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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Wearable electronic devices and technologies – Part 402-2: Performance measurement of fitness wearables – Step counting

Technologies et dispositifs électroniques prêts-à-porter – Partie 402-2: Mesure des performances des dispositifs prêts-à-porter d'activité physique – Podomètres

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WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES –

Part 402-2: Performance measurement of fitness wearables – Step counting

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

Draft	Report on voting
124/249/FDIS	124/262/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.

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INTRODUCTION

The step counting feature is a common functionality in wearable devices. The accurate measurement and reporting of the step count is an important factor in the acceptance by consumers of that step count. Data from wearable devices may be useful in helping to improve the health and well-being of consumers that use wearable devices. The usability of the data to improve health outcomes is dependent on the reliability of the data to facilitate their acceptance by consumers and health improvement.

This document defines and provides standard test methods for evaluating the performance and reliability of step counting in wearable devices. The benefit of using this document is that it provides a method to compare the step counting function of a wearable device against the actual step count, which can provide manufacturers with a method to improve the step count functionality of their devices.

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WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES –

Part 402-2: Performance measurement of fitness wearables – Step counting

1 Scope

This part of IEC 63203 specifies test methods for measuring and evaluating the performance, reliability, and accuracy of the step counting feature in any wearable device that can count steps (e.g. activity and fitness trackers, smart bands, smart shoes, and smart insoles).

These standard test methods exclude the evaluation of data associated with travel distance or calorie consumption.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 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

3.1.1
body mass index
BMI
value derived from the mass (weight in kilograms) and height (in metres) of an individual, defined as the body mass divided by the square of the body length, expressed in units of kg/m^2, calculated by the following formula:

$$\text{BMI} = m/l^2$$

where

m is the mass in kg;

l is the length in m

[SOURCE: ISO 20342-1:2022, 3.7]

3.1.2
investigator
qualified person responsible for testing at a testing site

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3.1.3
jogging
raising and lowering each foot, with a period of time where neither foot is in contact with the ground, with less intensity than running

3.1.4
running
action of moving faster than jogging with more vigorous intensity than jogging never having both feet on the ground simultaneously with the express purpose of locomotion

3.1.5
step
action or movement of lifting and then placing one foot in front of the other during walking or running with the goal of locomotion

3.1.6
subject
person wearing a DUT

3.1.7
treadmill
training equipment with a running surface on which walking or running activity can take place, where the feet are free to leave the running surface

[SOURCE: ISO 20957-6:2021, 3.1]

3.1.8
walking
action of moving at a regular pace by lifting and setting down each foot in turn, never having both feet off the ground simultaneously with the express purpose of locomotion

3.2 Abbreviated terms

DUT	device under test
MAPE	mean absolute percentage error
PAR-Q	Physical Activity Readiness Questionnaire
REF	reference

4 Test methods and procedures

4.1 General

A subject shall either walk, jog, or run on a motor-driven treadmill at a pre-set speed while the activity is video-recorded. The recorded video shall be analysed by two investigators to acquire the confirmed actual step counts. See Figure 1.

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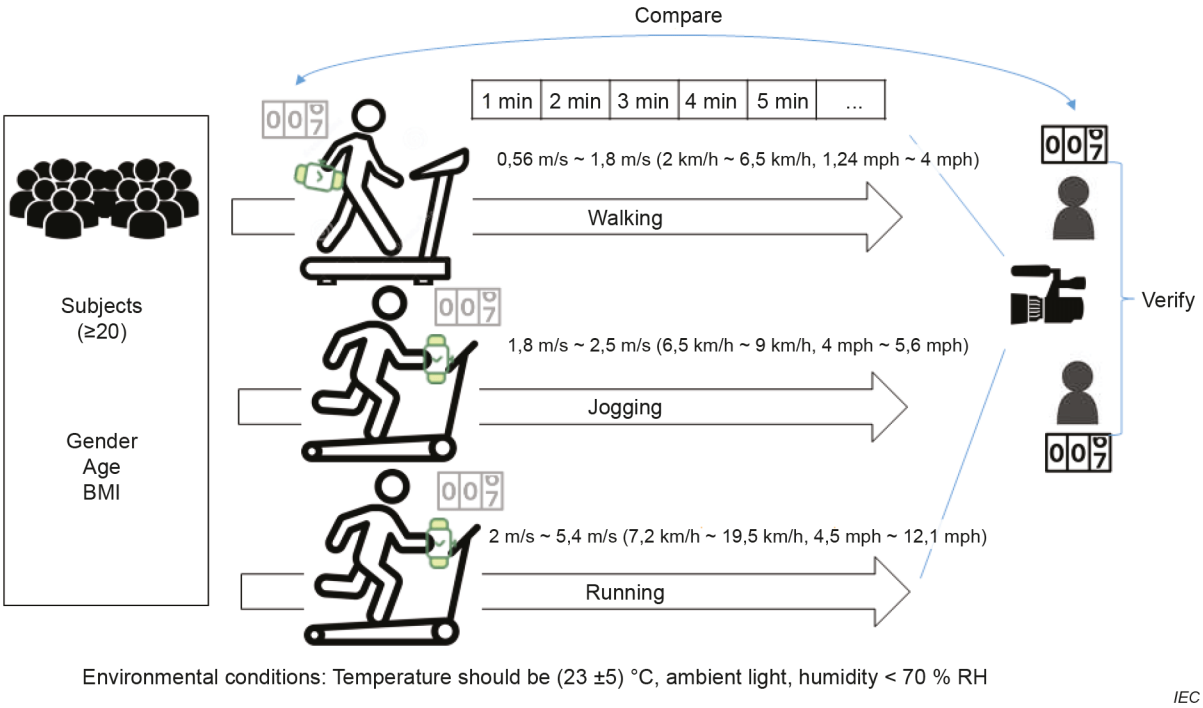

Figure 1 – Overview of test environment and methods

4.2 Apparatus

4.2.1 General

The usual laboratory apparatus and, in particular, the following apparatus described in 4.2.2 and 4.2.3 shall be used.

4.2.2 Treadmill

A motorized treadmill shall be used for testing.

A motorized treadmill should be capable of adjusting the speed from 0,56 m/s to 5,4 m/s and tilt to 0° for at least 5 min.

4.2.3 Video recorder

A video recorder is configured securely and properly to capture the entire view of the test area for each test. A video recorder should be affixed to a device that ensures it remains stationary during the test (e.g. tripod, stand).

A video recorder should provide recording and monitoring capability, should be able to record for at least 5 min, and should have sufficient camera angle and sensitivity to record the motion of feet.

The recorded scene shall include the entire body of the subject and the treadmill without obstructions. The video frame shall clearly show all the subject's foot strikes on the treadmill during the test.

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4.3 Preparation

4.3.1 Subject requirements

Subjects shall have no medical conditions that restrict them from completing the test. Prior to testing, subjects shall complete a Physical Activity Readiness Questionnaire (PAR-Q) to determine their eligibility to be included in testing. Any subject that answers "yes" to one or more questions of the PAR-Q shall be excluded. See Annex A.

Clothing or shoes worn by the subject under test should not obstruct the ability to count steps.

Subjects shall not hold onto the treadmill during walking, jogging, or running tests on the treadmill. The subjects' arms shall be able to freely swing and move during testing.

For an effective test design, it is important to select test participants using the PAR-Q.

Unexpected errors can occur with a specific test subject resulting in unusual test results, in which case additional subjects should be considered.

Any excluded test results can be explained in item 9) in the test report.

4.3.2 Number of subjects

Testing shall include at least 20 subjects.

4.3.3 Gender – Balance

At least 40 % of subjects shall be male. At least 40 % of subjects shall be female.

4.3.4 Age

All subjects shall be at least 18 years of age and not older than 69 years of age.

4.3.5 BMI – Range

The following percentage of subjects should be within the BMI range specified:

– at least 10 % of subjects should have a BMI below 20 kg/m^2 and
– at least 10 % of subjects should have a BMI above 25 kg/m^2.

The height and weight of each subject are measured with the subject wearing light clothing and without shoes. The BMI is calculated from these height and weight measurements.

4.3.6 Wearing position of DUT

For wrist-worn devices, all subjects should indicate on which wrist they prefer wearing the DUT (i.e. left or right). Other DUTs should be worn following the manufacturer's recommendations.

The DUT shall be worn in the recommended position provided by the manufacturer. The investigator shall assist the subject in the proper placement of the DUT according to the device manufacturer's instructions. This information shall be recorded in the test report.

4.3.7 Balanced speed conditions

For the testing of each activity, the balanced distribution of speed conditions should be considered. See Annex B.

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4.4 Testing conditions

4.4.1 Temperature

The temperature should be 23 °C ± 5 °C, which is typical of indoor environments. See Annex C.

4.4.2 Ambient light

The ambient light levels in the testing area should consist of typical lighting conditions for indoor environments. See Annex C.

4.4.3 Humidity

Relative humidity conditions in the test room should be less than 70 % RH.

4.4.4 Apparatus setting

4.4.4.1 Treadmill

4.4.4.1.1 General

The treadmill shall be reset to its initial power-up state before the test.

4.4.4.1.2 Speed and slope conditions

The treadmill shall be set to the following speed and slope conditions based on the test being performed. Table 1 shows the minimum speed condition and the maximum speed condition for each activity under various speed units. See Annex B.

– Walking: minimum speed 0,56 m/s to maximum speed 1,8 m/s at minimal incline but not less than 0 % (i.e. between 0 % to 10 %). The test speed for each subject should be chosen within the walking speed condition range considering the subject's physical activity readiness.
– Jogging: minimum speed 1,8 m/s to maximum speed 2,5 m/s at minimal incline but not less than 0 % (i.e. between 0 % to 10 %). The test speed for each subject should be chosen within the jogging speed condition range considering the subject's physical activity readiness.
– Running: minimum speed 2,0 m/s to maximum speed 5,4 m/s at minimal incline but not less than 0 % (i.e. between 0 % to 10 %). The test speed for each subject should be chosen within the running speed condition range considering the subject's physical activity readiness.

Table 1 – Conversion table of the speed unit

	m/s		km/h		mph	
	Min.	Max.	Min.	Max.	Min.	Max.
Walking	0,56	1,8	2	6,5	1,2	4,0
Jogging	1,8	2,5	6,5	9	4,0	5,6
Running	2	5,4	7,2	19,5	4,5	12,1

4.4.4.2 Video recorder

The video recording device shall be set up with a full view of the testing area.

The video frame shall clearly show all the subject's foot strikes on the treadmill during the test.

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