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16. Abstract

Although the effects of dirt on headlamp performance have been of interest for many years, additional data concerning the levels of dirt on headlamps in actual use would be helpful in better understanding the effects of dirt and the potential benefits of countermeasures, including headlamp cleaning systems. In order to provide such data, it is useful to have methods for making simple field measurements of headlamp dirt that are related to the effects of dirt on light output. In this report, we describe a simple statistical model that predicts the photometric effects of dirt based on measures of the surface gloss of headlamps. Using the model, the light output at various points in the beam pattern of a dirty headlamp can be approximated reasonably well by simple functions of two variables: the light output at those specific points in the clean state, and a measure of overall dirt level based on gloss. In addition to describing the model, this report uses the model to quantify variations in the properties of artificial dirt that illustrate how the range of natural dirt may affect headlamp performance. Specifically, some forms of dirt probably cause relatively high levels of light scattering while others probably cause relatively high levels of light absorption. For two types of artificially applied dirt—salt and carbon dust—the model developed here works well in predicting the effects of dirt on light at a variety of test points. It appears to provide an adequate basis to use simple measurement of surface gloss as a surrogate for more comprehensive photometric measurements of the effects of dirt on headlamp beam patterns. In a separate report, we will apply the model to a set of gloss data collected in the field from a fleet of vehicles during a period of just over one year. This should provide an assessment of the likely effects of headlamp dirt over a range of real-world conditions, including seasonal effects.

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