Publication of Duncan Aviation

STRAIGHT TALK ABOUT AIRCRAFT LIGHTING

Contributions by Adrian Chene, Dennis Kruse, and Steve Elofson

DUNCAN AVIATION

www.DuncanAviation.aero/straighttalk

TABLE OF CONTENTS

EDITOR'S NOTE

Any experienced interior designer will tell you that lighting is one of the most important elements in a space; whether it be a home, office, work space, or aircraft interior. With considerations such as obsolescence, new technologies and features, and the importance of design, we saw the need and developed this *Straight Talk Book* as a quick reference guide for those considering an upgrade.

We hope you find this guide helpful and informative. Feel free to contact our avionics and cabin systems experts to discuss options and get answers to any questions you may have about lighting upgrades.

Duncan Aviation Avionics Sales Team

AIRCRAFT LIGHTING EVOLUTION

All lighting uses electricity to turn current flow into light. The earliest type of lighting, incandescent, produces light by heating a conductor until it glows. Fluorescents came next and produce light by exciting mercury vapor and phosphor powder coating on the inside of the lamp. Both of these light types have undesirable attributes. They burn out relatively quickly. They can be hot, inefficient, and easily broken. Fluorescent lights can also do irritating things like strobe and flicker. For those reasons, LEDs (Light Emitting Diodes) have become the norm in virtually all lighting products.

LEDS (Light Emitting Diodes)

LEDs, like any other diodes, are a semiconductor sandwich that emits light when electrical current is flowed through it. Light emission happens at low temperatures, voltages, and currents. This makes them both highly efficient and long lasting. LEDs are now available as replacements in all areas of the aircraft as explained later in this guide.

The latest generation of full-spectrum LED lights allow the user to select different colors. This is accomplished by mixing the light of three different LEDs in the same way that television pixels are made of separate colors but interact to produce a single color from that one pixel.

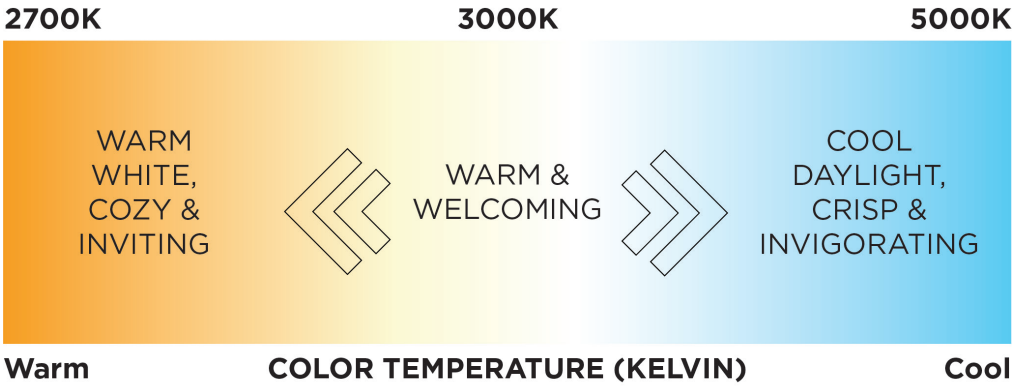


INTENSITY AND COLOR

Light breaks down into two physical properties: intensity and color. To avoid confusion, engineers and designers developed two scales that have been widely adopted to describe these attributes. The

term lumens measures light intensity. A typical 60W home bulb produces around 700 lumens. Intensity is measured using the Kelvin scale, and its unit of measure is degrees. Samples of typical color ranges are contained in the chart below for reference.

When selecting materials for an interior refurbishment at the Duncan Aviation facility in Lincoln, Nebraska, you'll find our Design Center is equipped with a lighting booth. The booth lets you view the effects of various lights and colors on the materials being considered. Similar booths will soon be available at the Duncan Aviation Design Centers in Battle Creek, Michigan, and Provo, Utah.



WHY CONVERT TO LED?

One of the best reasons to convert to LEDs is the low cost of maintenance. LEDs also have longevity in their favor, operating for thousands of hours, and the diodes themselves are durable. LEDs are not susceptible to breakage as are glass bulbs and tubes. They produce less heat and are much more energy efficient than bulbs and tubes, too. The last important consideration is aesthetics. LEDs allow light color choices that are more in tune with materials selected for the cabin interior.

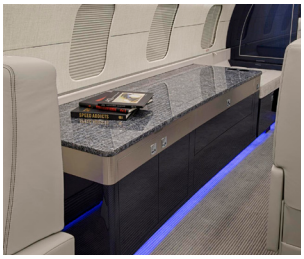
AIRCRAFT LIGHTING TYPES

Wash Lighting (Indirect Lighting)—as its name implies, wash lighting is lighting contained in the upper cabin sides that is cast onto a headliner or window-line. Wash or indirect lighting provides a light source that is more uniform and less harsh on the eyes than a light that shines directly.

Direct Lighting—is strip lighting that is built into the face of the PSU (Passenger Service Unit) or headliner. This light shines directly into the cabin through a frosted lens.

Reading and Table Lights—are small adjustable spot beam lights used at individual seats and tables. Their narrow focus illuminates a small area without disturbing those seated nearby. Often, you can simply replace the incandescent bulb needs with a compatible LED bulb. Other times, the entire fixture must be replaced.

Galley Lighting—is generally composed of small strips of lights designed to provide both lighting for work surfaces as well as aesthetic appeal. One example of this is backlighting an upper-galley area where glasses are stored to highlight the crystal's beauty.

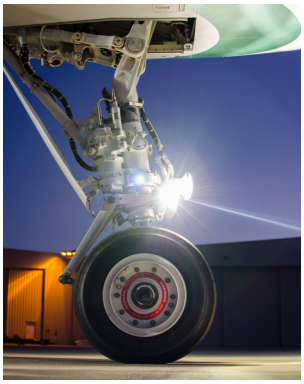


Dome Lights—are typically found in the entry, lavatories, and baggage compartment areas. They are centered in the headliner, providing overhead lighting for a particular area.

Floor (Accent) Lighting—is another type of indirect lighting mounted in the toe-kick areas of cabinets and along the bottom of the lower sidewall panels in the cabin.

Stair Lights—are mounted on the riser surface of the main entry door.

Emergency Lighting—When considering replacements for lights that are part of an emergency lighting system know that additional certification is required to demonstrate that the lights produce the proper lumens when operating on emergency battery power. Emergency lighting may include existing aisle lights, exit signs, and specific reading lights.



Exterior Lighting—There are a number of exterior aircraft lighting systems. Required lighting includes navigation (position) lights and anti-collision strobe or beacon lights. Other common exterior lighting includes landing lights, taxi lights, logo lights, and pylon (for baggage load area). In addition to LEDs, HID (High Intensity Discharge) lights are another option available for landing and taxi lights.

FLUORESCENT REPLACEMENT

Most legacy aircraft were outfitted with fluorescent tube lighting in the cabins, galleys, and lavatories. These systems use a high-voltage power supply to power the actual fluorescent tubes. LED manufacturers offer both ballasted and non-ballasted replacement options. In ballasted LED replacements, you're retaining the older power supply in your aircraft. Although this is a less expensive and less time-consuming upgrade, the old power supply is subject to failure.

We recommend removing and replacing the old ballasts completely, so you have one less point of potential failure.

Upgrading to lighting that doesn't rely on a ballast may require installing dimmer modules and additional wiring. This option is costlier to install, but it produces the most reliable system overall. Cabin interfaces must also be evaluated to ensure that the lighting system is compatible with the system controlling it. In most cases, it isn't necessary to replace all of the existing wiring to achieve the desired system.

FOCUS ON THE CABIN EXPERIENCE

With regard to the interior, it is clear that light plays the single most important role. Master oil painters often work at the same time each day to capture the same light for that reason. It is also true that your sense of a color will depend largely on the temperature of the light cast on it. Traditional business aircraft interiors with earth-tone materials are most suited to warm (more yellow) light sources. Interiors where grays and whites prevail are better suited to cooler (truer white) colors.

MOOD (Multicolor) LIGHTING

Mood (aka multicolor) lighting is an option for those who want more than one color. As its name implies, different colors produce a different experience. A red, dimmed light is ideal for a sleeping cabin. It shines enough light to allow passengers to make their way to the lav without disturbing anyone. For that reason, multicolor LEDs are commonly used at the galley so flight attendants can work without casting a harsh white light into a sleeping cabin. Mood lighting should be wash lighting as opposed to direct lighting.

Ideally, any color presets should match the needs of the passengers (sleeping, for example) or match the light being cast through the windows from the sun. Yellow light at dawn, white light at midday, and a yellow orange at sunset. Blue is a nice color choice for night flying.




CMS INTERFACE AND DIMMING

The degree to which the lights and CMS (Cabin Management System) are integrated determines how well and how easily you can control the lights. The recommended interface is variable voltage/resistance or a digital interface. Older CMSes generally control the lighting with an analog method and are often limited to step-dimming. An example of step dimming is pushing a button to turn the light to full bright and pushing another to dim the lights to 50% brightness. An example of variable dimming is when you push an on/off button to turn the light to full bright and press and hold a button to raise the lighting brightness. Variable-dimming capabilities are dependent on the type of lighting system and the CMS you have.

With older lighting control systems, such as blind or step systems, you get no feedback and no precision control. That means you're simply turning up the lights or dimming them, without seeing any kind of a meter or gauge.

Newer CMSes and lights are often digitally controlled, proving a greater level of precision control. An example of a digital control is pushing a button on a touchscreen for full bright and using a slider bar for variable dimming. A digital control with a newer CMS will also provide full color-changing capabilities for the LEDs. Another advantage of a newer CMS is that you're able to fully integrate control of the lights wirelessly through the same personal electronic device, such as a smartphone or iPad, that you use to control seats, window shades, and the entertainment system.

PRESETS

New CMSes with a digital lighting interface often let you create presets. Preset modes will turn on lights in the cabin to whatever level of brightness, color, or dimness that corresponds to the various times of day or phases of outside light/dark. Examples of preset modes for lights are Boarding Day, Boarding Night, Sleep, and Theatre. You can activate a preset mode by pushing a button on a touchscreen display or wireless device.

INTERIOR MODIFICATIONS

New LEDs often fit into existing spaces, but not always. Interior modifications to accommodate new lighting can be expensive. Mood lighting is often larger and mounts differently than existing indirect lighting systems. Similarly, new LED fixtures are typically a different size than the fixtures for incandescent or fluorescent bulbs. We recommend that you fully consider the extent of interior modifications necessary when opting for a new lighting system.

FUTURE LIGHTING TECHNOLOGIES

New lighting technologies are being developed all the time. Lights made of flexible film are being developed for use in areas where a flat surface is not available. Specific types of UV (ultraviolet) light are being used for Li-Fi (Light Fidelity). Li-Fi is a bidirectional wireless system that transmits data via LED, visible, and infrared light spectrums. Look for these and other new lighting technologies to become available for the aircraft cabin in the years to come.

LIGHTING MANUFACTURERS

Below is a list of current lighting manufacturers with systems and upgrades certified for business aircraft, along with their specialties.

Aircraft Lighting International (ALI)–Cabin lighting (wash, mood, floor, reading/table/dome LED bulbs). Both direct replacements and new wiring options

Collins—Cabin lighting. Wash, mood, floor, reading/table, dome. Both direct replacements and new wiring options

Prizm—Cabin lighting. Wash, mood, floor

PWI—Cabin lighting

DPI—Cabin lighting. Wash, reading/table, dome

Heads up Technologies—Cabin lighting

Whelen—Exterior lighting. LED and HID

Talon Aerospace—Exterior lighting. LED

ACRONYMS AND DEFINITIONS

Ballast—Device needed with fluorescent lighting. The ballast regulates the current and provides the voltage needed to start the lamp. Ballasts are not needed with LED lights and are typically removed.

Beam Angle—Angle at which the light is distributed from the source. A spotlight will have a narrow beam angle while a flood light will have a wider beam angle.

Direct Lighting—Lighting that points directly into the cabin or a particular spot.

Emergency Lighting—Lights the cabin so you can find your way out during an emergency. The emergency lighting must be able to operate independent of the main lighting system and in the event of an interruption of normal aircraft power.

Fluorescent Lamp—Sealed glass tube lighting with phosphor powder coating on the inside of the lamp. Fluorescent lamps are generally used for wash or indirect lighting in the aircraft.

HID—High Intensity Discharge lights function by producing an electrical arc between two tungsten electrodes within a quartz tube. The light produced is very cool and bright and is an available option for some landing and taxi lights.

Incandescent Lighting—Light is produced as a result of heating a conductor in a light bulb. Incandescent bulbs are generally found in reading/table and dome lights.

Indirect Lighting—Lighting that is hidden behind a panel or recessed area and is directed to a surface the light bounces off, creating a softer, illuminating effect.

Intensity—Amount of light produced by a lamp.

Kelvin—Scale used to measure the color temperature of a light. Typical range is 2000K (warm) to 6000K (cool).

LED—Light Emitting Diode

Lumens—Measure of light intensity or brightness of a lamp.

Lunele Lighting—Direct lighting, typically long tube type, behind a lens in the headliner or PSU (Passenger Service Unit).

Li-Fi (Light Fidelity)—Lighting system capable of transmitting data. This is an emerging technology.

Mood Lighting—Full-spectrum, color-changing lighting that's used to create a specific mood or ambience in the cabin.

AUTHORS

Adrian Chene
Avionics Sales Representative
Direct: +1 269.565.3561
Mobile: +1 269.589.3180
Email: Adrian.Chene@DuncanAviation.com

Dennis Kruse
Avionics Senior Sales Rep
Direct: +1 801.342.5588
Mobile: +1 402.309.3246
Email: Dennis.Kruse@DuncanAviation.com

Steve Elofson
Avionics Senior Sales Rep
Direct: +1 402.479.1603
Mobile: +1 402.416.6311
Email: Steve.Elofson@DuncanAviation.com

