Particle Solutions Limited – IATA Strategic Partner

Resolver on-line

A method for separately determining particulate and water contaminants in fuel from light obscuration measurements
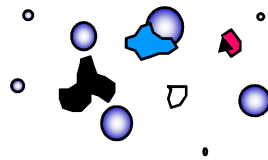
Briefing prepared for IATA Aviation Fuel Forum, 15/17 May 2011.
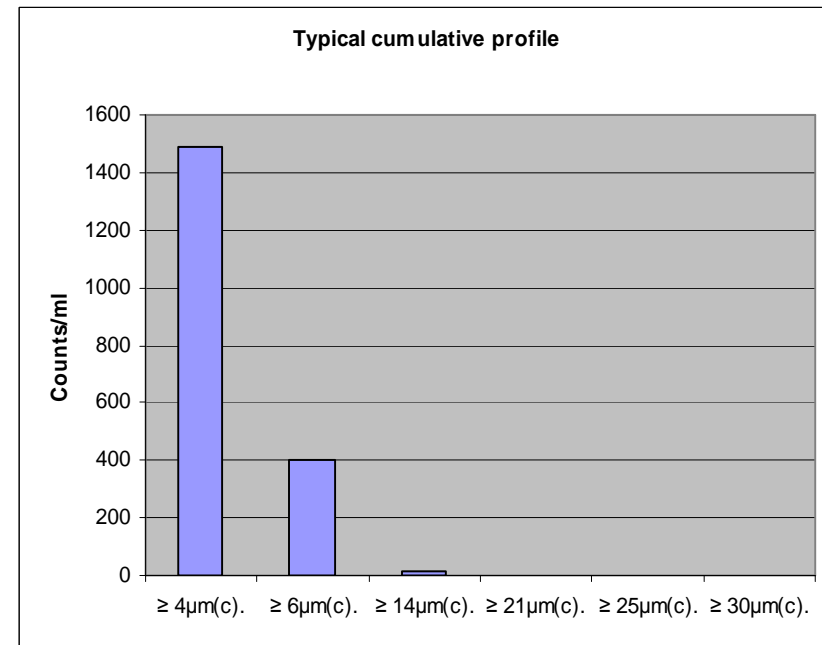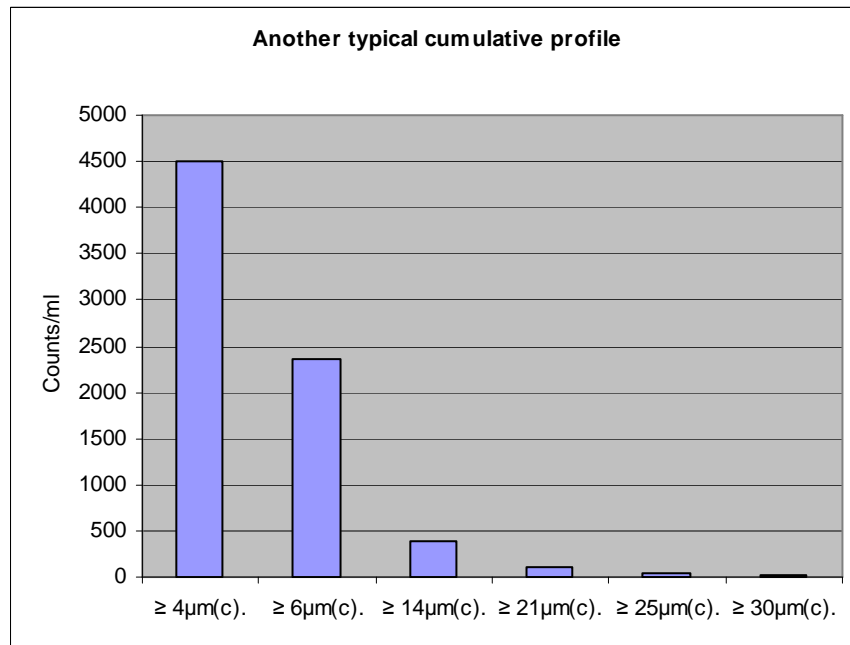
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Particle Counting by light obscuration-

Typical results from light obscuration measurements in jet fuels from EI Test Methods 564, 565 and 577:

Complex mixed distribution:

Log-normal particulate distribution:

Another typical cumulative profile

Counts/ml

| ≥ 4µm(c). | ≥ 6µm(c). | ≥ 14µm(c). | ≥ 21µm(c). | ≥ 25µm(c). | ≥ 30µm(c). |

Typical cumulative profile

Counts/ml

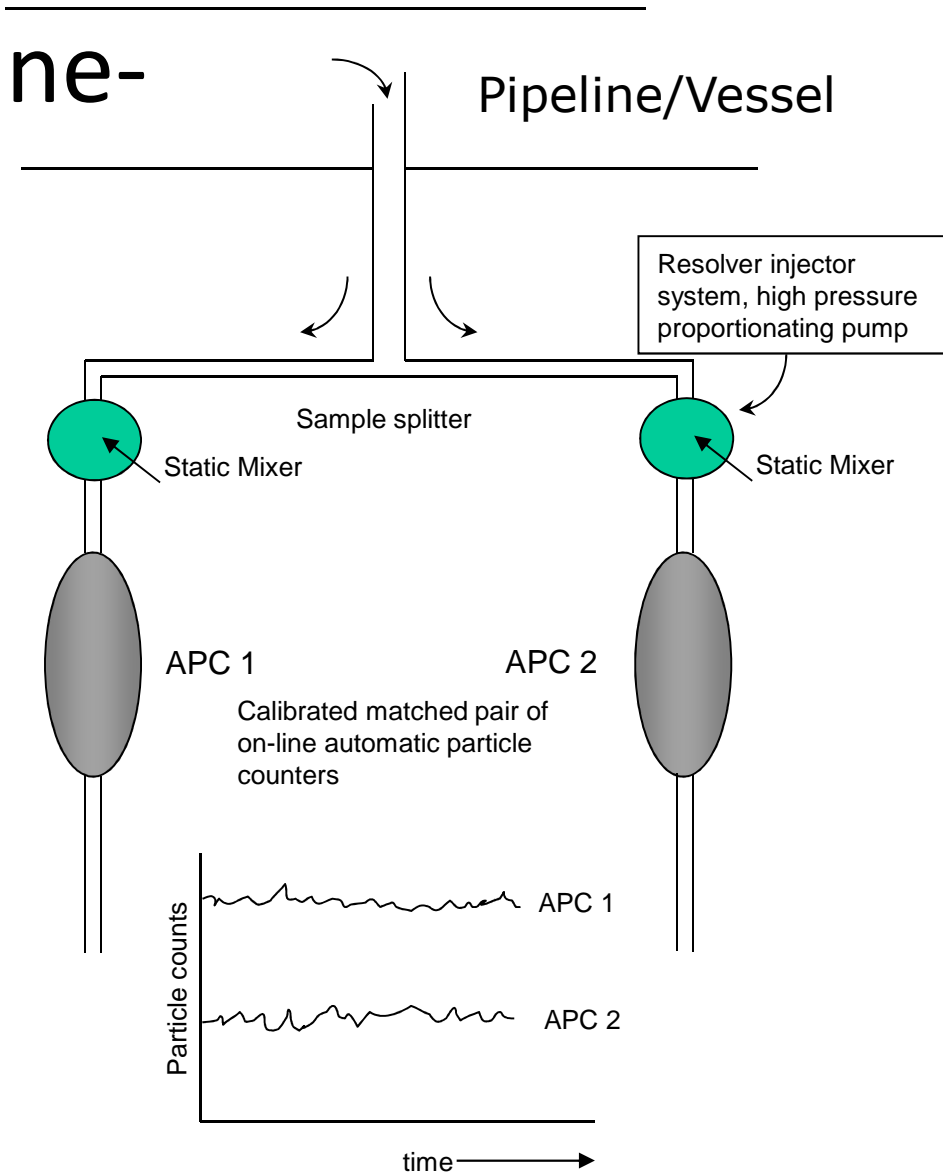| ≥ 4µm(c). | ≥ 6µm(c). | ≥ 14µm(c). | ≥ 21µm(c). | ≥ 25µm(c). | ≥ 30µm(c). |

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Particle Counting on line-

The Resolver approach was tested and validated during trials carried out at Parker's Holly Springs facility. An EI report is in preparation.
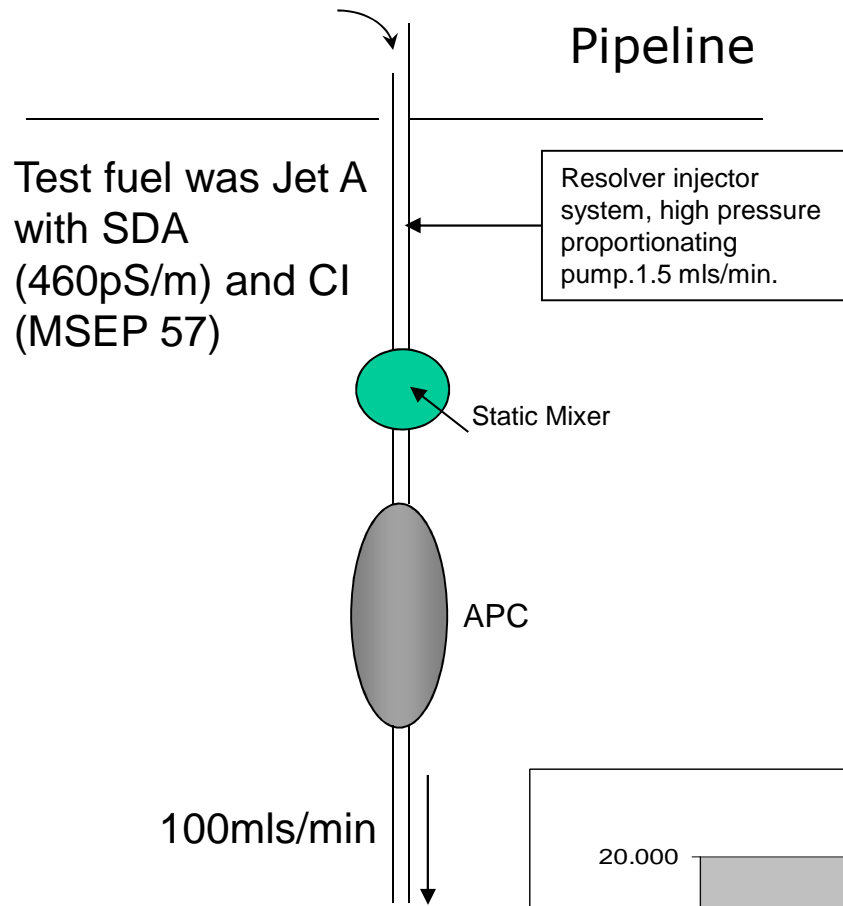
With the approach successfully validated an on-line system has been designed as per schematic shown.

Pipeline/Vessel

Resolver injector system, high pressure proportioning pump

Sample splitter

Static Mixer

Static Mixer

APC 1

APC 2

Calibrated matched pair of on-line automatic particle counters

Particle counts

APC 1

APC 2

time

APC 1 yields total counts including both particles and water droplets

APC2 yields particulate material only. The difference is water

Particle Counting on line-preliminary data from SwRI

Pipeline

Test fuel was Jet A with SDA (460pS/m) and CI (MSEP 57)

Resolver injector system, high pressure proportionating pump.1.5 mls/min.

Static Mixer

APC

100mls/min

Test Matrix

Test Number	A-1 Test Dust, mg/l	Water by D2, ppm	Resolver flow
1	0	0	NO
2	0.25	0	NO
3	0.25	40.8	NO
4	0.25	41.1	YES
5	0.25	31.4	NO
6	0.25	25.7	YES
7	0.25	3.3	NO
8	0	2.4	YES
9	0	3.2	NO
10	0	2.9	YES

**Sigrist Turbidity**

90 deg   25 deg
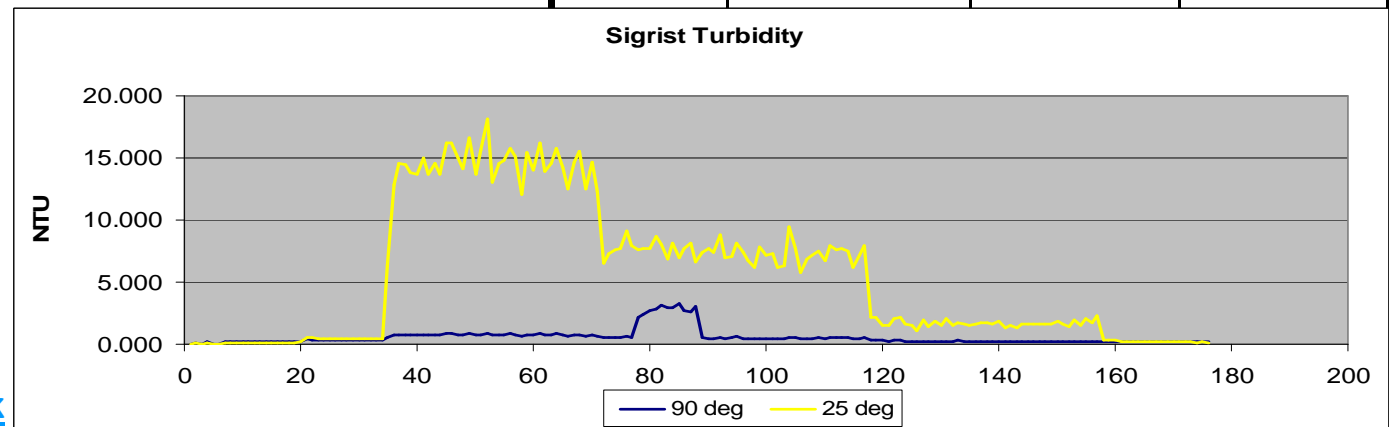
Particle Counting on line-preliminary data from SwRI
using a Parker I-count pd
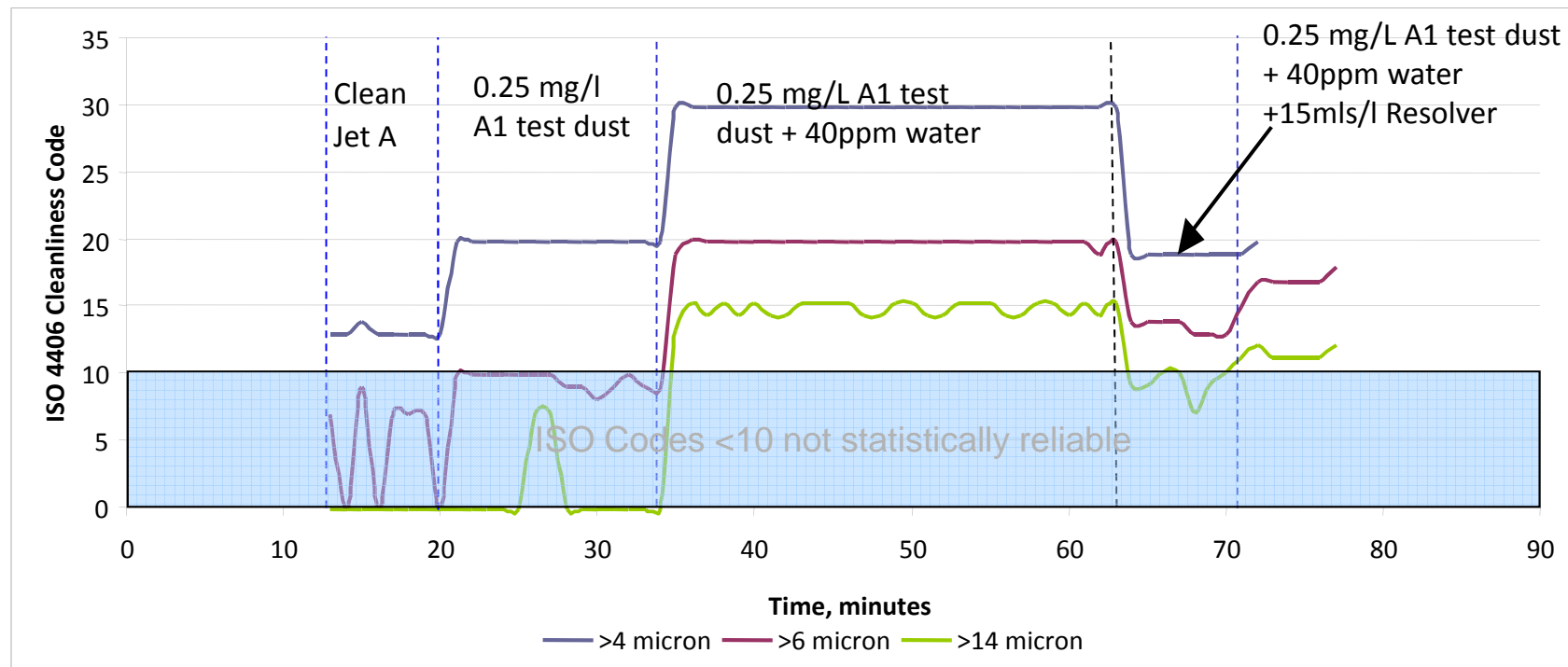
Operating with a cyclical additional of Resolver to a single sensor, the results demonstrate how well the system can work. In reality it would be best if 2 sensors are operating in parallel with one receiving continuous doses of Resolver

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Particle Counting on line-preliminary data from SwRI

using a Parker I-count pd
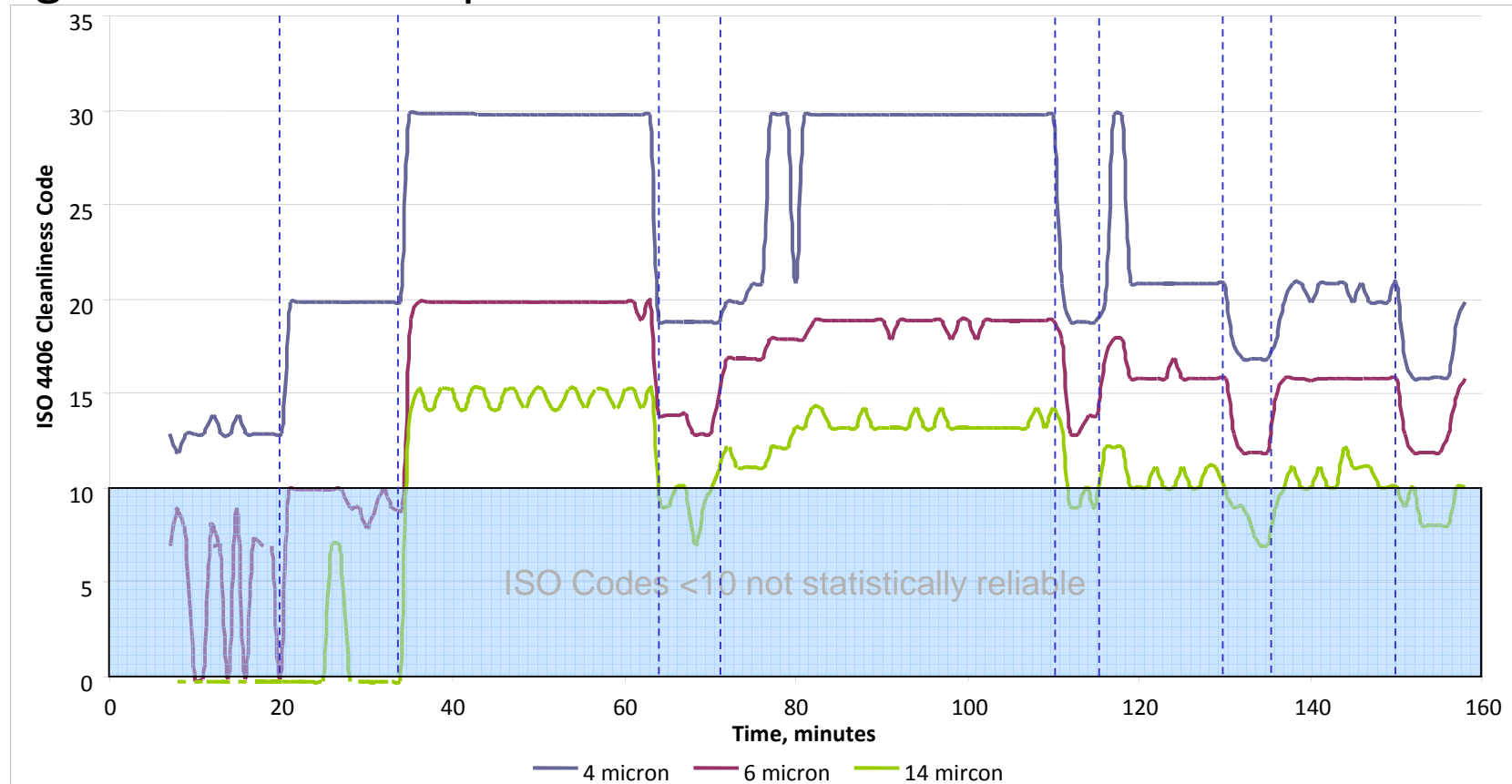
Test Number	1	2	3	4	5	6	7	8	9	10
A1, mg/l	0	0.25	0.25	0.25	0.25	0.25	0.25 - 0	0	0	0
Water, ppm	0	0	40.8	41.1	31.4	25.7	3.3	2.4	3.2	2.9
Resolver	No	No	No	Yes	No	Yes	No	Yes	No	Yes

Particle Counting on line-preliminary data from SwRI
using a Pamas portable APC

Resolver on line with Pamas instrument (each data point is the average of at least 3 measurements)

Counts/ml

Legend: >4, >6, >14
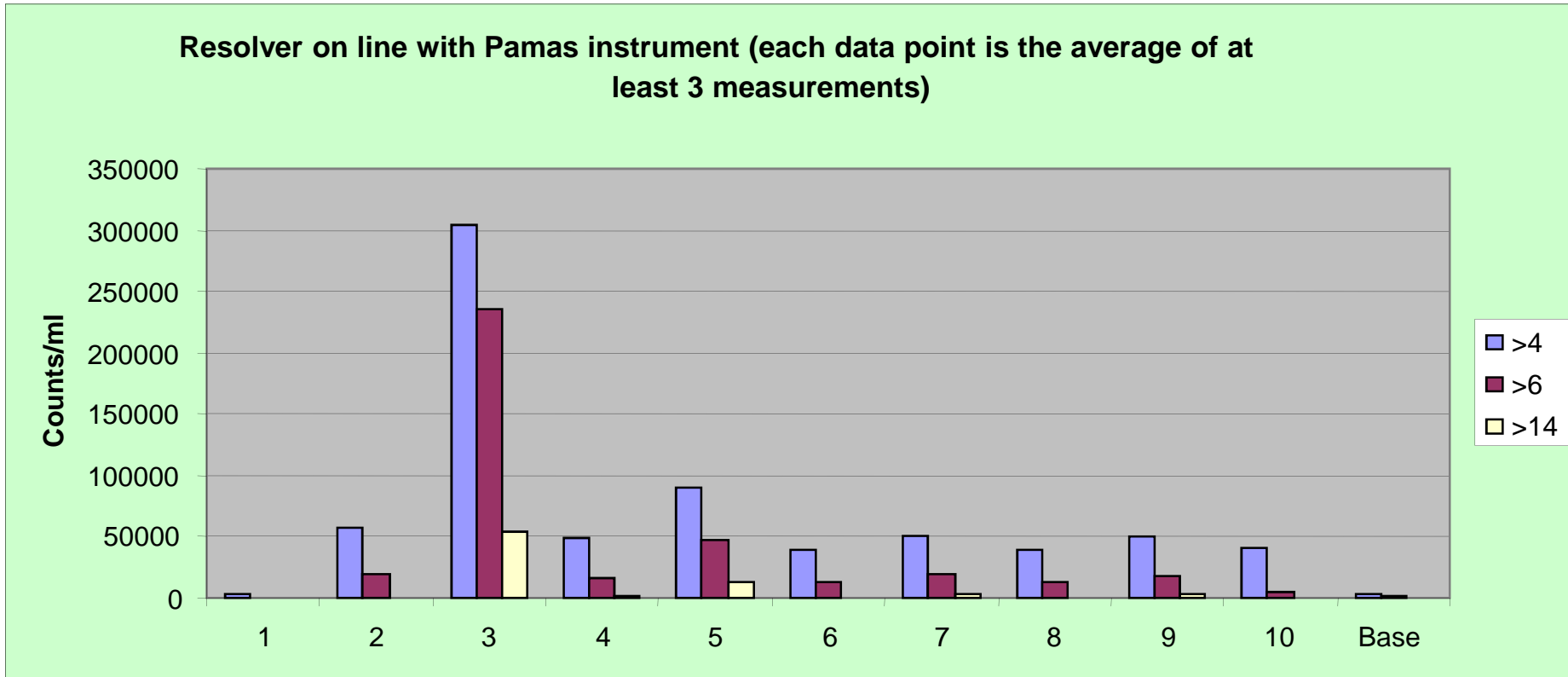
Test Number	1	2	3	4	5	6	7	8	9	10
A1, mg/l	0	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Water, ppm	0	0	40.0	40.0	?	25.0	3.0	3.0	3.0	3.0
Resolver	No	No	No	Yes	No	Yes	No	YES	No	Yes

Resolver

on-line

Conclusions:

➢ Use 1 counter and use Resolver continuously to obtain particulate counts only.

➢ Use 1 counter and use Resolver intermittently to obtain particulate counts and an alert that water is also present.

➢ Use 2 counters, 1 with Resolver continuously injected to obtain particulate and water separately

Future actions:

Manufacture

IP 564, 565, 577

REFINERY

Distribution

TERMINAL

Supply

DefStan 91-91 Checklist

+Resolver/Cosolvent to enable limit setting

The same APC technology + Resolver in-line can enable a common cleanliness terminology from refinery to aircraft

F

F

REFUELLER

HYDRANT DISPENSER

M   F

AIRPORT STORAGE

F

Resolver on-line
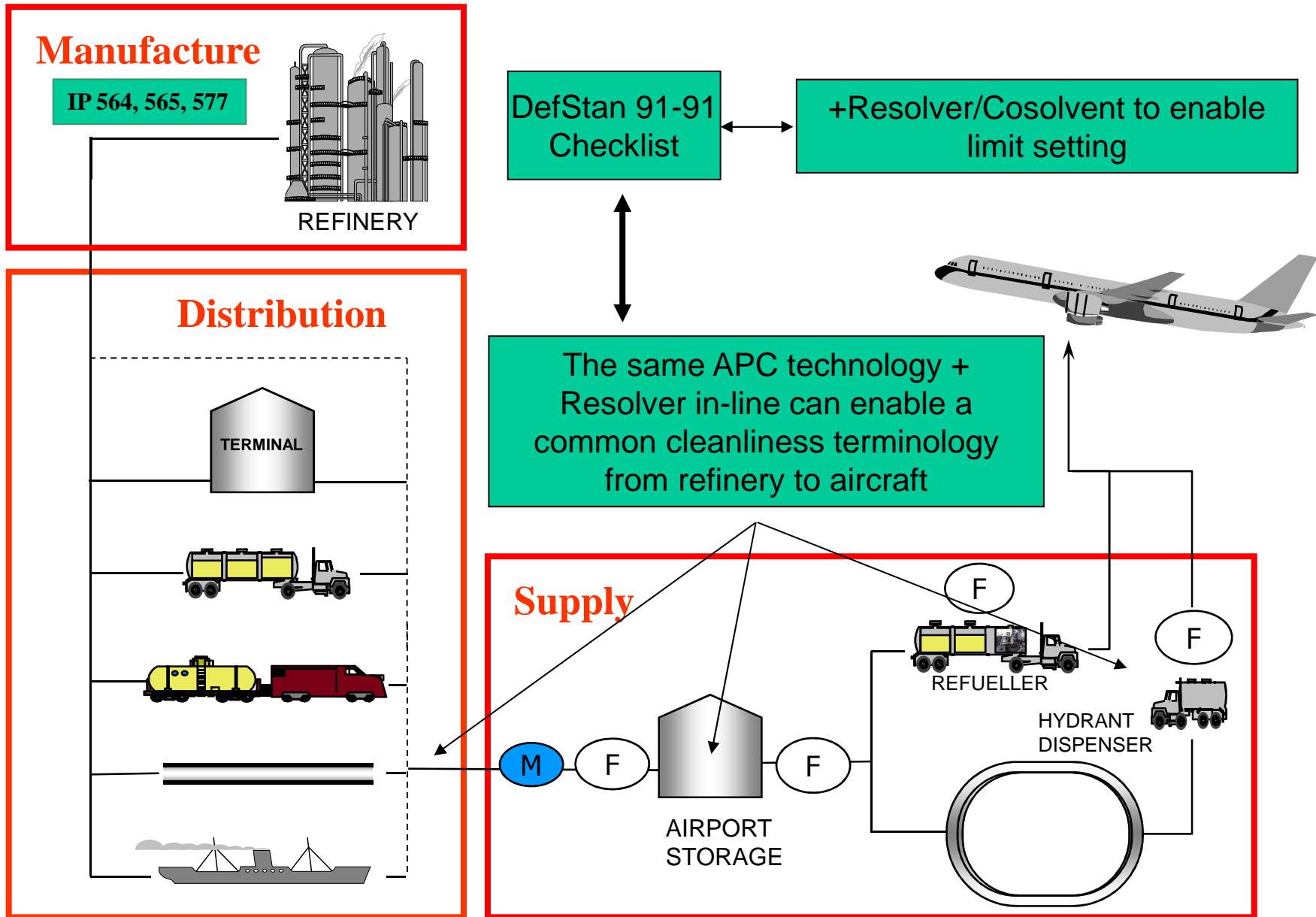
Acknowledgments:

Particle Solutions would like to thank Pamas and Parker-Hannifin for their help on this project and in particular the loan of particle counting instruments.

Also thanks to IATA TFG for allowing us time to present these exciting results.

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FYI:

Table 1 ISO 4406 — **Allocation of scale numbers**

Number of particles per	millilitre	Scale number
More than	**Up to and including**	
20 000	40 000	22
10 000	20 000	21
5 000	10 000	20
2 500	5 000	19
1 300	2 500	18
640	1 300	17
320	640	16
160	32 0	15
80	160	14
40	80	13
20	40	12
10	20	11
5	10	10
2,5	5	9
1,3	2,5	8
0,64	1,3	7

NOTE Reproducibility below scale number 8 is affected by the actual number of particles counted in the fluid sample.