

TEST REPORT

no. E-260402-1

ISO 14644-14 CLEANROOM SUITABILITY TEST:
PARTICLE EMISSION TEST

Labino AB
Fabriksvägen 9b
186 32 Vallentuna
Sweden

BB 2.0 Helios Mains
UV-A Lamp

1ST APRIL 2026

Laboratory: BNT SIGMA
Test report author: Krzysztof Zarczynski



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1. Test item

Name: BB 2.0 Helios Mains

Serial number: BHM16280

Type: UV-A Lamp

Customer name and address: Labino AB, Fabriksvägen 9b, 186 32 Vallentuna, Sweden

Test mode: In operation (On)

2. Testing laboratory, contact details, date of the test

Name: BNT SIGMA (full name: Biuro Naukowo-Techniczne SIGMA), Section of Cleanroom Technology

Address: Jezycka 44a/5 Street, 60865 Poznan, Poland

Website: www.bnt-sigma.pl

Email: info@bnt-sigma.pl

Phone: 0048 61 624 27 22

Operator: Krzysztof Zarczynski, Senior Validation Engineer

Date of the product transfer into the cleanroom: 23.03.2026

Date of the tests: 24.03.2026

Date of test report issue: 1.04.2026

3. Test methodology

3.1 Test method

Particle emission test and product qualification (cleanroom suitability assessment) was carried out according to international standard: **ISO 14644-14:2025** *Cleanrooms and associated controlled environments — Part 14: Assessment of suitability for use of equipment by airborne particle concentration*. Limits for particle concentrations for different ISO classes were based on current version of *ISO 14644-1 Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness by particle concentration* (2025).

3.2 Test environment

Tests were carried out at BNT SIGMA Laboratory, Section of Cleanroom Technology, at specially-designed clean zone fulfilling ISO Class 2 air cleanliness requirements (according to ISO 14644-1). Ultraclean test environment is ensured by vertical laminar flow of air, with the velocity of 0,45 m/s $\pm$ 20%, filtered at the last stage of air

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preparation by ULPA 15 filters. Test zone is surrounded by ISO Class 5 clean zone. Temperature and relative humidity is controlled within the cleanroom to ensure stable test conditions of $21^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and $50\% \pm 30\%$ RH. Results of environmental conditions verification are given below:

Measured values (before test start):

Temperature: 21.2°C

Relative humidity: 47.9%

Flow velocity: 0.45 m/s

Air cleanliness verification: ISO 1*

*Based on: sample volume of 28.3l; one measuring point; particle size channels: $\geq 0.1\mu\text{m}$; $\geq 0.2\mu\text{m}$; $\geq 0.3\mu\text{m}$; $\geq 0.5\mu\text{m}$; $\geq 1.0\mu\text{m}$; $5.0\mu\text{m}$

3.3 Test set-up and parameters

When transferring the test item into the cleanroom, all surfaces were wiped clean with low particle emission cloth soaked in 70% ethanol solution. Then the test item was left in the cleanroom ISO Class 5, exposed to a flow of clean air to let residues of ethanol dry out ($>24\text{h}$). Next, visual inspection of the test piece was carried out (no magnification, distance between inspector and the surface being examined approx. 30 cm). In the next step the test item was placed in ISO Class 2 environment where particle emission test was to be carried out. During particle emission measurements, the test item was in operation mode (turned on).

Approximate identification of high particle concentration location(s)

Approximate identification of high particle concentration (critical locations) was performed using systematic scan of the test piece with a Laser Particle Counter equipped with scanning probe (in the beep mode; varying the distance of the probe from the test piece). The conclusions of the measurements undertaken for the approximate identification of particle sources are qualitative in nature - any critical points identified at this step are to be included in the next step of the test (precise determination of high particle concentration locations).

Precise determination of high particle concentration location(s)

Following the approximate identification, for each high particulate concentration location, precise determination of critical locations is carried out with Laser Particle Counter connected to round isokinetic sampling probe (sample volume per location: 28.3 litre). Location with the highest particles emission is used in the next step of the test (suitability measurement).

Suitability measurement

Suitability measurement (at the highest particle emission location) is carried out with Laser Particle Counter connected to round isokinetic sampling probe. As described in ISO 14644-14, to ensure appropriate statistical relevance of the qualification result, 100 individual measurements are taken with 28.3 litres sample volume each.

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3.4 Measuring equipment

Critical points determination (qualitative and quantitative measurements of particle emission), as well as final qualification test (series of quantitative measurements of particle emission at critical point/-s determined in previous steps), were carried out with calibrated high resolution Laser Particle Counter equipped with round sampling probe. Laser Particle Counter is calibrated at regular intervals. Calibration results can be traced back to national and international standards. The relevant documentation can be viewed on request at any time.

Test device used in the test: Laser Particle Counter TSI 9110, s/n: 91101102001

Sampling efficiency: 1 cfm (28,3l/min)

Particle size channels used in the test: $\geq 0.1\mu\text{m}$; $\geq 0.2\mu\text{m}$; $\geq 0.3\mu\text{m}$; $\geq 0.5\mu\text{m}$; $\geq 1.0\mu\text{m}$; $5.0\mu\text{m}$

4. Test results

4.1 Visual inspection

No contamination, dust or any surface defects were visible on the test item.

4.2 Approximate identification of high particle concentration location(s)

All surfaces of the test item showed no to minimum particle emission during scanning. Individual “beeps” noted few times during whole scanning procedure (corresponding to 1-2 particles counted during 1 second measuring time), were believed to be more the consequence of tubing (connecting scanning probe and Laser Particle Counter) movements and particles detach from it, rather than particle emission from the test item itself. This was confirmed in the next step of the test.

4.3 Precise determination of high particle concentration location(s)

Two sampling points were chosen for the measurement:

P1: Side of the lamp

P2: Front of the lamp

All sampling points showed no particle emission during measurements. Measured number of particles at each sampling point is given below:

Sampling point	Ch1 0.1µm	Ch3 0.2µm	Ch5 0.3µm	Ch6 0.5µm	Ch7 1µm	Ch8 5µm
P1	1	0	0	0	0	0
P2	0	0	0	0	0	0

Sampling points P1 was chosen as a critical point for suitability measurement.

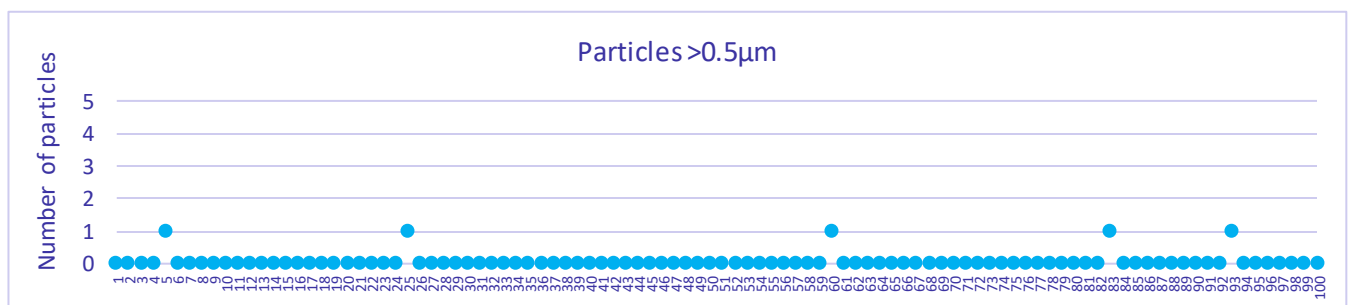
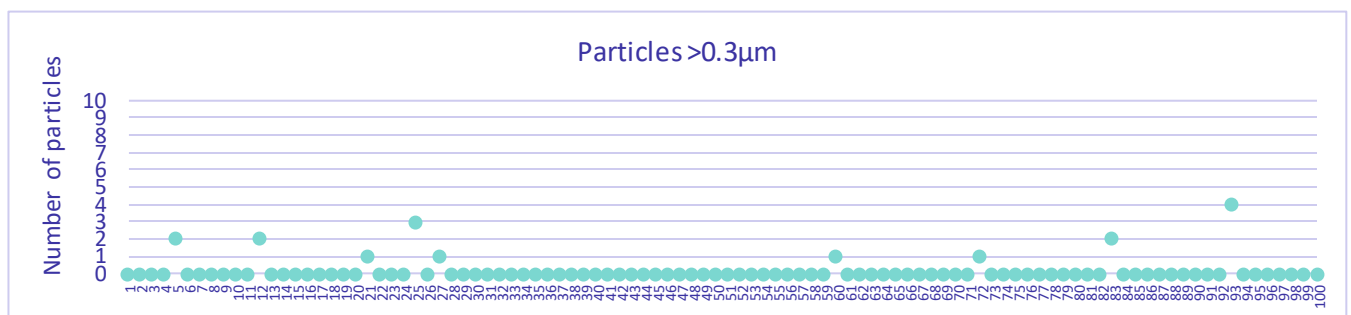
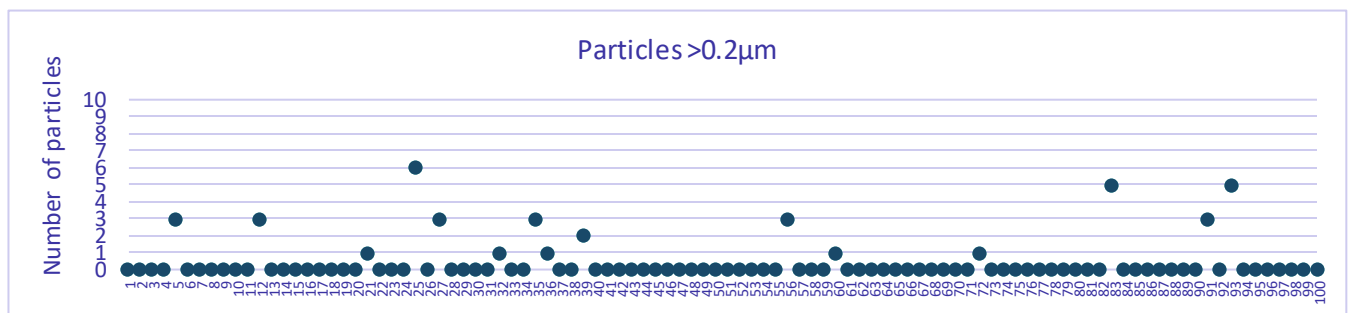
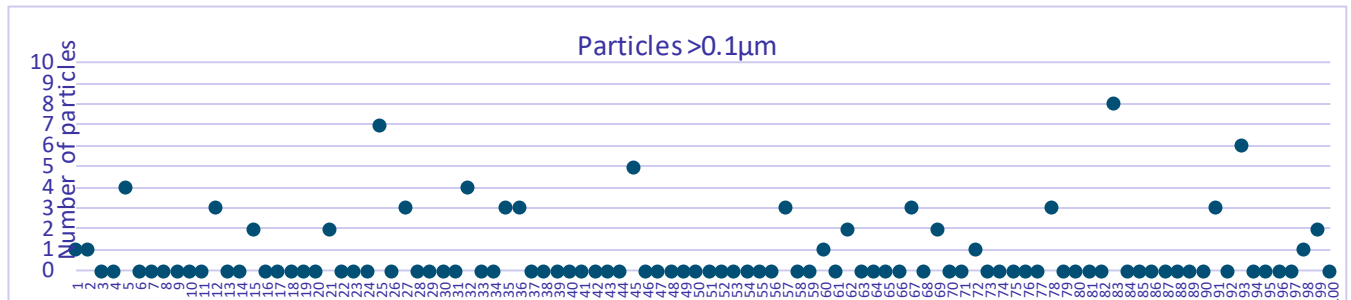


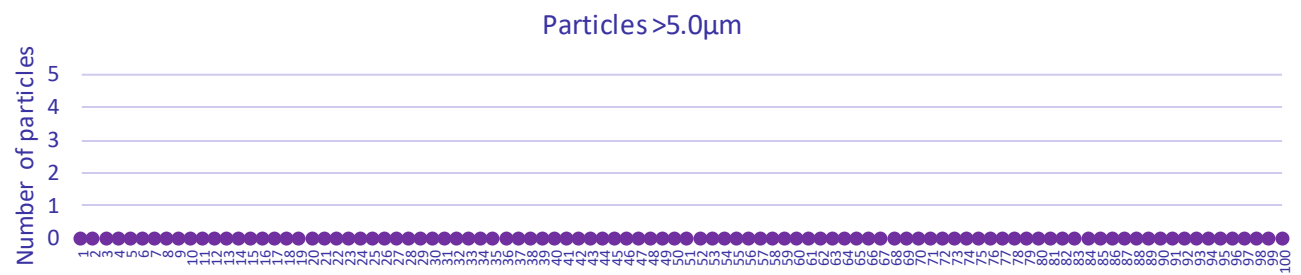
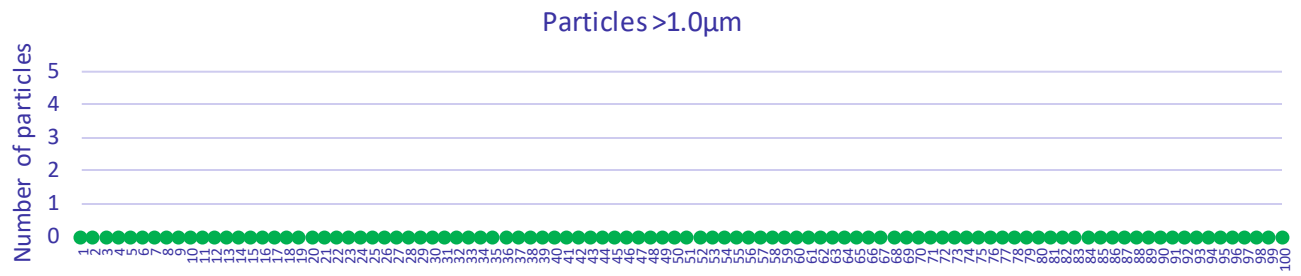
Sampling point P1: Side of the lamp (critical point)

4.4 Suitability measurement

Particle emission test was carried out over total time of 100 minutes (100 individual samples were taken; sample volume: 28.3 l; sample time: 1 minute).

Measured number of particles is shown on below graphs:





Statistical evaluation

Statistical evaluation of data obtained from particle emission test was carried out according to *ISO 14644-14* point 6.2.9 Data processing

	CH 0,1µm	CH 0,2µm	CH 0,3µm	CH 0,5µm	CH 1µm	CH 5µm
x (Mean value – Number of particles/1cf)	0,73	0,41	0,17	0,05		
n (Number of samples)	100	100	100	100	-	-
Pu (Upper confidence level)	2	2	1	0	0	0
ISO Class (ISO Class under consideration)	ISO 3					
G (Class under consideration limit)	28	6.71	2.89	1	Not considered for ISO 3 Class as per ISO 14644-1	Not considered for ISO 3 Class as per ISO 14644-1
Are acceptance criteria met? [Is UCL lower than G?]	Yes					
ISO Class suitability	ISO 3					

Above calculations demonstrate cleanroom suitability of the test item, as derived from the measurements, for ISO Class 3 Cleanrooms (0,1µm; 0,2µm; 0,3µm; 0,5µm). Likelihood of exceeding cleanroom air cleanliness ISO class 3 limit is <5%.

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5. Conclusions

UV-A Lamp BB 2.0 Helios Mains by Labino AB is suitable for use in cleanrooms meeting the air cleanliness specifications of ISO Class 3–9 (according to ISO 14644-1:2016).

