EXTERNAL NVG FRIENDLY AND COVERT LIGHTING FOR HELICOPTERS

LFD LIMITED

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COMMERICIAL IN CONFIDENCE

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EXECUTIVE SUMMERY

1, The LFD exterior lighting system is based on proven and qualified technology already in operation with many customers. This offers the opportunity to procure and install a system with little or no risk.

2, Drawings, specifications and tooling are available.

3, The supportability is enhanced with the use of state of the art highly reliable LEDs in service with many customers.

4, Over 10,000 various lighting products delivered with proven combat reliability.

5, LFD is ISO approved and highly focused in external NVIS aircraft lighting equipment with many years of knowledge in its area of business.

6, To our knowledge, LFD are the first company in the world to have visible diode position lights successfully flight tested (1995).

7, Patented Drive/Control System for aircraft external warning lights.

8, LFD have now fitted more and a wider range of aircraft than any other company. As pioneers of LED aircraft lighting technology the company has a greater length, span and depth of experience in this field than anyone else in the business.

9, LFD are specialists and world leaders in the design of visible and infra-red aircraft lighting.

INTRODUCTION

LFD have been developing and supplying Covert/Visible LED navigation lighting to military customers since 1990. We have a thorough understanding of the environmental, thermal, optical and mechanical conditions which ultimately effect the design and mounting of diode lighting. LFD pioneered the use of LEDs for NVG compatibility in the airborne role, initially on the UK and Italian Tornado aircraft. Our expertise in LED technology has led to, amongst others, the following aircraft modifications:-

TORNADO GR4/F3	**ITALIAN MOD**
EF18	**SPANISH AIR FORCE**
LYNX	**VARIOUS**
CHINOOK	**VARIOUS**
MB339	**ITALIAN AIR FORCE**
B105	**SWEDISH AIR FORCE**
MD500	**FINNISH AIR FORCE**
SEAKING	**GERMAN NAVY**
AW101	**VARIOUS**
EC120	**SINGAPORE A/F**
AB212	**SPAIN**
SUPER PUMA	**SPAIN**
AW189	**VARIOUS**

LED Technology

We have several LED technologies available in house to implement in equipment design and conversion of existing incandescent light assemblies. Our two main technologies are:-

1, LED substrate arrays. These are manufactured using high density chip placement and wire bonding. This type of array uses InGaN and AlInGaP chip stock which is bonded to a ceramic substrate. Infra-red chips are also placed in the die array to give dual mode capability. This type of array is used to produce red and green lighting.

2, Packaged devices. LFD also uses this type of device in many of its tail light solutions. Surface mounted packages are mounted on a similar substrate to the chip devices described above. They are supplied with a molded glass lens which provides a predictable preset distribution pattern. This type of array is used to produce white light.

Qualification Testing

We have a fully equipped darkroom on site at our facility with traceable standards for measuring chromaticity, spectral radiance and intensity.
These instruments are also portable which gives LFD the ability to conduct pre-modification surveys of lighting equipment and post-modification trials.

For environmental, vibration, shock and acceleration testing we use the facilities of Cape Engineering or TUV. Both have state of the art facilities and expertly trained personnel, combined with many years experience serving the defence, aerospace, telecoms, automotive, energy, I.T, rail and commercial industries.

SOLUTIONS

Dual Mode Left and Right Navigation Lights

The side position light assemblies are as shown in Fig 1. The supply voltage will be from the control box and the light is fully compliant to FAA requirements for colour, intensity and distribution and MIL-3009. The emitted light is Aviation Red or Green.

Figure 1. Left and Right Navigation Light

Dual Mode Rear Navigation Light

The tail lamp assembly is as shown in Fig 2. The supply voltage will be from the control box and the light is fully compliant to FAA requirements for colour intensity and distribution and MIL-3009. The emitted light is Aviation White.

Figure 2. Rear Navigation Light

Formation Light

The formation light assembly is as shown in Fig 3. The supply voltage will be from the control box and the light is fully compliant to MIL-STD-3009. The emitted light is infra-red.

Figure 3. Formation Light

Dual Mode LED Anti-collision Light

The Anti-collision light assemblies can be either of those Fig 4 or Fig 4a. The advantage of Fig 4, being the higher intensity. The supply voltage will be 28V and the lights are fully compliant to MIL-STD-3009. The emitted light is NVG friendly and Infra-Red.

Figure 4. Dual Mode LED Anti-collision Light (400ECP Version)

Dual Mode LED Anti-collision Light

Figure 4a. Dual Mode LED Anti-collision Light (150ECP Version)

Navigation Lights – Spectral Output

Fig 5. is the spectral output of a red LED and Fig 6. is the CIE plot showing that the colour produced meets the Aviation Red requirements.

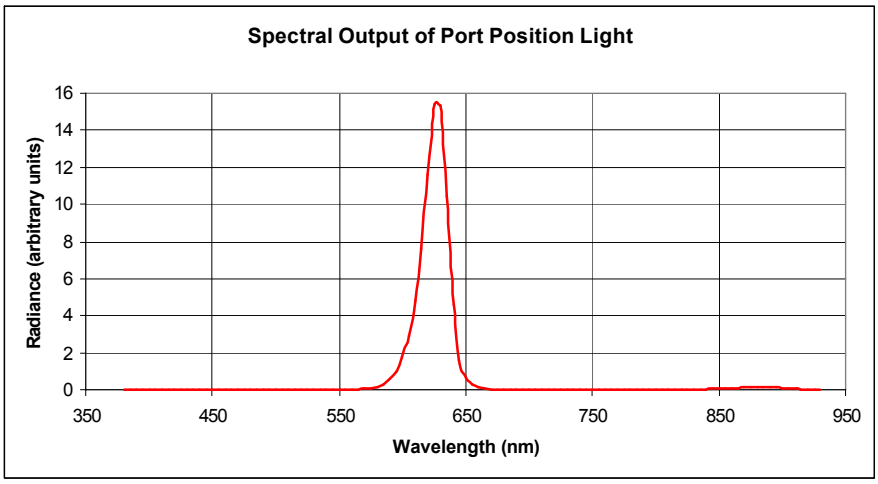


Figure 5. Port Position Light – Spectral Output

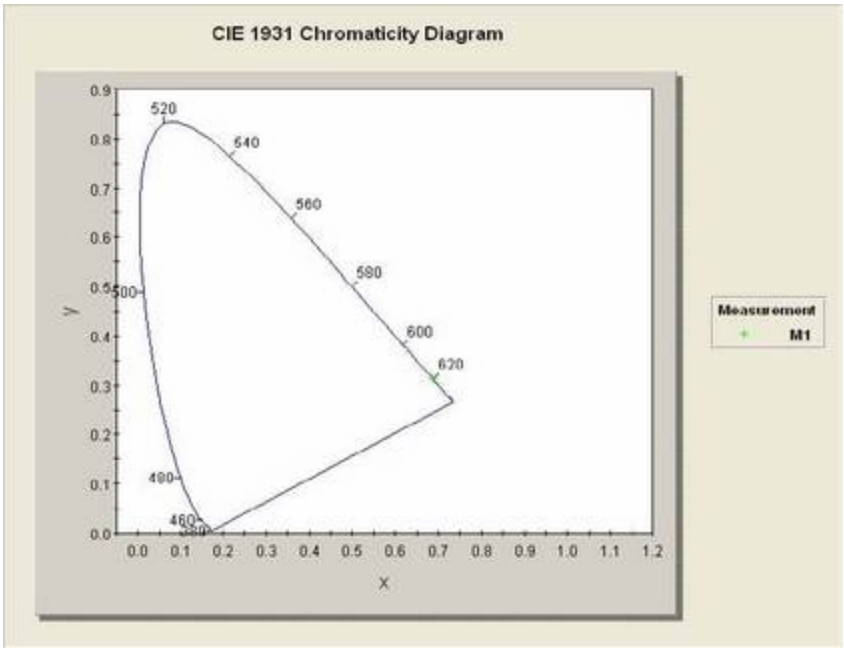


Figure 6. Port Position Light - Chromaticity

Fig 7. is the spectral output of a green LED and Fig 8. is the CIE plot showing that the colour produced meets the aviation green requirements.

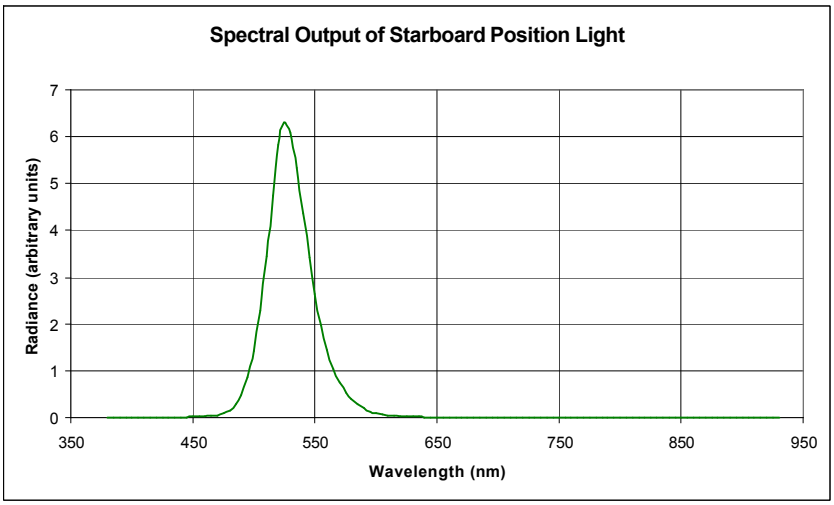


Figure 7. Starboard Position Light – Spectral Output

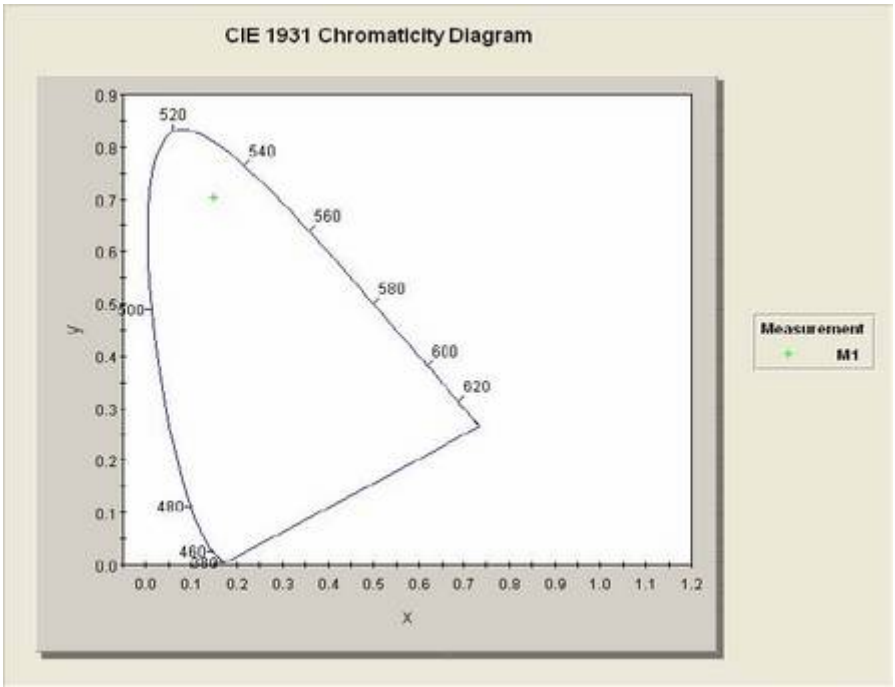


Figure 8. Starboard Position Light - Chromaticity

Fig 9. is the spectral output of a white LED and Fig 10. is the CIE plot showing that the colour produced meets the aviation white requirements.

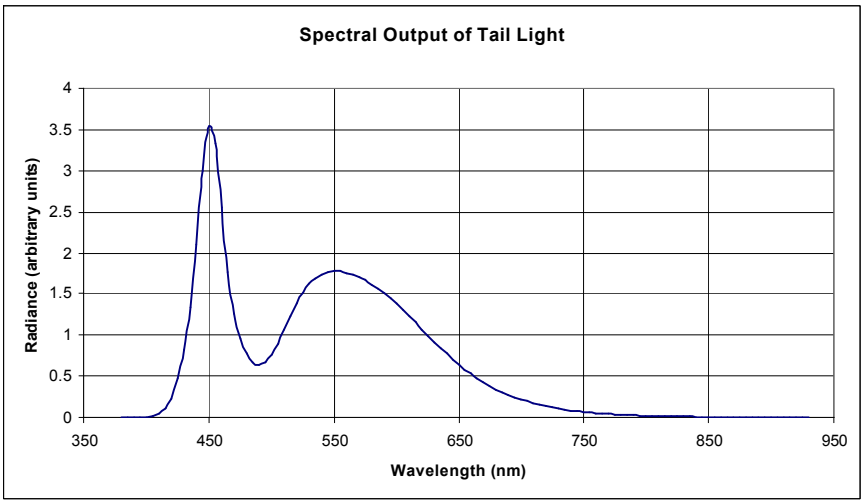


Figure 9. Tail Light – Spectral Output

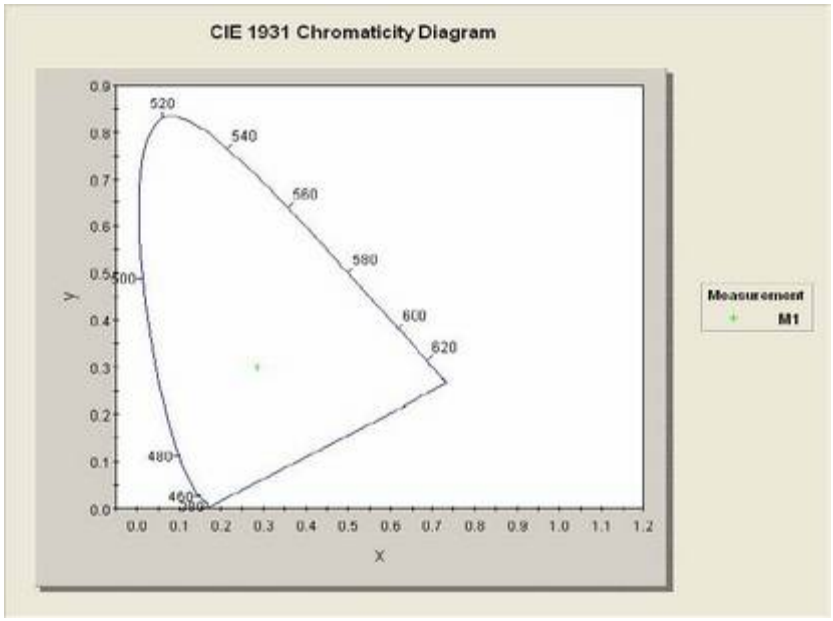


Figure 10.Tail Light - Chromaticity

Intensity distribution measurements were carried out with a photometer optimized for use with LED sources.
Spectral measurements were performed using a Bentham dual monochromator spectroradiometer, permitting NVIS Radiance and chromaticity to be calculated as follows:

	NR_A	**NR_B**	**I3**	**I3W**	**u´**	**v´**	**x**	**y**
Green	2.25E-10	1.48E-10	318	193	.0516	.5571	.1368	.6563
Red	8.05E-8	1.05E-8	2.3	14.1	.5135	.5229	.6883	.3115
White	1.79E-8	1.17E-8	3.7	4.9	.2035	.4675	.3177	.3260

NAVIGATION LIGHTS – VISIBLE INTENSITY DISTRIBUTION

LFD lighting assemblies meet and exceed the FAR Part 25 (FAA) requirements for intensity and distribution as shown in Figs 11-16 and 17-19.

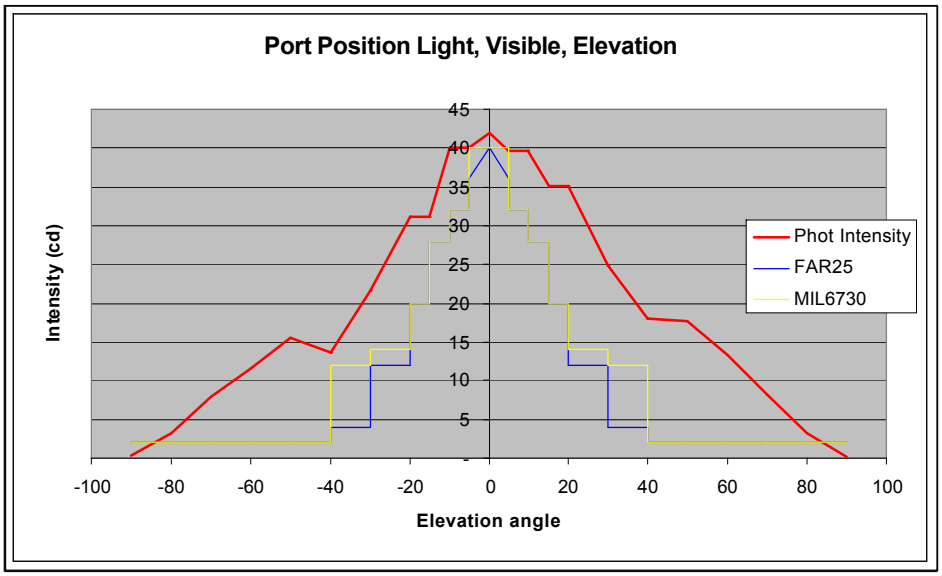


Figure 11. Port Position Light – Visible, Elevation

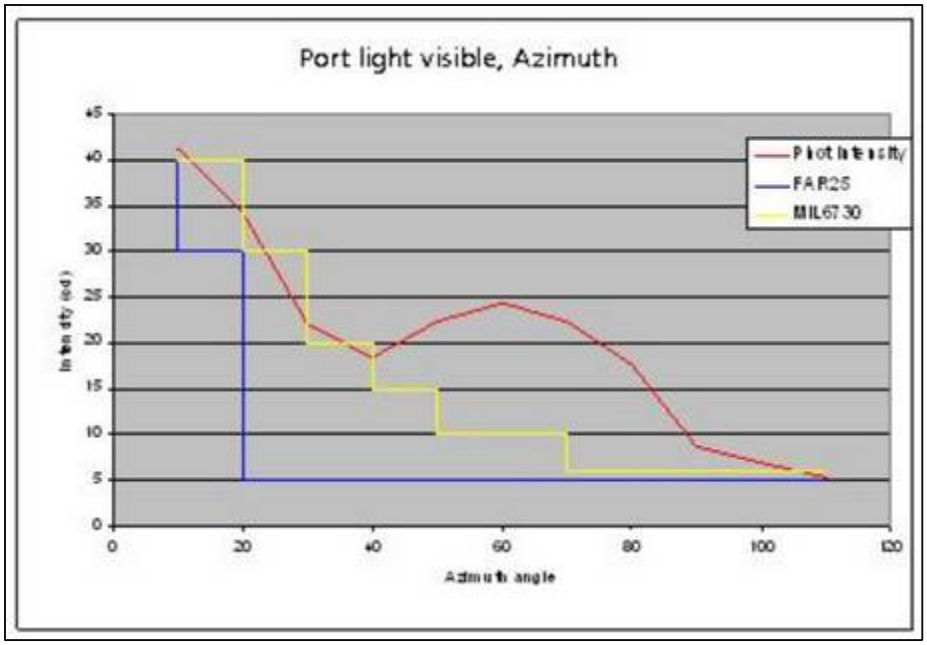


Figure 12. Port Position Light – Visible, Azimuth

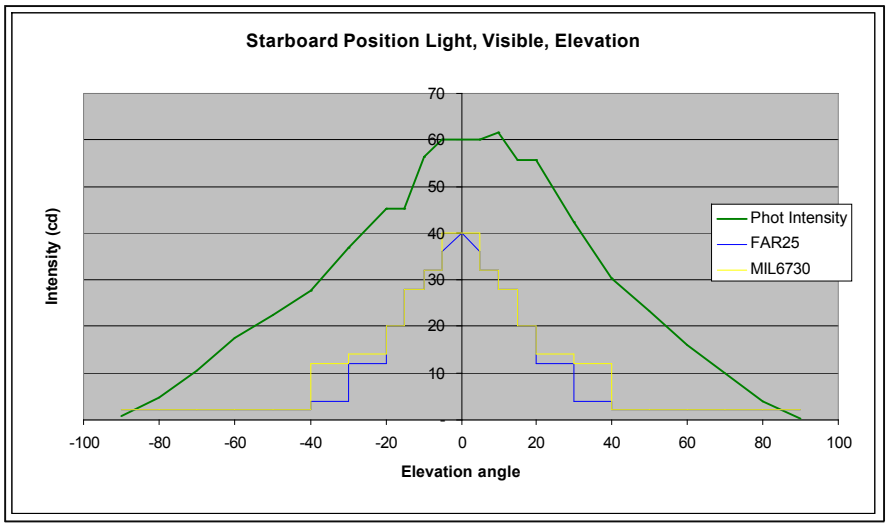


Figure 13. Starboard Position Light – Visible, Elevation

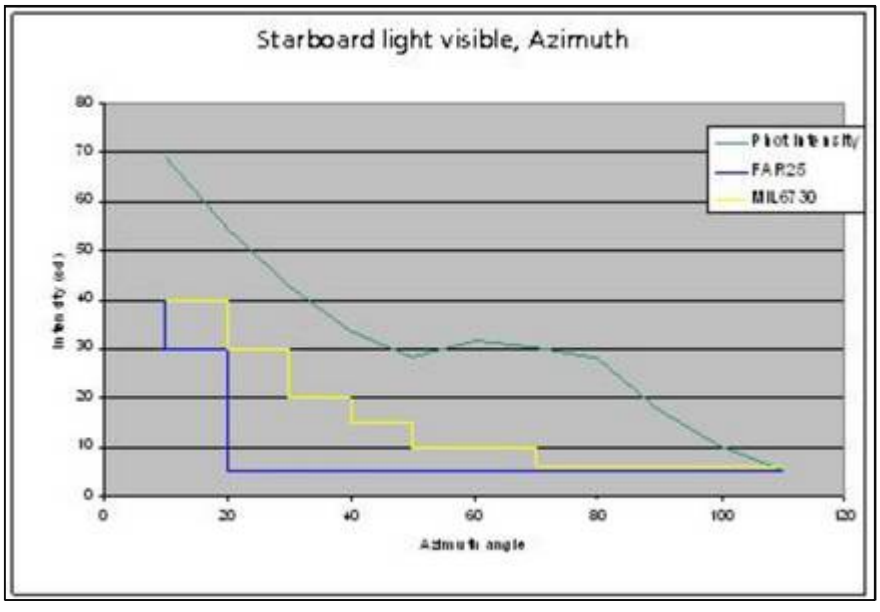


Figure 14. Starboard Position Light – Visible, Azimuth

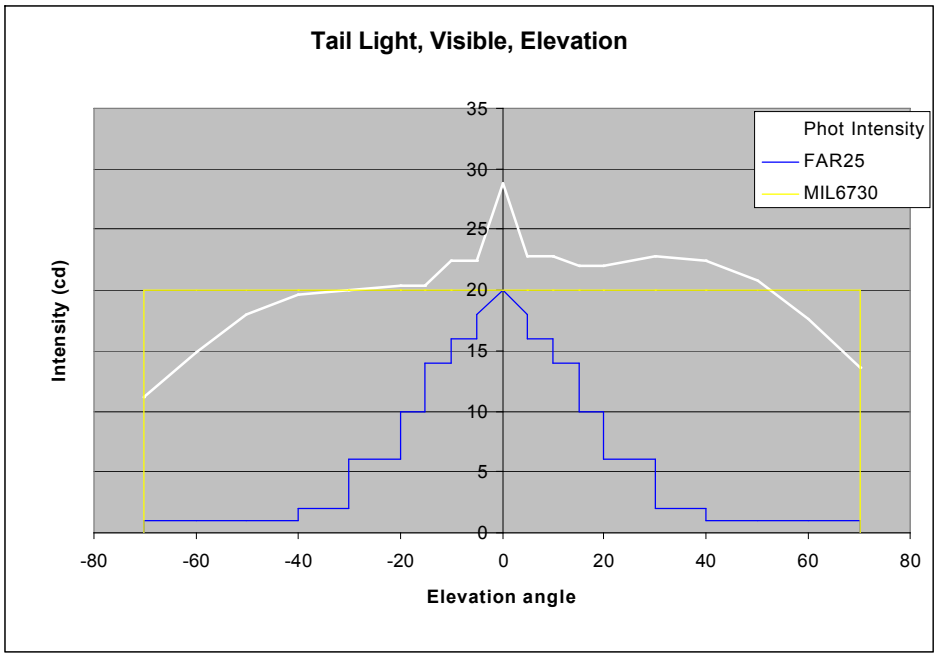


Figure 15. Tail Light – Visible, Elevation

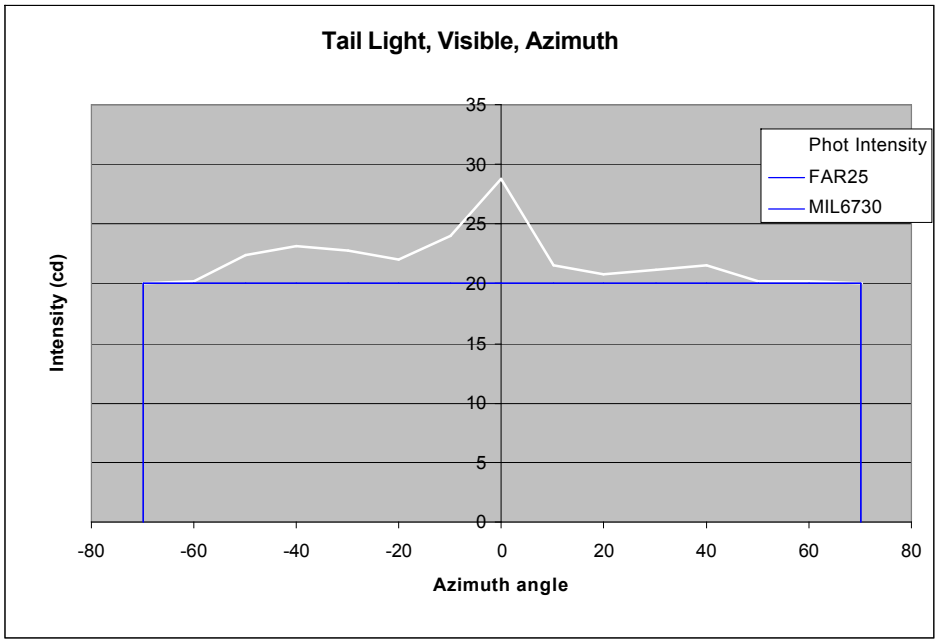


Figure 16. Tail Light – Visible, Azimuth

Figure 17. Visible Intensity Distribution

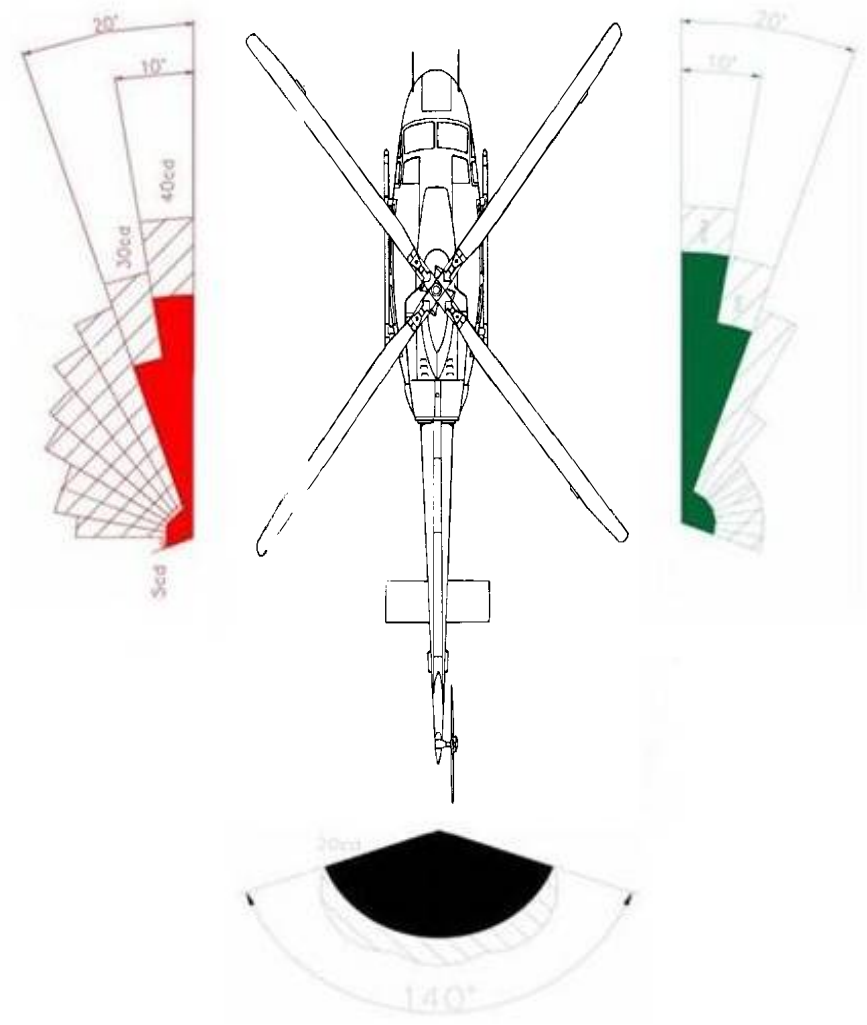


Figure 18. Infra-Red Distribution

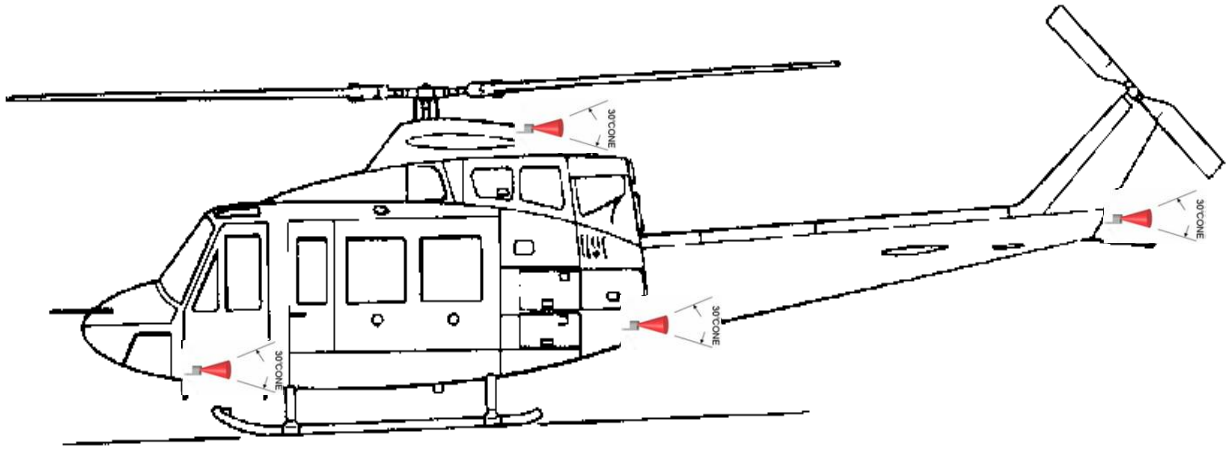
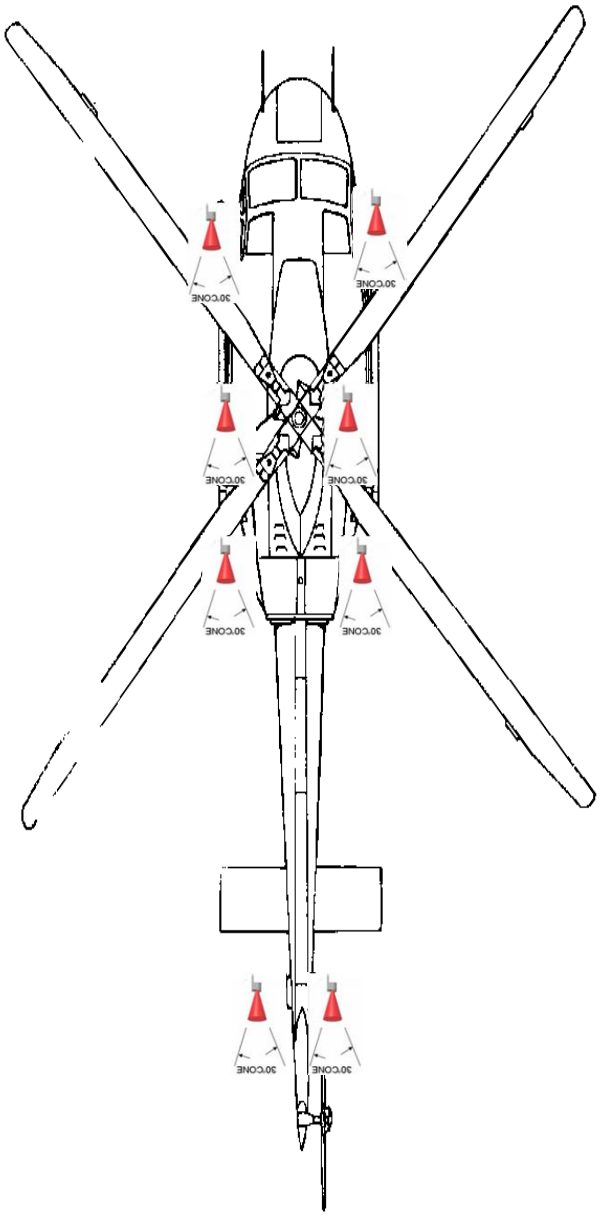


Figure 19. Infra-Red Distribution



Lighting Control Box

The Control Unit provides the means to switch between Visible and Covert modes of the exterior lighting system, without the need to rewire the aircraft. As well as enabling switching between Bright and Dim settings and Steady and Flashing modes. It takes inputs from the cockpit control panel and converts to appropriate outputs to drive the lights as required.

Figure 20. Remote Located Lighting Control Box

Figure 21. Typical Cockpit Rail Mounted Lighting Control Box

Above is a typical rail mounted control box supplied by LFD. If the customer wishes to retain the current lighting panel this will need to be discussed with the supplier to integrate the required switching.