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World Forum for Harmonization of Vehicle Regulations

Working Party on Brakes and Running Gear

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Geneva, 2-6 February 2009
Item 3(d) of the provisional agenda

REGULATIONS Nos. 13 AND 13-H (Braking)

Trailer parking brake

Proposal for an amendment to Regulation No. 13

Submitted by the expert from the United Kingdom *

The text reproduced below was prepared by the expert from the United Kingdom to insert into Regulation No. 13 a calculation method to ensure that the parking brake(s) on each side of the axle(s) are capable of providing their appropriate share of the braking force required to hold the trailer on an 18 per cent gradient. However, as an alternative to the calculation method, a simple physical test is needed to ensure that the trailer parking brake will contribute sufficient force and that it remains stable even when subjected to side forces. It is based on ECE/TRANS/WP.29/GRRF/2008/25 and informal document GRRF-64-13, distributed at the sixty-fourth session of the Working Party on Brakes and Running Gear (GRRF). The modifications to the existing text of the Regulation are marked in **bold** characters.

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* In accordance with the programme of work of the Inland Transport Committee for 2006-2010 (ECE/TRANS/166/Add.1, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance performance of vehicles. The present document is submitted in conformity with that mandate.

A. PROPOSAL

Annex 12

Insert new paragraphs 2.3.10. to 2.3.12., to read:

"**2. SYMBOLS AND DEFINITIONS**

2.3.10. s_{cf} : Rear cable or rod travel at compensator when brakes operate in forward direction 1/

2.3.11. s_{cr} : Rear cable or rod travel at compensator when brakes operate in rearward direction 1/

2.3.12. s_{cd} : Differential travel at compensator when only one brake operates in the forward direction and the other in the reverse direction 1/

Where: $s_{cd} = s_{cr} - s_{cf}$ (see figure 5A Appendix 1)"

Insert new paragraphs 2.6. to 2.6.4., to read:

"**2.6. Symbols valid for simulated gradient parking brake force differential 2/**

2.6.1. x: Width of track

2.6.2. y: Distance from the tow hitch to centreline of the axle, or the centreline of the axles if two are fitted, or the centreline of the middle axle if three are fitted.

2.6.3. F_{tb}: Minimum total braking force to hold trailer on 18 per cent gradient.

2.6.4. F_{app}: Minimum application force at the tow hitch which has to be resisted by trailer brake."

Amend paragraph 3.1., to read:

"**3.1. …... this part shall be as short as possible. The control rods and cables shall not contact the trailer frame or other surfaces that may affect the application or release of the brake**."

1/ Paragraphs 2.3.10., 2.3.11. and 2.3.12. only apply to the parking brake differential travel calculation method.
2/ Paragraph 2.6. only applies to the parking brake differential travel dynamic test method.

Insert new paragraphs 8. to 8.5.2., to read:

"**8. SIMULATED GRADIENT PARKING BRAKE FORCE DIFFERENTIAL 3/**

8.1. Dynamic test method

8.1. The trailer shall be tested in its fully laden condition on a level surface.

8.1.1. Position the trailer on a level surface and apply the parking brake with a force not exceeding that specified in Annex 4, paragraph 3.2.1. 3/

8.1.2. Prevent one of the wheels from rotating to ensure that the brakes on only one side of the trailer are forced to operate in the reverse direction (see figure 1 below).

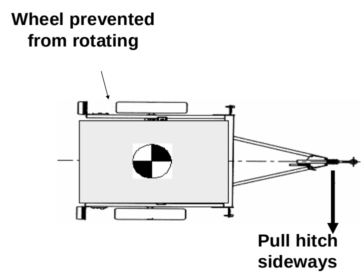


Figure 1

The test layout, showing prevention of wheel rotation and application of side load

Following this test, the parking brake should be released and the brakes re-settled prior to repeating the test on the wheel(s) on the other side of the axle(s) with the test layout requirements reversed.

8.1.3. Any resistance from the jockey wheel shall be removed as far as is practicable and the minimum load as calculated in paragraph 8.4. is applied at 90^{O} to the tow-hitch in the direction opposite from the side of the trailer to where the wheel(s) are prevented from rotating.

8.1.4. The load is increased until the trailer starts to rotate or the minimum force is reached. The method of applying the load to the tow hitch must ensure that there is no reduction in the gradient simulation force, even when the trailer begins to move. The limited movement typically 50 mm associated with the operation of the auto-reverse mechanism is ignored in this respect.

3/ The manufacturer shall provide the Technical Service with details of which method has been used (dynamic or calculation).

8.1.5. Calculation of the minimum required gradient force

8.1.5.1. Calculate the minimum gradient force F_{app} required at the tow hitch to guarantee adequate performance from each brake.

Figure 2 below shows dimension x (the trailer track) and dimension y (the distance from the tow-hitch to the axle centre line).

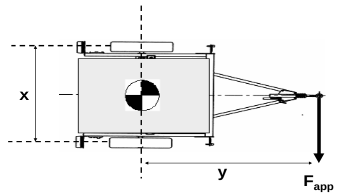


Figure 2: Calculation of relationship between applied side load and brake force

8.1.5.2. The minimum total brake force F_{tb} (in Newton) to hold the trailer on an 18 per cent slope is defined by the following equation.

$$F_{tb} = 0.18 \cdot g \cdot m$$

where:

g is the acceleration due to gravity: g = 9.81 m/s²

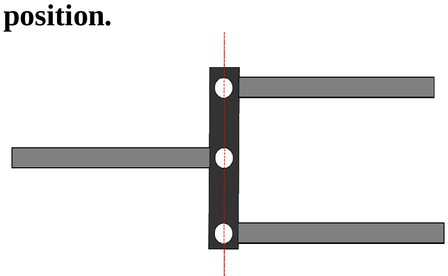
m is the mass in kg.

For the purposes of this test, it is assumed that 50 per cent of this force should be provided by each brake. The minimum applied force (F_{app}) that has to be resisted by the trailer brake is defined by the following formula:

$$F_{app} = \frac{x \cdot F_{tb}}{2 \cdot y}$$

8.2. Calculation method

8.2.1. The pivot points in the compensator shall lie in a straight line with the park brake at the rest position.



All compensator pivots to be in-line

Alternative arrangements can be used, if they provide equal tension in both rear cables, even when there are differences in travel between the rear cables.

8.2.2. Drawing details are to be provided to demonstrate that the compensator articulation is sufficient to ensure equal cable tension is applied to each of the rear cables. The compensator needs to have sufficient distance across the width to facilitate the differential travels left to right. The jaws of the yolks also need to be deep enough relative to their width to make sure that they do not prevent articulation when the compensator is at an angle.

Differential travel at compensator (s_{cd}) shall be derived from:

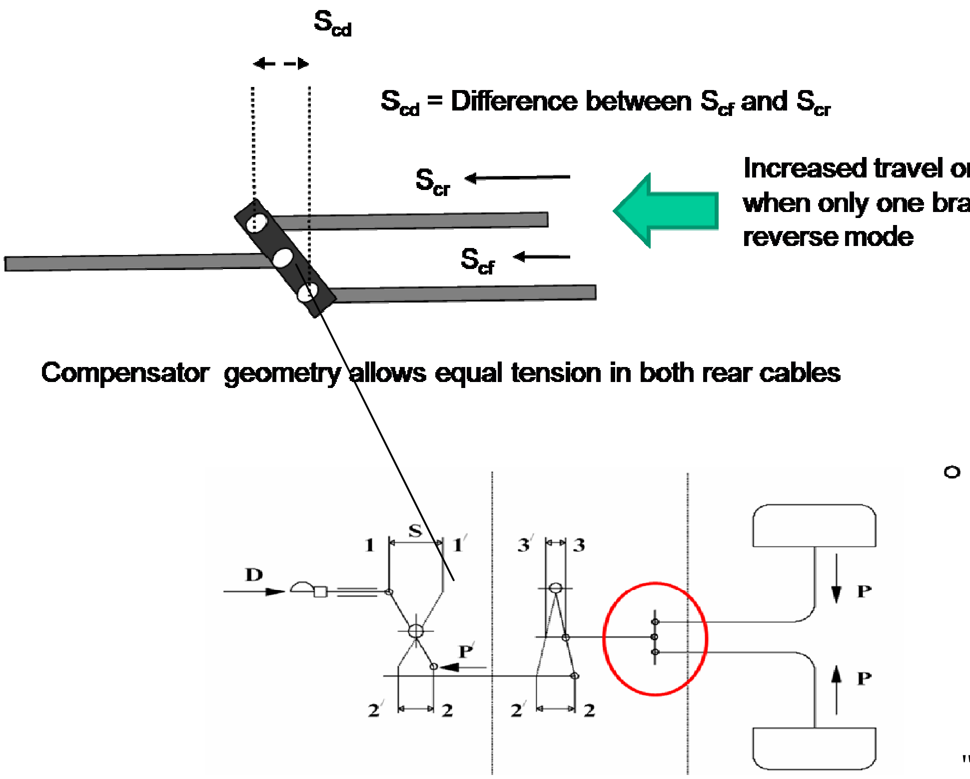
$$s_{cd} \geq 1.2 \cdot (S_{cr} - S_c')$$

Where:

$S_c' = S'/i_H$	**(travel at compensator - forward operation) and $S_{c'} = 2 \cdot S_B/i_g$**
$S_{cr} = S_r/i_H$	**(travel at compensator - rearward operation)"**

Appendix 1, insert a new figure 5A, to read:

"Figure 5A: MECHANICAL-TRANSMISSION BRAKING SYSTEM
(See paragraph 2.3. of this annex)

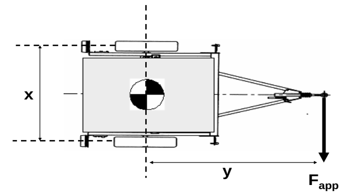


"

Paragraphs 8. to 10. (former), renumber as paragraphs 9. to 11.

Annex 12, Appendix 1, add a new figure 9, to read:

"**Figure 9: Parking brake gradient check**
(See paragraphs 2., 2.6. and 8. of this annex)



$$F_{tb} = 0.18 \cdot g \cdot m \qquad F_{app} = \frac{x \cdot F_{tb}}{2 \cdot y}$$ "

Annex 12, Appendix 4

Insert new paragraphs 6. to 7.1.3., to read:

"**6.** **Parking brake differential travel (Only applicable to dynamic test method)**

6.1. **Minimum calculated parking brake force to hold on trailer 18 per cent gradient**
$F_{tb} = 0.18 \cdot g \cdot m$ **………………………………………………………………… N**

6.1.2. **Minimum calculated force applied at tow hitch to confirm simulated 18 per cent gradient performance of individual parking brakes**
$F_{app} = \frac{x \cdot F_{tb}}{2 \cdot y}$ **………………………………………………………………… N**

7. **Differential travel at park brake compensator (only applicable to calculation method)**

7.1.1. **Maximum permissible compensator travel (forward)** s_{cf} **= .... mm**

7.1.2. **Maximum permissible compensator travel (rearward)** s_{cr} **= .... mm**

7.1.3. **Maximum permissible differential compensator travel** s_{cd} **= .... mm**"

Paragraph 6. (former), renumber as paragraph 8. and amend to read:

"**8**. The inertia braking system described above complies/does not comply 1/ with the requirements of paragraphs 3. to **10.** of this annex.

Signature ………………………. Date ……………………………."

Paragraphs 7. and 8. (former), renumber as paragraphs 9. and 10.

B. JUSTIFICATION

This proposal outlines two test procedures which will confirm that the parking brake system will apply appropriate forces to either side.

Dynamic test method

The general requirements of Annex 12 to Regulation No. 13, specifically paragraph 3.5. states that auto-reverse devices should not adversely affect the parking brake performance when facing up a gradient. However, the current approval test for an inertia braking system does not completely assess the parking brake system to ensure that the brakes on each side are capable of providing their appropriate share of the braking force required to hold the trailer on an 18 per cent gradient.

The design of the auto-reverse mechanism includes a small hump in the profile of the shoe web. This feature is designed to prevent unnecessary operation of the auto-reverse function during normal forward driving (such as when shunt occurs between the vehicle and trailer). This means that there is a small threshold to overcome to initially invoke the mechanism. Once the hump is passed, there is a reduction in the level of force required to maintain the auto-reverse function, however providing both brakes go into auto-reverse mode together the brake force available is sufficient to hold the trailer on the 18 per cent gradient.

Problems arise when the geometry of the compensator permits only one brake to go into auto-reverse mode leaving the other brake to contribute little or no braking effort. The resultant cause is that the trailer can pivot around the one locked wheel. This proposed simple physical test will ensure that each brake will contribute sufficient force to ensure that it remains stable even when subjected to side forces.

Calculation method

The general requirements of this Annex 12, specifically paragraph 3.5. states that auto-reverse devices should not adversely affect the parking brake performance when facing up a gradient. However, the current approval test for an inertia braking system does not completely assess the parking brake system to ensure that the brakes on each side are capable of providing their appropriate share of the braking force required to hold the trailer on an 18 per cent gradient.

Problems arise when the geometry of the compensator permits only one brake to go into auto-reverse mode leaving the other brake to contribute little or no braking effort. The resultant cause is that the trailer can pivot around the one locked wheel. This proposed calculation method will ensure that each brake will contribute sufficient force to ensure that it remains stable even when subjected to side forces.

It is possible for a trailer braking system to comply with Annex 12, but to fail to operate correctly under certain circumstances. If the compensator is not designed correctly, then most or all of the tension is taken by only one of the rear cables and the other brake is no longer properly applied.

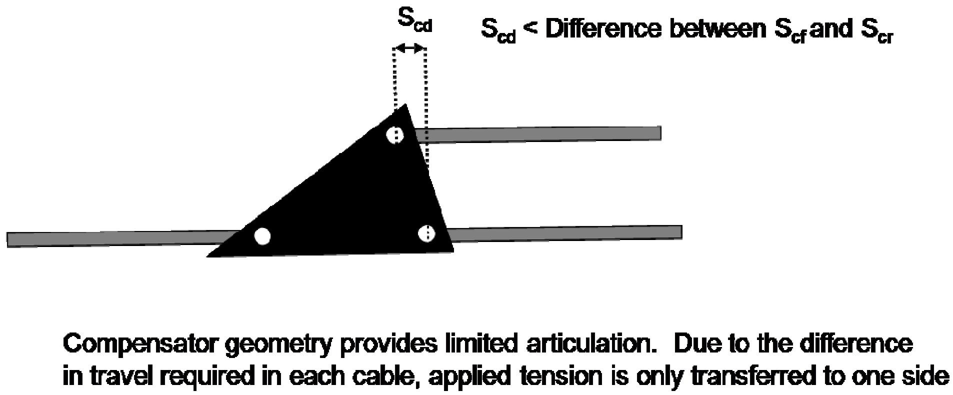


Figure 1: Inappropriate design of compensator

If the compensator design includes appropriate geometry, then both cables are subject to the same tension. Figure 2 shows the park brake operation of the compensator under various situations.

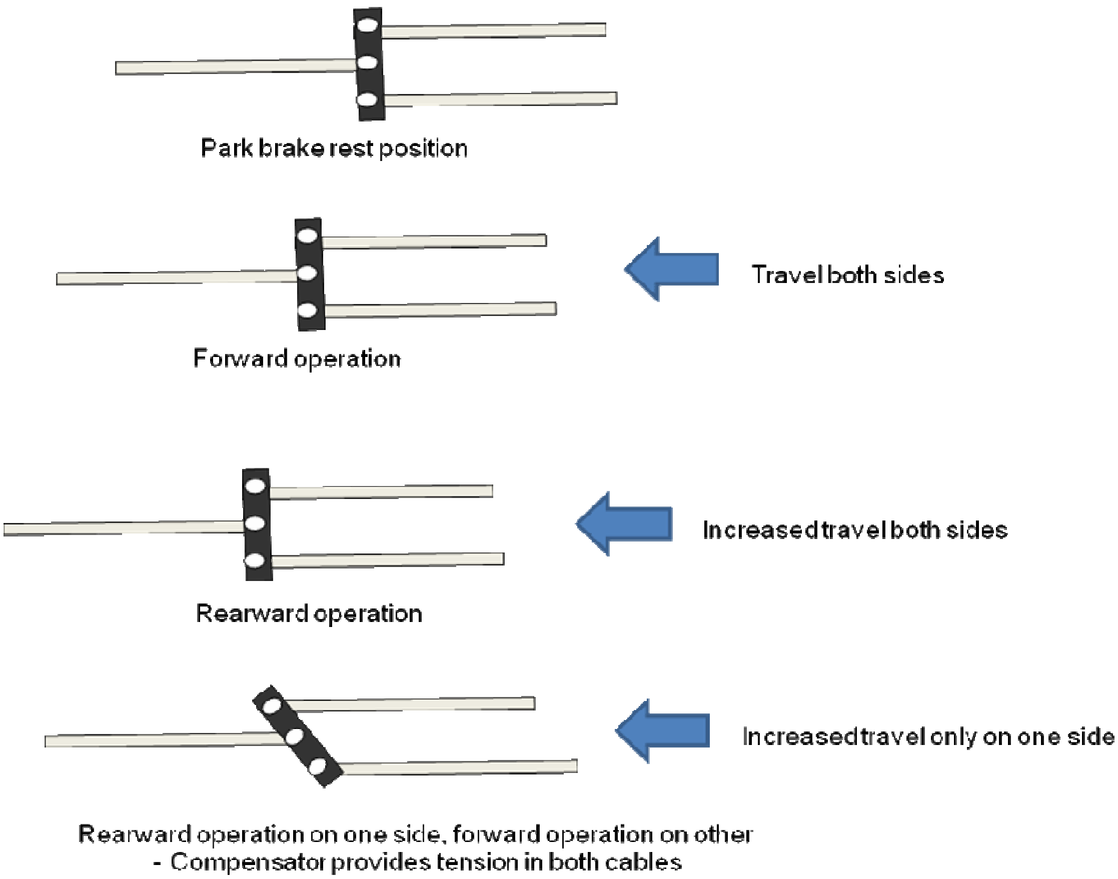


Figure 2: Compensator operation

When the park brake is applied, the compensator applies tension to both rear cables. The compensator normally operates with either both brakes working in the forward or both in the reverse direction. However, if one wheel is stopped from moving by an external force (e.g. held against the kerb), then one brake can remain in the forward operating direction and the other will move into the reverse mode. This results in different travels in the left and right cables. The compensator must tilt to ensure that both cables are still held under the appropriate tension. This is shown in the last diagram in Figure 2.

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