Developing a Nighttime Traffic Sign Performance Evaluation Technique

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19th Biennial TRB Visibility Symposium
May 13, 2009

Acknowledgements

- Federal Highway Administration

- International Commission on Illumination Technical Committee 4-40: Requirements for Retroreflective Traffic Signs

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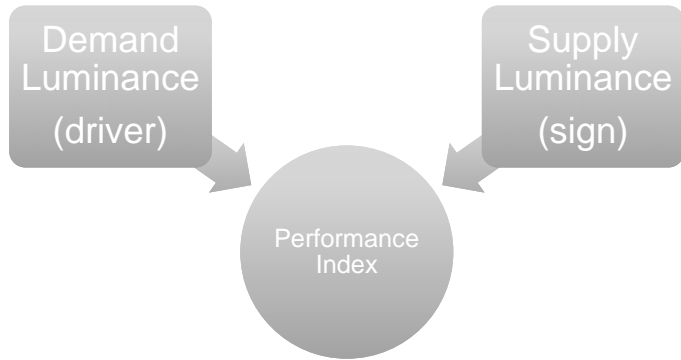## Overview

- Existing CIE Evaluation Process

- Development of Evaluation Process for Semi Trucks
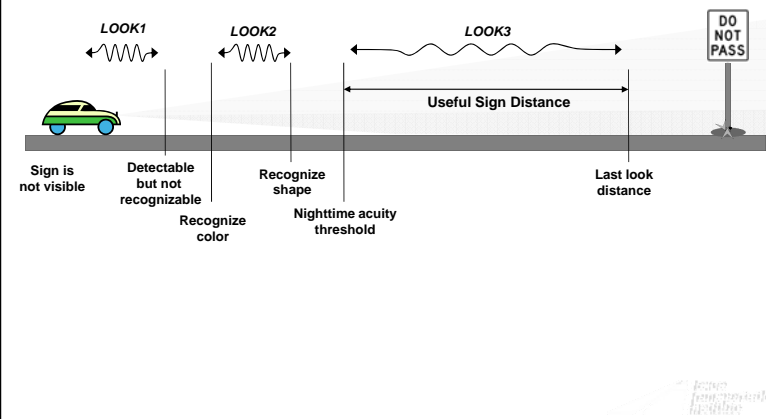
- Additional Evaluation Results
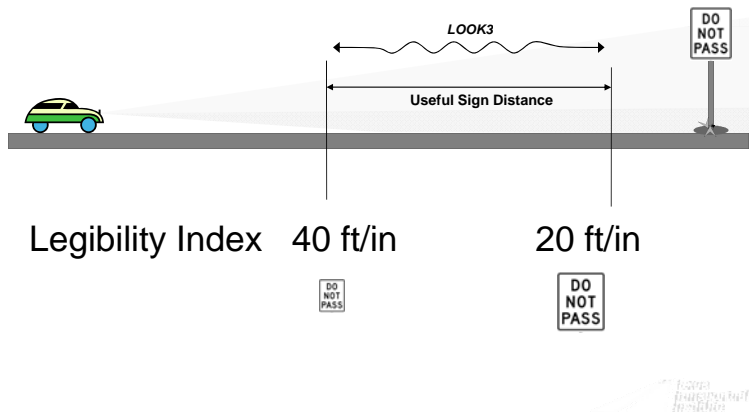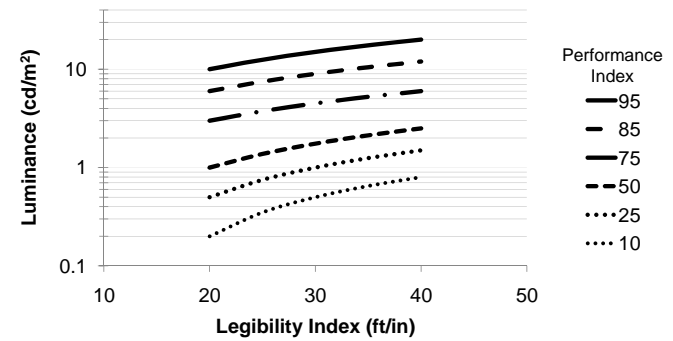

Reference Scenario Example

CIE Evaluation Process

Demand Luminance

Demand Luminance

Legibility Index   40 ft/in   20 ft/in

Demand Luminance

Distances Required for 16 inch Legend

Legibility Index (ft/in)	20	25	30	35	40
Distance (feet)	320	400	480	560	640

Demand Luminance (16 in Legend)
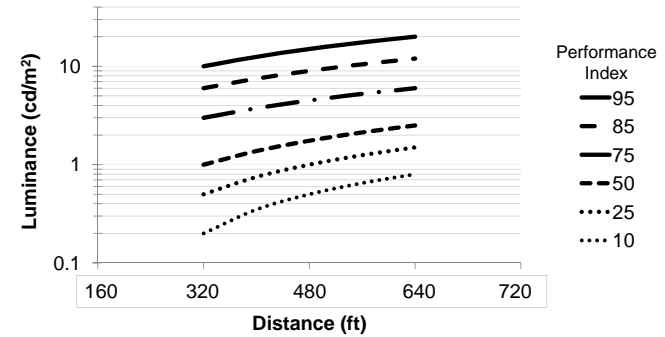
Supply Luminance
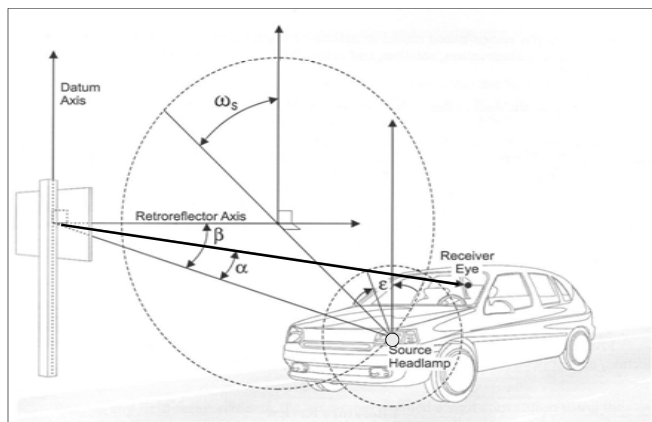
Reference Scenarios

- Vehicle Type
  - Passenger Car
  - Semi Truck
- Headlamp Type
  - European
  - US

Sign Locations

OV

HR

LS

RS

FR

LR

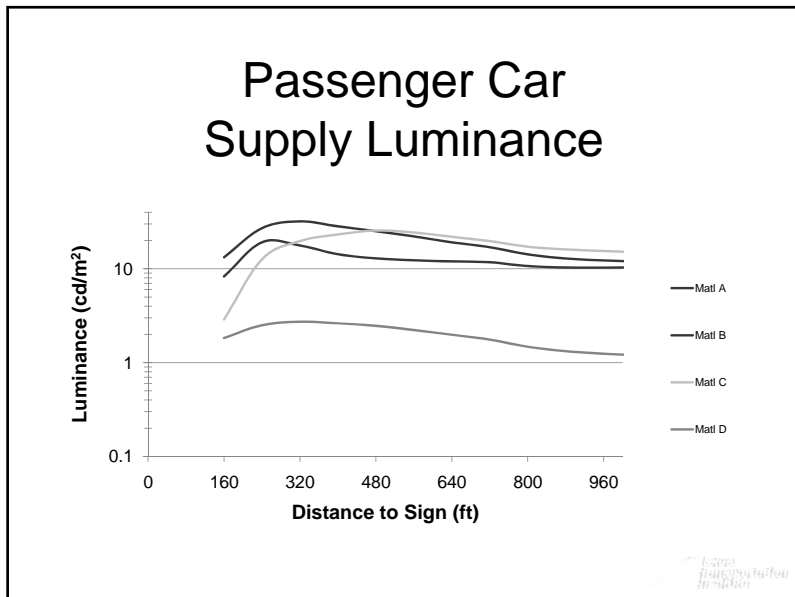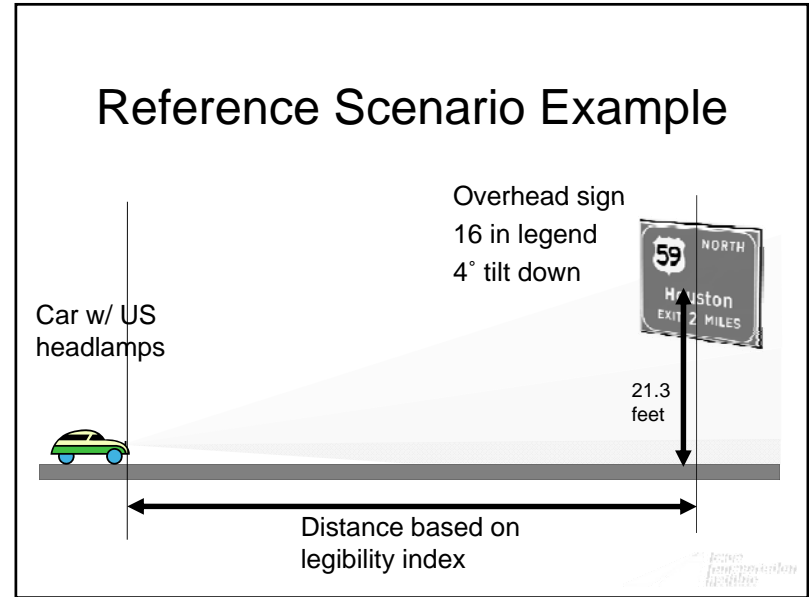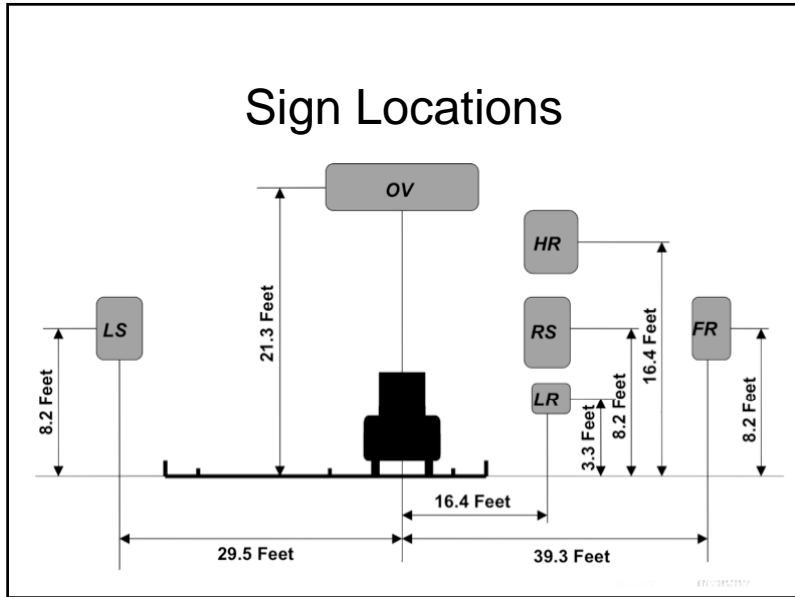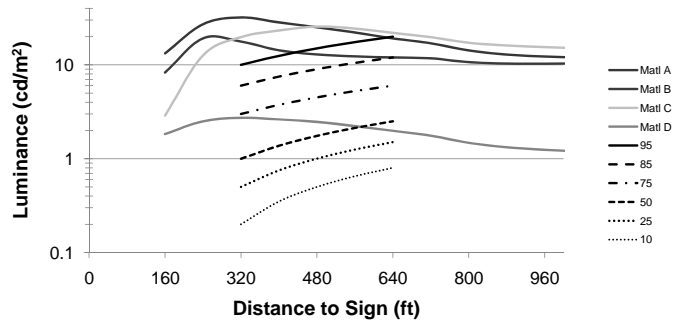21.3 Feet

8.2 Feet

16.4 Feet

8.2 Feet

3.3 Feet

8.2 Feet

16.4 Feet

29.5 Feet

39.3 Feet

Reference Scenario Example

Overhead sign
16 in legend
4˚ tilt down

Car w/ US
headlamps

59 NORTH
Houston
EXIT 2 MILES

21.3
feet

Distance based on
legibility index

Passenger Car Supply Luminance

Luminance (cd/m²)

Distance to Sign (ft)

Matl A
Matl B
Matl C
Matl D

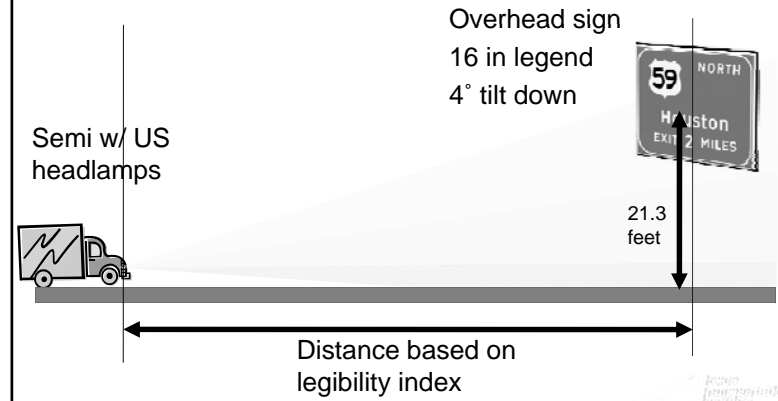## Demand Luminance

Luminance (cd/m²)

Distance to Sign (ft)

95
85
75
50
25
10

Passenger Car Evaluation

Reference Scenario Example

Overhead sign
16 in legend
4° tilt down

Semi w/ US
headlamps

21.3
feet

Distance based on
legibility index
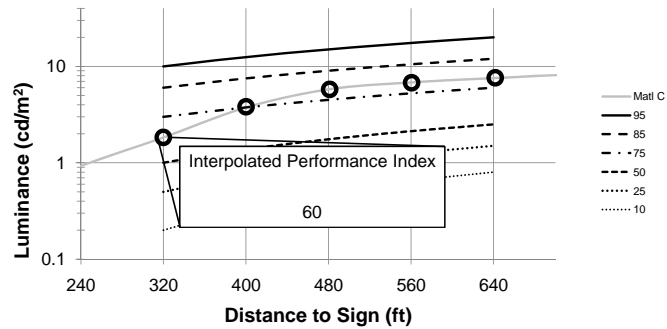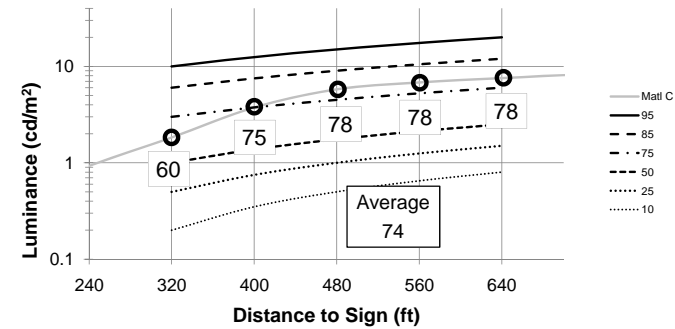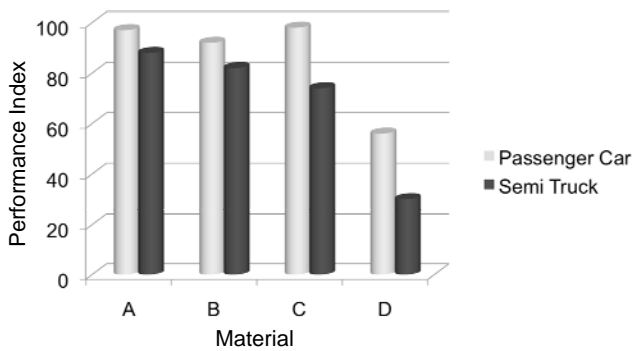

Supply Luminance
Truck
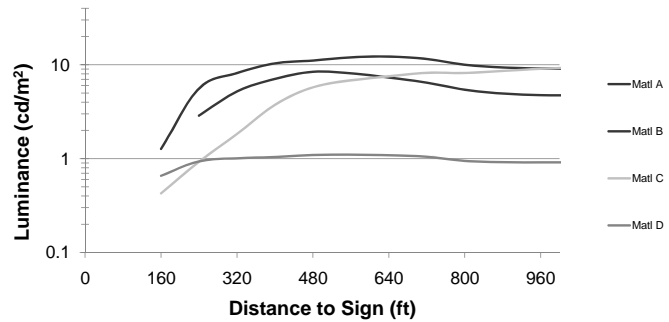
Truck Evaluation
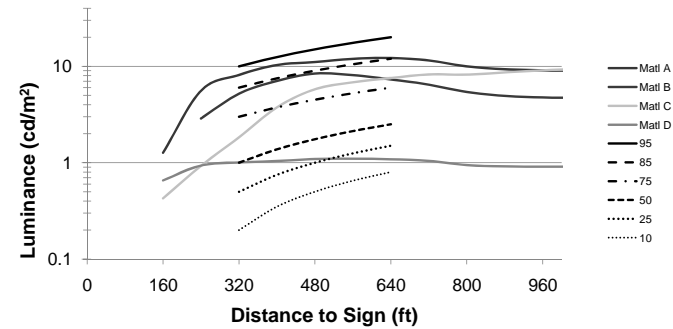
Truck Evaluation
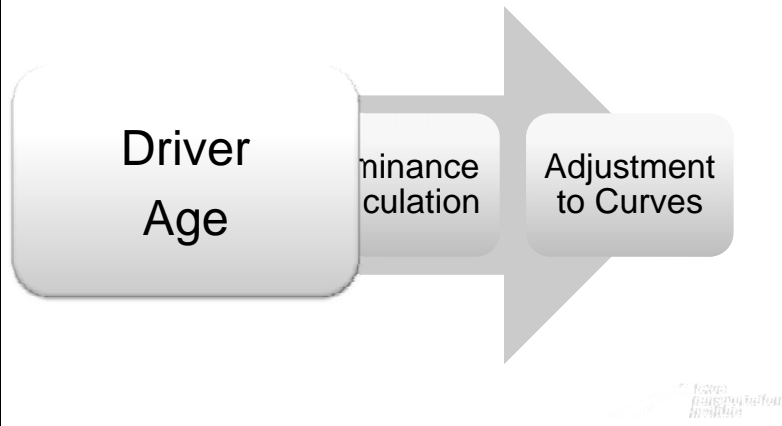

Truck Evaluation

Performance Index

Limitations

- Typical sign locations
- Tangent sections
- Supply luminance from retroreflectivity
- Difference in driver demographics

Development of Performance Index Curves

Driver Age → ...minance ...culation → Adjustment to Curves

Driver Age

- Existing Performance Index Curves
  - 36 subjects
 - Average age of 62 years

- Is there an age difference?

Licensed Drivers

Licensed Drivers		
Age	Percent of Total	Cumulative Percent
20 and Under	6.8	6.8
21 – 24	6.7	13.5
25 – 29	9.2	22.7
30 – 34	10.1	32.8
35 – 44	22.1	54.9
45 – 54	18.9	73.8
62 years	85th percentile	
65 and Over	14.3	100.0

Truck Drivers

Truck Drivers		
Age	Percent of Total	Cumulative Percent
20 and Under	0.0	0.0
21 – 24	3.4	3.4
25 – 29	9.0	12.4
30 – 34	12.0	24.4
35 – 44	32.8	57.1
45 – 54	55 Years	83.4
55 – 64		97.2
65 and Over	2.8	100.0

Development of Performance Index Curves

Driver Age → Luminance Calculation → Adjustment to Curves
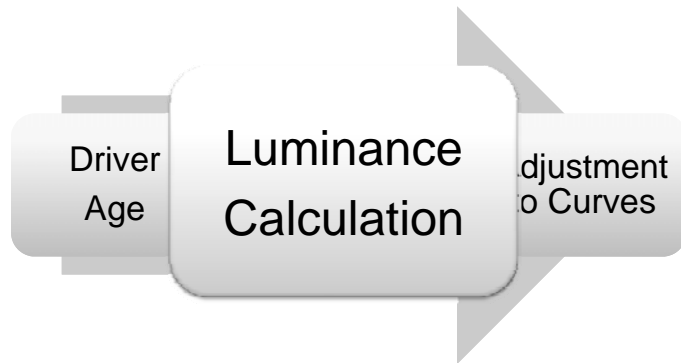
Calculation of Luminance

$$\log_{10} L = -0.545 + \frac{A}{46.27} + \frac{VA}{20.56} + (-212.9)\frac{SW}{D}$$

- Age in years (A)
- Snellen visual acuity (VA)
- Stroke width of the font (SW)
- Distance between driver and sign (D)

Source: Holick, A.J. and P.J. Carlson. Model of Overhead-Sign Luminance Needed for Legibility. *Transportation Research Record 1801*, Transportation Research Board, National Research Council, Washington, DC, 2002.
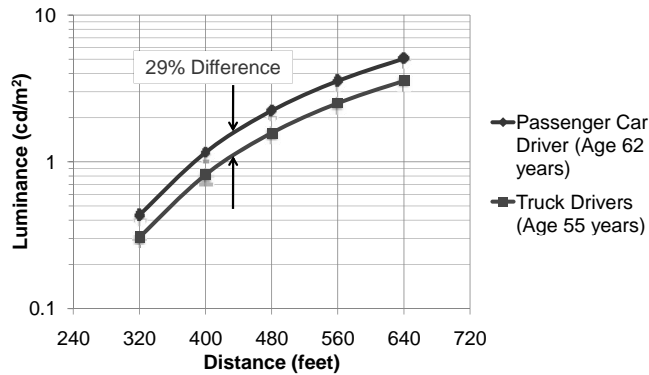
Driver Characteristics

Variable	Passenger Car Drivers	Truck Drivers
Age (years)	62	55
Snellen Visual Acuity (denominator)	20/20	20/20

Scenario Characteristics

Overhead sign
16 in legend
Stroke Width 20% legend height
3.2 Inches

Legibility Index (ft/in)	20	25	30	35	40
Distance (feet)	320	400	480	560	640

Calculation Results

29% Difference

- Passenger Car Driver (Age 62 years)
- Truck Drivers (Age 55 years)

Luminance (cd/m²) vs Distance (feet)

Development of Performance Index Curves

Driver Age → Luminance Calculation → **Adjustment To Curves**
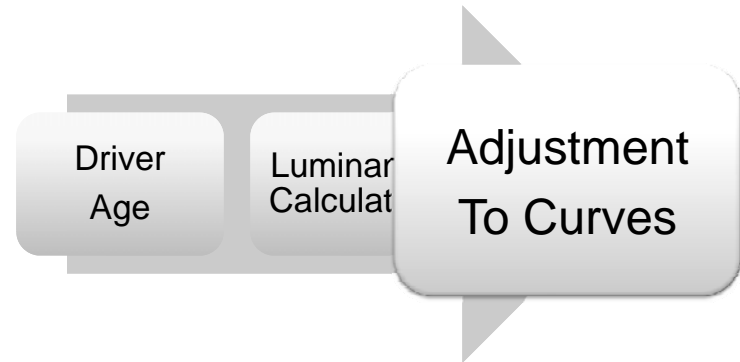
Adjustment for Truck Drivers

Performance Index	Percentage Reduction	Applied Factor
10	0%	1.00
25	20%	0.80
50	29%	0.71
75	21%	0.79
85	13%	0.87
95	5%	0.95

Adjustment of 29% applied to
Performance Index of 50

Performance Index Curves for Truck Drivers / Cars

Legend:
- 95 Truck
- 85 Truck
- 75 Truck
- 50 Truck
- 25 Truck
- 10 Truck
- 95 Car
- 85 Car
- 75 Car
- 50 Car
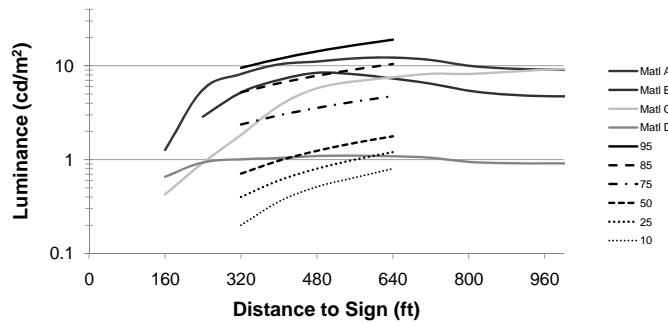- 25 Car
- 10 Car

Luminance (cd/m²) vs Legibility Index (ft/in)
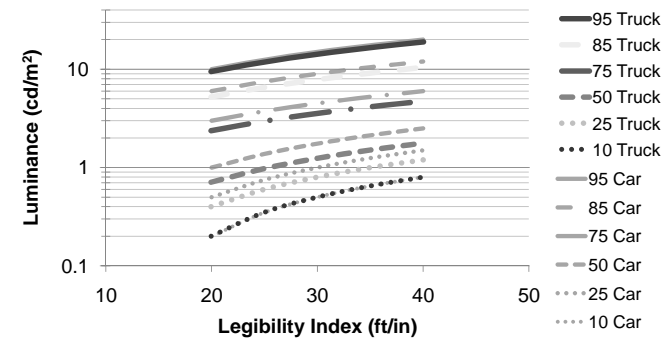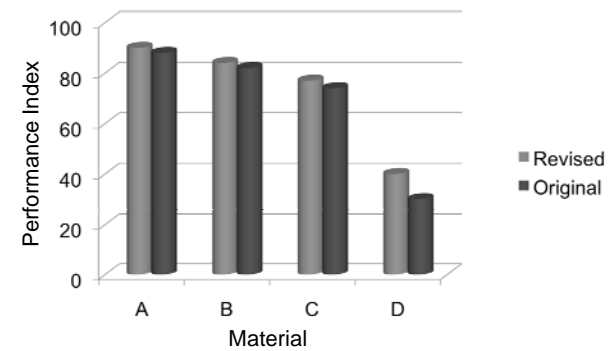
Supply Luminance Truck
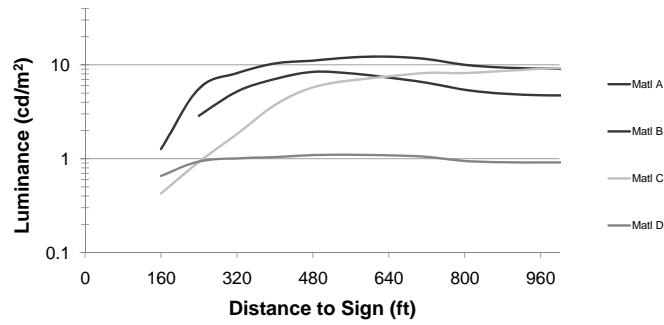
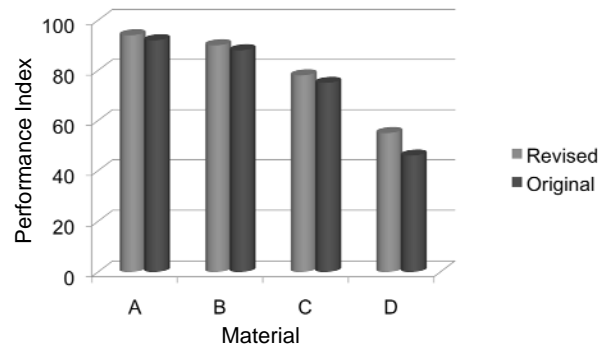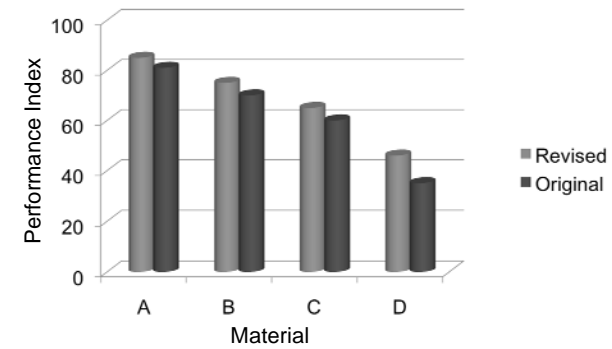Truck w/o Adjustments
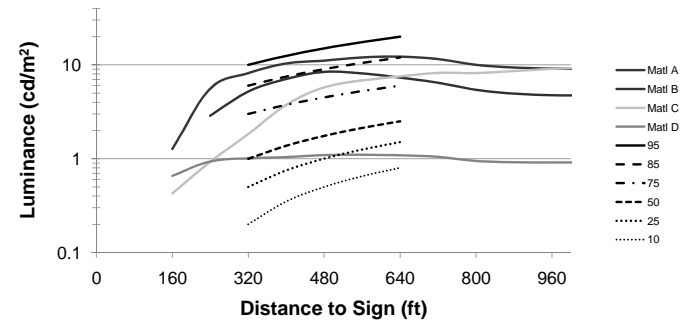
Truck w/ Adjustments

Performance Index Overhead Sign

Performance Index
Left Shoulder

Performance Index
High Right Sign

Conclusions

- Traffic sign performance evaluation technique
- Based on CIE current proposed procedure
- Difference in age

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