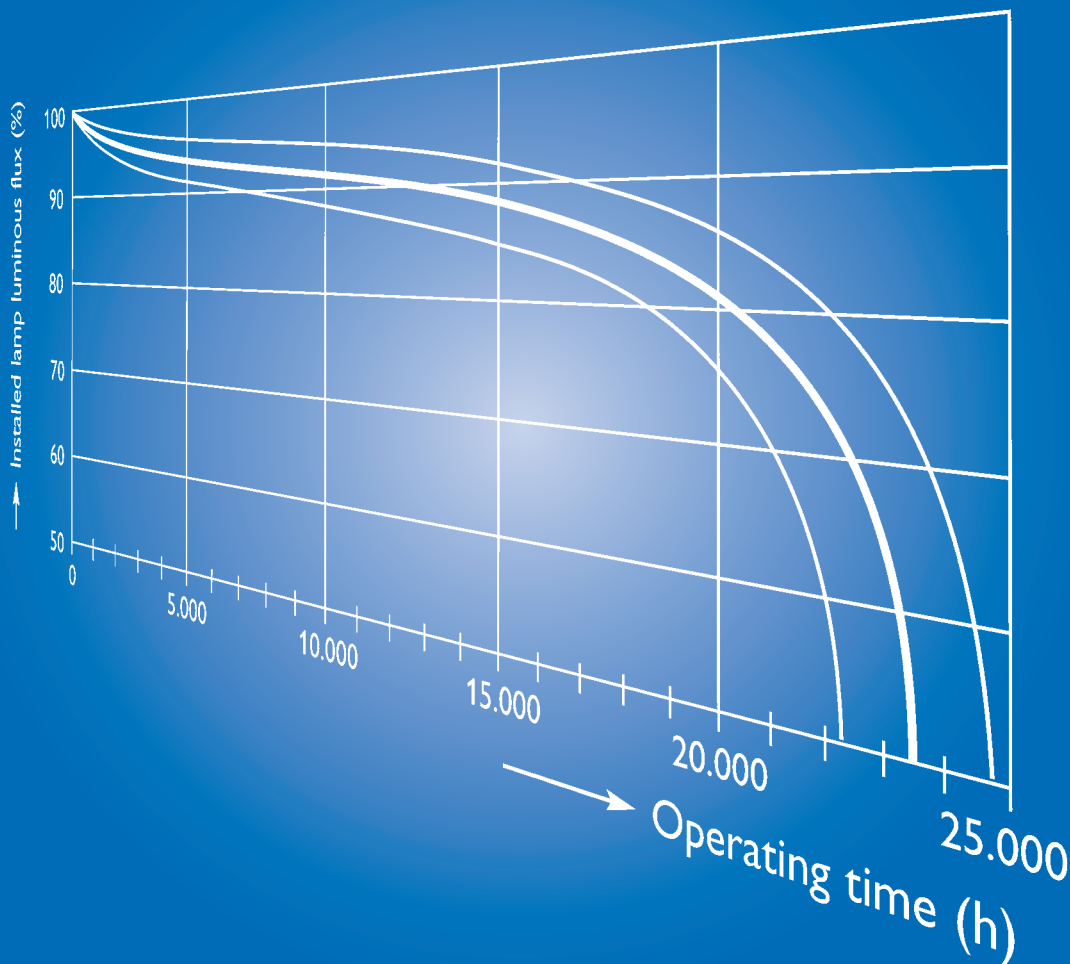


Life behaviour of discharge lamps for general lighting



Support
for planning and
maintenance

Life behaviour of discharge lamps for general lighting

1. Introduction

This documentation supports planning and maintenance of professional lighting applications.

The data provided in this guide apply for typical standard products of those lamp manufacturers which are member of the Fachverband Elektrische Lampen of the ZVEI. Features of lamp types outside this guide can be found in the manufacturers' literature.

The tables in clause 3 show the nominal life of lamp type groups. In addition to the tabled values, for the most important lamp types the life behaviour is demonstrated by three curves. The three curves describe (see also clause 2, Definitions):

1. lamp survival factor (LSF)
2. lamp lumen maintenance factor (LLMF)
3. lamp maintenance factor (LWF)

It should be noted that the curves and tabled values result from a large number of measurements in the laboratory under controlled, standardised and reproducible conditions. The upper and the lower curve describe the spread resulting from various lamp types (i.e. wattages) and batches. For operation of single- and double-capped fluorescent lamps with low loss ballasts (VVG, see group 1 and 2 of the table), the circuit type (inductive, capacitive) has an additional impact on the variation.

For the life of the individual lamp, the tabled values and curves do not present a means for assessment. For the purpose of planning, the maintenance factors are usually based on the bold curves.

In practise, the life of discharge lamps is influenced, among others, by the following parameters:

- lamp type, - wattage
- type of phosphor
- circuit type
- ballast type (KVG/VVG, EVG)
- voltage supply
- switching cycle

The following data apply for the intended use. Deviations from the intended use may cause changes in the life behaviour.

2. Definitions

For the topic "life of lamps" different definitions and terms are in use, depending on lamp type, lamp manufacturer and geographical region. This can lead to misunderstandings for the user. The essential definitions are given below (see also EN 12464-1, EN 12665 and CIE 97):

Life, general term

Time during which a lamp is operated until its failure.

Average life

Mean value of the electrical life of a quantity of lamps, operated at standardised conditions after 50% lamp failure.

Failure rate Bx

Percentage of failed lamps, e.g. B10 (10% failure).

Lamp survival factor – LSF (Lamp survival in %)

Ratio of the number of electrically intact lamps to the total number of lamps.

Nominal life

Life (h) as declared by the manufacturer. It is published together with the switching cycle and failure rate on which it is based. Example for a short version: 12B10 (12 h switching cycle / 10% failures).

Nominal luminous flux

Luminous flux as declared by the manufacturer.

Lamp lumen maintenance factor – LLMF (Lamp luminous flux in %)

Ratio of the luminous flux of a specific quantity of lamps at a defined number of hours of operation to their luminous flux at 100 h.

Lamp maintenance factor – LWF (Installed lamp luminous flux in %)

Product of lamp survival factor and lamp lumen maintenance factor.

KVG

Conventional copper-iron ballast.

VVG

Conventional low loss ballast

EVG

Electronic ballast

3. Life values of discharge lamps for general lighting

3.1 Double-capped fluorescent lamps

The nominal life values given are based on a 12 h-switching cycle (11 h "On", 1 h "Off") and a failure rate B10 (life 12B10).

Grp.	Lamp type	Bal-last	Lamp type, -cap	Nominal lifetime (h)	Ann. No.
01	Fluorescent lamps Ø 16 mm (T5)	EVG ¹	14 W - 80 W, 3-Band-Phosphor	20.000	1
	Fluorescent lamps Ø 26 mm (T8)	EVG ¹	18 W - 58 W, 3-Band-Phosphor	16.000	2
		VVG ²	18 W - 58 W, 3-Band-Phosphor	11.000	3
		VVG ²	18 W-58 W, Standard Phosphor ³	8.000	4
			other types	see manufacturers' literature	

3.2 Single-capped fluorescent lamps

The nominal life values given for group 02 are based on a 12 h-switching cycle (11h "On", 1h "Off") and a failure rate B10 (life 12B10).

Grp.	Lamp type	Bal-last	Lamp type, -cap	Nominal life (h)	Ann. No.
02	Single-capped fluorescent lamps, external ballast	EVG ¹	Dual-shaped and multi-limbed shaped ⁶ 5 W-42 W, cap 2G7 and GX24q	8.500	5
		EVG ¹	Quad-shaped ⁶ 10 W - 26 W, cap G24q	10.000	6
		VVG ⁴	Dual-shaped, quad-shaped and multi-limbed shaped ⁶ 5 W - 26 W, cap G23, G24d and GX24d	7.000	7
		EVG ¹	18 W - 80 W, cap 2G11	16.000	8
		VVG ²	18 W - 36 W, cap 2G11	11.000	9
			other types	see manufacturers' literature	
03	Self-ballasted fluorescent lamps ⁵	EVG	all types	see manufacturers' literature	

3.3 HID-Lamps (High Intensity Discharge), Induction lamps

The nominal life values given are based on a 12 h-switching cycle (11 h "On", 1 h "Off") and a failure rate B10 (life 12B10).

Grp.	Lamp type	Bal- last	Lamp type, -cap	Nominal lifetime (h)	Ann. No.
04	High-pressure sodium vapour lamps	KVG	50 W and 70 W	12.000	10
		KVG	150 W - 400 W, standard luminous flux	16.000	11
		KVG	100 W - 400 W, increased luminous flux	18.000	12
			other types	see manufacturers' literature	
05	Low-pressure sodium vapour lamps	KVG EVG	all types	see manufacturers' literature	
06	High-pressure mercury vapour lamps	KVG	50 W - 1000 W, standard	8.000	13
			other types	see manufacturers' literature	
07	Metal halide lamps	KVG EVG	all types	see manufacturers' literature	
08	Induction lamps	EVG	all types	see manufacturers' literature	

1 Warm start EVG

2 50% inductive / 50% capacitive

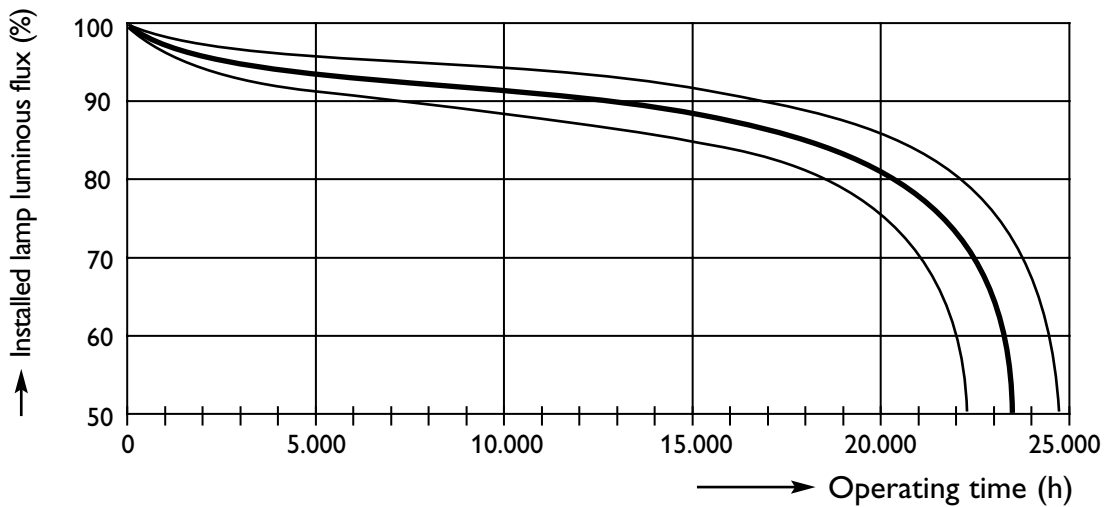
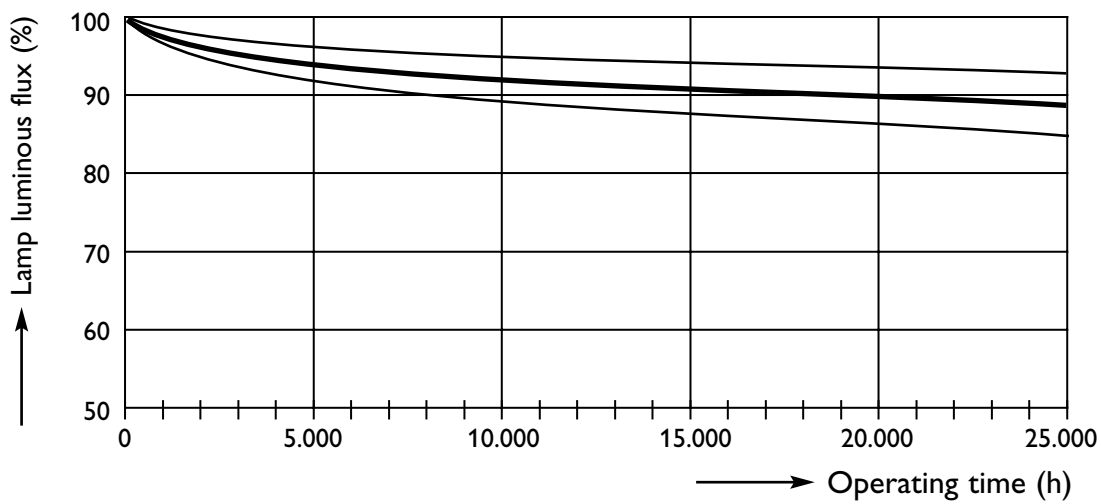
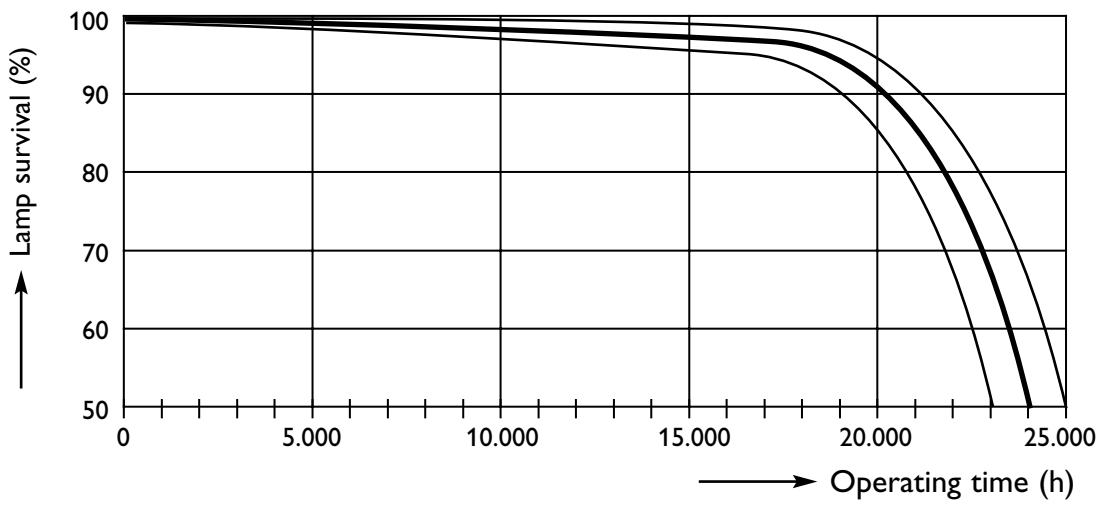
3 "Lamps with a colour rendering index lower than 80 should not be used in interiors where people work or stay for longer periods." (EN 12464-1, sub-clause 4.6.2)

4 inductive

5 3 h-switching cycle (2 ¾ h "On", ¼ h "Off") and failure rate B50 (average life)

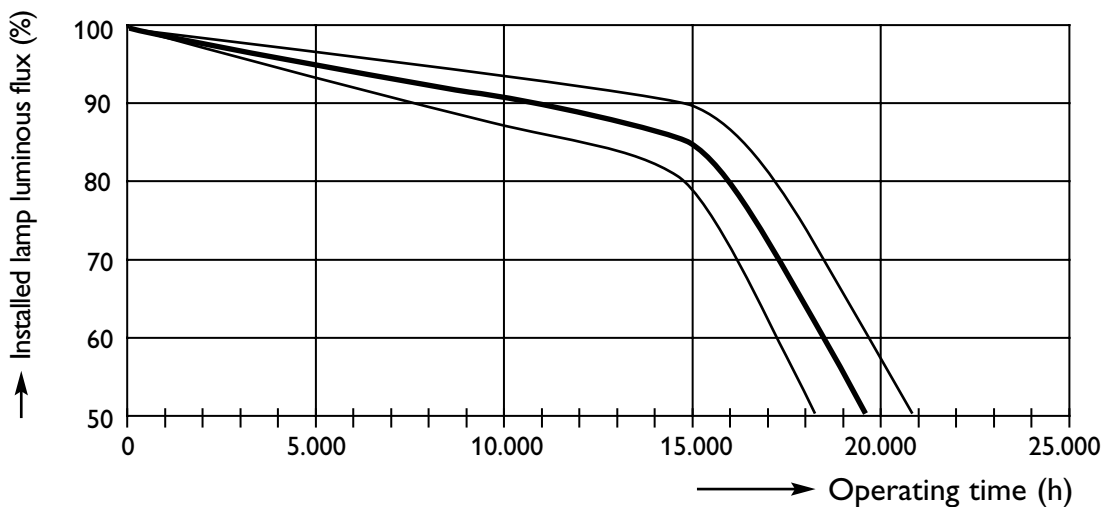
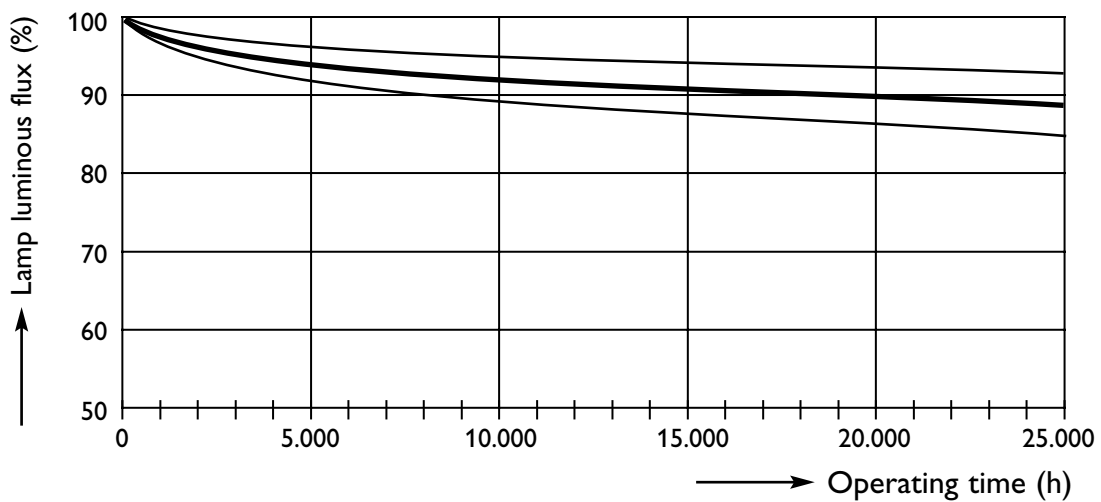
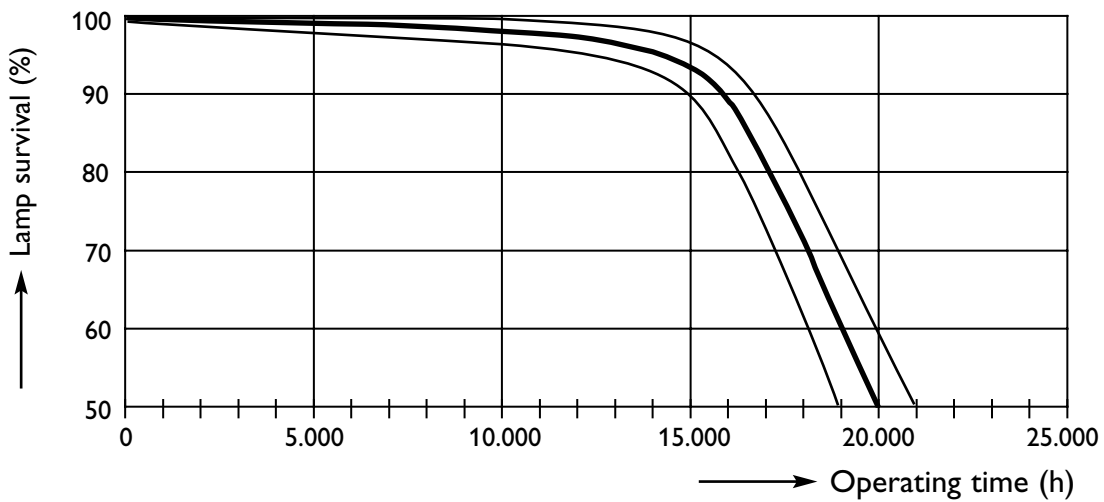
6 The designations "Dual-shaped", "quad-shaped" and "multi-limbed-shaped" (1, 2 or 3 bended tubes and 2, 4 or 6 limbs) are synonymous to the well-known lamp types FSD, FSQ and FSM (ILCOS) with caps as indicated.

01	Fluorescent lamps Ø 16 mm (T5)	EVG	14-80W 3-Band-Phosphor	Annex 1
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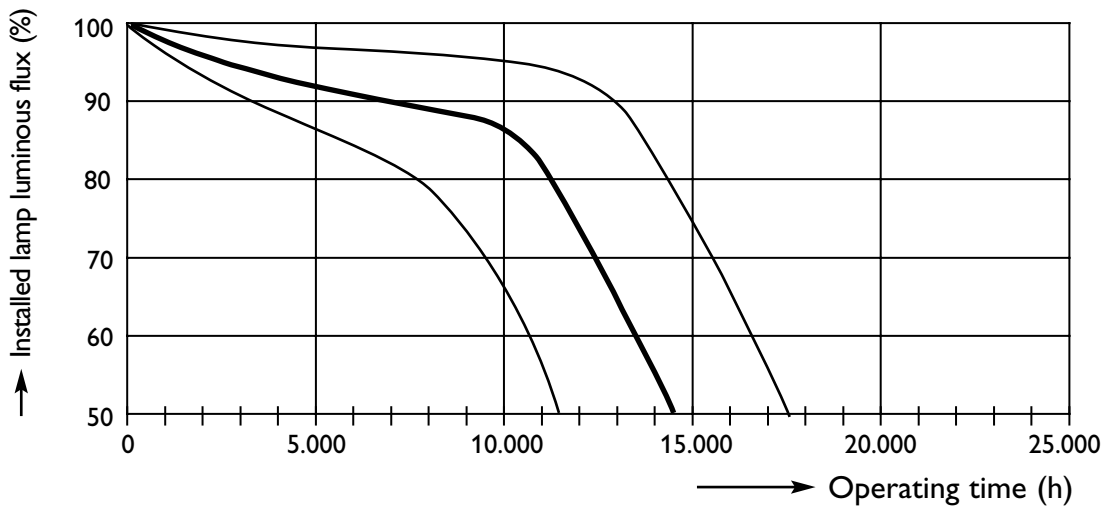
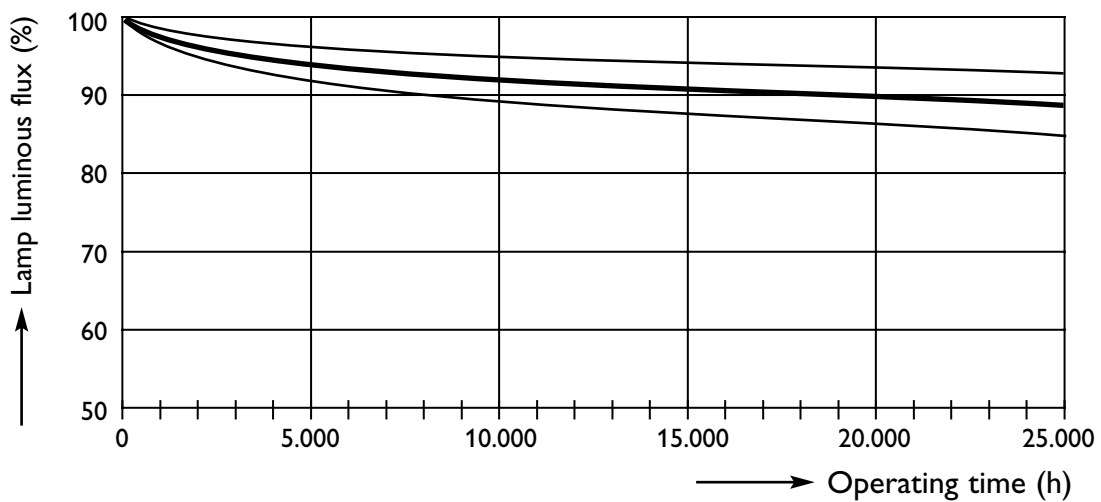
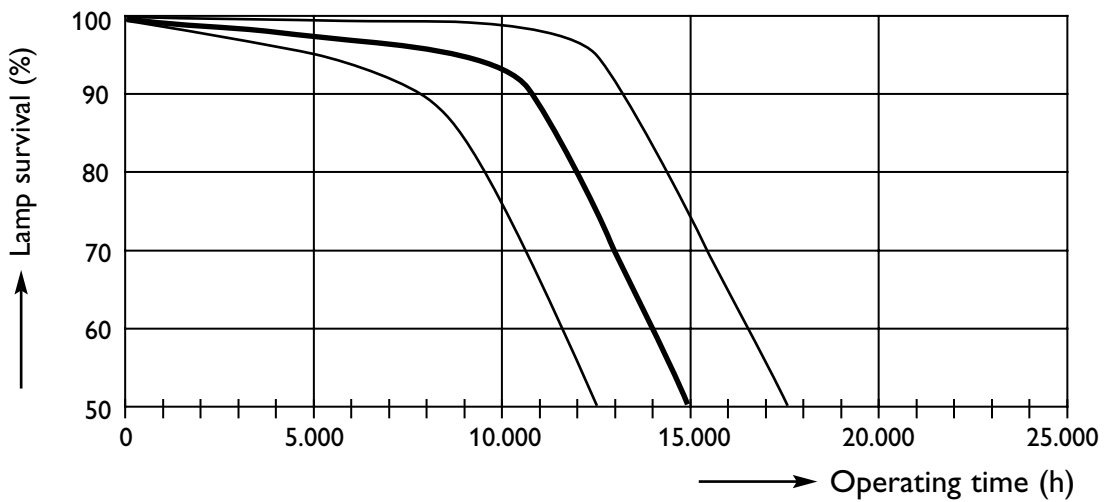
For further details see Introduction and tables (3.1-3.3)

01	Fluorescent lamps Ø 26 mm (T8)	EVG	18-58 W 3-Band-Phosphor	Annex 2
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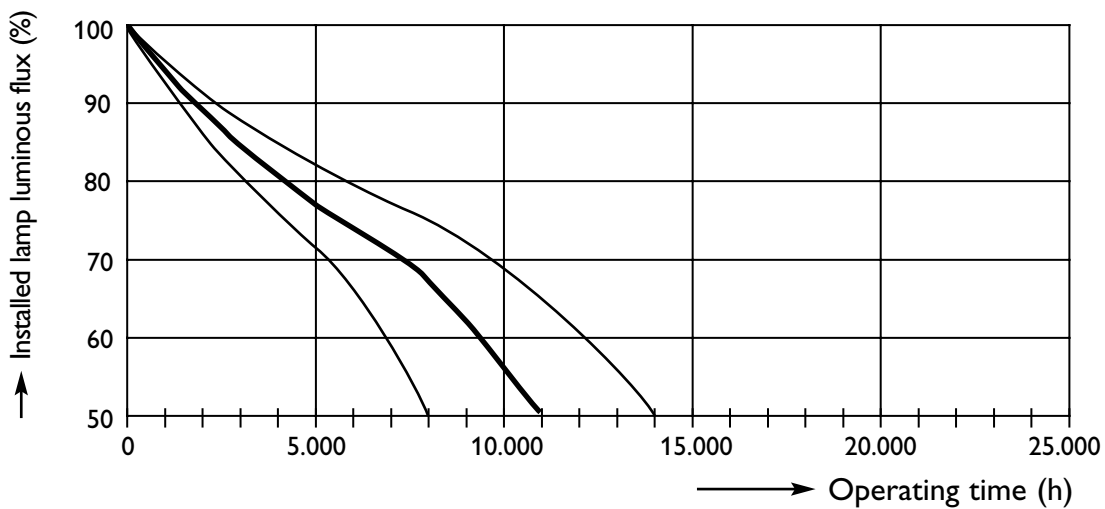
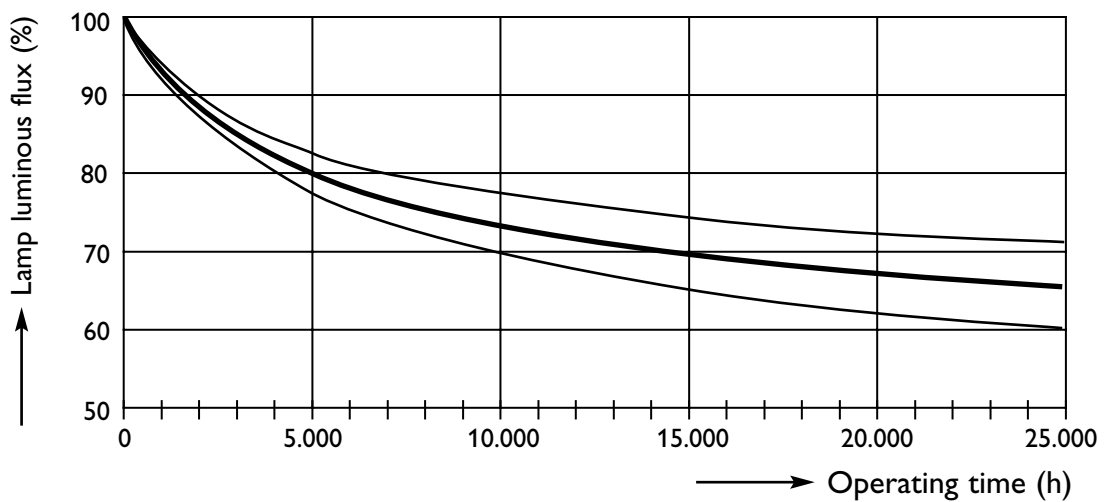
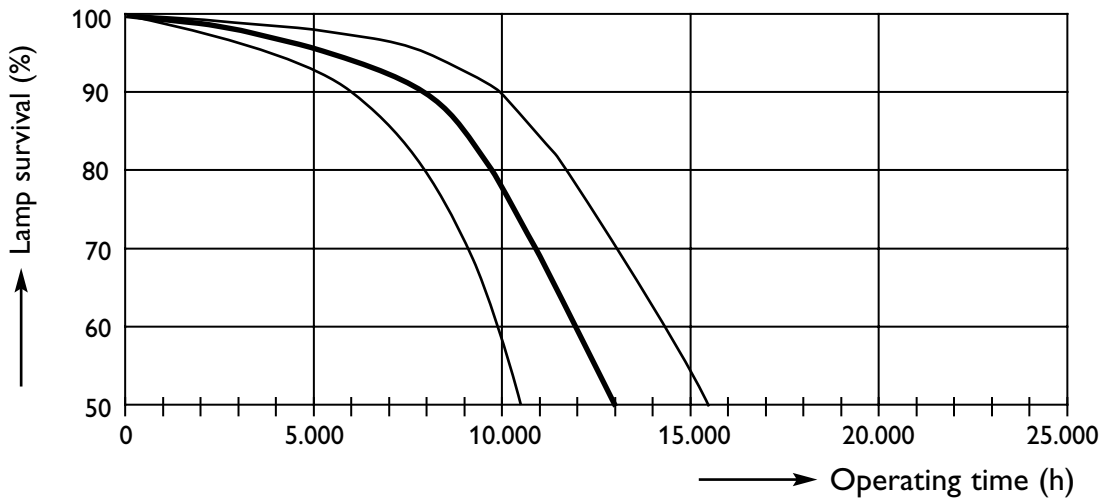
For further details see Introduction and tables (3.1-3.3)

01	Fluorescent lamps Ø 26 mm (T8)	VVG	18-58 W 3-Band-Phosphor	Annex 3
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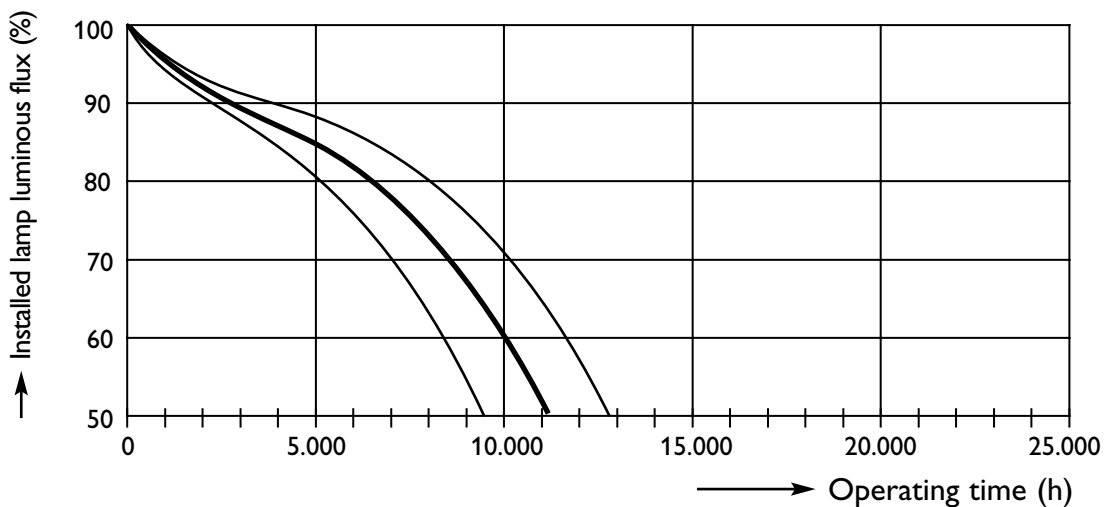
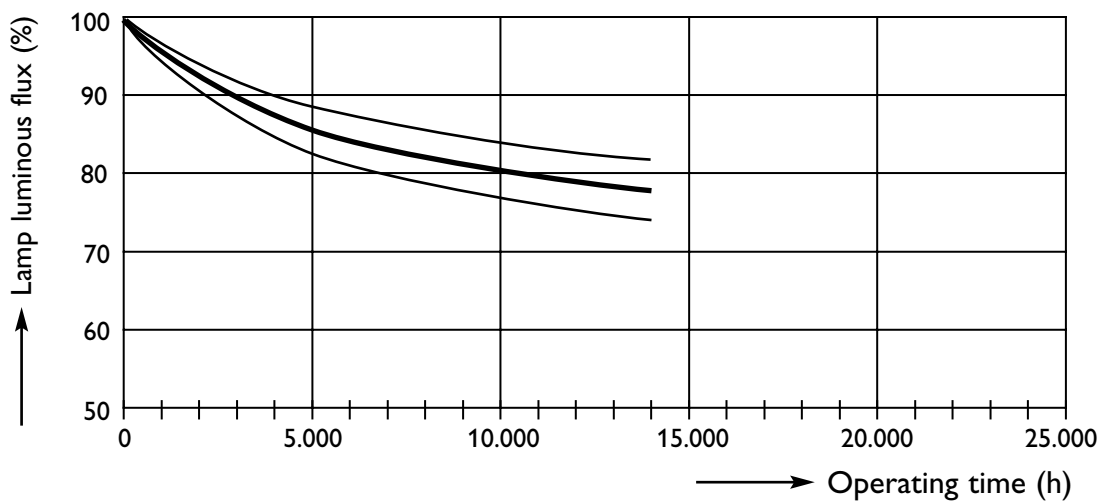
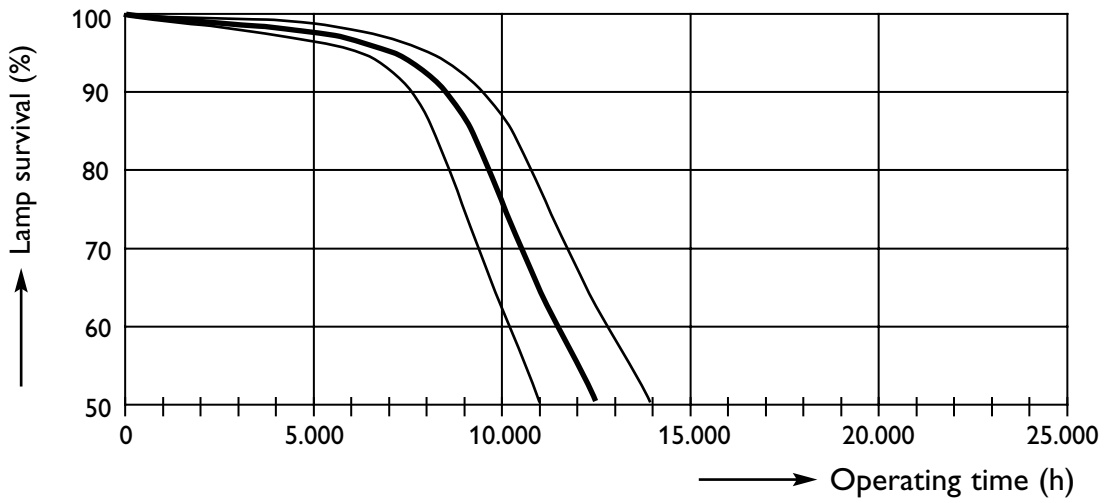
For further details see Introduction and tables (3.1-3.3)

01	Fluorescent lamps Ø 26 mm (T8)	VVG	18-58 W Standard phosphor	Annex 4
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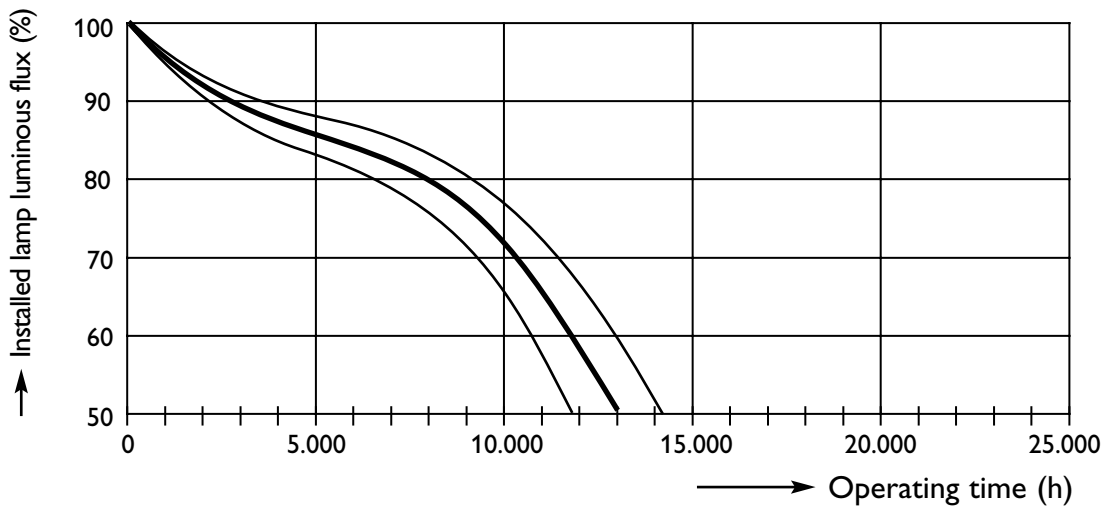
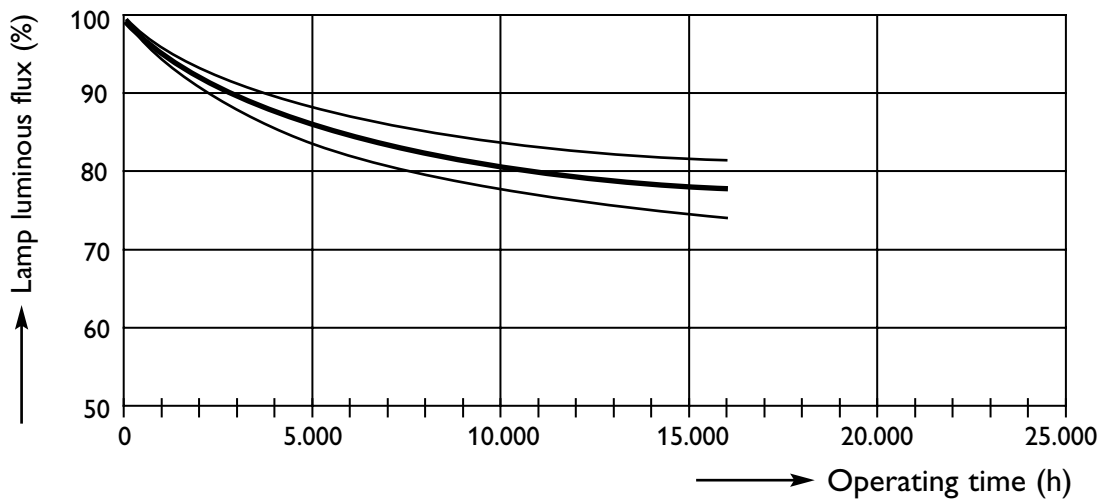
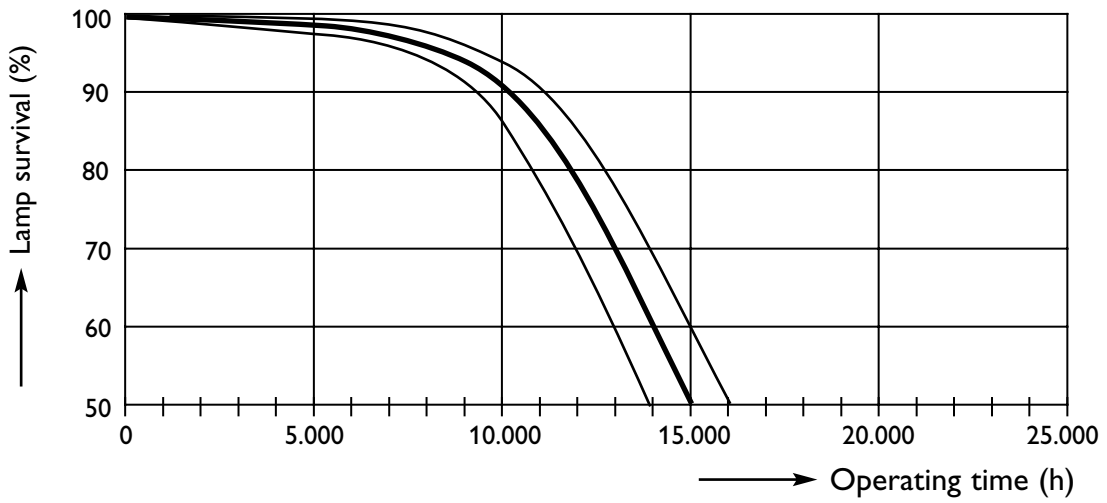
For further details see Introduction and tables (3.1-3.3)

02	Single-capped fluorescent lamps, external ballast	EVG	Dual-shaped and multi-limbed shaped 5-42W, cap 2G7 and GX24q	Annex 5
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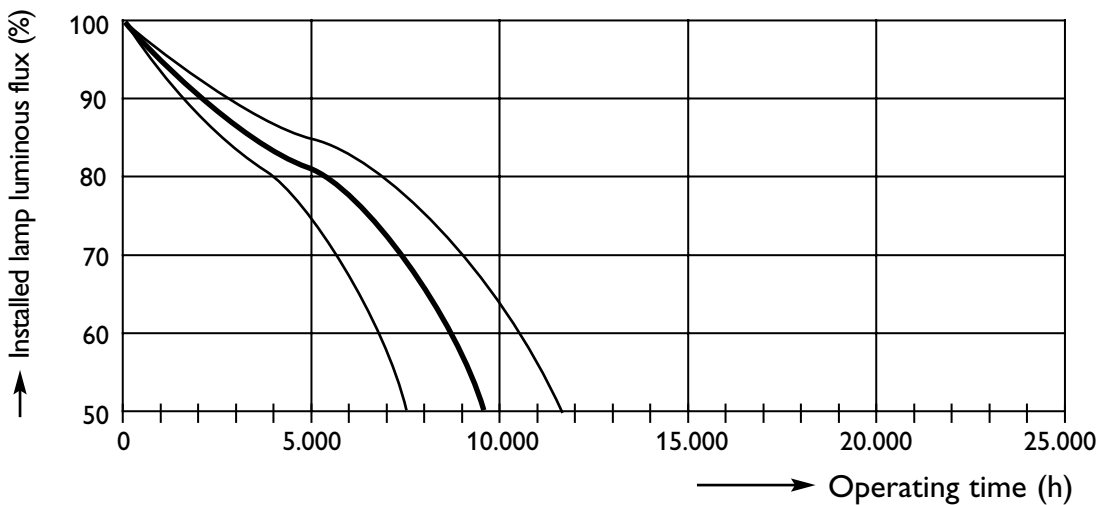
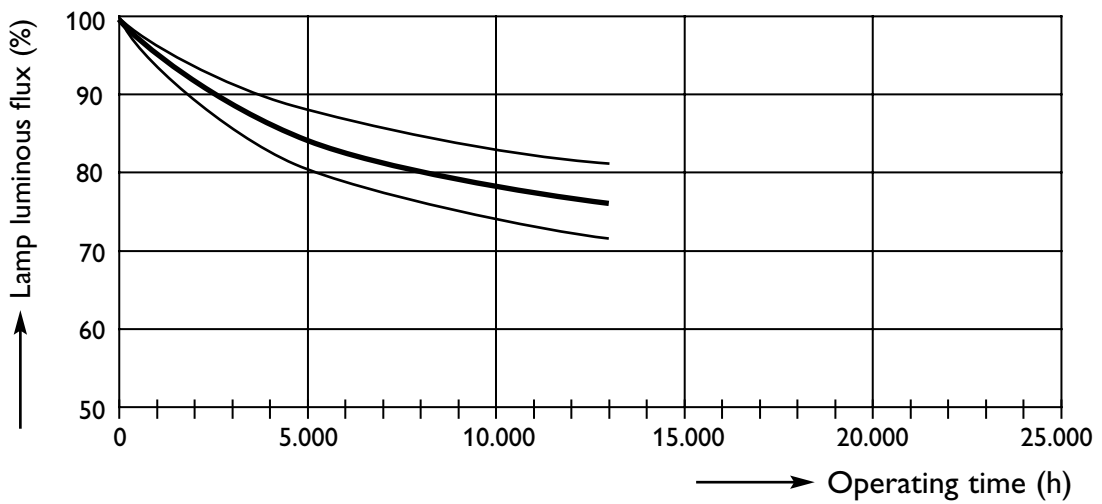
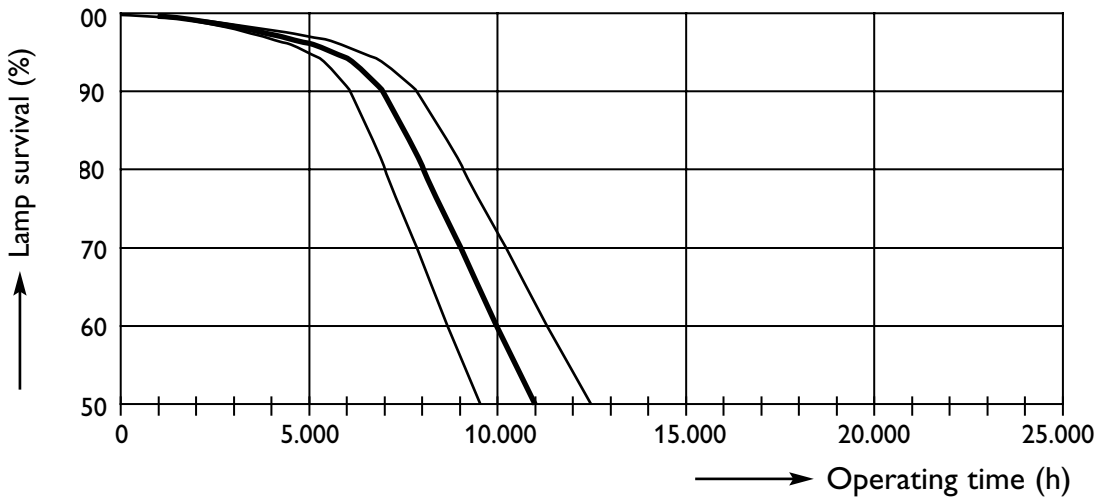
For further details see Introduction and tables (3.1-3.3)

02	Single-capped fluorescent lamps, external ballast	EVG	Quad-shaped 10-26 W, cap G24q	Annex 6
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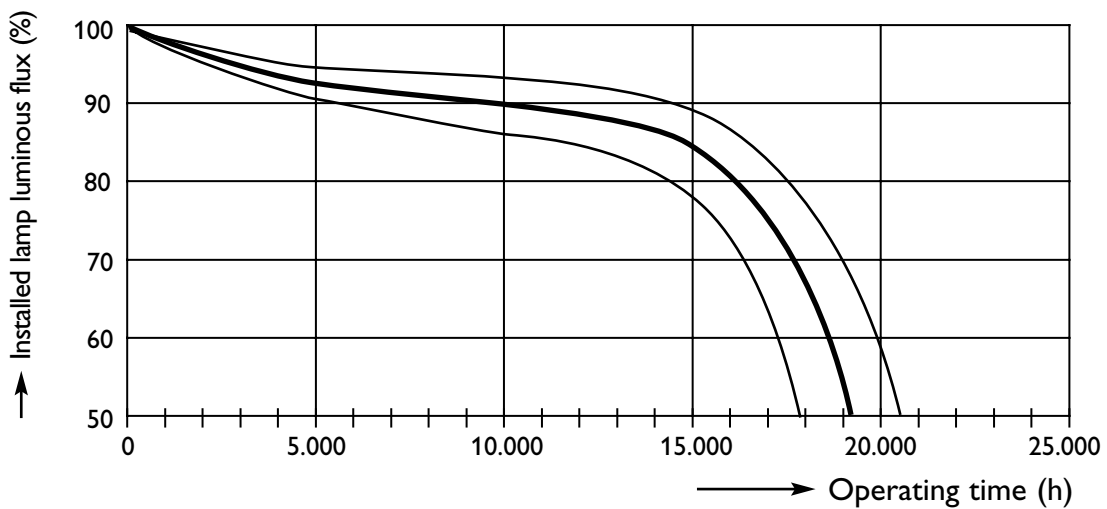
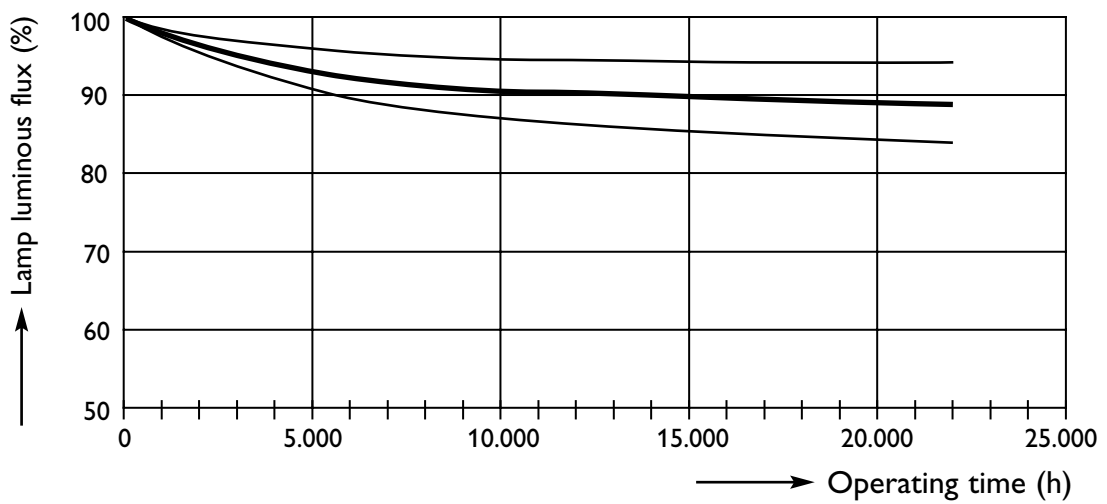
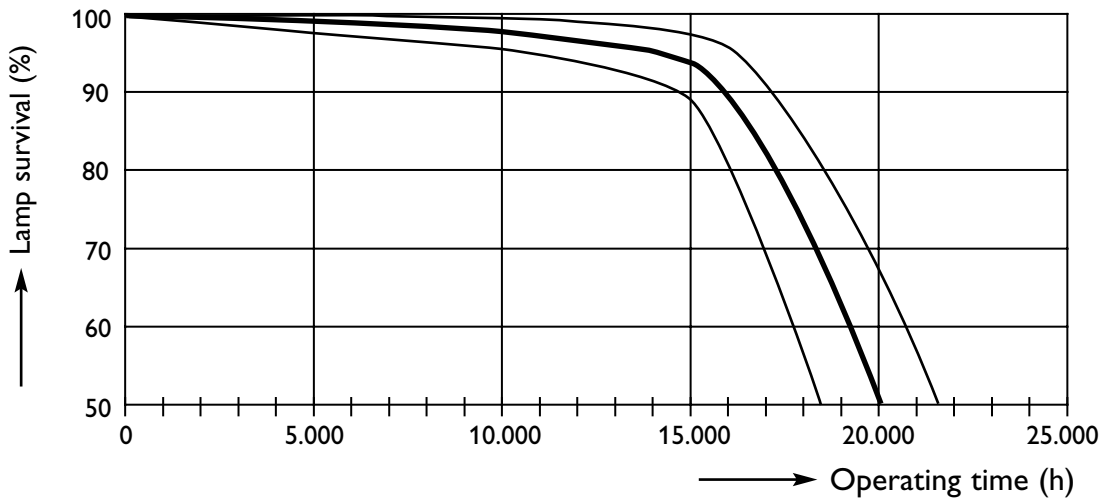
For further details see Introduction and tables (3.1-3.3)

02	Single-capped fluorescent lamps, external ballast	VVG	Dual-shaped, quad-shaped and multi-limbed shaped 5W-26W, cap G23, G24d and GX24d	Annex 7
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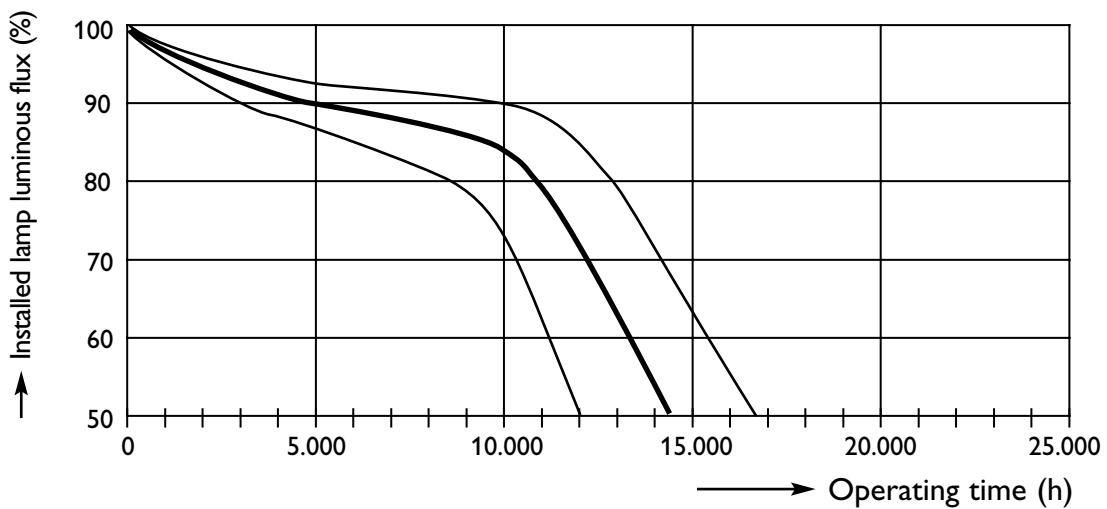
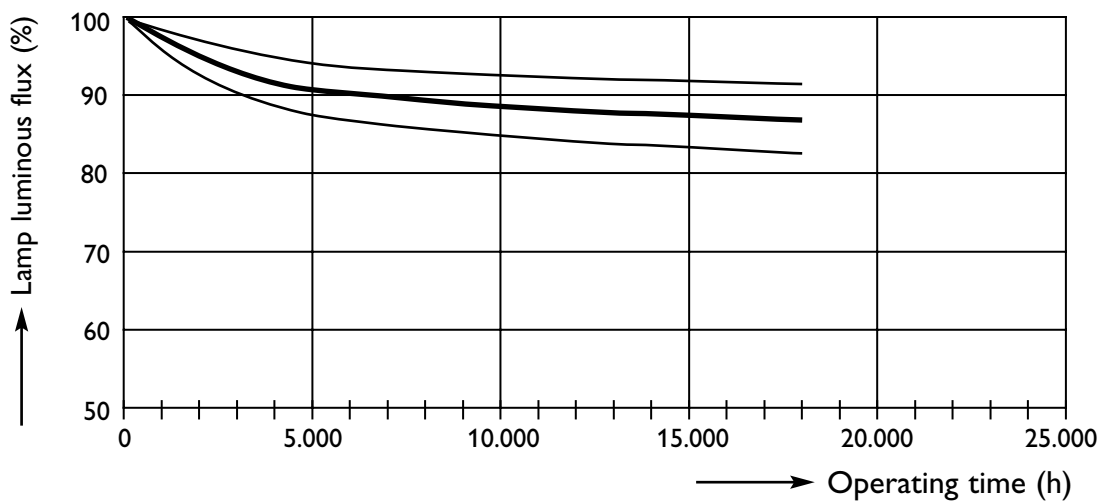
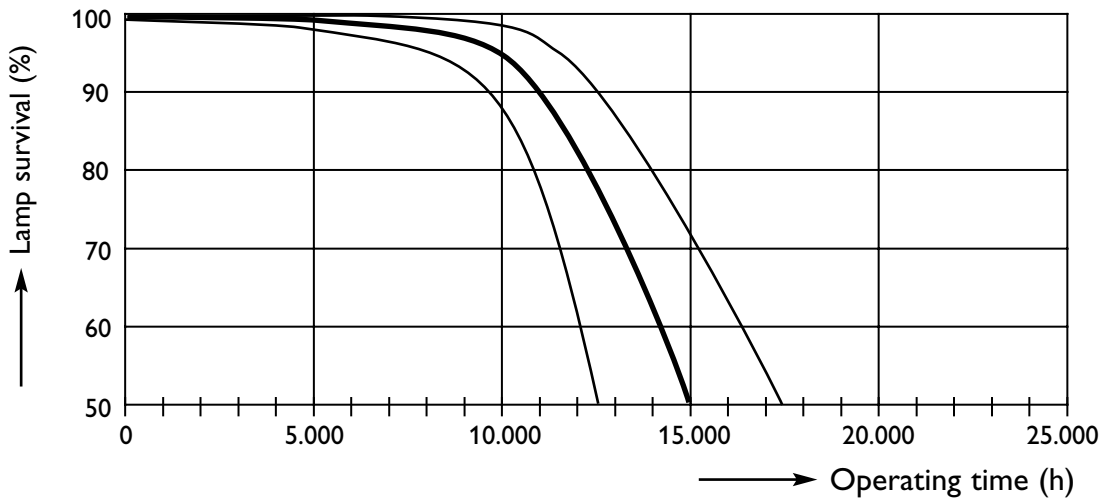
For further details see Introduction and tables (3.1-3.3)

02	Single-capped fluorescent lamps, external ballast	EVG	18-80 W cap 2G11	Annex 8
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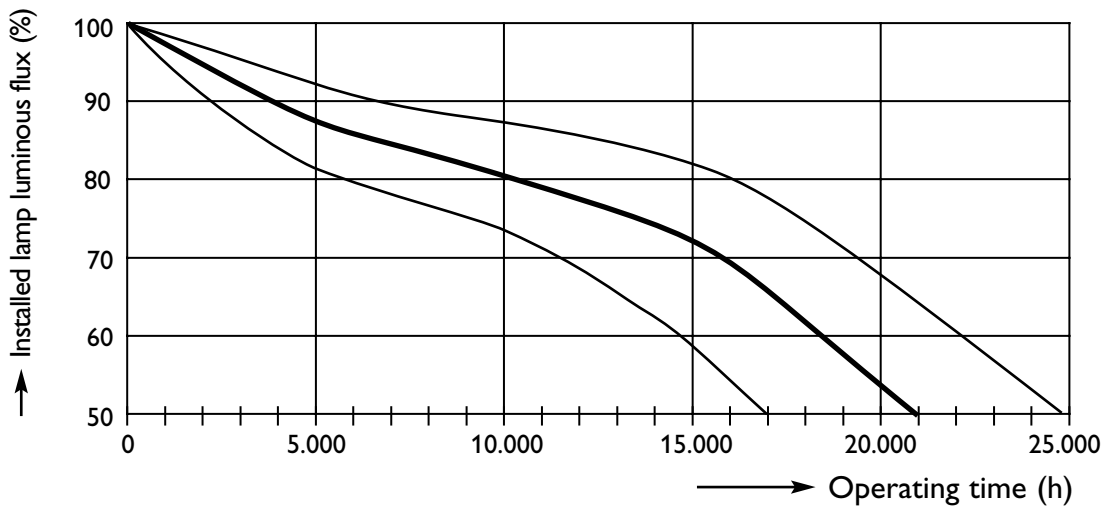
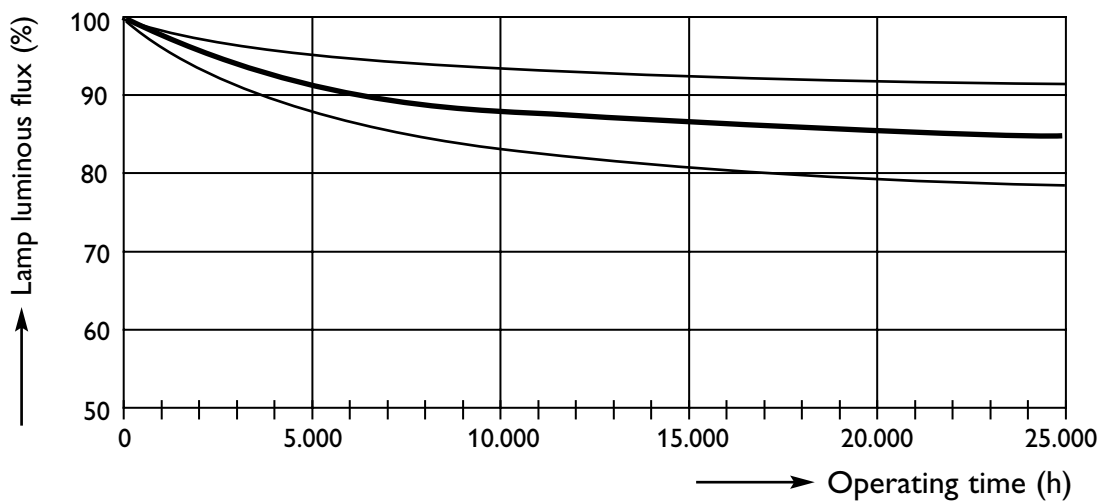
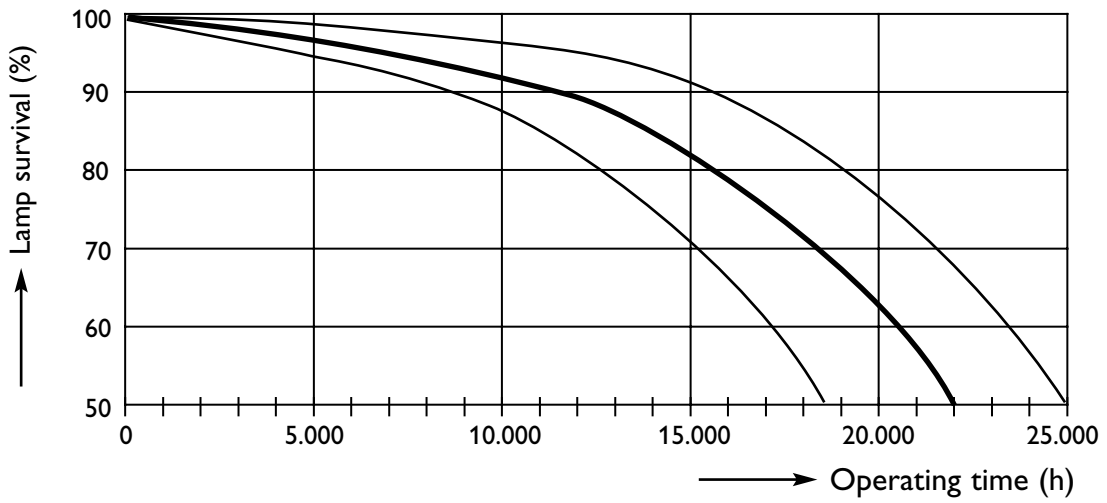
For further details see Introduction and tables (3.1-3.3)

02	Single-capped fluorescent lamps, external ballast	VVG	18-36 W cap 2G11	Annex 9
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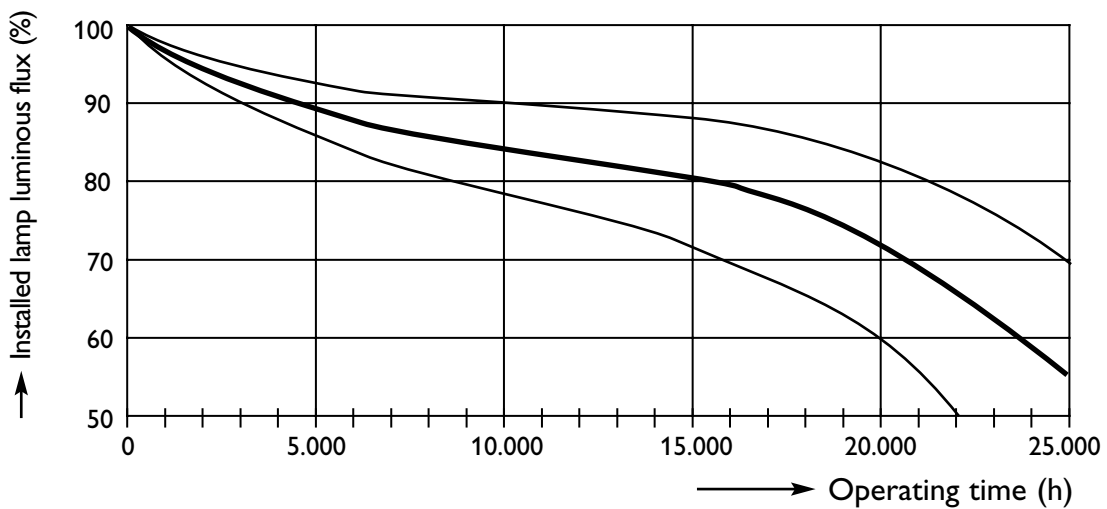
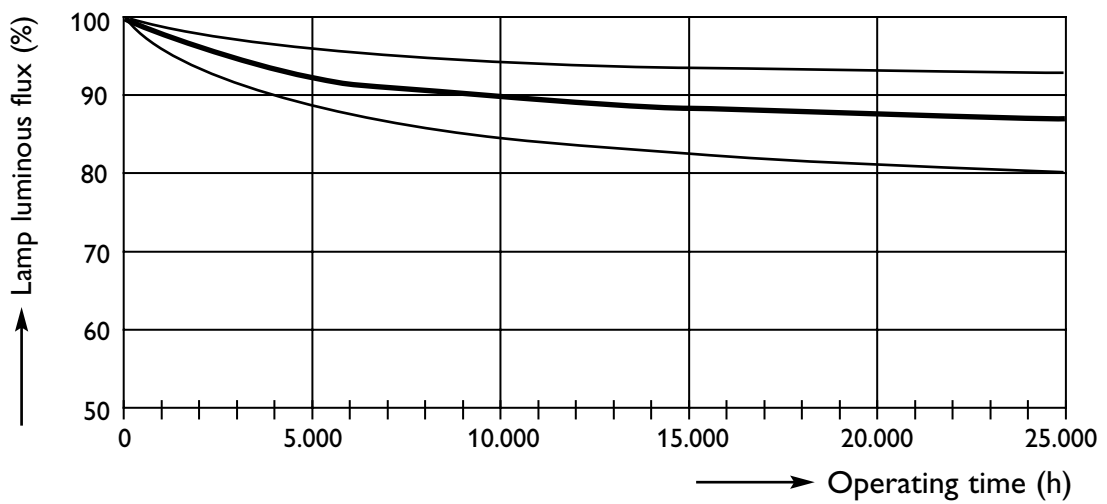
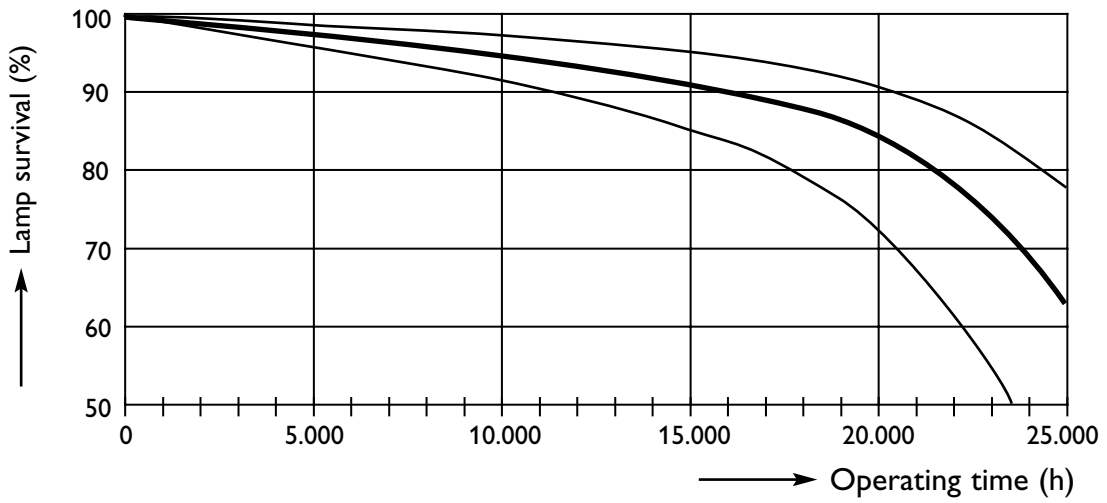
For further details see Introduction and tables (3.1-3.3)

04	High-pressure sodium vapour lamps	KVG	50W and 70 W	Annex 10
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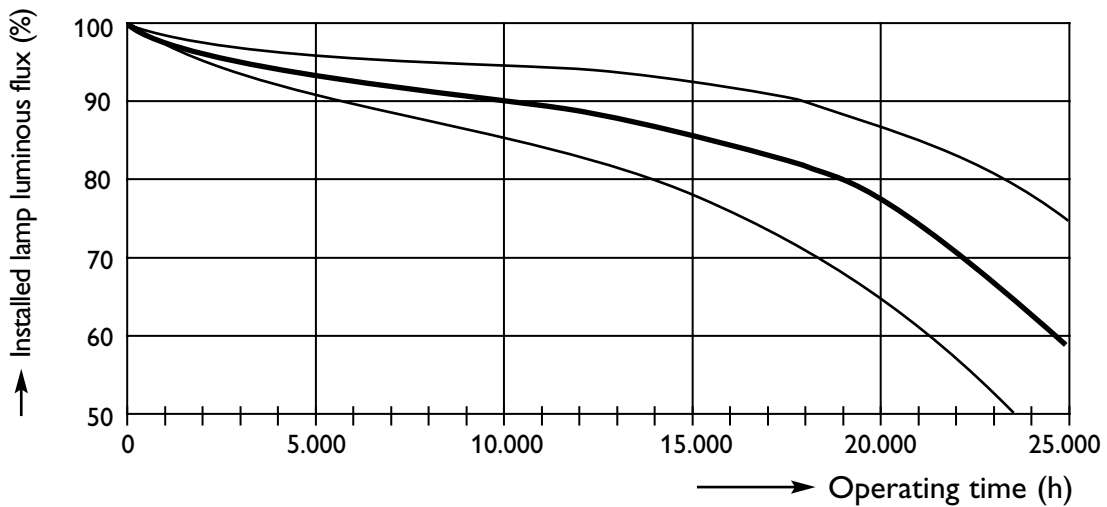
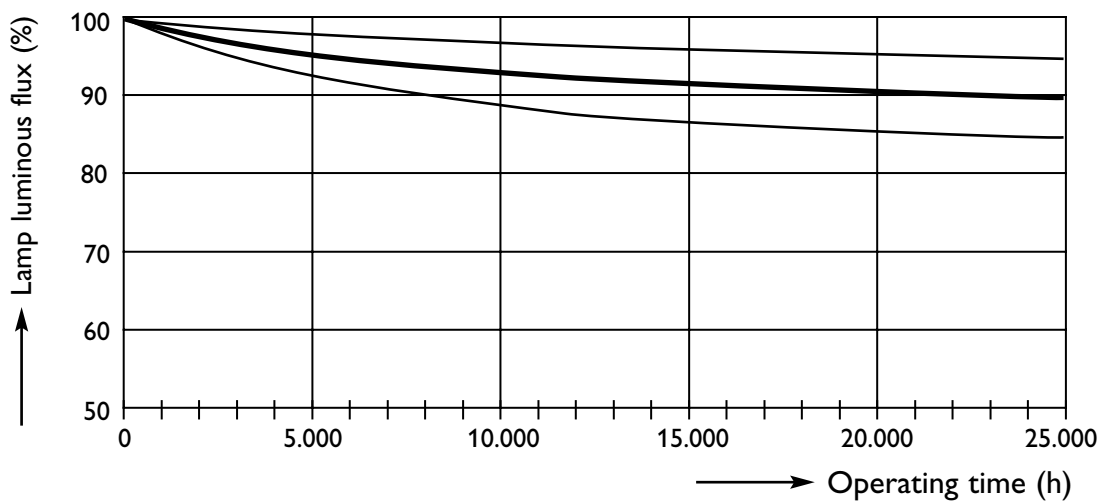
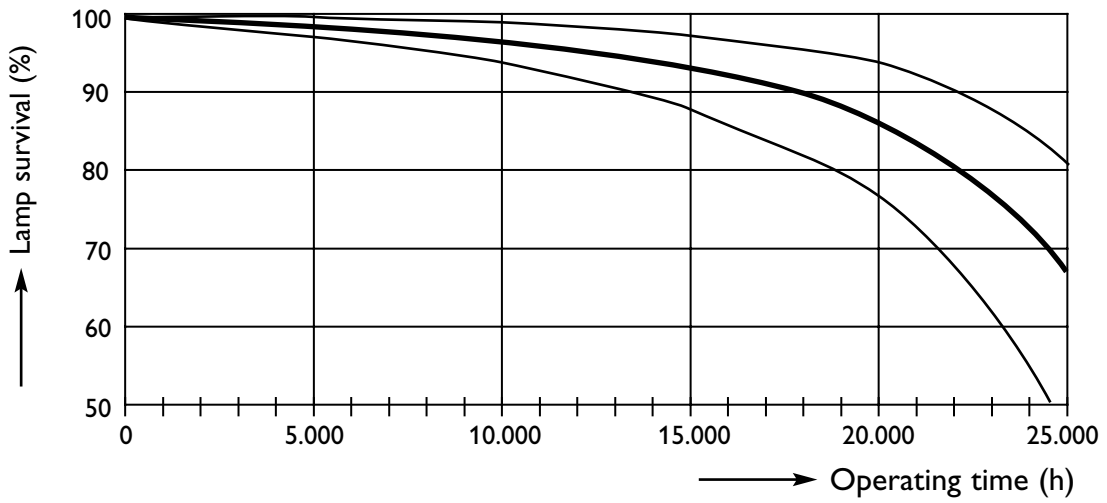
For further details see Introduction and tables (3.1-3.3)

04	High-pressure sodium vapour lamps	KVG	150-400 W standard luminous flux	Annex 11
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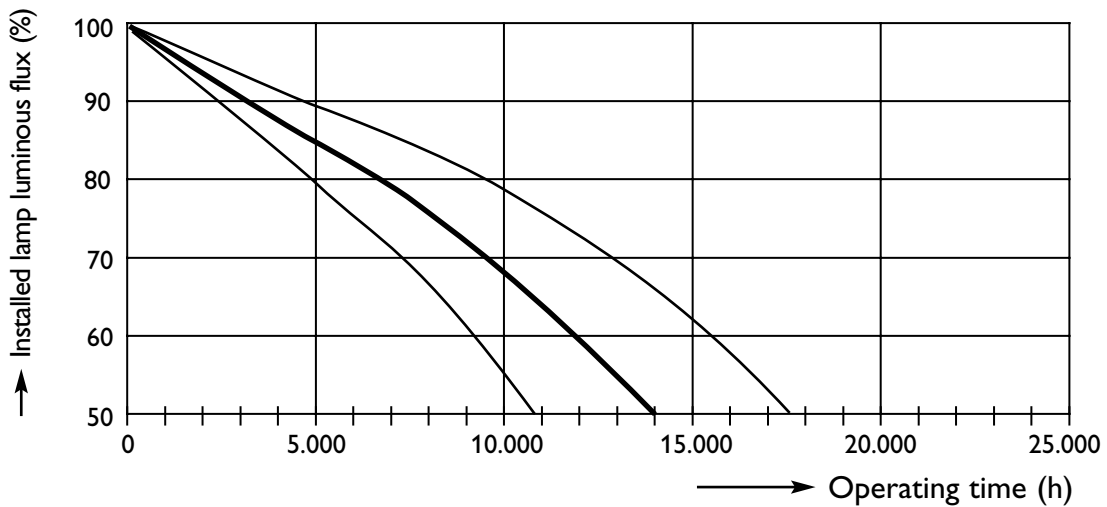
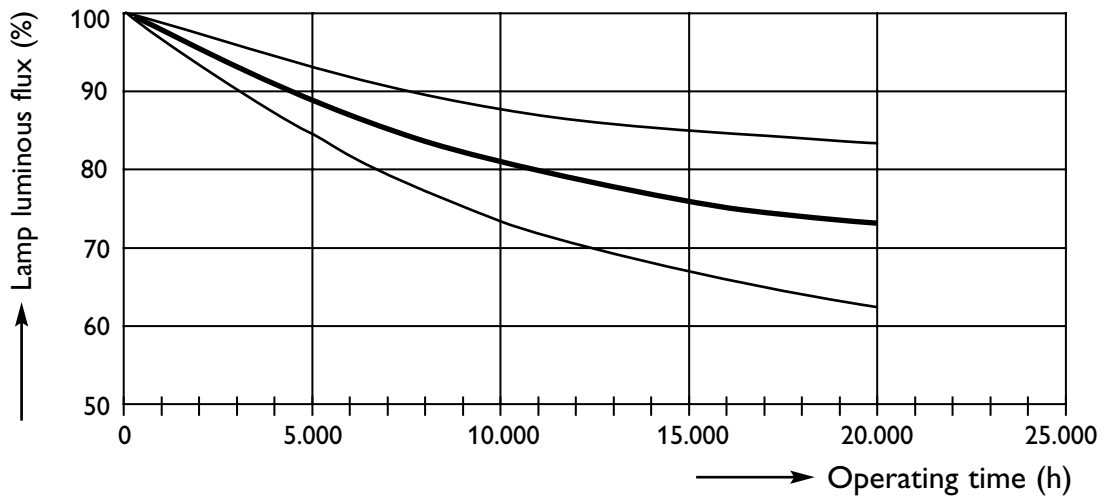
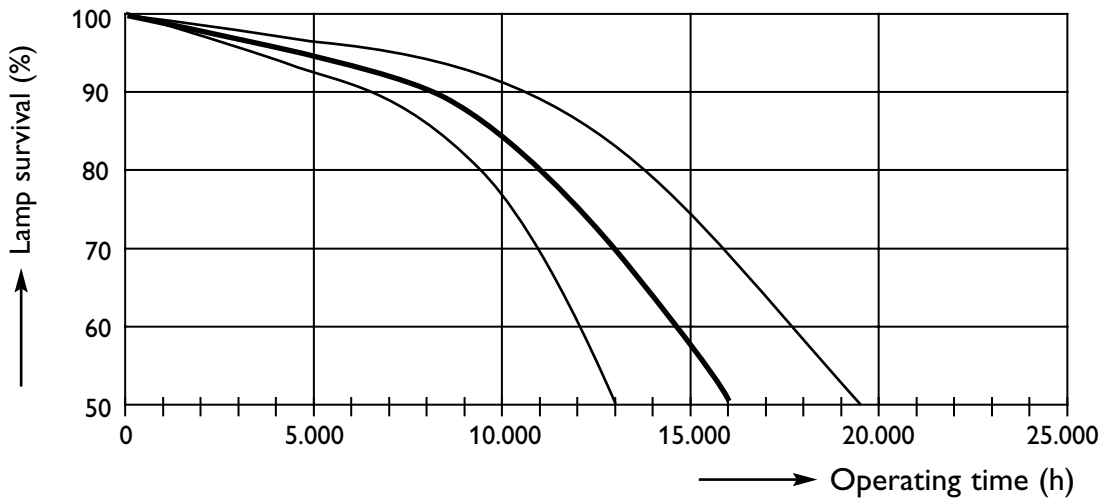
For further details see Introduction and tables (3.1-3.3)

04	High-pressure sodium vapour lamps	KVG	100-400 W increased luminous flux	Annex 12
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For further details see Introduction and tables (3.1-3.3)

06	High-pressure mercury vapour lamps	KVG	50-1000 W standard	Annex 13
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For further details see Introduction and tables (3.1-3.3)