Expert report GMBU 2021-01-04

Testing for UV-C emission on the product

san:aer 45 active

Conducted by:

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Legal foundations

Relevant standards, regulations and standard specifications in the context of safety-relevant UV-Cradiation measurement, including standards for the basic definition of terms.

Directive 2006/25/EC, transposed into German law by ordinance July 2010.

DIN EN ISO 15858:2016(0)

DIN 5031-10

DIN EN 14255-1:2005-06

DIN ISO 2043-2007

DIN EN 60335-2-65 (VDE 0700-65)

CIE 155-3

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1.) Description of the object

The unit to be tested is an air disinfection module. The UV-C irradiation area consists of a rectangular, housed air duct. The air inlet and outlet areas have a cross-section of A= 105 x 105 mm^2

The unit has an active air circulation system, and there are flat air inlet and outlet areas with the specified cross-sectional areas A at the end faces, which represent potential radiation outlet areas.A flat grille forms the end of the enclosure.

The air inlet and outlet areas are identical in construction with regard to their housing closure.

The measuring object was provided ready for operation. The unit has a fixed air volume flow. TheUV-C output cannot be changed.

Fig.1) Air inlet side or identically designed air outlet side

2.) Testing background

The use of UVC lamps in the workplace requires compliance with several safety regulations, in particular

DIN EN ISO 15858 "UV-C equipment - Safety information - Permissible exposure of persons".

as well as the superordinate and spectrally broader:

Directive 2006/25/EC, transposed into German law by ordinance July 2010.

Both documents deal with the protection of persons at the workplace.

The intended measurements therefore include testing in a real environment of an installed device, cf. also the implementation regulation according to DIN EN 14255-1:2005-06.

The corresponding measurement describes the actual personal exposure depending on the installation type and height of a unit, the number of units in the room and possible additional UV-C sources. It must therefore be carried out after installation under operating conditions and is the responsibility of the operator.

According to R 2006/25/EC, the permissible radiation dose refers to a daily 8-hour exposure time and the entire UV spectral range, DIN/EN/ISO 15858 explicitly considers 254nm radiation sources, but also allows an assessment up to 24h/day exposure duration.

Corresponding measurements can be carried out as a substitute or in a modified form under reference conditions in order to provide installation instructions for minimum distances when installing individual devices per room.
In this way, the manufacturer or the executing specialist company can ensure that a test will be successful.

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3.) Measurement procedure

The measurement procedure uses the permissible UV exposure limit value for workplaces definedby the aforementioned standards of H_{ett} = 30 J/m² for 8h / day. (2006-25-EG, Annex 1, Tab. 1.1) orthe equivalent table value according to DIN EN ISO:15858:2017 .

The measurements take into account the requirements for the measurement setup according to DIN 15858 para. 4.4. The prescribed measurement heights for execution are between 1.83m and 2.13m. Within the scope of the measurements carried out, a measuring height of 2.10m was used throughout.

Measurements were taken both on the air inlet side (LE) and the air outlet side (LA).

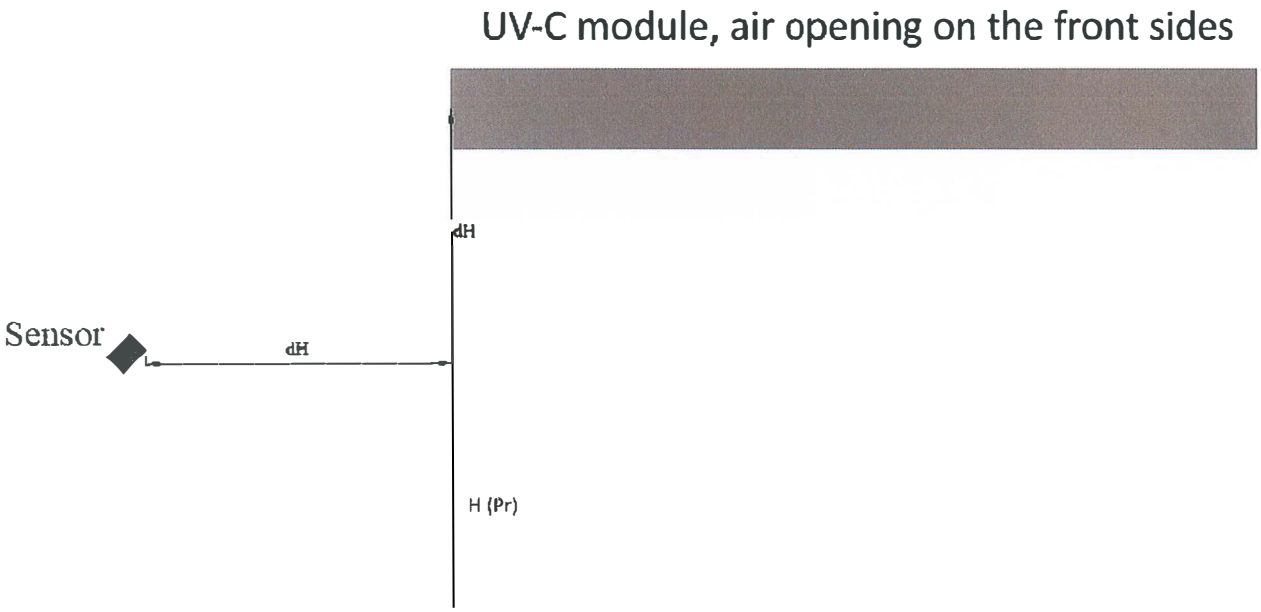

Fig.2) Testing arrangement: Check for minimum mounting height when using 45°geometry with sidelength dH and test height H(Pr).

4.) Execution

For all measurements, the system was installed on the ceiling. The mounting height to the centre ofthe unit was 2.10m.
The horizontal alignment of the test specimen was checked using a spirit level.
The alignment of the test specimen and the measuring system was monitored with a cross-linelevelling laser.
For the exact alignment of the sensor surface to the radiation exit surface, the detector head wasequipped with a targeting laser.

For the measurements on the other sides of the unit (LA or LE), the test specimen was unhooked,rotated, remounted and realigned.

The radiation at the outlet openings was free-radiating; no UV-C reflecting surfaces were to be considered within a radius of 3 metres.

For the measurement, the distance was changed by changing the position of the sensor in 10... 20 cm steps (lowering and backsliding), whereby the alignment of the sensor to the exit surface was additionally monitored by the target laser.

5.) Used test equipment

Spectroradiometer SP 320, Instrument Systems GmbH, SN 11132095 with EOP 146, OFG-424, PLG-420
spectroradiometrically calibrated *Ee(Lambda)* from 220 nm up to 1350 nm, test mark number CAL-203-16-036

The scanning spectrometer has a sensitivity range for irradiance of 10^{-1} to $1\text{-}0^{13}$ W/cm^2 nm in spectral range of 190 - 1000 nm.

The EOP 146 detector head has a cosine-shaped coupling characteristic.

6.) Results

Emissions in UV-8 and UV-A up to 400 nm according to DIN 15858 are not considered. The following maximum permissible UV-C exposure applies for an emission at 254 nm according toDIN EN 15858:2017-01/ EN ISO 15858: 2016 (D)

Permitted exposure duration h/day DIN 15858	Irradiance µW/cm²
8h	0,2
4h	0,4
2h	0,8

The following measurement results were determined for the san:aer 45 active unit in 45° geometry:

Measuring point	Measurement configuration	Irradiance measured
Air outlet LA	20x20cm	0,01 µW/cm²
Air outlet LA	40x40cm	0,004 µW/cm²
Air outlet LA	50x50cm	-

Only the exposure values for the air outlet are given here, as the irradiation values on the air inletside are consistently lower.

The minimum installation height HMo for compliance with the limit values for UVC exposure according to DIN 15858 is given in the following table.

Exposition 8 h/ day	Exposition 4 h/ day
HMa=230 cm	HMo=230 cm

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7.) Exposure assessment

The exposure assessment guidelines are based on an 8h working day. The following assessments use this exposure time, i.e. assume an 8h stay in the exposure area.
According to DIN 15858, however, the maximum limits are to be selected according to the actual occupancy of rooms, so that they may be different for different rooms depending on the daily working time and duration of stay.

If it can be ensured that the daily limit value is not exceeded by further exposures, correspondingly higher effective irradiance levels can also be used in rooms with a short stay.

7a.) Exposure assessment according to DIN EN ISO 15858:2017

For mounting positions significantly above head height, a minimum mounting height of 2.30m could be determined for a representative 45° geometry.

7.b) Exposure assessment according to R2006/25/EG

For single line emitters without relevant secondary peaks, the calculation can be carried out in a simplified manner using the factor of the corresponding wavelength, 254nm.

$H_{(ett)}$ = 30 J/m² for 8h / day , $S_{(2s4nm)}$ = 0,5 (R2006/25/EG, Tab1.1)

Derivation of the effective irradiance $E_{(elf)}$:

$E_{(LE\,elf,\ LA\,elf)} = E_{(LE\,\lambda)} * s(Lambda)$

Calculation of the exposure time until the limit value is exceeded:

$t_{(Exp)} = H_{(eff)} / E_{(eff)}$

This results in the same limit values for UV-C assessment at 254 nm as for DIN 15858.

With sufficient mounting height, the UV-C exposure for people decreases significantly. From a mounting height of 20 cm above the sensory measurement height (1.83 m - 2.13 m, DIN 15858), the daily limit value is reliably undershot, even during a stay of 8 hours.

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8.) Errors

The measurement uncertainty of the irradiance is:

200nm ¾*Lambda*< 250nm: 17%
250nm ¾ *Lambda* < 300nm: 9%

9.)

Notes I

The review of DIN EN 60335-3-25 "Safety of electrical devices for household use and similar purposes - Part 2-65: Special requirements for air purification devices" resulted in no further restrictive requirements (under item 32 "Radiation, toxicity and similar hazards"), which go bevondthe laws and norms considered.

Notes II

The included measurement protocol does not represent a workplace occupational health and safety inspection.

Processing and reporting:

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Review

Dipl.-Physiker B. Seme

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