<tr>
<td>&gt;14µ (c)</td>
<td>44</td>
<td>1</td>
<td>44.0</td>
<td>97.73</td>
</tr>
</tbody>
</table>

![Graph showing particle count per mL before and after pre-filter 3F ISO 22413](chart.png)
Field Data – Tank Settling Times
Date Interpretation
Secondary Output, Diagnostic Use

Solid Only
Free Water Only
Solid & Free Water

Cumulative Plot

%Volume distribution

Counts per mL

Particle size, micron (c)

Particle size, micron (c)

Particle size, micron (c)

5 mg/lit
10ppm
5 mg/lit & 13ppm
First 3 measurements represent fuel from a previous cargo followed by a regular clean delivery, thus demonstrating the range of fuel cleanliness being experienced at this particular location.
Laboratory & Field Data – Major International Airport

**OMF**

**FWS**

Airport storage

**FWS**

**To Hydrant/Refueller**

$\beta = 2.6 = 66\%$ efficient

$\beta = 13 = 93\%$ efficient

$\beta = 26 = 96\%$ efficient

<table>
<thead>
<tr>
<th>ISO CODE</th>
<th>18/17/11</th>
<th>17/15/11</th>
<th>13/11/00</th>
<th>15/12/00</th>
<th>10/08/07</th>
<th>13/11/07</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&gt;4\mu(c)$</td>
<td>$&gt;6\mu(c)$</td>
<td>$&gt;14\mu(c)$</td>
<td>$&gt;21\mu(c)$</td>
<td>$&gt;25\mu(c)$</td>
<td>$&gt;30\mu(c)$</td>
<td>$&gt;30\mu(c)$</td>
</tr>
<tr>
<td>2172.0</td>
<td>779.9</td>
<td>13.3</td>
<td>1.2</td>
<td>0.3</td>
<td>0.1</td>
<td>$&gt;30\mu(c)$</td>
</tr>
<tr>
<td>745.6</td>
<td>300.4</td>
<td>17.2</td>
<td>5.6</td>
<td>2.8</td>
<td>0.2</td>
<td>$&gt;30\mu(c)$</td>
</tr>
<tr>
<td>54.6</td>
<td>11.4</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>$&gt;30\mu(c)$</td>
</tr>
<tr>
<td>225.8</td>
<td>31.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>$&gt;30\mu(c)$</td>
</tr>
<tr>
<td>8.5</td>
<td>1.7</td>
<td>0.9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>$&gt;30\mu(c)$</td>
</tr>
<tr>
<td>57.1</td>
<td>12.5</td>
<td>1.1</td>
<td>0.5</td>
<td>0.2</td>
<td>0.1</td>
<td>$&gt;30\mu(c)$</td>
</tr>
</tbody>
</table>
Receipt into Microfilter
Expect 2,500 counts per ml or cleaner @ 4µ(c)

Receipt into FWS (After MF)
Expect 500 counts per ml or cleaner @ 4µ(c)

Receipt into Storage (After FWS/MF)
Expect 100 counts per ml or cleaner @ 4µ(c)

FWS out of storage
Expect 500 counts per ml or cleaner @ 4µ(c)

After FWS into Hydrant
Expect 100 counts per ml or cleaner @ 4µ(c)

After Monitor Into Plane
Expect 100 counts per ml or cleaner @ 4µ(c)
### Future Developments – Application Areas

<table>
<thead>
<tr>
<th>Application</th>
<th>Use!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport Fuel Farm</td>
<td>• System Cleanliness</td>
</tr>
<tr>
<td>Airplane Refueling</td>
<td>• Fuel Cleanliness/Quality</td>
</tr>
<tr>
<td>Oil Refinery</td>
<td>• Pipeline Commissioning</td>
</tr>
<tr>
<td>Distribution Terminals</td>
<td>• Filter Element Performance</td>
</tr>
<tr>
<td>Hubs Pipeline &amp; Storage</td>
<td>• Correct Element Installation/Integrity</td>
</tr>
<tr>
<td>Sea Ports Fuel Storage</td>
<td>• Storage Tank Inspection/monitoring</td>
</tr>
<tr>
<td>Fuel Testing Laboratories</td>
<td>• Fuel Settling time reduction</td>
</tr>
<tr>
<td>API/IP Full Scale Test Laboratories</td>
<td>• Certification – In accordance with</td>
</tr>
<tr>
<td>Private Light Aircraft Operators</td>
<td>Manufacturers/Purchasers specification</td>
</tr>
<tr>
<td>Helicopter Refueling</td>
<td>• Service Life</td>
</tr>
<tr>
<td></td>
<td>• Free water detection</td>
</tr>
<tr>
<td></td>
<td>• Go – Non Go Alarm detection</td>
</tr>
<tr>
<td></td>
<td>• Remote Monitoring</td>
</tr>
<tr>
<td></td>
<td>• Cost reduction in Laboratory expense</td>
</tr>
<tr>
<td></td>
<td>• Trend Analysis</td>
</tr>
</tbody>
</table>
PARKER HANNIFIN & THE AVIATION INDUSTRY

A WORKING PARTNERSHIP

Thank you!