INTERNATIONAL STANDARD

ISO 23274-1

First edition
2013-01-15

Hybrid-electric road vehicles — Exhaust emissions and fuel consumption measurements —

Part 1: Non-externally chargeable vehicles

Véhicules routiers électriques hybrides — Mesurages des émissions à l'échappement et de la consommation de carburant —
Partie 1: Véhicules non rechargeables par des moyens externes

Reference number
ISO 23274-1:2013(E)

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Published in Switzerland

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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.

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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 23274-1 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 21, *Electrically propelled road vehicles*.

This first edition, together with ISO 23274-2, cancels and replaces ISO 23274:2007, which has been technically revised.

ISO 23274 consists of the following parts, under the general title *Hybrid-electric road vehicles — Exhaust emissions and fuel consumption measurements*:

— *Part 1: Non-externally chargeable vehicles*

— *Part 2: Externally chargeable vehicles*

Hybrid-electric road vehicles — Exhaust emissions and fuel consumption measurements —

Part 1: Non-externally chargeable vehicles

1 Scope

This part of ISO 23274 specifies a chassis dynamometer test procedure to measure the exhaust emissions and the electric energy and fuel consumption for the vehicles.

This part of ISO 23274 applies to vehicles with the following characteristics:

— the vehicle is classified as passenger cars or light duty trucks, as defined in each regional annex;

— the nominal energy of the rechargeable energy storage system (RESS) is at least 2 % of the total energy consumption over an applicable driving test (ADT);

— internal combustion engine (ICE) only using liquid fuels (for example, gasoline and diesel fuel).

NOTE 1 In the case of the vehicles with ICE using other fuel [for example, compressed natural gas (CNG), liquefied petroleum gas (LPG), hydrogen], this part of ISO 23274 can apply except the measurement of consumed fuel; otherwise the measurement method for those using the corresponding fuel can apply.

This part of ISO 23274 proposes procedures for correcting the measured emissions and fuel consumption of hybrid electric vehicles (HEVs), in order to obtain the values when the battery state of charge (SOC) of the RESS does not remain the same between the beginning and the end of an ADT.

It can also be applied to measurement procedures for exhaust emissions and fuel consumption of externally chargeable HEVs when a vehicle is not externally charged and operated only in the charge sustaining (CS) state, as described in ISO 23274-2.

NOTE 2 For CS state, see ISO 23274-2.

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 10521 (all parts), *Road vehicles — Road load*

ISO/TR 8713, *Electrically propelled road vehicles — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 8713 and the following apply.

3.1
applicable driving test
ADT
single driving test schedule which is specified for each region

EXAMPLE Chassis dynamometer test cycle for light-duty vehicles in Japan (JC08), New European Driving Cycle (NEDC), Urban Dynamometer Driving Schedule (UDDS)

3.2
charge balance of battery
change of charge in battery during fuel consumption measurement

Note 1 to entry: Normally expressed in ampere hours (Ah).

3.3
energy balance of battery
ΔE_{RESS}
change of battery energy state during an applicable driving test

Note 1 to entry: Normally expressed in watt hours (Wh).

Note 2 to entry: For practical use, the energy balance of RESS is approximated by multiplying the charge balance of battery in ampere hours (Ah) by the nominal voltage in volts (V). Nominal voltage is defined in ISO 12405-1 or ISO 12405-2.

3.4
externally chargeable HEV
HEV with a rechargeable energy storage system (RESS) that is intended to be charged from an external electric energy source

Note 1 to entry: External charge for the purpose of conditioning of the RESS is not included.

Note 2 to entry: Externally chargeable HEVs are widely known as plug-in HEVs (PHEVs).

3.5
hybrid-electric vehicle
HEV
vehicle with both a rechargeable energy storage system (RESS) and a fuelled power source for propulsion

EXAMPLE Internal combustion engine or fuel cell systems are typical types of fuelled power sources.

3.6
non-externally chargeable HEV
HEV with a rechargeable energy storage system (RESS) that is not intended to be charged from an external electric energy source

3.7
rated capacity
supplier's specification of the total number of ampere hours that can be withdrawn from a fully charged battery pack or system for a specified set of test conditions such as discharge rate, temperature, discharge cut-off voltage, etc.

3.8
rechargeable energy storage system
RESS
system that stores energy for delivery of electric energy and which is rechargeable

EXAMPLE batteries or capacitors

3.9
regenerative braking
braking with conversion of kinetic energy into electric energy for charging the RESS

3.10
state of charge
SOC
available capacity in a battery pack or system

Note 1 to entry: Expressed as a percentage of rated capacity.

4 Test conditions and instrumentation

4.1 Test conditions

4.1.1 General

For test conditions, 4.1.2 to 4.1.4 apply. Otherwise, the regional standards or regulations (see Annex A, B or C, for example) apply.

4.1.2 Ambient temperature

Tests shall be conducted at ambient temperature of (25 ± 5) °C.

4.1.3 Vehicle conditions

4.1.3.1 Vehicle conditioning

Prior to testing, the test vehicle with RESS shall be stabilized as specified by manufacturers, or the mileage shall be accumulated to above 3 000 km and less than 15 000 km.

4.1.3.2 Vehicle appendages

Vehicles shall be tested with normal appendages (mirrors, bumpers, etc.). When the vehicle is on the dynamometer, certain items (e.g. hub caps) should be removed for reasons of safety, where necessary.

4.1.3.3 Vehicle test mass

The vehicle test mass shall be selected in accordance with the regional standards and/or regulations (see Annex A, B or C, for example).

4.1.3.4 Tyres

4.1.3.4.1 General

The correctly rated tyres as recommended by the vehicle manufacturer shall be used.

4.1.3.4.2 Tyre pressure

The vehicle tyres shall be inflated to the pressure specified by the vehicle manufacturer in accordance with the test chosen (track or chassis dynamometer).

4.1.3.4.3 Tyre conditioning

The tyres shall be conditioned as recommended by the vehicle manufacturer.

4.1.3.5 Lubricants

The vehicle lubricants normally specified by the manufacturer shall be used.

4.1.3.6 Gear shifting

If the vehicle is fitted with a manually shifted gear box, gear shifting positions shall correspond to the regional test procedure (see A, B or C, for example). However, the shift positions should be selected and determined in accordance with the vehicle manufacturer's specification.

4.1.3.7 Regenerative braking

If the vehicle has regenerative braking, the regenerative braking system shall be enabled for all dynamometer testing except where specified in 4.1.4.4 Determining the dynamometer load coefficient.

If the vehicle is tested on a single axle dynamometer and is equipped with systems such as an antilock braking system (ABS) or a traction control system (TCS), those systems may inadvertently interpret the non-movement of the set of wheels that are off the dynamometer as a malfunctioning system. If so, these systems shall be temporarily disabled for adjustment to achieve normal operation of the remaining vehicle systems, including the regenerative braking system.

4.1.3.8 RESS conditioning

The RESS shall be conditioned with the vehicle as specified in 4.1.3.1, or by equivalent conditioning.

4.1.4 Chassis dynamometer conditions

4.1.4.1 General

The vehicle should generally be tested on a single axle chassis dynamometer. A vehicle with four-wheel drive shall be tested by modifying the drive train of the vehicle. When the vehicle is modified, the details shall be explained in the test report.

Double axle chassis dynamometer testing should be performed if a modification for single axle chassis dynamometer testing is not possible for a specific four-wheel drive vehicle.

4.1.4.2 Dynamometer calibration

The dynamometer shall be calibrated in accordance with the specifications indicated in the service manual provided by the dynamometer manufacturers.

4.1.4.3 Dynamometer warm-up

The dynamometer shall be warmed up sufficiently prior to testing.

4.1.4.4 Determining the dynamometer load coefficient

The determination of vehicle road load and the reproduction on a chassis dynamometer shall conform to ISO 10521. Vehicles equipped with regenerative braking systems that are activated at least in part when the brake pedal is not depressed shall have regenerative braking disabled during the deceleration portion of coast-down testing on both the test track and dynamometer.

4.2 Test instrumentation

Test instrumentation shall have accuracy levels as shown in Table 1, unless specified differently in Annex A, B, or C.

Table 1 — Accuracy of measured vehicles

Item	Unit	Accuracy
Time	s	± 0,1 s
Distance	m	± 0,1 %
Temperature	°C	1 °C
Speed	km/h	± 1 %
Mass	kg	± 0,5 %
Current	A	± 0,5 %
Capacitor voltage	V	± 0,5 % of nominal voltage

5 Measurement of exhaust emissions and fuel consumption

5.1 General

The appropriate procedure for a particular region shall be selected from Annex A, B or C, for Japan, Europe or North America, respectively. Common procedures are described below.

5.2 Test procedure

5.2.1 Vehicle preconditioning

Vehicle preconditioning shall be carried out in accordance with the corresponding annex of regional test procedure, if necessary.

If necessary, the RESS SOC may be pre-adjusted by charging or discharging, to obtain a suitable energy balance of RESS between the beginning and the end of the test.

5.2.2 Vehicle soak

The vehicle shall be soaked in accordance with the appropriate regional procedure in Annex A, B or C.

5.2.3 Vehicle movement to the test room

When the vehicle is brought into the test room, and moved during the test if necessary, it shall be pushed or towed (neither driven nor regenerative recharged.). The test vehicle shall be set on the chassis dynamometer after the chassis dynamometer has warmed up just before the test. The vehicle shall not be activated during soak until right before starting the test.

5.2.4 Measurement over ADT

Energy balance of RESS, consumed fuel and exhaust emissions shall be measured in each ADT. The conditions of the vehicle during the ADT shall follow the appropriate regional test procedure (see Annex A, B or C, for example).

5.3 Correction of the test results

5.3.1 General

Measured fuel consumption and exhaust emissions shall be corrected if these test results are influenced by RESS energy balance during the test. However, the correction is not necessary if the RESS energy balance satisfies the conditions in 5.3.2.

5.3.2 Allowable range of RESS energy balance

The correction is not necessary if RESS energy balance is within the following range:

$$\left|\Delta E_{\mathrm{RESS}}\right| \leq 0{,}01 \times E_{\mathrm{CF}} \quad (1)$$

where

ΔE_{RESS} is the energy change in RESS over the ADT;

E_{CF} is the energy of consumed fuel over the ADT.

Practical methods that apply to battery and capacitor are described in Annex E.

5.3.3 Correction procedure by correction coefficient

The vehicle manufacturer shall deliver the correction coefficient to calculate the fuel consumption and the exhaust emission at $\Delta E_{\mathrm{RESS}} = 0$. The correction coefficient can be obtained in accordance with Annex D. When the measured value is independent of ΔE_{RESS}, a correction is not required.

6 Calculations and expressions

Resultant exhaust emission and fuel consumption for an ADT shall be calculated in accordance with the regional requirement in Annex A, B or C.

Annex A
(informative)

Test procedure in Japan

A.1 General

This Annex describes the procedures and related conditions in Japan (JC08 mode) to measure the exhaust emissions and fuel consumption of the passenger cars and light duty trucks defined in Japan Regulations.

Japan Regulations are written as "Announcement that Prescribes Details of Safety Regulations for Road Vehicles (Ministry of Land, Infrastructure, Transport and Tourism [MLIT] Announcement No. 619, 2002; Attachment 42)", TRIAS 99-006-01 and TRIAS 31-J042(3) –01.[1)]

A.2 Test

A.2.1 Chassis dynamometer

The equivalent inertia mass of the chassis dynamometer shall be set to the standard value of equivalent inertia mass specified in the right column of Table A.1 according to the relative test vehicle mass (vehicle curb mass plus 110 kg) specified in the left column of the table. Furthermore, if the standard value of the equivalent inertia mass in the right column of the table cannot be set, it is permissible to set the equivalent inertia mass within a range between the said standard value and the said standard value plus 10 %.

A.2.2 Applicable driving test (ADT)

The test vehicle shall run the applicable driving test (ADT). In Japan, JC08-mode driving schedule [0 s to 1 204 s] specified in Japan Regulations is applicable (See Figure A.1).

A.2.3 Test vehicle mass

Test vehicle mass at measuring running resistance and at measuring exhaust emissions on the chassis dynamometer shall be vehicle curb mass plus 110 kg.

A.3 Test

A.3.1 General

Preconditioning shall be performed on the chassis dynamometer after given road load setting. Then, the test procedure shall be carried out according to the test flow in Figure A.2 or A.3.

A.3.2 Cold start JC08 mode (JC08CM)

In the case of a cold start, the test starts immediately after the specified soaking procedure, see A.1. Test flow in Figure A.2 is applicable.

A.3.3 Hot start JC08 mode (JC08HM)

In the case of a hot start, the vehicle is under warmed-up condition. Test flow in Figure A.3 is applicable.

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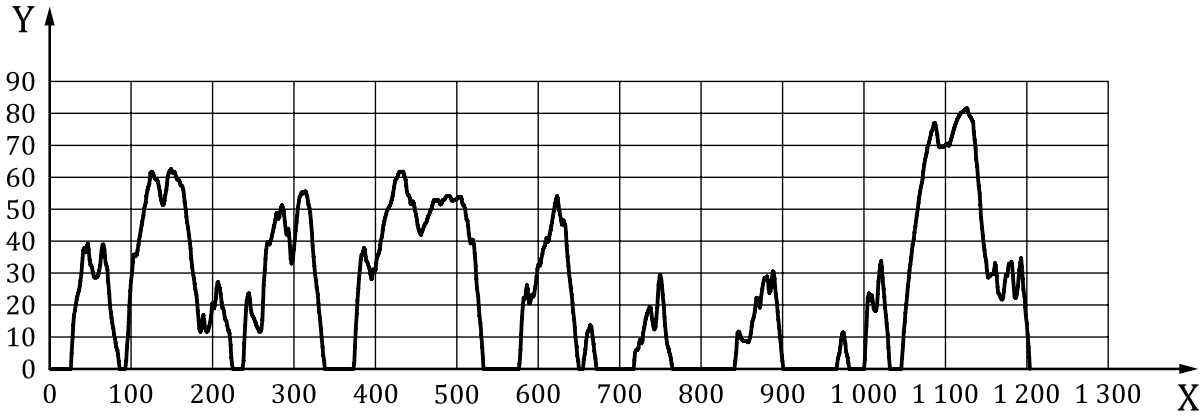
1) TRIAS is available for purchase from the Japan Automobile Standards Internationalization Center (http://www.jasic.org/e/08_publication/bb/20_handbook.htm).

Table A.1 — Test vehicle mass and standard value of equivalent inertia mass

Test vehicle mass (kg)	Standard value of equivalent inertia mass (kg)
– 480	455
481 – 540	510
541 – 595	570
596 – 650	625
651 – 710	680
711 – 765	740
766 – 850	800
851 – 965	910
966 – 1080	1 020
1 081 – 1 190	1 130
1 191 – 1 305	1 250
1 306 – 1 420	1 360
1 420 – 1 530	1 470
1 531 – 1 640	1 590
1 641 – 1 760	1 700
1 761 – 1 870	1 810
1 871 – 1 980	1 930
1 981 – 2 100	2 040
2 101 – 2 210	2 150
2 211 – 2 380	2 270
2 381 – 2 625	2 500
2 626 – 2 875	2 750
2 876 – 3 250	3 000
3 251 – 3 750	3 500
Continued in increments of 500 kg	Continued in increments of 500 kg



Key

X time(s)
Y speed(km/h)

Figure A.1 — JC08-mode driving schedule