Tue, 27 May 2025
Weekly Newsletter

DVN Lighting

NEWSLETTER #906

Editorial

¡Hola! To Spain's Lighting Community

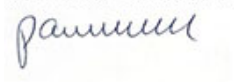
I began my career in vehicle lighting 25 years ago in October 2000, and my first project with Renault was the Modus (in Valladolid) and the Megane (in Palencia). My first 'lamp baby' was the X84 Renault Megane with Jesus Romo's team at Valeo Martos, and I have always kept good relationship with Spanish suppliers. When Carlos Elvira from SEAT Cupra invited us to visit the Cupra R&D and design centres in Barcelona, we thought it would be a nice idea to gather the vehicle lighting R&D community for a 'family photo', which you see here!

Spain is a great automotive country. 2.37 million vehicles were made there last year, making Spain the number 2 in Europe, number 9 worldwide. SEAT Cupra, Renault, Stellantis, Iveco, Mercedes, VW, Ford, and Chery make vehicles there, representing 8.2% of Spain's GDP.

The vehicle lighting community is well represented in Spain with R&D centres and manufacturing plants for companies including Valeo (exterior lighting), Antolin (interior lighting), Zanini (lit logos), Elausa (electronics)…Marelli, Forvia Hella, and Flex-N-Gate. There are test houses (Idiada and LCOE), and service companies (Andaltech, CTAG, Capgemini, Ingedetech, OTC engineering). So, in this week's DVNewsletter, we bring you along with us on our DVN field trip to Spain…and also to Shenzhen! All around the world, the vehicle lighting community is flourishing. We're glad you're with us.

Sincerely yours,

Paul-Henri Matha
DVN Chief Executive Officer and Lighting General Editor

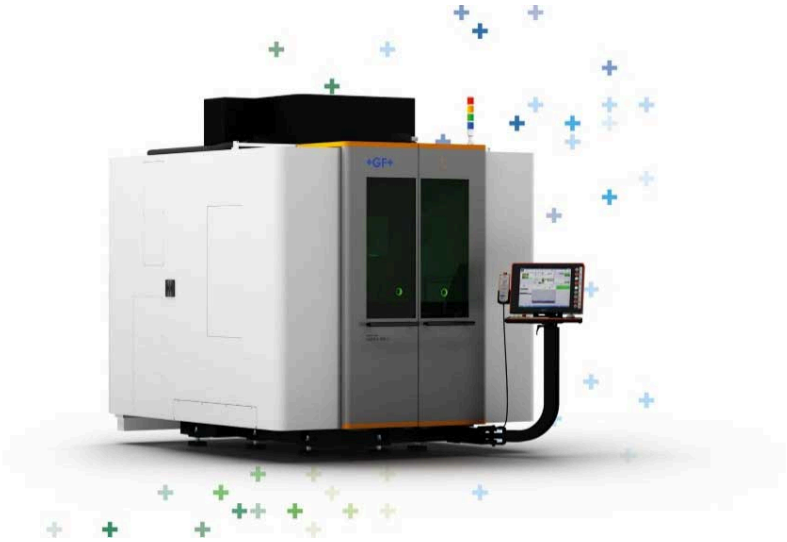


In Depth Lighting Technology

Microrelleus: A Family Story

Everything started for Microrelleus in 1983. CEO Raúl Garcia's father started to work with his own milling machine for engraving.

Raúl joined his father later, after earning his industrial engineering diploma, and they bought their first Nanolaser machine in 2013, still for engraving. They started in this business on account of a request from a famous US textile company who requested special pattern, only feasible with laser solutions. Raúl and his father went to famous Swiss laser company GF who delivered them their second laser machine in 2016 — a femto laser machine, making Microrelleus the first company in the world to offer this service.



Femtosecond laser technology emits ultra-short pulses—each lasting just one quadrillionth of a second (1 fs = 10^{-15} s)—which allows for material engraving without generating heat. Unlike nanosecond lasers, whose longer pulses (1 ns = 10^{-9} s) cause thermal effects such as burrs, edge rounding, melting, and inconsistent surface finishes, femtosecond lasers achieve extreme precision with no heat-affected zones. The result is sharp-edged, burr-free microstructures with excellent tolerances and high-quality surface finishes—essential characteristics for industries like automotive lighting for engraving of micro-optics or free-form microprisms in injection-molds and tools. This technology is ideal for applications requiring microscopic detail at industrial scale.

A foundational application for Microrelleus' engraving was cosmetics and perfume. With this new technology, really small details could be realized, creating new textures like brushed aluminium or velvet.

Raúl thought of using this machine for other application domains, like medical and automotive. During a conference in 2015 in Barcelona, he met by chance an old Cupra design guy who saw the potential of this machine for lamp design. Contacts were made, and the Cupra Tavascan concept was presented in 2017 with prototype lamps including femtolaser engraving on optical components. Raúl came for the first time to ISAL in 2018, and shortly thereafter Microrelleus entered the vehicle lighting field and community.

Lamps with this technology can be found on the Cupra Formentor (Valeo), Renault Rafale (Hella), Lancia Ypsilon (Flex-N-Gate), Range Rover Sport (OPmobility), Fiat Topolino (Aspock) and Land Rover logo (Zanini)

Femtolasers can realise very accurate free-form shapes. You can do microöptic optical designs for indirect reflection, as on the Renault Rafale or Cupra Tavascan. You can improve homogeneity of the inner screen with direct light, as on the Lancia Ypsilon. To support these developments, Raúl just hired last year a senior optical engineer — Jordina Boveda, with many years' experience at Hella, Marelli, and Flex-N-Gate — to interact with tier-1 and OEM customers on the one hand, and on the other with software providers like Synopsys and Ansys to have all information available and included in the optical library.

Microrelleus focus on correlation between physical mockups (they do laser graining on PMMA cubes, for prototypes), simulations, and production parts. The lack of such correlation has long made challenges for OEM engineers and designers. Microrelleus hope to solve it with their internal research project; results will be presented at DVN Munich 2026.

Laser graining is quick. In context of complex lens tooling lead time of 20 weeks, laser engraving lead time is between 1 and 4 weeks, depending on the size of the tool and the complexity. Microrelleus receive the insert from a tier-1, then they do the laser work and the final control. Special optical tools are needed to check conformity in the micrometre-scale realm.

Laser engraving is booming in the vehicle lighting sector. Microrelleus now have 13 employees — there will be 16 in a few weeks — and revenue expanded 30 per cent last year to reach more than €2m. When Raúl started in 2016 with the femtolaser, he was alone on the market, but now he has competition keeping him motivated to carry on innovating.

Great visit Raúl, thank you; I learnt a lot!

Lighting News

DVN Field Trip Refond Optoelectronics, Shenzhen

LIGHTING NEWS

During our Shenzhen business trip, we also took time to visit Refond Optoelectronics, a new DVN member this year. They exhibited at the Munich and Cologne DVN events this year, and will exhibit in Tokyo next month.

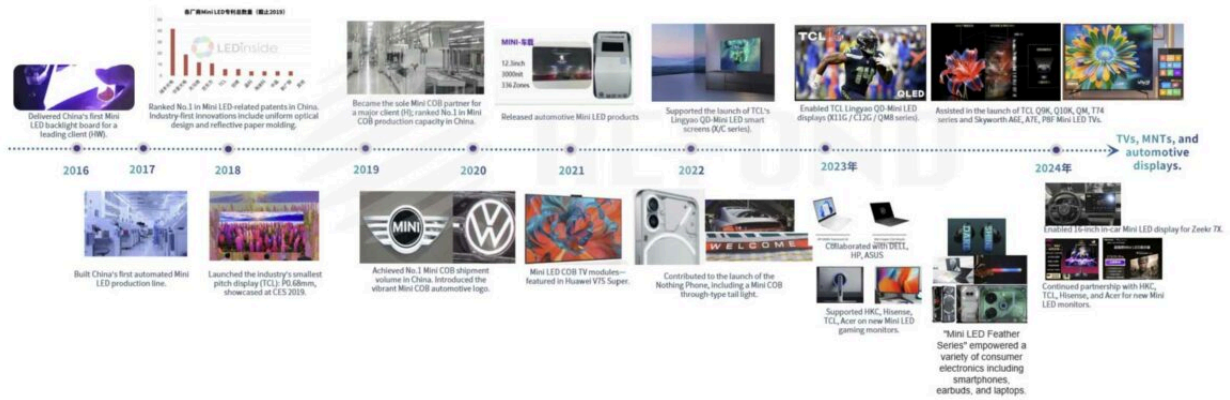
I decided to focus my article on their miniLED products, as Refond are a miniLED pioneer and they are delivering one of the first miniLED rear lamps in production in China for the Great Wall SAR: RGB tri-colour red LEDs with 0.92-mm pitch. LVDS data transmission is used to drive each LED pixel, with CAN and Ethernet options.

Refond were established in 2000 in Shenzhen. There are more than 2,000 employees, of whom 800 are in Shenzhen.

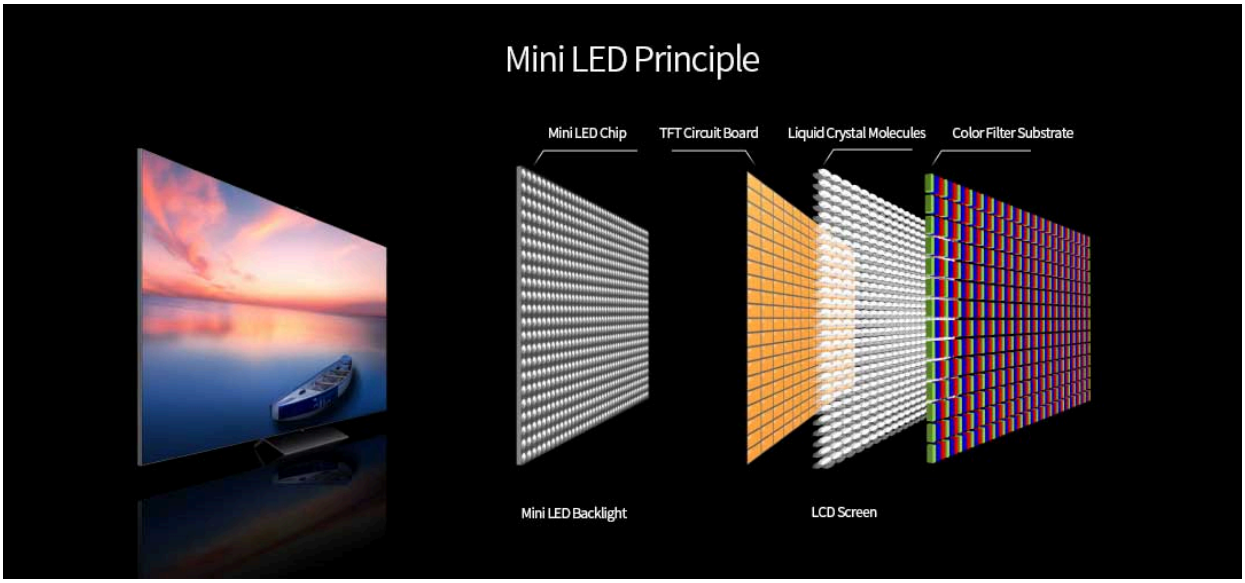
Their first automotive LED delivery was to Hyundai in 2007; now automotive business represents around 30 per cent of the company's global revenue. R&D represents between 6 and 8% of the global revenue.

Refond Optoelectronics has accumulated over eight years of expertise in the field. Since initiating Mini LED technology development in 2016, the company has achieved several industry milestones.

In 2016, Refond developed the first Mini LED product in China, and in 2017, established the country's first Mini LED production line. It was also the first in China to achieve mass production of Mini LED backlight products using COB (Chip-on-Board) packaging technology, filling a key technological gap in small-pitch LED display solutions. These products have since been widely adopted by several leading Mini LED TV brands, gaining significant market recognition.



Refond have continued to build robust technological barriers, owning more than 100 IP rights in the miniLED field. The company have mastered key core technologies including COB architecture, flip-chip bonding, molded encapsulation, light uniformity optimization, ultrathin structures, high-brightness solutions, driver hardware and software design, and cost optimization. These advancements have significantly contributed to the development of China's ultra-high-definition (UHD) display industry.



For vehicle lighting application, Refond are presently delivering their MiniLED RGB Tri-Color product, with 0.92-mm pitch and 2.3-kilonit luminance. The module is 75W × 92H mm, and quite thin. At DVN Munich, Refond demonstrated products with RGB COB LEDs, 0.68-mm pitch, and 2-kilonit luminance — the technology can achieve 30 kilonits. This miniLED dynamic car logo enables dynamic display effects by precisely controlling the brightness, colour, and flash frequency of each LED chip. It can display text, graphics, animations, and other information — attracting attention, facilitating vehicle recognition, and enabling new aesthetics.

Refond operate three major production facilities in Shenzhen, Hubei, and Zhejiang. Through lean management across the production process, the company have established precise, flexible, intelligent digital workshops, with multiple dedicated miniLED production lines and a complete process control system.

During our DVN visit, we talked about the challenges in mass-marketing miniLED applications.

Automakers want finer pitch, that's one of them. Currently, Refond can mass produce minimum pixel pitch of 0.39 mm for RGB, and 0.2mm for monochrome. The main technical challenges for pitch reduction are efficiency and yield bottlenecks of mass transfer, inspection, and repair. There's also a cost challenge.

The second challenge is the shape of the PCB—flat, flexible, or curved. As the display pitch decreases, the number of PCB layers must increase, making it difficult to achieve flexibility in small-pitch displays. The finest flexible-display pitch achieved by Refond is 0.68 mm.

The third challenge is the signal transmission and control. As the pixel count increases, the complexity of signal transmission and control escalates rapidly, necessitating a new E/E architecture for resolution. Refond continues to collaborate closely with partners to address this challenge.

In the automotive exterior display application, the POB (Package on Board) and Mini COB (Chip on Board) solutions coexist in the market. Refond has achieved mass production for both solutions. Refond's Mini COB solutions focus on small pixel application (pitch less than 2.5mm), POB solution focus on pixel pitch more than 2.5mm application.

Canada Adds US Spec to ADB Regs List

LIGHTING NEWS

Transport Canada has moved to allow U.S.-specification adaptive driving beam systems in Canada. The newly-released Revision 8 of TSD 108 now includes the ADB design, construction, performance, and testing requirements from U.S. FMVSS 108, so vehicles can be sold with U.S. ADB in Canada.

The U.S. specification is the latest ADB standard to be recognized in Canada; rest-of-world UN/ECE R123 + R48 ADB is permitted (as this DVNewsletter goes live, we do not know if or when this reference will be updated to include R149). And SAE J3069 is also recognized; Canada might be the world's only country to do so. Several high-volume vehicle models have been available for some years in Canada with J3069 ADB.

Toyota's Newest RAV4 Unveiled

LIGHTING NEWS

Toyota have revealed their 6th generation RAV4. It's one of the best-selling cars in the world — around 1,178,000 units in 2024.

On the exterior, the new RAV4 adopts the latest family design. The front lights are Toyota's latest C-shaped design, connected by a black trim strip to create a full-width design effect. The taillights have a vertical-strip design, which is highly recognizable when illuminated. At the rear, as well, a black trim panel creates a full-width effect.

It is interesting to see three different front lighting system variants — vertical DRL, horizontal DRL, or front fog lamp give different atmosphere for the cars: more sporty, more off road, more classical.

ams OSRAM Eviyos Shape for Dynamic Lighting

LIGHTING NEWS

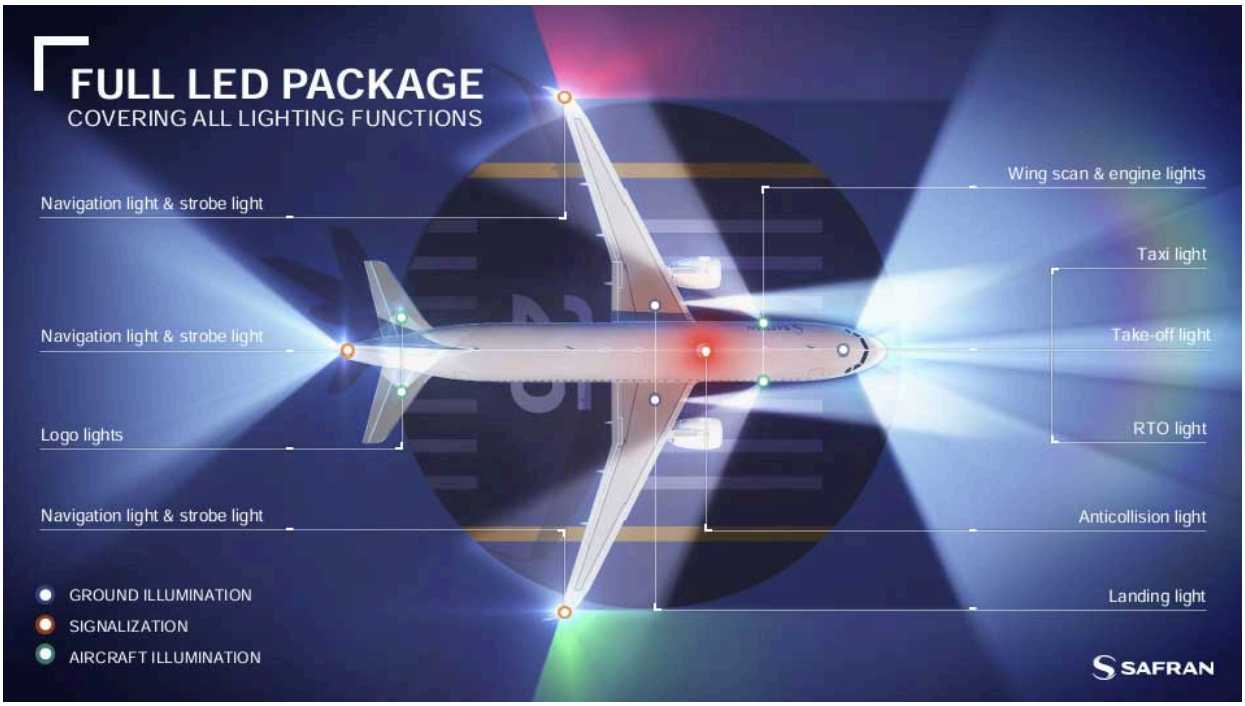
ams OSRAM's new Eviyos Shape range of LED light sources, with pixel-level controllability, enables the likes of streetlights which project guide paths for pedestrians, vehicle headlamps which display driver assistance projections on the road surface, and architectural installations to transform spaces with dynamic projections. This evolution allows light to communicate, guide, and even enhance safety in ways that were once the realm of science fiction.

ams OSRAM say "In urban and smart city environments, [Eviyos Shape] enhances public spaces and cultural installations through dynamic, interactive projections, creating engaging and vibrant atmospheres (…) for machine vision, Eviyos Shape delivers high-precision visual output, ensuring accuracy and efficiency in automated systems and industrial applications. Additionally, it provides custom lighting solutions tailored to meet the specific needs of professional and creative environments, offering bespoke designs that cater to unique requirements”.

To go further ...

Flying Vision News: Aircraft Lighting

TO GO FURTHER ...



I took time during the last weeks to investigate the lighting package on planes. I had questions: is it something similar to vehicle lighting, do you have lighting and signalling functions, what is the needed range, what are the intensity requirements?

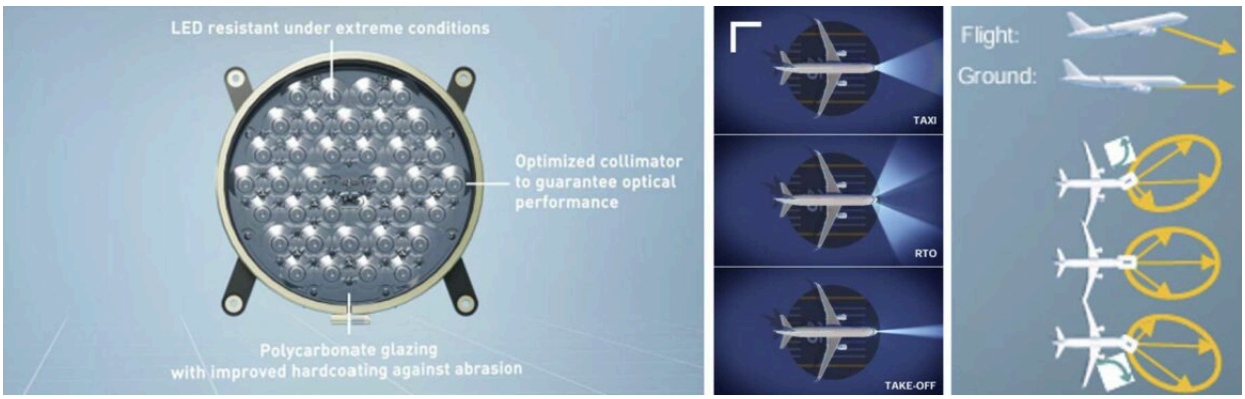
There are multiple lamps on a plane — 10 different functions as shown in the graphic here from Safran.

First, the ground-illumination lamps. The most powerful is the landing lamp, for take-off and landing. It puts out around 700 kcd peak intensity, with a 14°H × 9°W beam — similar beam shape to an old US high-beam sealed beam, but with much greater intensity. Before LED introduction, tungsten and halogen sealed beams and lamps were used, with a rated lifespan of perhaps 10 to 25 hours. Redundant lamps were needed to be sure the plane would have working light during take-off and landing. Redundancy has long been a core tenet of aeronautic engineering in general, and it applies also to lighting. Then halogen bulbs were replaced by HID technology similar to the D1S and D2S Xenon automotive headlight lamps.

700,000 candelas! That is equivalent to the flux of ten automotive high beams with E_{max} 100 lux. If we talk about power consumption, halogen power was around 600 watts, while LED lamps serving the same function are around 100 - 150 Watt. Thermal dissipation is crucial, of course, when developing a high-power, safety-critical lamp. What is the needed derating curve, how to dissipate heat and what are the environmental conditions to be face at different altitude from 0 to several dozens of kilometres, with speed from zero to Mach 2…!

Why 9 degrees vertical field of view on the landing light? this is to cover all the different pitch angles of the plane during take-off and landing due to speed and wind.

There is no levelling system in these lamps like on cars with sensors and actuators to calculate and compensate for the pitch of the plane.



Landing light, example from Safran

To fulfil environmental-degradation requirements (sun and sand), outer lenses are now mostly made of polycarbonate — like automotive headlamps, but with thermal coating, because UV coating isn't sturdy or durable enough. This is also the case for most lidar covers, though some of those are still glass.

The next ground illumination function is the taxi light. This is for low speed, so the required intensity is less, but the beam is thrice as wide as the landing light, at 42° degree). This would be the equivalent of the automotive low beam.

Finally, there is the RTO (runway turn-off) beam. A rough automotive equivalent would be fog/cornering lamps. These are for the crew to see to the side when the plane is turning during ground manœuvres.

Then there are a plane's signal lights, which can be readily compared to a road vehicle's position and signal lights.

There are white forward and rearward strobe lights, with intensity at least 400 cd (like an automotive DRL). These are on the left and right wings, for collision avoidance. They flash with a certain pattern (50 ms ON - 1,400 ms OFF as an example). In addition, there's a strobe at the rear of the plane.

Navigation lights, red to port (left) and green to starboard (right), advertise the position of the plane, and its direction of travel. Intensity is lower, around 20 to 40 candelas. The beam specifies a cutoff to avoid projecting light to the rear. These are quite directly comparable to a car's white front and red rear position lamps, and its amber side marker lamps.

To reach the photometry requirement is sometimes not easy due to significant wing curvature. Optical rules for light transmission are similar for all optical engineers. Position of the lamps is crucial, and there must be loops between aircraft designers and lamp makers — just like vehicle lighting's design convergence loops.

Strobe and navigation lights behind an aerodynamic cover lens on a wing

Then there's the anticollision light. This red light is on the roof of the plane, and must produce at least 400 cd in red color, flashing. The highest-intensity red automotive lighting function, the rear fog lamp, requires only 140 cd. To obtain 400 cd minimum with red LEDs is not simple; it needs many LEDs and very effective thermal management.

Finally, there's the logo light. Mounted on the tailwings, it illuminates the tail number (comparable to a vehicle licence plate) and any logo on the fin. Due to the size of the fin and the location of the lamp, minimum intensity is quite high — 4,000 cd — so as to provide adequate luminance on the fin.

Beyond all these safety lights, other types of light exist as well, such as wing/engines lights (to check from the cockpit if everything is okeh), helicopter search lights (350,000 cd) for search and rescue, and more.

All these lamps must meet regulations — as automotive lamps must, but aircraft regulations are more stringent — and also customer requirements from the likes of Airbus, Boeing, and other plane makers. Certification is done by authorities: EASA in Europe, and FAA in the USA that delegate certification to aircraft manufacturers. What is different compared to automotive certification is that they are certifying also the development and production process, not only test results.

Environmental conditions are harsher compared to automotive. Plane lamps must meet military norms of -55°C rather than the automotive -40°C spec. Obsolescence is figured at 25-30 years, compared to 15 years in automotive. That can affect the supply chain, and there can be challenges when components like light sources or LED drivers become unavailable.

Another difference between airfaring and roadgoing vehicle lighting is the access of the final customer. They will never talk and listen with pilots (from the likes of Air France or Lufthansa or United or…) to know their habits, what lighting they would like to have, etc…not easy to know what the need for final customer is to optimize a new lamp development.

This global market is estimated at €100m per year, so it's quite a niche market. The main tier-1s are Safran, Collins, Honeywell, Astronics, and Aveo.

Skills to develop plane lamps are similar to what we need for automotive. Photometrics tools to develop beam patterns…goniophotometers, luminance cameras, and for sure optical engineers.

One of the big activities is the LED retrofit to replace the filament lamps still in service on a lot of planes. The goals are the same as ours: to increase lifetime of the light source and end the need for frequent replacement. A central challenge is to reduce the price of the current aircraft, and to reduce power consumption for new aircraft development. In a very competitive environment with Chinese competition. All in all, then, they are living and working in a world similar to ours.