

IESNA Seminar

Vancouver, BC

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**CANADIAN STANDARDS
ASSOCIATION**

C-653

**Optical Efficiency of
Roadway Luminaires**

History of C653

- First Edition published in 1992
- Second Edition published in 1994
- Re-Affirmed in 2000
- Under Review by Technical Sub-committee

What is CAN/CSA C653?

- Addition to CSA C22.2 Electrical Safety Standard
- Approved by;
 - Technical Committee on Performance of Industrial Equipment
 - Standards Steering Committee on the Performance of Electrical Products
- Approved as a National Standard of Canada by Standards Council of Canada

What is CAN/CSA C653-94?

- Minimum Optical Performance Standard for Cobra Head Luminaires
- Based on ANSI/IESNA RP-8-83 Luminance Method
- It is not a Design Standard
- Manufacturers must go to CSA to Obtain Certification

Scope of C653-94

- 50 - 400W HPS Cobra-head luminaires
- 70 - 400W HPS Cobra-head luminaires
Small and Medium Refractors made of
Glass, Polycarbonate or Acrylic
- Used for Streets, Roadways and Highways
- Applies only to Clear Lamps

Criteria Used in C653-94

- Minimum value for Avg. cd/m^2
 - One-side layout
 - Road Width = 10m (Three Lanes)
 - Mounting Height = 10m
 - Overhang = 1m
 - Pavement type = R3 ($Q_o = 0.07$)
 - LLF = 0.80
 - Luminaire Spacing = 60m

Criteria Used in C653-94

- Minimum value for Avg. cd/m^2
 - Orientation = 90° or 270°
 - Rotation = 0°
 - Tilt = 0°
 - Luminance Uniformity Ratio $\leq 5:1$
 - Veiling Luminance Ratio ≤ 0.3

Table 1
Performance Requirements of HPS Luminaires
(Not for Lighting Design)
(See Clauses 4.3 and 4.5.)

Refractor size	Rated lamp watts, W	Reference lamp lumens, lm	Maximum value, W/m ²	Minimum value average luminance, cd/m ²	
				July 1, 1994	January 1, 1996
Small	250	27500	0.417	1.03	1.08
	200	22000	0.333	0.82	0.86
	150	16000	0.250	0.42	0.63
	100	9500	0.167	0.25	0.37
	70	6000	0.117	0.16	0.24
	50	4000	0.083	0.11	0.16
Medium	400	50000	0.667	1.33	1.47
	250	27500	0.417	0.73	0.81
	200	22000	0.333	0.59	0.65
	150	16000	0.250	0.43	0.47
	100	9500	0.167	0.25	0.28
	70	6000	0.117	0.16	0.18
	50	4000	0.083	0.11	0.12

Drawbacks of C653-94

- All optics were measured against a single road geometry
- Only long narrow (ie Ty 2) photometrics could meet requirements
- Very few manufacturers applied for certification
- Very few designers called for certified luminaires

Energy Management

Implications for Reducing
Connected Load
and
Energy Costs

Energy Management Implications

- Effective Energy Management is Achieved if the Designer will Utilize:
 - Efficient luminaires & lamps with distributions suited to the task
 - Appropriate mounting heights & luminaire positioning
 - A good maintenance program to ensure system integrity & to maintain the design lighting level

Criteria for C653-05

- UPD Values based on optimized spacing using lowest usable HPS lamp wattage
- Calculations include a maintenance factor of 0.80
- Calculations based on IESNA RP-08-00 criteria for Luminance (Table 3)
- Approved Photometric data must also meet STV requirements from Table 4

Criteria for C653-05

- All IESNA RP-8-00 Road Classifications and Pedestrian Conflict Areas will be tested
- R1 and R3 pavement classifications will be tested in separate tables
- Lane widths are all assumed to be 3.75m
- Standard pole heights are chosen for each Road Width and Classification
- Full-Cutoff luminaires will be included in separate tables

Table of Maximum UPD for HPS Cobra-Head Luminaires

Roadway Classification		1 lane			2 lanes			3 lanes		
Road	Pedestrian Conflict Area	Mounting Height	Full cutoff	Dropped Prismatic	Mounting Height	Full cutoff	Dropped Prismatic	Mounting Height	Full cutoff	Dropped Prismatic
Freeway Class A		12M			12M			12M		
Freeway Class B		12M						12M		
Express Way	High							12M		
	Medium							12M		
	Low							12M		
Major	High				12M			12M		
	Medium				12M			12M		
	Low				12M			12M		
Collector	High				10M			10M		
	Medium				10M			10M		
	Low				10M			10M		
Local	High	7M			7M			7M		
	Medium	7M			7M			7M		
	Low	7M			7M			7M		

Roadway Classification		4 lanes			5 lanes		
Road	Pedestrian Conflict Area	Mounting Height	Full cutoff	Dropped Prismatic	Mounting Height	Full cutoff	Dropped Prismatic
Freeway Class A		15M			15M		
Freeway Class B		15M			15M		
Express Way	High	12M			12M		
	Medium	12M			12M		
	Low	12M			12M		
Major	High	12M			12M		
	Medium	12M			12M		
	Low	12M			12M		
Collector	High	10M			12M		
	Medium	10M			12M		
	Low	10M			12M		

Implications

- Still not a Design Guide
- Each Photometric file will be certified to qualify for specific Road Classifications and Widths
- It will provide more realistic testing of optical performance based on real conditions

Implications

- Manufactures more likely to apply for certification
- Utilities more likely to use in Standards
- Designers more comfortable that energy management criteria are realistic
- A lot of education will be required

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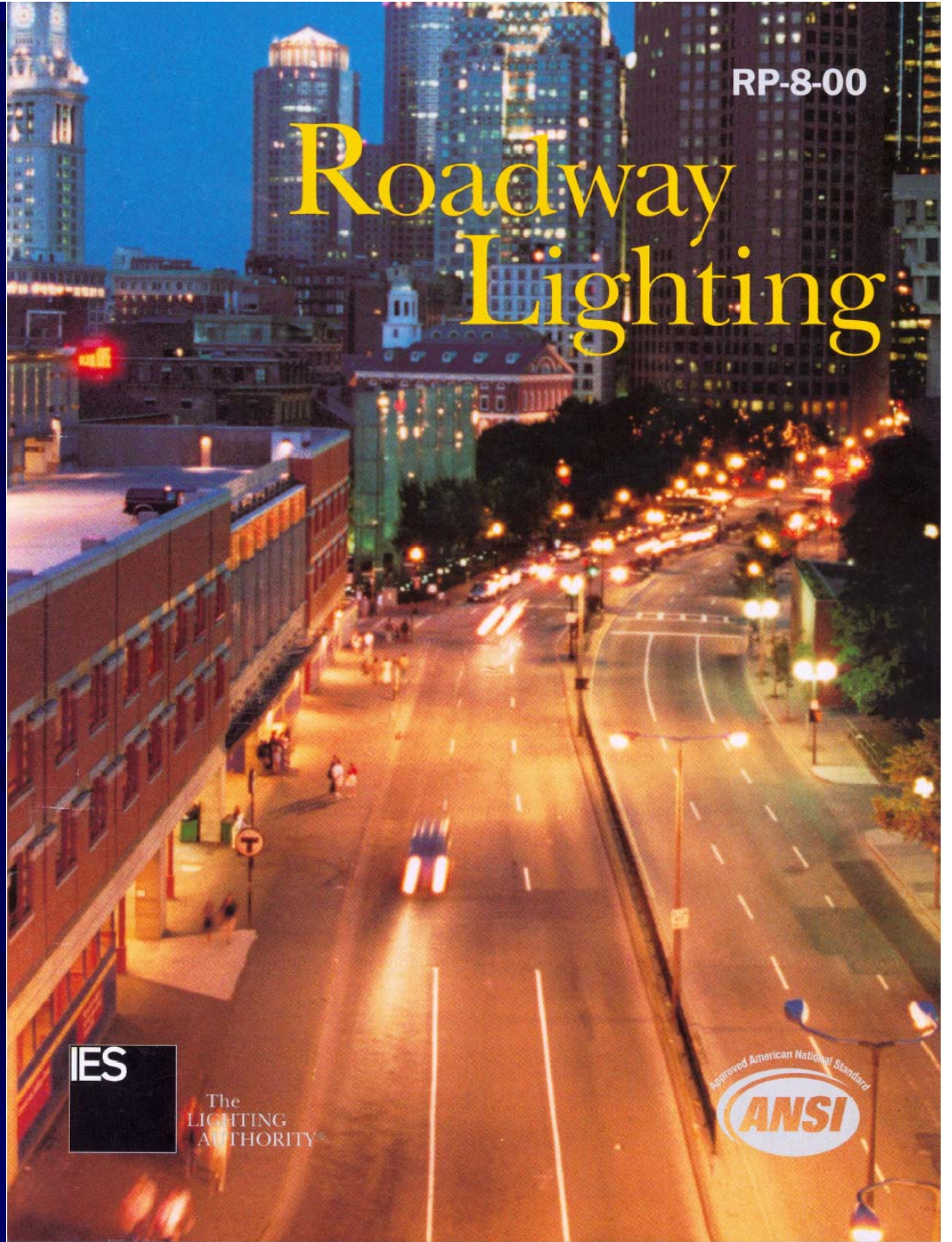
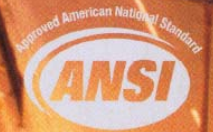
IESNA RP-8-00

RP-8-00

Roadway Lighting

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LIGHTING
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Design Criteria

IESNA Definitions

RP-8-00

Method Comparisons

- **Illuminance:**
 - Delivers Light To Road - Broad brush approach
- **Luminance:**
 - Pavement is uniformly visible to driver - Driver confidence
- **STV:**
 - Objects are visible - Driver and pedestrian Safety

Energy Management Implications

- Experience has shown that the luminance method;
 - Will usually reduce connected load per kilometer
 - Is a better predictor of good perceived lighting uniformity
- Good practice suggests that design should satisfy STV standards for safety.

Computer Program Analysis

- Illuminance calculations may be done manually but many computer programs exist to simplify
- Luminance and STV require computer program
- Some programs will calculate optimum spacing for given geometries and photometrics

Visual 2.3

AcuityBrands™



- Roadway Illuminance
- Roadway Luminance
- STV
- Optimization
- Available on Web @

www.americanelectricalighting.com

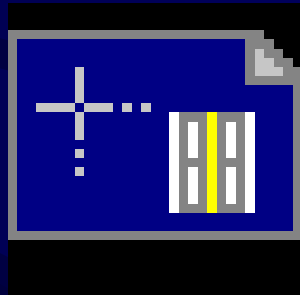
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Visual Roadway Tool

Visual 2.3 Design File for C653

Collector/Intermediate, 4 Lane

10 Meter Pole Height



4L 10M.RWT