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Economic Commission for Europe**Inland Transport Committee****World Forum for Harmonization of Vehicle Regulations****Working Party on Brakes and Running Gear (GRRF)****Seventy-fifth session**

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Item 3(b) of the provisional agenda

Regulations Nos. 13 and 13-H (Braking) –**Automated Connections between Vehicles (ACV)****Proposal for amendments to Regulation No. 13 (Heavy vehicle braking)****Submitted by the informal working group on Automated Connections between Vehicles***

The text reproduced below was prepared by the informal working group on Automated Connections between Vehicles (ACV) to introduce automatic coupling systems into UN Regulation No. 13. The modifications to the existing text of the Regulation are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Insert new paragraphs 2.39. and 2.40. to read:

- "2.39. "Brake electric/electronic interface" means the part of a separable electrical/electronic connection between the towing vehicle and the towed vehicle which is dedicated to the braking system.**
- 2.40. "Automated Connector" means a system through which the electric and pneumatic connection, between the towing vehicle and towed vehicle is made automatically without direct intervention of a human operator."**

Paragraph 5.1.3.6., amend to read:

- "5.1.3.6. (a) The electric control line shall conform to ISO 11992-1 and 11992-2:2003 including its amendment 1:2007 and be a point-to-point type using:
- (i) the seven pin connector according to ISO 7638-1 or 7638-2:2003 **or,**
 - (ii) **in the case of systems where the connection of the electric control line is automated, the automated connector shall, as a minimum, provide the same number of pins as the above-mentioned ISO 7638 connector and meet the requirements specified in Annex 22 of this Regulation.**
- (b) The data contacts of the ISO 7638 connector shall be used to transfer information exclusively for braking (including ABS) and running gear (steering, tyres and suspension) functions as specified in ISO 11992-2:2003 including its Amd.1:2007. The braking functions have priority and shall be maintained in the normal and failed modes. The transmission of running gear information shall not delay braking functions.
- (c) The power supply, provided by the ISO 7638 connector, shall be used exclusively for braking and running gear functions and that required for the transfer of trailer related information not transmitted via the electric control line. However, in all cases the provisions of Paragraph 5.2.2.18. of this Regulation shall apply. The power supply for all other functions shall use other measures."

Paragraph 5.1.3.8., amend to read:

- "5.1.3.8. Shut-off devices which are not automatically actuated shall not be permitted."

Add new paragraph 5.1.3.9. to read:

- "5.1.3.9. In the case of tractor and semi-trailer combinations, the flexible hoses and cables shall be a part of the power-driven vehicle. In all other cases, the flexible hoses and cables shall be a part of the trailer.**
- In the case of an automated connector, this requirement regarding the allocation of flexible hoses and cables is not applicable."**

Paragraph 5.2.1.23., amend to read:

"5.2.1.23. Power driven vehicles authorized to tow a trailer equipped with an anti-lock system shall also be equipped with a special electrical connector, conforming to ISO 7638:2003⁷, for the electric control transmission.

Alternatively, or in addition, in the case of vehicles where the connection of the electric control line is automated, the automated connector shall meet the requirements specified in Annex 22 of this Regulation."

Paragraph 5.2.2.17. , amend to read:

"5.2.2.17. Trailers equipped with an electric control line and O₃ and O₄ category trailers equipped with an anti-lock system, shall be fitted with a special electrical connector for the braking system and/or anti-lock system, conforming to ISO 7638:2003^{15, 16}.

Alternatively, or in addition, in the case of vehicles where the connection of the electric control line is automated, the automated connector shall meet the requirements specified in Annex 22 of this Regulation.

Failure warning signals required from the trailer by this Regulation shall be activated via the above connectors. The requirement to be applied to trailers with respect to the transmission of failure warning signals shall be those, as appropriate, which are prescribed for motor vehicles in paragraphs 5.2.1.29.4., 5.2.1.29.5. and 5.2.1.29.6.

Trailers equipped with an ISO 7638:2003 connector as defined above shall be marked in indelible form to indicate the functionality of the braking system when the ISO 7638:2003 connector is connected and disconnected.¹⁷

The marking is to be positioned so that it is visible when connecting the pneumatic and electrical interface connections.

¹⁷ In the case of a trailer equipped with both an ISO 7638 connector and automated connector, the marking shall show that the ISO 7638 connector should not be connected when an automated connector is in use"

Annex 2, add new paragraphs 14.5., 14.15.1 and 14.15.2., to read:

"14.15. The vehicle is equipped with an automated connector: yes/no.²

14.15.1. If yes, does the automated connector fulfil the requirements of Annex 22: yes/no.²

14.15.2. The automated connector is of category A/B/C/D.²

² Strike out what does not apply."

Annex 6, paragraphs 2.5, amend to read:

"2.5. In the case of power-driven vehicles having a pneumatic control line for trailers, in addition to the requirements of paragraph 1.1. of this Annex, the response time shall be measured at the extremity of a pipe 2.5 m long with an internal diameter of 13 mm which shall be joined to the coupling head of the control line of the service braking system. During this test, a volume of $385 \pm 5 \text{ cm}^3$ (which is deemed to be equivalent to the volume of a pipe 2.5 m long with an internal diameter of 13 mm and under a pressure of 650 kPa) shall be connected to the coupling head of the supply line.

Tractors for semi-trailers shall be equipped with flexible pipes for making the connection to semi-trailers. The coupling heads will, therefore, be at the extremity of those flexible pipes. The length and internal diameter of the pipes shall be entered at item 14.7.3. of the form conforming to the model in Annex 2 to this Regulation.

In the case of an automated connector the measurement including the use of a 2.5m pipe and $385 \pm 5 \text{ cm}^3$ of volume as described above shall be made, considering the connector interface as the coupling heads."

Annex 6, Paragraph 3.3.3., amend to read:

3.3.3. The simulator shall be set, e.g. through the choice of orifice in accordance with paragraph 3.3.1. of this annex in such a way that, if a reservoir of $385 \pm 5 \text{ cm}^3$ is joined to it, the time taken for the pressure to increase from 65 to 490 kPa (10 and 75 per cent respectively of the nominal pressure of 650 kPa) shall be 0.2 ± 0.01 seconds. If a reservoir of $1155 \pm 15 \text{ cm}^3$ is substituted for the above-mentioned reservoir, the time taken for the pressure to increase from 65 to 490 kPa without further adjustment shall be 0.38 ± 0.02 seconds. Between these two pressure values, the pressure shall increase in an approximately linear way. ~~These reservoirs shall be connected to the coupling head without using flexible pipes and the connection shall have an internal diameter of not less than 10 mm.~~

These reservoirs shall be connected to the coupling head without using flexible pipes. The connection between the reservoirs and the coupling head shall have an internal diameter of not less than 10 mm.

The setting shall be carried out using a coupling head arrangement that is representative of the type fitted to the trailer for which type approval is sought."

Add Annex 22 to read:

"Annex 22

Requirements for the brake electric/electronic interface of an automated connector

1. General

This Annex defines the requirements applicable to installations where the connection and disconnection of the brake electric/electronic interface between the towing vehicle and the towed vehicle is achieved by an automated connector.

This Annex also considers the case where a vehicle is equipped with both ISO 7638 connector and an automated connector.

2. Categories of automated connectors

Automated connectors are classified in different categories 1:

Category A automated connector for tractor/semi-trailer combinations shall meet the requirements of Appendix 2 of this annex. All automated connectors within this category are compatible together.

Category B automated connectors for tractor/semi-trailer combinations that do not meet all the requirements of Appendix 2. They are not compatible with category A. Interfaces of category B are not necessarily compatible to all type of interfaces within this category.

Category C automated connectors for combination other than tractor/semi-trailer shall meet the requirements of Appendix 3 of this Annex 2/. All automated connectors within this category are compatible together.

Category D automated connectors for combinations other than tractor/semi-trailer that do not meet all the requirements of Appendix 3. They are not compatible with category C. Interfaces of category D are not necessarily compatible to all type of interfaces within this category.

Footnotes

1/ new categories of couplings may be added later on for new/innovative technical solutions, when standard interfaces will be defined and agreed upon.

2/ until a standard is defined and agreed upon, no automated connector shall be defined as being of category C.

3. Requirements

The brake electric/electronic interface of the automated connector shall achieve the same functional requirements as specified for the ISO 7638 connector throughout this regulation and its Annexes.

3.1. The contacts (pins and sockets) for the brake electric/electronic interface shall have the same electrical characteristics and functionality as the ISO 7638 contacts.

3.1.1. The data contacts of the brake electric/electronic interface shall be used to transfer information exclusively for braking (including ABS) and running gear (steering, tyres and suspension) functions as specified in ISO 11992-2:2003 including its Amendment 1:2007. The braking functions have priority and shall be maintained in the normal and failed modes. The transmission of running gear information shall not delay braking functions.

3.1.2. The power supply, provided by the brake electric/electronic interface, shall be used exclusively for braking and running gear functions and that required for the transfer of trailer related information not transmitted via the electric control line. However, in all cases the provisions of paragraph 5.2.2.18. of this Regulation shall apply. The power supply for all other functions shall use other measures.

3.2. In the case of semi-trailer combinations equipped with an automated connector the maximum length of the cable for braking data communication shall be;

(a) tractor: 21 m;

(b) semi-trailer: 19 m;

in the running mode.

In all other cases the conditions of paragraphs 5.1.3.6. and 5.1.3.8. of this Regulation apply with respect to maximum cable lengths.

- 3.3. Vehicles being equipped with both a connector conforming to ISO 7638 and an automated connector shall be built in such a way that only a single path is possible for the functioning of the electric control transmission or in the transmission of information in accordance with ISO 11992-2:2003 including Amendment 1:2007. See Appendix 1 for examples.**
- In the case of automatic path selection the priority shall be given to the automated connector.**
- 3.4. Any trailer equipped with an automated connector shall be equipped with a spring braking system according to Annex 8 of this regulation.**
- 3.5. The manufacturer applying for type approval shall submit an information document describing the functionality and any limitations in the use of the automated connector and any associated equipment, including information about the category according to paragraph 2 of this Annex.**
- In the case of automated connectors of categories B and D, the means to identify the type of automated connector shall also be described to ensure identification of compatibility.**
- 3.6. The vehicle user's handbook provided by the manufacturer shall warn the driver of the consequences of not checking the compatibility of the automated connector between the towing vehicle and the trailer. Information about mixed mode operation shall also be provided if applicable.**
- To enable the driver to check the compatibility, vehicles fitted with an automated connector shall have a marking specifying the category according to paragraph 2. of this Annex. For category B and D also the type of the installed automated connector shall be shown. This marking shall be indelible and visible to the driver when standing on the ground beside the vehicle.**

Annex 22

Appendix 1

Examples of the layout of an automated connection between vehicles

Automated connection and manual connection equipped vehicles: data bus requirements.

Diagrams for electrical connections show routing of signals of pin 6 and 7 according to ISO 7638.

Legend

Electrical

E1	ISO 11992-2 node in tractor, e.g. ECU ABS/EBS
E2	Tractor ISO 7638 socket
E3	Tractor ISO 7638 plug for automated connector
E4	Tractor part of automated connector
E5	Trailer ISO 7638 plug for automated connector
E6	Trailer ISO 7638 socket
E7	Trailer part of automated connector
E8	ISO 7638 coiled cable
E9	ISO 7638 park socket
E10	ISO 11992-2 node in trailer, e.g. ECU ABS/EBS
I	Cable from E1 to E2
II	Cable from E3 to E4
III	Cable from E8 to E6
IV	Cable from E7 to E9

Pneumatic

P1	Trailer control valve mounted on tractor
P2	T-piece
P3	Pneumatic coiled tube (control and supply)
P4	Tractor part of automated connector
P5	Pneumatic coupling head on trailer (control and supply)
P6	Pneumatic valve to seal the unused terminal (double check valve) (control and supply)
P7	Trailer part of automated connector
P8	Pneumatic coiled tube (control and supply)
P9	Pneumatic park socket (control and supply)

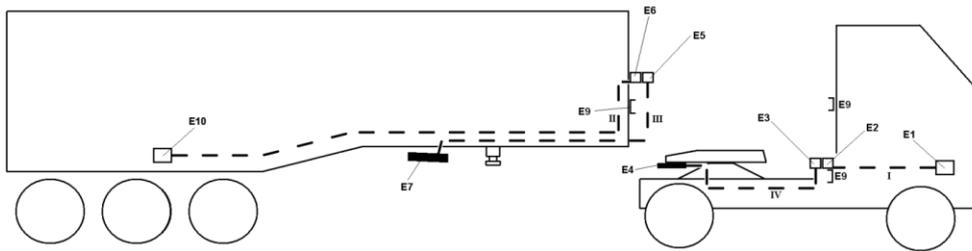
Tractor and semi-trailer example

I. Automated connection and Manual Connection equipped Vehicles

Automated connection mode

Figure A

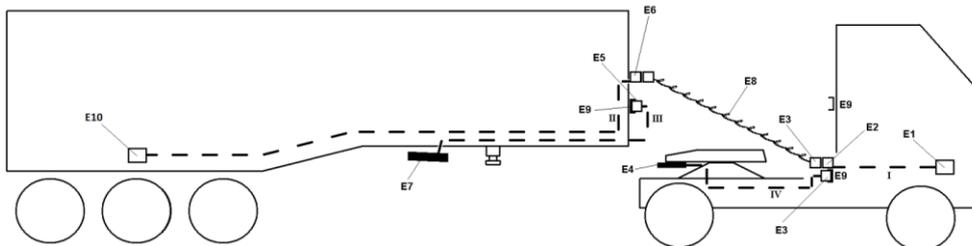
Point-to-point connection ECU Tractor (E1) and ECU Trailer (E10) via ACV. Automated connection mode: No coiled cables connected, Connection between E1 and E10 when E4 and E7 are connected (i.e. when the fifth wheel is coupled)



Manual connection mode

Figure B

Point-to-point connection ECU Tractor (E1) and ECU Trailer (E10) via coiled cable. Manual mode: Coiled cables connected, Connections between E3 and E4 as E5 and E7 are not in use

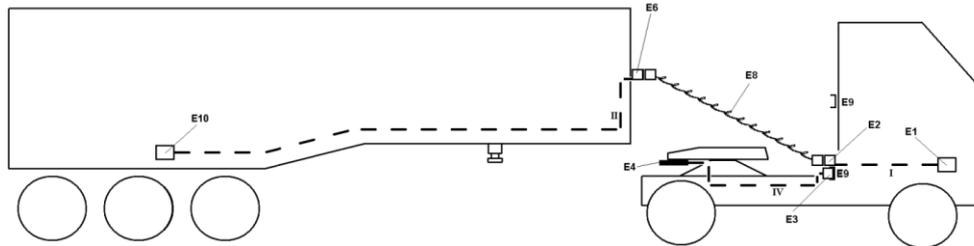


II. Only one part of the vehicle combination is equipped with an automated connection

Manual mode A (only the tractor equipped with automated connection)

Figure C

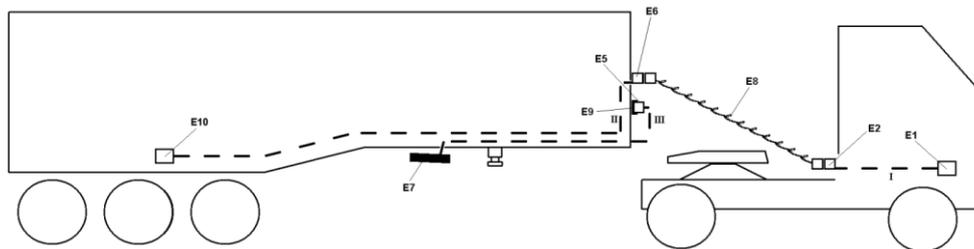
Point-to-point connection ECU Tractor (E1) and ECU Trailer (E10) when the fifth wheel is closed. Coiled cables connected, Line E3 to E4 is not in use



Manual mode B (only the semi-trailer equipped with automated connection)

Figure D

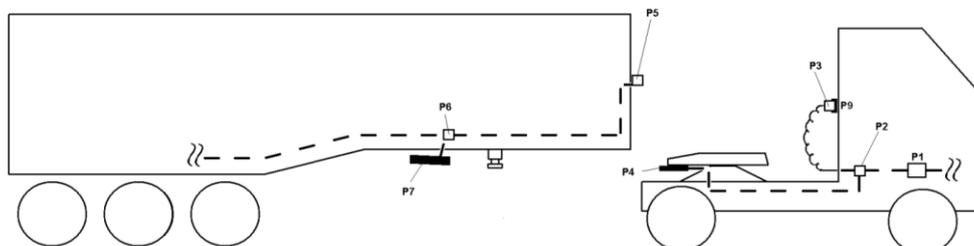
Point-to-point connection ECU Tractor (E1) and ECU Trailer (E10). Coiled cables connected, Line E5 to E7 is not in use



Automated connection mode

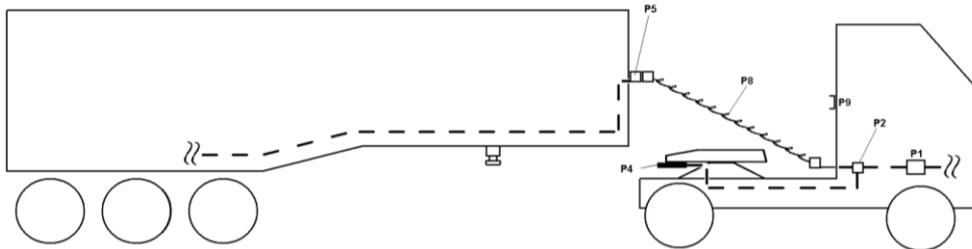
Figure E

Pneumatic connection Tractor and Trailer via ACV. Automated connection mode: No coiled cables connected, Connection between tractor and trailer when P4 and P7 are connected (i.e. when the fifth wheel coupled)



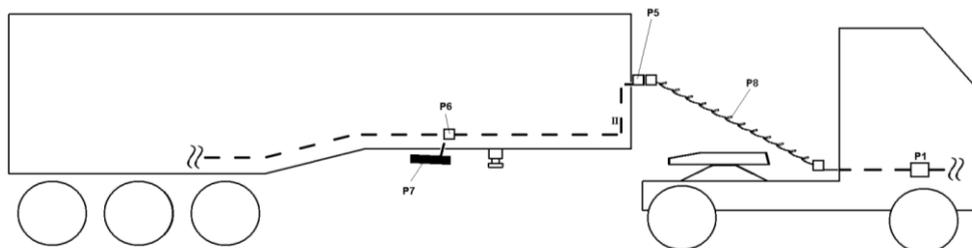
Manual mode A (only the tractor equipped with automated connection)

Figure F
Pneumatic connection Tractor and Trailer via coiled tube. Coiled tubes connected, Line P2 to P6 is not in use



Manual mode B (only the semi-trailer equipped with automated connection)

Figure G
Pneumatic connection Tractor and Trailer via coiled tube. Coiled tubes connected, Line P2 to P6 is not in use



Appendix 2

Couplings of category A shall conform with the relevant provisions of ISO 13044-2:2013 to ensure compatibility of braking systems of tractor and semi-trailer

Appendix 3

(Reserved)

To be defined at a later date."

II. Justification

A. Introduction

1. The connection of a trailer to a towing vehicle is a hazardous process involving a person (usually the driver) who manually connects air pipes and electrical wiring, in addition to the mechanical connection. Automated coupling systems are designed to reduce/remove this risk. For the optimal control of the braking of the towing vehicle and the trailer combinations the electrical interface is specified as an ISO 7638 connector with the interchange of electronic information conforming to ISO 11992. However, the ISO 7638 connector is not an optimal design for an automated connection and, therefore, it is necessary to amend the electrical control line requirements to allow alternative means of making the electrical connection between towing vehicle and trailer.

2. The objective of this proposed amendment is, therefore, to allow automated coupling systems while retaining all the requirements related to the use of the ISO 7638 connector and ISO 11992 for data transfer.

3. Additional requirements specific to an automated coupling system are contained in a new Annex 22.

Paragraphs 2.39 and 2.40:

4. The definitions "brake electric/electronic interface" and "automated connector" are added to ensure a clear understanding of what is meant by automated coupling systems within the terms of this regulation.

5. Additional requirements specific to an automated coupling system are contained in a new Annex 22.

Paragraph 5.1.3.6.:

6. For clarity the existing paragraph is sub-divided into 3 parts: (a), (b) and (c). The parts (b) and (c) are without change. Part (a) is re-structured so that the existing requirements are retained without change in (i) and the requirements for an automated coupling system, as an alternative, are specified in (ii).

7. The requirements in (ii) on the minimum number of pins and the ability to transfer data as per ISO 11992 are identical to (i). Reference to the new Annex 22 is made concerning additional specific requirements for an automated coupling system.

8. By making this amendment and a similar one in the "vehicles of category O" section, and by making reference to the new Annex 22, the number of changes in the Regulation text is minimized.

9. The actual physical layout of the automated connector with regard to the electrical pins and the air connections, together with any alignment structures for the 2 halves of the connector, are not specified. At this stage of the development process it is not deemed appropriate to specify such an interface as it could be design restrictive, although at a later stage it may be appropriate to introduce an ISO standard.

10. The use of parts (a), (b) and (c), and (i) and (ii) means that it is not necessary to re-number a significant number of existing paragraphs.

Paragraphs 5.1.3.8. and 5.1.3.9.:

11. The current text of paragraph 5.1.3.8. has been divided into two parts with the second part being given the number 5.1.3.9. without a change in content. For clarification

the term "articulated vehicle combinations" has been replaced by "tractor and semi-trailer combinations".

Paragraph 5.1.3.9. is expanded to cover the case of automated connectors not requiring the flexible hoses or cables as used in non-automated systems.

Paragraphs 5.2.1.23. and 5.2.2.17.:

12. The automated connector is added as an alternative to the ISO 7638 connector together with a reference to the corresponding requirements in the new Annex 22. The requirements are stipulated in Annex 22 to avoid too much new text in the main body of the Regulation.

Annex 6

Paragraph 2.5.:

13. As the automated connector does not have any flexible hoses or cables in spite of being sometimes installed on a semi-trailer tractor, a clarification on applying the measurement method is needed.

14. The clarification also includes a statement about which vehicle should have the extra added volume.

Paragraph 3.3.3.:

15. The amendment does not change the content of the existing paragraph but clarifies the method of carrying out the test.

Annex 22

16. A categorization scheme of different automated connectors has been introduced:

(a) Categories A and B are related to tractor / semi-trailer combinations, when C and D are related to other types of combinations.

(b) All automated connectors of category A (C) are compatible together, whatever the brand or the manufacturer. The automated of category B (D) are not necessarily compatible with all types of interfaces within this category.

17. The objective of this categorization is to give a clear encouragement to vehicle / system manufacturers to use / provide standardized (i.e compatible) ACVs of category A (following ISO 13044 standard), while keeping the door open to future innovative systems, by the use of category B.

18. Appendix 2 has been added to Annex 22, for the purpose of defining the minimum requirements to be fulfilled to ensure that two automated connectors of category A are compatible together, by a reference to ISO 13044-2 focusing on braking relevant aspects.

19. However no standard exists today on automated connectors for other vehicles than tractors / semi-trailers, UN Regulation No. 13 has been prepared for that perspective, with a specific category C and a reservation on an Appendix 3.

20. To ensure the robustness of the proposed regulatory scheme, a footnote clarifies that new categories of couplings may be added later on new / innovative technical solutions, when standard interface will be defined and agreed upon.

Paragraph 3.1.:

21. Ensures that the electrical capability and functionality of the automated connector is the same as the current ISO 7638 electrical connector.

22. Two new sub-paragraphs were added to ensure that the same provisions apply for ACV regarding data communication and power supply.

Paragraph 3.2.:

23. For automated coupling systems for tractors and semi-trailers, the allocation of data communication cable lengths defined in ISO 11992-1 is not appropriate. The total length of 40 m specified in ISO 11992-1 has been retained to ensure the same quality of data transmission. The coiled cable length of 7m has been divided on the basis of 6m on the tractor and 1m on the semi-trailer. This provides the necessary additional cable on both vehicles required for the automated connector.

24. In all other cases (semi-trailer non-automated, full trailer in both automated and non-automated modes, centre axle trailer in both automated and non-automated modes) the requirements of ISO 11992-1 apply.

Paragraph 3.3:

25. This paragraph was added to ensure that we have a point to point system without branches.

Paragraph 3.4,

26. The issue of warning the driver about the brake connector not being correctly connected has been addressed by different proposals. The analysis of these proposals has shown that the standard requirements of UN Regulation No. 13 already provide a haptic warning to the driver through the trailer being braked and/or the trailer warning signal being activated (through pin 5). However, there is a small risk that this haptic warning is not happening with a non-spring braked trailer with leaking air systems. To exclude this risk, we have a requirement that automated connectors shall only be fitted to trailers having spring brakes.

Paragraphs 3.5 and 3.6

27. Information enabling the driver to handle the compatibility is required through the paragraphs 3.5 and 3.6. In the case of an ACV truck being connected to a non-ACV trailer, it is the driver's responsibility to connect a manual connection as of today. If no manual connection is available on the truck then the two vehicles are not compatible. Information on how to operate in mixed mode is requested in paragraph 3.6.

28. The compatibility matrix below shows different connector configurations. The matrix shows where the warning system of paragraph 3.4 is applicable.

<i>Tractor/truck</i>	<i>Trailer</i>	<i>Consequence</i>	<i>Remarks</i>
ACV	Compatible ACV	Good connection possible via ACV	No problem
	Non-ACV	No connection possible	Driver may have the idea that connections will be made automatically Driver shall check compatibility. Driver is warned if he connects anyway
	Non-compatible ACV-system	No connection possible	Comparable to a situation where the trailer coupling is different. Driver shall check compatibility. Driver is warned and ACV is potentially damaged if he connects anyway.

<i>Tractor/truck</i>	<i>Trailer</i>	<i>Consequence</i>	<i>Remarks</i>
Non- ACV	ACV	No connection possible	Driver is used to connect the connectors by hand and will see what the problem is.
	Non-ACV	Good connection possible via ISO 7638	Current situation
	Non-ACV, different other connectors (air, lights) and trailer coupling	Air; no automatic release of the trailer brakes. Lights; no special consequences for brakes Trailer coupling; not possible to couple the trailer	Current situation Driver is used to connect the connectors by hand and will see what the problem is.

Comment: the table above is also applicable to vehicles equipped with both an automated connection as well as a manual connection.

29. Warning modes described in the matrix below show that automated connectors have a driver warning with at least an equivalent safety level as we have today.

<i>Warning Modes</i>				
<i>System Component Configuration</i>	<i>Automatic</i>	<i>Manual</i>		
	<i>ACV</i>	<i>Pneumatic</i>	<i>Brake Electric ISO7638</i>	<i>Mechanic Coupling</i>
<i>Failure</i>				
Mechanical connection error (R55)	Same as today, Driver check. Optical warning if vehicle fitted with remote operation of the mechanical coupling.	----	----	Driver Check
Pneumatic connection error (P)	Trailer brakes applied **	Trailer brakes applied. Driver check possible (leakage) **	----	----
Brake Electric connection error (E)	At least: Optical indication according to R13, para. 5.2.1.29.5 (Pin 5)	----	Driver Action (Optical), according to R13, para. 52.1.29.5 (Pin 5)*	----

* Optical driver warning in cab at "Ignition ON".

** In case of ACV the P&E connectors are integrated in a single unit that provide both the P and the E sets of warnings.

30. Paragraph 3.5 was added to ensure that the technical service and type approval authority are provided with an information document outlining the functionality and any limitations in use with regard to compatibility.

31. Paragraph 3.6 was added to ensure that the driver is provided with information regarding possible incompatibilities and their consequences.

B. Justification for the pictures

32. Picture examples are provided to improve the understanding of the requirements without being design restrictive.

33. Only tractor and semi-trailer combinations are shown as mixed-mode operation on these vehicles is envisaged today.
