SECU CHEK IF FAILURE IS NOT AN OPTION

Standardization, Influences, Possibilities and Risks of UV LED Technology to Fluorescent Magnetic Particle Inspection (MPI) and Penetrant Inspection (FPI)

SECURE UV-LED Lamps for Reliable and Cost-Efficient Inspection

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Solution provider for NDT with high skills in Aerospace Industry

NDT Equipment Designer and Supplier

German Manufacturer of
Technology Leading UV LED Sources

Passionate and Dedicated to Easier, Better, Faster,
More Reliable and Less Tiring Fluorescent Mag and Pen Inspection
Without Compromises
Because Failure Is Not An Option

SECURE UV-LED Lamps for Reliable and Cost-Efficient Inspection

Marc Breit

Owner of SECU-CHEK GmbH and RIL-CHEMIE

Obsessed to reliable, secure and easy NDT processes

More than 15 years NDT-experience in Magnetic- and Penetrant-Testing

Active Member and participant of all relevant groups and standardization committees worldwide regarding UV-LED-Technology: ASTM, DIN EN ISO committees for MT and PT, NADCAP, SAE

Working close with Aircraft- and Engine-manufacturers regarding standard development on a technical basis

Standardization

STANDARDIZATION IS ALWAYS THE LOWEST BASELINE
often far away from a good practice

It shall cover all posibilities to be inspected

From a tiny screw up to full wing…and everything in between

MOSTLY THE LOW BASELINE OF STANDARDIZATION IS NOT ENOUGH FOR EFFICIENT AND RELIABLE INSPECTION in the most used NDT methods (MPI and FPI)

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Design, Performance and Qualification Requirements, Standards

General Industry:

ASME CODE

ASTM E-3022
(not an Aerospace Standard)

EN ISO 3059

Aerospace Standards:

AITM 6-1001 **Issue** 11

Rolls Royce RRES 90061

Pratt & Whitney FPM Master

Boeing

Lamp Qualification is responsibility of the

Standard conformance is user's responsibility

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Standardization

- General Industry Standards actually less than a baseline
  e.g. ASTM-E 3022 only ensure correct wavelength when tested at 25 ± 3°C, not always during operation. This can cause detrimental process performance (e.g. Level 4 process only allows to detect Level 3 indications) and minimum inspector performance (inspectors are only able to search indications and can not detect indications anymore), due to focused lamps are allowed

- No universal Aerospace Standard available
  ASTM E 1444 and E 1417 do not have adequate requirements (refers to the general industry standard ASTM E-3022) and does NOT ensure inspection at least on the level of Mercury Vapor lamps when using UV LED Technology for inspection

- Only one Aerospace prime requirement (Airbus AITM 6-1001, Issue 11) actually ensures similar reliability of the inspection process and process performance when using UV LED lamps, compared to the usage of the unwritten standard 100 W Mercury Vapour Lamps

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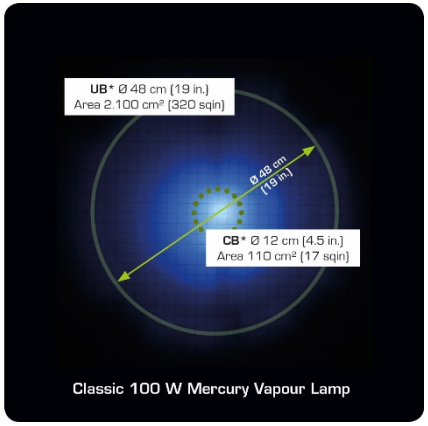
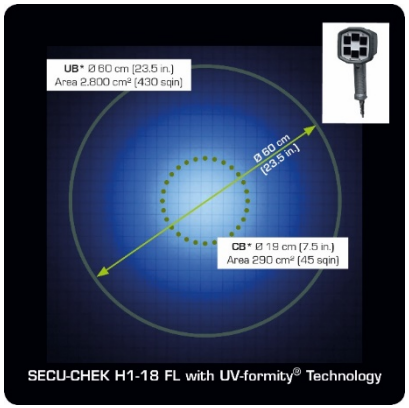
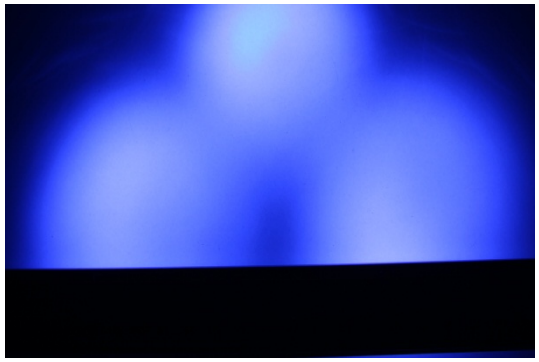
Uniformity of the beam



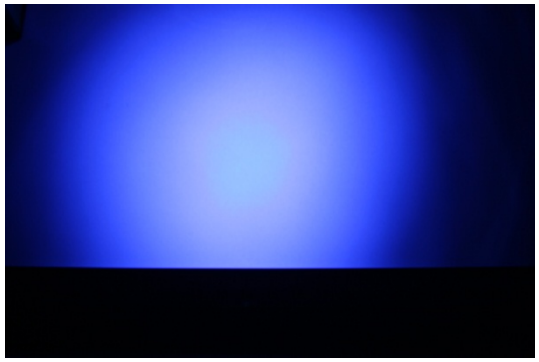
100W Mercury Vapour Lamp



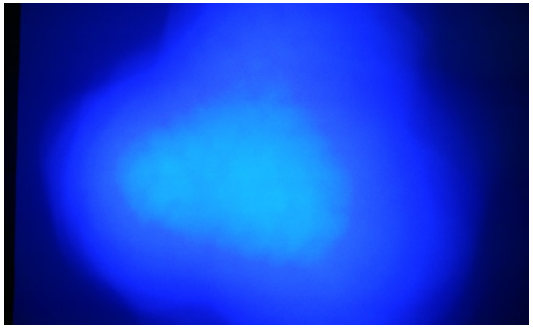
SECU-CHEK UV-LED Lamps with UV-formity™ TEchnology



Inacceptable (radiation hole)



UV-LED Spot with hard drop-off



Critical UV-LED Lamp with micro-variations and marblings

SECURE UV-LED Lamps for Reliable and Cost-Efficient Inspection

Uniformity of the Beam

Type of non-uniformities	Description of the non-uniformity	Classification	Examples (Picture)	Example wording
Visual total uniform	No visual non-uniformities, just smooth intensity drop form the center to the edges	desirable		
Hot Spots without separations	Name the number of hotspots and the distance within the minimum and maximum distance they are visible	acceptable		3 hotspots between 10 and 20 cm distance
Cloudiness	Name the minimum and maximum size	Acceptable		
Microstructures	Fine structure mostly just visible when moving the source	Acceptable		Consistent micro-structures within in the beam, fine in shorter and coarse in longer distances
Steps	Visual steps		µXenon Medium Spot	1 circular step that separates 2 beam sections that are uniform with single
Splashes / Splatters	Fragments with visual higher or lower intensity	Acceptable		Uniform central beam with hard drop and irregular splatters in the surrounding
Coarse Variations without separations	laminar zone with visual intensity change between areas	Acceptable	Mercury in 38cm distance	2 visual uniform areas connected with a coarse non-uniformity from 12 to 6 o'clock
Irradiation holes	Round areas with too low or no irradiation	Critical / unacceptable		
Separations	areas with too low or no irradiation	Critical / unacceptable		Until 10cm distance between lamp and inspection surface

Uniformity of the beam

Inspection is always performed while moving the lamp and/or the parts

The human vision is not sensitive for motionless texture but can easy see then when moving

To see non-uniformity just move the lamp above a sufficient large sheet of white paper and have a ‘deep long’ look

Inacceptable (radiation hole)

UV-LED Spot with hard drop-off

Classification and Description of the Beam Style

Shape and Size of the central and usable beam

- ≥ 1.200 µW/cm² (12 W/cm²) Bentral Beam (for observation with the central vision)
- ≥ 100 µW/cm² (1 W/cm²) Usable Beam (for detection with peripheral vision)

Catergorisation of intensity drop at a specific distance

Type	Drop of Intensity
• Spot (SP):	≥75 % per 2,5 cm (1 in.)
• Spotwith marginal peripheral irradiation (SPP)	< 75 % per 2,5 cm (1 in.)
• Flood with soft drop (FL) (similiar or better than 100 W Hg Vapour Lamp)	< 40 % per 2,5 cm (1 in.)

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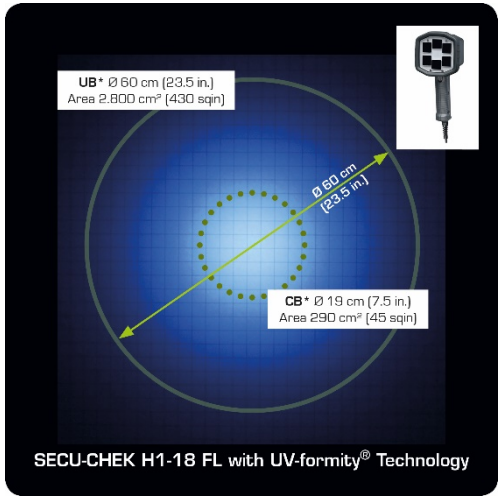
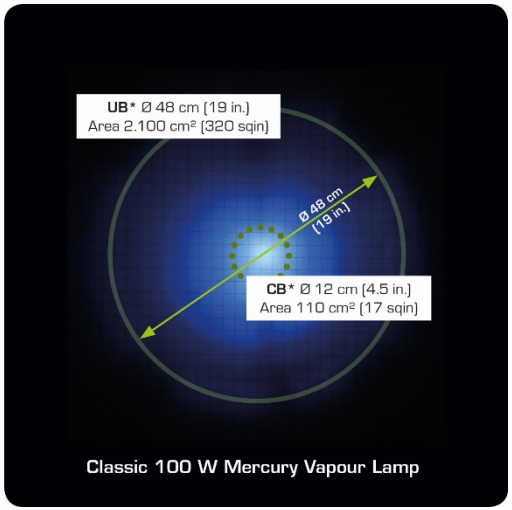
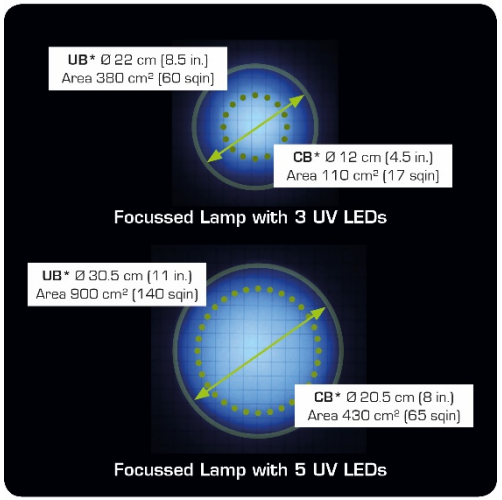
Classification and Description of the Beam



(FL) Totally uniform and homogen Flood for easy, secure, fast, fatigue-proof and cost efficient inspection



100 W Mercury Vapour Lamp (The Unwritten Standard) Flood with central Spot and Non-uniformities from 12 to 6 o'clock



A: (SPP) Spot mit marginal peripheral irradiation and hot spots
(3 UV LEDs)
B: (SP) Spot with micro-structures

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Classification and Description of the Beam

Central Beam

(≥ 1.200 µW/cm² / 12 W/m2)

Lamp Type	Dimension	Area	Intensity (max.)	Drop
SECU-CHEK UVE365 H1A-18 W FL	ø 21 cm	350 cm²	≥ 3.100 µW/cm²	< 32 %
New100 W Mercury Vapour	ø 12 cm	110 cm²	≥ 5.000 µW/cm²	< 40 %
SPP Spot (3 UV LED)	ø 12 cm	110 cm²	≥ 5.000 µW/cm²	< 60%
SP Spot (5 UV LED)	ø 23 cm	430 cm²	≥ 4.000 µW/cm²	> 80 %

Multiple faster OBSERVATION

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Classification and Description of the Beam

Usable Beam

(≥ 100 µW/cm² / 10 W/m2)

Lamp Type	Dimension	Area	Intensity (max.)	Drop
SECU-CHEK UVE365 H1A-18 W FL	ø 65 cm	3.300 cm²	≥ 3.100 µW/cm²	< 32 %
New100 W Mercury Vapour	ø 48 cm	1,800 cm²	≥ 5.000 µW/cm²	< 40 %
SPP Spot (3 UV LED)	ø 22 cm	380 cm²	≥ 5.000 µW/cm²	< 60%
SP Spot (5 UV LED)	ø 30 cm	900 cm²	≥ 4.000 µW/cm²	> 80 %

Multiple reliable and faster DETECTION

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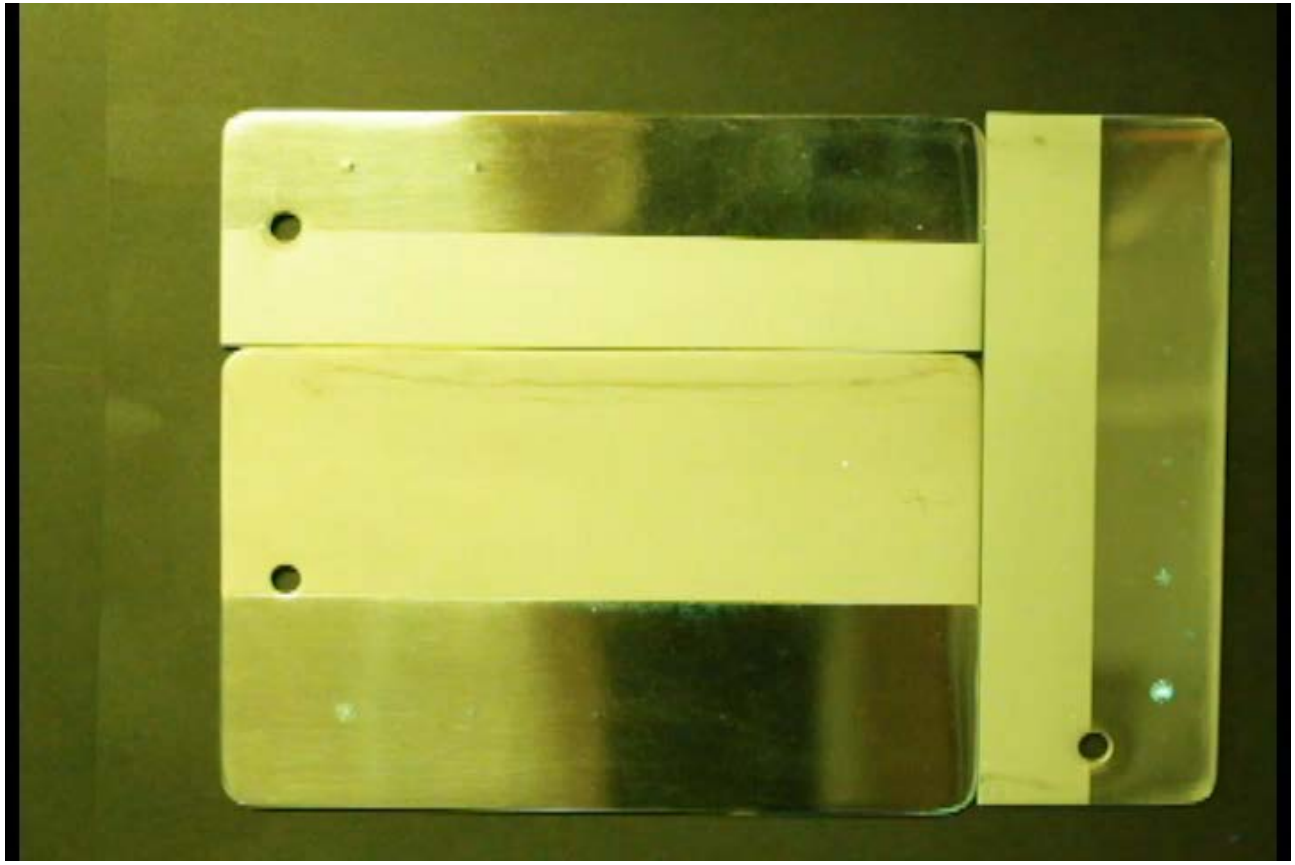
Impact of Beam to the Performance of the Inspection



SECURE UV-LED Lamps for Reliable and Cost-Efficient Inspection

Unchangeable Part: Human Vision

INSPECTION of fluorescent indications are physiologically and technically **3 different steps**:

- **DETECTION** (peripheral vision),
- **OBERSERVATION** (central vision)
- **INTERPRETATION** (supported by white light, magnifiers, etc.)

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Unchangeable Part: Human Vision

PERIPHERAL (OUTER) VISION

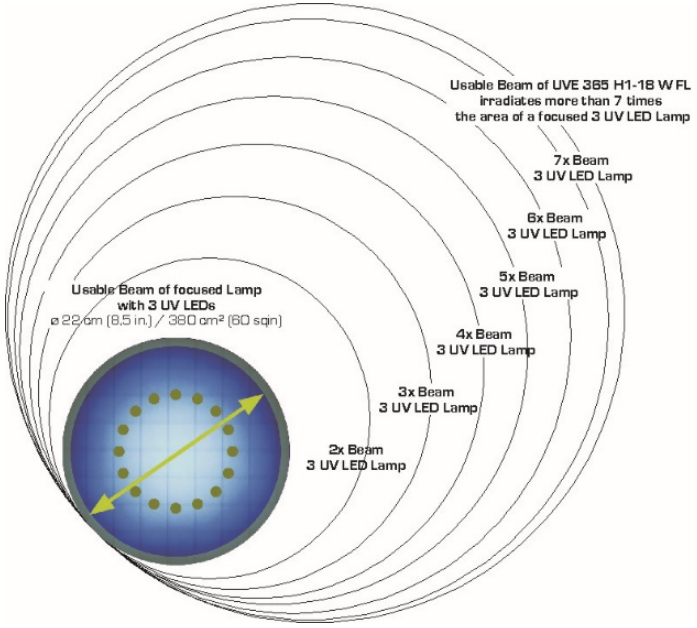
- **DETECTING 'engine'**
- High sensitivity for moving contrasts
  - Free eye movement required
  - Works well also at low UV-intensity (> 100 µW/cm² = usable beam)
- Unsharp vision area
- 35 faster than the central vision
- Gives orientation
- Responsible for sufficient and fatigue-proof detection
- Guides intuitively the central vision to the relevant indications

CENTRAL (FOVEAL) VISION

- **OBSERVATION ,engine'**
- Only tunnelview
- Low Sensitivity
  - Needs high UV-intensity (> 1.200 µW/cm² = central beam)
- Very sharp
- Slow
- Unable to detect indications
- Can only observe or search details
- Responsible for interpretation
- High resolution
- Coloured

SECURE UV-LED Lamps for Reliable and Cost-Efficient Inspection

Classification and Description of the Beam



Sufficient Size, Soft Drop and Uniformity of the Usable Beam

=

Usage of the Detection Capability of the Human Vision

- **NO Missed Indications (secure detection of inidications)**

Multiple Reduction of Inspection Time

Fatigue-Proof Inspection

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Process Enhancement by Sufficient Background Illumination

(>500 µW/ cm² on the parts surface)

Impact to Washing Process

- Optimized Interactive Washing Process by just enabling the inspectors to see what they are doing
- Optimal Washing Result
- No Over-Washing
- Easy and Fast Removal of Excess Penetrant

Advantages for Part Inspection

- Minimized fluorescent background on the parts when performing the inspection
- Maximum contrast of the indications
- Optimal, Easy and fast detection of indications
- Easy and fatigue-proof examination

SECURE UV-LED Lamps for Reliable and Cost-Efficient Inspection

UV protection glasses must fit application

Adequate Optical Quality for Visual Inspection in Darkness

Large field of vision / no limitation of the field vision

Working in Darkness eyes are much more sensitive

Adequate UV Protection

Sufficient Comfort For Wearing A Full Shift

NDT Compliant

H&S Standard Compliant

SECURE UV-LED Lamps for Reliable and Cost-Efficient Inspection

UV protection glasses must fit application

Eliminitation of ‘UV-Stress’ of the eyes

Elimination of ‚moving glare‘

Elimination of the fluorescence of personal glasses

No Mirrorings (Lighter Check)

UV400 Cut-Off Filter

No Fluorescent Parts (Even the Glasses)

No Reflections (Even Micro Reflections)

Protection From the Top and from the Sides

High Wearing Comfort / User Adjustable

ANSI / CE Compliant (EN 166F & EN 170)

SECURE UV-LED Lamps for Reliable and Cost-Efficient Inspection

COST INFLUENCED BY PERFORMANCE AND QUALITY OF UV LED SOURCES

User Performance (Time needed for inspection)

- Level of Usage of Detection Capability of the Human Vision
  - Tunnelview and exhausting searching of indications with central visionusing spot lights
  - Easy, Reliable and Fast Detection with the peripheral vision when using flood lights
- Tiring of the inspector
- Strain while performing the inspection

Reliability and Endurance of the UV LED source

Quantity, Size and Geometry of the parts

Quality of the Washing Process

Reprocessing of Parts

Missed Indications

SECURE UV-LED Lamps for Reliable and Cost-Efficient Inspection

Conclusion

Standardization is just a low baseline and

does not ensure an efficient processes and inspection

UV LED Technology has a high impact to

performance, costs and quality of MPI and FPI.

Good equipment can massively reduce costs and

enhance the all over process performance

The price of the source can not significantly affect the price of the inspection, while the UV Source and its performance can drastically influence the costs of the inspection

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FURTHER QUESTIONS?

CONTACT US FOR FREE ON-SITE TRIAL
or a sample of optimized protection glasses

www.uv-led-lamp.com

www.secu-chek.com

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