

Transmitted by the expert from Japan

Ad-hoc 02

Change in Night-time Driving Visibility Due to Soiled Headlamps and Its Improvement by Headlamp Cleaners

November, 2019

Japan

Background and Purpose

Mud, dust, etc. on the headlamp surfaces may increase glare to oncoming vehicles.



UN R48 requires that dipped beam headlamps that use a light source exceeding 2,000 lumens be equipped with headlamp cleaner systems.

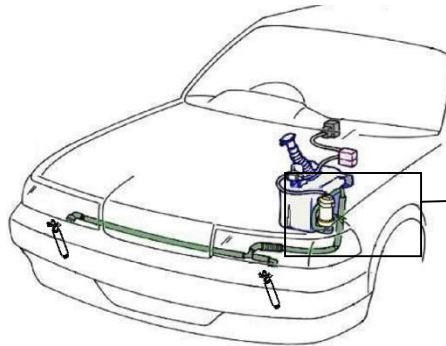


Fig.1 Appearance of headlamp cleaner system



A proposal has been made to the GRE to delete the requirement for headlamp cleaners.

Background and Purpose

To discuss the necessity of headlamp cleaners, analysis data is needed to help judge their effectiveness.



Performed analysis and evaluation of:

- Increase in glare due to dirt **on headlamps**
- Reduction of glare by headlamp cleaner

Experiment Method (1)

Verification by bench test

Mud mixed as specified by the UN regulation was sprayed by gun on the headlamp lens surface



The light distribution before and after use of the headlamp cleaner was measured, and the change in light distribution due to mud and the cleaning effect of the headlamp cleaner were evaluated.

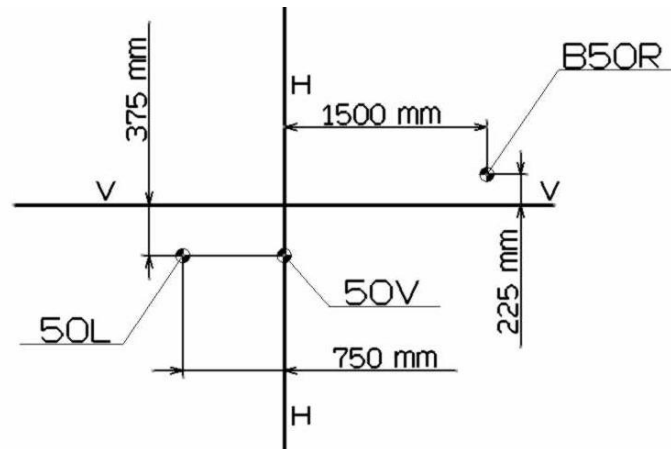


Fig.2 Light distribution measurement points - Left-side traffic (UK, Japan)

Results of Experiment

Relationship between soiled headlamps and glare produced, and the cleaning effect by headlamp cleaners
(Using HID headlamps of 2000 lm or more)

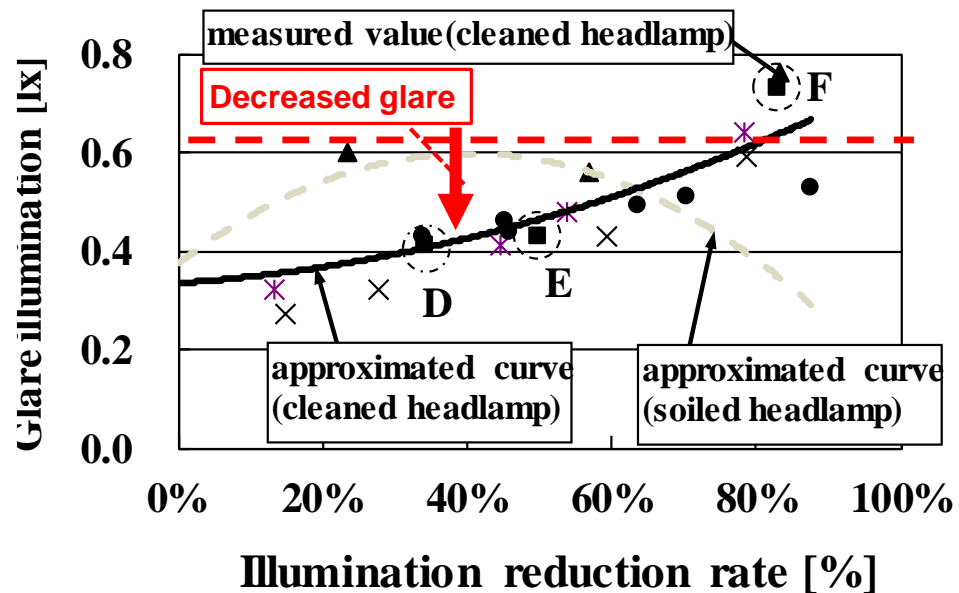
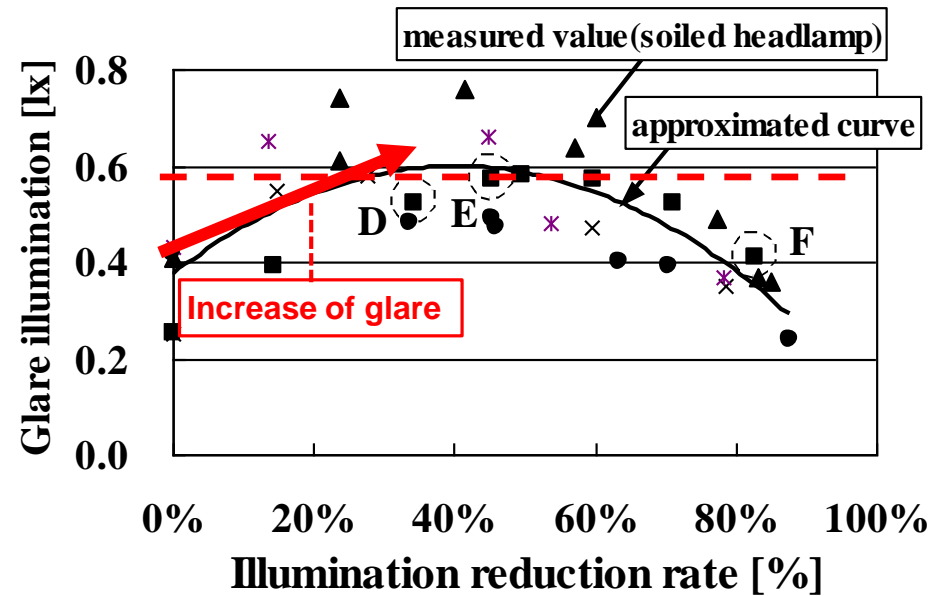


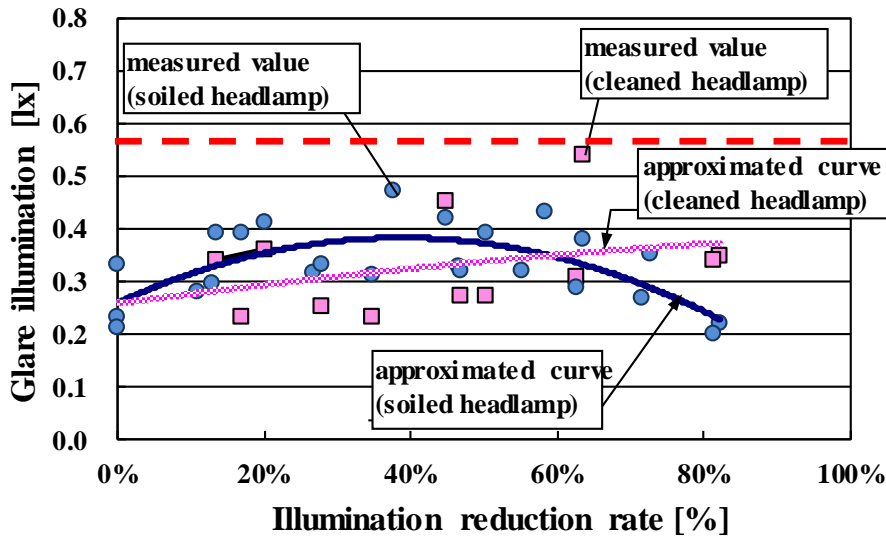
Fig.3 Change of glare illumination on point B50R
(Soiled HID headlamp in bench test)

Fig.4 Change of glare illumination on point B50R
(Cleaned HID headlamp in bench test)

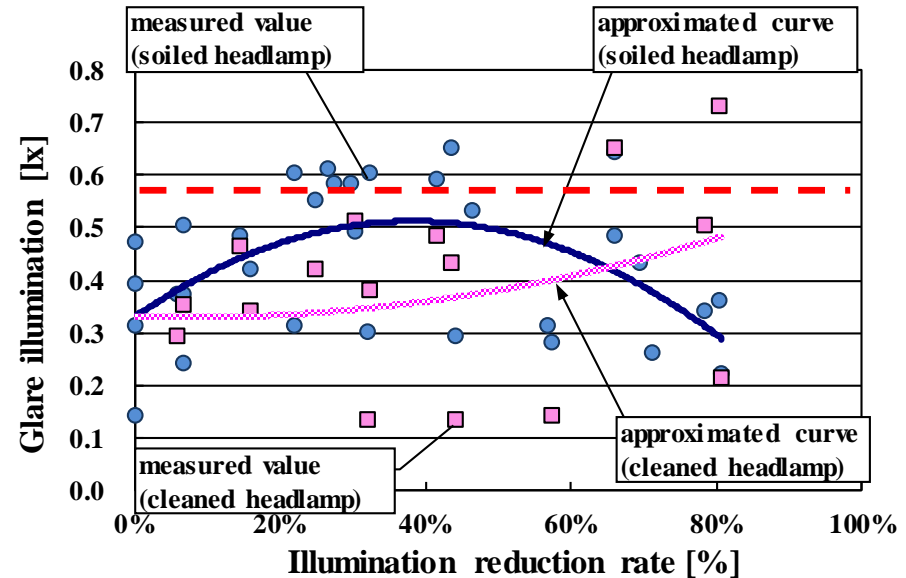
- The glare rating increased with higher soil rating, reaching a maximum when soil covered 40 to 60% of the headlamp surface (exceeding 0.57 lx, the upper limit in the UN regulation).
- The headlamp cleaner reduced glare when soil covered 0 to 60% of the headlamp surface.

Results of Experiment

Characteristics of LED and halogen headlamps (Using headlamps of 2000 lm or less)



(a) halogen



(b) LED

Fig.5 Change of glare illumination on point B50R/L(Soiled/cleaned headlamp in bench test)



Same results as HID

- The glare rating increased with higher soil rating, reaching a maximum when soil covered 40 to 60% of the headlamp surface (but not exceeding the upper limit in the UN regulation in the approximated curve).
- The headlamp cleaner reduced glare when soil covered 0 to 60% of the headlamp surface.

Experiment Method (2)

Quantitative analysis of discomfort glare

- Quantified discomfort glare of oncoming vehicles using the model formulas of **H.-J. Schmidt-Clausen and J. Th. H. Bindels**

$$W = 5.0 - 2 \log \Sigma (E / ((1 + (Lh / Cpl) 0.5) \theta^{0.46} C_{poo}))$$

E: Illumination at the driver's eye (lx) Lh: Adaptation luminance of the driver (cd/m²)

θ : Angle formed by the driver's line of sight and the headlamps' direction

$$Cpl : 4.0 \times 10^{-2} (\text{cd/m}^2) \quad C_{poo} : 3.0 \times 10^{-3} (\text{lx} \cdot \text{min}^{-0.46})$$

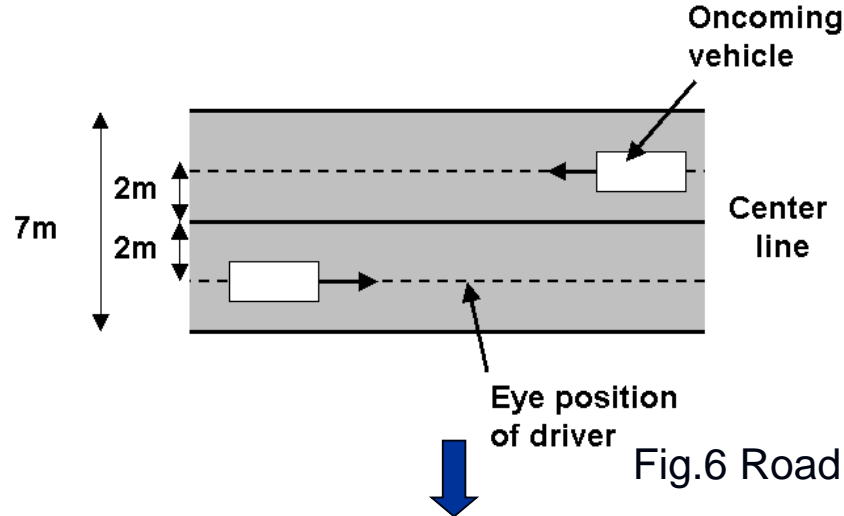


Fig.6 Road setting conditions

Quantitatively evaluated the change in glare to oncoming vehicles due to soiled headlamps and the reduction of glare by the headlamp cleaner

Results of Experiment

Quantitatively analyzed the evaluation values of glare to oncoming drivers
(Using HID headlamps of 2000 lm or more)

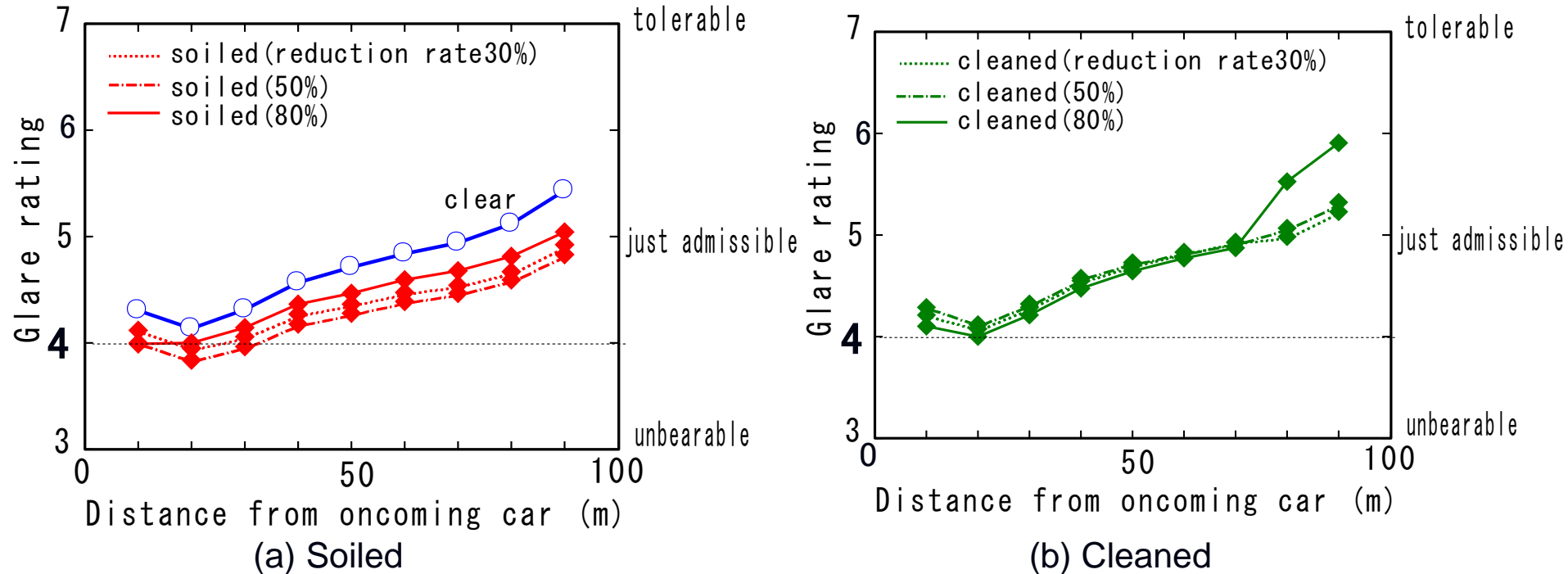


Fig.7 The glare rating with soiled lamplight and cleaned lamplight



- In some cases the glare from soiled headlamps to oncoming vehicles exceeded the allowed limit*. (Glare rating <4)
- The headlamp cleaner reduced glare to within the limit.

* According to the study of the NTSEL in 2003, the lower the glare rating was, the higher the discomfort the driver felt from the glare. Further, the study evaluated that the driver felt unbearable when the glare rating fell below 4.

Experiment Method (3)

Verification in real-world environment (Using LED headlamps)

Driving conditions

(i) Urban areas and mountainous areas (roads with some sections wet with melted snow and some sections covered with snow)

Drove the vehicle at 40 to 50 km/h with a following distance of about 40 m.

(iii) Expressways (sprayed with antifreeze chemicals)

Drove the vehicle on the Hokuriku Expressway at 70 to 80 km/h with a following distance of about 80 m.

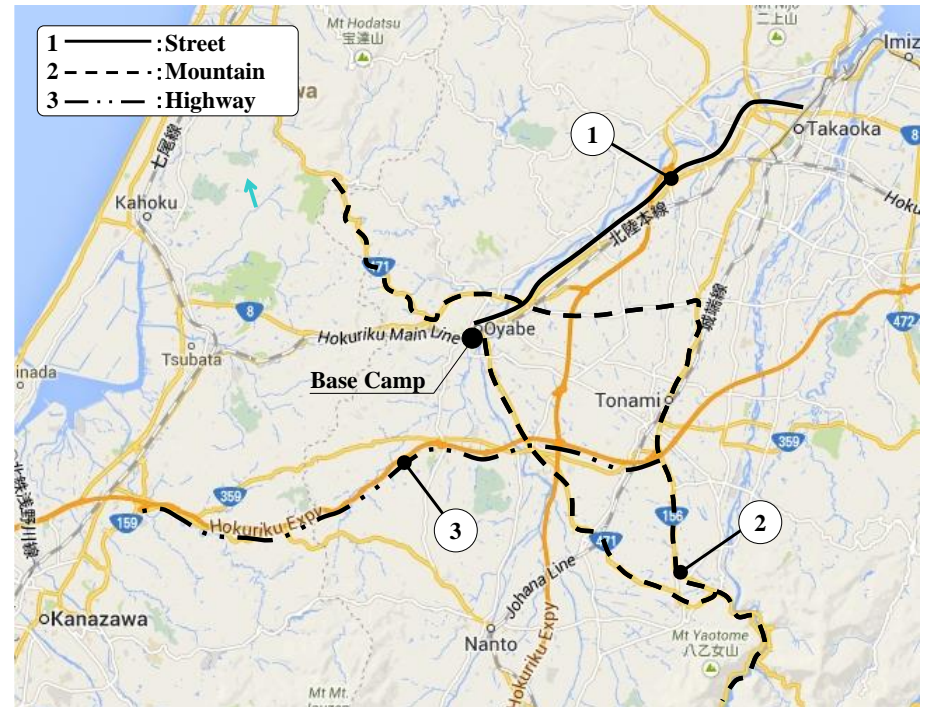
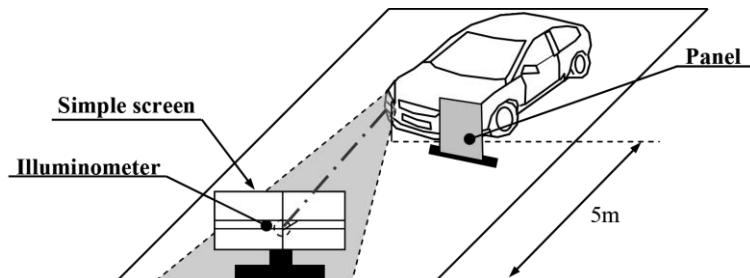


Fig.8 The run route in vehicle evaluation

Results of Experiment

Relationship between soiled headlamps and glare produced and the cleaning effect by headlamp cleaners in real-world environments

Before and after cleaning of the headlamps covered with snow or ice



(a) soiled by snow stuck accretion



(b) cleaned headlamp

Fig.9 Snow stuck accretion in actual use environment

Results of Experiment

Relationship between soiled headlamps and glare produced and the cleaning effect by headlamp cleaners in real-world environments
(Using LED headlamps of 2000 lm or less)

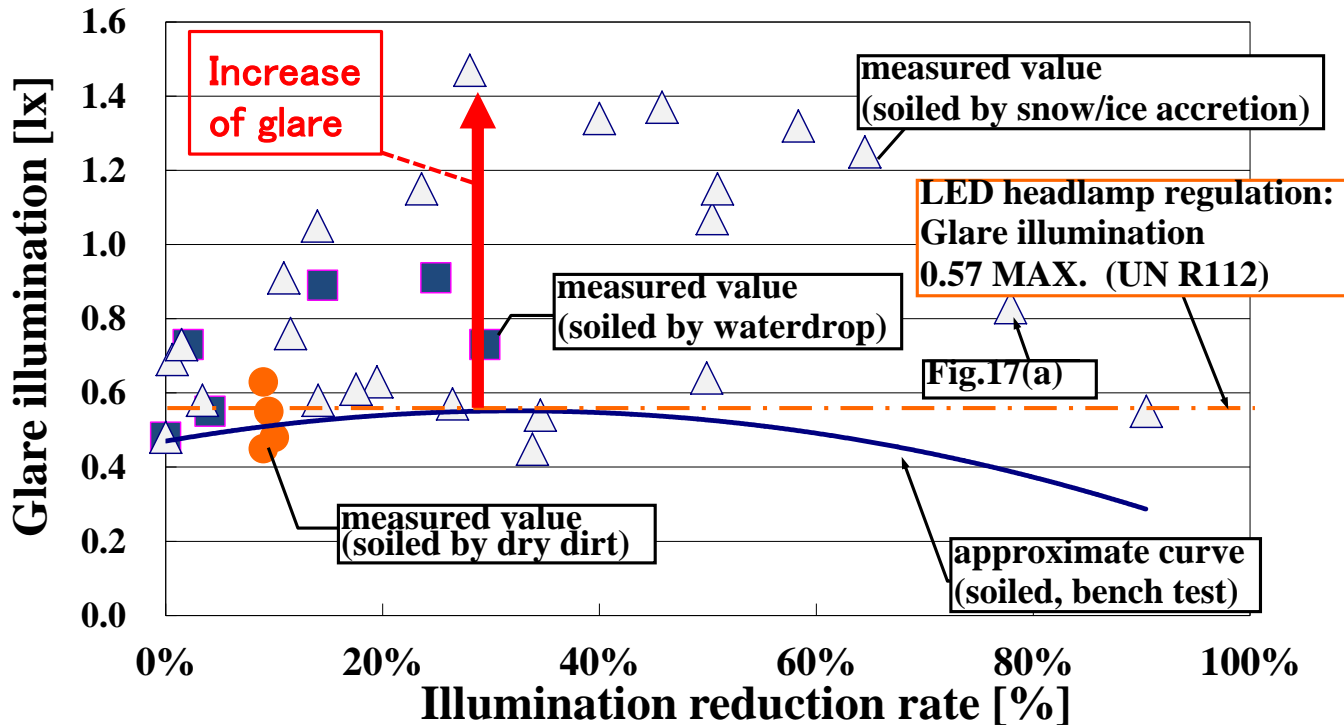


Fig.10 Change of glare illumination on point B50R(Soiled headlamp in actual use environment)



In real-world environments, the glare rating markedly increased to more than twice that measured in the bench test.
In snow and other real-world environments, glare to oncoming vehicles becomes even more discomforting.

Results of Experiment

Relationship between soiled headlamps and glare produced and the cleaning effect by headlamp cleaners in real-world environments

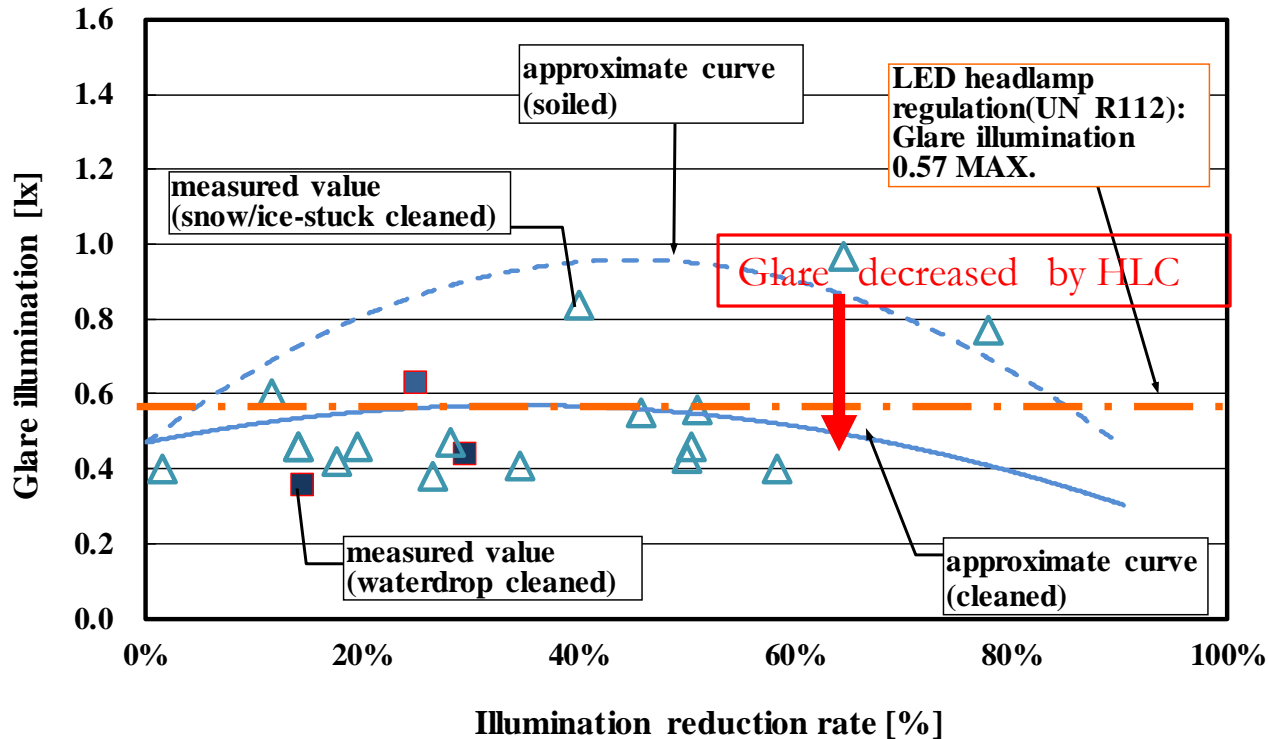


Fig.11 Change of glare illumination by headlamp cleaners on point B50R (Cleaned headlamp in actual use environment)



The headlamp cleaner reduced glare under all conditions.

Conclusion

- The headlamp cleaner reduces glare.
- With headlamps of 2000 lm or more, discomfort glare from soiled headlamps may exceed the allowed limit, but it was reduced to within the limit by using a headlamp cleaner.
- In the real-world driving experiments in snowy areas, glare was often much stronger than that measured in the benchmark tests. In those cases, too, the headlamp cleaner reduced glare.

Justification

Glare and Cleaner

- GRE-82-25 deletes the headlamp cleaner installation requirement. However, Japan cannot find the justification. There were not enough studies and discussions in IWG SLR and VGL. The amendment would increase glare problems for drivers. Therefore, Japan proposes to keep the current requirement until the studies and discussions of glare and headlamp cleaner are completed and a new alternative requirement is found.