MALAYSIAN STANDARD

MS 2413-3:2017

Electric motorcycles - Part 3: Performance test

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The Industry Standards Committee on Transport (ISC L) under whose authority this Malaysian Standard was developed, comprises representatives from the following organisations:

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Department of Environment
Department of Standards Malaysia
Jabatan Pengangkutan Jalan Malaysia
Malaysia Automotive Institute
Malaysian Automotive Association
Malaysian Automotive Components Parts Manufacturers Association
Malaysian Institute of Road Safety Research
Marine Department Malaysia
Ministry of Domestic Trade, Co-operatives and Consumerism
Ministry of International Trade and Industry
Motorcycle and Scooter Assemblers and Distributor Association of Malaysia
Motosikal dan Enjin Nasional Sdn Bhd
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Road Safety Department Malaysia
SIRIM Berhad (Secretariat)
Suruhanjaya Pengangkutan Awam Darat
Universiti Putra Malaysia
Universiti Teknologi Malaysia

The Technical Committee on Motorcycles which supervised the development of this Malaysian Standard consists of representatives from the following organisations:

Automobile Association of Malaysia

Department of Environment

Jabatan Pengangkutan Jalan Malaysia

Malaysia Motorcycle and Scooter Dealers Association

Malaysian Institute of Road Safety Research

Ministry of Domestic Trade, Co-operatives and Consumerism

Ministry of International Trade and Industry

Motorcycle and Scooter Assemblers and Distributor Association of Malaysia

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The Working Group on Electric Motorcycles which developed this Malaysian Standard consists of representatives from the following organisations:

Eclimo Sdn Bhd

Focus Applied Technologies Sdn Bhd

Jabatan Pengangkutan Jalan Malaysia

Malaysian Institute of Road Safety Research

Ministry of Energy, Green Technology and Water

Motorcycle and Scooter Assemblers and Distributor Association of Malaysia

Motosikal dan Enjin Nasional Sdn Bhd

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Voltron Malaysia Sdn Bhd

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Foreword

This Malaysian Standard was developed by the Working Group on Electric Motorcycles under the authority of the Industry Standards Committee on Road Vehicles.

MS 2413 consists of the following parts, under the general title *Electric motorcycles*:

Part 1: General

Part 2: Safety

Part 3: Performance test

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Electric motorcycles - Part 3: Performance test

1 Scope

This Malaysian Standard specifies the maximum speed, hill climbing, energy consumption and range test of electric motorcycles.

2 Normative references

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

IEC 61982, *Secondary batteries (except lithium) for the propulsion of electric road vehicles - Performance and endurance tests*

UN Regulation No. 40, *Uniform provisions concerning the approval of motor cycles equipped with a positive-ignition engine with regard to the emission of gaseous pollutants by the engine*

Motor Vehicle (Construction and Use) Rules, 1959, Jabatan Pengangkutan Jalan Malaysia

Garis Panduan Kelulusan Jenis Kenderaan VTA, Pindaan 2013*,* Jabatan Pengangkutan Jalan Malaysia

3 Test requirement

3.1 The test vehicle shall be run-in for at least 300 km following the published maintenance and operation procedures before testing.

3.2 Testing shall be performed with a traction battery which is less than one year old and has undergone less than 50 nominal charge or discharge cycles.

3.3 Before testing, vehicle shall be conditioned at 25 °C ± 5 °C for 8 h.

3.4 During testing, setting of vehicle lighting shall comply with *Motor Vehicle (Construction and Use) Rules,* 1959, Jabatan Pengangkutan Jalan Malaysia and the *Garis Panduan Kelulusan Jenis Kenderaan VTA, Pindaan* 2013*,* Jabatan Pengangkutan Jalan Malaysia.

4 Performance test method

4.1 In the case of a deviation between a road test and a chassis dynamometer test, the road test results should be used.

If several tests are to be performed, they shall be conducted in the following sequence:

a) maximum road speed test; and

b) hill climbing capability test.

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Battery should be fully charged before performing each test.

4.2 Maximum road speed test

4.2.1 Test requirement

The test road length shall be more than 200 m. The track shall have enough space to allow vehicle to stop and turn safely for bidirectional driving.

4.2.2 Test method

4.2.2.1 This test shall only be conducted on the road.

4.2.2.2 Electric motorcycle speeds are to be measured using a speed measurement device such as GPS or similar device. This device should be verified to be accurate within 1 km/h at 50 km/h nominal speed.

4.2.2.3 Before measuring the top speed, the vehicle shall be run for 6 km at a speed of 30 km/h.

4.2.2.4 Apply full throttle, and allow the vehicle to reach full speed. Maintain the maximum speed within the test area. Measure the time taken (record as t_1) for the vehicle to pass a distance L within the test area.

4.2.2.5 Carry out the same test using the same road in the opposite direction and record the time to pass the same distance L as t_2. One cycle is considered a single run in each direction. This test shall be performed for 3 cycles, i.e. 6 runs.

4.2.2.6 The velocity v of each cycle shall be calculated as follows:

$$v = 3.6\ L/t$$

where

v is the average speed (km/h);

L is the length of the test area (m); and

t is the average go and return time, $(t_1 + t_2)/2$ (s).

NOTE. Other methods of velocity measurement are acceptable provided they are accurate to within ± 1 % of the above technique.

4.2.2.7 The distance covered and the time taken to cover that distance shall be determined with sufficient accuracy for the error in the maximum speed does not exceed 1 % of the measured value.

4.2.2.8 The maximum and minimum value for the average maximum speed shall not be more than 3 % of the lowest measured maximum speed or else the test shall be repeated.

4.2.2.9 The final maximum speed is by calculating the average of the three calculated velocities and rounded to the nearest 0.1 km/h.

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4.2.3 All pertinent data shall be recorded in the report form.

4.3 Hill climbing capability test

4.3.1 Test requirement

4.3.1.1 Before measuring the top speed, the vehicle shall be run for 6 km at a speed of 30 km/h.

4.3.1.2 Test shall be performed on a well paved asphalt or concrete surface free of water or debris. The test surface shall have a slip-proof surface with a test area of 10 m in length with consistent 20 % gradient.

4.3.2 Test method

4.3.2.1 Vehicle shall be tested at additional mass with a minimum of 75 kg for every rider/passenger as declared by the manufacturer.

4.3.2.2 Use the lowest gear to conduct the test.

4.3.2.3 Vehicle shall be placed facing up the test slope and held at position by the braking system at the beginning of the 10 m section.

4.3.2.4 The throttle should be opened as the brakes are simultaneously released.

4.3.2.5 Any reverse motion of the vehicle shall be recorded as the 'roll-back' distance.

4.3.2.6 The vehicle shall then accelerate forward passing the 10 m test section.

4.3.2.7 Time to traverse the 10 m section shall be recorded.

4.3.2.8 The vehicle is considered to have failed the test if any of the following conditions occur:

a) the vehicle rolls back more than 0.15 m before accelerating forward;

b) the vehicle fails to accelerate forward;

c) the vehicle moves so slowly that the rider is required to place his feet on the ground to stabilise the vehicle within the 10 m test section; or

d) the total time from application of throttle to passing the 10 m mark exceeds 10 s.

4.4 Energy consumption and range test procedure

In general the tolerances for various parameters should be maintained as per Table 1.

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Table 1. Tolerance for various parameters

Measurement parameter	Unit	Resolution	Tolerance
Time	s	0.1 s	± 0.1 s
Range	m	1 m	± 0.1 %
Temperature	ºC	1 ºC	± 1 ºC
Speed	km/h	0.1 km/h	± 1 %
Mass	kg	1 kg	± 0.5 %
Energy	Wh	0.2 Wh	0.2 Wh

4.4.1 Pre-test vehicle conditioning

The vehicle shall comply with *Motor Vehicle (Construction and Use) Rules,* 1959, Jabatan Pengangkutan Jalan Malaysia and the *Garis Panduan Kelulusan Jenis Kenderaan VTA, Pindaan* 2013*,* Jabatan Pengangkutan Jalan Malaysia.

The vehicle shall be operated for at least 300 km prior to testing.

4.4.2 Test conditions

Environmental test conditions shall be maintained throughout the test duration as follows:

a) during testing the temperature shall be at 35 ºC ± 5 ºC;

b) humidity shall be less than 90 % (non-condensing); and

c) average wind speed shall be below 3 m/s, with the maximum gust not to exceed 5 m/s.

Vehicle shall be tested at additional mass with a minimum of 75 kg for every rider/passenger and test equipment as declared by the manufacturer.

During testing the vehicle rider shall maintain normal riding posture.

The road surface shall be of smooth asphalt or concrete free of holes, debris or water.

Vehicle lights shall be illuminated as per applicable *Motor Vehicle (Construction and Use) Rules,* 1959, Jabatan Pengangkutan Jalan Malaysia and the *Garis Panduan Kelulusan Jenis Kenderaan VTA,* Jabatan Pengangkutan Jalan Malaysia*.*

4.4.3 Energy consumption measurement methodology

An electrical power measurement system shall be inserted between the utility mains and the battery charger for measurement of energy consumption in units of watt-hour (Wh) during charging. A watt-hour meter shall be used to measure the total power consumption for the duration of the charging until fully charged condition. The fully charged battery shall be used to test vehicle. The test shall be carried out until the indicator shows the final cut out voltage for recharging the battery. The same charging method shall be used for this recharging. The energy consumed during this charging shall be considered as the power consumed during the tests. The power consumed shall be stated in terms of AC power and Ah.

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The energy consumed during battery charging shall be measured in accordance with IEC 61982.

The vehicle battery shall be fully charged. The charging of the battery shall comply with 4.4.5 of this standard and IEC 61982. The method used shall be stated in the test report.

4.4.4 Test method

The range and energy consumption test shall be performed in two tests as follows:

a) test 1 for driving cycle test; and

b) test 2 for constant speed test.

4.4.5 Pre-test discharge-recharge

Before each of the tests the battery should be fully discharged according to the following procedure:

a) operate the vehicle at 70 % of the maximum speed until:

   i) for vehicles with a stop indicator, the vehicle instrument display gives indication to stop operation; or

   ii) for vehicles without a stop indicator, the vehicle's speed drops below 65 % of the vehicle maximum speed with 100 % throttle;

b) following the discharge, the battery shall be fully recharged using the vehicle's charger; and

c) the tests should be performed within 1 h to 4 h after charging.

4.4.6 Driving cycle test

The vehicle shall be operated following the velocity pattern as specified in UN Regulation No. 40.

The test pattern shall be repeated until any of the following conditions occurs:

a) the vehicles instrumentation indicates that the operator should stop the vehicle;

b) the vehicle should no longer attain the designated speed within 2 km/h; and

c) the designated speed range cannot be achieved from more than 4 s continuously.

Upon any of the above conditions the test is considered finished.

Record the total test distance travelled in kilometers (km) and total time taken in minutes (min) as well as the average and maximum speeds.

Within 2 h of the test termination recharge the battery measuring the energy consumption according to 4.4.3.

Record the energy consumed during battery charging.

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The driving cycle energy consumption C_1 is calculated via:

$$C_1 = \frac{E}{D_1}$$

where

E is energy consumed during charging (Wh); and

D_1 is distance travelled for driving cycle test (km).

4.4.7 Constant speed test

The battery should be fully discharged and recharged according to 4.4.5 of this standard.

The vehicle shall be operated at 70 % ± 2 km/h of its maximum speed as measured in the maximum speed test.

The test vehicle shall be operated until any of the following conditions occurs:

a) the vehicles instrumentation indicates that the operator should stop the vehicle; or

b) the vehicle can no longer maintain at least 65 % of the maximum speed.

Upon either of the above conditions the test is considered finished.

Record the total test distance travelled in kilometres (km) and total time taken in minutes (min) as well as the average and maximum speeds.

Within 2 h of the test, recharge the battery and measure the energy consumption according to 4.4.3.

Record the energy consumed during battery charging.

The constant speed energy consumption C_2 is calculated via:

$$C_2 = \frac{E}{D_2}$$

where

E is energy consumed during charging (Wh); and

D_2 is distance travelled for constant speed test (km).

4.4.8 Weighted average energy consumption calculation

Weighted average energy consumption C_{avg} is then calculated via:

$$C_{avg} = (0.6 \times C_1) + (0.4 \times C_2)$$

A test report listing all recorded data should be saved for each test.

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Acknowledgements

Members of Technical Committee on Motorcycles

Dato' Syed Mohammad Aidid (Chairman)	Motorcycle and Scooter Assemblers and Distributor Association of Malaysia
Mr Muhaimin Mat Salleh (Secretary)	SIRIM Berhad
Mr Ahmed Ismail Haji Amin	Automobile Association of Malaysia
Mr Mohd Famey Yusoff	Department of Environment
Mr Mohd Sharulnizam Sarip/ Mr Azizul Abdul Aziz	Jabatan Pengangkutan Jalan Malaysia
Mr Hong Dat Yong	Malaysia Motorcycle and Scooter Dealers Association
Prof Dr Wong Shaw Voon	Malaysian Institute of Road Safety Research
Ms Hasliza Khasim	Ministry of Domestic Trade, Co-operatives and Consumerism
Mr Ravi CK Raman	Ministry of International Trade and Industry
Mr Tajudin Loman	Motorcycle and Scooter Assemblers and Distributor Association of Malaysia
DSP Zaba Abd Rahman	Polis Diraja Malaysia
Haji Yacob Ismail	PUSPAKOM Sdn Bhd
Mr Raymond Teoh Joo Han	Road Safety Department Malaysia
Mr Mohd Faizar Mustafa	SIRIM QAS International Sdn Bhd

Members of Working Group on Electric Motorcycle

Dr Horizon Walker Gitano - Briggs (Chairman)	Focus Applied Technologies Sdn Bhd
Mr Muhaimin Mat Salleh (Secretary)	SIRIM Berhad
Mr Liew Chung Peng	Eclimo Sdn Bhd
Mr Mohd Sharulnizam Sarip/ Mr Azizul Abdul Aziz	Jabatan Pengangkutan Jalan Malaysia
Mr Azhar Hamzah	Malaysian Institute of Road Safety Research
Ms Nur Ayuni Zolkifli	Ministry of Energy, Green Technology and Water
Mr Tajudin Loman	Motorcycle and Scooter Assemblers and Distributor Association of Malaysia
Mr Alfian Abdul Wahab/ Mr Nir Azhar Abdul Aziz	Motosikal dan Enjin Nasional Sdn Bhd
Mr Ahmad Sabandi Othman	Roda Prestasi Sdn Bhd
Mr Zulkifli Zahari	SIRIM Berhad (Automotive Development Centre)
Mr Ravindran Chinathamby	SIRIM QAS International Sdn Bhd (Electrical and Electronic Section)
Mr Mohd Faizar Mustafa	SIRIM QAS International Sdn Bhd (Mechanical Section)
Mr Azizul Azman Jaafar	SIRIM QAS International Sdn Bhd (RF and EMC Testing Section)
Mr Tan You Soon	Voltron Malaysia Sdn Bhd

Co-opted member

Mr Afifuddin Omar	IDIADA Malaysia

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