

Informal document GRE-89-09
89th GRE, 24-27 October 2023,
agenda item 6 (b)



Brainstorming on conspicuity markings for agricultural vehicles

GRE 89, 24-27 October 2023

Conspicuity markings for agricultural vehicles

- ▶ CEMA proposal GRE88-04 to amend Regulation No. 86 on lighting installation for agricultural vehicles
 - proposal to use conspicuity markings as an alternative to retro-reflectors
 - proposal to use conspicuity markings as an alternative to side marker lamps
- ▶ GRE members did not support this proposal
- ▶ CEMA provides additional information to explain why this alternative was suggested

How does the contour marking compare today with a reflex reflector, side marker lamp and conspicuity marking?

Christoph Schulze Elting,
R&D

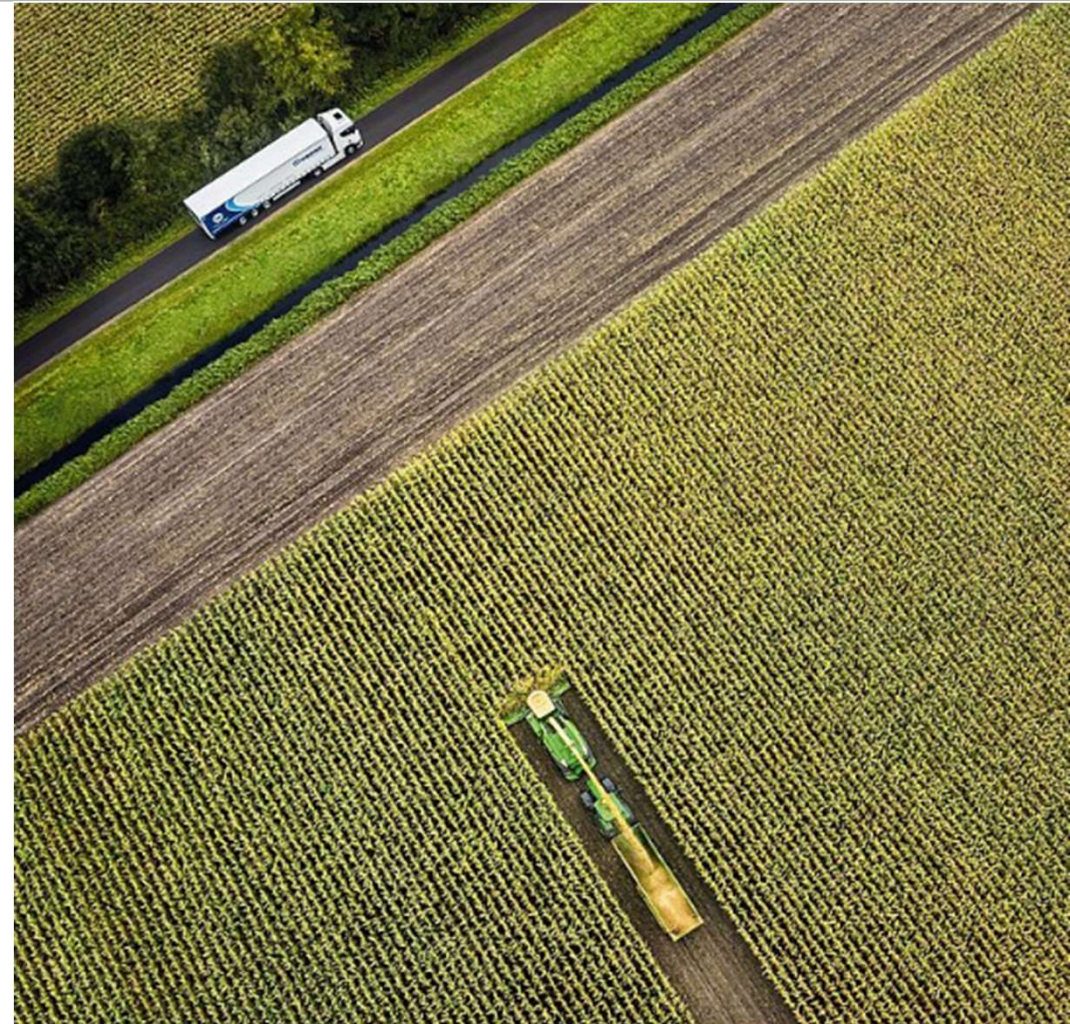
June 2023



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Background information



Background information



- German study
- 926 Accidents investigated
 - 307 Turning accidents
 - 289 Bending / Crossing

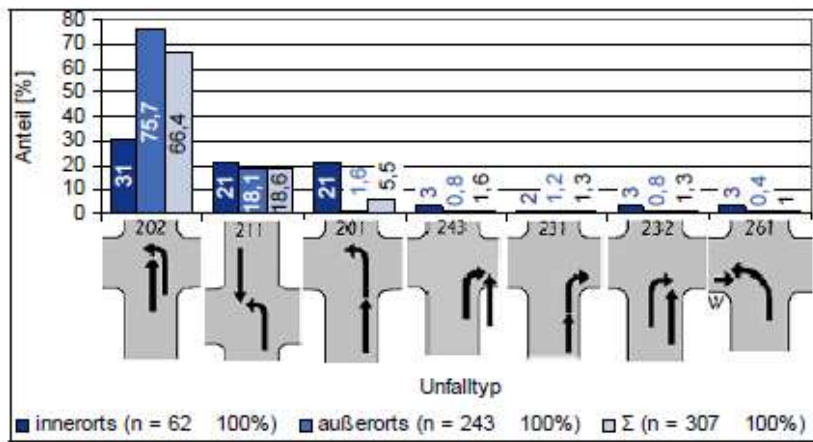


Abbildung 7-26: Anteil der AB-Unfalluntertypen an allen Abbiegeunfällen von landw. Zugmaschinen nach der Ortslage [LZM-Datenbank]

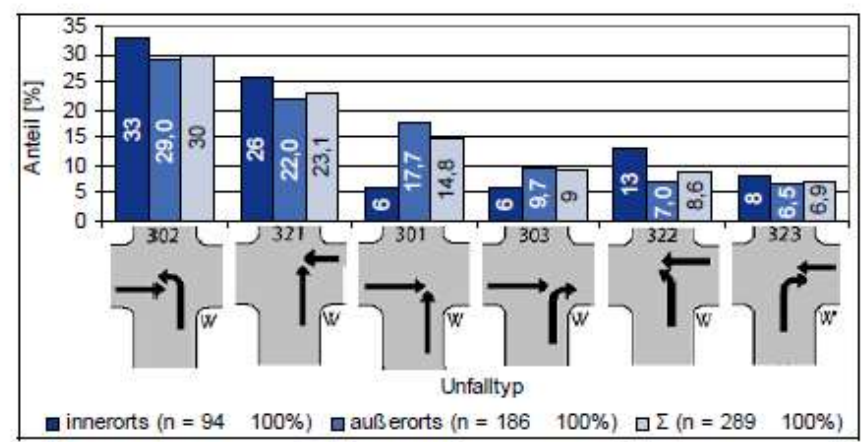


Abbildung 7-31 Anteil der EK-Unfalluntertypen an allen Einbiege-/Kreuzen-Unfällen von landw. Zugmaschinen nach der Ortslage [LZM-Datenbank]

Background information



<https://www.nordbuzz.de/niedersachsen/hannover-ort28793/hannover-b6-vw-rast-traktor-fahrer-tot-auto-nicht-wiederzuerkennen-zr-10847173.html>



https://www.nwm-tv.de/news/news-anzeigen/?news_id=15072

02

Visibility of side of the machine



Visibility of side of the machine

4.1 Side Markings

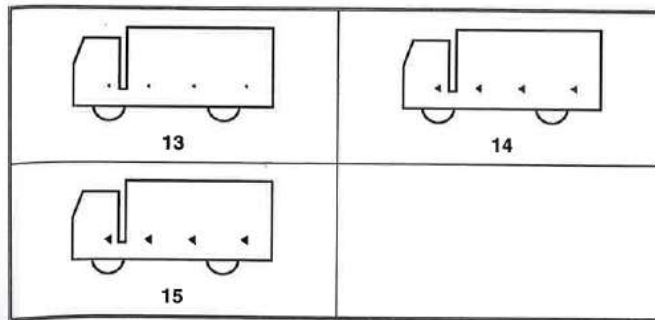
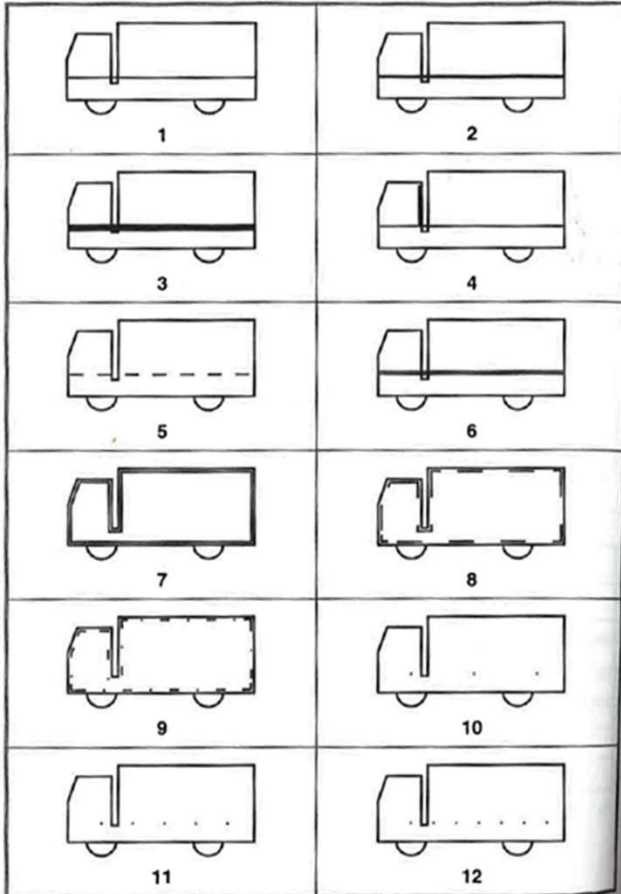


Table 4-2: Different types of marking; side view

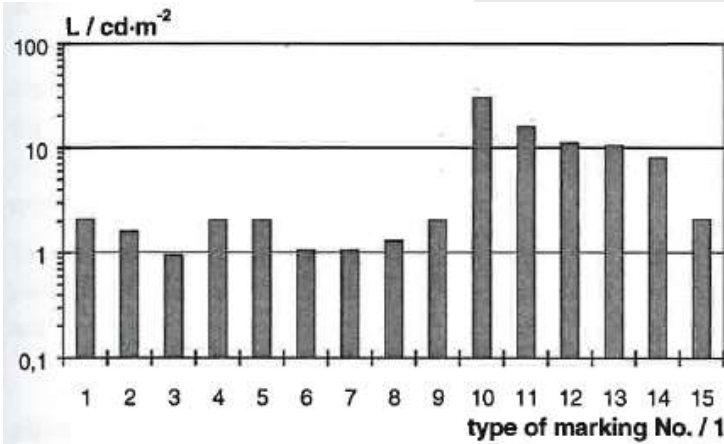




Figure 4-3: Necessary luminances L for optimal recognition (rate $r = 5$) of side markings for trucks (type of marking see Table 4-2)


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RETROREFLECTIVE MARKING OF VEHICLES

Department of Lighting Technology



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Visibility of rear of the machine



Visibility of the rear of the machine



4.2 Rear Markings

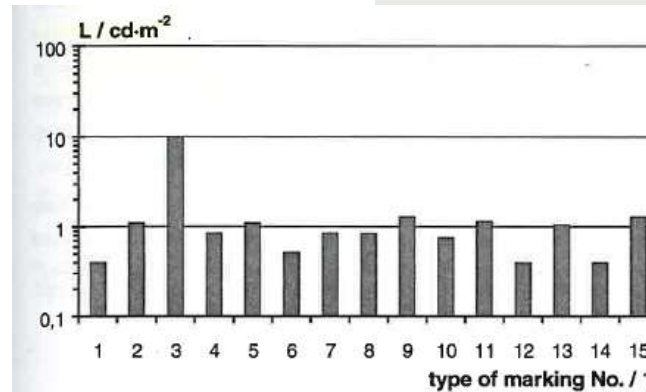
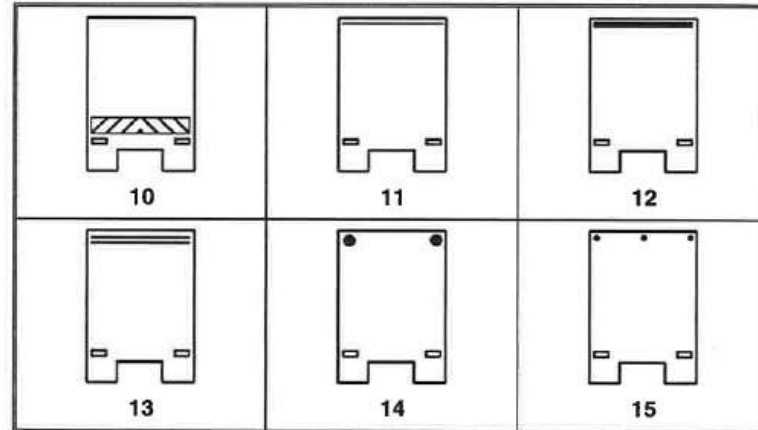
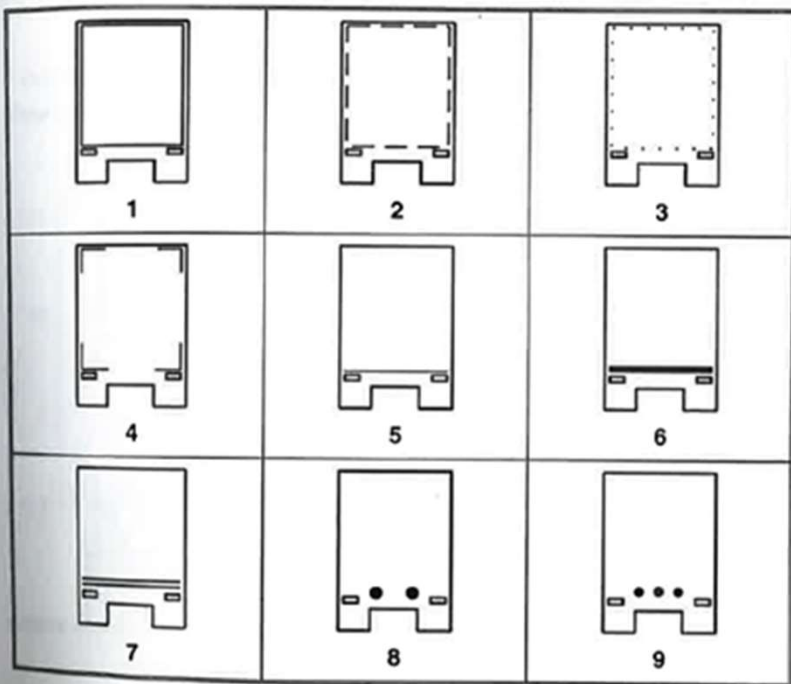
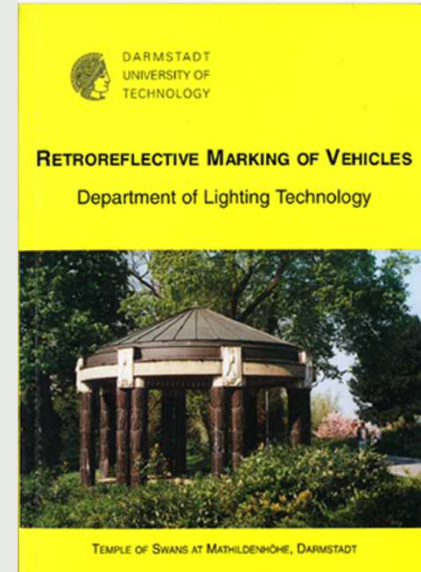


Figure 4-4: Necessary luminances L for optimal recognition (rate $r = 5$) of rear markings for trucks (type of marking see Table 4-3)



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Comparison of value for reflection



Comparison of value for reflection



3. CIL values **UNECE R 3 – Rev. 3 Annex 7**

3.1. Class IA, Class IB, Class IIIA and Class IIIB

3.1.1. The CIL values for red retro-reflecting devices must be at least equal to those in the table below, expressed in millicandelas per lux, for the angles of divergence and illumination shown.

Class	Angle of divergence α	Illumination angles (in degrees)			
		Vertical V Horizontal H	0° 0°	••10° 0°	••5° ••20°
IA, IB	20'		300	200	100
	1°30'		5	2.8	2.5
IIIA, IIIB	20'		450	200	150
	1°30'		12	8	8

1.1. Minimum values for the coefficient of Retro-reflection **UNECE R 104 – Annex 7**


Photometric specifications for retro-reflective markings of Class C:

Table 1
Minimum values for the Coefficient of Retro-reflection R' [cd.m⁻².lx⁻¹]

Observation angle α [°]	Entrance Angle β [°]					
	β_1	0	0	0	0	
$\alpha = 0,33(20')$	β_2	5	20	30	40	60
Colour						
Yellow		300	—	130	75	10
White		450	—	200	95	16
Red		120	60	30	10	—

Specific values
for reflectors acc. R3: **100 cd/lx/m²**
for conspicuity marking acc. R104: **300 cd/lx/m²**

Reflective value for vehicle with reflector:
area for one reflector ca. 0,003m²
0,3 cd/lx : 0,003m² = 100 cd/lx/m²
5 reflector a 0,3 cd/lx = **1,5 cd/lx**

for conspicuity marking: 
12m x 0,05m = 0,6m²
300cd/lx/m² x 0,6m² = **180cd/lx**

side marker lamp: 4-25 cd 

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Reaction time in relation to marking



Reaction time in relation to marking

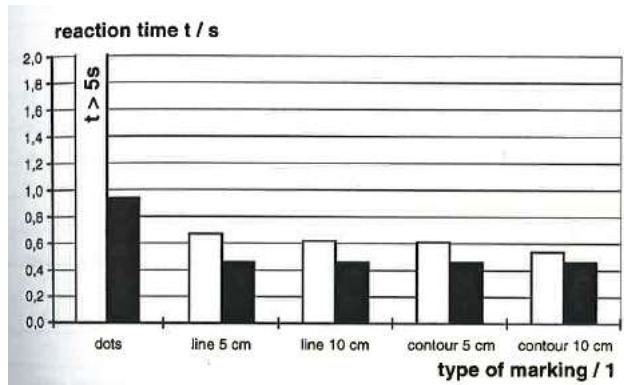


Figure 4-5: Reaction time t to different side markings of trucks in a structured surrounding with 2 different marking luminances L_m

- $L_m = 0,5 \text{ cd}\cdot\text{m}^{-2}$
- $L_m = 5 \text{ cd}\cdot\text{m}^{-2}$

IMPORTANT !



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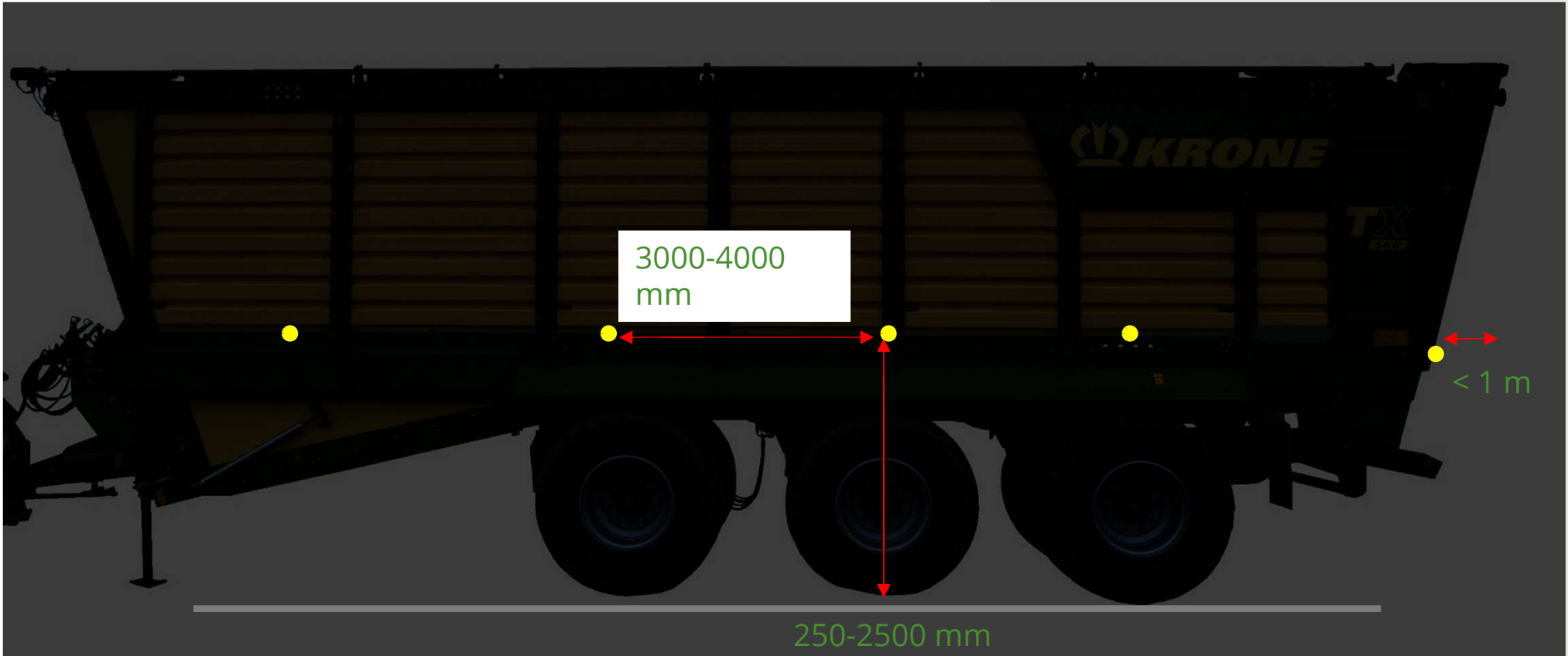
Requirements for height/ length/ width



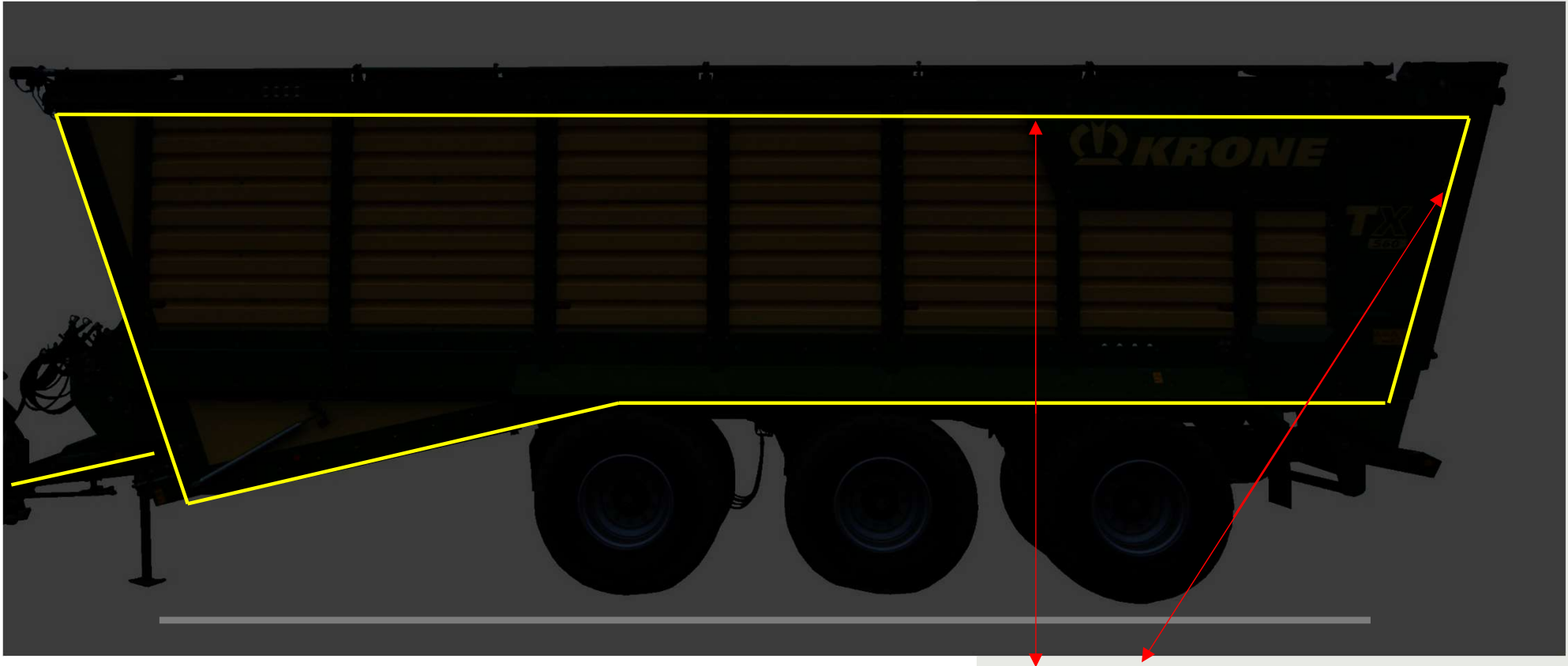
Requirements for height/ length/ width - reflector



Requirements for height/ length/ width – side marker lamp



Requirements for height/ length/ width – conspicuity marking



„The conspicuity markings shall be as close as practicable to horizontal and vertical, compatible with the shape, structure, design and operational requirements of the vehicle.“

Requirements for height/ length/ width – conspicuity marking



No side marker lamp at the rear of the machine!

„The conspicuity markings shall be as close as practicable to horizontal and vertical, compatible with the shape, structure, design and operational requirements of the vehicle.“

Overview of all



07

Further examples



Further examples



Thanks for your attention!



Conclusion



- ▶ Proposal to set a brainstorming sub-group to set alternatives to improve the side-signalling of an agricultural vehicle. ???