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company paper

AN AFFORDABLE & SUSTAINABLE ALTERNATIVE: LED RETROFIT TUNNEL LIGHTING

[1] Author: Thomas Nessel, [2]Markus Keller

[1] **ASFiNAG Service GmbH,** AT
[2] **ASFiNAG BMG**, AT

1. INTRODUCTION

The operating technology department at ASFiNAG has found a sustainable way of converting existing lighting to LEDs cost-effectively and independently of manufacturers.

Lighting is one of the most important safety features in road tunnels.

There have been many improvements in lighting technology in recent years but the new systems were either very high maintenance or expensive. The metal halide lamps give white light but quickly lose luminosity, have high power consumption and need to be replaced every two years. The most recently installed LED fixed systems are very expensive, require their own wiring, and when they need to be replaced, you are dependent on the manufacturer's system.

Our research has shown that the existing stainless steel housings and wiring will last at least 25 years. Therefore, we looked for a manufacturer who was willing to develop with us a completely new modular system with LED inserts and lens technology. The specifications from the beginning were that the inserts must fit into any system, that more and even light must arrive on the road, that it must be a modular system where a spare part costs no more than 40 € and the installation must be possible under 5 minutes. After completing our tests, we knew that the implementation was technically possible and we released the specification for procurement.

Today, there are already five manufacturers supplying these highly compatible and sustainable inserts according to our specifications. The number is constantly increasing. Due to the competition, the price dropped and since 2020 even the powerful tunnel entrance lighting is equipped with LED inserts.

2. KNOWN PROBLEMS

Common problems with **halogen metal vapour lamps**:

- become darker
- change colour
- high power consumption
- Reflector angle
- Ballasts
- Replace EVERY 2 years! Lock!

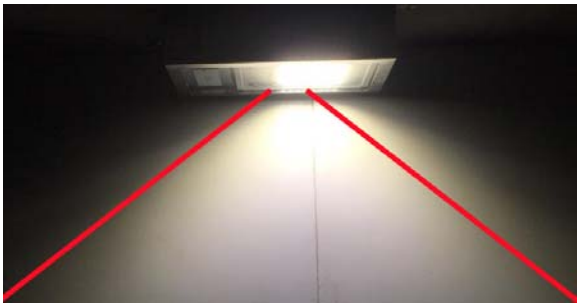
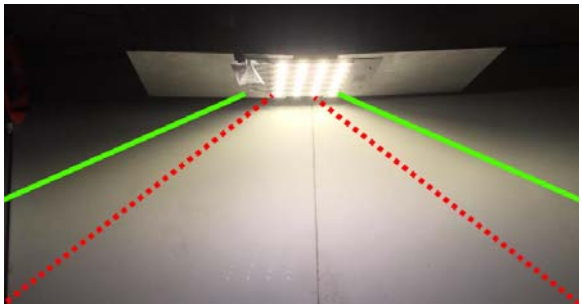
Current problems with **LED Fix System:**

- Expensive! >700€ per luminary
- Bespoke wiring
- Bespoke brackets
- Manufacturer-dependent

- Aluminium <Longevity

3. INNOVATION

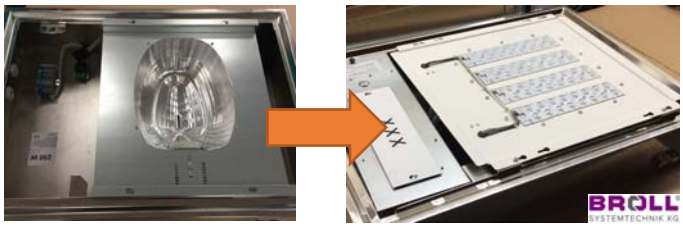
We started the **Lighting Insert Development:**

What we wanted:

+Retrofit: old housing, old wiring
+More light, more evenly dispersed
+Modular system, < 70€ per spare part
+Installation <5min
+Use below 400€
+Less power
+Light quality (colour temp., colour reproduction)

With support of Detas DLeds and BROLL made a **simple modular retrofit design**



…simple and easy to install:

With great results:

4. NEW LED INSERT SUCCESSES:

Old housings + wiring last 30 years
+ Item price starting from 200€
+ Replaced in < 5 minutes
+ 25% more light at 34% lower power consumption
Since 2020 we install it also at the TUNNEL ENTRANCE

5. **NEXT STEPS** IN THE ASFINAG BMG EM

- Study on Cri value correction in the RVS
- Introduction of changes to the RVS/FSV to reduce the energy demand & CosPhi
- Revise the design manual tunnel lighting considering stainless steel suitcase luminaires
- Determine the basis of replacement needs

6. **PLAPB CHANGES** IN THE ASFINAG BMG EM

- Revise tender texts
- LEDs Cri & Energy & 80.000h
- Driver temperature & unifying the housing
- cd/m² measurements & what does the customer see?
- Ensure testing possibilities by local construction supervision (ÖBA)

- Ra CRI >= 70 checkable at data sheet !
- Control without series connection & 8-4 steps
- 3 parts = one luminaire in DACH & simple on-site exchange
    - stainless steel box & luminaire up to € 800 EFB
    - DFB driver & quick exchange (e.g. 2x150W € 300)
    - EFB unit & quick exchange (e.g. 1x400W € 400)

7. QUALITY

<u>QUALITIY: Fail safety – temperature:</u>

- The temperatures measured indicate whether the light meets the quality requirements.

- Temperature management
  - -> minimum volume required
  - -> high quality LED-drivers

QUALITIY: Color consistency

What we never want to see again:

Color-over-angle (CoA) effect:

At normal incidence, a fraction of the blue pump light leaks out to produce a balanced white spectrum. At large angles, more blue light is absorbed, resulting in an off-color spectrum with less blue and more green+red=yellow than wanted.

Not on IR LED, but IR LEDs are half-efficient on Color consistency at Ra ≥ 90. (Soraa/LEDinside)

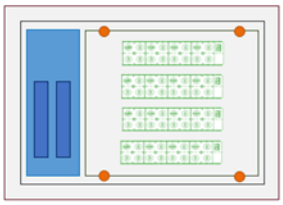
Solution:

We need a Lens LED combination without color-over-angle (CoA) effect

8. SUMMARY AND CONCLUSION

New ASFiNAG STANDARD

(2 modular, sustainable housing types)



- 2 Standard housings
  with flat glass – easy cleanable
- Standard equipment carrier
  for 2 drivers (failure safety,
  same quantity of LED Modules)
- Standard mounting points
  (only minimum volume defined)
- Add quality definition:
  - ⇨ temperature &

- ⇨ color consistency
- ⇨ makes Ra≥70 possible

10 Years & 30 years

- new optimized concept & sustainable use
- increase of life cycle
- reduction of energy consumption
- survey of the need for replacement
- adaptation RVS & PlaBP
- Stainless steel case lights (retrofit also for entrance area) & 17.5 up to 35 years lifetime