

Case Study



Case Study: Dental Lamp

LUXEON's True White Light & Longer Life Ease Dentists' Job.

The idiosyncrasies of halogen-based dental lamps have been a fact of life in dental offices for decades. The bulbs burn out quickly, generate intense heat, devour electricity, and cast a light that alters gum and tooth color. For dentists, these quirks have simply gone with the territory—like toothaches, crowns and root canals.

In 2008, Brazil-based Gnatus Equipamentos Médico-Odontológicos Ltda. (www.gnatus.com.br) changed the landscape by introducing the first dental lamp to use solid-state lighting technology. The Gnatus Dental Light LED Plus—built with LUXEON® K2 LEDs from Philips Lumileds (www.philipslumileds.com)—has significant advantages for both the dentist and the patient.

Enabling Better Dentistry

From a performance perspective, the LEDs in Gnatus' LUXEON-based lamp last 50 times longer than halogen bulbs that must be replaced every three to six months. They

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- Gilberto Nomelini
Gnatus CEO

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Halogen Dental Lamp

also slash power usage by 60%, produce a cooler light beam without dentist or patient discomfort, eliminate spillover light with related glare, and pump out 35,000 lumens per square meter from just five LUXEON K2s. That's 40% brighter than Gnatus' own 25,000-lux halogen product.

From a dentistry perspective, the new lamp's ability to deliver pure white light that renders the true color of teeth and gums facilitates diagnosis as well as improving resin matching for crowns, veneers and other restorations. LED illumination also has less effect on curing light resins, giving dentists more time to do restorative work before the resins harden. In addition, the lamp is smaller and sleeker than its halogen counterpart because of the small LED form factor and different optical characteristics that eliminate the need for a large reflector.

"LUXEON technology has enabled a real advance in the way that patients' mouths are illuminated during dental exams and surgery. Our Dental Light LED Plus has features that simply are not possible with halogen lighting, and that has made it one of the most successful products we have ever launched," said Gnatus CEO Gilberto Nomelini, whose company is the second largest manufacturer of dental equipment in the world.

"Based on the response from the dental community, we believe that LED-based dental lamps are destined to become the standard in the product category."



LUXEON-Based Dental Lamp

Setting the Stage

Before bringing the new dental lamp to market, Gnatus utilized LUXEON LEDs in several other professional dental applications. The company's first LED-based product, released in 2003, was an X-ray backlight using LUXEON I white LEDs. That was followed by separate dental curing and dental whitening products using LUXEON III LEDs in royal blue.

Once those products had been successfully engineered and launched, Gnatus began development work on a LUXEON-based dental lamp. The company partnered with

the University of São Paulo (www.usp.br/internacional/) to assist with optics, thermal management and overall design; MMOptics (www.mmo.com.br) to develop the power supply and manufacture the LED modules; and Future Lighting Solutions (www.futurelightingsolutions.com) to assist MMOptics with the driver circuitry as well as to supply the LEDs under a binning program that ensures color consistency.

Designing Innovation

More than a retrofit of Gnatus' existing halogen dental lamp, the Dental Light LED Plus is a completely new design driven by LUXEON's physical and optical properties.

Instead of a single halogen bulb floating in the middle of a bulky trapezoid-shaped housing, the new lamp features five side-by-side LED modules that beam like adjacent headlights from a slimmer and smaller chassis shaped roughly like a car's rear-view mirror. Each module contains one LUXEON K2 LED, one optic and one heatsink mounted in a rack to achieve the desired optical alignment.

"We originally worked with earlier-generation LUXEON LEDs on this project, but it was LUXEON K2 technology that allowed us to surpass the light output of the standard halogen dental lamp."

- Vanderlei S. Bagnato
Professor of Physics
IFSC/University of São Paulo

Both the smaller footprint and the modern new look of the lamp were made possible principally by the ability to replace the oversized reflector required for the halogen model with an optic that is only slightly larger than the LED itself. Designing that optic was one of the primary challenges of the project.

Utilizing LUXEON LEDs in cool white (5500K), Vanderlei S. Bagnato, Professor of Physics, IFSC/University of São Paulo, headed a team that developed a custom optic intended to simultaneously maximize the brightness of the lamp while also directing light away from the patient's eyes. This was accomplished by a combination of reflective and refractive optics, special cutting and polishing processes, and anchoring each LED module at a precise angle in the racks mentioned earlier—with overlapping beams—to create a concentrated 100mm x 100mm square beam of light focused directly on the patient's mouth.



The use of LUXEON K2 LEDs also played a central role in producing the lamp's halogen-beating 35,000-lux performance, thanks to LUXEON K2's lumens-per-package output and ability to be driven at higher currents for longer periods of time than any other LED. For the Gnatius lamp, engineers at MMOptics and Future Lighting Solutions determined that utilizing a 1A drive current would allow them to crank up the brightness while also delivering a useful life of 50,000 hours—a quantum leap over halogen's skimpy 1,000-hour lifetime.

The LEDs in Gnatius' LUXEON-based lamp pump out 35,000 lumens per square meter from just five LUXEON K2s. That's 40% brighter than Gnatius' own 25,000-lux halogen product.

A custom heatsink was developed by the University of São Paulo team to handle the thermal load, in part with the help of a fan that transfers the heat to the ambient air.

"We originally worked with earlier-generation LUXEON LEDs on this project, but it was LUXEON K2 technology that allowed us to surpass the light output of the standard halogen dental lamp," Bagnato said. "We didn't just replicate the capabilities of the halogen version; we were able to help Gnatius essentially reinvent the product."

Dentists Bite

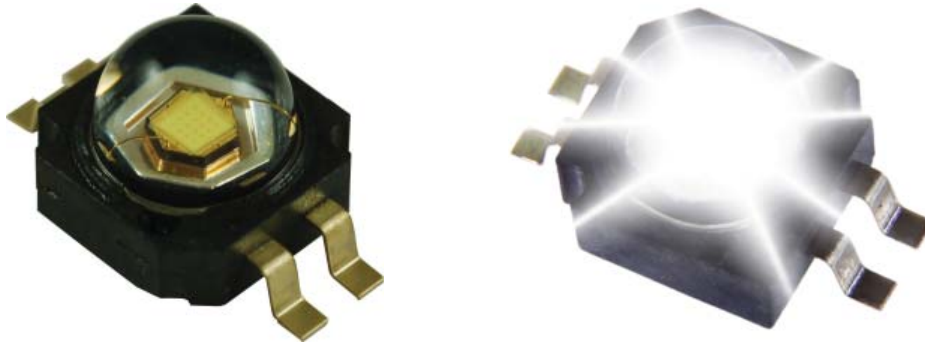
Today, the Gnatius Dental Light LED Plus is available in 135 countries as an attachment to the company's dental chair. A standalone version is scheduled for release by early 2009. Dentists have responded enthusiastically to the innovations made possible by LUXEON illumination.

"This is a pioneering product that is already yielding benefits for dentists in general and dental surgeons in particular," said Professor D. Rubens Corte Real de Carvalho, Managing President of ffo-fundecto, a foundation that is part of the Dental University of the State of São Paulo and that tested early prototypes. "Gnatius has been at the forefront of dental product design for many years, and this is one of their greatest contributions to the profession to date."

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LUXEON K2 Benefits for Gnatus Dental Lamp

- 40% brighter than halogen products
- 12-25 year life compared to 3-6 months
- 60% reduction in power consumption
- True white light, improving dental diagnosis and resin matching
- No heat, eliminating dentist and patient discomfort
- No peripheral light shining in patients' eyes
- Smaller, sleeker design enabled by smaller optic



LUXEON K2 power LEDs.

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Philips Lumileds

Philips Lumileds
370 W. Trimble Road
San Jose, CA 95131



North America
1-888-Luxeon2 (589 3662)
americas@futurelightingsolutions.com

Asia
1-800-Lumileds (5864 5337)
asia@futurelightingsolutions.com

Europe
00-800-44Future (388873)
europe@futurelightingsolutions.com

Japan
+81-0120-667-013
japan@futurelightingsolutions.com

www.futurelightingsolutions.com
www.philipslumileds.com

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