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Motorcycles — Guideline for verification of total running resistance force during mode running on a chassis dynamometer

Motocycles — Lignes directrices pour la vérification de la force totale de résistance à l'avancement durant les essais sur un banc dynamométrique en mode roulage

FDIS stage

Contents

Foreword

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This document was prepared by Technical Committee ISO/TC *22*, *Road vehicles*, Subcommittee SC 38, *Motorcycles and mopeds*.

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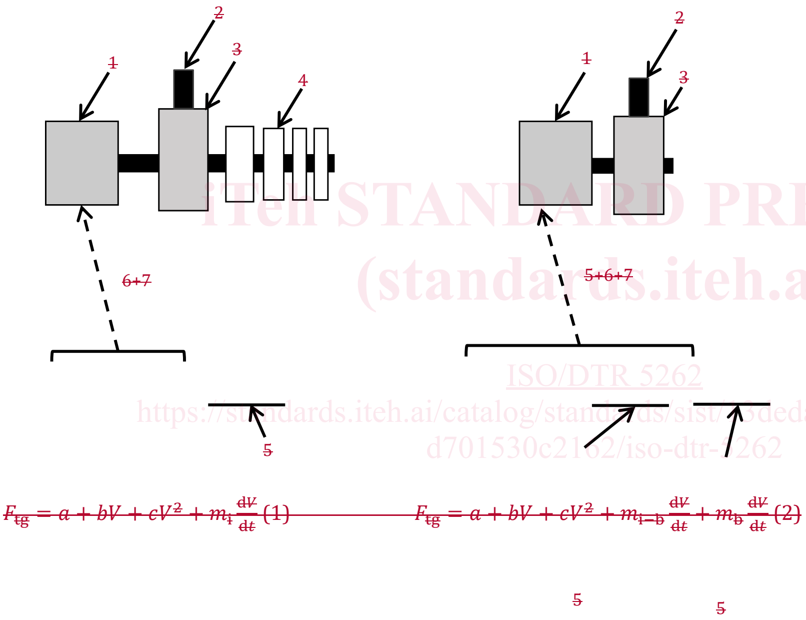
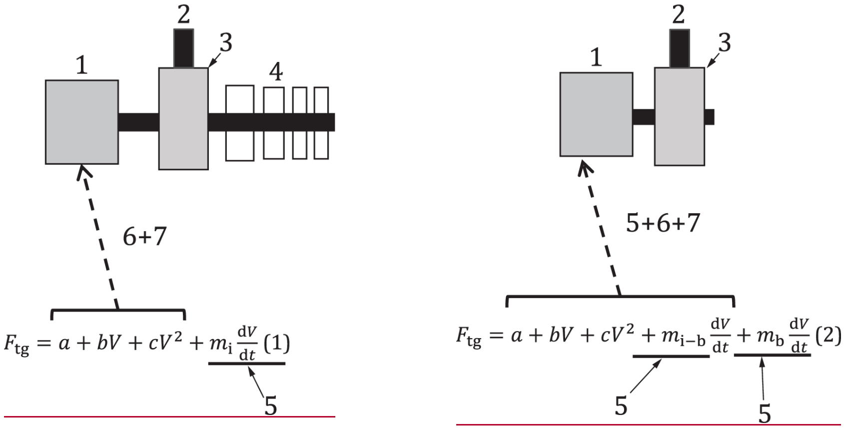
Introduction

A mechanical inertia chassis dynamometer (Formula (1)) is a device with a mechanical flywheel, whereas a chassis dynamometer (Formula (2)) using the electric inertia function is not equipped with such a mechanical flywheel equivalent to inertia mass system and the inertia force is electrically set in the same way of the running resistance force control (Figure 1(Figure 1).). The inertia force is generated by the acceleration and/or deceleration, therefore, it is necessary to check the performance of electric inertia function during the mode running test and ISO 18580 specifies the method to verify the chassis dynamometer operated normally.

However, ISO 18580 does not provide a threshold for the verification result, and it is difficult to determine its validity. Therefore, we investigate the effect of factors affecting fuel consumption on ISO 18580 verification results, and propose a technical report that shows the guideline for determining the threshold of the verification result.





a) mechanical inertia

b) electrical inertia

Key

1 dynamometer

2 tire

3 roller

4 flywheels

5 acceleration resistance

6 rolling resistance

7 aerodynamic drag resistance

NOTE The variablessymbols are defined in Clause 4Clause 4..

Figure 1 — The principle of mechanical and electrical inertia dynamometer

Motorcycles — Guideline for verification of total running resistance force during mode running on a chassis dynamometer

1 Scope

This document shows the results of investigating the guideline for determining the threshold of the evaluation result on an electric inertial chassis dynamometer that electrically controls the amount of inertia using fuel consumption.

This document is applicable when the running resistance force of a chassis dynamometer is set in accordance with ISO 18580.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 18580, *Motorcycles — Verification of total running resistance force during mode running on a chassis dynamometer*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18580 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

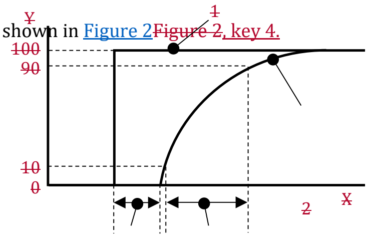
Field Code Changed

3.1
dead time
time between the input being given and the output appearing

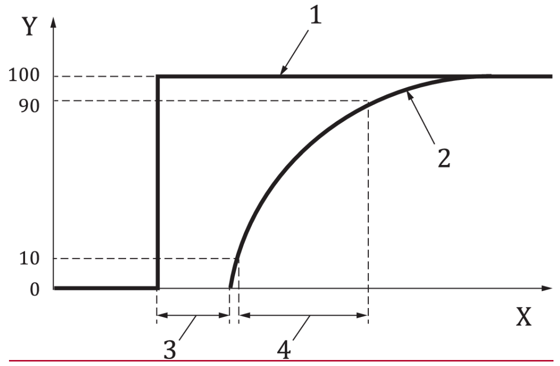
Note 1 to entry: Dead time is shown in Figure 2Figure 2, key 3.

3.2
rise time
time required to reach 10 %-90 % of the final output value

Note 1 to entry: Rise time is shown in Figure 2Figure 2, key 4.



3 4



Key

X time [s]

Y rate [%]

1 input

2 output

3 dead time

4 rise time

~~X time [s]~~

~~Y rate [%]~~

Figure 2 — Image of dead time and rise time

4 Symbols

Symbol	Definition	Unit
A	slope of the regression line	—
a	rolling resistance force of front wheel	N
B	intercept of the regression line	—
b	coefficient proportional to motorcycle speed	N/(km/h)
c	aerodynamic drag coefficient	N/(km/h)^2
CO	carbon monoxide	g/km
CO_2	carbon dioxide	g/km
D	gasoline density	kg/l
e_W	integral work error	%
R_{fc}	rate of fuel consumption	l/~~100km~~100 km
F_{tg}	target total running resistance force	N
HC	hydrocarbon	g/km
m_i	mass obtained by adding the rotating mass of the front wheel to the total mass of the motorcycle, rider and instruments	kg
m_b	equivalent inertia mass of mechanical rotating parts of chassis dynamometer	kg
t	time	s
V	roller rotational speed	km/h
γ	correlation coefficient	—

Symbol	Definition	Unit
σ_{cov}	relative standard deviation (cov: coefficient of variation)	%

5 Evaluation method

5.1 Test summary

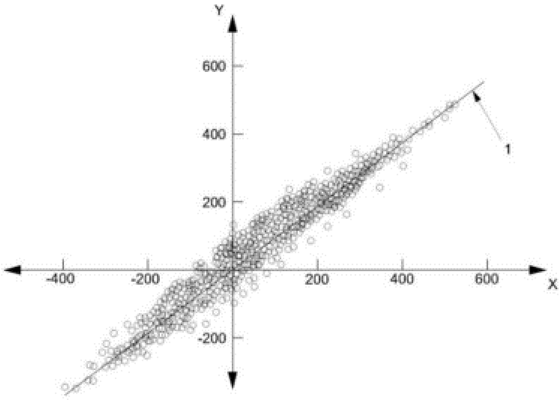
As factors affecting fuel consumption, inertial quantity, front wheel rolling resistance, wind loss resistance, dead time, and rise time were used.

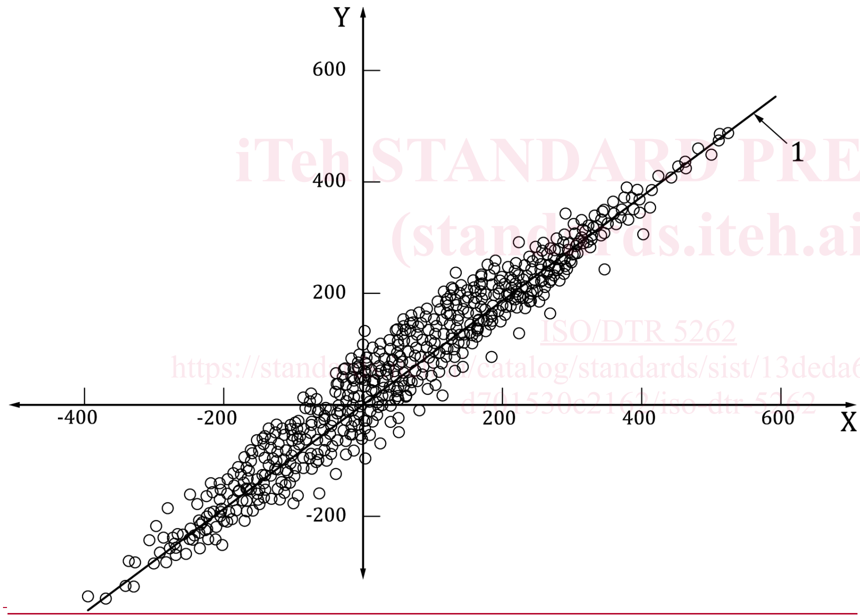
The test vehicles were investigated by selecting 5 models (1, 2, 3, 4 and 5) from different vehicle class, gear type, and displacement of Global technical regulation No. 2.

In the test vehicles of 1, 2, 3 and 4 the setting of the mechanical inertia amount, front wheel rolling resistance, and aerodynamic loss resistance was changed and tested in the vehicle, and the effect of each setting difference on the relationship between fuel consumption and the target of ISO 18580 and the evaluation items of measured total running resistance waswere investigated (Figure 3(Figure 3).).

Table 1 shows the ISO 18580 evaluation items and Table 2Table 2 shows the each vehicles specvehicle's specifications.

In addition, since dead time and rise time, which are the inherent performance of the chassis dynamometer, are difficult to actually generate and control by actually generating delays with the chassis dynamometer, using simulation, the fuel consumption effect of running resistance load delay in the test cycle of the vehicle 5 is calculated, the effect of simulated fuel consumption on the relationship between ISO 18580 targets and measured total running resistance evaluation items was investigated.





Key

1 regression line $A \times F_{tg} + B$

X target running resistance force [N]

Y measured running resistance force [N]

1 regression line$A \times F_{tg} + B$

Figure 3 — Image of relationship between target and measured total running resistance force

Table 1 — ISO18580 target and measured total running resistance evaluation items

Correlation coefficient	Slope of the regression line	Intercept of the regression line [N]	Relative standard deviation [%]	Integral work error [%]
γ	A	B	σ_{cov}	e_W

Table 2 — Vehicles list

Vehicle	Class	P/T Type	Displacement [cc]	Tire size (rear)	Number of cylinders	Number of gears
1	Class 2-2	AT	250	140/70-14	1	-
2	Class 2-1	MT	150	140/60R17	1	5
3	Class 3-2	DCT	1 000	130/70-17	1	6
4	Class 3-2	MT	650	160/60ZR17	2	6
5	Class 1	AT	50	80/100-10	1	-

5.2 Vehicle test

5.2.1 Test cycles

~~It~~The vehicle test was carried out in the test cycle of WMTC Type I test which matched the category of the vehicle 1, 2, 3 and 4.

5.2.2 Warm-up condition

In order to reduce the effect on the experimental data and improve reproducibility, the chassis dynamometer was warmed up by the method recommended by the chassis dynamometer maker before the test. The test vehicle warmed up on a chassis dynamometer so that the test vehicle manufacturer recommended oil temperature.

5.2.3 Evaluation requirements

As shown in the Table 3~~Table 3,~~, the setting range is determined in anticipation of an effect of about ±5 % work rate so that the fuel efficiency impact can be determined in each test vehicles.

The data evaluation range was 1 km/h or more, and the integrated work rate and fuel consumption rate were evaluated in the test cycle area where the vehicle was loaded with running resistance and consumed fuel.

Fuel consumption is calculated from exhaust gas data for all test cycles (Formula (3)~~(Formula (3)).~~).

Table 3 — Vehicles statements and change value

Vehicle	Parameter	Base	Change value
1	m_i [kg]	250	+30; -30 kg
	a [N]	22,0	+10; -10 N
	c [N/(km/h)²]	0,~~0238~~023 8	+10; -10 %
2	m_i [kg]	210	+40; -40 kg
	a [N]	18,5	+8; -8 N
	c [N/(km/h)²]	0,~~0232~~023 2	+10; -10 %
3	m_i [kg]	310	+90; -90 kg
	a [N]	27,3	+15; -15 N
	c [N/(km/h)²]	0,~~0247~~024 7	+7,5; -7,5 %
4	m_i [kg]	270	+80; -80 kg
	a [N]	23,8	+15; -15 N
	c [N/(km/h)²]	0,~~0241~~024 1	+7,5; -7,5 %

The fuel consumption calculation formula from emission data:

$$R_{fc} = \frac{0,1155}{D} \times (0,866 \times HC + 0,429 \times CO + 0,273 \times CO_2) \quad (3)$$