The Industry Committee for Emergency Lighting Ltd

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ICEL 1001 - The ICEL Scheme of Product and Authenticated Photometric Data Registration for Emergency lighting Luminaires and Conversion Modules

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Foreword - What is ICEL?

The Industry Committee for Emergency Lighting (ICEL) was originally formed in the UK in 1978 by the emergency lighting sections of the British Electrical and Allied Manufacturers Association (BEAMA) and the Lighting Industry Federation (LIF). It was formed as an industry committee to respond to a demand for national standards for emergency lighting equipment and is now an independent arm of the LIF.

Since its inception, ICEL has been publishing guidance documents and standards for Emergency lighting products and installations to ensure the best practices available are employed. ICEL continues to provide expert advice and guidance to all specifiers and users on the requirements for emergency lighting.

Formed with an independent regulatory committee of representatives from government departments, public authorities and larger end users, ICEL exists to help and guide users, specifiers and contractors in all matters that touch upon the emergency lighting industry worldwide. ICEL has become the foremost UK authority on emergency lighting and its representatives serve on BSI committees and represent UK interests within European committees dealing with emergency lighting.

The guides and standards published by ICEL since 1978 are well known and respected world-wide and form the basis of many National Standards prior to the harmonisation of European Standards.

A common standard for the construction of emergency lighting luminaires and the measurement of photometric data has been adopted in Europe. Emergency lighting conversion modules are also covered by a common standard for construction and safety but requirements for the verification of life expectancy of electrolytic capacitors are not included. Practical verification of battery suitability is also required.

ICEL's aims in operating schemes of product registration are, as always, to direct users to products that are of assured reliability, quality and photometric performance to assist in preserving life in an emergency situation.

Emergency lighting luminaires and conversion modules, if constructed in accordance with appropriate standards, assembled and tested in a factory employing recognised and suitable quality assurance procedures and correctly installed in accordance with verified performance data saves lives.

ICEL is the leading UK authority on emergency lighting and is probably the most experienced authority on the subject in Europe.

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1. The ICEL Scheme of Product and Authenticated Photometric Registration for Emergency Lighting Luminaires and Conversion Modules

The European emergency lighting product standards, EN 60598-2-22, EN 60924 and EN 60925 cover most points of safety and performance for emergency luminaires and conversion modules. However three important elements are not yet covered and therefore ICEL requires additional testing to provide evidence of satisfactory compliance with the following items: -

- Flammability of external parts of luminaires, as required by BS5266:Pt1 (clause 6.10.2) - For luminaires to be suitable for use on defined escape routes the housings should be manufactured from flame and ignition resistant materials.

  The ICEL requirements cover the period of withdrawal of EN60 598-2-22:1990 (BS4533: Section 102.22:1990) after which time BSEN60598-2-22:1999 makes this requirement mandatory for emergency lighting luminaires.

- Photometric Data - To enable the positioning of luminaires to achieve the required illuminance as stated in BS 5266 Pt.1 and BS EN 1838 / BS 5266 Pt.7, the relevant photometric data and third party authenticated spacing tables are required.

- Life expectancy – Adequate life expectancy of electrolytic capacitors for use in purpose designed emergency luminaires or for emergency conversion modules.

- Cell performance – A practical test regime and on-going audit to predict the suitability of cells during the 4 year design life required in EN 60 598-2-22.

To provide assurance to users of emergency lighting luminaires and conversion modules of the quality, integrity and performance of selected products, ICEL offers to manufacturers a scheme of Product Registration. The scheme ensures that in addition to providing the above, products registered have also previously been: -

- Certified to the appropriate national and international standards.
- Manufactured in a facility having a recognised, approved scheme of quality assurance.

The scheme also provides confidence that the product tested and data provided is representative of production.

Products registered under the scheme may be marked with the ICEL Product and Photometric Registration Scheme mark, including a unique registration scheme number, according to Appendix D.

1.1 Certification to European Product Standards

ICEL 1001 registered luminaires shall be third party certified to the European product standard EN 60598-2-22. Certification must have been granted through an approved national testing body.

ICEL 1001 registered conversion modules shall be third party certified to the European product standards EN 60924 and EN 60925. Certification must have been granted through an approved national testing body (e.g. BSI Kitemark).
[Note: Continuing registration to this Scheme is only valid whilst products comply with current appropriate standards]

1.2 Quality Assurance of Manufacturing Facility

The scheme of quality assurance operated within the manufacturing facility shall be in accordance with International Standard ISO 9001 or ISO 9002. The manufacturing facility must be continually assessed and found to be in compliance by a competent body, which must have approved it as such. In the UK the ISO 9000 series standards are adopted as the BS EN ISO 9000 series.

1.3 Fire Retardancy of Luminaire Housings

The materials utilised in the construction of the external components of the luminaire housing, normally a base and diffuser, must have been tested and found to withstand the glow wire test specified in EN 60598-1 but at a temperature of 850ºC. Compliance shall be assessed and agreed through an approved national testing body.

1.4 Verification of Photometric and Related Performance Data

Verification of emergency lighting photometric performance claims for self contained luminaires and slave luminaires shall be achieved through the submission to ICEL of the data described in appendix A of this document.

Appendix A, fig. 5 shows an example of the way in which data should be presented to the user of the product to enable correct luminaire positioning on emergency escape routes and in open areas. For an explanation of the way in which the authenticated spacing table is utilised see stage 4 of ICEL 1006

Verification of performance claims for conversion modules shall be achieved through the submission, to ICEL, of ballast lumen factors (BLFs) for all lamps within the stated range.

The data submitted to ICEL shall have been originated from test results obtained from an approved national testing body, UKAS accredited equivalent source or Supervised Manufacturers Testing facility.

1.5 Special Purpose Luminaires

Any emergency luminaire may be submitted for ICEL registration including special purpose luminaires. F_5 and F_{60} values must be determined for these luminaires as previously described.
Some examples are included below:

1.5.1 Internally Illuminated Emergency Exit Sign With No Significant Light Output.

Photometric tests are not required but all other aspects shall be in accordance with this scheme.

1.5.2 Internally Illuminated Emergency Exit Luminaire With Down light.

This may be regarded as a luminaire and shall be subjected to all tests including the photometric performance in the intended orientation. Authenticated spacing tables shall show face to face spacings and side to side (along one wall of a 2m wide escape route) spacings at mounting heights of 2.0m and 2.5m only. Spacings to other luminaires are not part of this registration scheme unless specifically submitted to ICEL, in which case 0.1, 0.25 and 0.5 Lux Isolux curves shall be determined.

1.5.3 Wall Mounted Emergency Luminaire.

This shall be subjected to all tests including the photometric performance in the intended orientation. Spacing tables shall show face to face spacings and side to side (along one wall of a 2m wide escape route) spacings at mounting heights of 2.0m and 2.5m only. Spacings to other luminaires are not part of this registration scheme unless specifically submitted to ICEL, in which case 0.1, 0.25 and 0.5 Lux Isolux curves shall be determined.

1.5.4 Unit with Tilt and Turn Lamp Heads.

This shall comply with all aspects of this scheme including fire retardancy of the external parts of the lamp heads. For the purposes of ICEL registration the photometric performance of one lamp head shall be determined by beam angles to 50% of peak values in the same way as T.H. down lighters are characterised, measured at F_5 and F_{end}.

1.6 Life Expectancy of Electrolytic Capacitors

The electrolytic capacitors used in luminaires or conversion modules shall have been temperature tested and calculations shall be provided to show their life expectancy.

For purpose designed luminaires life expectancy shall be shown to be no less than 8 years at an ambient temperature of 25°C.

For conversion modules, life expectancy shall be shown to be no less than 8 years with a temperature (T_{Life}) of 50°C or greater at the indicated place, or if not marked at the case centre side.

[Note: The T_{Life} mark is different from the T_c mark and both should be marked on the product. T_c is an endurance rating carried out at maximum rated voltage range (e.g. 254V). T_{Life} is a design life rating based on nominal voltage (e.g. 240V)]

Compliance shall be assessed and agreed by an ICEL approved testing body according to Appendix B

1.7 Cell Performance

The cells used with ICEL registered emergency luminaires and conversion modules shall be shown to have a design life of 4 years normal operation, as specified in EN 60598-2-22.
Compliance shall be assessed by submission to ICEL of the test results as specified in Appendix C of this document.

1.8 Registration Scheme Availability

The ICEL scheme of Product Registration is straightforward and available to all manufacturers able to meet the necessary criteria.
Manufacturers of emergency lighting luminaires and conversion modules from any country are able to register products through the ICEL Scheme, provided that the products are compliant with the above requirements. Any compliant product may be registered upon payment of a registration fee.

1.9 Transitional Provisions

Purpose designed luminaires ICEL registered before 1st January, 2000 to all requirements except clause 1.6 and 1.7, above, may be accepted for product registration by ICEL provided that:

a) a supplementary report from an ICEL approved testing body, to the relevant electrolytic capacitor life requirements (see Appendix B) is submitted to ICEL and
b) a cell performance declaration is submitted to ICEL showing test results according to Appendix C.

1.10 Date of Compliance for Existing Registered Products

All existing ICEL registered products shall conform to this Scheme by 1st January 2001 and be relabelled as shown in Appendix D, or be withdrawn from the registration scheme.

1.11 New Submissions

New submissions shall conform to the whole of this scheme.

Appendix A - Verification of Photometric Performance for Luminaires

In compliance with the requirements in section 1, photometric performance data shall be submitted to ICEL where it is verified and held for inspection if required.

A 1 Definitions

For the purpose of this appendix the definitions of EN 60598-1 and EN 60598-2-22 as well as BS5225 parts 1 and 3 shall apply.

A 2 Source of Data

The source of all data supplied shall be from Photometric Performance testing carried out through an approved national test body.

A 3 Data to be provided

The luminaire manufacturer shall supply to the Technical Manager of ICEL the following data for acceptance: -

A 1.1 The Initial (100hr) Lamp Lumen output of the lamp(s) utilised (ILL).

A 1.2 The measured Ballast Lumen Factor (BLF).

A 1.3 Average intensity distribution chart, quoted in candelas per thousand lamp lumens. (See Figure 2)

A 1.4 Authenticated spacing tables for each luminaire type to facilitate correct installation to achieve the required level of illuminance (spacing tables shall be suitable for use in accordance with the current and future Codes of Practice).

The above data to be substantially as shown in Figures 5 & 6

A 1.5 The appropriate Minimum Lumen Factor (MLF - sometimes referred to as K factor) for the luminaire, in accordance with the requirements of BS EN1838 / BS 5266 Pt.7, BS 5266 Pt1 and BSEN60598.2.22. Calculation of the MLF requires measurement of the following values:-

F_5 = The light output at 5 sec

F_{60} = The light output at 1 minute

F_{nom} = The light output when supplied at the nominal emergency supply voltage

F_{end} = The light output at the end of rated duration

- To determine F_5 for self contained luminaires the light output is measured 5 seconds after normal supply failure, using the internal emergency supply battery. Previously the battery shall have been recharged at 0.9 x minimum rated supply voltage (range) for 24hrs.
- To determine F_5 for centrally supplied luminaires the light output is measured 5 seconds after normal supply failure, using a voltage equivalent to V_5 provided by a stabilised power supply.
- To determine F_{60} for self contained luminaires the light output is measured 1 minute after normal supply failure, using the internal emergency supply battery. Previously the battery shall have been recharged at 0.9 x minimum rated supply voltage (range) for 24hrs.

- To determine F_{60} for centrally supplied luminaires the light output is measured 1 minute after normal supply failure, using a voltage equivalent to V_{60} provided by a stabilised power supply.
- To determine F_{end} the light output is measured at the end of the rated duration period, when the luminaire is operated at a voltage equivalent to V_{end} provided by a stabilised power supply.
- To determine F_{nom} the light output is measured at I hour, irrespective of rated duration, after failure of the normal supply, when the luminaire is operated at a voltage equivalent to V_{nom} provided by a stabilised power supply.

F_5 and F_{60} are measured with a lamp starting from cold (25º C ambient) and for the purposes of the test, maintained luminaires shall be operated in a non maintained mode unless manufactured as permanently maintained luminaires.

Where: -

V_5* = The emergency supply voltage 5 seconds after normal supply failure for centrally supplied luminaires.

V_{60}* = The emergency supply voltage 1 minute after normal supply failure for centrally supplied luminaires.

V_{nom} = The nominal emergency supply voltage.

V_{end} = The emergency supply voltage at the end of the rated duration period and at the end of rated life.

These voltages shall be supplied by the battery manufacturers.

A.1.5.1 BS EN1838 / BS 5266 Pt.7 requires that F_5 / 0.5 x F_{60} and the Minimum Lumen Factor (MLF) is the least of:

$$\frac{F_{60}}{F_{nom}} \quad \textit{or} \quad \frac{F_{end}}{F_{nom}}$$

This MLF shall be used to calculate 1.0 Lux spacing data as shown in Figure 5 and 0.5 Lux spacings as shown in Figure 6

A.1.5.2 For BS 5266 Pt1 the Minimum Lumen Factor (MLF) is the ratio of the minimum light output measured during the period from 5 seconds after normal supply failure and the end of the rated duration, to the light output when operated at nominal emergency supply voltage (F_{nom})

i.e, the Minimum Lumen Factor (MLF) is the least of:

$$\frac{F_{5}}{F_{nom}} \quad \textit{or} \quad \frac{F_{end}}{F_{nom}}$$

This MLF shall be used to calculate 0.2 Lux spacing data as shown in Figure 5

The above data to be substantially as shown in Figure 1.

* Note: V_5 and V_{60} are not required for self-contained luminaires because F_5 and F_{60} are measured directly using the complete luminaire including battery. This is to avoid an error due to the starting current surge, or any other starting boost used to enhance initial light output.

A 1.6 In addition the luminaire manufacturer may provide:-

A.1.6.1 The luminaire Light Output Ratio (LOR)

A.1.6.2 Graphs of illuminance against distance for particular mounting heights. (See Figure 4)

A.1.6.3 For Luminaires to be used in open areas, Utilisation Factors at zero reflectance (UF_0). This data is for calculations to BS 5266 Pt1:1988

A.1.6.4 The luminaire rated lumen output.

To aid the process of verification of data for each luminaire submitted for registration, the data shall be presented in a format, substantially as shown in Figures 1, 2, 4, 5 and 6

A 4 Measurement of Data

Photometric measurements of Luminaires shall be made in accordance with the requirements of BS5225 part 3 and may be made available in electronic file format in accordance with CIBSE Technical Memorandum TM14.

A 5 Presentation and Calculation of Data

A 1.7 Measurement of the Light Output Ratio, Intensity of Distribution and Ballast Lumen Factor shall be in accordance with the requirements of BS5225 part 3.

A 1.8 The claimed Emergency Lighting Lumens (ELL) figure for each luminaire will be verified by multiplying the manufacturer's stated Initial Lamp Lumens (ILL) figure for the lamp(s) utilised by the Ballast Lumen Factor (BLF) measured for the luminaire.

$$ELL = ILL \times BLF$$

A 1.9 Spacing data for the luminaire shall be calculated. Data submitted will be verified utilising the formulae shown in Figure 3.

A 6 Luminaire for Open Areas

A 1.10 Minimum Illuminance (as specified in BS EN1838 / BS 5266 Pt.7)

Spacing tables for the correct installation of luminaires into open areas may be provided if required, taking account of the installation in regular arrays of luminaires and achieving the required minimum level of illuminance throughout the open area, except for a border of 0.5m. around the edge of the room. An example of such a table is shown in Figure 6.

In establishing spacings, consideration should be given to the minimum illuminance within an array. Depending on the photometric performance of the luminaire(s), the minimum illuminance may be at the centre of an array of 4 luminaires or at the perimeter of a room between luminaires positioned axially.

A 1.11 Average Illuminance (as specified in BS 5266 Pt1:1988)

Utilising the UFo, ELL and MLF factors provided for luminaires together with the room dimensions, the following formula is utilised to calculate the number of luminaires required to achieve a required average illuminance level: -

$$N = \frac{E \times L \times W}{UFo \times SF \times MLF \times ELL \times ELIFE}$$

Where: -

N = Number of Luminaires required

E = Required Average Illuminance

L = Length of Room (metres)

W = Width of Room (metres)

UFo = Utilisation Factor at zero Reflectance at SHR =2.5

SF = Service Factor, derating for the effects of dirt and ageing. (0.8)

MLF = As specified in A.3.5.1 and A.3.5.2

ELL = Emergency Lighting Lumens

ELIFE = Maintained ratio to allow for lamp lumen depreciation

1.0 for Non Maintained

or 0.85 for Maintained operation

The value of the Utilisation Factor at zero Reflectance (UFo) is read from a table provided by the manufacturer according to the appropriate Room Index (RI) which is calculated as: -

$$\text{Room Index (RI)} = \frac{L \times W}{H \times (L + W)}$$

Where: - H = Height of room (metres)

L and W are defined above

Compliance with a 40 : 1 maximum uniformity ratio of illuminance between fittings must also be assured.

PHOTOMETRIC DATA

Luminaire Type -	**Bulkhead - Clear Prismatic Diffuser**	Lamp Type	**8 Watt T5**	
		Initial lamp lumens(ILL) =	**420**	(Lumens)
BSI Report No.	**ICEL 099999**	Nominal Cell Voltage	**3.6 Volt**	

Emergency output derated for service factor = ILL x BLF x MLF x SF x ELIFE

Where :-

ILL = Initial Lamp Lumens (declared by manufacturer)
BLF = Ballast Lumen Factor (measured Value)
MLF = Minimum Lumen Factor measured over the rated duration of the luminaire (see clauses A.3.5.1 and A.3.5.2 for methods of calculation)
SF = Emergency Luminaire Maintenance Factor = 0.8
ELIFE = Maintained Ratio = 1.0 for Non Maintained
= 0.85 for Maintained

Initial Lamp Lumens (ILL)	**BLF** (Measured)	**MLF Factor** (Declared)	**Non-Maintained Lamp Lumens**	**Maintained Ratio (ELIFE)**	**Maintained Lamp Lumens**
420	0.41	0.79	136	0.85	116
		(x SF)	0.8		0.8
		Emergency Output derated for Service Factor (Lamp Lumens)	108.8		92.5

LUMINOUS INTENSITY TABLE

	Ave. Transverse (0/180°)			**Ave. Axial (90/270°)**		
Angle	**Average Relative Intensity**	**True Intensity NM**	**True Intensity M**	**Average Relative Intensity**	**True Intensity NM**	**True Intensity M**
Degrees	(Candelas per 1000 Lamp Lumens)	(Candelas)	(Candelas)	(Candelas per 1000 Lamp Lumens)	(Candelas)	(Candelas)
0	161.40	17.57	14.93	161.40	17.57	14.93
5	163.10	17.75	15.09	159.35	17.34	14.74
10	160.20	17.43	14.82	156.50	17.03	14.48
15	157.25	17.11	14.55	151.80	16.52	14.04
20	153.95	16.75	14.24	145.50	15.83	13.46
25	144.20	15.69	13.34	137.20	14.93	12.69
30	138.95	15.12	12.85	128.05	13.94	11.85
35	136.05	14.81	12.59	117.35	12.77	10.86
40	148.10	16.12	13.70	104.50	11.37	9.67
45	163.40	17.78	15.12	90.77	9.88	8.40
50	181.50	19.75	16.79	76.04	8.28	7.03
55	188.40	20.50	17.43	61.75	6.72	5.71
60	204.65	22.27	18.93	48.60	5.29	4.50
65	205.10	22.32	18.97	35.02	3.81	3.24
70	193.35	21.04	17.89	23.73	2.58	2.19
75	158.95	17.30	14.70	16.58	1.80	1.53
80	126.75	13.79	11.73	12.15	1.32	1.12
85	115.90	12.61	10.72	6.86	0.75	0.63
90	129.65	14.11	11.99	4.14	0.45	0.38

To calculate illuminance, in Lux, see Figure 3

Figure 1 - Example of Photometric Data and Calculations for BS EN1838 / BS5266 Pt.7

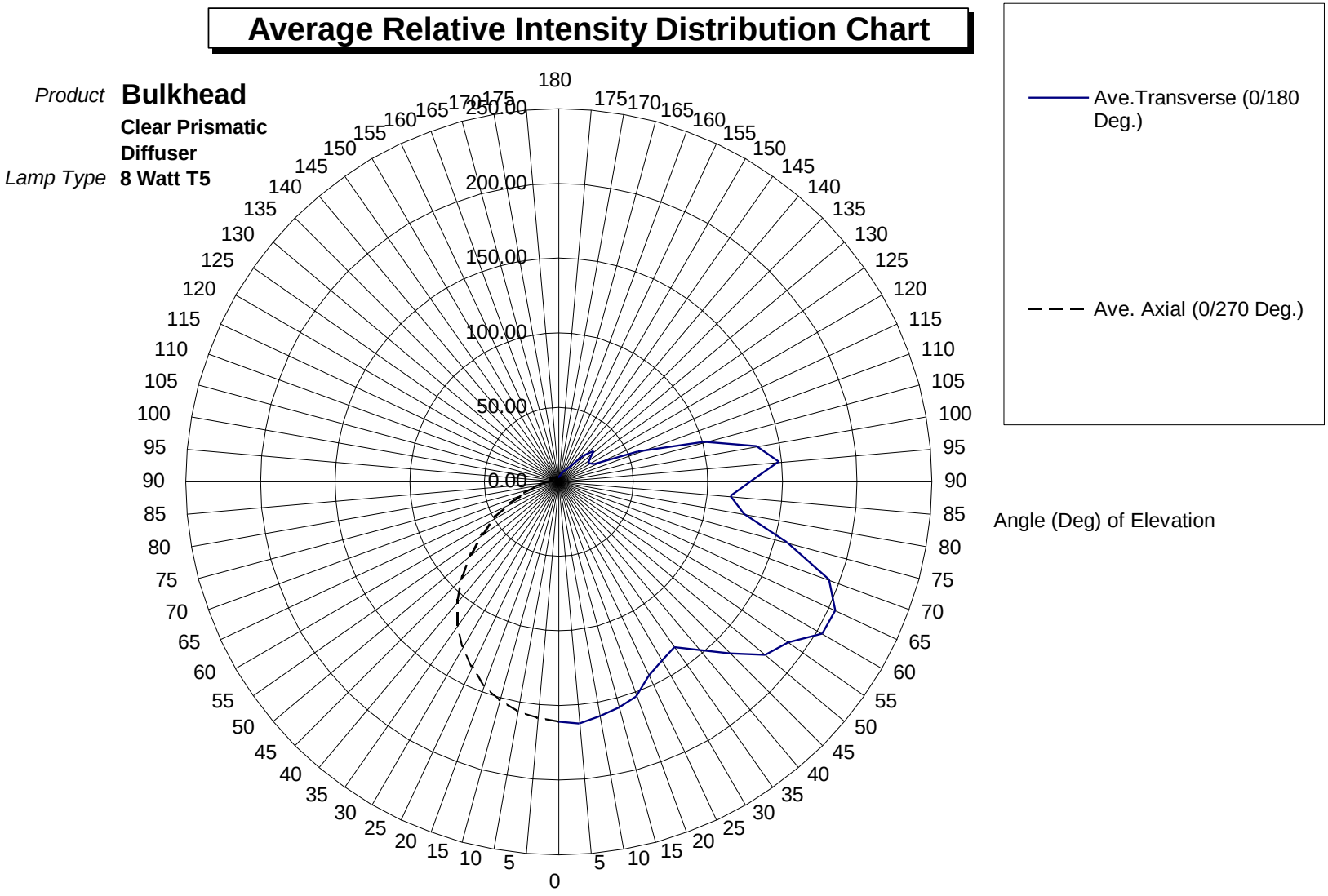
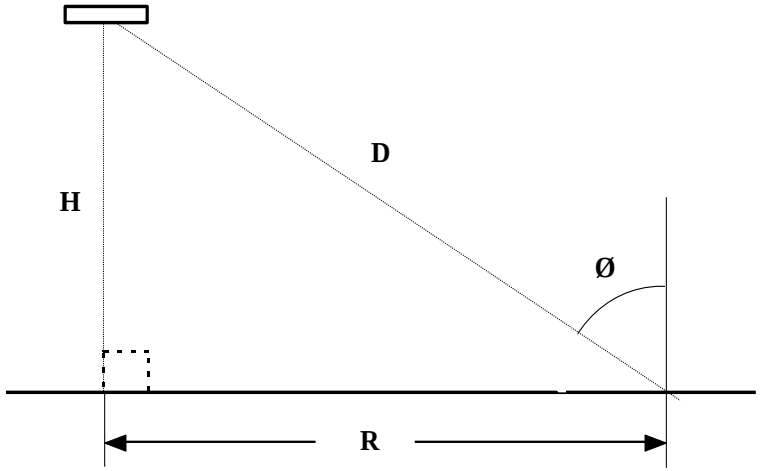


Figure 2 - Example of Average Relative Intensity Distribution Chart



Value	Description	Calculation
H metres	Height of unit above floor	Known
R metres	Length along floor vertically below unit	Different distances taken to find required value of Lux graphically
Tan Ø	Tangent of angle Ø	$\frac{R}{H}$ = distance R divided by H
Ø	Angle of light path from vertical (in degrees)	Angle obtained from Tangent tables
COS Ø	Correction for the angle of incidence at light on surface	Cosine value of angle Ø
I *	True intensity measured at angle Ø	From Luminous Intensity table
Lux	Illuminance level at distance R	$= \frac{I^* \times COS^3 Ø}{H^2}$

Figure 3 - Formulae to be Utilised to Verify Luminaire Spacing Data

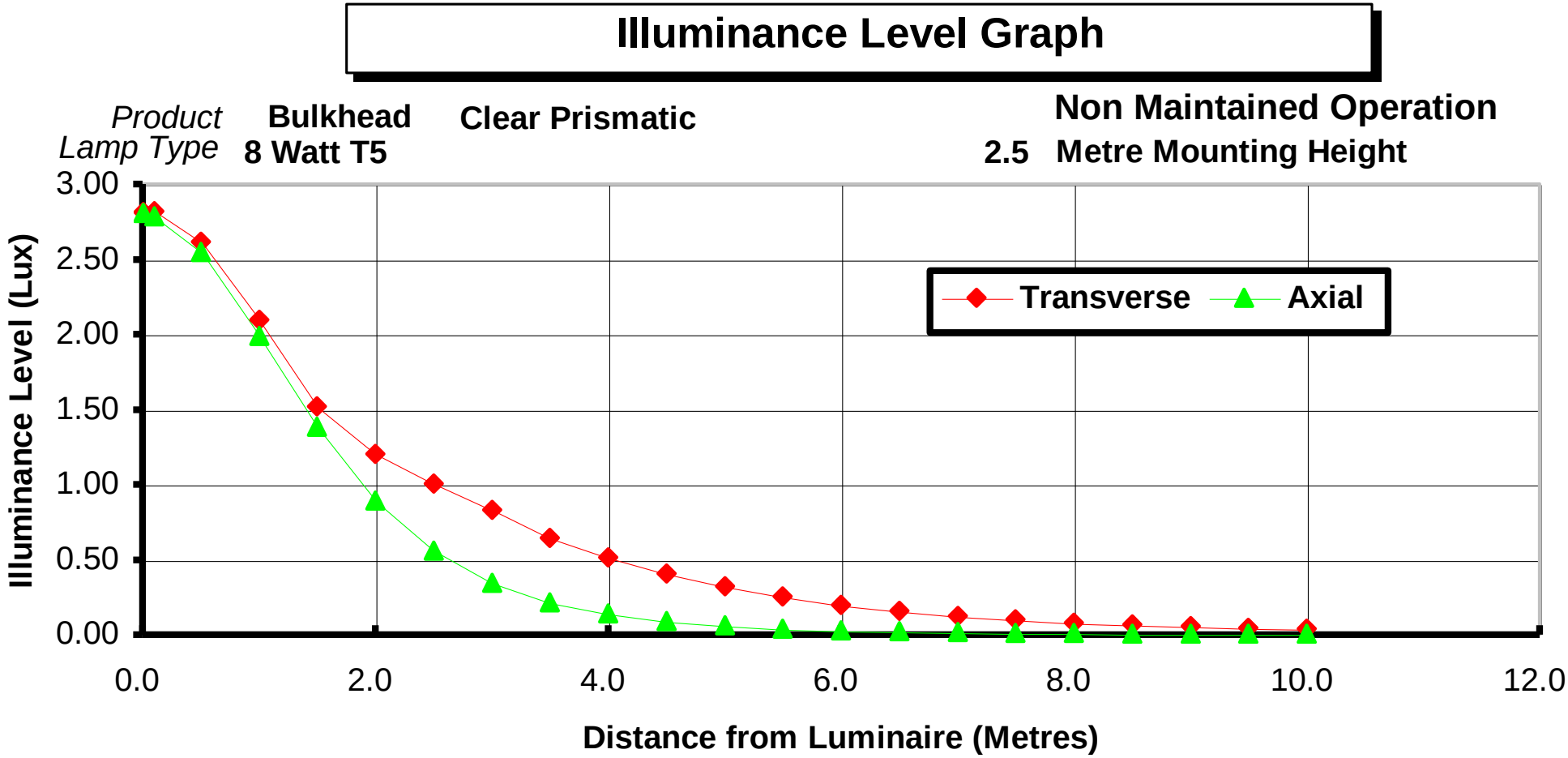


Figure 4 - Example of Illuminance Against Distance Graph for a Particular Mounting Height

EMERGENCY LIGHTING LUMINAIRE SPACING

Luminaire Model	Mounting Height	Lighting Level Directly Under Luminaire (Lux)	Luminaire Spacing (in Metres) On Emergency Escape Routes									
			Transverse Distance to Wall for Level of Illuminance (Lux)		Transverse to Transverse Spacing for Level of Illuminance (Lux)		Transverse to Axial Spacing for Level of Illuminance (Lux)		Axial to Axial Spacing for Level of Illuminance (Lux)		Axial Distance to Wall for Level of Illuminance (Lux)	
			0.2	1.0	0.2	1.0	0.2	1.0	0.2	1.0	0.2	1.0
Bulkhead	**2 Metres**	4.39	5.6	2.8	13.7	8.0	10.8	6.5	7.9	4.9	3.3	1.9
Clear Prismatic Diffuser	**2.5 Metres**	2.81	6.0	2.5	15.1	8.2	12.0	6.7	8.8	5.3	3.6	1.9
(NM Operation)	**3 Metres**	1.95	6.3	1.9	16.2	7.9	12.9	6.6	9.5	5.4	3.8	1.7
	4 Metres	1.10	6.4	0.8	17.5	5.9	14.1	5.5	10.6	5.1	4.2	0.7
	6 Metres	0.49	5.1	N/A	17.9	N/A	14.9	N/A	11.9	N/A	4.1	N/A
	8 Metres	0.27	3.3	N/A	15.6	N/A	13.7	N/A	11.8	N/A	3.0	N/A
	10 Metres	0.18	N/A	N/A	11.3	N/A	10.9	N/A	10.5	N/A	N/A	N/A

Figure 5 - Example of Luminaire Spacing Table for Emergency Escape Routes, Calculated According to BS 5266 Pt1 for 0.2 Lux and BS EN1838 / BS 5266 Pt.7 for 1.0 Lux

Luminaire Model	Mounting Height	Lighting Level Directly Under Luminaire (Lux)	Regular Array Luminaire Spacing (in Metres) In Anti Panic Open Areas for 0.5 Lux Minimum Illuminance (Inc. 0.5 Border Area)			
			Transverse Distance to Wall	Transverse to Transverse Spacing	Axial to Axial Spacing	Axial Distance to Wall
Bulkhead	**2 Metres**	4.39	3.3	9.1	5.3	2.2
Clear Prismatic Diffuser	**2.5 Metres**	2.81	3.4	10.0	6.0	2.4
(NM Operation)	**3 Metres**	1.95	3.3	10.5	6.3	2.4
	4 Metres	1.10	2.6	11.3	7.0	2.3
	6 Metres	0.49	N/A	11.1	7.6	N/A
	8 Metres	0.27	N/A	8.3	7.2	N/A
	10 Metres	0.18	N/A	5.9	5.6	N/A

Figure 6 - Example of Spacing Table for Open Areas, Calculated According to BS EN 1838 / BS 5266 Pt. 7

[Note: Calculation of Spacing Table for Open Areas is complex and requires check calculations to validate results obtained]

Appendix B - Life Expectancy of Electrolytic Capacitors

In compliance with the requirements of section 1.6, electrolytic capacitor temperature measurements and life expectancy calculations at the rated temperature shall be submitted to ICEL in accordance with the method described below.

B 1 Temperature measurement

Attach a thermo-couple onto the top (i.e. the end furthest from the seal) of all relevant capacitors. The thermo-couple shall be constructed such that it does not itself affect the temperature measurement.

The unit under test shall be operated in its normal running condition and orientation.

B 2 Test Conditions

For emergency conversion modules, measure the capacitor temperatures at the maximum rated voltage, not including tolerances (e.g. 240V, not 254V), with a thermo-couple on the emergency conversion module at the indicated place, or if not marked at the centre side of the module. Capacitor temperature measurements shall be normalised to 50°C. For example if the housing temperature is measured at 53°C then 3°C would be subtracted from the measured capacitor temperatures. For another example if 55°C is to be claimed the 2°C would be added to the measured capacitor temperatures.

For dedicated emergency luminaires, measurements shall be normalised to an ambient temperature of 25°C, unless otherwise marked on the luminaire.

Tests shall be carried out in a temperature stabilised room, as specified in EN60598-2-22, during the normal thermal testing

B 3 Basic Calculation Formula

This calculation applies to capacitors of a case diameter up to 18mm. If the capacitor case diameter is greater than 18mm proceed to B 4.

$$L = L_r \times 1.5 \times 2^{\frac{(T_r - T_{cap})}{10}}$$

Where:-

- L = life of electrolytic capacitor (assumed to be when the capacitance has degraded by 25% from the initial value)
- L_r = rated life (e.g. 5,000 hr at 105°C)
- T_r = temperature at which L_r is rated (e.g. 105°C)
- T_{cap} = temperature measured on top of capacitor case when tested at maximum rated voltage, not including tolerances

Providing:-

B 3.1 The rated ripple current through the capacitor is not exceeded. If the ripple current is exceeded refer to B4.

B 3.2 The capacitor rated voltage value is not exceeded.

B 3.3 Any gain in life when operating at a lower voltage than rated is disregarded

B 4 Special Circumstances Calculation

Refer to the capacitor manufacturer's published data to predict life expectancy. A technical file shall be made to justify the calculations.

B 5 New Technology or Application Specific Calculation

In certain circumstances where, due to advances in technology or due to a particular application, the capacitor manufacturer may supply data that can be used to predict life expectancy. A technical file shall be made to justify the calculations.

B 6 Compliance

The resultant calculations shall show that the life, L, equals or exceeds 8 years.

The regime of on to off time can extend the achieved life, but ICEL registered products are often used in highly critical safety applications so calculations shall be for continuous operation.

B 7 Life Expectancy at other Temperatures

For every 10°C increase in temperature above the design temperature (T_{Life}), the calculated life shall be halved.

Note: It is recommended that the technical file produced for an ICEL 1004 conversion shall include a section on temperature measurement to make clear any re-rating of the life expectancy calculations.

Appendix C - ICEL Approval Test for Sealed Nickel Cadmium Cells.

In order to determine the suitability of sealed Nickel Cadmium cells for use in emergency lighting luminaires, ICEL in conjunction with Cell manufacturers has devised test regimes for initial approval and also for ongoing audit testing.

For initial approval, evidence of compliance to the requirements BSEN 60285 in C1 plus the ICEL test regime in C2 is self declared by the cell manufacturer. The BSEN60285 and ICEL tests are carried out on different sets of cells.

The audit test is carried out on batches 6 monthly, or more frequently either by the emergency lighting manufacturer or the cell manufacturer or an ICEL approved testing body. Compliance is self declared.

The test regimes are:

C 1 Approval Test Procedure as Specified in BSEN 60285

Cells must comply with following provisions and specific tests especially dedicated to cells intended for permanent charge at elevated temperature ("T" type cells).

- Rated capacity declared by the manufacturer - clauses 1.3.3 and 4.2.1. (test).
- Cell designation and marking - clauses 2.1 and 2.3.
- Endurance in cycles - clause 4.4.1.
- Permanent charge endurance - clause 4.4.2.2.
- Overcharge - clause 4.6.2.
- Charge efficiency - clause 4.9.

C 2 ICEL Audit Test Regime

Consisting of:

- An initial charge efficiency test.
- An ageing period.
- A final charge efficiency test.

C 2.1 ICEL Initial charge efficiency test (3 cycles) at + 55ºC ± 2°C

Cycle no. 1:	Charge 48 hours at C/16 rate. Discharge at 0.25 C, no minimum duration required.
Cycle no. 2:	Charge 24 hours at C/16 rate. Discharge at 0.25 C, 3 hours minimum duration required.
Cycle no. 3:	Charge 24 hours at C/16 rate. Discharge at 0.25 C, 3 hours minimum duration required.

C 2.2 ICEL Ageing period at 70ºC ± 2°C

- continuous charge C/16 for 28 days.
- discharge at 0.25 C, no minimum duration required.

C 2.3 ICEL Final charge efficiency test (3 cycles) at 55ºC ± 2°C

Cycle no. 1:	Charge 48 hours at C/16 rate. Discharge at 0.25 C, no minimum duration required.
Cycle no. 2:	Charge 24 hours at C/16 rate. Discharge at 0.25 C, 3 hours minimum duration required.
Cycle no. 3:	Charge 24 hours at C/16 rate. Discharge at 0.25 C, 3 hours minimum duration required.

C 2.4 Compliance to ICEL test regime:

All discharge tests to be carried out to 1.0v per cell.

Where a minimum duration is required, failure to meet that duration is a test failure.

Acceptance is based on a failure rate of no more than 1 cell in a batch of 5. If a sample batch of cells tested fails to comply during an ICEL audit test, a repeat test should immediately be initiated. If the sample batch fails the second audit test this information shall be supplied to the ICEL Secretariat for confidential circulation to members.

Corrective action must be undertaken and a non-compliance instigated in accordance with the particular member's company procedure.

Notes

1. Sample size: 5 cells.
2. Only cells are tested. Batteries are assumed to perform in the same way, providing the clauses of EN60 598-2-22 regarding low voltage disconnect are complied with.
3. Test currents, charge and discharge ± 2.5%.
4. At the temperature transition points the temperature should settle within of the tolerance of the target temperature within 16h.
5. Rest periods may be introduced at the end of C2.1 and C2.2 to allow for different discharge times within a batch of cells. When the first cell in a batch completes a test, the temperature should continue as required previously in that test section, but the cell(s) that have completed test should be neither charged nor discharged during the rest period. When the last cell has completed that test section the test can proceed to the next section.

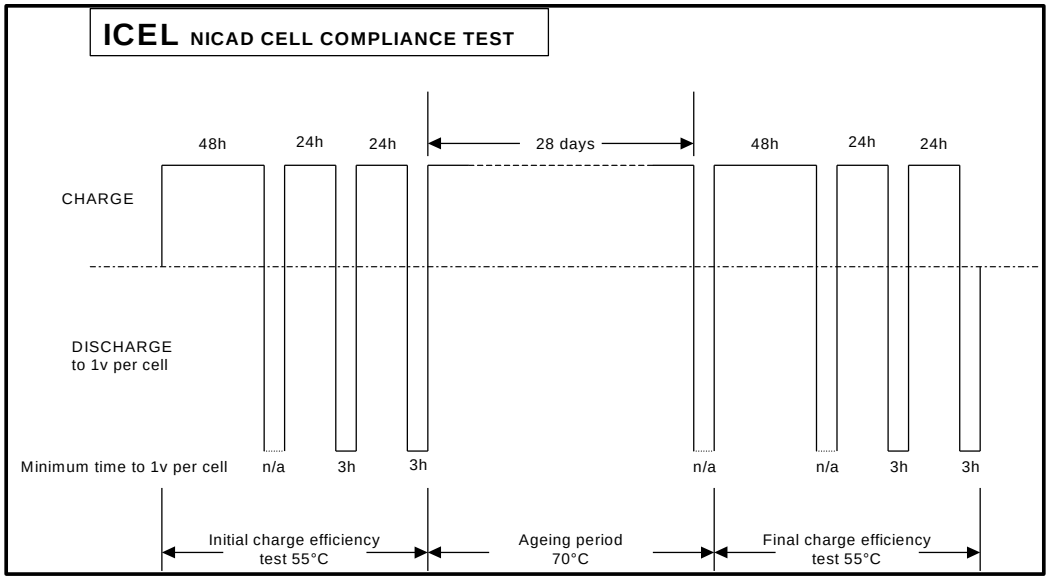


Figure 7 - Schematic Representation of ICEL Audit Test Regime

Appendix D - Registration and Marking Requirements

D 1 Applying for Registration

Manufacturers wishing to obtain registration of their emergency lighting luminaires or conversion modules should submit the relevant data and a copy of their ISO 9000 series licence and schedule to the Technical Manager of ICEL for acceptance.

D 2 Conditions of the Scheme

The following conditions shall apply to the Scheme of Registration of emergency lighting luminaires or conversion modules design and manufacturing:-

- Type testing shall be carried out as described in section 1 of this document for all applicable emergency lighting luminaires or conversion modules.
- Technical files shall be written, if requested, in accordance with this document, for all emergency lighting luminaires or conversion modules.
- The ICEL 1001 marking shall be applied only to those emergency lighting luminaires or conversion modules produced in accordance with the described procedures.

D 3 The Marking of Emergency Lighting Luminaires and Conversion Modules to ICEL 1001

Emergency lighting luminaires or conversion modules manufactured in accordance with this guide may bear the following labels: -

Figure 8 - ICEL 1001 Emergency Luminaire Label Format

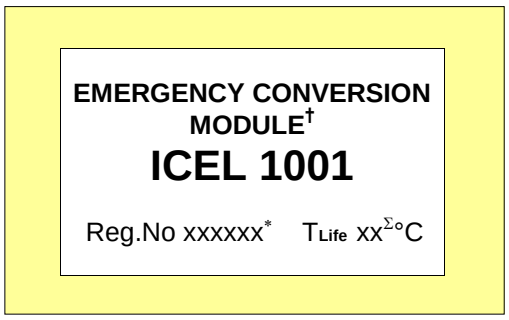


Figure 9 - ICEL1001 Emergency Conversion Module Label Format

The organisation carrying out the manufacture is entitled to affix the above label when they have the following: -

- Independently registered their quality assurance scheme to ISO 9000 series with the appropriate schedule to supply emergency lighting luminaires or emergency conversion modules in accordance with this guide.
- Registered with ICEL and entered their unique number on the registration label affixed to their emergency lighting luminaires or emergency conversion modules.
- For emergency conversion modules, the appropriate T_{Life} value shall be entered on the registration label.

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* Insert registration number allocated by ICEL
Σ Insert design temperature (T_{Life}) value
† Optional text

List of ICEL members

A current list of ICEL members together with details of the products each manufactures is available from:

Industry Committee for Emergency Lighting Limited
Ground Floor, Westminster Tower
3 Albert Embankment
London SE1 7SL

E-mail: *info*@icel.co.uk

Or visit the ICEL Ltd. website at WWW.icel.co.uk

Also visit the Lighting Industry Federation Website at WWW.lif.co.uk for a list of LIF members and their product ranges.