ADMETEC SOLUTIONS LTD.
HEADLIGHT BLUE-LIGHT IRRADIATION TESTING RESULTS

This document was developed by the Admetec Solutions Ltd. The intent is to provide general information to practicing dentists and to report the amount of blue light irradiation in the light specter our products. For more information please see References and Additional Information section.

Characteristics – The term "blue light hazard" refers to photochemical damage to the retina caused by light. Light in the wavelength range of 400-500 nm (violet, blue, and blue-green) is most detrimental, but all visible light as well as UV-A radiation can contribute to photochemical injury. The risk is related to the radiance (brightness) of the light source as well as the size of the image of the source that is projected onto the retina.

Units of Measure – The radiance of a light source is measured as the power emitted per unit area of the source, per unit solid angle. Solid angle is measured in steradians (sr), and can be pictured as a cone with its apex at the source. Radiance is typically expressed in units of W/cm2-sr. Irradiance, or power per unit area received at a surface, is typically expressed as mW/cm2. Radiant exposure, or energy per unit area received at a surface, is typically expressed as mJ/cm2. Wavelength is expressed in nanometers (nm).

Significant Sources – Blue LED arrays, intense white light sources (such as projection lamps, floodlights, microscope lights, welding arcs), strong sunlight.

Biological Effects – Absorption of short-wave visible light by some retinal pigments triggers photochemical reactions that can lead to retinal cell death. Though retinal damage from blue light has been amply demonstrated in experimental studies on animals, the epidemiologic evidence for an association in humans between chronic blue-light exposure and retinal damage such as macular degeneration is not yet conclusive.

Exposure Guidelines – The ACGIH TLV® for the blue-light hazard is harmonized with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines. The time-integrated radiance, weighted by the blue-light hazard function, should not exceed 100 J/cm2-sr over a total viewing time of 167 minutes in a day. If the viewing duration is longer than 167, the radiance weighted by the blue-light hazard function should not exceed 10 mW/cm2-sr. If the light source subtends an angle less than 0.011 radians (for example, if a light source 1.1 cm in length were viewed at a distance of 1 meter), the irradiance measured at the eye, weighted by the blue-light hazard function, should not exceed 100 µW/cm2 for viewing times longer than 100 seconds, and the radiant exposure at the eye, weighted by the blue-light hazard function, should not exceed 10 mJ/cm2 for viewing times shorter than 100 seconds.

Exposure Assessment – Blue-light radiance measurements should be performed with a broadband detector that has a spectral response well matched to the ACGIH/ICNIRP/IESNA blue-light hazard function. The detector's field of view should be 0.011 radians.

Blue Light and UV testing

Butterfly, Orchid and Orchid-F headlights were tested for the amount of visible blue light and UV-A radiation using no-filter, yellow filter (blue light only passes), blue filter (no-blue passes).

During the test the irradiance, weighted by the blue-light hazard, was not exceeded 0.58 mW/cm2 measured on distance of 25cm (10") for Orchid/Orchid-F light and 0.27 mW/cm2 for Butterfly model. All measurement made on maximum power.

Which are, in relation to maximum allowed limit, **5.8% for Orchid/Orchid-F** and **2.5% for Butterfly model**.

UV-A level – 0, since LED light sources do not irradiate waves of UV length.

References and Additional Information

AIHA NIR Committee: Light and Near-Infrared Radiation TLV Documentation, 2008.

Blue Light quick reference guide, 2012

American National Standards Institute/Illuminating Engineering Society of North America (ANSI/IESNA), Recommended Practice for Photobiological Safety for Lamps and Lamp Systems – Measurement Techniques, (ANSI/IESNA RP-27.2-00), New York: IESNA, 2000.

R.T. Hitchcock, C.E. Moss, W.E. Murray, R.M. Patterson, and R. James Rockwell: Chapter 22, Nonionizing Radiation in The Occupational Environment: Its Evaluation, Control, and Management, 2nd Edition. Fairfax, VA: AIHA, 2003.

M.L. Phillips and A: Butler: Chapter 31, Nonionizing Radiation: Broadband Optical, in Patty's Industrial Hygiene, 6th Edition. Hoboken, NJ: John Wiley & Sons, 2011.

C. Reme, J. Reinboth, M. Clausen, F. Hafezi: Light damage revisited: converging evidence, diverging views? Graefe's Arch Clin Exp Ophthalmol 234:2-11, 1996.

B.T. Smith, S. Belani, A.C. Ho: Ultraviolet and near-blue light effects on the eye. International Ophthalmology Clinics 45:107-115, 2005.