Ford Motor Company

James P. Vondale, Director
Automotive Safety Office
Environmental & Safety Engineering

January 28, 2002

Jeffrey W. Runge, M.D.
Administrator
National Highway Traffic Safety Administration
400 Seventh Street, SW
Washington, DC 20590

Re: Federal Motor Vehicle Safety Standard No. 108 - Lamps, Reflective Devices, and Associated Equipment - Request for Comments - Glare From Headlamps and Other Front Mounted Lamps - Docket No. 01-8885; Notice 1 (66 Fed. Reg. 49594, September 28, 2001)

Dear Dr. Runge,

Ford Motor Company (Ford), a domestic manufacturer and importer of automobiles with offices at One American Road, Dearborn, Michigan 48126-2798, submits the following comments to the referenced Request for Comments (RFC). This response covers all brands encompassed by the Ford Motor Company (Ford, Lincoln, Mercury, Mazda, Volvo, Jaguar, Land Rover, Aston Martin, and Think!) The RFC discusses issues related to glare produced by low beam headlamps, fog lamps, driving lamps and auxiliary low beam headlamps mounted on the front of vehicles, some potential solutions and requests information to help the National Highway Traffic Safety Administration (NHTSA) develop some practical and effective solutions.

Ford has participated in the development of the Alliance of Automobile Manufacturers (Alliance) response, and fully incorporates that response by reference.

In addition, Ford conducted a study using a target detection model to predict the effect on seeing distance and discomfort glare with different headlamp beam patterns, headlamp mounting heights and vertical aiming angles which the RFC discussed as potential measures to mitigate glare. The details, assumptions and results of this particular study are attached. The results are summarized below:

> As NHTSA noted in the RFC, compared to the US low beam pattern; the Economic Commission for Europe (ECE) low beam pattern offers less seeing distance and sign visibility. However, this study indicates that the ECE low beam pattern, relative to the US low beam pattern, provides little or no reduction in mirror glare from a following vehicle when the headlamp mounting heights and vertical aiming angles are constant.

Glare on the inside mirror would become 'just acceptable' (De Boer rating of 4) if headlamp mounting height were limited to approximately 1050 mm. However, glare on the outside mirror would not become 'just acceptable' until the headlamp mounting height is lowered to approximately 750 mm. The detection loss trade-off from reducing the maximum headlamp mounting height from 1200 to 1050 mm is approximately 1.5% for lane delineation, 2.2% for pedestrian visibility and 5% for overhead sign visibility. The detection loss trade-off from reducing the maximum headlamp mounting height from 1200 to 750 mm is approximately 3.7% for lane delineation, 7.8% for pedestrian visibility and 12.8% for overhead sign visibility.

Glare from an oncoming vehicle at 100 ft. was basically unaffected by headlamp beam pattern, vertical aiming angle and headlamp mounting height.

The seeing distance model from PCDETECT was employed to calculate data based on the following variables:

Two headlamp beam patterns:

a) 50th percentile US low beam average from all vehicles in the 2000 model year.
b) 50th percentile ECE low beam average from all vehicles in the 2000 model year.

Three vertical mounting heights above ground to top edge of headlamp:

a) 610 mm (2.0 ft.) - FMVSS 108 minimum
b) 950 mm (3.1 ft.) - draft GTR maximum for 'light duty vehicles'
c) 1200 mm (3.94 ft.) - Alliance proposed maximum aligned with ECE

Four vertical aiming angles:

a) 0 degrees down – nominal US aim
b) .57 degrees down - nominal ECE aim
c) 1.0 degree down
d) 2.0 degrees down

This study illustrates the ramifications and consequences of varying different parameters. Ford believes the small improvement in glare ratings which result from the ECE low beam pattern, reduced headlamp mounting heights or greater downward aiming angles are insufficient justification for the degree of reduction in critical seeing distance which the model estimates. We urge NHTSA to identify the specific causes of glare, enumerate their contribution to the perceived problem and to also quantify the effects of glare on vehicle safety prior to proposing changes to FMVSS 108 requirements.

Please contact Mr. Peter Souchock of my staff at (313) 322-6887 if you have questions or need additional information relative to Ford's response.

Sincerely,

James P. Vondale

Attachment

Attachment

The Effect of Headlamp Mounting Height on Sign Visibility and Following Car Glare

The seeing distance model from PCDETECT (E. Farber and C. Matle "PCDETECT: A revised version of the DETECT seeing distance model", Transportation Research Record 1213, 1989) was employed to calculate the visibility of overhead signs and signs at the right side of the road. The glare produced on the observer's inside and outside rearview mirrors resulting from a following vehicle was also calculated. The following assumptions were made:

Lane width was 12 ft.

Pedestrian:

- located 12 ft. to the right of the lane delineation
- 7% reflectivity

Overhead sign visibility was calculated at a point on the sign:

- Equal to centerline of observer vehicle (Y offset = 0.).
- 5.4 m (17.7 ft.) above ground.

Right hand sign visibility was calculated at a point on the sign:

- equal to 2.4 m (7.87 ft.) to the right of the observer vehicle centerline.
- 3.05 m (10 ft.) above ground.

Sign character size was 16 inches (.406 m).
Sign reflectivity

- 12% for the background.
- 79% for characters.

Observer's eye point:

- 1.2 m (3.9 ft.) rearward of the headlamps.
- 0.38 m (1.2 ft.) to the left of vehicle centerline.
- 1.1 m (3.6 ft.) above ground.

Observer's age was 50 years.
Observer's adaptation brightness was 0.5 cd/m^2.

Headlamps:

- dimensional height was 4 in.
- .61 m (2 ft.) on either side of vehicle centerline
- 5 m rearward of mirror for mirror glare
- 610, 950 and 1200 mm (2.0, 3.1, and 3.94 ft.) above ground
- for opposed seeing distances, observer vehicle headlamp height was 610 mm with 0 degrees aim down.

The glare on the inside rearview mirror was calculated at a point:

- .075 m (3 inches) to the left of vehicle centerline.

- 1.2 m (.1 m above eye point) above ground.

The glare on the outside rearview mirror was calculated at a point:

- .91 m (3 ft.) to the left of vehicle centerline.
- .8 m (.3 m below eye point) above ground.

The backlight transmissivity was 85%.
The mirror reflectivity was 60%.

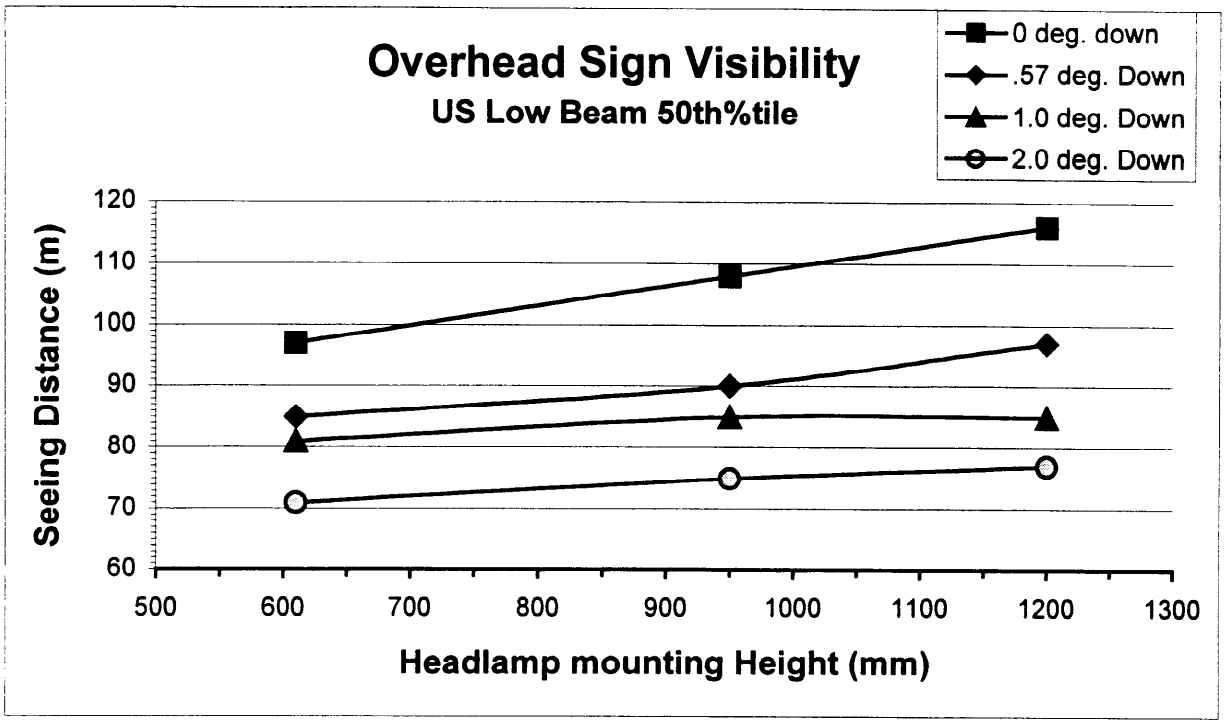
Two headlamp beam patterns were used for the evaluation:

- the 50th percentile US low beam average from all vehicles in the 2000 model year.*
- the 50th percentile ECE low beam average from all vehicles in the 2000 model year.*
- Opposed and Observer beam patterns were the same (US vs US and ECE vs ECE)

Four vertical aiming angles were used for the evaluation:

- 0 degrees down
- .57 degrees down
- 1.0 degrees down
- 2.0 degrees down

*May 2001 University of Michigan Transportation Research Institute research report UMTRI-2001-19 - **High-beam and Low-beam Headlighting Patterns in the U.S. and Europe at the Turn of the Millennium.** Photometric information for 20 headlamps manufactured for use on the 20 best-selling passenger vehicles for model year 2000 in the U.S., and 20 headlamps manufactured for use on the 20 best-selling passenger vehicles for model year 2000 in Europe was measured at 12.8V. The vehicles sampled represent 49% and 47%, respectively, of all vehicles sold in the U.S. and Europe. The photometric information for each lamp was weighted by the sales figures for the corresponding vehicle.


Overhead Sign Visibility
US Low Beam 50th%tile
0 deg. down
.57 deg. Down
1.0 deg. Down
2.0 deg. Down
Seeing Distance (m)
120
110
100
90
80
70
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500
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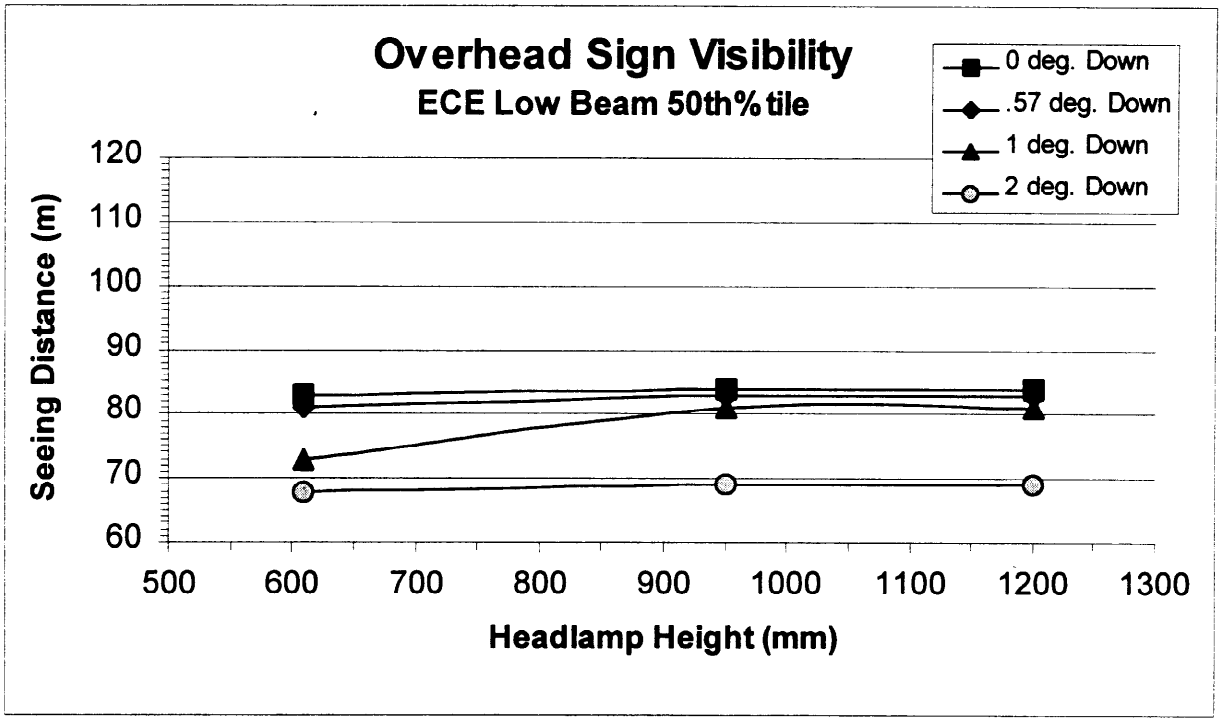
1300
Headlamp mounting Height (mm)


Overhead Sign Visibility
ECE Low Beam 50th%tile
0 deg. Down
.57 deg. Down
1 deg. Down
2 deg. Down
Seeing Distance (m)
120
110
100
90
80
70
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600
700
800
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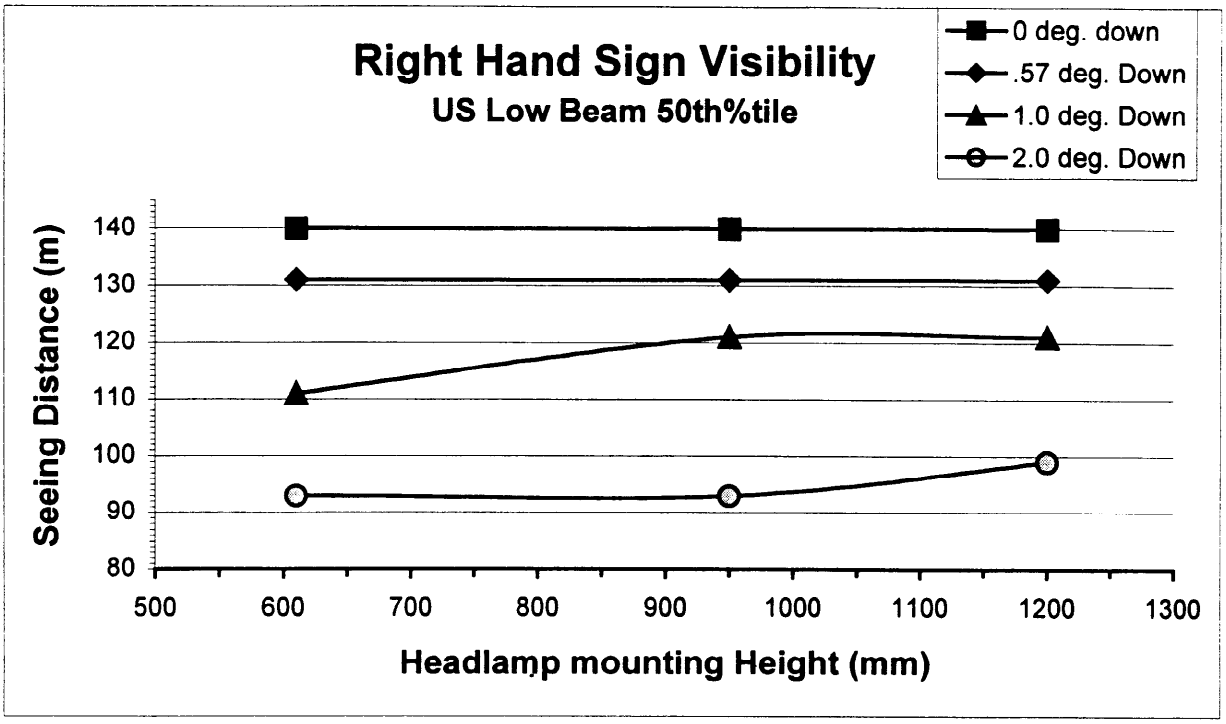
1000
1100
1200
1300
Headlamp Height (mm)


Right Hand Sign Visibility
US Low Beam 50th%tile
0 deg. down
.57 deg. Down
1.0 deg. Down
2.0 deg. Down
Seeing Distance (m)
140
130
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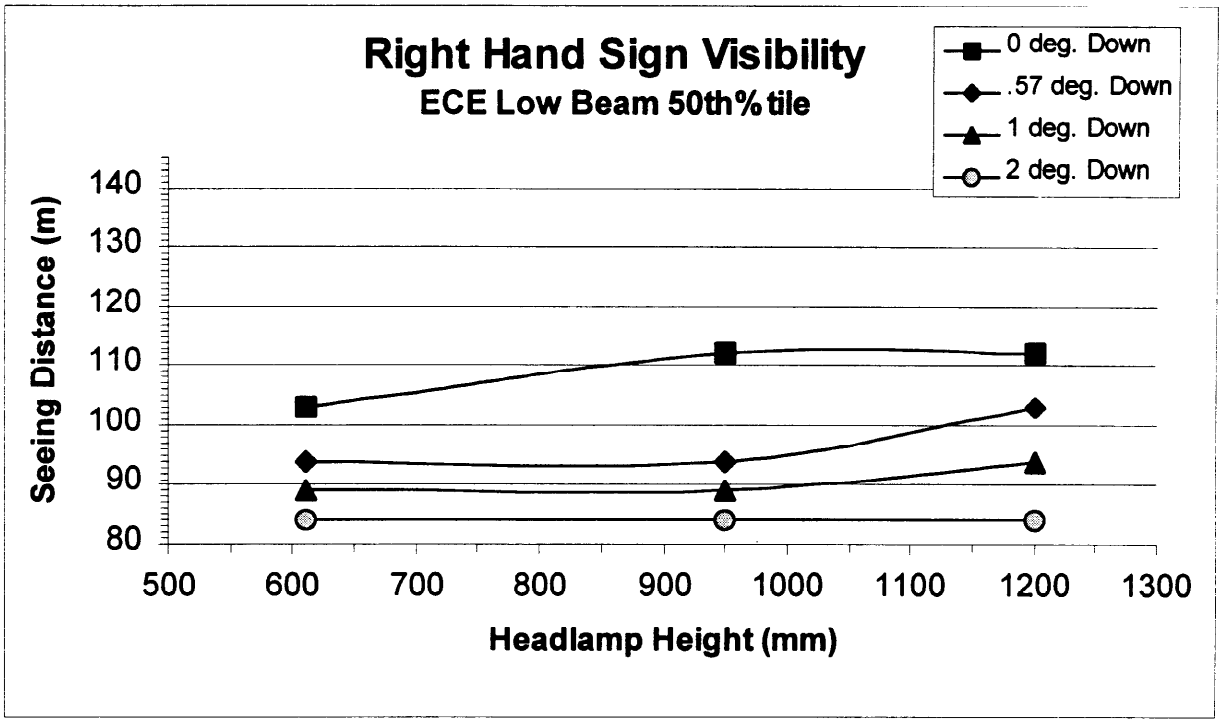
1200
1300
Headlamp mounting Height (mm)


Right Hand Sign Visibility
ECE Low Beam 50th% tile
0 deg. Down
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1 deg. Down
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Seeing Distance (m)
140
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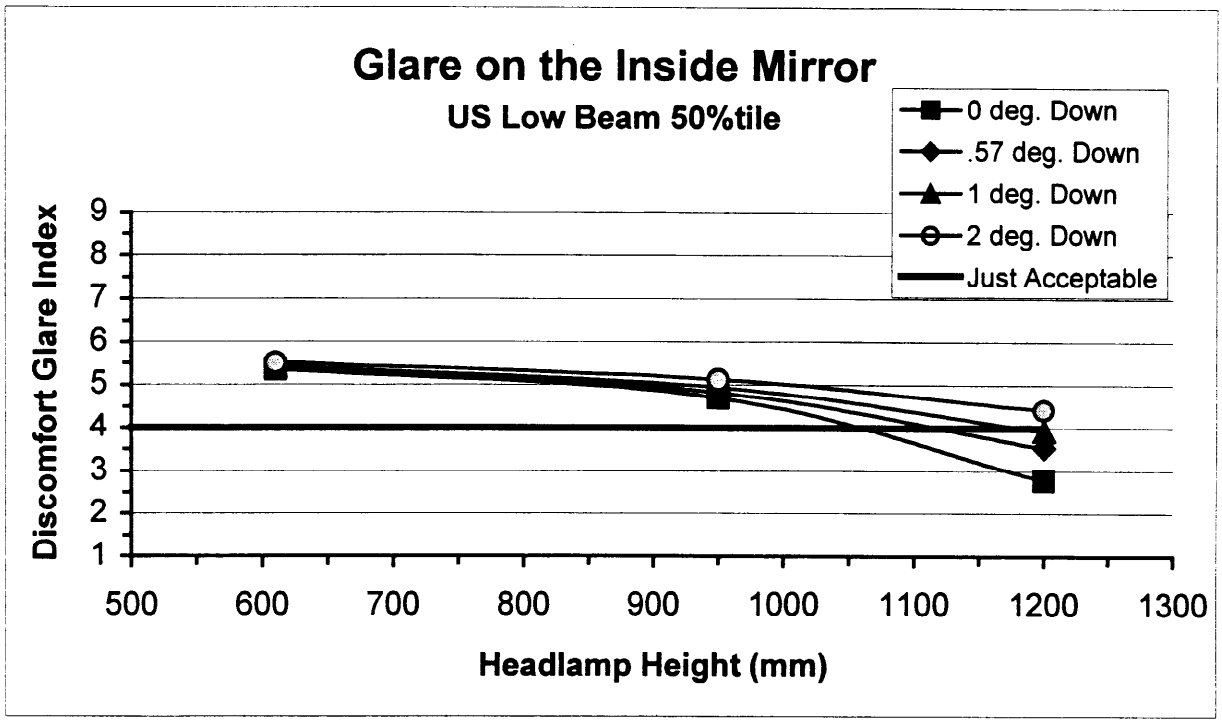
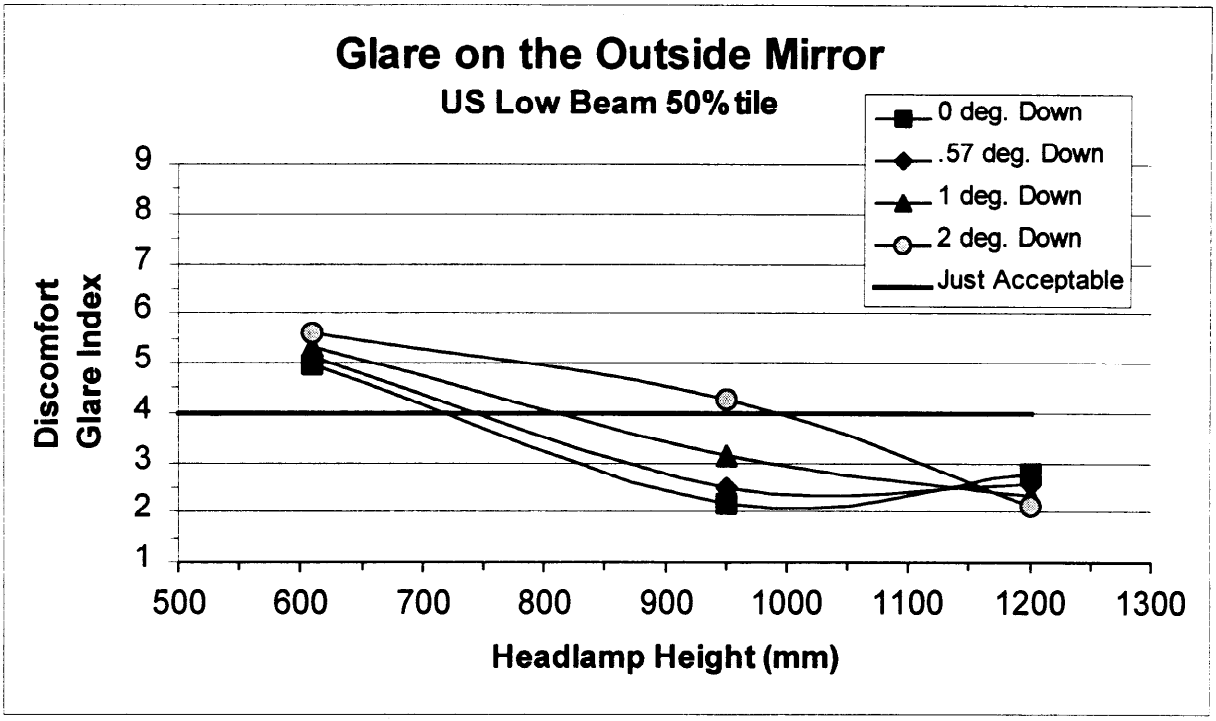
1300
Headlamp Height (mm)


Glare on the Inside Mirror
US Low Beam 50%tile
0 deg. Down
.57 deg. Down
1 deg. Down
2 deg. Down
Just Acceptable
Discomfort Glare Index
9
8
7
6
5
4
3
2
1
500
600
700
800
900
1000
1100
1200
1300
Headlamp Height (mm)


Glare on the Outside Mirror
US Low Beam 50% tile
0 deg. Down
.57 deg. Down
1 deg. Down
2 deg. Down
Just Acceptable
Discomfort Glare Index
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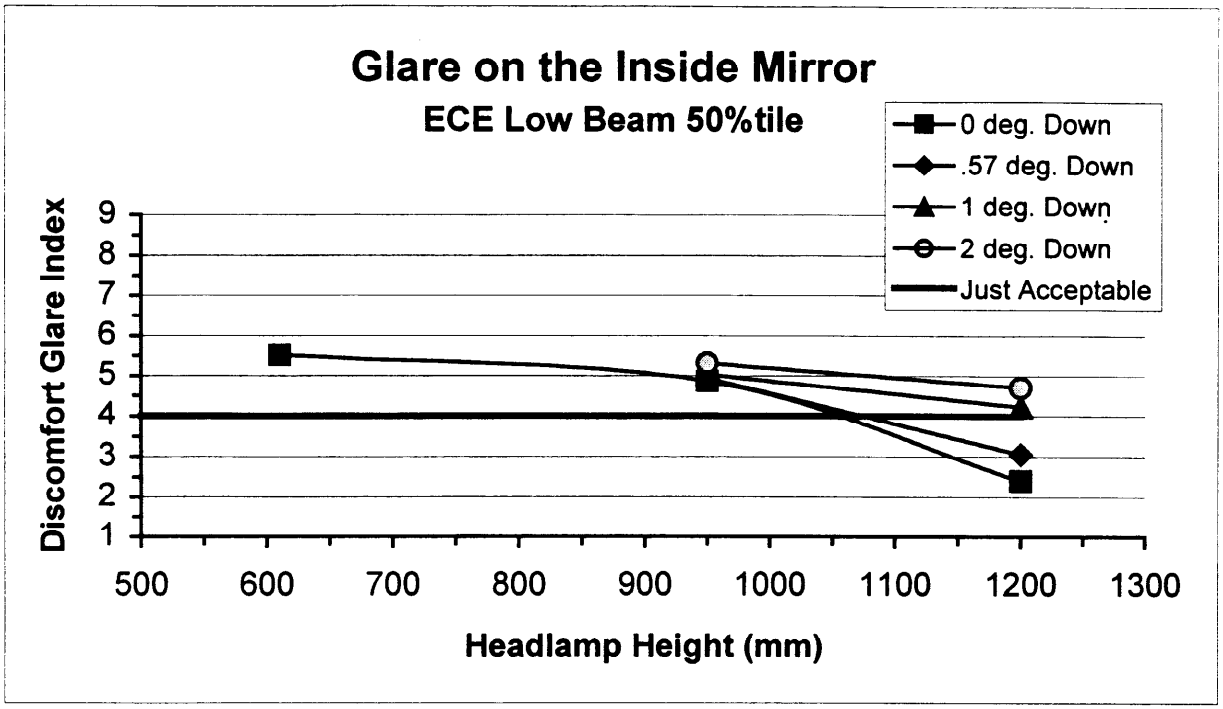
Headlamp Height (mm)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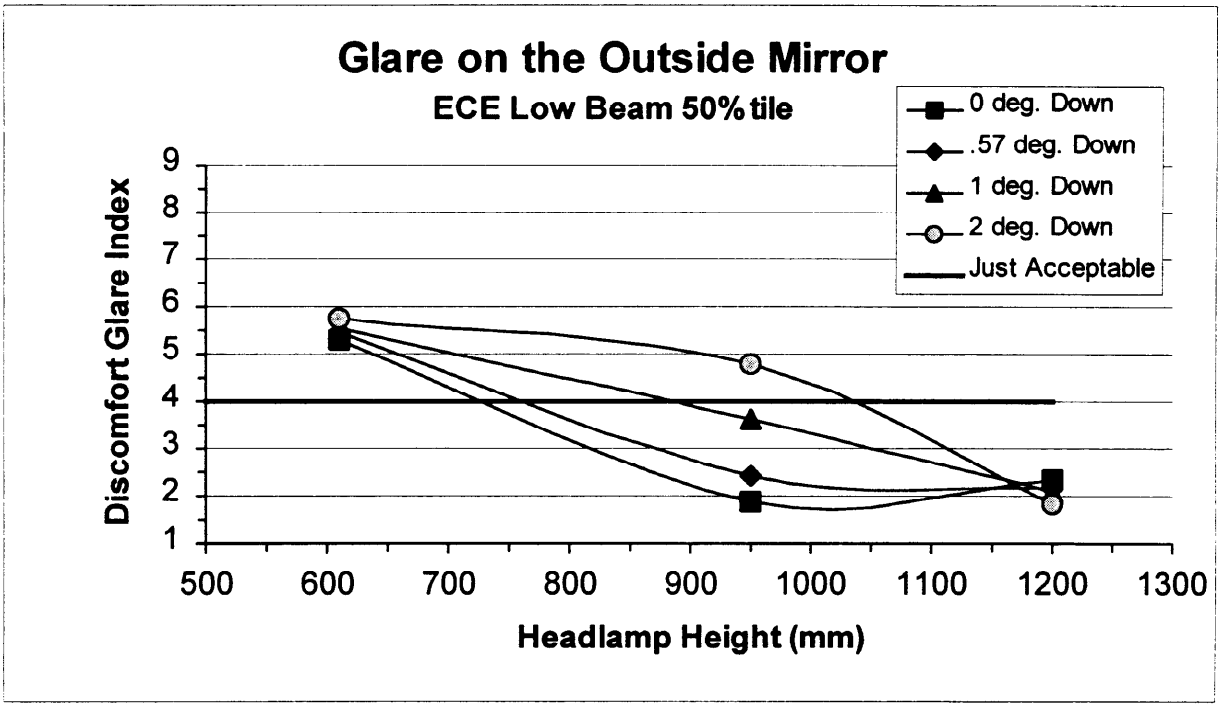
Headlamp Height (mm)


Glare on the Outside Mirror
ECE Low Beam 50% tile
0 deg. Down
.57 deg. Down
1 deg. Down
2 deg. Down
Just Acceptable
Discomfort Glare Index
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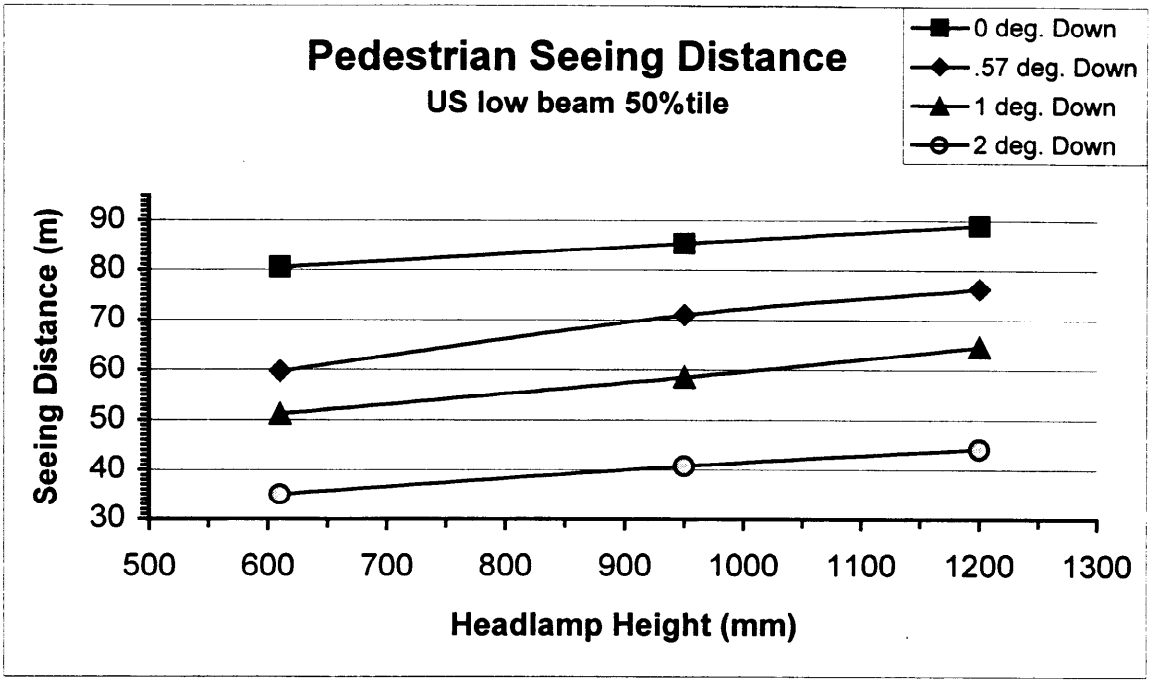
Headlamp Height (mm)


Pedestrian Seeing Distance
US low beam 50%tile
0 deg. Down
.57 deg. Down
1 deg. Down
2 deg. Down
Seeing Distance (m)
90
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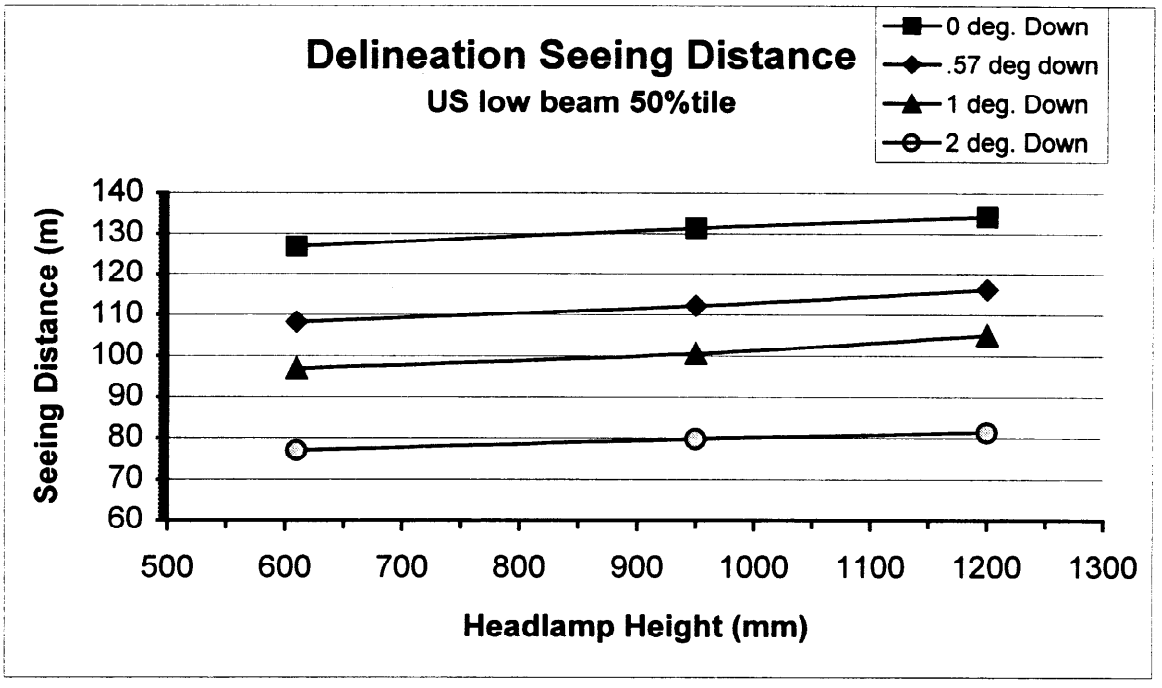
Headlamp Height (mm)


Delineation Seeing Distance
US low beam 50%tile
0 deg. Down
.57 deg down
1 deg. Down
2 deg. Down
Seeing Distance (m)
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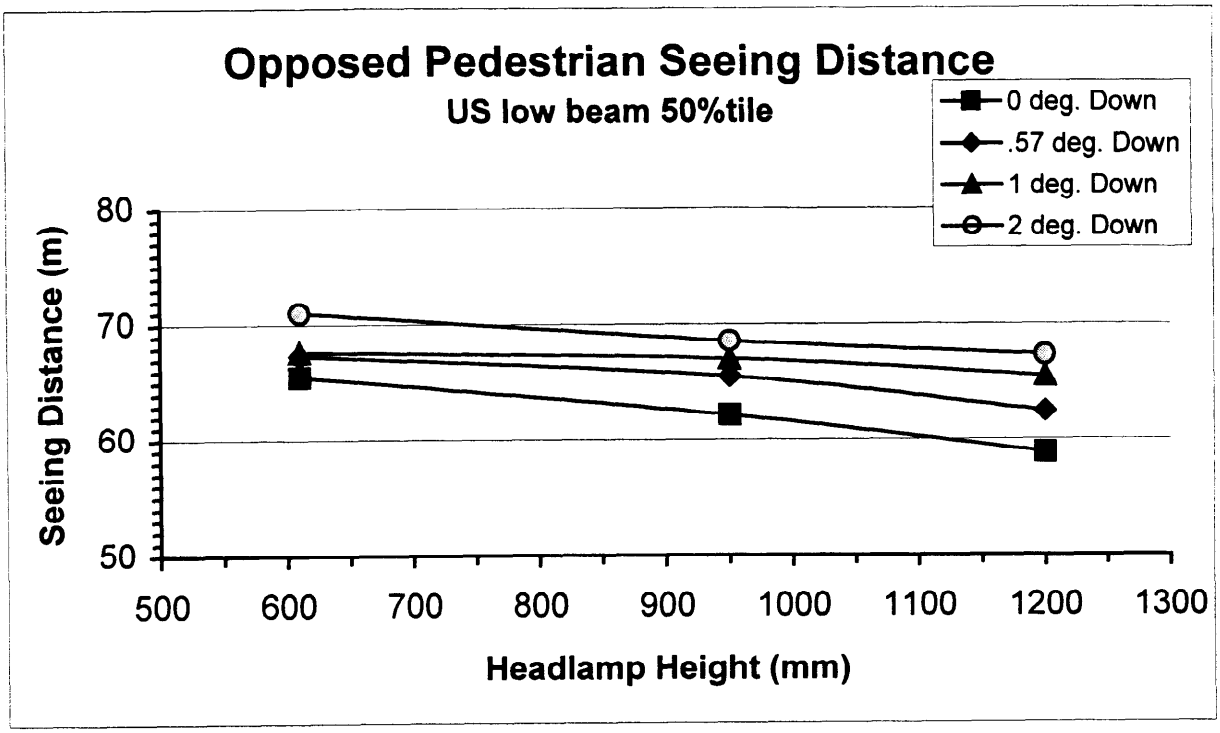
Headlamp Height (mm)


Opposed Pedestrian Seeing Distance
US low beam 50%tile
0 deg. Down
.57 deg. Down
1 deg. Down
2 deg. Down
Seeing Distance (m)
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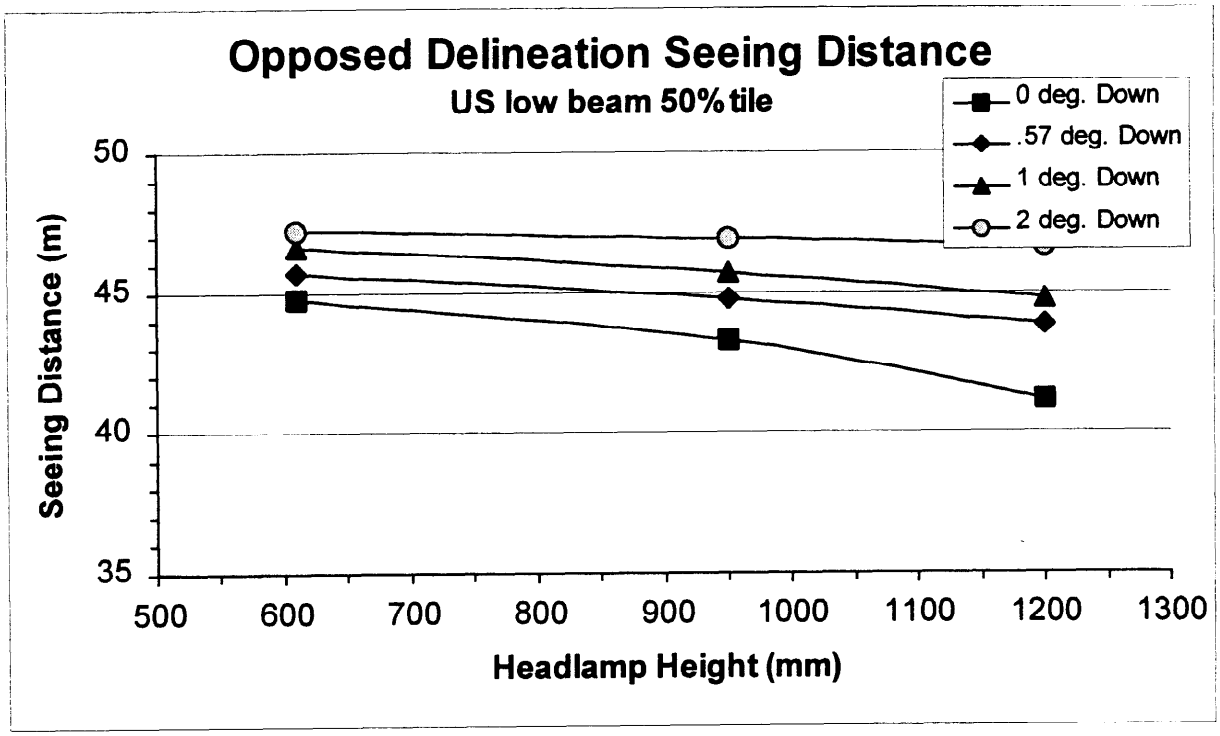
Headlamp Height (mm)


Opposed Delineation Seeing Distance
US low beam 50% tile
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1 deg. Down
2 deg. Down
Seeing Distance (m)
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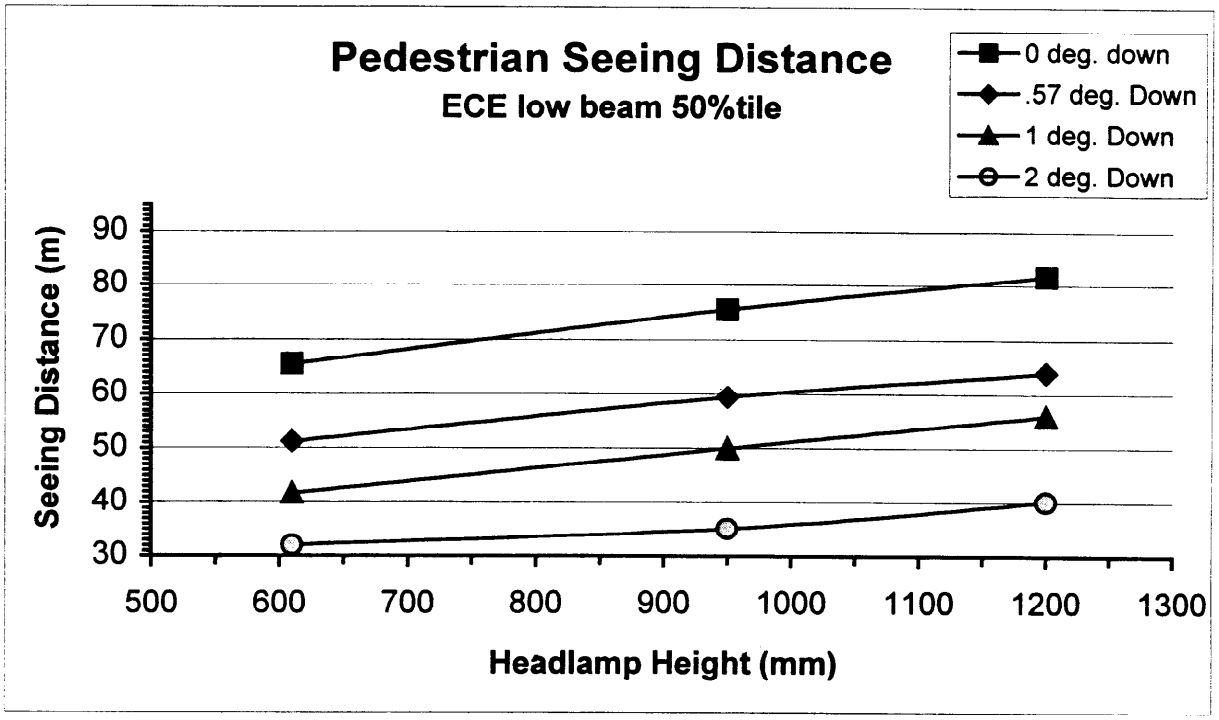
Headlamp Height (mm)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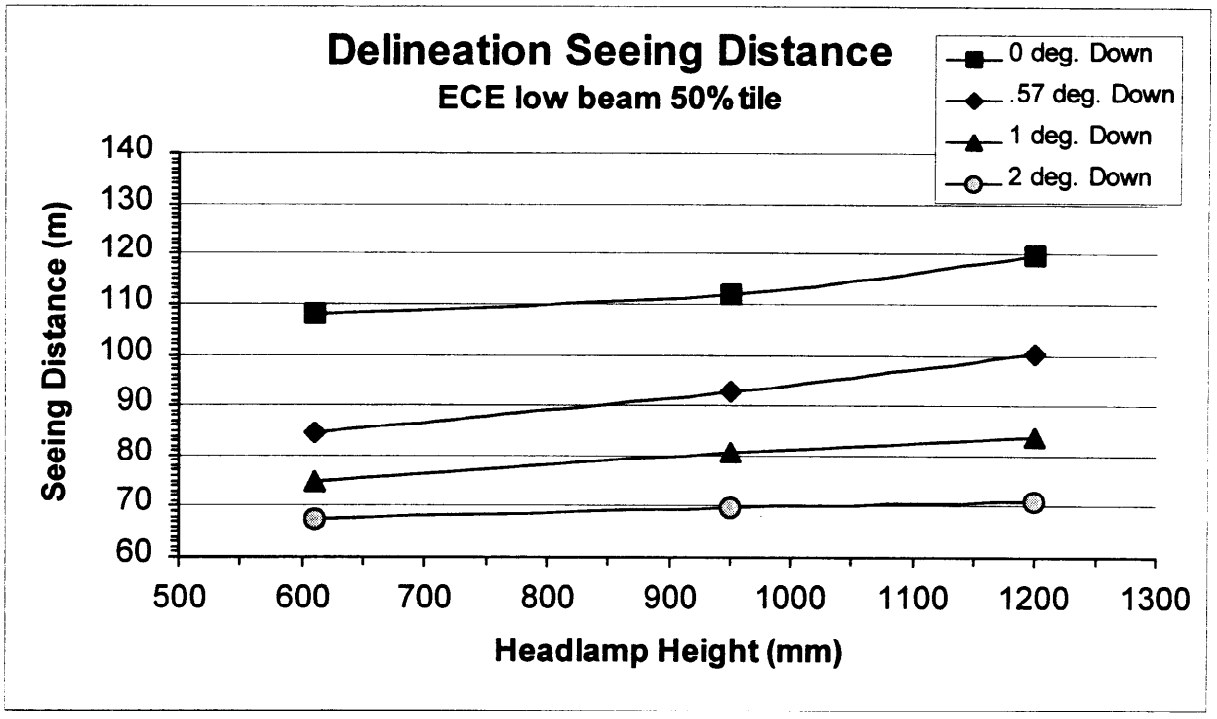
Headlamp Height (mm)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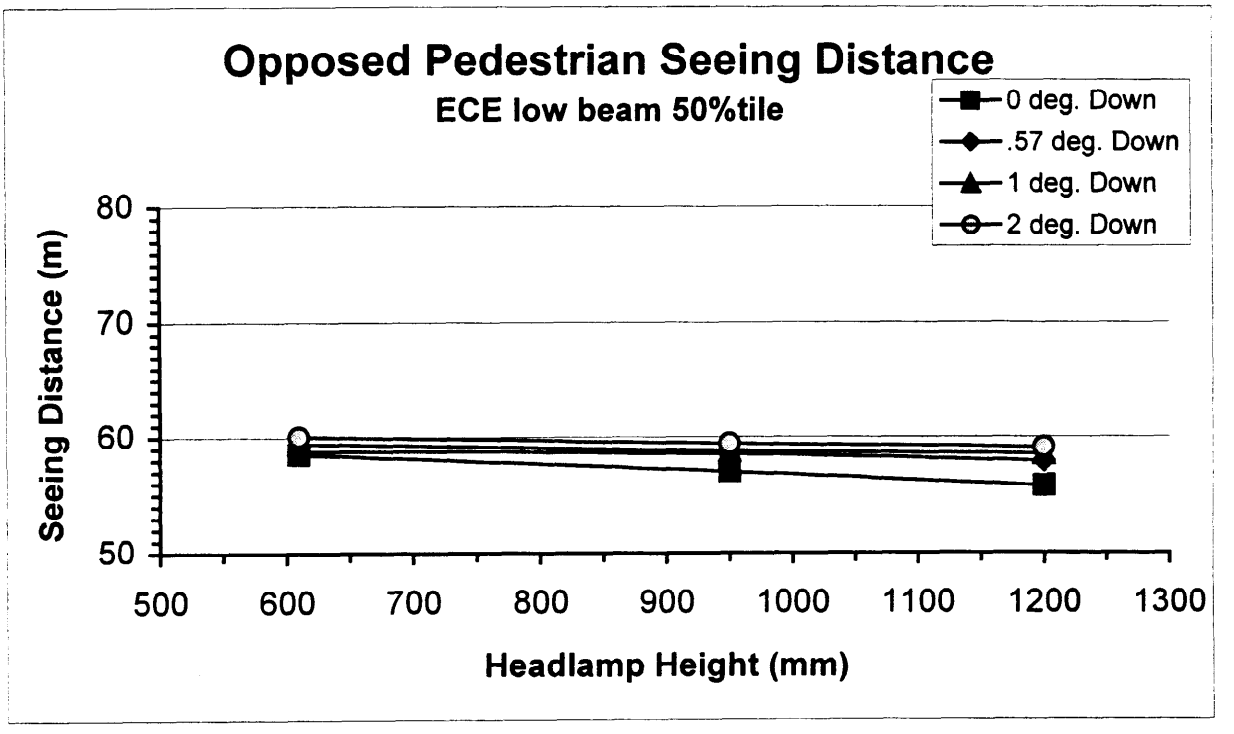
Headlamp Height (mm)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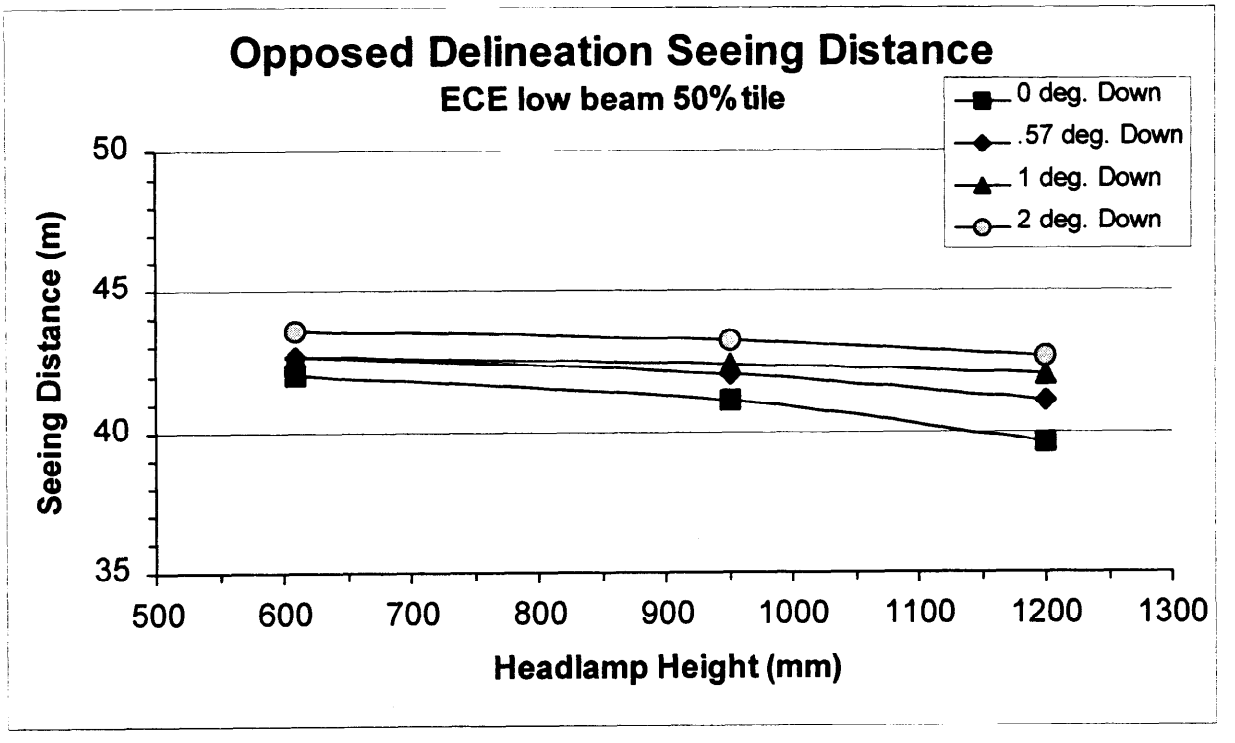
Headlamp Height (mm)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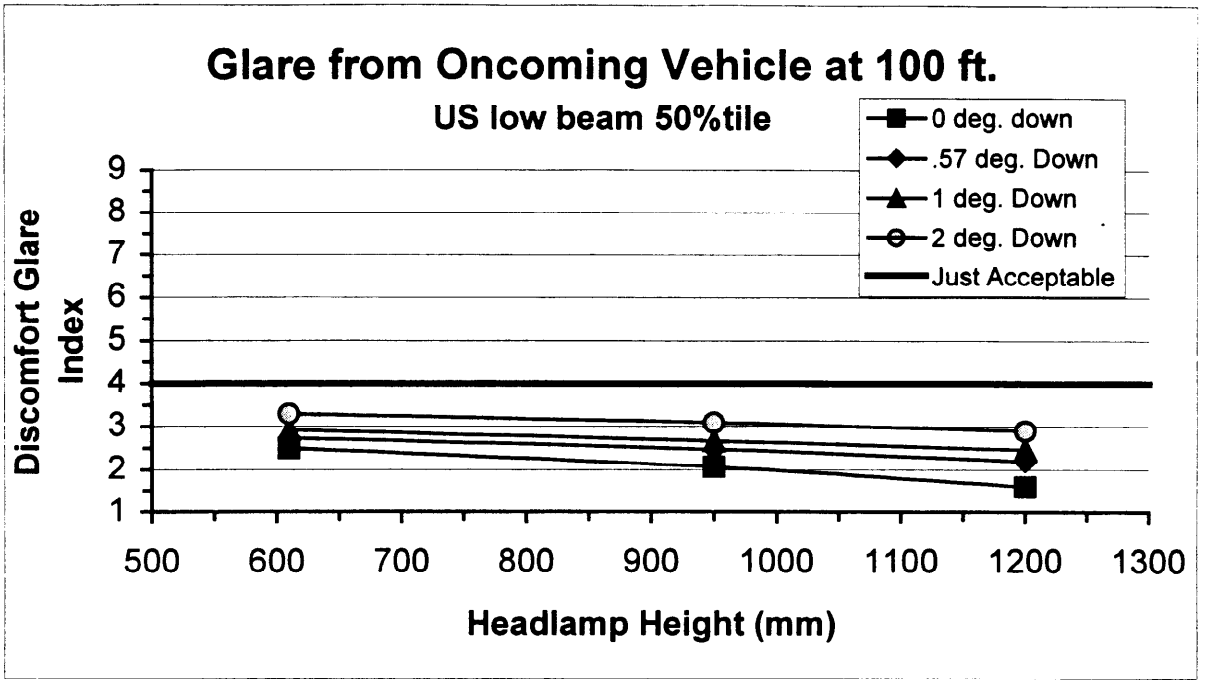
Headlamp Height (mm)


Glare from Oncoming Vehicle at 100 ft.
US low beam 50%tile
0 deg. down
.57 deg. Down
1 deg. Down
2 deg. Down
Just Acceptable
Discomfort Glare Index
9
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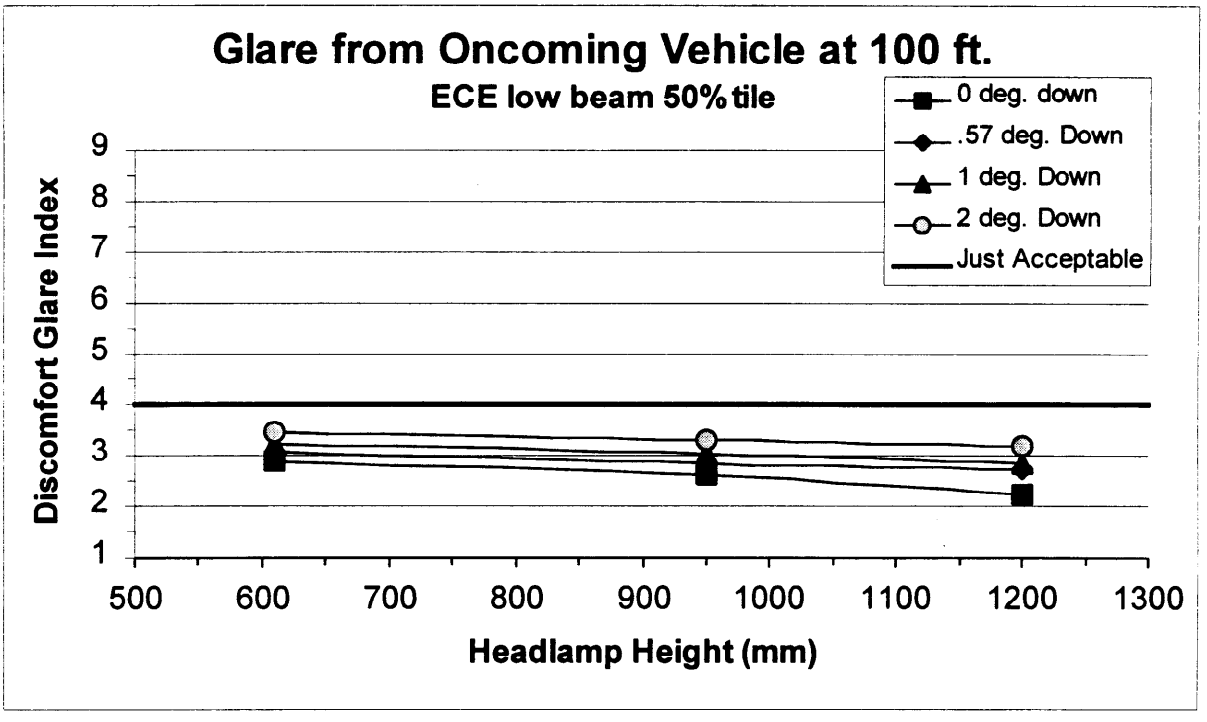
Headlamp Height (mm)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Headlamp Height (mm)