# Proposal for amendments to Regulation No. 13 (Heavy vehicle braking)

## Submitted by the expert from Denmark, coordinated and supported by the International Road Transport Union, International Commission of Technical Affairs (IRU CIT) and the Nordic Road Association, Vehicles and Transport Committee (NVF).

The text reproduced below was prepared by the expert from Denmark, coordinated and supported by the International Road Transport Union, International Commission of Technical Affairs (IRU CIT) and the Nordic Road Association, Vehicles and Transport Committee (NVF). The text aims at improving brake distribution between truck and trailer of heavy vehicle combinations at everyday low decelerations, to enhance uniform use of all wheel brakes and thereby to counteract loss of full brake performance. The text is based on informal documents GRRF-71-18 and -19 distributed during the seventy-first session of the Working Party on Brakes and Running Gear and is based on ISO 20918 International Standard "Road vehicles - Braking threshold pressures for heavy commercial vehicle combinations with fully pneumatic braking systems". The modifications to the existing text of the Regulation are marked in bold characters.

# I. Proposal

Insert a new paragraph 5.1.4.2.4:

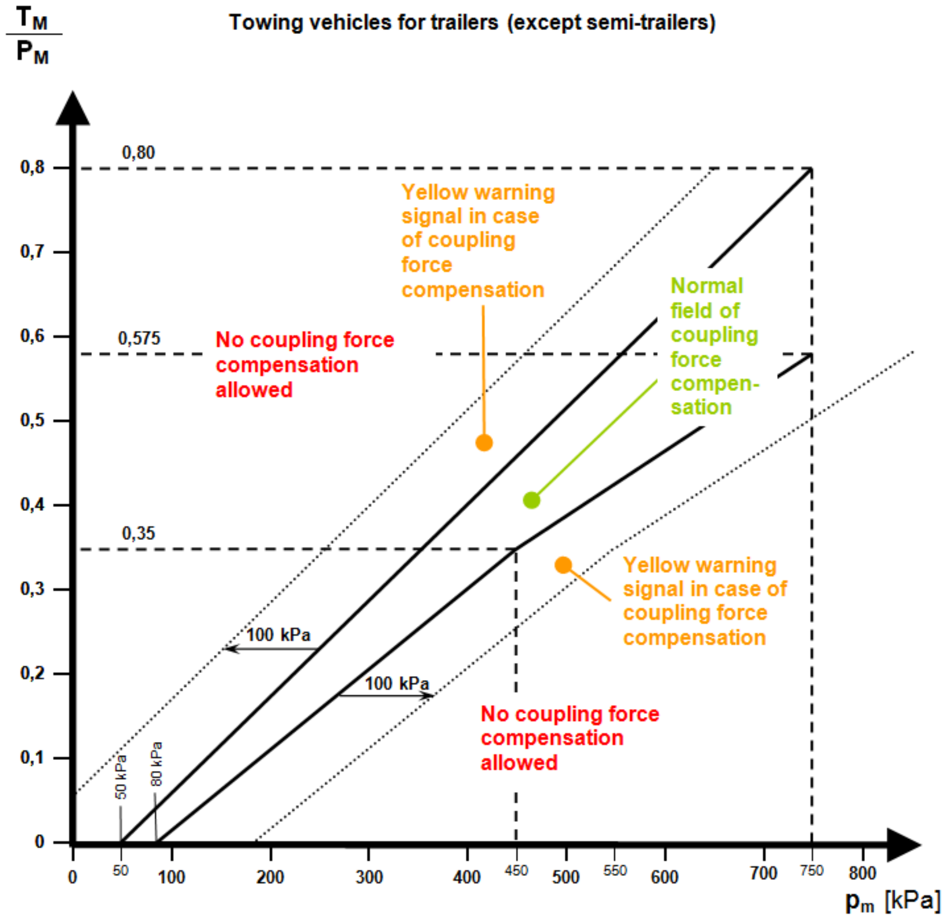
"**5.1.4.2.4: In the control line between the coupling head and the trailer relay emergency valve.**"

Existing paragraphs 5.1.4.2.4 and 5.1.4.2.5 to be renumbered to 5.1.4.2.5 and 5.1.4.2.6.

Paragraph 5.2.1.28.5., amend to read:

5.2.1.28.5. **The coupling force control system shall tend to minimise the coupling force. Max. allowed compensation by the coupling force control system is 100 kPa below the lower limit of the compatibility band and 100 kPa above the upper limit of the compatibility band as specified in Annex 10. If this compensation causes the operating point to lie outside the compatibility band as specified in Annex 10 for the motor vehicle the yellow warning signal specified in paragraph 5.2.1.29.2 shall be activated. After recoupling no compensation is allowed before the coupling force control system has registered a difference between the braking rates of the vehicles in the combination.**

**Diagram 1**



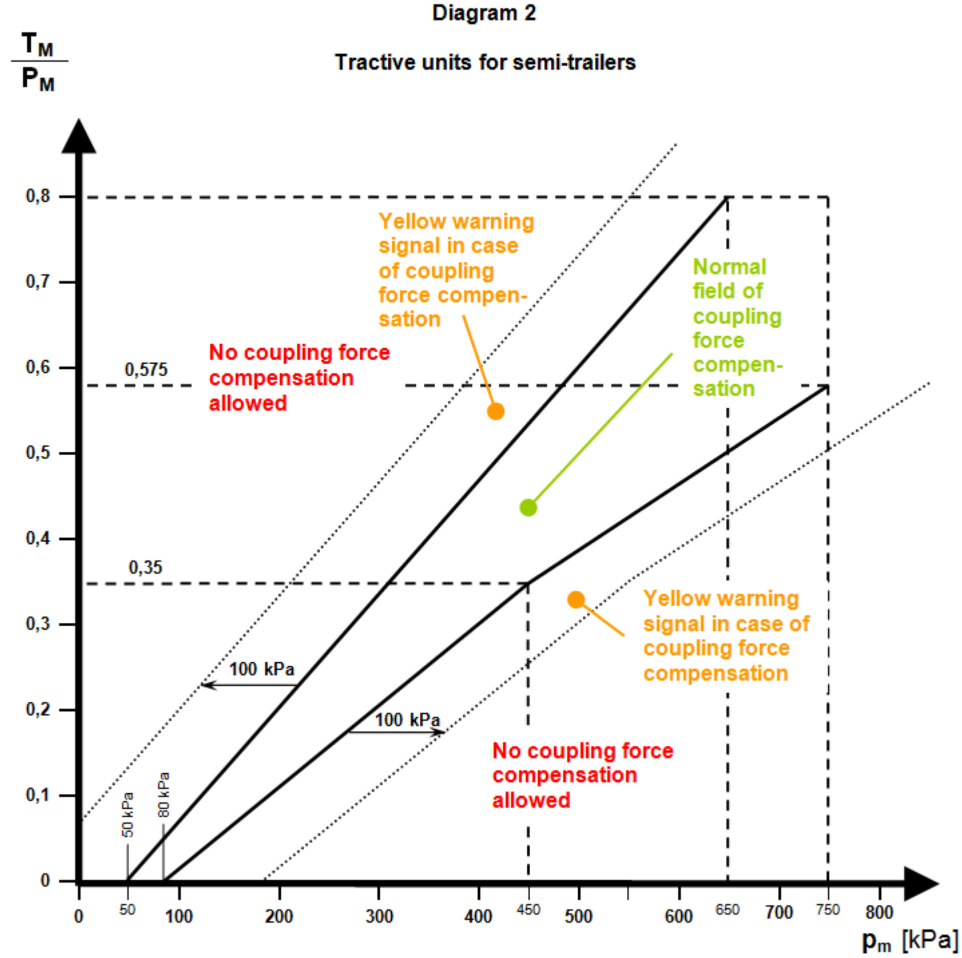
Towing vehicles for trailers (except semi-trailers)
TM / PM
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
0,80
0,575
0,35
Yellow warning signal in case of coupling force compensation
No coupling force compensation allowed
Normal field of coupling force compen-sation
Yellow warning signal in case of coupling force compensation
No coupling force compensation allowed
100 kPa
100 kPa
50 kPa
80 kPa
0
50
100
200
300
400
450
500
550
600
700
750
800
pm [kPa]

Submitted by the expert from Denmark

Informal document No. **GRRF-72-07**
(72nd GRRF, 20-24 February 2012)

Diagram 2

Tractive units for semi-trailers



Annex 10, diagrams 2, 3 and 4A, amend to read:

DIAGRAM 2

TOWING VEHICLES AND TRAILERS
(except tractors for semi-trailers and semi-trailers)
(see paragraph 3.1.5.1 of this annex)

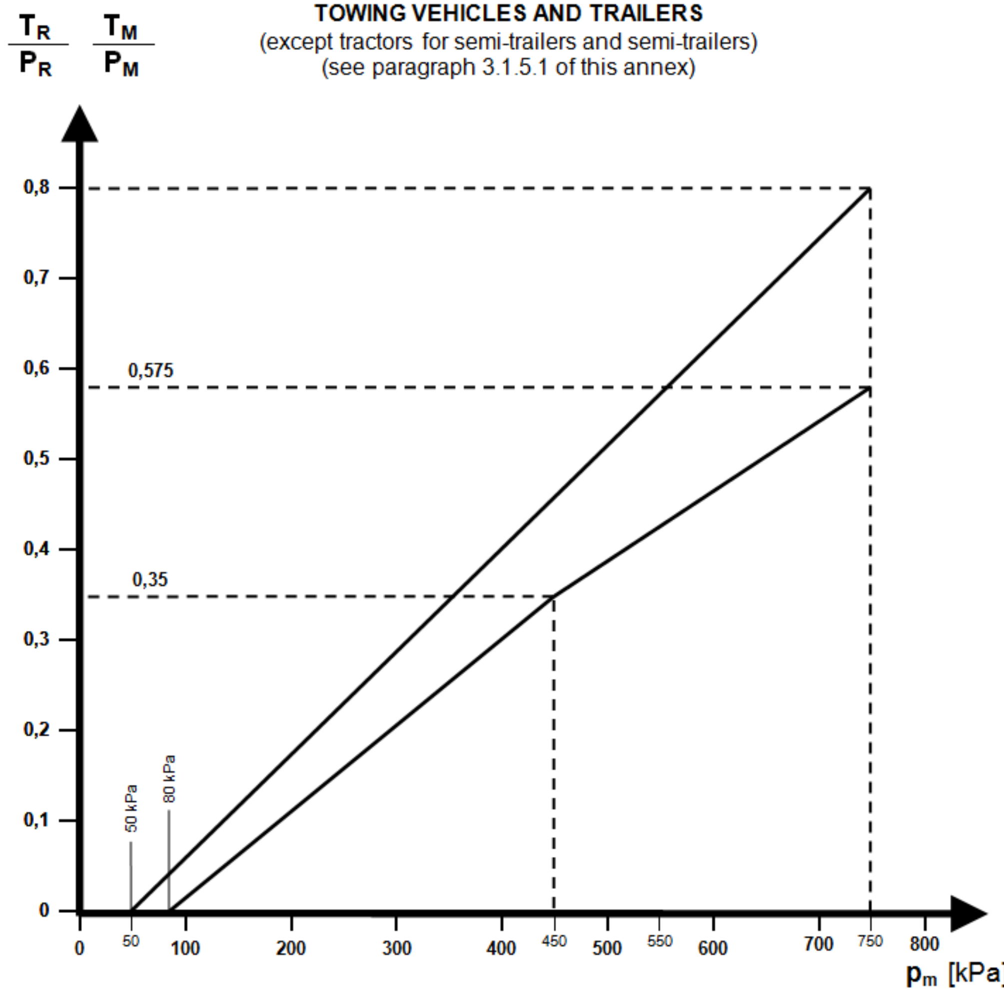
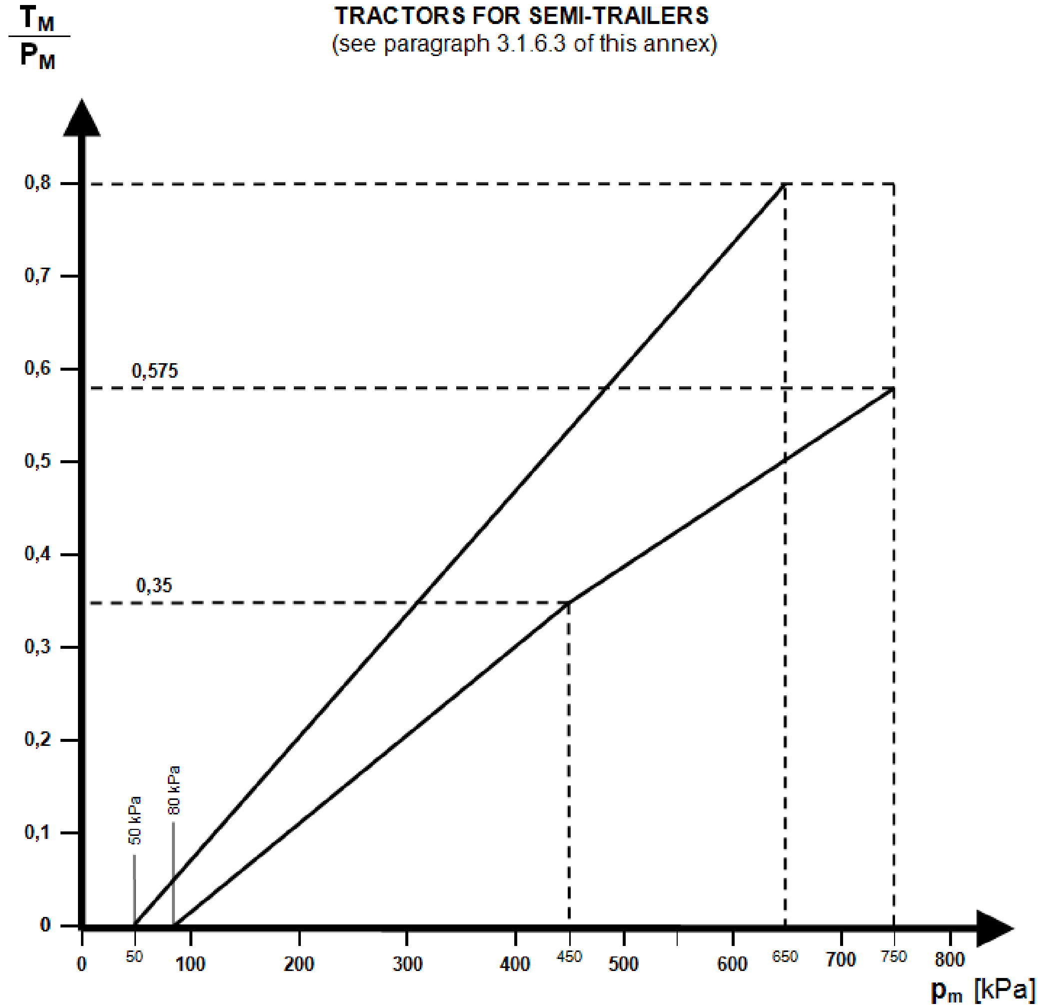
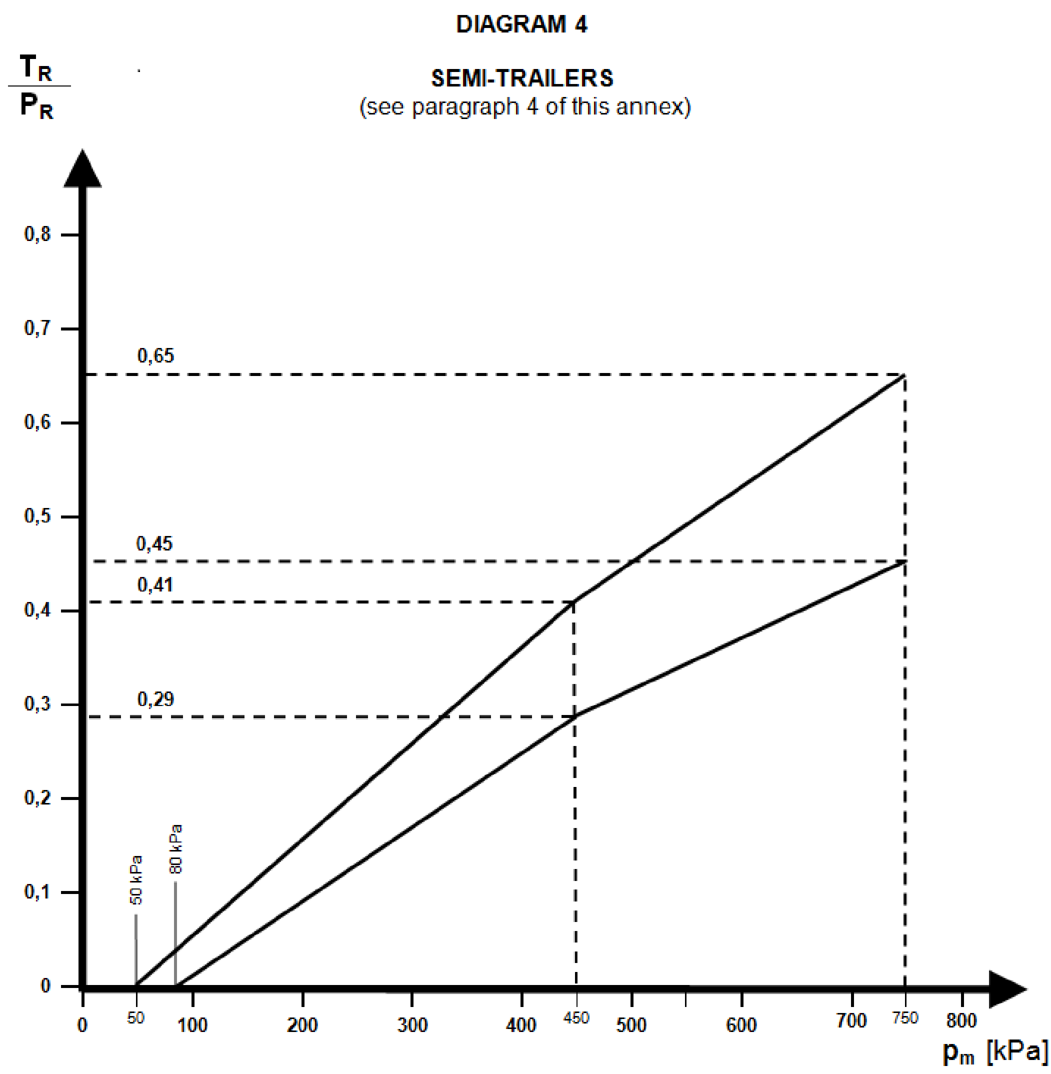


**DIAGRAM 3**

**TRACTORS FOR SEMI-TRAILERS**
(see paragraph 3.1.6.3 of this annex)






<u>Note</u>: The relation between the braking rate $T_R/P_R$ and the control line pressure is determined as follows:

To determine the **hatched** area the values of the ordinates of the upper and lower limits in diagram 4 are multiplied by the factor **K**. The factor **K** is obtained by **the calculation formula described in the following.**

# CALCULATION FORMULA FOR OBTAINING THE FACTOR K

1. Formula **for determination of the factor K:**

$$K = 1.35 - \frac{0.96}{E_R}\left(1.0 + (h_R - 1.2)\frac{g * P}{P_{Rmax}}\right)$$

2. Description of method of use with practical example.

2.1. The factor K **is determined** for the following vehicle, where:

| | |
|---|---|
| P | 24 tonnes (240 kN) |
| $P_{Rmax}$ | 150 kN |
| $h_R$ | 1.8 m |
| $E_R$ | 6.0 m |

2.2. Calculation of **the correction factor K:**

$$K = 1.35 - \frac{0.96}{6.0}\left(1.0 + (1.8 - 1.2)\frac{240}{150}\right) = 1.04$$

Annex 13,

Paragraph 1.1., amend to read:

1.1 This annex defines the required braking performance for road vehicles fitted with antilock systems. In addition, power-driven vehicles which are authorized to tow a trailer, and trailers equipped with compressed-air braking systems, shall, when the vehicles are laden, meet the requirements for compatibility set out in Annex 10 to this Regulation. However, for all load conditions, **the requirements for compatibility set out in Annex 10 to this Regulation shall be fulfilled for a pressure (pm) below 200 kPa** or the equivalent digital demand value at the coupling head of the control line(s).

# II.Justification

Various studies and results from annual periodical technical inspections as well as experiences reported from IRU (International Road Transport Union) call for focus on reduced maintenance costs for heavy goods vehicle combinations and enhanced and more consistent brake performance of trailers in particular.

The European Truck Accident Causation Study (2007) – although human factors were dominant – found technical failures in 5.3% of all main causes for traffic accident with trucks, and that queue accidents accounted for 20.6% of all accidents. Brakes can play a role in these accidents.

A Danish study (2005) of brake performance of heavy goods vehicle combinations found that most heavy trucks performed well as only 4% were under-performing. However major problems were identified regarding brake performance of trailers as 38% did not meet legal requirements.

The EU General Safety Regulation 661/2009 requires AEBS (Automatic Emergency Brake System) for trucks type approved from 01.11.2013. Well performing wheel brakes are a prerequisite for obtaining the safety benefit.

The ISO 20918 International Standard "Road vehicles - Braking threshold pressures for heavy commercial vehicle combinations with fully pneumatic braking systems - Test with roller brake tester" describes a method to evaluate the braking threshold of heavy commercial vehicle combinations with pneumatic braking systems by means of a roller brake tester. This International Standard describes procedures for workshops and garages and provides a recommended pressure range of the system threshold pressure for motor vehicles and trailers, and a recommended practice for determining the system threshold pressure. The standard says that optimization and low adhesion utilization requires good braking balance between axles in the pressure range up to 200 kPa. This improvement in balance is achieved by minimizing the variation in pressure when all brakes start to develop a braking force and recommends an interval of 50-80 kPa.

Likewise inspiration has been found in the former Swedish voluntary XTB (Extra Tested Brakes) maintenance prescription. The XTB maintenance prescription recommended a brake activation pressure of 50 to 80kPa for each individual wheel brake. A similar demand were planned to be introduced in Swedish national demands at PTI, but it was not implemented due to the less stringent EU/ECE demands: The ECE R13 allows for a brake activation pressure spread between 20 and 100 kPa for each vehicle in the combination, which is a too wide tolerance by today's standards.

Indications show that the limits for coupling force control system are too lenient which results in the possibility for overcompensation. This proposal also limits a strategy by some manufactures to start compensation before an actual need has been discovered. This compensation is a challenge for the brake compatibility and can result in overloading of the trailer brakes.

Denmark, NVF and IRU are aware that

- the braking performance measured at PTI differs a lot in different countries depending on different braking calculations (NVF report 2004)
- the precision of the measuring equipment – the roller brake tester – should be taken into account when evaluating measurement results (NVF report 2009)

- in the future reference braking forces will be available for all vehicles due to ECE R13 PTI requirements for new type approved vehicles and can be used as common method of determining brake performance resulting in harmonized evaluation at PTI
- the ISO 20918 standard sets out a method to determine braking balance of vehicle combinations which means that the whole transport unit starts braking at the same time resulting in truck and trailer braking their own proportion of the total unit weight
- the ISO 20918 standard narrows-in the starting pressure span to 50 kPa – 80 kPa
- Swedish experiences has shown that the ISO 20918 pressure span of 50 kPa – 80 kPa can be fulfilled even with conventional non-EBS vehicles (Better brakes on heavy vehicles, 2005)
- demands for improvement of brake balance between truck and trailer resulting in enhancement of durability in brake performance should be implemented for new vehicles and thereafter implemented for those vehicles in use as outlined in the ISO standard
- the yellow warning lamp regarding the coupling force control - in line with other MIL-lights - indicates that something might be wrong with the trailer brakes and should be taken care of. A supplementary text message in the dashboard could explain the reason for the signal, for instance “trailer 1,5 kPa outside compatibility band, check trailer brakes”. A good practical method for the driver to check if brakes are active is to check brake temperature
- glaced brake linings are a common problem and can be a result of bad low pressure compatibility resulting in lowered full brake performance
- maintenance of the heavy vehicle brakes is one of the most significant maintenance cost for the vehicle owner vehicles (Better brakes on heavy vehicles, 2005)

Based on the above points this proposal for an amendment of ECE R13 is presented.

Existing paragraph 5.2.1.28.5 diagrams (coupling force control) for reference:

Diagram 1
Towing vehicles for trailers (except semi-trailers)

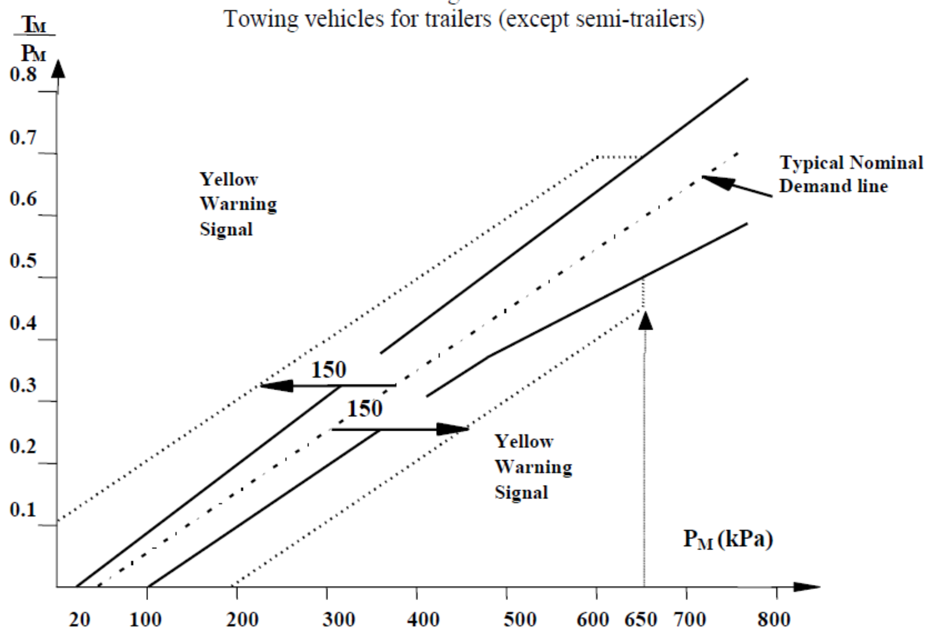
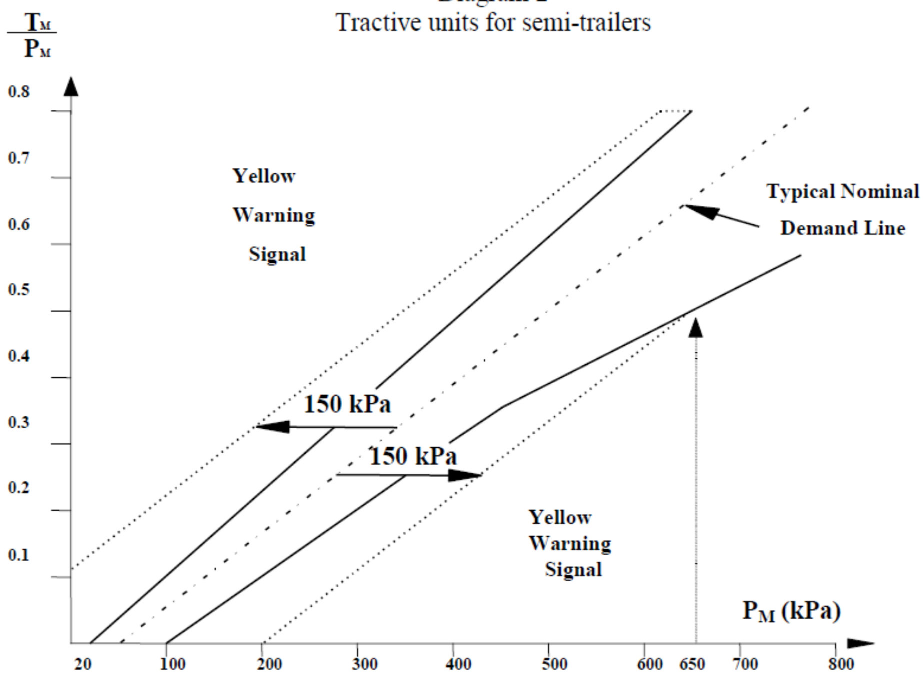


Diagram 2
Tractive units for semi-trailers




The following diagrams show the difference between the existing diagrams and the new proposed diagrams:

Annex 10, diagram 2, 3 and 4A (compatibility):

DIAGRAM 2

Revised

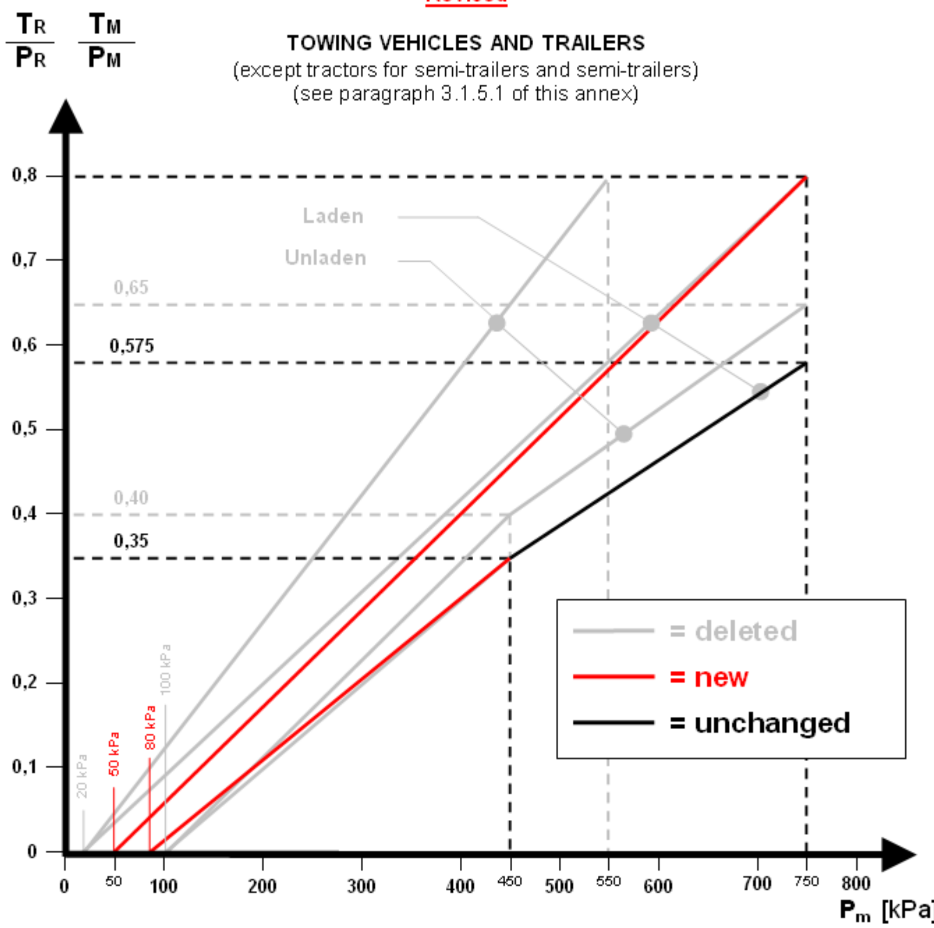


DIAGRAM 3

Revised

TRACTORS FOR SEMI-TRAILERS
(see paragraph 3.1.6.3 of this annex)

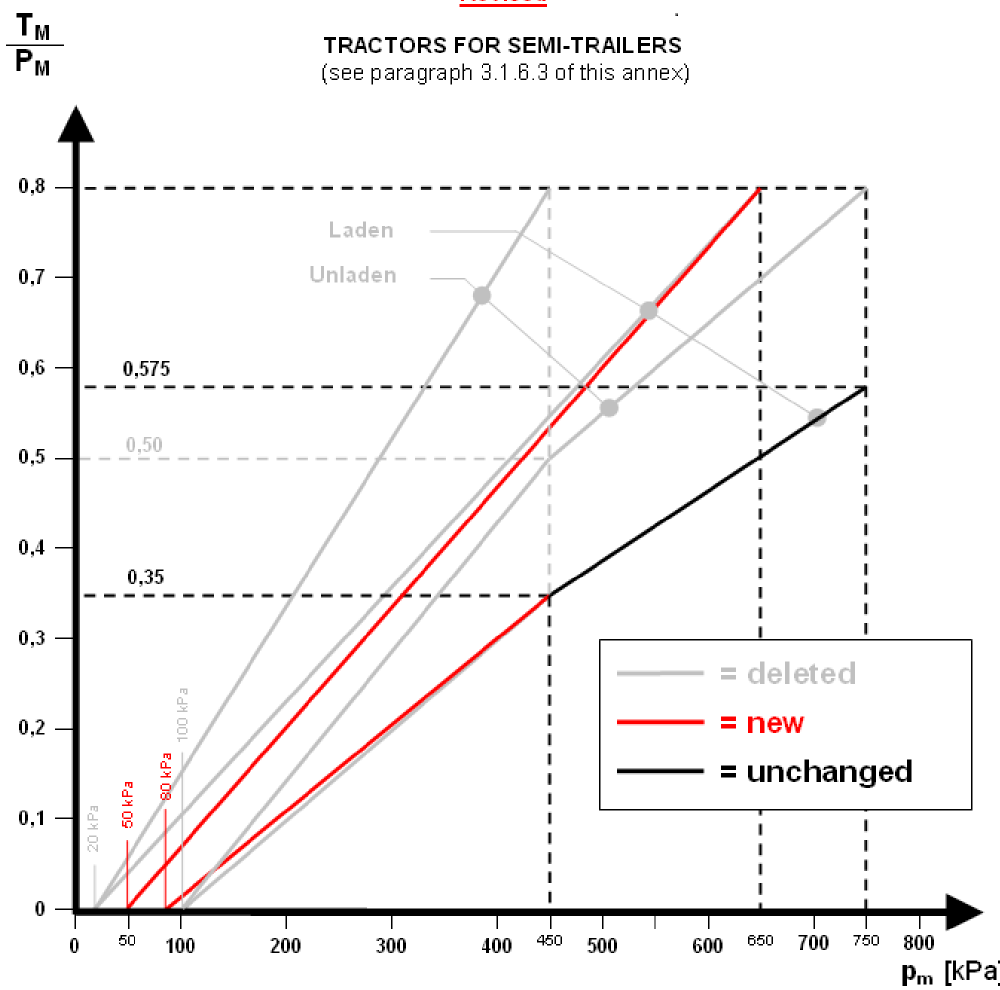
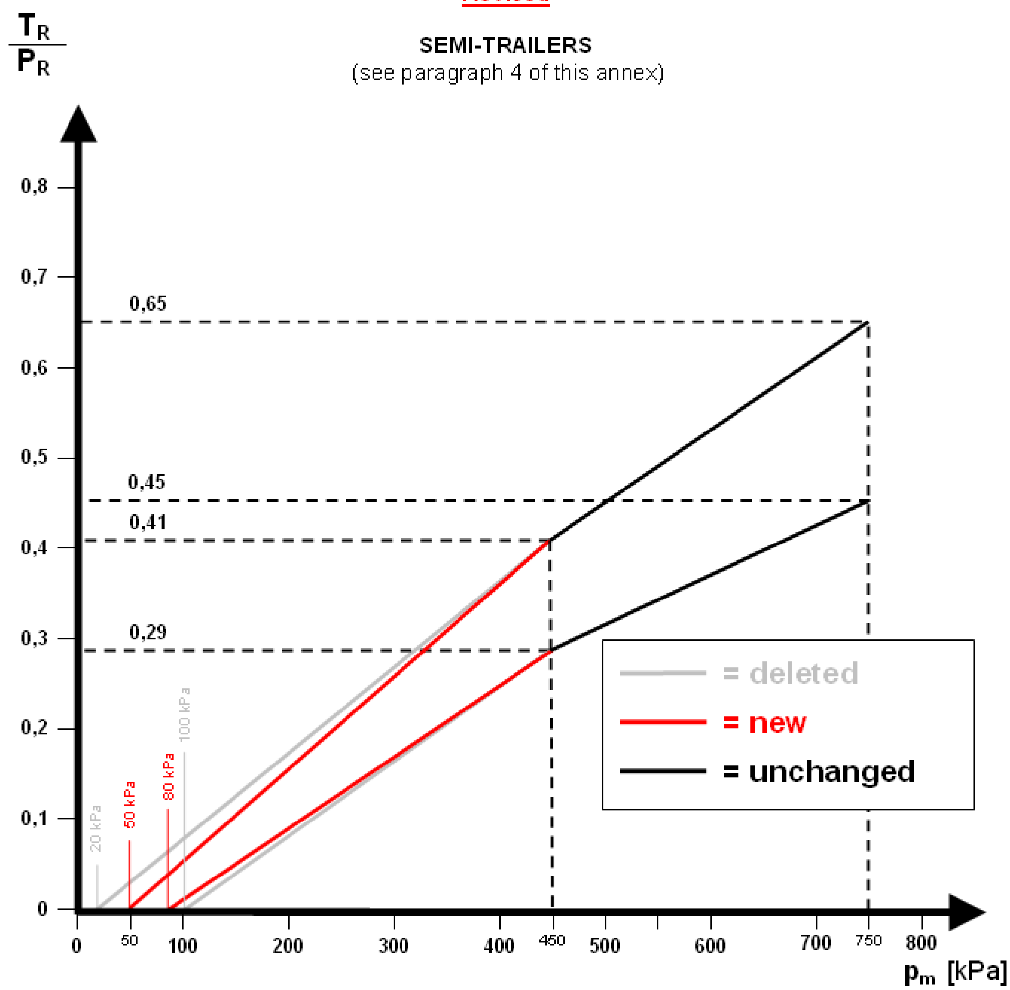


DIAGRAM 4

Revised

SEMI-TRAILERS
(see paragraph 4 of this annex)

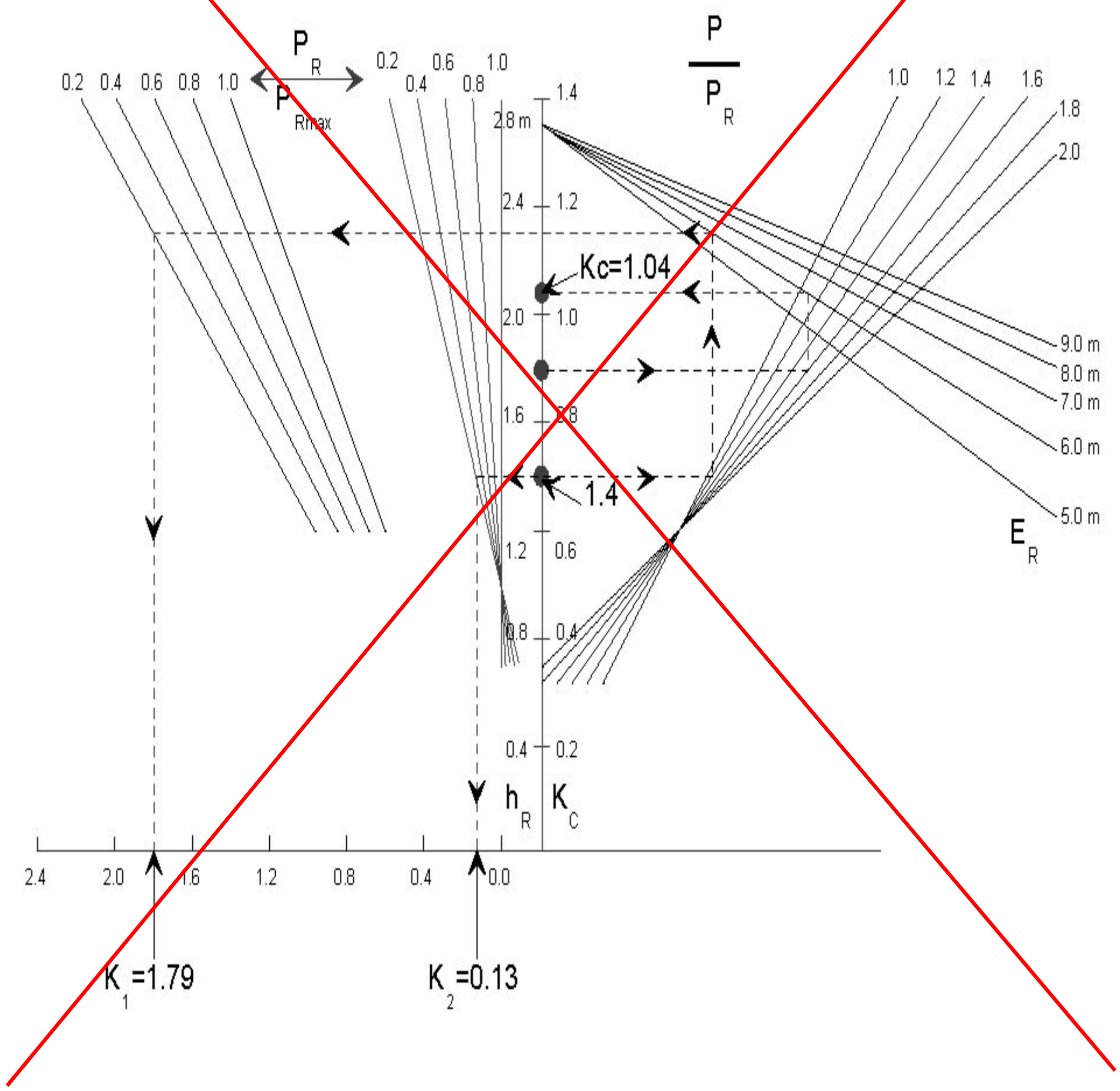



Note: The relation between the braking rate $T_R/P_R$ and the control line pressure ~~for the laden and unladen conditions~~ is determined as follows:

To determine the hatched area~~s corresponding to the laden and unladen conditions,~~ the values of the ordinates of the upper and lower limits ~~of the hatched area~~ in diagram 4~~A~~ are multiplied by the factor~~s~~ Kc ~~and Kv respectively~~. The factor~~s~~ Kc ~~(laden), Kv (unladen)~~ ~~are~~ **is** obtained by the calculation formula described in the following. ~~reference to diagram 4B~~.

DIAGRAM 4B

(see paragraph 4. and diagram 4A of this annex)



CALCULATION FORMULA FOR OBTAINING THE FACTOR K
~~EXPLANATORY NOTE ON THE USE OF DIAGRAM 4B~~

1. Formula ~~from which diagram 4B is derived~~ **for determination of the factor K**:

$$\cancel{K = \left[1.7 - \frac{0.7P_R}{P_{Rmax}}\right]\left[1.35 - \frac{0.96}{E_R}\left(1.0 + (h_R - 1.2)\frac{g.P}{P_R}\right)\right]\left[1.0 - \frac{P_R}{P_{Rmax}}\right]\left[\frac{h_R - 1.0}{2.5}\right]}$$

$$\mathbf{K = 1.35 - \frac{0.96}{E_R}\left(1.0 + (h_R - 1.2)\frac{g * P}{P_{Rmax}}\right)}$$

2. Descrition of method of use with practical example.

2.1. The ~~broken lines shown on diagram 4B refer to the determination of the~~ factor~~s~~ K~~c and Kv~~ **is determined** for the following vehicle, where:

| | ~~Laden~~ | ~~Unladen~~ |
|---|---|---|
| P | 24 tonnes (240 kN) | ~~4.2 tonnes (42 kN)~~ |
| ~~$P_R$~~ | ~~150 kN~~ | ~~30 kN~~ |
| $P_{Rmax}$ | 150 kN | ~~150 kN~~ |
| $h_R$ | 1.8 m | ~~1.4 m~~ |
| $E_R$ | 6.0 m | ~~6.0 m~~ |

~~In the following paragraphs the figures in parentheses relate only to the vehicle being used for the purpose of illustrating the method of using diagram 4B.~~

2.2. Calculation of ~~ratios~~ **the correction factor K:**

$$\mathbf{K = 1.35 - \frac{0.96}{6.0}\left(1.0 + (1.8 - 1.2)\frac{240}{150}\right) = 1.04}$$

$$\cancel{(a)\ \left[\frac{g.P}{P_R}\right]\ \text{laden}\quad (= 1.6)}$$

$$\cancel{(b)\ \left[\frac{g.P}{P_R}\right]\ \text{unladen}\ (= 1.4)}$$

$$\cancel{(c)\ \left[\frac{P_R}{P_{Rmax}}\right]\ \text{unladen}\ (= 0.2)}$$

2.3. Determination of the correction factor when laden, $K_C$:

(a) Start at the appropriate value of $h_R$ ($h_R$ = 1.8 m)
(b) Move horizontally to the appropriate g**.**P/$P_R$ line (g · P/$P_R$ = 1.6)
(c) Move vertically to the appropriate $E_R$ line ($E_R$ = 6.0 m)
(d) Move horizontally to the $K_C$ scale; $K_C$ is the laden correction factor required ($K_C$ = 1.04)

2.4. Determination of the correction factor when unladen, $K_V$:

2.4.1. Determination of the factor $K_2$:

(a) Start at appropriate $h_R$ ($h_R$ = 1.4 m)
(b) Move horizontally to the appropriate $P_R/P_{Rmax}$ line in the group of curves nearest to vertical axis ($P_R/P_{Rmax}$ = 0.2)
(c) Move vertically to the horizontal axis and read off the value of $K_2$ ($K_2$ = 0.13 m).

2.4.2. Determination of the factor $K_1$:

(a) Start at the appropriate value of $h_R$ ($h_R$ = 1.4 m)
(b) Move horizontally to the appropriate g**.**P/$P_R$ line (g**.**P/$P_R$ = 1.4)
(c) Move vertically to the appropriate $E_R$ line ($E_R$ = 6.0 m)
(d) Move horizontally to the appropriate $P_R/P_{Rmax}$ line in the group of curves furthest from the vertical axis ($P_R/P_{Rmax}$ = 0.2)
(e) Move vertically to the horizontal axis and read off the value of $K_1$ ($K_1$ = 1.79).

2.4.3. Determination of the factor $K_V$:

The unladen correction factor $K_V$ is obtained from the following expression:

$$K_V = K_1 - K_2 \quad (K_V = 1.66)$$