

fastmicro

cleanliness control

**How to secure consistency of clean products
through particle fallout monitoring, also in vacuum**

Clean 2023, Veldhoven

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Why is measurement of particle fallout important?

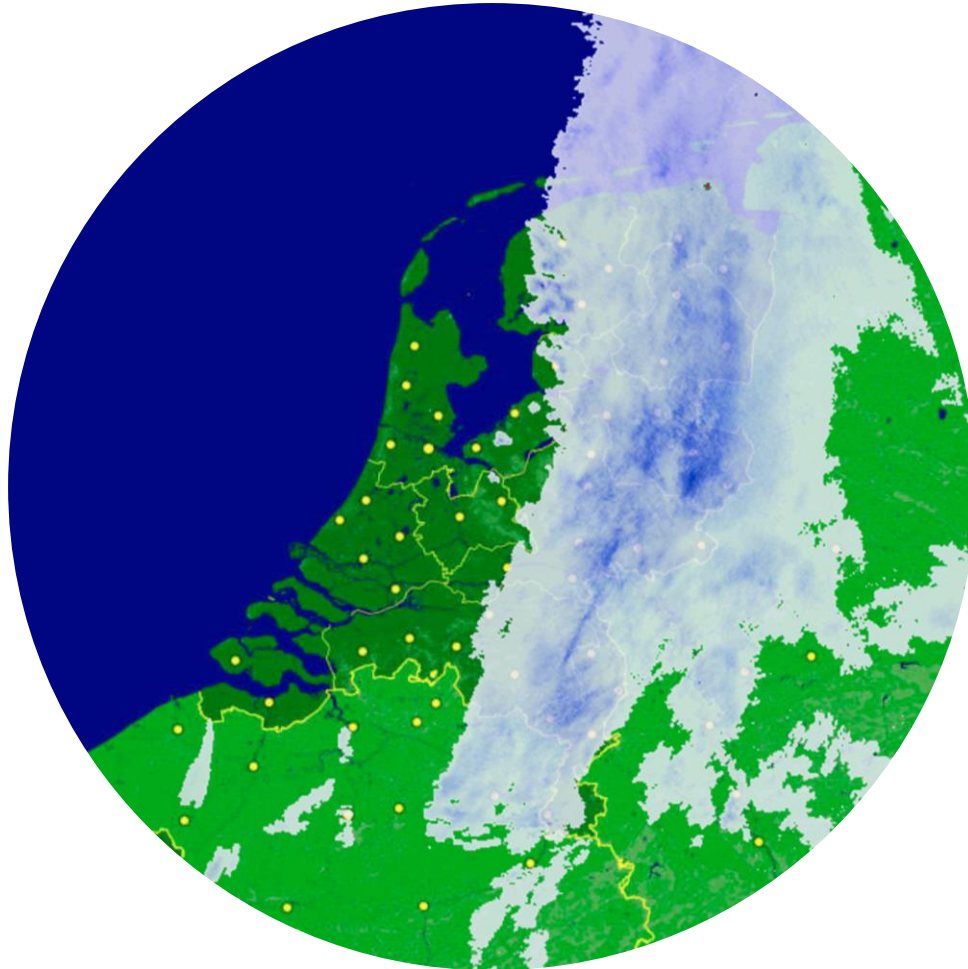
- Dimensions are reducing
- Cleanliness requirements are increasing
- Particle defectivity rising, causing yield challenges



**A clean room is not enough for
a clean product and workspace**

How wet after how long?

This depends on amount and size of raindrops



Do you need a Rainfall radar to evaluate your process and airflow in the cleanroom?



How to measure fallout?

Definition particle deposition rate PDR:

Number of particles depositing onto a known surface area during a known time of exposure

PDR according to ISO 14644-17 (2021)

Applications

- Critical areas
- Duration test setup
- Ambient and in Vacuum



Current fallout best practices

Options

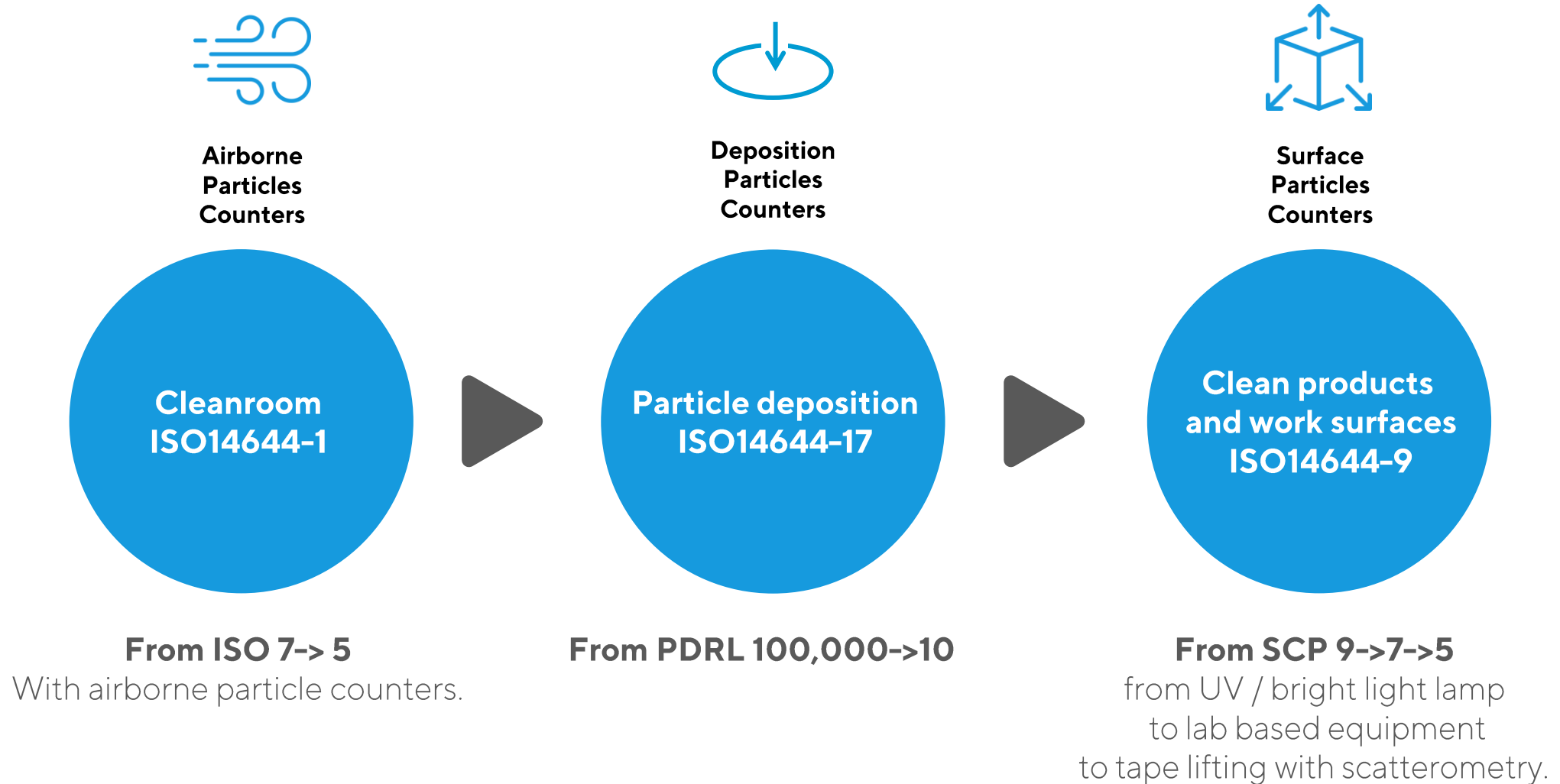
- Witness samples
- Fallout monitors

Challenges

- Sensitivity too high
- Interval too long
- Consistency unclear



Cleanliness process engineers' journey from interviews in the supply chain



The new standard for deposition and product surface particle contamination measurements



Airborne Particle Contamination ('Cleanrooms')

	Particles/m3	ISO 14644-1
Fab Clean	10 @ ≥0,1µm	1
	24 @ ≥0,2µm	2
Ultra Clean	35 @ ≥0,5µm	3
	352 @ ≥0,5µm	4
Very Clean	3,520 @ ≥0,5µm	5
	35,200 @ ≥0,5µm	6
Clean	352,000 @ ≥0,5µm	7
	3,520,000 @ ≥0,5µm	8
Dirty		
Room Air	35,200,00 @ ≥0,5µm	9

Airborne
Particle
Counters



Deposition
"Particle fall-out"

Particles /cm2 /hour	ISO PDRL 14644-17
0,0006 @ ≥0,5µm	0,3
0,004 @ ≥0,5µm	2
0,02 @ ≥0,5µm	10
0,2 @ ≥0,5µm	100
0,9 @ ≥0,5µm	450
5,6 @ ≥0,5µm	2,800
5 @ ≥20,0µm	10,000
2 @ ≥50,0µm	100,000
20 @ ≥50,0µm	1,000,000

Legacy
Solutions



Typical Product
surface cleanliness

Particles/cm²	ISO SCP Grade 14644-9	ASML GSA grade
~	~	~
0,002 @ ≥0.5µm	1	<Grade 1
0,02 @ ≥0.5µm	2	<Grade 1
0.2 @ ≥0.5µm	3	<Grade 1
2 @ ≥0.5µm	4	<Grade 1
20 @ ≥0.5µm	5	Grade 1
10 @ ≥20µm	6	Grade 2/4
20 @ ≥50 µm	7	Grade 4
200 @ ≥50 µm	8	

Legacy
Solutions

Partner use case results



Use case performed by partner

Environment

- 9 cleanroom workcenters
- All ISO 6 cleanroom
- Air change 40x/hour
- 1-6 persons active

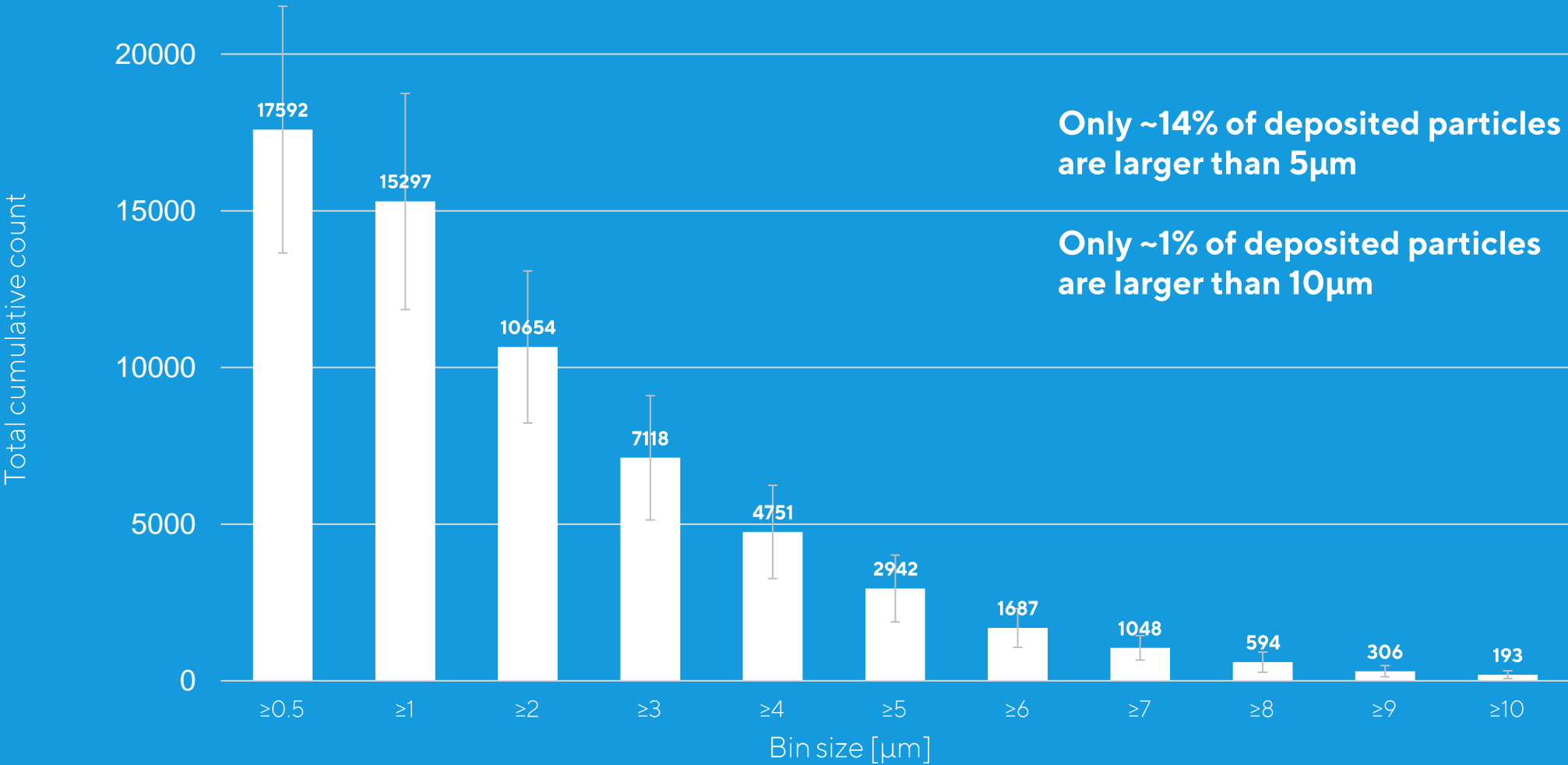
Substrates

- 22 pcs. Ø300mm blank wafers
- Placed 1 meter above ground

Measurement

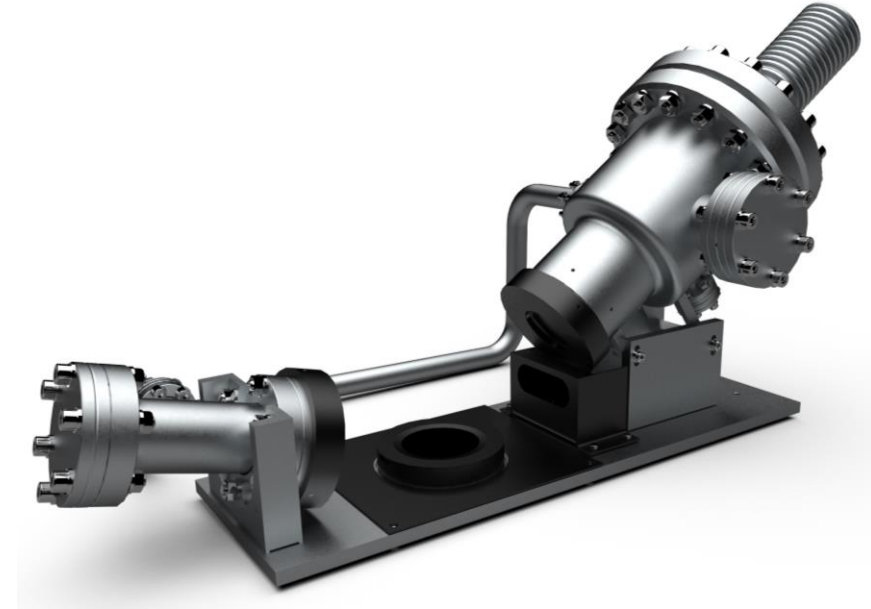
- Cumulative particle count measured on a high-end laser scatterometry system (non-Fastmicro)
- Size distribution per wafer determined on a high-end SEM-system

Partner use case results



Particle Fallout Scanner for continuous monitoring of particle deposition in ambient or vacuum

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Easy to operate

Operator independent



Accurate

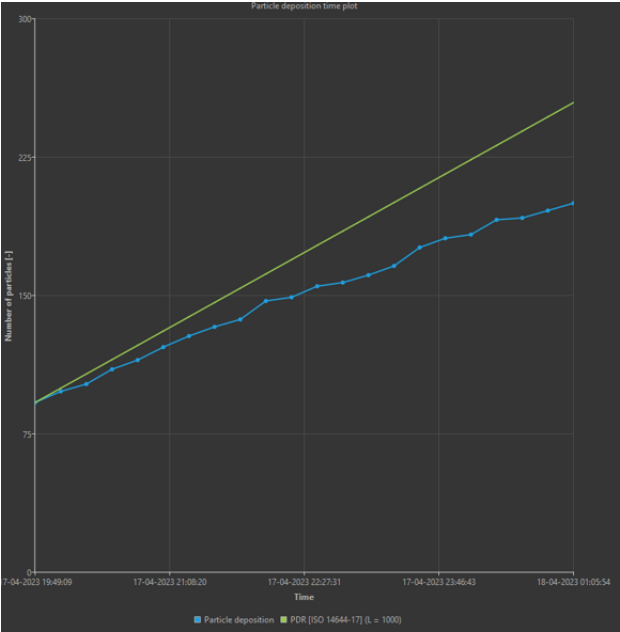
High-resolution measurement
(quantity, position, size)



Consistent

Objective measurements,
time after time

Fallout monitoring in practice



Surface Particle Cleanliness Report. YOUR LOGO HERE fastmicro

Single measurement: testReport

This qualification report determines whether the number of particles of measurement A comply with the required specifications. **PASSED**

Report details:

	Details
Report ID	testReport
Report timestamp	12/04/2023 14:02:45 UTC
Supplier ID	Test supplier ID
Generated by	Test operator name
Customer	Test customer name
Order number	Test order number
Comments	Test comments

Part details:

	Details
Serial number	Test serial number
BID number	Test bid number
12NC number	Test 12NC number
Description	Test description
Part surface covered	95.0%
Times stamped	2

Results:

Particle concentration:

Particle size	Specification name	Max. concentration	Actual concentration	Unit	Out-of-spec ratio	Result
≥ 0.5	-	-	0.00e+00	#/m³	-	-
≥ 1.0	-	-	0.00e+00	#/m³	-	-
≥ 5.0	SCP Grade 3.0	2.00e+02	0.00e+00	#/m³	0.00e+00	Passed
≥ 10.0	-	-	0.00e+00	#/m³	-	-

Fastmicro Scanning Suite

File View Edit Help

☐ Operator

☒ Supervisor

☐ Administrator

Username: testUser

Password: Please enter the password.

Particle ID	X [mm]	Y [mm]	Pixelcount
519	966.321	1547.5	56
518	1076.44	1535.78	9
510	837.125	1503.38	8
509	1231.4	1502.4	57
505	1035.77	1481.46	61
502	897.571	1463.71	7
501	980.6	1462.5	10
500	965	1460.5	2
493	1143.24	1450	21
489	1269.82	1444.73	49
473	641.333	1405.11	9
472	748	1400.5	2
469	777.938	1392.88	16



Consistent
Objective with visual
norm comparison



Quantitative
Traceable and digital reports



Easy to operate
Operator independent

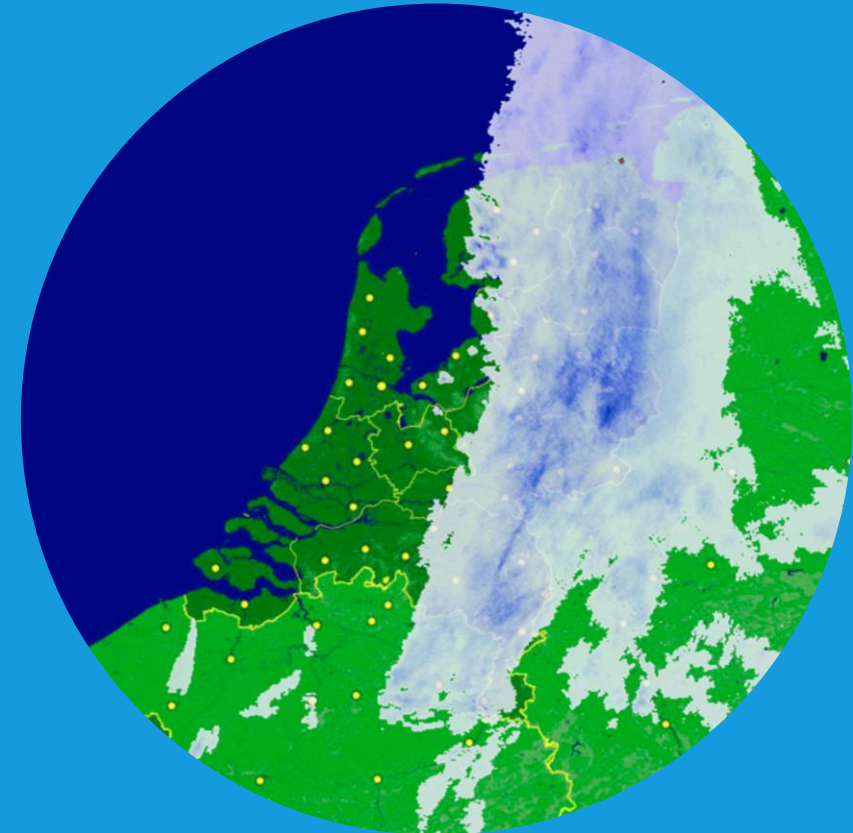


Fast
Interval from 5 seconds
In current product

Impact conclusions

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- **Deposition knowledge at (sub-)micron scale**
 - Continuous for enhanced cleanroom validation
 - Project based to know correlation between process and particles for wear & tear monitoring.
 - Monitor on SPC/event basis
 - Also in vacuum
- **Gain knowledge and confidence on your cleanliness**
- **Earlier and more according the circle of waste**
- **Confidence requires quantified, consistent fast iterations**



Your rainfall radar
to control your
particles cleanliness

Thank you, see us at booth #19!

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fastmicro

cleanliness control

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