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**Road vehicles — Road load —**

**Part 2:**

**Reproduction on chassis dynamometer**

*Véhicules routiers — Résistance sur route —*

*Partie 2: Reproduction sur banc dynamométrique*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10521-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 5, *Engine tests*.

This first edition, together with ISO 10521-1, cancels and replaces ISO 10521:1992, which has been technically revised.

ISO 10521 consists of the following parts, under the general title *Road vehicles — Road load*:

- *Part 1: Determination under reference atmospheric conditions*
- *Part 2: Reproduction on chassis dynamometer*

## Introduction

This part of ISO 10521 has been prepared to reflect the state-of-the-art technique for the vehicle road-load setting on chassis dynamometers. ISO10521-1 should be referred to for the basic road-load measurement method. This part contains the following technical and editorial changes compared with ISO 10521:1992:

- to simulate the road load on the chassis dynamometer precisely, the hydraulic absorber type dynamometer is excluded;
- only the chassis dynamometer of coefficient control is described in this part of ISO10521.

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# Road vehicles — Road load —

## Part 2: Reproduction on chassis dynamometer

### 1 Scope

This part of ISO 10521 specifies methods of setting the target road load on chassis dynamometers for the purpose of a subsequent test, for example the fuel consumption test or the exhaust-emission measurement test.

The road-load setting method on chassis dynamometers depends on the road-load measurement method, such as the coastdown method, the torquemeter method or the wind-tunnel and chassis-dynamometer method. This part of ISO 10521 gives detailed instructions on the methods of the chassis-dynamometer setting procedure for road-load value, obtained by the various measurement methods specified in ISO 10521-1.

This part of ISO 10521 is applicable to chassis dynamometers that can set road load at a minimum of three speed points, and to motor vehicles as defined in ISO 3833 up to a gross vehicle mass of 3 500 kg.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3833, *Road vehicles — Types — Terms and definitions*

ISO 10521-1:2006, *Road vehicles — Road load — Part 1: Determination under reference atmospheric conditions*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3833 and the following apply.

#### 3.1

##### **total resistance**

total force-resisting movement of a vehicle movement, measured either by the coastdown method or by the wind-tunnel and chassis-dynamometer method, including the friction forces in the drive train

#### 3.2

##### **running resistance**

torque-resisting movement of a vehicle, measured by the torquemeter installed in the drive-train of a vehicle, including the friction torque in the drive-train downstream of the torquemeter

### 3.3

#### **road load**

general meaning of force or torque which opposes the movement of a vehicle, including total resistance and/or running resistance

### 3.4

#### **reference speed**

vehicle speed at which a chassis-dynamometer load is verified

NOTE Reference speeds may be continuous speed points covering the complete speed range.

### 3.5

#### **target road load**

road load to be reproduced on the chassis dynamometer

### 3.6

#### **chassis-dynamometer setting load**

load to be set on the power-absorption unit of the chassis dynamometer

### 3.7

#### **simulated road load**

road load to be calculated from measured coastdown data using the least-square regression

NOTE See Annex A for the calculation procedure.

### 3.8

#### **speed range**

range of speed of chassis-dynamometer roller between 15 km/h and maximum reference speed plus 10 km/h, over which the coastdown test is conducted

### 3.9

#### **chassis dynamometer of coefficient control**

chassis dynamometer of which absorption characteristics are determined by giving coefficients of a road-load approximation polynomial

### 3.10

#### **chassis dynamometer of polygonal control**

chassis dynamometer of which absorption characteristics are determined by giving load values at several speed points

## 4 Required overall measurement accuracy

The required overall measurement accuracy shall be as follows:

a) chassis-dynamometer roller speed:  $\pm 0,5$  km/h or  $\pm 1$  %, whichever is greater;

b) chassis-dynamometer force:

Category 1 chassis dynamometer:  $\pm 6$  N, or

Category 2 chassis dynamometer:  $\pm 10$  N or  $\pm 0,1$  % of full scale, whichever is greater;

NOTE Category 2 chassis dynamometer usually has greater load capacity, e.g. 130 kW or more.

c) time:  $\pm 50$  ms or  $\pm 0,1$  %, whichever is greater;

d) wheel torque:  $\pm 3$  N·m or  $\pm 0,5$  %, whichever is greater;



- e) atmospheric temperature:  $\pm 1$  K;
- f) tyre pressure:  $\pm 5$  kPa.

## 5 Preparation for chassis-dynamometer test

### 5.1 Setting parameter

The following parameters shall be determined prior to the test, in accordance with the purpose of the subsequent test:

- a) target road load;
- b) speed range;
- c) reference speed.

### 5.2 Laboratory condition

#### 5.2.1 Roller

The chassis-dynamometer roller shall be clean, dry and free from anything which might cause tyre slippage. In the case of chassis dynamometers with multiple rollers, the chassis dynamometers shall be run in the same coupled or uncoupled state as the subsequent emission test, fuel consumption test, etc., and the chassis-dynamometer speed shall be measured from the roller coupled to the power-absorption unit.

#### 5.2.2 Room temperature

The laboratory atmospheric temperature shall be within 293 K to 303 K as the standard condition, unless otherwise required by the subsequent test.

### 5.3 Preparation of chassis dynamometer

#### 5.3.1 Inertia-mass setting

Set the equivalent inertia mass of the chassis dynamometer in accordance with the vehicle mass or vehicle mass category.

#### 5.3.2 Preconditioning of chassis dynamometer

Precondition the chassis dynamometer in accordance with the dynamometer manufacturer's recommendations, or as appropriate, so that the friction loss of the chassis dynamometer can be stabilized.

### 5.4 Vehicle preparation

#### 5.4.1 Tyre-pressure adjustment

The tyre pressure shall be adjusted to the recommended values for the test. These values shall correspond to those recommended for the range of vehicle speeds encountered during the subsequent emission test, fuel consumption test, etc., in conjunction with roller geometry of the chassis dynamometer to be used. If small-diameter roller(s) are being used, the tyre pressure may be increased so as to ensure a safe test. This pressure increase should be typically 50 %.

## 5.4.2 Vehicle setting

The tested vehicle shall be installed on the chassis-dynamometer roller in a straight position and restrained in a safe manner. In the case of a single roller, the tyre contact point shall be within  $\pm 25$  mm or  $\pm 2$  % of the roller diameter, whichever is smaller, from the top of the roller.

## 5.4.3 Vehicle preconditioning

The power-absorption unit of the chassis dynamometer shall be set in the way specified in 6.1.1.1 or 6.2.1.1, so that an adequate load will be applied to the test vehicle during preconditioning.

Prior to the test, the vehicle shall be preconditioned appropriately until normal vehicle operating temperatures have been reached. It is recommended that the vehicle should be driven at the most appropriate reference speed for a period of 30 min. During this preconditioning period, the vehicle speed shall not exceed the highest reference speed.

# 6 Load setting on the chassis dynamometer

## 6.1 Chassis-dynamometer setting by coastdown method

This method is applicable when the road load is determined using the coastdown method, or the wind-tunnel and chassis-dynamometer method as specified in ISO 10521-1:2006, 5.3, 5.4 or Clause 6.

### 6.1.1 Load setting of chassis dynamometer

#### 6.1.1.1 Initial load setting

For a chassis dynamometer of coefficient control, the chassis-dynamometer power-absorption unit shall be adjusted with the arbitrary initial coefficients,  $A_d$ ,  $B_d$  and  $C_d$ , of the following equation:

$$F_d = A_d + B_d V + C_d V^2$$

where

$F_d$  is the chassis-dynamometer setting load, in newtons (N);

$V$  is the speed of the chassis-dynamometer roller, in kilometres per hour (Km/h).

The following are the recommended coefficient assumptions to be used for the initial load setting:

a)  $A_d = 0,5 \times A_t$ ,  $B_d = 0,2 \times B_t$ ,  $C_d = C_t$ , in the case of single-axis chassis dynamometers, or

$A_d = 0,1 \times A_t$ ,  $B_d = 0,2 \times B_t$ ,  $C_d = C_t$ , in the case of dual-axis chassis dynamometers,

where  $A_t$ ,  $B_t$  and  $C_t$  are the coefficients for the target road load;

b) empirical values, such as those used for the setting for a similar type of vehicle.

For a chassis dynamometer of polygonal control, adequate load values at each speed point shall be set to the chassis-dynamometer power-absorption unit.

### 6.1.1.2 Coastdown

Perform the coastdown test on the chassis dynamometer once with the procedure given in ISO 10521-1:2006, 5.3.1.3.1 and 5.3.1.3.2. Then proceed to 6.1.1.3.

### 6.1.1.3 Verification

**6.1.1.3.1** Calculate the target road-load value using the target road-load coefficient  $A_t$ ,  $B_t$  and  $C_t$  for each reference speed  $V_j$ .

$$F_{tj} = A_t + B_t V_j + C_t V_j^2$$

where

$F_{tj}$  is the target road load at reference speed  $V_j$ , in newtons (N);

$V_j$  is the  $j^{\text{th}}$  reference speed, in kilometres per hour (km/h).

**6.1.1.3.2** Calculate the error,  $\varepsilon_j$ , in percent of the simulated road load  $F_{sj}$ , which is calculated using the method specified in A.1, for target road load  $F_{tj}$  at each reference speed  $V_j$ , using the following equation.

$$\varepsilon_j = \frac{|F_{sj} - F_{tj}|}{F_{tj}} \times 100$$

NOTE  $F_{mj}$ , obtained in A.1.1, may be used in the above equation instead of  $F_{sj}$ .

Verify whether errors at all reference speeds satisfy the following error criteria in two consecutive coastdown runs, unless otherwise specified by regulations.

$$\varepsilon_j \leq 3 \% \text{ for } V_j \geq 50 \text{ km/h}$$

$$\varepsilon_j \leq 5 \% \text{ for } 20 \text{ km/h} < V_j < 50 \text{ km/h}$$

$$\varepsilon_j \leq 10 \% \text{ for } V_j \leq 20 \text{ km/h}$$

If an error at any reference speed does not satisfy the criteria, then proceed to 6.1.1.4 for the adjustment of the chassis-dynamometer setting load.

### 6.1.1.4 Adjustment

Adjust the chassis setting load in order to minimise the error in accordance with the procedure specified in B.1. Then repeat 6.1.1.2 and 6.1.1.3.

## 6.2 Chassis-dynamometer setting using torquemeter method

This method is applied when the road load is determined using the torquemeter method, as specified in ISO 10521-1:2006, 5.5.