

INTERNATIONAL STANDARD

NORME INTERNATIONALE

E- Transporters –

Part 3-1: Performance test method for total run time of e-scooters with consideration to environmental conditions of actual use

E- Transporteurs –

Partie 3-1: Méthode d'essai de performance du temps de fonctionnement total d'une trottinette électrique en prenant en considération les conditions de température correspondant à une utilisation réelle

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

E-TRANSPORTERS –**Part 3-1: Performance test method for the total run time of an e-scooter
with consideration of temperature conditions of actual use**

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IEC 63281-3 has been prepared by IEC technical committee 125: e-Transporters. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
125/92/FDIS	125/99/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 63281 series, published under the general title *e-Transporters*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

E-TRANSPORTERS –

Part 3-1: Performance test method for the total run time of an e-scooter with consideration of temperature conditions of actual use

1 Scope

This document specifies the test method for the total run time of an e-scooter for single-person transportation with consideration of the temperature conditions of actual use when the e-scooter is operated by the user in various temperatures for use on the road or in public spaces.

This document does not cover e-scooters for persons with disabilities or elderly persons. Also, this document excludes cargo e-scooters.

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.

IEC 62301, *Household electrical appliances – Measurement of standby power*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

e-scooter

electrically powered device for single-person transportation, consisting of a footboard mounted on two aligned wheels, a steering handlebar, and no seat

3.2

battery

one or more cells fitted with devices necessary for use, for example case, terminals, marking and protective devices

[SOURCE: IEC 60050-482:2004, 482-01-04]

3.3

end-of-discharge voltage

specified voltage of a battery at which the battery discharge is terminated

[SOURCE: IEC 60050-482:2004, 482-03-30, modified – Synonyms "final voltage", "cut-off voltage" and "end-point voltage" have been omitted.]

3.4

end-of-charge voltage

voltage attained at the end of a charging step, at a specified constant current

Note 1 to entry: The end-of-charge voltage may be used to initiate the termination of the charge process.

[SOURCE: IEC 60050-482:2004, 482-05-55]

3.5

speed control device

device that sets the speed and/or the motion according to the user's intention

3.6

data monitoring system

test device used for measuring total run time of an e-scooter by recording the amount of power measured using a power analyser to run time

3.7

single charge run time

continuous run time of an electrically powered device starting from a fully charged battery until the battery reaches discharged status resulting in non-operation of the device

3.8

load box

box designed to apply load to the centre of the footboard of the e-scooter

3.9

roller test rig

test rig installed with rollers to conduct driving test of e-scooter which is fixed to the rig

3.10

steering column

bar with a handle mounted on top of the front wheel at a determined caster angle to steer the front wheel of the e-scooter

4 Standard atmospheric conditions

The test shall be conducted in the standard atmospheric conditions of IEC 60068-1:2013, 4.3 unless otherwise agreed by the manufacturer and test provider. If there is a change in atmospheric conditions, the relevant information shall be recorded in the test report.

5 Specimen preparation

5.1 General

The test specimen shall be prepared with the following considerations to measure the total single charge run time of the e-scooter.

5.2 Test specimen

The test specimen shall be tested in accordance with the manufacturer's user manual as a completely assembled product or in its original form as provided by the manufacturer. If changes are made to the specimen, consultation with the manufacturer is required before conducting the test. To obtain reliable test data, it is recommended to test with at least three test specimens. Additional tests may be conducted for higher accuracy as required. However, if the test specimen is not sufficient, proceed with the test and indicate the number of test specimens used.

5.3 Charging of the battery

The battery shall be charged to the end-of-charge voltage in accordance with the manufacturer's instructions.

5.4 Applied load

The mass used for the test should be the rated load announced by the manufacturer (75 ± 2) kg, which is the assumed weight of the driver riding the e-scooter. However, the mass may be adjusted for the test by consultation and agreement with the manufacturer. If there is a change in load mass, the relevant information shall be recorded in the test report.

5.5 Adjustment of maximum speed

The test specimen is evaluated based on the maximum rated speed provided by the manufacturer, as the run time of the e-scooter can be the shortest when operated at maximum speed. The speed control device shall be adjusted to keep the speed controller at its maximum position. If necessary, the maximum speed for the test may be determined through consultation with the manufacturer. The speed for the test shall be specified on the test protocol and recorded speed over the run time. Set to maximum speed, and allow the speed to reduce due to low battery.

5.6 Autonomy at fixed speed

The test specimen is evaluated based on the fixed speed at ($15 \pm 1,5$) km/h. The speed control device shall be used to maintain this speed until the e-scooter battery has discharged or until the above speed drops to below 90 % of the initial value. The speed for the test shall be recorded over the run time.

5.7 End-of-discharge voltage

The e-scooter shall be discharged to that specified voltage of a battery at which the battery discharge is terminated.

6 Test method

6.1 General

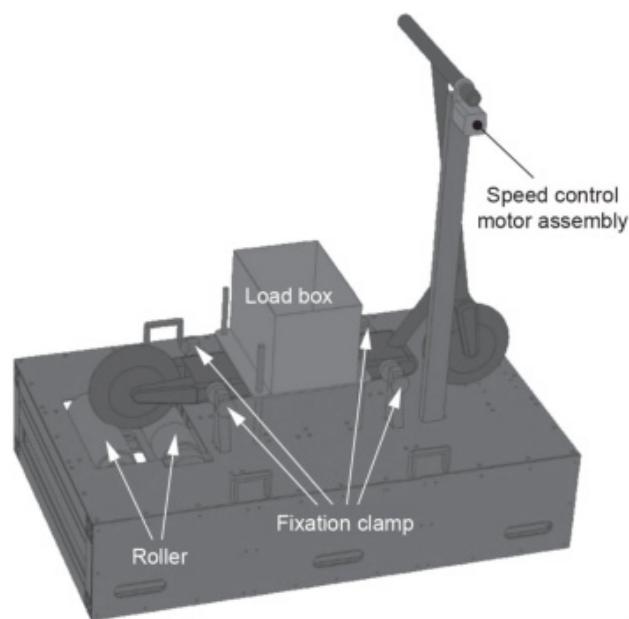
This test method aims to determine the amount of time the e-scooter can be used by the driver. E-scooters are used under various temperature conditions, which are factors that affect the total run time. The test method for measuring the total run time of the e-scooter shall meet the specified temperature conditions as set out in 6.2 due to the fact that the total run time may vary depending on such conditions.

6.2 Test equipment

6.2.1 Total run time measurement equipment

The following characteristics of the test bench can be used as an informative example. The specifications of the equipment for measuring driving power consumption of the e-scooter up to 50 V are as follows:

- As shown in Figure 1, the measurement equipment can be composed of a roller test rig equipped with fixation clamps, load box, speed control device, power analyser and data monitoring system.
- The roller test rig can be installed with rollers for the fixed driving test of an e-scooter with an approximate wheelbase (distance between the front and rear axles) of 1 200 mm and a height of 1 200 mm.
- The roller test rig can be made of non-flammable, corrosion-resistant metal material and height adjustable so that the steering column of the e-scooter is fixed horizontally to the rig.
- The roller may be of a metal material (e.g., SUS304) of not less than 113 mm in diameter, $(7,2 \pm 0,2)$ kg in weight, and approximately 300 mm in length, and two rollers can be used to prevent dislocation of the e-scooter. The distance between the central axes of the two rollers is 180 mm and may be changed according to the wheel size of the e-scooter to be tested. See Figure 2 for details of roller specification. The roller test rig can be equipped with fixation clamps that do not affect the load and that fix the e-scooter onto the rig.
- The roller test rig can be equipped with a load box and fixation clamps capable of loading and fixing a vertical load of (75 ± 2) kg to the centre of the footboard of the e-scooter.
- For the initial driving of an e-scooter, one roller needs a drive mechanism and a controller, including a clutch that is disconnected from the motor after driving, connected to a motor of 300 W or more.
- The roller test rig can be equipped with a sub-motor and controller to operate the accelerator on the steering column to start the e-scooter and continue its operation.
- A power analyser in accordance with IEC 62301 shall be used to measure battery power consumption and run time in real time.
- A data monitoring system shall be connected to the power analyser to store data on run time.



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Figure 1 – Example of total run time test equipment

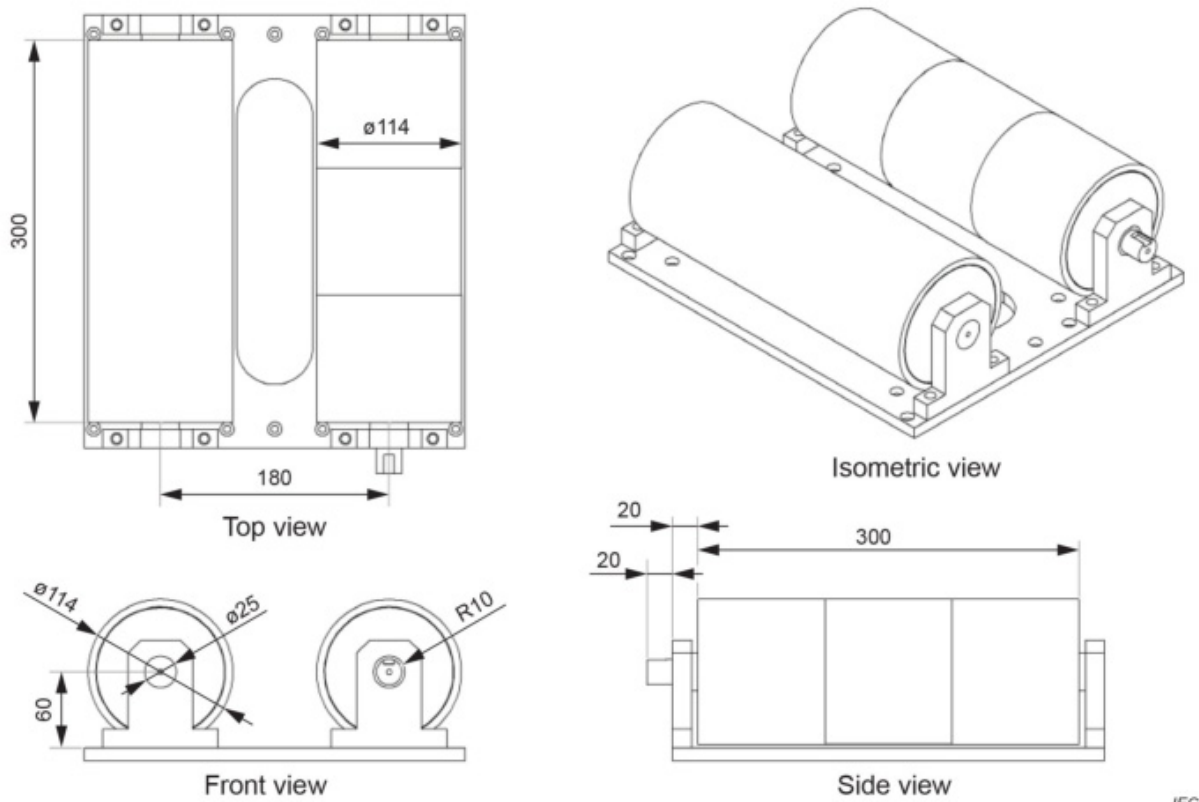


Figure 2 – Detail roller specification

- If necessary, the test bench can be calibrated in the manner specified in ISO 28981 to eliminate losses (rolling resistance, coefficient of inertia, etc.) caused by friction on the bench.

6.2.2 Temperature test chamber

The specifications of the temperature chamber in which to test the e-scooter in the necessary temperature conditions are as follows:

- The temperature test chamber shall meet the requirements of IEC 60068-2-1 and IEC 60068-2-2.
- The size of the temperature test chamber shall be large enough for the total run time measurement equipment.
- A wiring connector shall be used to connect the battery test probe of the e-scooter to an external voltmeter.
- The chamber shall be made of non-flammable and corrosion-resistant material and it shall be isolated.
- The chamber shall be equipped with an air intake and exhaust system that is connected to the fire detection sensor, so that smoke can be discharged in case of fire.
- The chamber shall be equipped with a data monitoring system that can measure the internal temperature of the chamber in real time with an accuracy of ± 2 °C.
- The chamber shall be equipped such that under standard atmospheric conditions for measurements and test (see IEC 60068-1) with an air velocity less than 0,2 m/s, the specimen shall be electrically loaded as specified for the low and high temperatures at which the test is to be carried out.

- The chamber shall be equipped such that three categories of temperature, namely high, normal and low temperatures, may be set and maintained based on the e-scooter user temperature as shown as an example in Table 1. Temperature test conditions may be changed depending on each country's environment and the request by the manufacturer, and unless there is any special requirement, Table 1 shall be followed.
- If there is a change in temperature test conditions, the relevant information shall be recorded in the test report.

Table 1 – Example of temperature test conditions

Condition	High	Normal	Low
Temperature	$(40 \pm 2) ^\circ\text{C}$	$(23 \pm 2) ^\circ\text{C}$	$(-20 \pm 2) ^\circ\text{C}$

6.3 Test procedure

Prepare and perform the test according to the following procedure, referring to Figure 3.

Assemble all operating devices and components according to the user manual provided by the e-scooter manufacturer. Check whether each function of the e-scooter operates normally without any problems.

After verifying that the test specimen is functioning without any problems, turn off the power of the product and start charging it according to the user manual provided by the manufacturer. The specimen shall be charged at $(23 \pm 5) ^\circ\text{C}$. The charger provided by the manufacturer shall be used, and no other charger shall be used. As the voltage value of a fully charged battery differs by product, the voltage value for full charge cannot be predetermined. The specimen shall be deemed fully charged when the voltage value measured using the data monitoring system becomes stable without variation.

Determine which temperature testing conditions shall be applied based on the temperature presented by the manufacturer as the temperature for actual use of the e-scooter. If the temperature presented by the manufacturer complies with the three categories given as an example in Table 1, conduct all three tests. If necessary, the test may be performed in conditions determined by the manufacturer. The chamber shall be operated according to the conditions set out within $\pm 2 ^\circ\text{C}$, to prepare for the test.

Fix the e-scooter to the run time measurement equipment using ropes and bolts so that the e-scooter is not displaced during the test.

Install the load box on to the e-scooter and place the determined load by adding load weights. The applied load should be $(75 \pm 2) \text{ kg}$, and the applied load may vary depending on the manufacturer's request. If there is a change in load mass, the relevant information shall be recorded in the test report.

Place the run time measurement equipment with the e-scooter fixed to the equipment into the chamber. Then operate the chamber until the target temperature is reached to check whether the desired temperature has been reached, and check the voltage value of the fully charged battery using the data monitoring system. After checking whether the temperature is maintained for the test, determine the initial voltage value and record the voltage value and time.

Use the speed control device to set the speed at the maximum speed specified by the manufacturer, and operate the e-scooter, while monitoring the time (T_s). Maintain the speed and operate the e-scooter until the battery is discharged (e-scooter is at complete stop). Record the voltage values during the test using the data monitoring system.

When the battery is discharged, the test is completed, and the time of the battery discharge is recorded (T_e). The time of starting and completing the test shall be recorded using the data monitoring system. Calculate the total run time using the following equation (R).

$$R = T_e - T_s \quad (1)$$

where

R is the total run time at which the specimen is operated temperature test condition, in seconds (s)

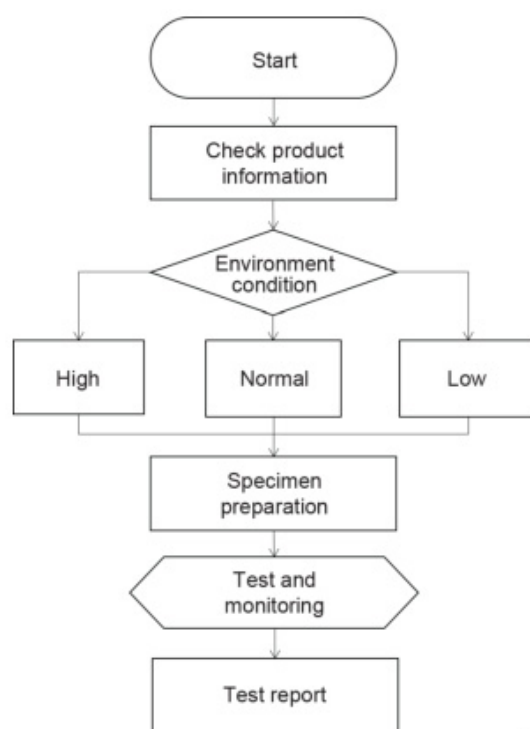
T_e is the time at which the specimen is completely discharged, in seconds (s);

T_s is the time at which the specimen is fully charged and the test starts, in seconds (s).

NOTE An example of the test result would be total run time $((23 \pm 2) ^\circ\text{C}, \text{Normal}) = 1 \text{ h } 20 \text{ m } 35 \text{ s}$.

When the test is completed, stop the operation of the chamber and remove the total run time measurement equipment and e-scooter from the chamber.

Check the condition of the e-scooter to see if there are any abnormalities such as deformation of the product and expansion of the battery area.



IEC

Figure 3 – Flow chart of the test method

7 Test result

The test report of all tests based on this document shall include the following information:

- a) the number and date of issue of the applied International Standard;
- b) identification of the e-scooter model number and battery capacity;
- c) normal operating conditions according to user manual;
- d) temperature conditions and speed applied to the test;
- e) end-of-charged voltage value;
- f) end-of-discharged voltage value;
- g) amount of time taken from charged state to discharged state.

Bibliography

ISO 28981, *Mopeds – Methods for setting the running resistance on a chassis dynamometer*

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