

# Does Automotive Window Films Affect Driver's Safety by Decreasing Vision Sensitivity?

## A Cross-sectional study.

Ramos C.V.F.<sup>1-2</sup>, MD-PHD, Pap L.P.<sup>1</sup>, OT, Amaral D.R.<sup>1</sup>, OT, Prodocimo L.M.<sup>1</sup>, OT, Walsh A.<sup>2</sup>, MD, Crema C.W.<sup>3</sup>, MS, Crema A.S.<sup>2</sup> MD-PHD, Schor P.<sup>1</sup>, MD-PHD.

1- Bioengineering Department- Vision Institute-UNIFESP, Escola Paulista de Medicina, São Paulo- Brazil.

2- Clinica Walsh & Crema- Rio de Janeiro- Brazil

3- Fundação Tecnico Educacional Souza Marques- Escola de Medicina, Rio de Janeiro- Brazil

**Introduction:** Automotive window films have been developed to bring thermic comfort, UV protection, privacy and security to drivers and passengers, but how much of the driver's vision is affected by these films is not well documented. The films reduce the "Visible Light Transmission" (VLT) through car windows and can decrease vision sensitivity, especially at night, or when drivers should be able to see through the windows of other vehicles in order to spot hazards. Therefore, in many jurisdictions, there are laws to restrict the darkness of tinting. In Brazil it is legal to have Front window with 75% of VLT, Lateral with 70% and Rear with 28%.

The Brazilian Legislation divides into 5 categories the permission to drive. (see Table 2). Categories A and B require minimum visual acuity of 0,3LogMar and categories C, D and E require minimum visual acuity of 0.2 LogMar.

**Purpose:** to measure visual acuity in high and low contrast sensitivities in different grades of visible light transmission films in three different positions (front, lateral and rear windows).

**Methods:** 44 healthy volunteers between the ages of 30-75 years. Distance visual acuity was assessed under photopic illumination conditions and scored on a letter by letter basis. BCVA was measured 3 times and then the average was considered, first at distance of 4meters outside the car with the high contrast ETDRS Chart, then at the driver's seat in 5 different vehicles, each vehicle had one grade of VLT, and the measures were taken in 3 positions (front, lateral, and rear window) with high (100%) and low (20%) contrast ETDRS Charts (Precision Vision, LaSalle, Illinois, USA). (see Table 1).

Vehicle 1 (Default) was considered the automotive with VLT of 75% in the front window and 70% in lateral and rear windows. Vehicle 2 (Legal in Brazil), had front and lateral windows with VLT of 70% and rear with 28%; Vehicle 3 (Illegal), had front window with 70%, lateral with 28% and rear with 15%; Vehicle 4 (Illegal) had 35% in all 3 windows and Vehicle 5 (Illegal) 50% in the front, 20% in the lateral and 15% in the rear window. Descriptive statistics was used and the average of the 3 measurements of VA was considered. Wilcoxon Test was used to compare the average VA in each vehicle and position. Pvalue<0.05 was considered statistically significant.

**Results:** With regards to the front window, it is shown that in low contrast all the VLT tested were borderline for driving in categories C/D/E. In the lateral window, also in slightly low contrast, all the VLT tested were outside the limit for driving in categories C/D/E. In the rear window all measurements in High and Low Contrasts, with all VLT tested, were outside the limit for C/D/E with the exception of the vehicle with VLT of 35%. Furthermore, most of them are borderline or outside the limit for categories A/B. All vehicles showed significant reduction of BCVA compared to the default, except the group with VLT of 35% for the rear window.

**Conclusion:** visual acuity in high and low contrast is affected, especially in the rear window, by window films, not excluding the legally permitted ones. The increase of the rear window film VLT to 35% should bring safety to drivers especially in situations of decrease of contrast sensitivity.

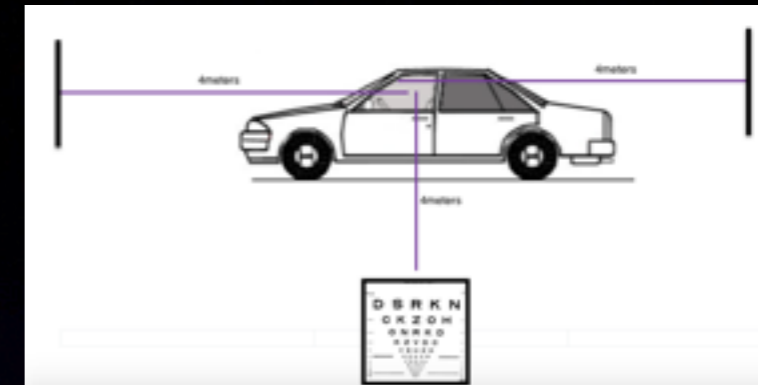
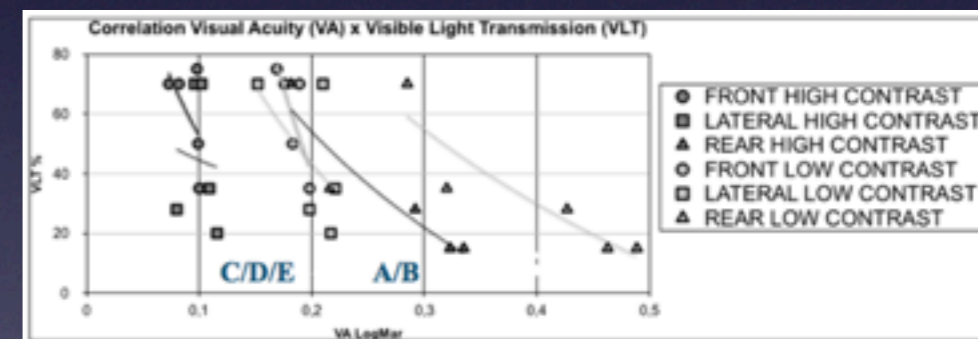


Figure 1: Visual acuity measure in each window, front, lateral and rear.

Vehicle	Front	Lateral	Rear
1	75%	70%	70%
2	70%	70%	28%
3	70%	28%	15%
4	35%	35%	35%
5	50%	20%	15%

Table 1: VLT (%) in each window



Graph showing that Front and Lateral windows in High Contrast are under the permission for categories C, D and E to drive, but Low Contrast are borderline. In the rear window high contrast is already outside of the limit for categories C, D and E, and Low Contrast is outside of the limit even for categories A and B.

DRIVING CATEGORIES	A	B	C	D	E
	MOTOR CICLE	CAR	CARGO	VAN MNIBUS	EXTRA AXLE

Table 2: categories for driver's license