OCCUPATIONAL HEALTH CONSIDERATIONS IN THE ADOPTION OF THE IMPROVED UNDERGROUND WORKFACE VISIBILITY LEADING PRACTICE

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Basic Evolution of Artificial Illumination / Lighting

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- Various studies suggest that good workplace illumination / lighting pays dividends in terms of improved productivity, and a reduction in errors
- Illuminated workplaces also allow the human eye to discern objects, forms, colours and identify potential hazards
- The Occupational Health benefits associated with the Improved Underground Workface Visibility Leading Practice includes:
  - Alignment of the circadian rhythm of the human body
  - Decreased incidence of the development of headaches
  - Increased productivity and human performance
  - Decreased levels of stress and anxiety
  - Low stroboscopic effect risk
  - Reduced heat emission from Light Emitting Diode (LED) luminaries / lights
  - Improved longevity of LED luminaries / lights, when compared to conventional luminaries / lights

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- **Occupational Health aspects to be considered when installing luminaries / lights in the underground workface areas, includes:**
  - **Placement of luminaries / lights:**
    - ✓ **The placement of luminaries play a key role in the quality and quantity of illumination, with the following aspects to be considered:**
      - ❑ **Avoidance of direct glare**
      - ❑ **Avoidance of reflective glare**
      - ❑ **Avoidance of shadows on the workface**
      - ❑ **Dark adaptation considerations**
  - **Maintenance of luminaries / lights:**
    - ✓ **Cleaning of luminaries / lights**
    - ✓ **Replacement of non-functional or damaged luminaries /lights**
  - **Intrinsic Safety of luminaries / lights:**
    - ✓ **The Intrinsic safety requirements (IP-65 rating) / flame proof enclosure requirements of the luminaries / lights to be installed should be appropriate to the workplace risk (Fiery Mines, Flammable gas intersection risk, etc.)**
  - **Colour temperature range of the luminaries / lights:**
    - ✓ **The colour temperature is measured on a color temperature scale using Kelvin (K), ranges from 1,000K up to 10,000k and is sometimes loosely referred to as “warm white’ and/or “cool white”**

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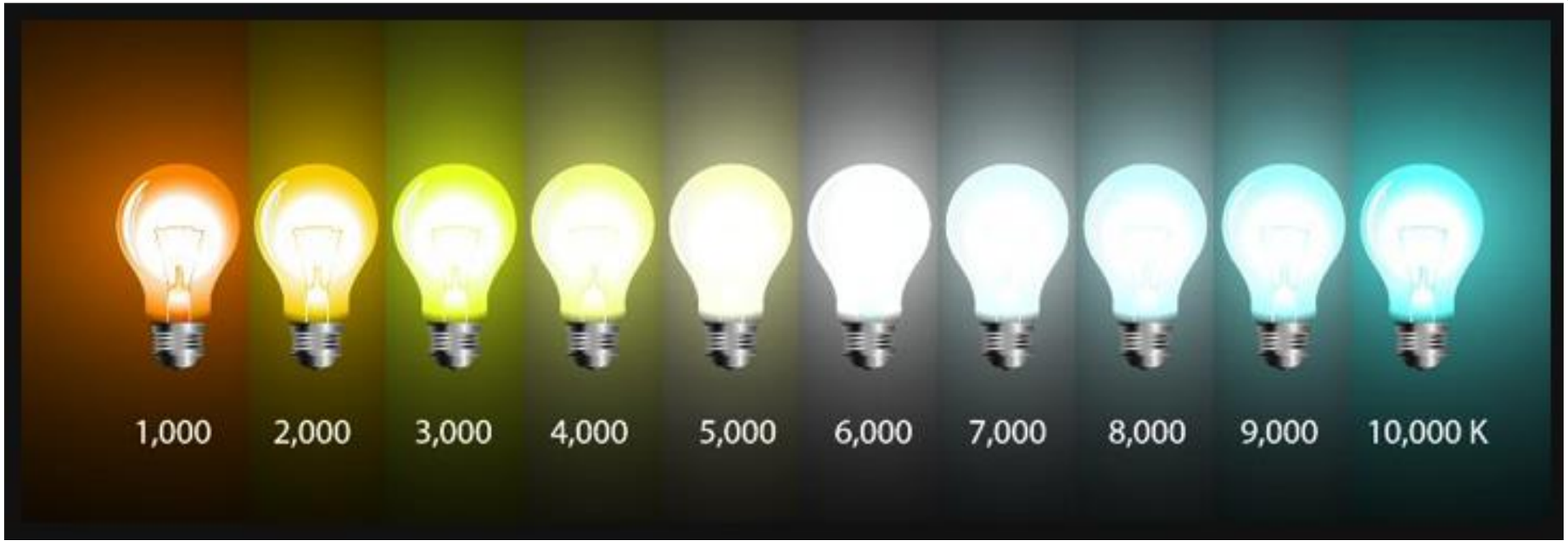

DOES THE COLOR TEMPERATURE OF A LIGHT REALLY MATTER?

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- **Occupational Health aspects to be considered when installing luminaries / lights in the underground workface areas, includes (Continued):**
  - **Colour temperature considerations for luminaries / lights on the workface:**
    - ✓ **The suggested colour temperature for underground workfaces would be in the 2700K to 3500K range, with the following documented benefits:**
      - **2700K would provide for a warm and inviting feeling and is easy on the eyes**
      - **3000K would be most suitable for clarity when completing work tasks and is easy on the eyes**
      - **3500K would be most suitable for workspaces which require alertness and is easy on the eyes**
    - ✓ **The American Medical Association (AMA) previously reported the following on exposure to light sources emitting light in the high-energy blue and violet end of the visible light spectrum:**
      - **Life-long exposure of the retina and lens to light with a blue peak can increase the risk of cataract and age-related macular degeneration**
      - **Exposure to light with a blue peak in its emission spectrum may have a harmful effect on our health because the blue light suppresses the production of melatonin**
      - **One of the functions of melatonin is to synchronize the biological clock of the human body. This prepares our body for sleep, triggering a series of physiological responses that regulate various bodily functions at night, including body temperature, blood pressure and the secretion of digestive enzymes**

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- **Occupational Health aspects to be considered when installing luminaries / lights in the underground workface areas, includes (Continued):**

✓ **Considerations on the assessment of illumination / lighting in Underground Workfaces:**

- **Establishment of a minimum illumination level standard:**
  - Too little light can lead to eyestrain and headaches, too much light can result in glare
  - Based on existing standards, a minimum illumination level of 20lux is recommended where Underground Workface lighting is installed, but should be risk-based on the activities performed
- **Illumination measurement procedure:**
  - Measurement positions to be defined (footwall, sidewall, equipment, etc.)
  - Measurement orientation to be defined (Horizontal or Vertical orientation of the photocell sensor)
  - Number of measurements required to be defined, to ensure the representativeness of the results
  - Frequency of workface illumination measurements / surveys to be defined
- **Correct Instrumentation:**
  - Illumination is measured with a Luxmeter
  - A luxmeter contains a Calibrated Cosine Colour-Corrected Photometer which converts the light intensity of luminaries/ lights into a measurement result
  - Calibration of the Luxmeter, as required / specified by the manufacturer of the instrument
  - Luxmeters have historically not been corrected for the measurement of LED lighting and therefore a LED Luxmeter is required for LED luminaries / lighting illumination measurements

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The integrated meters are available in ranges of LUX (0-20 000 LUX for LEDLUX meter and 0-200 000 for LEDLUX probe)

Your measurement solution for LED lighting

The LEDLUX is an illuminance meter specifically calibrated for high accuracy measurement of LED lighting.

Guaranteed performance for white LEDs with colour temperature from 2700k to 6500k.

The instrument is issued with a Certificate of Conformance.

An accredited certificate endorsed by an ISO 17025 lab is available as an option.

All the usual features of quality of the Conventional light meter aslo apply to the LEDLUX.

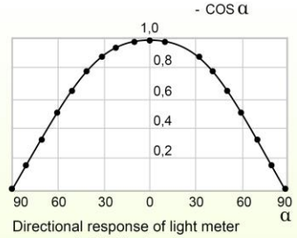
- Stability
- Linearity
- Digital display
- Measuring range & resolution
- 1 Year manufacturers guarantee

Features

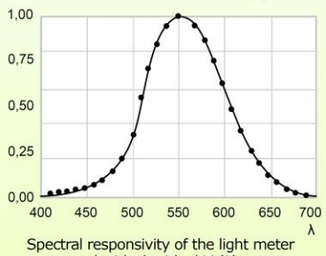
- Robust, lightweight, hand-held dedicated unit
- Excellent stability over extended time periods
- Excellent linearity
- Wide measurement range of illuminance
- Digital display
- Hold function on meters and readout units
- Powered by single, replaceable battery
- Standard with calibration certificate, legal backing for measurements
- One year manufacturers guarantee

Specifications

Measuring functions:	Illuminance (LUX)
Measuring range:	0-20 000 LUX or 0-200 000LUX depending on instrument model
Accuracy:	3% uncertainty and better
Readout:	4½ digit LCD display
Temperature range:	0 to 50ºC
Hold function:	Hold button
Power source:	One PP3 9V battery, preferably alkaline.
Battery life:	Approximately 180 hours for alkaline battery
Dimensions:	150 x 80 x 35 mm (basic unit)
Mass:	Display unit: 220 g (with battery) Probe: 85g
Accessories:	Plug-in remote detectors (probes), packing case, instruction manual.
Calibration:	Certificate of Conformance.



Directional response of light meter compared with ideal cosine response



Spectral responsivity of the light meter compared with the ideal V (λ) curve

Parameter	Symbol	Value
V (λ) match	f'_1	<3%
UV response	u	<0,1%
IR response	r	<0,1%
Cosine response	f_2	<1,5%
Linearity error	f_3	<0,1%
Error of display unit	f_4	<0,1%
Temperature coefficient	(T2=5°C)	<-0,2%/°C
Fatigue	f_5	<0,1%
Modulated radiation	f_7	<0,1%
Polarization	f_8	<0,1%
Range change	f_{11}	<0,1%
Crest factor	c	<2
Lower frequency limit	f_1	<40 Hz
Upper frequency limit	f_u	>50 kHz

Quality parameters, as recommended by the International Commission of Illumination (CIE)*

*(CIE) Publication No 69 (1987) "Methods of characterising illuminance and luminance meters."

Accessories: Instruction manual, protective cover for detector, carry pouch (optional).

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THANK YOU

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