



THE HIGHWAYS AGENCY

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THE SCOTTISH OFFICE DEVELOPMENT DEPARTMENT



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THE DEPARTMENT OF
THE ENVIRONMENT FOR NORTHERN IRELAND

Design of Road Lighting for All-Purpose Trunk Roads

Summary: This Departmental Standard sets out the design objectives and procedures for lighting on all-purpose Trunk Roads.

VOLUME 8	TRAFFIC SIGNS AND LIGHTING
SECTION 3	LIGHTING

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**DESIGN OF ROAD LIGHTING FOR
ALL-PURPOSE TRUNK ROADS**

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1. INTRODUCTION

1.1 This Departmental Standard implements the 1987 revisions of British Standard BS 5489: Road Lighting: Part 1: Guide to the general principles (Ref 1) and Part 2: Code of Practice for Lighting for Traffic Routes (Ref 2). This Departmental Standard makes specific choices from the options given in Reference.

1.2 This Standard gives the design objectives for planning effective road lighting on all-purpose trunk roads. Road safety at night is the main consideration in designing road lighting system.

1.3 The luminance method design procedure in this Standard introduces the preparation of alternative road lighting designs in performance terms. Performance is expressed in the photometric terms of road surface luminance level and uniformity with glare control, and the effect on these of varying several parameters can be tested. The procedure taken into account the expected operation and maintenance procedures, safety and environmental factors and lamp and lantern developments.

1.4 Applying the Departmental Advice Note TA 49/86 (Ref 3) leads to the decision on whether road lighting should be provided.

1.5 The above Advice Note (Ref 3) also indicates which modes of lighting are likely to be preferable in both economic and environmental terms. Such preliminary indications are subject to confirmation or modification during the design stage, since they depend on various environmental, safety, geometric and operating constraints and assumptions.

2. SCOPE

2.1 This Standard sets out the performance requirements and procedures which shall be adopted for the design of road lighting on all-purpose trunk roads, except that which is in tunnels.

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3. PERFORMANCE REQUIREMENTS

3.1 General

3.1.1 Road Lighting for all-purpose trunk roads shall be designed accordance with the general principles, relevant performance requirements and design procedure of BS 5489 (Refs 1, 2, 5).

3.1.2 The objective is to achieve:-

- (a) The quantifiable requirements of luminance level, luminance uniformity (overall and longitudinal) and glare control.
- (b) The subjective requirements of visual guidance and appearance by day and by night.

3.1.3 The design procedure in Section 5 introduces the preparation of road lighting designs in performance terms, taking the required characteristics of equipment, environmental factors and maintenance procedures into account.

3.2 Quantifiable Performance Requirements

The design objectives for road lighting systems are now expressed in performance terms using the three photometric measures introduced in paragraphs 1.3 and 3.1, which can be calculated at the design stage. The requirements for the lighting equipment to provide that performance are set out in paragraph 3.4.

3.2.1 Luminance level and uniformity requirements for all-purpose trunk road lighting shall be as in categories 1 and 2 of Table 1 in Reference 2.

3.2.2 Glare control requirement shall be in terms of Threshold Increment (TI) as follows, referring to the lighting categories in Table 1 in Reference 2.

- (a) On high speed and dual carriageway roads with category 1 lighting, the value of TI shall not exceed 15%.
- (b) For installations on other roads with category 2 lighting, except where there are special requirements (see paragraph 3.2.2 below), the value of TI shall not exceed 30%.

3.2.3 Special light control shall be required:

- (a) In the vicinity of airfields, where luminous intensity above the horizontal shall be limited (see Ref 5),
- (b) In the vicinity of railways, docks and navigable waterways (see Ref 5),
- (c) In environmentally sensitive areas, where stray or spill light would otherwise be regarded as unacceptable and visually intrusive (see Ref 1),
- (d) In the vicinity of astronomical observatories (see Ref 6).

3.3 Subjective Performance Requirement

The requirements for visual guidance and performance by day and night shall be as in Reference 1 and 2.

3.4 Equipment Performance Requirements

3.4.1 Equipment shall comply with the appropriate British Standard or International Standard. See Appendix A for a list of British and other Standards applicable to equipment used in all-purpose trunk road lighting.

3.4.2 The installation of road lighting as a part of constructional improvement work to an all-purpose trunk road shall be as set out in the Department's Specification for Highway Works (Ref 7).

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4. DECISIONS PRIOR TO DESIGN

4.1 Mounting Height

Mounting Height shall be in accordance with the options set out in Reference 2.

4.2 Limitation of Glare

The performance requirements of Section 3 of this Standard shall be met by the selection of lanterns as described in Reference 2, except in the special circumstances described in paragraph 3.2.3. In those cases, type FCO or AOR or other lanterns with specific light control requirements (see Refs 5, 6) shall be selected.

4.3 Lamp Type

Designs for road lighting schemes shall be prepared for both high pressure sodium (HPS) and low pressure sodium (LPS) lamp types, except where the choice is determined by specific site considerations (refs 1, 2, 5 and 6). A comparison of whole life present value of costs (PVC) for the two designs allows the most cost effective option to be chosen. The method for computing present value of costs is described in Departmental Advice Note TA 49/86 (Ref 3).

4.4 Overhang

Overhang shall be in accordance with the options set out in Reference 2.

4.5 Lantern Arrangement

Lantern arrangement shall be in accordance with the options set out in Reference 2.

4.6 Maintenance Factor

Maintenance factors, as defined in Reference 2, within the range of value 0.79 to 0.94 shall be taken for design from Table 4 of Reference 2 where:-

- (a) The IP rating, as defined in BS 5490 (Ref 8), of the lamp housing is IP 54 (see paragraph 4.7).
- (b) The proposed cleaning interval is in the range 12 to 36 months (see paragraph 4.8).
- (c) The category of environmental atmospheric pollution is identified (see Ref 2).

4.7 Lantern Enclosure (IP) Rating

The lantern enclosure including the lamp housing shall have a minimum degree of ingress protection rating of IP 54, as defined in References 2 and 8.

4.8 Cleaning Interval

The normal cleaning interval shall be not less than 12 months.

4.9 Road Surface

Design tables based on the 'representative British road surface' as given in Table 3 or Reference 2 shall be used. However a more economical lighting design is possible if a concrete road service is to be used.

The alternative enhanced reflection properties for a concrete surface shall be presented in the form of an 'r-table' as described in the CIE/PIARC Joint Technical Report (Ref 9).

If at a later stage the concrete surface is overlaid with bituminous material then the lighting shall be re-assessed.

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5. DESIGN PROCEDURE

5.1 Normal Design Procedure

The design procedure shall be that set out in Reference 2, except where special factors as given in paragraph 5.2 apply.

5.2 Modified Design Procedure

In the special cases given below, the design procedure of paragraph 5.1 shall be modified as far as practicable to allow particular features to be taken into account these features include:-

- (a) Unconventional road layouts outside the scope of References 2 and 5.
- (b) Enhanced road surface reflection characteristics (see paragraph 4.9).
- (c) Mounting height between or above 8, 10 and 12 metres covered in Reference 2.
- (d) Tighter glare or light-spill limitation requirements (see paragraph 3.2.3).

5.3 Alternative Design Procedure

In the special cases of paragraph 5.2, where modifications to the requirements of paragraph 5.1 render the design tables inapplicable:-

either

- (a) the full circulation method in Appendix B of Reference 2,
- (b) one of the CIE full luminance design computer programs as listed in CIE Publication 30-2 (Ref 4) of their derivatives

shall be used, together with the appropriate lantern 'I-tables' and road surface 'r-tables' (see Refs 2, 9).

5.4 Consultations

Consultations may be necessary during the design procedure in order to:

- (a) Eliminate as far as possible any confusion with air or water navigation lights, railway signals or the safe operation of other services.
- (b) Identify the most appropriate and acceptable mode of lighting for locations in environmentally sensitive and conservation areas.

For those situations where consultation is considered necessary, a typical list of consultees is given in Appendix B. This may vary to suit local circumstances.

6. DESIGN DOCUMENTATION

6.1 General

A full record of the design adopted (Section 5) shall be compiled by the Department's design agent and retained for inspection by the Department.

6.2 Design Records

The design records shall be in sufficient detail (eg performance requirements, design parameters, assumptions about safety, operational and maintenance conditions, calculation methods and results) and in suitable form for:

- (a) Any necessary checking or consideration of alternatives (see Section 4).
- (b) Any necessary consultations (see paragraph 5.4)
- (c) Use in the preparation of site-specific working drawings, schedules, and appendices, in accordance with the Department's Specification for Highway Works (Ref 7).
- (d) Reference during the subsequent installation and commissioning work including the preparation of 'as-built' drawings (Ref 7).
- (e) Inventory purposes during the subsequent operation and maintenance procedures (Refs 10, 11).
- (f) The recording of any subsequent alteration in safety, operational and maintenance conditions that affect the design.

7. REFERENCES

1. British Standard BS 5489. Road Lighting. Part 1. Guide to the general principles. 1987.
2. British Standard BS 5489. Road Lighting. Part 2. Code of practice for lighting for traffic routes. 1987.
3. Departmental Advice Note TA 49/86. Appraisal of New and Replacement Lighting on Trunk Roads and Trunk Road Motorways. Department of Transport. 1986.
4. Commission Internationale de l'Eclairage. Calculation and measurement of luminance in road lighting. CIE Publication No. 30.2 (TC-4.6). CIE. 1982.
5. British Standard BS 5489. Road Lighting. Part 8. Code of practice for lighting for roads near aerodromes, railways, docks and navigable waterways. 1987.
6. International Astronomical Union/Commission Internationale de l'Eclairage. Guidelines for minimising Urban Sky Glow near Astronomical Observatories. IAU/CIE Publication No. 1. CIE. 1980.
7. Department of Transport. Specification for Highways Works. 6th Edition. HMSO. 1986.
8. British Standard BS 5490. Specification for classification of degrees of protection provided by enclosures. 1977 (1985).
9. Commission Internationale de l'Eclairage/Permanent International Association of Road Congresses. Road Surfaces and Lighting. Joint technical report CIE/PIARC. CIE Publication No. CIE. 1984.
10. Departmental Standard TD 23/86. Trunk Roads and Trunk Road Motorways - Maintenance of Road Lighting. Department of Transport. 1986.
11. Departmental Code of Practice for Routine Maintenance. Department of Transport. 1985 (as amended).

8. ENQUIRIES

WITHDRAWN

LIST OF BRITISH STANDARDS

Note: This list is not comprehensive.

A.1. BS 5489: Road Lighting	
Part 1	Guide to the general principles
Part 2	Code of practice for lighting for traffic routes
Part 3	Code of practice for lighting for subsidiary roads and associated pedestrian areas
Part 4	Code of practice for lighting to single level road junctions including roundabouts
Part 5	Code of practice for lighting for grade separated junctions
Part 6	Code of practice for lighting for bridges and elevated roads
Part 7	Code of practice for lighting for tunnels and underpasses
Part 8	Code of practice for lighting for roads near aerodromes, railways, docks and navigable waterways.
Part 9	Code of practice for lighting on urban centres and other public amenity areas.
Part 10	Code of practice for lighting for motorways (in preparation)
A.2 Lanterns	
BS 4533:	Luminaires
Part 101	General requirements and tests: 1981
Part 102	Particular requirements Section 102.3 Luminaires for road and street lighting: 1981
Part 103	Performance requirements Section 103.1 Light distribution from load-lighting lanterns: 1981 (due for amendment 1987)
A.3 Enclosure (IP) rating	
BS 5490:	Specification for classification of degrees of protection provided by enclosures: 1977 (1985)
A.4 Lighting columns	
BS 5649:	Lighting columns implemented in accordance with Departmental Standard BD 26/86 Design and Supply of Lighting Columns, and the Department's Specification for Highway Works 1300 series. 6th edition. HMSO, 1986

Appendix A

A.5 Lamps

BS 3767: Low pressure sodium vapour lamps: 1982

IEC 662: High pressure sodium vapour lamps: 1980 with Amdt No. 1: 1986

A.6 Ballasts

BS 4782: Ballasts for discharge lamps (excluding ballasts for tubular fluorescent lamps): 1971 with amd's to 1982.

A.7 Capacitors

BS 4017: Capacitors for use in tubular fluorescent, high pressure mercury and low pressure sodium discharge lamp circuits: 1979

A.8 Photo-electric Control Units (PECUs)

BS 5972: Specification for photo-electric control units for road lighting: 1980 under revision.

LIST OF CONSULTEES

Note: This is not an exhaustive list. The choice of consultees depends on local issues, as described in paragraphs 3.2.3 and 5.4.

(a) AIR AND WATER NAVIGATION AND SIGNAL ISSUES

- | | |
|---------------------------------------|-------------------------------|
| Civil Airports Authority | - Civil Airfields |
| Ministry of Defence | - Military Airfields |
| Trinity House | - Coastal Waters and harbours |
| Inland Waterways Navigation Authority | - Navigable waters |
| British Rail | |

(b) ENVIRONMENTAL ISSUES

- The Department of Transport's Landscape Advisors
- Royal Fine Art Commission (RFAC)
- English Heritage: Historic Buildings & Monuments Commission for England (HBMC)
- Civic Trust
- Professional Astronomers
- Planning Officers