Minimum Following Distance:
What are the requirements where the "minimum following distance" is relevant in the current regulation?

$$dmin = vALKS* tfront$$

(km/h)	(m/s)	(s)	(m)
7.2	2.0	1.0	2.0
10	2.78	1.1	3.1
20	5.56	1.2	6.7
30	8.33	1.3	10.8
40	11.11	1.4	15.6
50	13.89	1.5	20.8
60	16.67	1.6	26.7

5.1.2. The activated system shall comply with traffic rules relating to the DDT in the country of operation.

5.2.3.3. The activated system shall detect the distance to the next vehicle in front as defined in paragraph 7.1.1. and shall adapt the vehicle speed in order to avoid collision.
While the ALKS vehicle is not at standstill, the system shall adapt the speed to adjust the distance to a vehicle in front in the same lane to be equal or greater than the minimum following distance.
In case the minimum time gap cannot be respected temporarily because of other road users (e.g. vehicle is cutting in, decelerating lead vehicle, etc.), the vehicle shall readjust the minimum following distance at the next available opportunity without any harsh braking unless an emergency manoeuvre would become necessary.

The minimum following distance shall be calculated using the formula:

5.2.4. The activated system shall be able to bring the vehicle to a complete stop behind a stationary vehicle, a stationary road user or a blocked lane of travel to avoid a collision. This shall be ensured up to the maximum operational speed of the system.

5.2.5. The activated system shall detect the risk of collision in particular with another road user ahead or beside the vehicle, due to a decelerating lead vehicle, a cutting in vehicle or a suddenly appearing obstacle and shall automatically perform appropriate manoeuvres to minimize risks to safety of the vehicle occupants and other road users.

Minimum Following Distance:
What can be the approach to get the values for vehicle categories N2/N3 and M2/M3?

- If there are traffic rules relating to the DDT in the country of operation, they should be applied in first priority.

- The vehicle shall be brought to a complete stop behind a stationary vehicle, a stationary road user or a blocked lane of travel to avoid a collision → adapt following distance, if needed, as the table defines only minimum values.

- Special characteristics of CVs for calculation of the minimum following distance values:
  - Deceleration of 5 m/s² used in the calculation (minimum performance of the service brakes in R13) for each speed value
  - Brake delay of 0.4s used in the calculation (linear increase up to full brake performance→ 0.8s/2) for each speed value
  - Ensuring that the minimum following distance is always greater than the calculated braking distance

New Approach for appropriate deceleration(2)

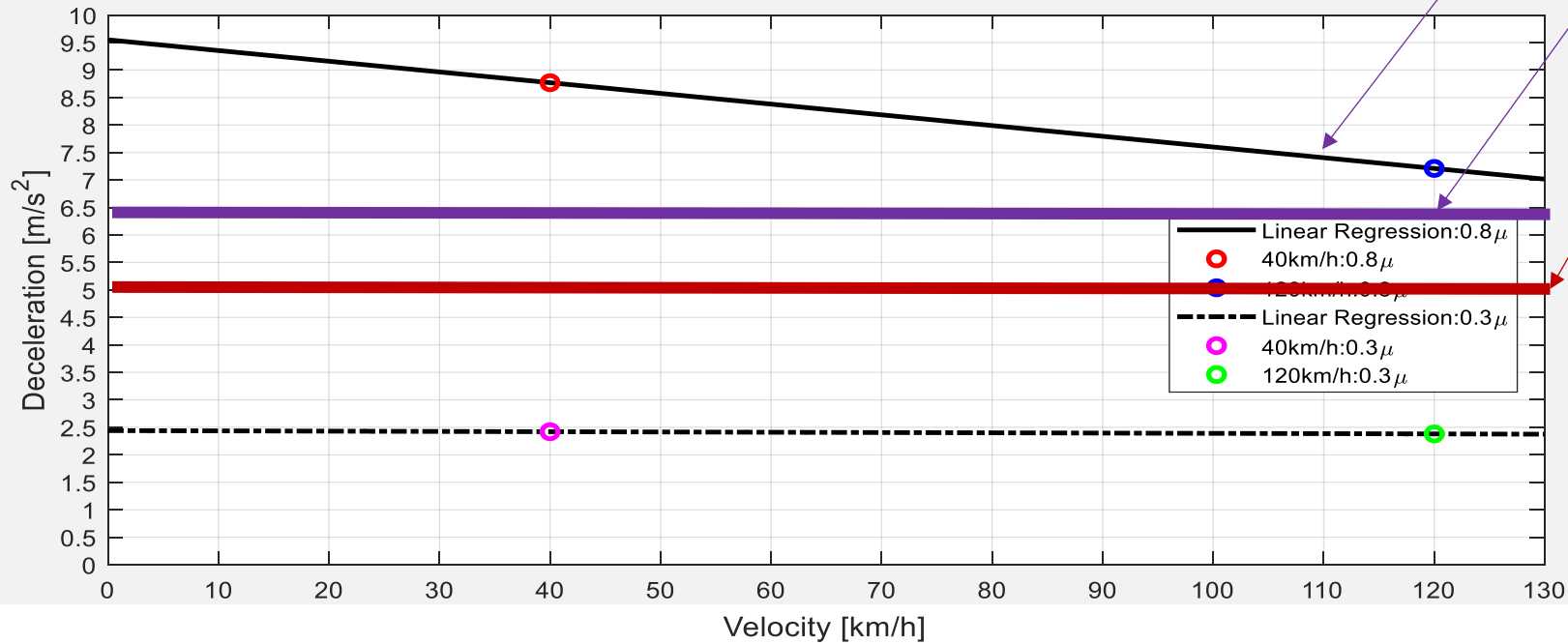- **Deceleration** ($a_{x,max}$) **formulas by road condition(wet asphalt, wet basalt)**

  - Avg. MFDD deceleration ($a_{x,max}$) at 40km/h and 120km/h (0.8μ)= $8.77 m/s^2$ and $7.21 m/s^2$

  $$a_{x0.8\mu}(v_x) = -0.0702 \times v_x + 9.55$$

  - Avg. MFDD deceleration ($a_{x,max}$) at 40km/h and 120km/h (0.3μ)= $2.42 m/s^2$ and $2.38 m/s^2$

  $$a_{x0.3\mu}(v_x) = -0.0018 \times v_x + 2.44$$

  - Linear Decelerations by velocity

M1:
Use actual measurement data to define minimum following distance

UN R13H minimum requirements

N2/N3 and M2/M3:
Use UN R13 minimum requirements to define minimum following distance
=
A more conservative approach than PCs

Minimum Following Distance:
Proposal for time gap for N2/N3 and M2/M3

a (average)	v		s-brake	s-brake with **0.4s** delay	following distance	time gap (in R157 for M1)	time gap (proposal)
				calculated distance < min. follwing distance			
[m/s²]	[km/h]	[m/s]	[m]	[m]	[m]	[s]	[s]
5	7,2	2,00	0,4	1,2	2,4	1,0	1,2
5	10	2,78	0,8	1,9	3,9	1,1	1,4
5	20	5,56	3,1	5,3	8,9	1,2	1,6
5	30	8,33	6,9	10,3	15,0	1,3	1,8
5	40	11,11	12,3	16,8	22,2	1,4	2,0
5	50	13,89	19,3	24,8	30,6	1,5	2,2
5	60	16,67	27,8	34,4	40,0	1,6	2,4

Example for calculation for a speed of 10 km/h:

S-brake = V²/2*a → (2.78m/s) ²/(2*5 m/s²) = 0.8m

S-brake with 0.4s delay = S-brake + (0.4s*V) → 0.8m + (0.4s*2.78m/s) = 1.9m

Trailer Length:
Where could "trailer length" be of interest for the truck strategy?

7.1. Sensing requirements

… The ALKS vehicle shall be equipped with a sensing system such that, it can at least determine the driving environment (e.g. road geometry ahead, lane markings) and the traffic dynamics:

    (a) Across the full width of its own traffic lane, the full width of the traffic lanes immediately to its left and to its right, up to the limit of the forward detection range;

    (b) Along the full length of the vehicle **or combination** and up to the limit of the lateral detection range.

The requirements of this paragraph are without prejudice to other requirements in this Regulation, most <u>notably paragraph 5.1.1</u>.

7.1.2. Lateral detection range

The manufacturer shall declare the lateral detection range. The declared range shall be sufficient to cover the full width of the lane immediately to the left and of the lane immediately to the right of the vehicle **or combination**. The Technical Service shall verify that the vehicle sensing system detects vehicles during the relevant test in Annex 5. This range shall be equal or greater than the declared range.

Conclusions:
- These requirements are to be checked at type approval.
- No need for the truck to know about trailer length.

Trailer Length:
Where could "trailer length" be of interest for the truck strategy?

5.1.1. The activated system shall perform the DDT shall manage all situations including failures, and shall be free of unreasonable risks for the vehicle occupants or any other road users.
The activated system shall not cause any collisions that are reasonably foreseeable and preventable. If a collision can be safely avoided without causing another one, it shall be avoided. When the vehicle is involved in a detectable collision, the vehicle shall be brought to a standstill.

5.2.1. The activated system shall keep the vehicle inside its lane of travel and ensure that the vehicle does not cross any lane marking (outer edge of the front tyre to outer edge of the lane marking). The system shall aim to keep the vehicle in a stable lateral position inside the lane of travel to avoid confusing other road users.

5.2.2. The activated system shall detect a vehicle driving beside as defined in paragraph 7.1.2. and, if necessary, adjust the speed and/or the lateral position of the vehicle within its lane as appropriate.

Trailer Length:

Where could "trailer length" be of interest for the truck strategy?
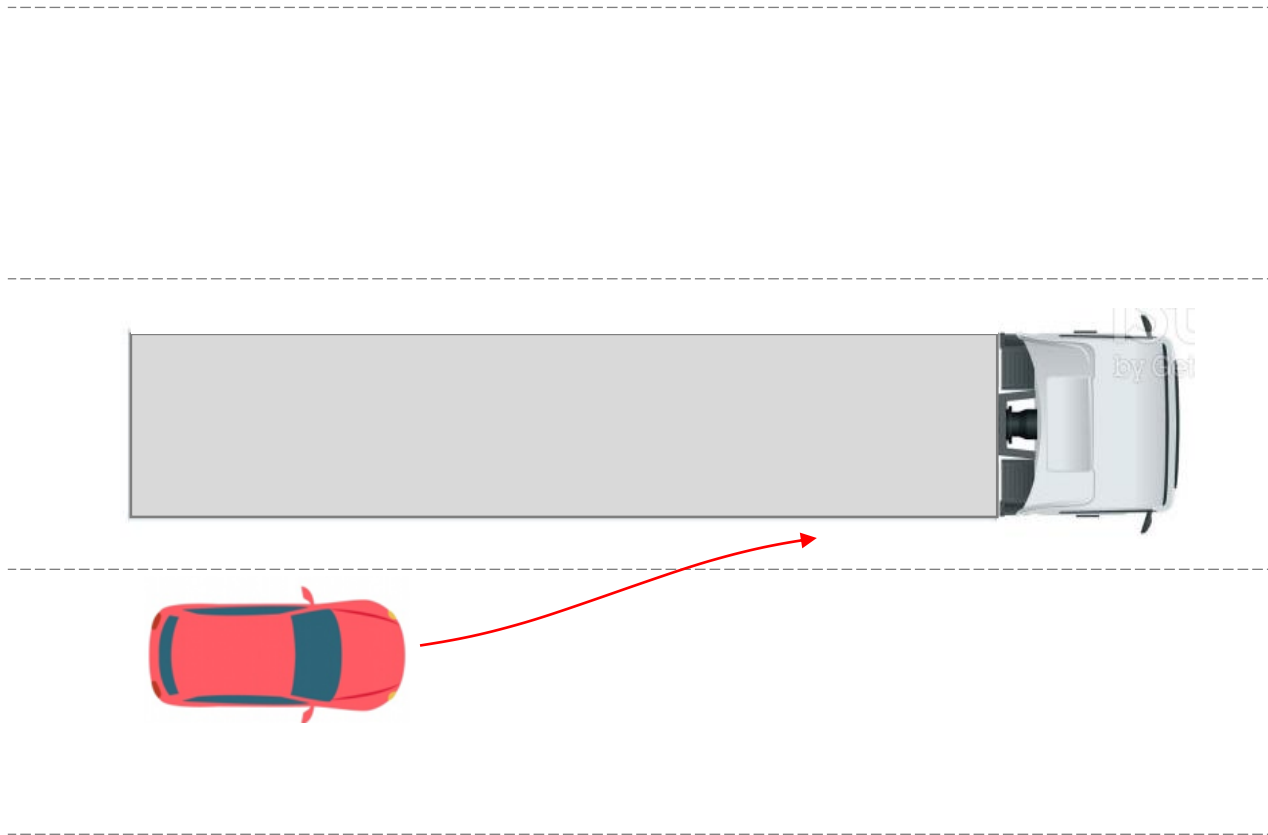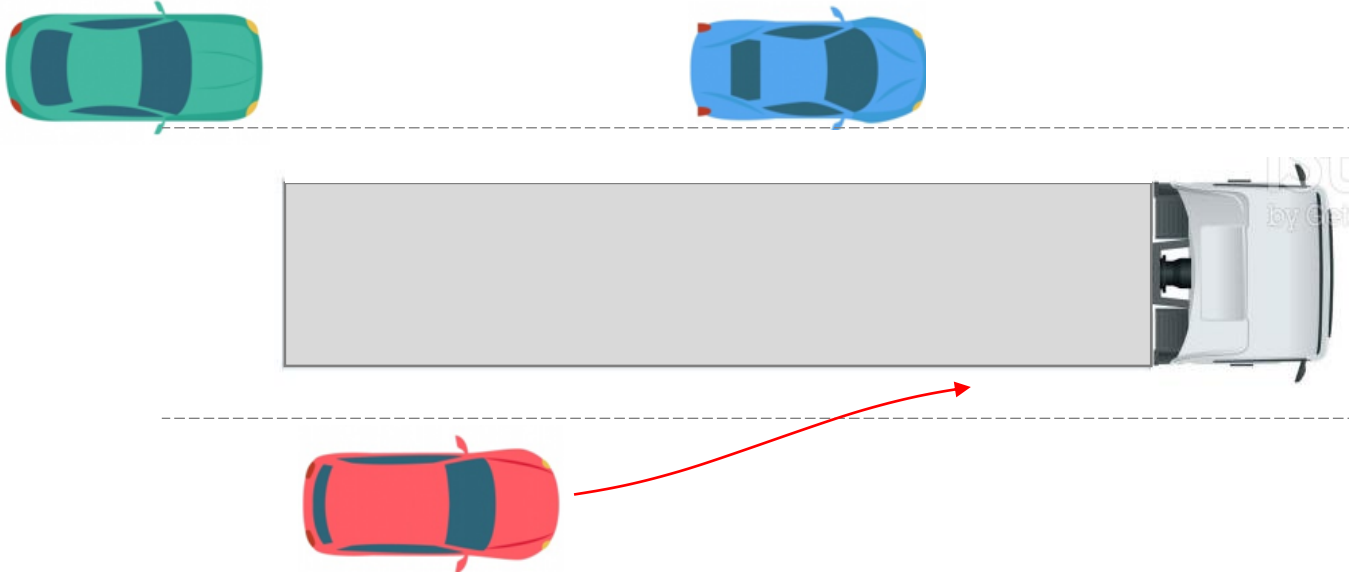

Scenario:

The **red car** drifts towards the truck.

Strategy:

Detection of the red car by 7.1.. The truck cannot do so much to avoid a collision, apart from possibly drifting a bit to the left side of the lane (by e.g. 30cm). This is permitted by 5.2.2.

Trailer Length:

Where could "trailer length" be of interest for the truck strategy?

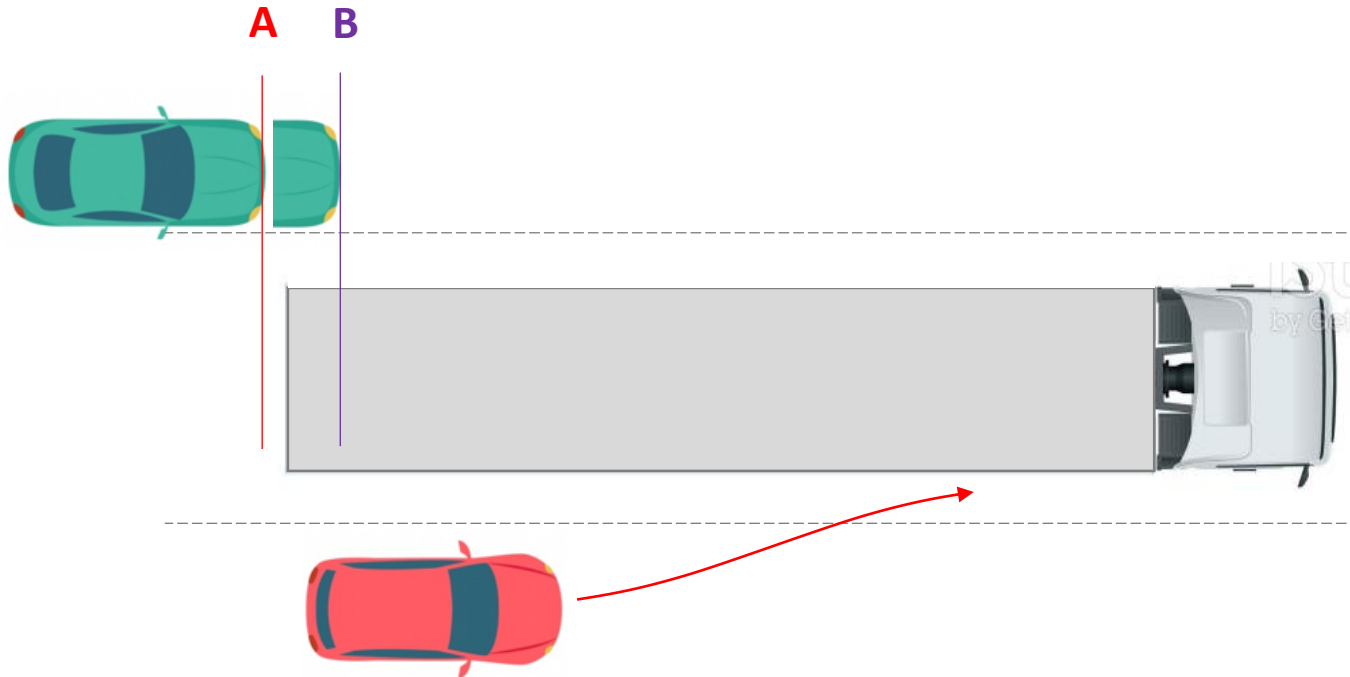**Scenario:**

The **red car** drifts towards the truck.

Strategy:

Detection of red and blue car by 7.1.. In that situation, the truck should rather not move in its lane, due to the presence of the **blue car** close to the marking. This behaviour responds to 5.2.1.

Trailer Length:
Where could "trailer length" be of interest for the truck strategy?

Scenario:
The **red car** drifts towards the truck.

Strategy:
In that case the trailer length may be "good to know" in order the truck to be able to differentiate between positions A and B of the green car.
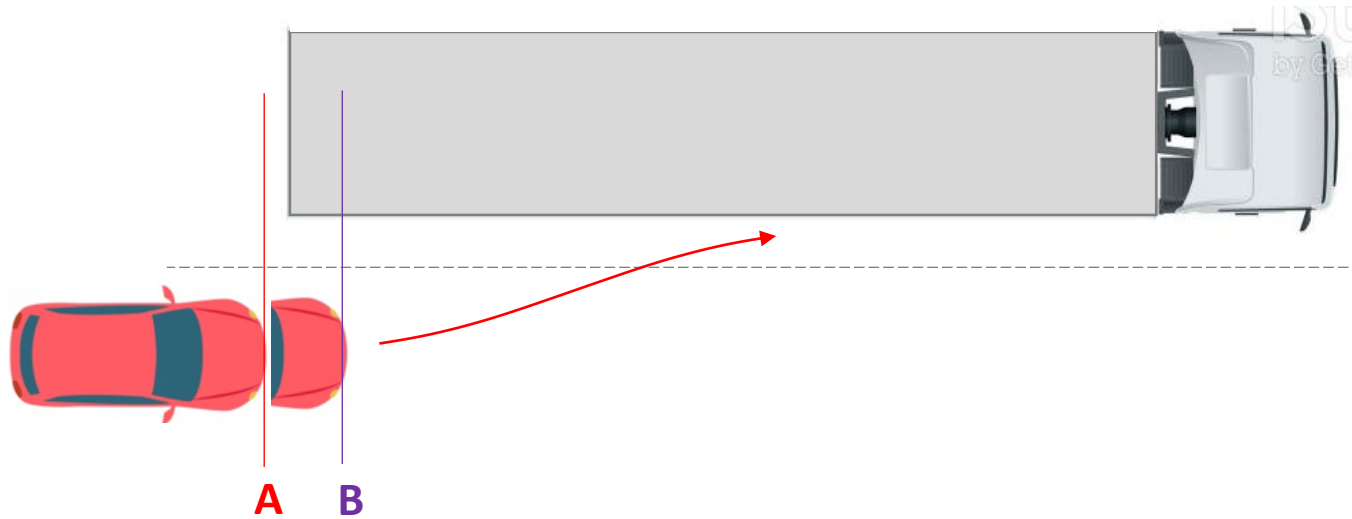
Assuming the **green car** is at the same speed as the truck:

- **With green car in position A**: the truck may drift to the left without confusing the green car (which would actually be really the case if the green car was several meters behind the trailer rear-end…).
- **With green car in position B:** the truck should not drift to the left.

Conclusion: in this case, the exact trailer length is not necessarily needed. A rough assessment of trailer length, associated with a conservative strategy is sufficient to implement a safe strategy in line with 5.2.1 and 5.2.2.

Trailer Length:
Where could "trailer length" be of interest for the truck strategy?

A   B

Scenario:
The **red car** drifts towards the truck.

Strategy:
In that case the trailer length may be "good to know" in order the truck to be able to differentiate between positions A and B of the red car.

Assuming the **red car** is at the same speed as the truck:

- **With red car in position A**: the truck should not drift to the left, since no collision risk (par. 5.2.1). (However a conservative strategy where the truck would drift a bit anyway would not create any risk).
- **With red car in position B**: the truck could possibly drift to the left (and/or accelerate?). (par. 5.2.2).

Conclusion: in this case, the exact trailer length is not necessarily needed. A rough assessment of trailer length, associated with a conservative strategy is sufficient to implement a safe strategy in line with 5.2.1 and 5.2.2.

Trailer Length:
Conclusion

- The exact trailer length is not necessarily needed.

- A rough assumption of trailer length by the truck, associated with a conservative strategy is sufficient to implement a safe strategy in line with 5.2.1 and 5.2.2.

- Given the relative size of a heavy combination with regard to the lane width, the best strategy in case another vehicle in an adjacent lane would drift towards the ego vehicle may be to select to keep the ego vehicle stable in the lane → no need to know the exact trailer length.

DSSAD:
Draft proposal to amend §8.4.3. in UN ECE R157

8.4.3.　　**Retrievability of data**

8.4.3.1.　**For vehicles of category M1 and N1** the data shall be retrievable even after an impact of a severity level set by UN Regulations Nos. 94, 95 or 137 **as applicable**.

8.4.3.2.　**For vehicles of categories M2, M3, N2 and N3, the following applies.**
　　　　　Either:
　　　　　• 　**the data shall be retrievable even after a mechanical shock of a severity level as specified in the component test of Annex 9C of the 03 series of amendment to UN Regulation No. 100, and**
　　　　　• 　**the DSSAD shall be mounted in a position such as to be protected against mechanical damage resulting from a typical vehicle crash (e.g. frontal impact). This shall be demonstrated to the technical service together with appropriate documentation (e.g. calculations or simulations);**
　　　　　or
　　　　　Alternatively, sufficient crash protection may be demonstrated by the manufacturer by fulfilling the requirements of paragraph 8.4.3.1. (e.g. for M2 / N2 vehicles derived from M1 / N1).

8.4.3.3.　If the main on-board vehicle power supply is not available, it shall still be possible to retrieve all data recorded on the DSSAD, as required by national and regional law.