

TECHNICAL AND PRACTICAL REQUIREMENTS, NEW POSSIBILITIES, ACTUAL AND UPCOMING STANDARDIZATION OF UV-LED LAMPS FOR FLUORESCENT MAGNETIC-PARTICLE- (MPI) AND PENETRANT INSPECTION (FPI)

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Abstract. The change of the technology for UV-Sources in NDT from simple, unloved discharge-bulb-based UV-Lamps (Mercury-Vapour-, Xenon- and Metall-Halid-bulb-based) to complex, sophisticated electronic UV-LED-based devices is also a huge change in practice.

The drastic growing, intransparent and diversified range of UV-LED-lamps offered in the market, the actual missing standardization as well as the heterogeneous requirements by the primes require much more effort and knowledge by the responsables to select, qualify and operate UV-LED-sources sustained and audit-secure.

Due to the matter of fact, that the UV-Source is the most influencing and sensitive part within the fluorescent inspection process the selection of the UV-LED-source can drastically affect the reliability, security and process costs as well the effort for the in-use-monitoring and process-documentation.

The usage of adapted UV-LED-sources with integrated advanced features and functions, offer for the first time, in history of fluorescent inspection, a more easy, less tiring, more secure, more reliable, more cost-efficient and optimized inspection process.

The presentation will clarify the following technical and practical issues to enable responsables to easily and sustainable choose and operate adequate UV-LED-sources for their individual applications:

- Practical advantages and risks using UV-LED-sources
- Relevant new and old parameters for the selection of UV-LED-lamps
- New possibilities, electronic monitoring and optimized viewing conditions
- Overview of the upcoming and actual standardization, the technical backgrounds and necessities
- prevention of unneeded monitoring and documentation efforts by integrated electronic monitoring

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Motivation

- Clarification and explanation of the technological and technical difference of conventional UV-Sources & UV-LED-based sources
- Establishing the awareness of the user, that the visibility of the indication for the human vision is the primary and unchangeable focus in the system
- Showing the technical possibilities of UV-LED-sources
- Introducing upcoming new parameters and features
- Explaining that selection of suitable UV-LED-Systems is not as simple as ordering conventional UV-source
- Informing about upcoming standardization



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I. c. The unwritten standard: 100W Mercury-vapour bulb based UV-Sources

- a. All lamps are technical equal and based on same bulb, filter and ballast
- b. Same physical determined and fixed spectral output
- c. Same irradiated area
- d. Same beam pattern (soft radiation drop)

Using lamps that do not fulfill at least 100% of the performance and reliability regarding ALL factors of influence to the fluorescent inspection process of 100W Mercury discharge lamps are a risk for the probability of detection (POD) and performance of the whole process and destroy the qualification systems worldwide!



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I. d. Technology Shift:

**from a simple electric device to a
complex sophisticated electronic system**

**UV-LED-lamps can look totally the same but
can be technically extremely different**



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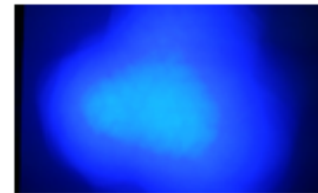
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II.b. Beam Pattern



100W Hg-Lamp

Beam size
Beam uniformity
Radiation drop
at the Edges

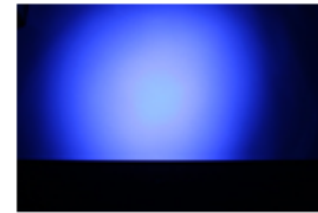


Non-uniform
UV-LED-Lamp



HQ-UV-LED-
Lamp

HAVE DRASTICAL
INFLUENCES TO
PROCESS-
PERFORMANCE AND
PROBABILITY OF
DETECTION



Standard-UV-LED



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II. c. Soft Radiation Drop at the Edges

It enables the intuitive, fast and reliable inspection by enabling the usage of the full capability of the human vision

Peripheral Vision (unsharp and fast):

RESPONSIBLE FOR FAST & RELIABLE
DETECTION OF INDICATIONS
ALLOWS ORIENTATION ON THE PARTS AND
CONDUCTS THE CENTRAL VISION TO RELEVANT INDICATIONS



Foveal (central) Vision (very sharp and slow):

RESPONSIBLE FOR INTERPRETATION OF INDICATIONS.
INAPPROPRIATE TO DETECT INDICATIONS



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II. e. Additional Checks and Records required to ensure process security if not electronically monitored

- Failure of LED-elements
- Failure of the cooling system
- Constant output when battery powered
- Overheat and Temperature issues



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III. New Possibilities and Features for Enhanced Inspection Quality and Performance

- a. Advanced system monitoring
- b. Signalization of operating status and system status
- c. Adaption time signalization
- d. White light toggling
- e. Additional white light
- f. Adjustable white light
- g. Automated crossfade and dimming
- h. Eco-Mode (automatic switch-off if not used)
- i. Secure customizing by responsible
- j. Adequate ambient temperature range

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III. a. Advanced system monitoring

- Prevent the need of doing additional system checks manually and records
- Ensures maximum process security
- Ensures maximum lamp reliability
- Protects the investment
- No internal heat damage possible
- No unnoticed critical failure during operation



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III. c. Adaption time signalization



III. d. White Light Toggling (UV or VIS)



III. e. Additional White Light (UV+VIS)



III. f. Adjustable White Light



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III. g. Automated Crossfade and Dimming of White Light

Slow stepless variation of the amount of white light instead of switching allows the users to observe the transition of the seen picture while the human vision can stay focussed on relevant indications without interruption
NO loss of the visual orientation or sharpness
NO flash blinding of the eyes will occur



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III. j. Adequate Ambient Temperature Range

Electronic devices are sensitive to heat
Especially when used in rough industrial ambient and field usage
UV-LED-lamps must ALWAYS work properly, also under extreme conditions
Unnoticed failures are INACCEPTABLE
Inspection must be STOPPED when ambient temperature is higher than the temperature the lamp is qualified for



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**Guaranteed
Requalification
Possibility
(at least until 2017)**



**Worldwide Standardization
and Aerospace
Requirements 11/2015**

- a. ASTM
- b. AMS / SAE
- c. EN / ISO
- d. Rolls-Royce
- e. NADCAP*
- f. Airbus*
- g. GE*
- h. Pratt & Whitney*

* Without claim to be the last updated and complete information

**Detailed
Qualification,**

**Detailed
Certification**



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V. Conclusion

- LED-based UV-Sources are not simple electric lamps, they are electronic device that require adequate qualification and maintenances
- Well **qualified and designed high-quality UV-A-LED-sources** can **easily and completely substitute** conventional bulb-based-UV-lamps without any technical and practical disadvantage in NDT
- Fluorescent inspection processes can be improved using optimal UV-Sources
- Selecting and buying adequate UV-LED-lamps is much more complicated and complex due to high variability, further it is necessary to select and approve specific lamp types for specific application by the user and responsible Level 3
- New Standards have to replace the 'unwritten' Standard by using the very similar bulbs, filters and ballasts
- When using LED-based sources in practice we have to respect and check (manually or electronically) more relevant parameters
- More controls to do when not electronically monitored (e.g. correct operation of all LED-elements and cooling system)
- Many new and great applications can be realized (e.g. combination with dimmable white light)

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