Future looks bright for LEDs

By D Kasper, BEKA

The lighting industry's need for proper international standards or local standards to ensure the safety and measure the performance of LED products is obvious. As products are being introduced rapidly, new standards are required.

Public policies, environmental and energy saving concerns are driving the local trend towards energy-efficient lighting. Light Emitting Diodes (LEDs), or solid-state lighting solutions, are becoming more and more popular, owing to their excellent levels of performance and rapidly falling prices.

Manufacturers claim that the standardisation of performance requirements is an important first step towards fair comparison of luminaires. Amongst the many quality criteria to be considered when evaluating these claims, the upcoming performance standard document lists the following:

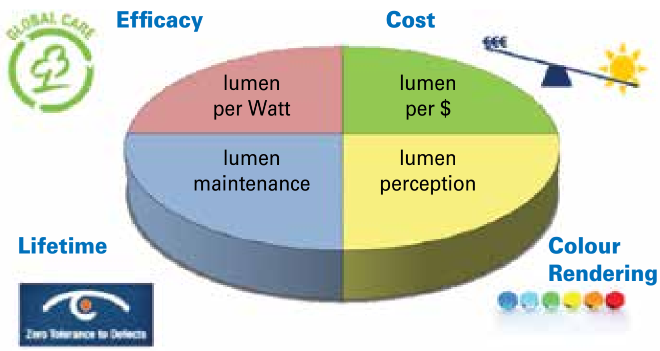
- Rated input power (expressed in watts); that is, the amount of energy consumed by a luminaire, including its power supply
- Rated luminous flux (expressed in lumens), which corresponds to the light emitted by the luminaire
- LED luminaire efficacy (expressed in lumens per watt), which measures the initial luminous flux of a luminaire divided by its initial input power
- Photometric code, which includes rates for colour temperature, colour rendering and chromaticity
- Rated life of the LED module

Some of these parameters, rated life in particular, are difficult to measure accurately as the technology is relatively new and the lifetime of LED products is expected to be much longer than that of other types of lighting systems.

LED performance update

The LED market is showing highly dynamic development, particularly in the areas of general lighting. Leading market researchers continue to predict double-figure growth rates for this technology. Continuous investments in the technology and quality lead to higher energy efficiency and lifetime reducing energy costs and maintenance. LED technology still holds a great deal of potential in terms of efficiency. It is still a young technology and records are continuously being broken. In the process, LEDs are steadily becoming the standard lamp solution in numerous fields of application.

- Efficacy: The LED efficacy will reach values of 200 lm/W within the next few years for commercially available LEDs. Calculations hold that values of even 300 lm/W could be achieved.
- Cost: LED prices - especially the system costs of outdoor luminaires - are reducing by 20 - 30% each year. This trend will continue until the system costs are lower than those of conventional luminaires
- Lifetime: The lifetime of certain commercially available LEDs has increased substantially. Where claims of 50 000 hours were the norm one to two years ago, the suppliers predict a lifetime of up to 100 000 hours and higher. These claims today are proven by independent laboratories applying international standards.
- Lumen perception: The easy adaptation of the spectral distribution of LEDs offers great variety in different colour recognition indices (CRI). This will be utilised in the near future to optimise the perception of light in various applications, such as the food industry and offices.



Approved recommended practice (ARP 035 [1])

The SABS guideline for the installation and maintenance of street lighting has been recently revised and redrafted to include LED technology and give some guidance as to how to apply this technology correctly when comparing and evaluating predominantly outdoor lighting installations. The following tables give guidance on new and existing installations, emphasising that light sources should not be compared by the lumen value.

Abbreviations

CRI – Colour Recognition Index/ Indices

LED – Light Emitting Diode

SABS – South African Bureau of Standards

1	2	3	4
Type of luminaire and lamp type	Unit	Item 1	Item 2
		250 W HPSE/SE	LED
Design criteria			
Lighting category		A3	A3
Arrangement		Single sided left	
Lanes per carriageway		2	
Width of each lane	m	3,7	
Mounting height	m	10	
Overhang of left hand side	m	1	
Lamp lumen depreciation factor		0,8	
Dirt depreciation factor			
for IP 6: 0,83*0,90		0,75	
for IP 5: 0,76*0,90		0,68	
Traffic volume for road without median	vehicles per hour per lane	300	
Luminance	cd/m²	0,6	
Overall uniformity	Uo	0,4	
Longitudinal uniformity	UL	0,5	
Threshold increment	%	20	

Design results			
System Wattage, per luminaire	W		
Light source lumen	lm	27 000	
Angle of tilt	degrees		
Pole spacing	m		
Luminance	cd/m²		
Overall uniformity	Uo		
Longitudinal uniformity	UL		
Threshold increment	%		

Price schedule, based on the following given criteria and costs			
Number of years to be considered for evaluation	years	10	
Electricity Cost per kWh, averaged over the projected period	R	1,3	
Cost of installed pole, inclusive internal wiring	R	3 000	
Unit price of luminaire, inclusive of light source	R		
Scheme price: (1000/(2) * (5)+(6)	R		
Power consumption per km: (1000/(2))*(1/1000)	kW		
Annual Energy Cost per km, (4)*4000*(8)	R		

Cost of Ownership for the evaluation period: (7)+(3)*(9)	R		

*Note: * This evaluation excludes the maintenance costs, which could substantially influence the Cost of Ownership.*
** The shaded cells shall be adapted to the criteria of the customer.*
Values within grey shaded cells should be amended to user's requirements

Table 1: Tender form for design criteria, design results and price schedule: Group A - street lighting - new installations.

Please note: Values within grey shaded cells should be amended to user's requirements			
Type of luminaire and lamp type	Unit	Item 1	Item 2
		250 W HPSE/SE	LED
Design criteria			
Lighting category		A3	A3
Arrangement		Single sided left	
Lanes per carriageway		2	
Width of each lane	m	3,7	
Mounting height	m	10	
Overhang of left-hand side	m	1	
Existing Pole spacing	m	45	
Lamp Lumen Depreciation Factor		0,8	
Dirt depreciation factor			
for IP 6: 0,83*0,90		0,75	
for IP 5: 0,76*0,90		0,68	
Traffic volume for road without median	vehicles per hour per lane	300	
Luminance	cd/m²	0,6	
Overall uniformity	Uo	0,4	
Longitudinal uniformity	UL	0,5	
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Design results			
System Wattage, per luminaire	W		
Light source lumen	lm	27 000	
Angle of tilt	degrees		
Luminance	cd/m²		
Overall uniformity	Uo		
Longitudinal uniformity	UL		
Threshold increment	%		

Price schedule, based on the following given criteria and costs			
Number of years to be considered for evaluation	years	10	
Electricity Cost per kWh, averaged over the projected period	R	1,3	
Unit price of luminaire, inclusive of light source	R		
Annual energy cost per luminaire, as per formula: (1/1000)*4000*(3)	R		

Cost of Ownership for the evaluation period: (4)+(2)*(5)	R		

Table 2: Tender form for design criteria, design results and price schedule: Group A street lighting - existing installation.

Reference installations in South Africa

Most end-users seem to expect and assume that the LED technology is in its infant stage and not yet ready for roll-out lighting installations in the public domain. Global sales statistics, however, show the opposite. In North America, Europe and Asia, hundreds of thousands of LED light points are illuminating the outdoor environment with very high energy savings of 70 - 80%. Further cost savings, such as reduced maintenance, are further reasons to switch to LED technology. In South Africa various installations have been installed for a couple of years and prove the concept of benefit to the end-user. *Table 3* illustrates this in more detail.

Province	Number of street light points
Eastern Cape	360
Free State	210
Gauteng	2060
KZN	6770
Western Cape	250

Table 3: Street light points in South Africa.

Performance SANS LED draft standard [2]

The IEC has prepared and published various safety and performance standards for LED-related control gear, lamps, modules, luminaires and products. Some of them can easily be adopted in South Africa and published as SANS documents. However, the performance IEC standards relating to LED luminaires cannot easily be adopted as not many international testing facilities - including our local testing facility - have the capacity and equipment to successfully and timeously conduct the required performance tests. The local lighting industry, consumer representatives and other key players have therefore founded a working group to address this and compose a local LED luminaire performance standard which will be soon available for public comment and published thereafter.

This locally developed draft standard - SANS 62612: 2013/ IEC 62612:2013) [2] - covers the performance requirements for solid state lighting products including interior lighting, street lighting and floodlighting. It covers LED-based products incorporating control electronics and heat sinks for operation on ac or dc voltage power supply. It describes the procedures to be followed and precautions to be observed in performing reproducible measurements of:

- Total luminous flux or efficiency matrices
- Electrical power
- Luminous intensity distribution and
- Colour temperature

Furthermore it describes procedures to be followed and the information that needs to be provided where lifetime claims of operational performance are made. This includes:

- Rated life (in h) of the LED product and the associated rated lumen maintenance (Lx)
- Junction reference points (ts) of LED product that corresponds to the rated life
- Performance ambient temperature (tq) for a luminaire
- Ambient temperature (ta) for a luminaire
- Endurance test

Each LED product will be issued with a final test report. This lists all significant data for each LED product tested together with the test results. The report lists all pertinent data concerning conditions of testing, type of equipment, LED products and reference standards. Items reported are:

- Date and testing agency
- Manufacturer's name and designation of LED product under test
- Measurement quantities measured (total luminous flux, luminous efficacy, chromaticity coordinates and/or nominal CCT and/ or CRI for white light products, input voltage (V), (clarify ac (frequency) or dc current (A)), power (W) and power factor of LED product
- Number of hours operated prior to measurement (0 h for rating new products)
- Total operating time of the product for measurements including stabilization
- Ambient temperature during measurement
- Orientation (burning position) of LED product during test
- Stabilisation time
- Photometric method of instrument used (spectroradiometer, sphere-spectroradiometer, or goniophotometer)
- Designation and type of reference standard used (wattage, lamp type, intensity distribution type- omni-directional/ directional) and its traceability
- Photometric measurement conditions (for sphere measurement, diameter of the sphere, 4ϖ or 2ϖ geometry. For goniophotometer, photometric distance)
- Measured total luminous flux [lm] (absolute) or reference luminous flux (state parameters) and total lm/input W
- Luminous intensity distribution (if applicable).
- Equipment used
- Deviation from standard operating procedures, if any
- Detailed results of tests, eg thermal, stress test.

Conclusion

The future looks bright for LEDs. Rapid improvement in economics, along with their fundamental technical advantages, will see them become the preferred option in almost all lighting niches – both indoor and outdoor. The LED lighting market is expected to grow by a compound rate of 20% each year until at least 2016, to reach market penetration in general lighting of well over 60% in most of the world's nations by 2020. Using the local reference street light installations and the availability of local performance standards shall assist local authorities to more easily adopt and drive confidence in the technology and increasing economies of scale.

References

[1] ARP 035:2005. Guidelines for the installation and maintenance of street lighting.

[2] SANS 62612: 2013/ IEC 62612:2013 (Draft South African Standard): Self-ballasted LED lamps for general lighting services with supply voltages >50 V – Performance requirements.

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