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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****Eighty-second session**

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Item 4 of the provisional agenda

Regulation No. 55**Proposal for amendments to Regulation No. 55 (Mechanical couplings)****Submitted by the Chair of the informal working group on Regulation No. 55***

The text reproduced below was prepared by the experts of the informal working group on Regulation No. 55 and introduces:

- (a) An amendment for the separation of requirement calculation procedures from the procedure of setting and certifying performance values.
- (b) An amendment that adds procedures for requirement calculation for vehicle combinations that have hitherto not been accounted for in the Regulation.

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 2016–2017 (ECE/TRANS/254, para. 159 and ECE/TRANS/2016/28/Add.1, cluster 3.1), 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 paragraph 1.2.1.1., to read:

"1.2.1.1. For the purpose of this regulation a dolly is defined as a towing trailer designed for the sole purpose to tow a semi-trailer.

Paragraph 2.11., amend to read:

"2.11. The characteristic values D, D_c, S, V, ~~and U~~ **and A_v** are defined ~~or~~ **and determined-verified** as:"

Paragraph 2.11.1., amend to read:

~~2.11.1. The D or D_c value is the theoretical reference value for the horizontal forces in the towing vehicle and the trailer and is used as the basis for horizontal loads in the dynamic tests.~~

~~For mechanical coupling devices and components not designed to support imposed vertical loads, the value is:~~

$$\del D = g \frac{T \cdot R}{T + R} \text{ kN}$$

~~For mechanical coupling devices and components for centre axle trailers as defined in 2.13, the value is:~~

$$\del D_c = g \frac{T \cdot C}{T + C} \text{ kN}$$

~~For fifth wheel couplings of Class G, fifth wheel coupling pins of Class H and mounting plates of Class J, as defined in paragraph 2.6., the value is:~~

$$\del D = g \frac{0.6 \cdot T \cdot R}{T + R - U} \text{ kN}$$

~~Where:~~

~~T~~ — is the technically permissible maximum mass of the towing vehicle, in tonnes. ~~Where relevant, this includes the vertical load imposed by a centre axle trailer.¹~~

~~R~~ — is the technically permissible maximum mass, in tonnes, of a trailer with drawbar free to move in a vertical plane, or of a semitrailer.²

~~C~~ — is the mass, in tonnes, transmitted to the ground by the axle or axles of the centre axle trailer, as defined in paragraph 2.13., when coupled to the towing vehicle and loaded to the technically permissible maximum mass.² ~~For Category O1 and O2 centre axle trailers² the technically~~

¹ The mass T and R and the technically permissible maximum mass, may be greater than the permissible maximum mass prescribed by national legislation.

² See definitions in Regulation No. 13 annexed to the 1958 Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions. The definition is also contained in the Consolidated Resolution on the Construction of Vehicles (R.E.3) (document TRANS/WP.29/78/Rev.3, para.2).

~~permissible maximum mass will be that declared by the manufacturer of the towing vehicle.~~

~~g — is the acceleration due to gravity (assumed to be 9.81 m/s²)~~

~~U — is as defined in paragraph 2.11.2.~~

~~S — is as defined in paragraph 2.11.3.~~

The D and D_c value are characteristic performance values for the horizontal forces of the coupling equipment verified as described in Annex 6 of this Regulation."

Paragraph 2.11.2., amend to read:

"2.11.2. ~~The U value is the vertical mass, in tonnes, imposed on the fifth wheel coupling by the semitrailer of technically permissible maximum mass.²~~

The U value is a characteristic performance value for the vertically imposed mass, in tonnes, on the fifth wheel coupling. This performance value shall be verified as described in Annex 6 of this Regulation."

Paragraph 2.11.3., amend to read:

"2.11.3. ~~The S value is the vertical mass, in kilograms, imposed on the coupling, under static conditions, by the centre axle trailer, as defined in paragraph 2.13., of technically permissible maximum mass.²~~

The S value is a characteristic performance value for the vertically imposed mass, in kilograms, to the coupling from a center axle trailer under static conditions. This performance value shall be verified as described in Annex 6 of this Regulation."

Paragraph 2.11.4., amend to read:

"2.11.4. ~~The V value is the theoretical reference value of the amplitude of the vertical force imposed on the coupling by the centre axle trailer of technically permissible maximum mass greater than 3.5 tonnes. The V value is used as the basis for vertical forces in the dynamic tests.~~

$$\del V = \frac{a \cdot C \cdot X^2}{L^2} \text{ (See the Note below)}$$

~~Where:~~

~~a — is an equivalent vertical acceleration at the coupling depending on the type of suspension system of the rear axle of the towing vehicle.~~

~~For air suspension (or suspension systems with equivalent damping characteristics)~~

$$\del a = 1.8 \text{ m/s}^2$$

~~For other types of suspension:~~

$$\del a = 2.4 \text{ m/s}^2$$

~~X — is the length of the loading area of the trailer, in metres (see Figure 1)~~

~~L — is the distance from the centre of the drawbar eye to the centre of the axle assembly, in metres (see Figure 1)~~

~~Note: $\frac{X^2}{L^2} \geq 1.0$ (If less than 1.0, the value of 1.0 shall be used)~~

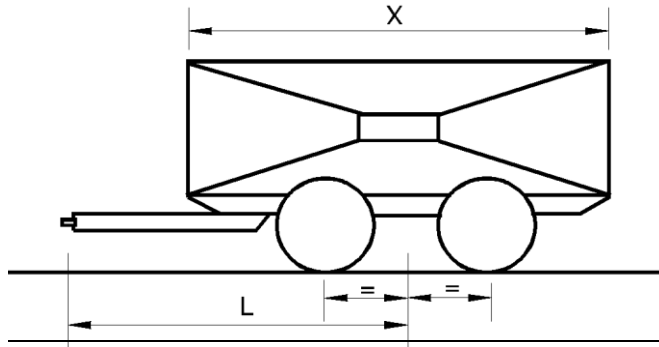


Figure 1
Dimensions of the centre axle trailer

The V value is a characteristic performance value of the amplitude of the vertical force imposed on the coupling by a center axle trailer. This performance value shall be verified as described in Annex 6 of this Regulation."

Insert new paragraph 2.11.5., to read:

"2.11.5. The A_v value is a characteristic performance value for hinged drawbars that sets maximum permitted axle mass in tonnes of the front steered axle group of a full trailer. This performance value shall be verified as described in Annex 6 of this Regulation."

Insert new paragraph 2.11.56. to read:

"2.11.56. To each of the characteristic performance value D, D_c , U, V and S there are corresponding application requirement values. Those requirements values are determined according to Annex 8 of this Regulation."

Paragraph 2.12., amend to read:

- "2.12. Symbols and definitions used in Annex 6 **and Annex 8** of this Regulation.
- A_v = maximum permitted axle mass of the steered axle in tonnes – **see paragraph 2.11.5.;**
 - C = mass of centre axle trailer in tonnes – **see Annex 8 paragraph ~~1.1.1.~~ 2.1. ~~2.11.1.~~** of this Regulation;
 - D = D-value in kN - see paragraph 2.11.1. of this Regulation.
 - D_c = D_c -value in kN for centre axle trailers - **see Annex 8 paragraph 2.1. ~~2.11.1.~~** of this Regulation;
 - R = mass of towed vehicle in tonnes - **see Annex 8 paragraph 2.1. ~~2.11.1.~~** of this Regulation;
 - T = mass of towing vehicle in tonnes - **see Annex 8 paragraph 2.1. ~~2.11.1.~~** of this Regulation;
 - F_a = static lifting force in kN;
 - F_h = horizontal component of test force in longitudinal axis of vehicle in kN;
 - F_s = vertical component of test force in kN;
 - S = static vertical mass in kg. – **See paragraph 2.11.3. of this Regulation;**

U = fifth wheel imposed vertical mass in tonnes. – **See paragraph 2.11.2. of this Regulation;**

V = V-value in kN - see paragraph 2.11.4. of this Regulation;

a = equivalent vertical acceleration factor at the coupling point of centre axle trailers depending on the type of suspension of the rear axle(s) of the towing vehicle - see **Annex 8** paragraph **2.2. 2.11.1.** of this Regulation.

..."

Paragraph 5.3.4., renumber as paragraph 5.3.5. and amend to read:

"5.3.45. A statement of the **characteristic performance** values of D, D_c, S, V and U as applicable and as defined in paragraph 2.11."

Paragraph 5.3.4.1., renumber as paragraph 5.3.5.1 and amend to read:

"5.3.45.1. The characteristic **performance** values shall be at least equal to those **requirement values** applicable to the maximum permissible towing vehicle, trailer and combination masses, **determined according to Annex 8 of this Regulation.**"

Annex 2, item 7., amend to read:

"7. D..... kN D_c..... kN S..... kg
U..... tonnes V..... kN

In case of a towing trailer performance of rear coupling equipment:

**D..... kN D_c..... kN S..... kg
U..... tonnes V..... kN"**

Annex 6, paragraph 3.6.1., amend to read:

"...

Where the force amplitude V is **the magnitude of the characteristic performance V to which coupling equipment is being type approved** that given in paragraph 2.11.4. of this Regulation.

..."

Insert new Annex 8, to read:

"

Annex 8

Coupling performance requirements in application

1. **Coupling equipment shall only be used in applications where calculated performance requirements do not exceed the performance capacity as determined in accordance with Annex 6 of this Regulation. The following paragraphs of this annex state the way in which the performance requirements shall be calculated in different applications.**

2. **Two-vehicle combinations**

2.1. **Horizontal forces**

For mechanical coupling devices and components not designed to support imposed vertical loads, the value is:

$$D = g \frac{T \cdot R}{T + R} \text{ kN}$$

For mechanical coupling devices and components for center axle trailers as defined in 2.13, the value is:

$$D_C = g \frac{T \cdot C}{T + C} \text{ kN}$$

For fifth wheel couplings of Class G, fifth wheel coupling pins of Class H and mounting plates of Class J, as defined in paragraph 2.6., the value is:

$$D = g \frac{0.6 \cdot T \cdot R}{T + R - U} \text{ kN}$$

where:

T is the technically permissible maximum mass of the towing vehicle, in tonnes. Where relevant, this includes the vertical load imposed by a center axle trailer³.

R is the technically permissible maximum mass, in tonnes, of a trailer with drawbar free to move in a vertical plane, or of a semitrailer³.

C is the mass, in tonnes, transmitted to the ground by the axle or axles of the center axle trailer, as defined in paragraph 2.13., when coupled to the towing vehicle and loaded to the technically permissible maximum mass³. For Category O1 and O2 center axle trailers⁴ the technically permissible maximum mass will be that declared by the manufacturer of the towing vehicle.2.2. Vertical forces from center axle trailer

The vertical force imposed on the coupling by the center axle trailer of technically permissible maximum mass greater than 3.5 tonnes is:

$$V = \frac{a \cdot C \cdot X^2}{L^2} \text{ kN} \quad (\text{See the Note below})$$

where:

C is as defined in paragraph 2.1. of this Annex

a is an equivalent vertical acceleration at the coupling depending on the type of suspension system of the rear axle of the towing vehicle

For air suspension (or suspension systems with equivalent damping characteristics)

$$a = 1.8 \text{ m/s}^2$$

For other types of suspension

$$a = 2.4 \text{ m/s}^2$$

X is the length of the loading area of the trailer, in meters (see Figure 27)

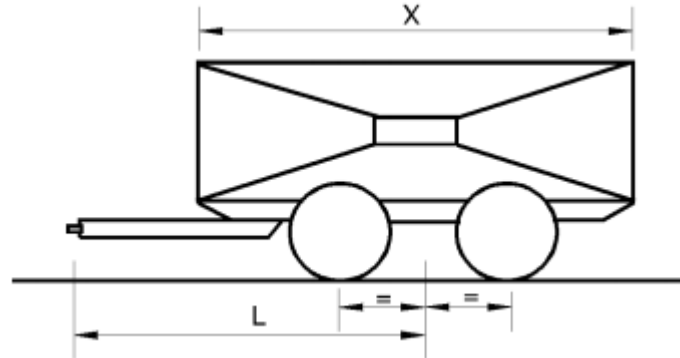
³ The mass T and R and the technically permissible maximum mass, may be greater than the permissible maximum mass prescribed by national legislation.

⁴ See definitions in Regulation No. 13 annexed to the 1958 Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions. The definition is also contained in Annex 7 of the Consolidated Resolution on the Construction of Vehicles (R.E.3) (document ECE/TRANS/WP.29/78/Rev.4).

L is the distance from the center of the drawbar eye to the center of the axle assembly, in meters (see Figure 27)

Note: $\frac{x^2}{L^2} \geq 1.0$ (If less than 1.0, the value of 1.0 shall be used)

Figure 27
Dimensions of the center axle trailer



3. **Multi-vehicle combinations**

3.1. **Combination 1:**

Description: Rigid truck + Dolly + Semitrailer

Masses [tonnes]:

M₁ = total axle load of rigid truck as coupled

M₂ = total axle load of dolly and semitrailer as coupled

M₃ = total axle load of dolly as coupled

M₄ = total axle load of rigid truck as coupled plus tare weight of dolly

M₅ = support load at king-pin of semitrailer

M₆ = M₅ + total axle load of semitrailer as coupled

Total combination mass = M₁ + M₂

Dimensions:

L = distance from drawbar eye to center of dolly axle group [m]

Coupling capability requirement:

Clevis coupling: $D = g \frac{M_1 \cdot M_2}{M_1 + M_2} \dagger$ $V = \text{Max}(\frac{54}{L}; 5 \frac{M_3}{L}) \dagger$

Fifth wheel: $D = 0.5g \frac{M_4(M_6 + 0.08M_4)}{M_4 + M_6 - M_5}$

† Dolly with rigid drawbar:

This calculated D-value requirement shall be lower than the certified D_C-value performance of coupling equipment used.

Dolly with hinged drawbar:

This calculated D-value requirement shall be lower than the certified D-value performance of coupling equipment used. With a hinged drawbar there is no V-value requirement.

3.2.

Combination 2:

Description: Tractor + Semitrailer + center axle trailer

Masses [tonnes]:

M_1 = total axle load of tractor as coupled (including support load from semitrailer)

M_2 = total axle load of center axle trailer as coupled

M_3 = total axle load of tractor and semitrailer as coupled

M_4 = support load at king-pin of semitrailer

$M_5 = M_4 +$ total axle load of semitrailer and center axle trailer as coupled

Total combination mass = $M_2 + M_3$

Dimensions:

L = distance from drawbar eye to center of center axle trailer axle group [m]

X = length of loaded area of center axle trailer [m]

$a = 2.4$ [m/s²] for semitrailer with steel suspension; 1.8 [m/s²] for semitrailer with air suspension

Coupling capability requirement:

Clevis coupling on semitrailer: $D_c = 0.65g \frac{M_3 * M_2}{M_3 + M_2}$ $V = a \frac{X^2}{L^2} M_2$

Fifth wheel: $D = 0.5g \frac{M_5(M_1 + 0.08M_5)}{M_1 + M_5 - M_4}$

Note: $\frac{X^2}{L^2} \geq 1.0$ (If less than 1.0, the value of 1.0 shall be used)

3.3.

Combination 3:

Description: Tractor + Semitrailer + Dolly + Semitrailer

Masses [tonnes]:

M_1 = total axle load of tractor as coupled (including support load from first semitrailer)

M_2 = total axle load of tractor and first semitrailer as coupled

$M_3 = M_4 +$ total axle load of second semitrailer as coupled

M_4 = total axle load of dolly as coupled (including support load from second semitrailer)

$M_5 = M_2 +$ tare weight of dolly

M_6 = support load at king-pin of first semitrailer

M_7 = support load at king-pin of second semitrailer

$M_8 = M_7 +$ total axle load of second semitrailer as coupled

$M_9 = M_6 +$ total axle load of first semitrailer as coupled + M_3

Total combination mass = $M_2 + M_3$

Dimensions:

L = distance from drawbar eye to center of dolly axle group [m]

Coupling capability requirement:

Clevis coupling on first semitrailer:

$$D = 0.65g \frac{M_2 \cdot M_3}{M_2 + M_3} \dagger$$

$$V = \text{Max}\left(\frac{5^4}{L}; 5 \frac{M_4}{L}\right) \dagger$$

Fifth wheel: $D = \text{Max}(D_1; D_2)$, with:

$$D_1 = 0.5g \frac{M_5(M_8 + 0.08M_5)}{M_5 + M_8 - M_7}$$

$$D_2 = 0.5g \frac{M_9(M_1 + 0.08M_9)}{M_9 + M_1 - M_6}$$

† Dolly with rigid drawbar:

This calculated D-value requirement shall be lower than the certified D_C -value performance of coupling equipment used.

Dolly with hinged drawbar:

This calculated D-value requirement shall be lower than the certified D-value performance of coupling equipment used. With a hinged drawbar there is no V-value requirement.

3.4. Combination 4:

Description: Rigid truck + center axle trailer + center axle trailer

Masses [tonnes]:

M_1 = total axle load of rigid truck as coupled

M_2 = total axle load of first center axle trailer as coupled

M_3 = total axle load of second center axle trailer as coupled

$$M_4 = M_2 + M_3$$

$$M_5 = M_1 + M_2$$

$$\text{Total combination mass} = M_1 + M_2 + M_3$$

Dimensions:

L_1 = distance from drawbar eye to center of the ~~center axle trailer~~ axle group of the first center axle trailer [m]

L_2 = distance from drawbar eye to center of the axle group of the second center axle trailer [m]

X_1 = length of loaded area of the first center axle trailer [m]

X_2 = length of loaded area of the second center axle trailer [m]

T_1 = distance from center of axle group to coupling point of clevis coupling in rear end of first center axle trailer [m]

$a = 2.4$ [m/s²] for semitrailer with steel suspension; 1.8 [m/s²] for semitrailer with air suspension

Coupling capability requirement:

$$\begin{aligned}
 \text{Clevis couplings:} \quad D &= 0.9g \frac{M_1 \cdot M_4}{M_1 + M_4} \\
 V &= V_1 \\
 V_2 &= a \frac{X_2^2}{L_2^2} M_3 \\
 V_1 &= \sqrt{\left(a \frac{X_1^2}{L_1^2} M_2\right)^2 + \left(\frac{T_1^2}{L_1^2} V_2\right)^2}
 \end{aligned}$$

Note: (If less than 1.0, $\frac{X_1^2}{L_1^2} \geq 1$ $\frac{X_2^2}{L_2^2} \geq 1$ the value of 1.0 shall be used)

3.5. Combination 5:

Description: Tractor + Link-trailer* + Semitrailer

Masses [tonnes]:

M_1 = total axle load of tractor as coupled (including support load from link-trailer)

M_2 = support load at king-pin of link-trailer

M_3 = M_2 + total axle load of link-trailer and semitrailer as coupled

M_4 = total axle load of link-trailer and semitrailer as coupled

Total combination mass = $M_1 + M_4$

Coupling capability requirement:

$$\text{Fifth wheel:} \quad D = 0.5g \frac{M_3(M_1 + 0.08M_3)}{M_1 + M_3 - M_2}$$

* Link-trailer is a semitrailer equipped with a fifth wheel in its rear end enabling a second semitrailer to be towed.

II. Justification

1. Regulation No. 55 provides provisions for the type approval of a specific level of performance for coupling equipment and coupling installation. This can be done without knowing anything about the applications in which the coupling will be used. However, the regulator has realized that a certified performance does not provide enough confidence about the safety of coupling or coupling installation. There must exist a way to control to what extent the coupling equipment can be stressed in relation to the certified performance.
2. Hence the current version of Regulation No. 55 accounts for the application of coupling equipment in traditional vehicle combinations, i.e. rigid truck + full trailer, rigid truck + center axle trailer or tractor + semi-trailer.
3. Current transport systems use many different vehicle combinations, that are not accounted for in Regulation No. 55 such as rigid truck + dolly + semi-trailer. A number of countries in Europe apply modular vehicle combinations. Outside Europe, combinations differing from the traditional two vehicle combinations are applied in many places. Those “new” combinations, with respect to coupling dimensioning, are handled in different ways in different countries, i.e. the level of safety is varying.

4. In order, for the regulator, to have control over a common safety level, more applications need to be included in the Regulation. The current version of the Regulation contains the traditional applications integrated in the specification of the performance certification. Including the “new” applications in the same integrated way would risk making the Regulation very hard to read and interpret. Hence, the proposal brings all application related text in to one new Annex. On one hand, it clarifies the performance requirements for any application. On the other hand, the way to handle different applications becomes very easy to find. The proposed new Annex is drafted to offer an easy structure that will simplify the insertion of any future additional.

5. The traditional applications moved to the new Annex are handled just in the same way as it has been handled hitherto. The new applications introduced are the same as those in the ISO18868:2013 standard. The formulas used are also the same as agreed in that standard. In turn this standard is based on Australian regulations used since the mid-eighties. Before introducing those rules, Australia made extensive measurements. The processing of the ISO18868:2013 standard with in the ISO expert committee goes back to 2001. Hence it can be said that the formulae have been well scrutinized. During recent years many measurements of coupling forces in different vehicle combinations have been performed in Sweden. The results from those measurements have been compared to dimensioning using ISO18868:2013. The maximum forces registered from those measurements have all been found to be low in comparison to the dimensioning calculated using the formulae proposed.

6. Hence we find the proposal well founded.

7. For the sake of clarity, a definition of a dolly has been included. A dolly can have a rigid or a hinged drawbar. This puts different requirements on the coupling equipment connecting the dolly to the towing vehicle, i.e. with a rigid drawbar that coupling equipment shall withstand dynamic vertical forces generated by the dolly. This is not the case for a dolly with a hinged drawbar. Consequently, for a dolly with a rigid drawbar, the certified performance values D_c and V shall be compared to the calculated requirements. For a dolly with a hinged drawbar, there are no or negligible dynamic vertical forces generated in the clevis coupling. Hence for such dollies the certified performance value D shall be compared with the calculated requirement for longitudinal forces.

8. It is recognized that some markets (e.g. Australia) use the denomination "converter dolly". This implicates that a semi-trailer is converted to a full trailer by a dolly. This is true when a dolly with hinged drawbar is used. This is not true in the case of a dolly with a rigid drawbar. In this latter case, a clevis coupling without certified V -value performance shall not be used. To make this very clear, the corresponding provision have been added in Annex 8, to clarify how to handle dollies with hinged and rigid drawbars respectively. In this way, a better clarity than in some "local" regulations is achieved. It is noted that in some markets, no couplings without certified V -value performance are installed. In those markets the risk of using inferior clevis couplings is less pronounced.
