

**ISO CD 12161**

**Doc TC22/SC2 N 597**

**“Road vehicles  
— Endurance braking systems  
of motor vehicles and towed vehicles  
— Test procedures”**

by

**ISO TC22/SC2/WG6  
SWG 6 „Endurance braking systems“**

**Dr. Reinhold Pittius (VOITH TURBO)**

# 1. Structure of ISO Working Group

**Subworking group SWG 6 „Endurance braking systems“**  
**Chairman Dr. Reinhold Pittius**

- **reporting to ISO 22/2/WG6 „Braking Systems“**  
**Chairman Prof. v. Glasner**

- **Active members of SWG 6:**

DaimlerChrysler	TELMA
IVECO	VOITH TURBO
MAN	ZF

- **Status**

- Working Draft agreed by TC22 → Committee Draft (CD)
- Distribution as ISO DIS in Dec. 2003
- Balloting until May 2004

# Contents

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- 2. The Target**
- 3. Basic legal requirements**
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- 5. Specific properties of different types of retarders**
- 6. Test methods**
- 7. Conclusion**

# 2. The Target

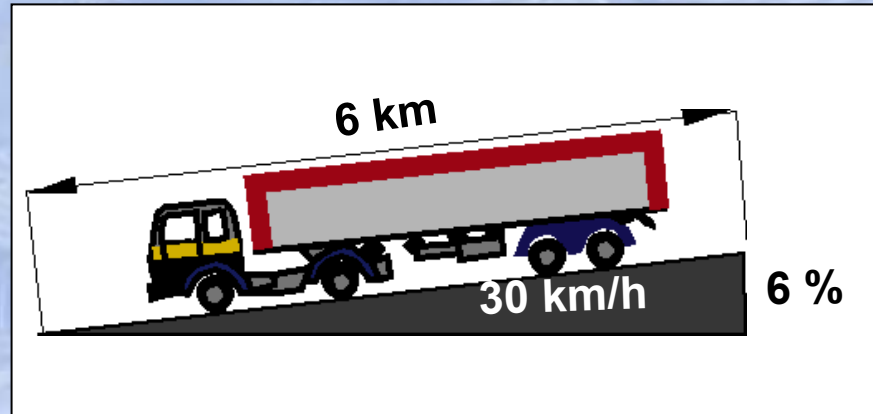
## Standardization

- of testing procedures
  - of vehicles
    - equipped with endurance braking systems
    - to be type approved
  - according to existing legal requirements
- 
- Detailed description of
  - different test methods such that
  - results are
    - objectiv,
    - realistic and
    - compatible

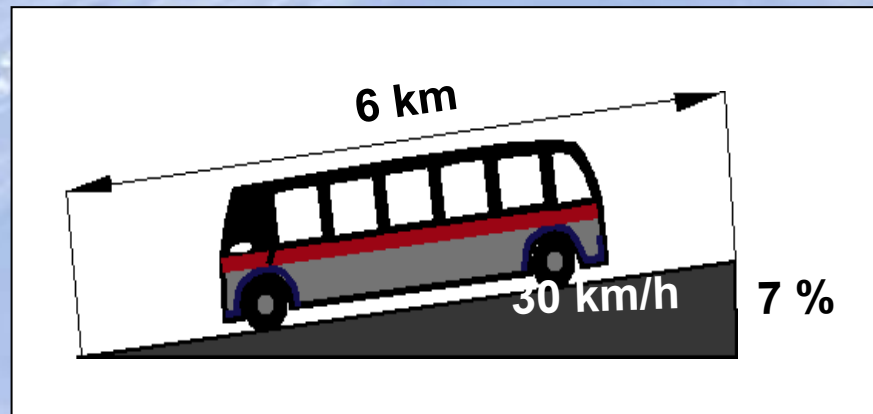
# 3. Basic legal requirements (1)

## ECE-R 13, Annexe 4

para. 1.6 Type II



para 1.8 Type IIA  
service brakes  
must not be used !



# 3. Basic legal requirements (2)

## 1.8.2. Test conditions and performance requirements

1.8.2.1. The performance of the endurance braking system shall be tested at the maximum mass of the vehicle or of the vehicle combination.

1.8.2.2. Laden vehicles must be tested in such a manner that the energy input is equivalent to that recorded in the same period of time with a laden vehicle driven at an average speed of 30 km/h on a 7 per cent down-gradient for a distance of 6 km. During the test, the service, secondary and parking braking systems must not be engaged. The gear engaged must be such that the speed of the engine does not exceed the maximum value prescribed by the manufacturer. An integrated endurance braking system may be used, provided that it is suitably phased such that the service braking system is not applied; this may be verified by checking that its brakes remain cold, as defined in paragraph 1.4.1.1. of this Annex.

# 3. Basic legal requirements (3)

## 1.8.2. Test conditions and performance requirements

1.8.2.1. The performance of the endurance braking system shall be tested at the maximum mass of the vehicle or of the vehicle combination.

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# 3. Basic legal requirements (4)

## 1.8.2. Test conditions and performance requirements

1.8.2.1. The performance of the endurance braking system shall be tested at the maximum mass of the vehicle or of the vehicle combination.

1.8.2.2. Laden vehicles must be tested in such a manner that the energy input is equivalent to that recorded in the same period of time with a laden vehicle driven at an average speed of 30 km/h on a 7 per cent down-grad for a distance of 1000 m. During the test the service, secondary and parking braking systems must be used. The gear selected must be suitable for the test and shall not exceed the maximum value permitted by the manufacturer. An integrated endurance braking system may be used, provided that it is suitably phased such that the parking system is not applied; this may be verified by checking that its brakes remain cold, as defined in paragraph 1.4.1.1. of this Annex.

**Equivalent energy !**

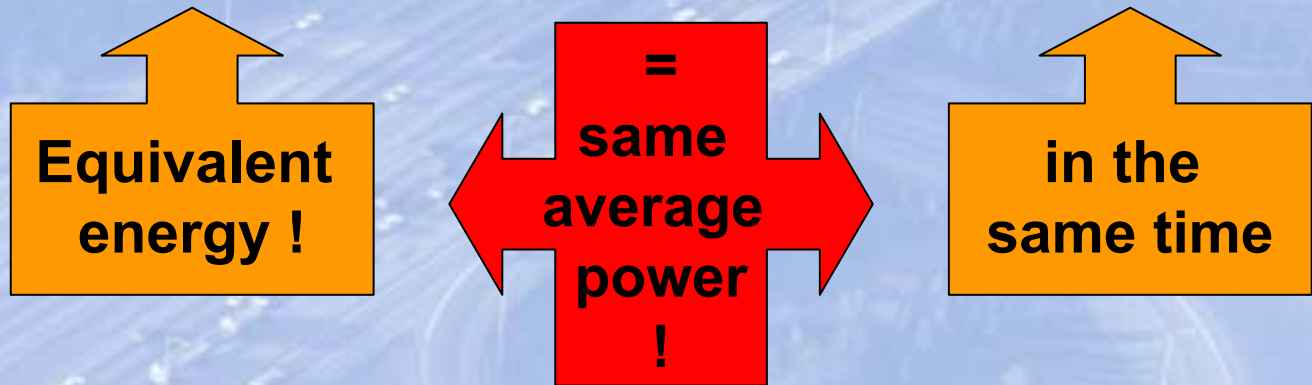
**=  
same average power !**

**in the same time**



# 4. Basic understanding (1)

**Key philosophy of ISO CD 12161  
with regard to the standardization of  
performance tests of endurance braking systems**



$$W = m \cdot g \cdot \Delta H \quad ^{1)}$$
$$= m \cdot g \cdot L \cdot \tan \alpha$$

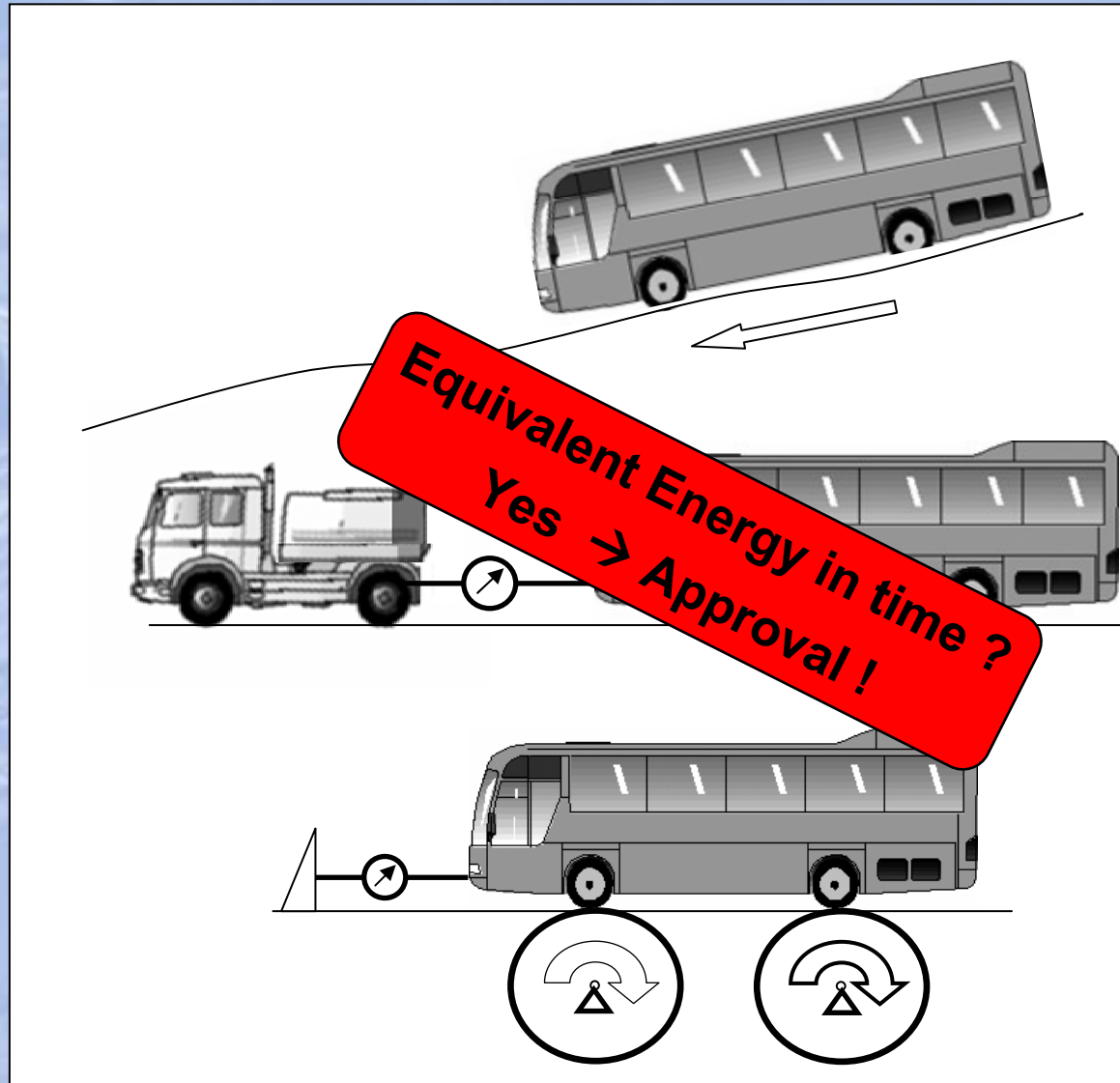
$$P = W / t$$

$$t = L / v$$

<sup>1)</sup> rolling resistance to be considered!

# 4. Basic understanding (2)

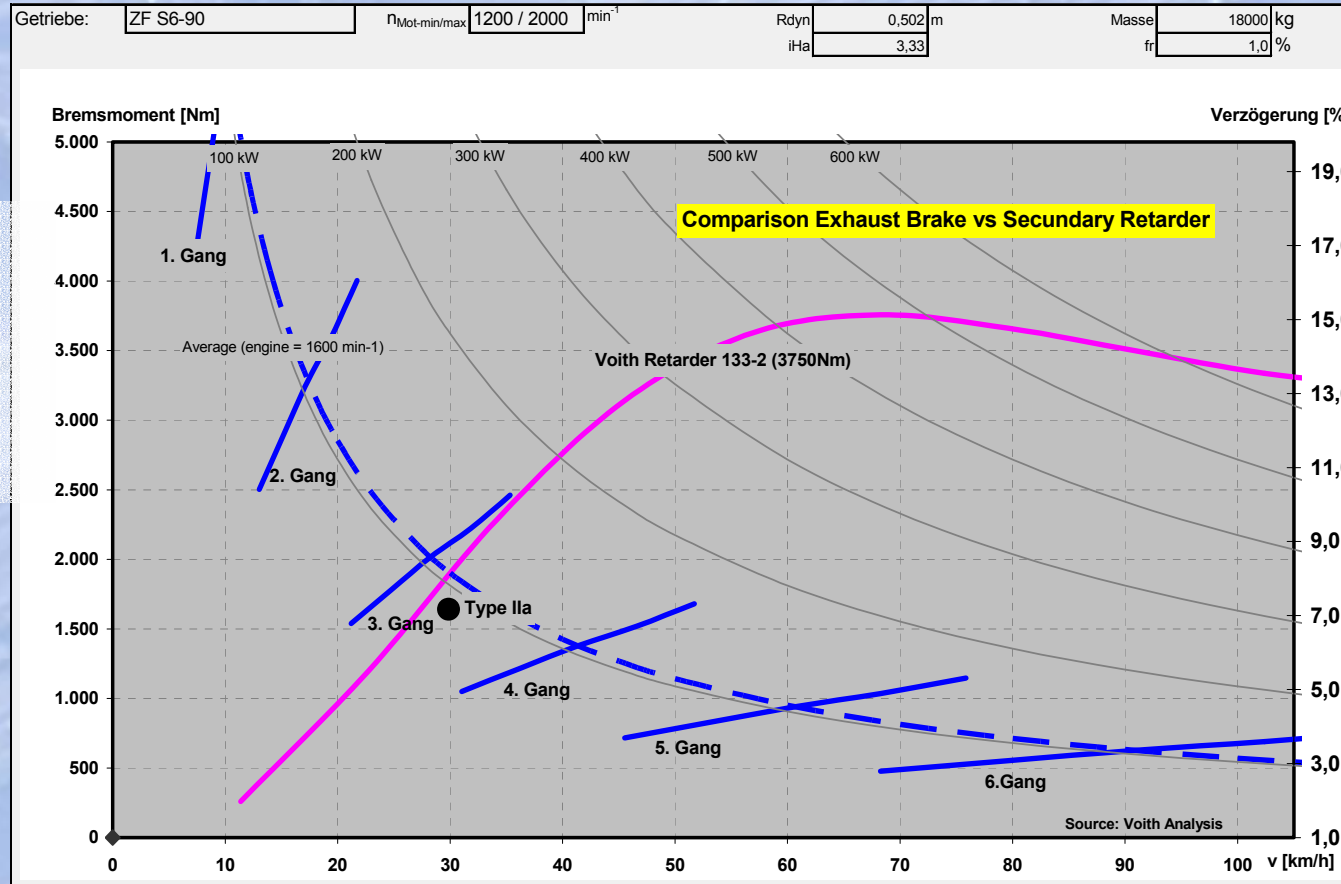
- **Downhill test**  
(preference IVECO)
- **Towing test**  
(preference MAN)
- **Test bench**  
(preference DC)



# 5 Specific properties of different types of retarders (1)

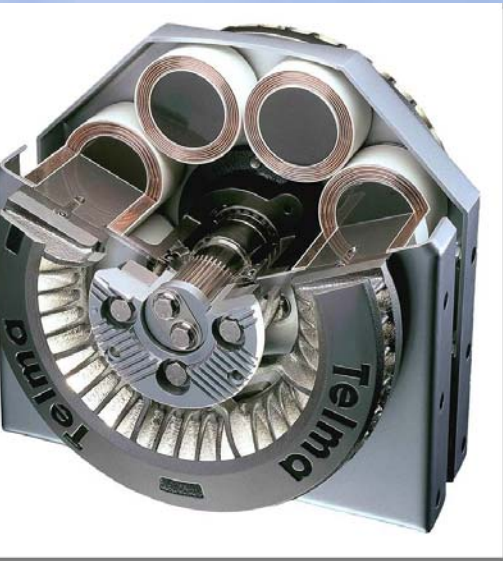
## Engine brake vs secondary (hydrodynamic) retarder

- Torque vs speed
- Power vs speed
- controllability

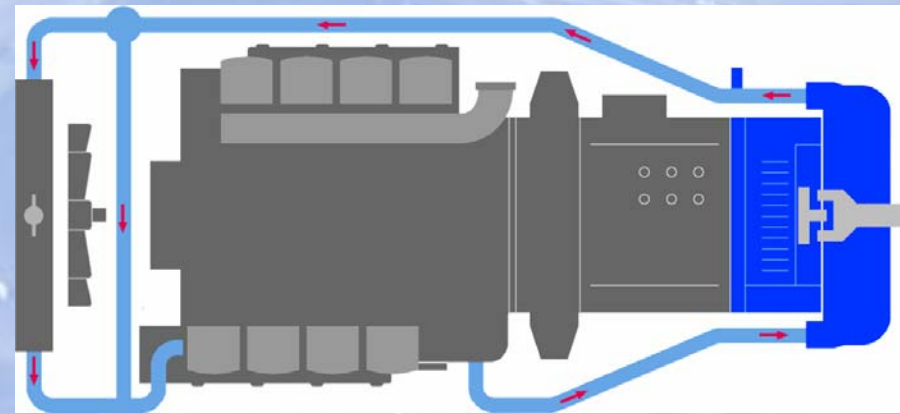
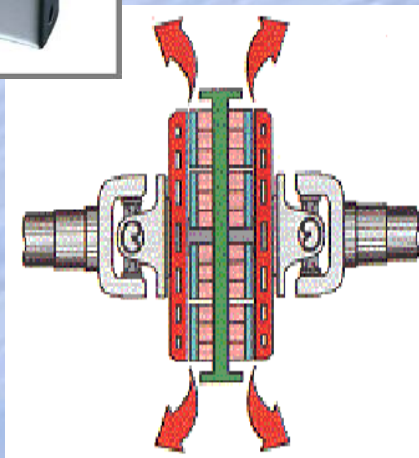
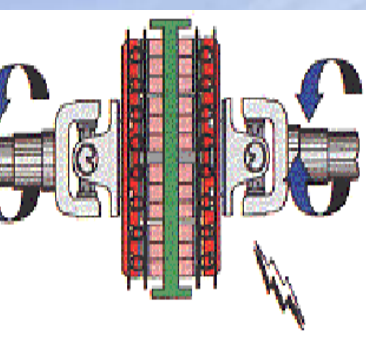
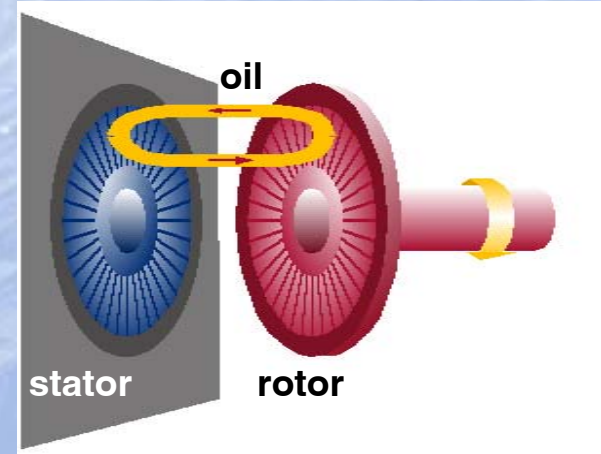


# 5 Specific properties of different types of retarders (2)

## Electromagnetic vs hydrodynamic retarder

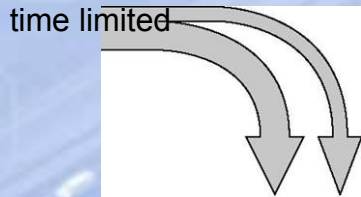


**Thermal performance**



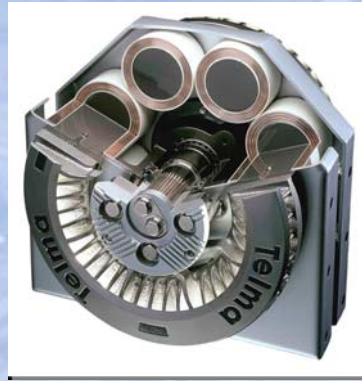
# 5 Specific properties of different types of retarders (3)

## Service Brake



capacitive absorption  
radiation via surface

## Electromagnetic Retarder



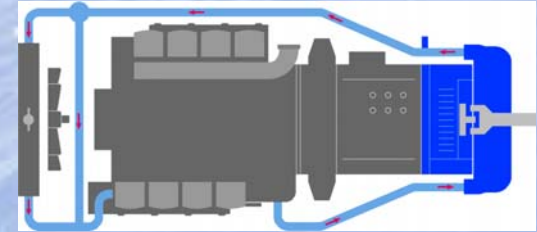
continus braking capability

time limited

capacitive absorption  
radiation via surface

elimination through cooling system

## Hydrodynamic Retarder



continus braking capability

time limited

capacitive absorption  
radiation via surface

elimination through cooling system

# 6.1 Test methods – Downhill test (1)

## Specific criterias:

There is no real downhill track **having exactly 7% and 6km length**

Perhaps the height difference is available, **but not exactly the length (resp. the slope)**

Even if the height and the length are correct, the **slope may vary along the track.**

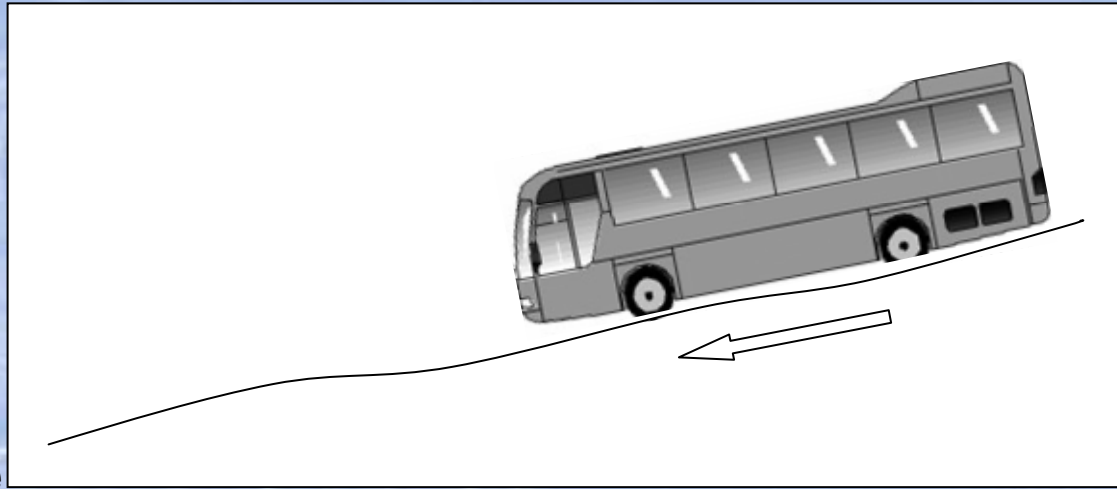
CD 12161



**Only small tolerances on equivalent energy and time !**

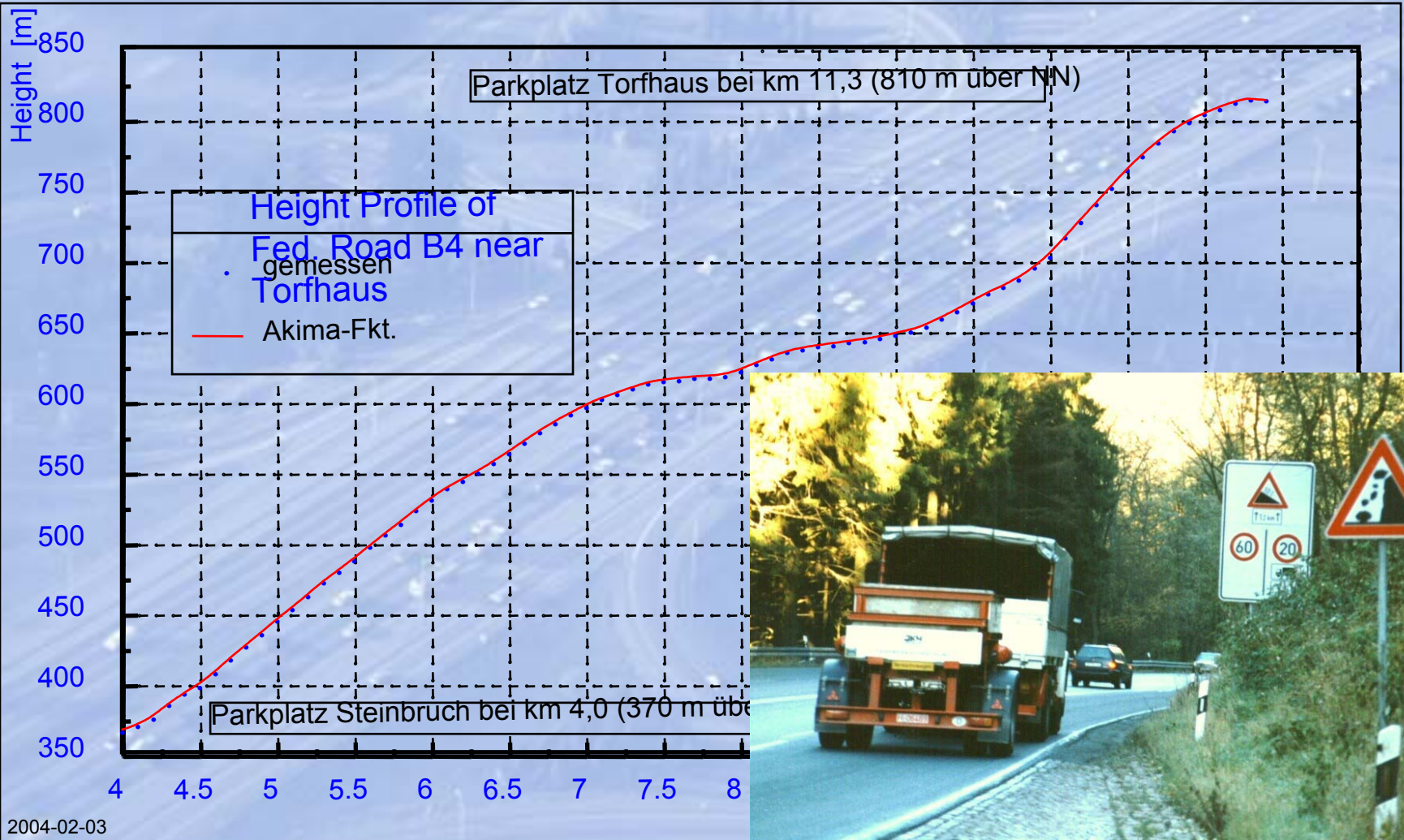
**but**

- tolerances on slope variation
- compensation on average slope
- compensation on height difference



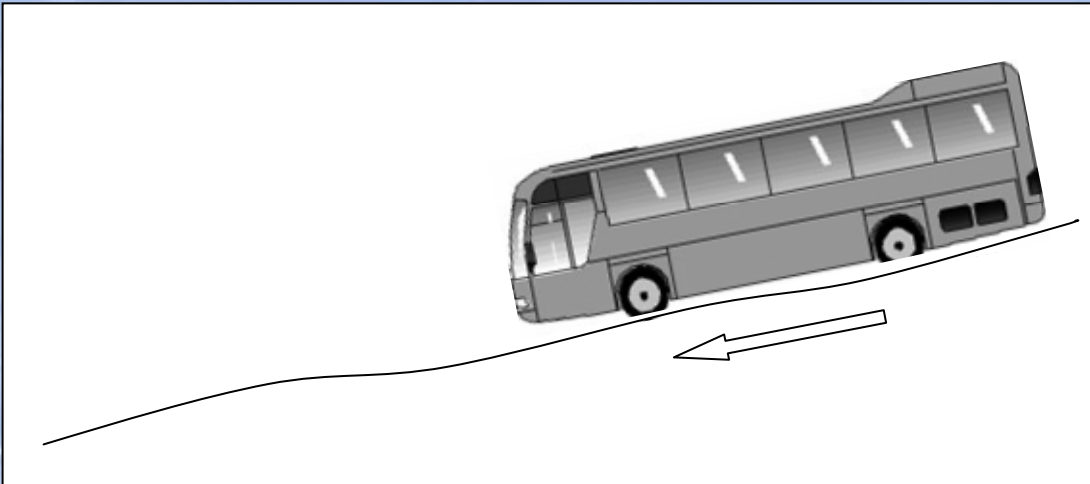
# 6.1 Test methods – Downhill test (2)

## Height profile of a realistic test track

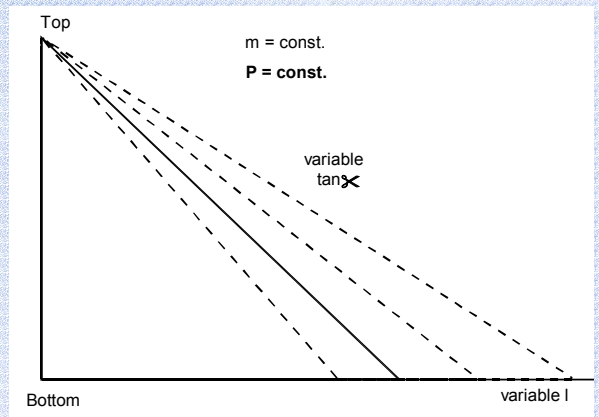


# 6.1 Test methods – Downhill test (3)

## Downhill test - procedure



- „Qualifying“ of desired downhill track acc. to explained criterias
- Calculation of compensation parameters such as speed, mass etc.
- nearly no instrumentation necessary
- performance of the downhill test run
- measurement of the time needed
- if less then required time → DONE





## 6.2 Test methods – Towing test (1)

### Specific criterias:

The braking force **may vary**  
**due to retarder**  
**characteristic**

The speed of the  
combination **may due to**  
**the variation or force**

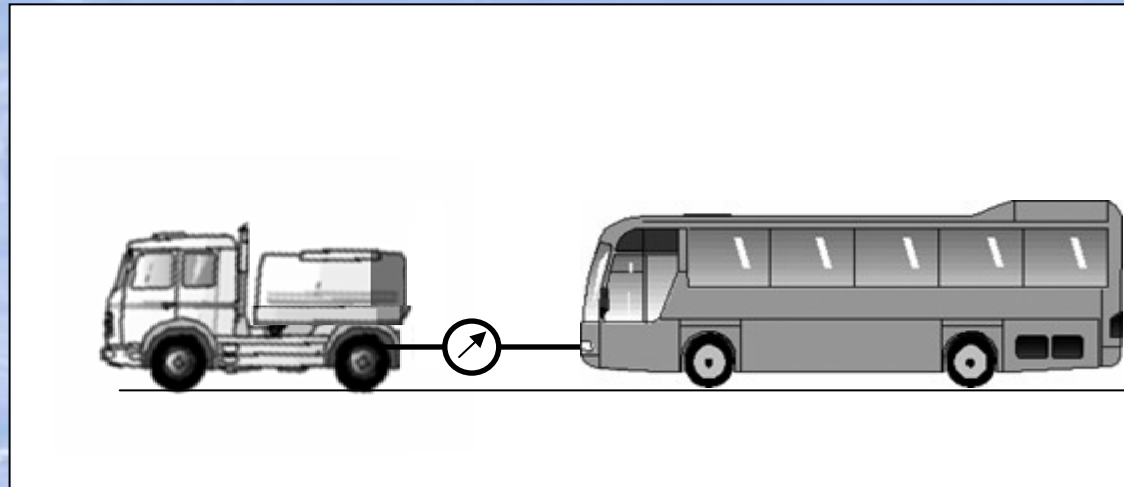
If the the towed vehicle has  
not fully laden **the rolling**  
**resistance must be**  
**considered at the**  
**evaluation of the test.**



**Only small tolerances on  
equivalent energy and time !**

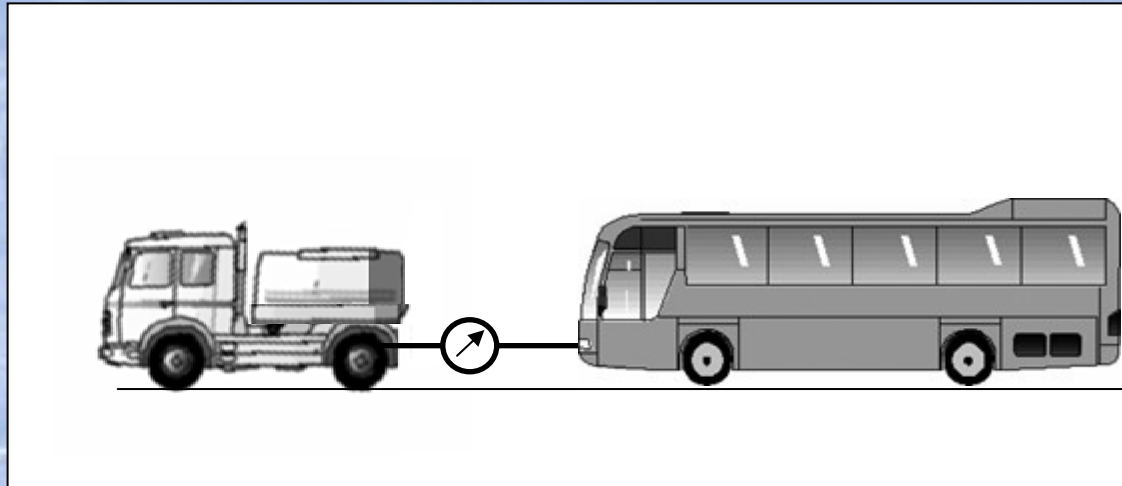
**but**

- tolerances on force variation
- tolerance on speed variation
- compensation of GVW and rolling resistance



## 6.2 Test methods – Towing test (2)

### Towing test - procedure



- „Qualifying“ of vehicles and test conditions
- Compensation of rolling resistance and determination of requ. force
- Instrumentation of vehicles necessary
- performance of the towing test 12 min and data recording
- postprocessing of test data → calculation of braking energy
- if equal to equivalent energy → DONE

# 6.3 Test methods –Dynamometer test bench (1)

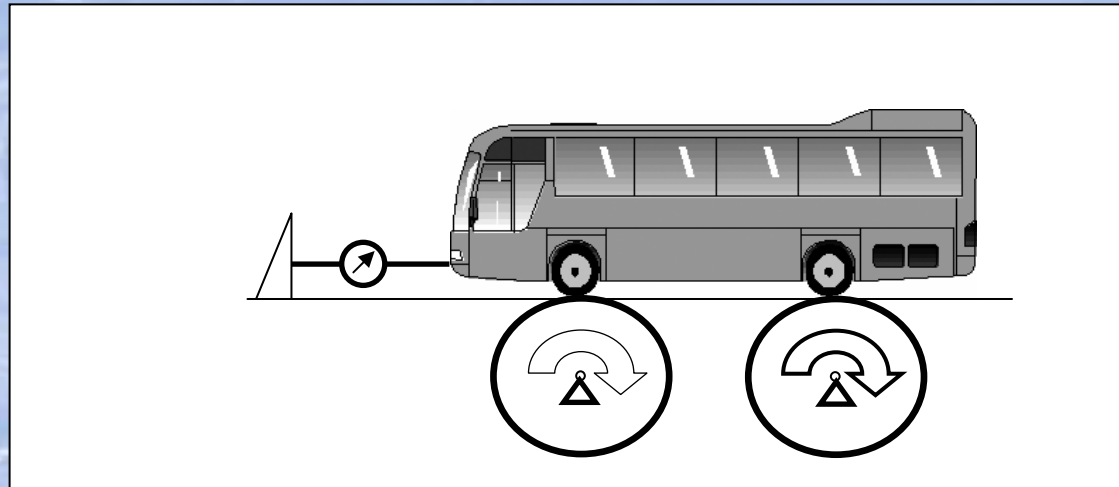
## Specific criterias:

The braking force **may vary due to retarder characteristic**

The speed of the test bench **may due to the variation or force**

If the the measured vehicle is not fully laden **the rolling resistance must be considered at the evaluation of the test.**

A cooling device must **simulate the air stream due to the vehicle speed**



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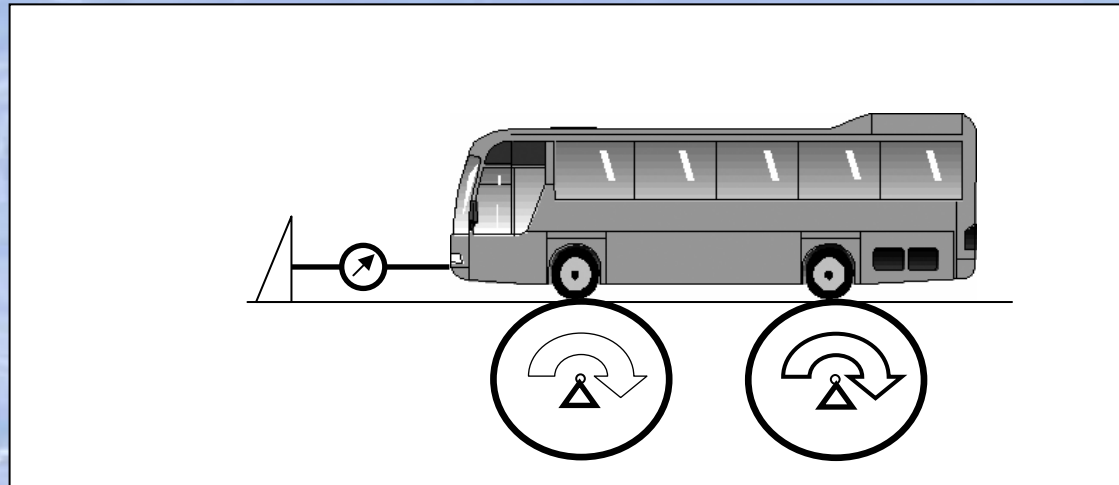
**Only small tolerances on equivalent energy and time !**

**but**

- tolerances on force variation
- tolerance on speed variation
- compensation of GVW and rolling resistance

## 6.3 Test methods –Dynamometer test bench (2)

### Simulation test - procedure



- „Qualifying“ and instrumentation of the test bench
- Compensation of rolling resistance and determination of requ. force
- performance of the towing test 12 min and data recording
- postprocessing of test data → calculation of braking energy
- if equal to equivalent energy → DONE

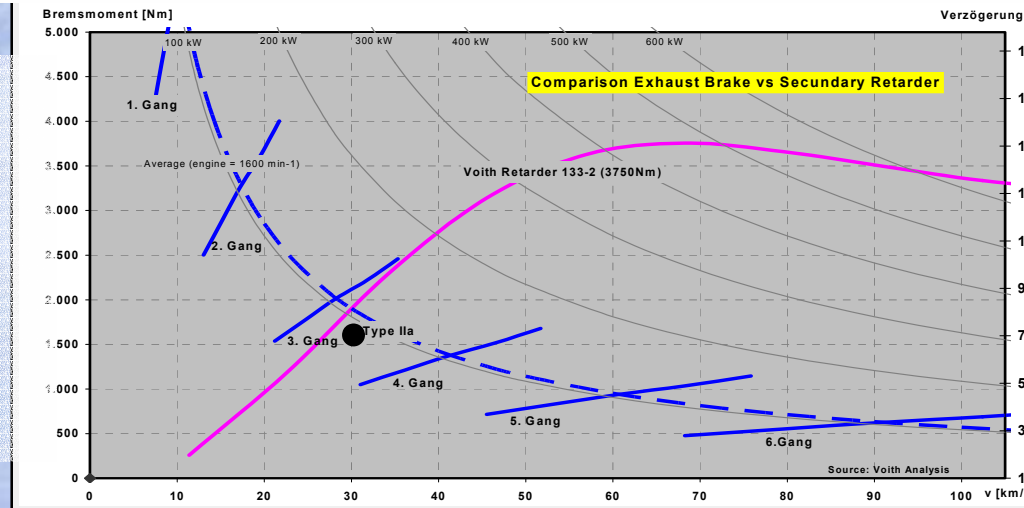
# 7 Specific test parameters for engine brakes (1)

Speed tolerance  $30 \pm 5$  km/h

1.8.2.3. For vehicles in which the energy is absorbed by the braking action of the engine alone, a tolerance of  $\pm 5$  km/h on the average speed shall be permitted, and the gear enabling the speed to be stabilized at a value closest to 30 km/h on a 7 per cent down-gradient shall be engaged. If the performance of the braking action of the engine alone is determined by measuring the deceleration, it shall be sufficient if the mean deceleration measured is at least  $0.6 \text{ m/s}^2$ .

➤ All primary retarders shall be treated same as engine retarders

- because they operate via the gearbox as well



# 7 Specific test parameters for engine brakes (2)

Deceleration test  $\geq 0.6 \text{ m/s}^2$

- 1.8.2.3. For vehicles in which the energy is absorbed by the braking action of the engine alone, a tolerance of  $\pm 5 \text{ km/h}$  on the average speed shall be permitted, and the gear enabling the speed to be stabilized at a value closest to  $30 \text{ km/h}$  on a 7 per cent down-gradient shall be engaged. If the performance of the braking action of the engine alone is determined by measuring the deceleration, it shall be sufficient if the mean deceleration measured is at least  $0.6 \text{ m/s}^2$ .

- The deceleration test is NOT covered by the ISO CD 12161
  - because this test is not „in line“ with the general idea of the equivalent energy

# 6 Conclusion (1)

- ISO CD 12161
- provides detailed definitions of three test procedures according to the **principle of equivalent energy**
- the test procedures have been harmonized based on the principle of equivalent energy
- allows adequate and individual decisions on the test procedure. It does not need high-end test facilities
- considers primary retarders in the same „family“ as engine retarders because all are operating via the gearbox
- does not cover the deceleration test in ECE-R 13

**ISO/CD 12161**

ISO TC 22/SC 2/WG

Secretariat: BNA

**Road vehicles — Endurance braking systems of motor vehicles and towed vehicles — Test procedures**

*Véhicules routiers — Véhicules à moteur et véhicules tractés disposant de systèmes de freinage d'endurance — Procédures d'essai*

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**Thank you for your attention**