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Edition 1.0 2020-10

INTERNATIONAL STANDARD

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Surface cleaning appliances – Part 7: Dry-cleaning robots for household or similar use – Methods for measuring the performance

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Surface cleaning appliances – Part 7: Dry-cleaning robots for household or similar use – Methods for measuring the performance

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SURFACE CLEANING APPLIANCES –

Part 7: Dry-cleaning robots for household or similar use – Methods for measuring the performance

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC/ASTM 62285-7 has been prepared by subcommittee 59F: Surface cleaning appliances, of IEC technical committee 59: Performance of household and similar electrical appliances, in co-operation with ASTM Committee F11: Vacuum cleaners, under the IEC/ASTM Dual Logo Agreement.

It is published as a dual logo standard.

This first edition of IEC/ASTM 62885-7 cancels and replaces IEC 62929:2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 62929:2014:

a) the box test has been cancelled;
b) the set of straight-line tests have been extended to contain also tests on removal of different kinds of debris both from hard floors and carpets;
c) the set of straight-line tests also contains a test on the removal of fibres from carpets;

d) as a miscellaneous test, a method for the determination of energy consumption has been added;

e) a separate clause on test material and equipment has been added.

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

FDIS	Report on voting
59F/393/FDIS	59F/401/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

In this standard, the following print types are used:

– terms defined in Clause 3: **bold type**.

A list of all parts in the IEC 62885 series, published under the general title *Surface cleaning appliances*, 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 "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

In addition to the performance measurement methods that are included in this International Standard, a few more performance items have been reviewed and considered. The list of the performance items that have been discussed over time but have not yet been included comprises corner/edge dust pick-up, docking, fall-off prevention, and dust re-emissions.

The performance items that have been left out in this edition will be continuously reviewed and will soon be included in future editions of this document.

SURFACE CLEANING APPLIANCES –

Part 7: Dry-cleaning robots for household or similar use – Methods for measuring the performance

1 Scope

This part of IEC 62885 is applicable to **dry-cleaning robots** for household use or under conditions similar to those in households.

The purpose of this document is to specify the essential performance characteristics of **dry-cleaning robots** that are of interest to users and to describe methods for measuring these characteristics.

This document is neither concerned with safety requirements nor with performance requirements.

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 TS 62885-1, *Surface cleaning appliances – Part 1: General requirements on test material and test equipment*

IEC 62885-2:2016, *Surface cleaning appliances – Part 2: Dry vacuum cleaners for household or similar use – Methods for measuring the performance*

IEC 60704-1, *Household and similar electrical appliances –Test code for the determination of airborne acoustical noise – Part 1: General requirements*

IEC 60704-2-17, *Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 2-17: Particular requirements for dry cleaning robots*

ISO 554, *Standard atmospheres for conditioning and/or testing – Specifications*

ISO 2813, *Paints and varnishes – Determination of gloss value at 20 degrees, 60 degrees and 85 degrees*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62885-2 and the following apply.

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

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

3.1
cleaning robot
automatic battery-powered cleaner
automatic floor cleaner that operates autonomously without human intervention within a defined perimeter

Note 1 to entry: The **cleaning robot** consists of a mobile part and may have a **docking station** and/or other accessories to assist its operation.

3.2
dry cleaning robot
cleaning robot that is intended to remove only non-liquid material from the floor by means other than with the aid of solutions or liquids

Note 1 to entry: Typical means of cleaning include vacuum, brush(es), pad(s) and duster.

3.3
robot cleaning head
cleaning head
air intake nozzle at the bottom of the **cleaning robot**

Note 1 to entry: This does not include **side brush**(**es**).

3.4
width of robot cleaning head
W
width of the air intake nozzle in the direction of forward travel

3.5
docking station
base unit
unit that can provide manual or automatic battery charging facilities, dust removal from the robot, data processing facility or other robot support functions

Note 1 to entry: For some robots, the docking station could come in the form of an external power supply.

3.6
pose tracking system
PTS
measurement system which enables the tracking of the **cleaning robot**'s position and orientation

3.7
dust receptacle
container inside of the **cleaning robot** used to hold the collected dust

3.8
test instance
entirety or superset of all trials of all samples to be measured for a single **cleaning robot** model

3.9
trial
single instance of a performance measurement carried out under identical conditions that can be repeated multiple times

3.10
run
subset of a **trial** where one or more factors affecting the test results is (are) changed

3.11
pass
single traverse of the **cleaning head** over the **test area**

Note 1 to entry: The number of **pass**es refers to the number of times the same **test area** has been traversed by the **cleaning head**.

3.12
test area
area where the test dust, or debris, or fibre is distributed for the cleaning performance test

3.13
Wilton carpet
carpet as defined in IEC TS 62885-1

3.14
fully charged
point during charging when, according to the manufacturer's instructions, by indicator or time period, the product does not need to be charged anymore

3.15
fully discharged
point in use when the manufacturer's instructions state the product is fully discharged or the robot cannot restart the operation

3.16
side brush
rotating peripheral brush whose main function is to relocate the dust and debris along the floor and extend the cleaning reach beyond the **width of robot cleaning head**

4 General conditions for testing

4.1 General

During the tests, any external interference that affects the functions of the **cleaning robot** (e.g. sensors, processors and actuators) shall be minimized.

4.2 Atmospheric conditions

The test procedures and measurements shall be carried out under the following atmospheric conditions (in accordance with ISO 554).

Cleaning performance test:

Temperature:	(23 ± 2) °C
Relative humidity:	(50 ± 5) %
Air pressure:	86 kPa to 106 kPa

All other tests:

Temperature:	(23 ± 5) °C
Relative humidity:	(45 ± 15) %
Air pressure:	86 kPa to 106 kPa

Temperature and humidity conditions within the specified ranges are required for good repeatability and reproducibility. Care shall be taken to avoid changes during a test.

4.3 Lighting conditions

Unless otherwise specified, the test procedures and measurements shall be carried out under the following lighting conditions.

Intensity:	(200 ± 50) lx
Colour temperature:	2 000 K to 7 000 K

Measurements shall be made at floor level.

NOTE Lighting conditions for autonomous navigation/coverage test (Clause 7) are different from the general lighting conditions, which are defined in 9.3.3.

4.4 Test equipment and materials

To minimize the influence of electrostatic phenomena, measurements on carpets shall be carried out on a level floor consisting of a smooth untreated pine plywood or equivalent panel, at least 15 mm thick and of a size appropriate for the test.

Unless otherwise specified, equipment and materials for measurements (devices, test carpets, test dust, etc.) to be used in a test shall, prior to the test, be kept for at least 16 h at standard atmospheric conditions in accordance with the type of test (see 4.2).

Carpets that have already been used shall be stored beaten at standard atmospheric conditions in accordance with 4.2.

When not in use, carpets shall be hanging free, or lying flat, pile upwards and uncovered. Carpets shall not be rolled when stored between testing. Carpets that have been rolled shall be laid flat for a minimum of 16 h before use.

4.5 Number of samples

All measurements of performance shall be carried out on the same sample(s) of the **cleaning robot** with its attachments, if any. During a set of tests, the sample robot shall not be changed.

A minimum of three samples of the same model shall be tested.

If possible, the software shall be updated to the latest available for the robot in the region of purchase in accordance with the manufacturer's instructions.

If available, the manufacture date, the serial number, and the software version of the samples shall be reported.

4.6 Preparation of the battery

Any unused Li-ion battery shall be fully charged and fully discharged once prior to conducting the first test on a **cleaning robot**. Any unused other type of battery shall be fully charged and fully discharged three times prior to conducting the first test on a **cleaning robot**.

Full discharge shall be done by carrying out one or more normal cleaning operation(s) in a clean area following the manufacturer's instructions until the robot ceases to function. Remove the charge station once it is in operation to ensure full discharge.

NOTE It is understood that some robots do not allow discharge below a certain energy level for battery protection. Full discharge means either low battery signal without robot motion or robot stops operation without being able to restart.

4.7 Running-in of a new cleaning robot

Prior to the first test on a new **cleaning robot**, it shall be run in accordance with 4.6 for one battery cycle. Prior to conducting any series of tests, the age, condition, and history of the product shall be recorded.

4.8 Operation of the cleaning robot

Unless otherwise specified,

- the **cleaning robot**, its attachments, the **docking station** and any accessories shall be used and adjusted in accordance with the manufacturer's instructions before a test is carried out; and
- the operation mode of the robot can be selected and adjusted in accordance with the manufacturer's published instructions only before the test to fit the environment to be cleaned.

The mode and settings used for the test shall be recorded and reported.

Any safety-related device shall be able to operate.

4.9 Measurement of collected dust weight

Some reusable receptacles consist of a rigid container and an integral filter. In this case, the container and the filter are considered to be the receptacle and should be treated as if they were a single component.

The dust receptacle and removable filtration units shall be carefully removed from the robot and weighed together.

For **cleaning robot**s equipped with separation devices, being part of the appliance, used to separate the dust from the air flow and/or having additional filters to be changed or cleaned by the user, without the use of tools, the weight of such specific devices shall be taken into account for dust removal ability.

Cleaning robots with disposable or reusable **dust receptacles** may have secondary filtration stage devices, which do not collect meaningful dust in removal ability tests, but which do impact on filtration and life tests. Replacement and/or maintenance of such devices shall be in accordance with relevant clauses and carried out in accordance with the manufacturer's instructions.

4.10 Measurement resolution and accuracy

Unless specified in the test methods, the resolution and the accuracy of the measurement device shall be as follows.

Weight measurement:

Fibre measurement:

Resolution ≤ 0,001 g

Accuracy ≤ 0,005 g

All other measurement:

Resolution ≤ 0,01 g

Accuracy ≤ 0,02 g

Recommended position measurement by pose tracking system:

Position resolution ≤ 1 cm

Position accuracy ≤ 1 cm

Orientation resolution ≤ 0.1°

Orientation accuracy ≤ 3°

Acquisition rate ≥ 30 Hz

Time measurement:

Resolution ≤ 0,1 s

Accuracy ≤ 0,2 s

The sampling rate of the pose tracking system shall be adequate to ensure the dynamic position accuracies as specified above.

4.11 Tolerance of dimensions

For all dimensions that are not presented as a range and where no tolerance is specified, the tolerance shall be determined from Table 1.

Table 1 – Tolerance of dimensions

Nominal size range mm	**Tolerance** mm
3 ≤ 6	±0,5
< 6 ≤ 30	±1,0
< 30 ≤ 120	±1,5
< 120 ≤ 400	±2,5
< 400 ≤ 1 000	±4,0
< 1 000 ≤ 2 000	±6,0
< 2 000 ≤ 5 000	±8,0
Values are taken from Table 1 of ISO 2768-1:1989.	

5 Cleaning performance – Straight line

5.1 General

This test is designed to isolate the performance of the cleaning system of the robot from the autonomous movement function at a nominal speed. This makes it possible to only assess the robot's ability to remove dust, fibre, medium size debris, and large debris. This facilitates direct comparison between **cleaning robots**. If the side brushes are removable, they shall be removed for all tests in Clause 5.

NOTE A method to evaluate the influence (or effectiveness) of the side brush will be investigated in future revisions.

5.2 Preparation of test

5.2.1 Pre-treatment of cleaning robot

If the **cleaning robot** is designed to be used with disposable **dust receptacles**, it shall, prior to each test, be equipped with a new **dust receptacle** of the type recommended or supplied by the manufacturer of the **cleaning robot**.

If the **cleaning robot** is provided with a reusable **dust receptacle** (as the sole original **dust receptacle** or as an enclosure for disposable **dust receptacles**), the **dust receptacle** shall, prior to each trial, be cleaned in accordance with the manufacturer's instructions until its weight is within 1 % or 2 g of its original weight, whichever is lower.

A **dust receptacle** made of textile is not permitted to be cleaned by brush and water unless allowed by the manufacturer's instructions.

A plastic **dust receptacle** shall be cleaned following the instructions in the user manual. If the **dust receptacle** is cleaned with water, it shall be well dried before any test and measurement.

Some reusable receptacles consist of a rigid container and an integral filter. In this case, the container and the filter are considered to be the receptacle and shall be treated as if they were a single component.

The whole robot including dust collecting parts shall be pre-treated in accordance with 4.4 in order to minimize the influence of humidity.

Prior to each **trial**, replaceable filter(s) and dust collection parts (e.g. wiping pad) in the robot (or in the secondary collection system) shall be replaced with new ones.

The battery shall be fully re-charged prior to each **trial**, following the manufacturer's instructions.

5.2.2 Preconditioning of test floor

The test floor shall be cleaned before each **trial**.

5.2.3 Pre-treatment of test carpet

5.2.3.1 General

Before recordable testing is carried out, any new carpet shall be pre-conditioned in the manner described in IEC TS 62885-1.

5.2.3.2 Conditioning of test carpet

Prior to each **trial**, the test carpet shall be cleaned to remove remaining dust and preconditioned as described below. For cleaning of the test carpet, it is recommended to use a suitable carpet-beating machine such as described in 5.3.3.2 in IEC 62885-2:2016.

If a carpet-beating machine is not used, the carpet shall be placed upside down on a rigid mesh support and beaten by hand or with an active nozzle. After the beating, one sequence of five double strokes at (0,50 ± 0,02) m/s over the **test area**, the acceleration area and the deceleration area, with the forward stroke in the direction of the carpet pile (direction of manufacturing) with a vacuum cleaner, which has good dust removal ability, shall be carried out to remove remaining dust. The whole **test area**, the acceleration area and the deceleration area shall be cleaned with the cleaning machine.

5.2.3.3 Verification and preconditioning of test carpet

After cleaning of the test carpet, the **cleaning robot** under test shall be equipped with a clean **dust receptacle** (see 5.2.1) and be used to verify that the carpet has been cleaned to the point where no dust pick-up is discernible. This point is considered to be reached if the amount of dust removed from the carpet during one trial of five cleaning **pass**es over the **test area** (refer to 5.5.3 without spreading dust) is less than 0,2 g. If the amount is greater than 0,2 g, this step is repeated until the requirement is achieved.

NOTE Even if the equipment for removing remaining dust from the carpet is known to be sufficiently reliable to leave the carpet in an acceptable condition, it is still important to carry out this procedure of preconditioning to ensure that the effect of humidity on the carpet is minimized.

To prevent a gradual filling of the carpet with dust, the weight of the test carpet should be maintained as close as possible to that of the initially clean carpet.

5.2.3.4 Embedding dust or fibre into the test carpet

The dust or fibre shall be embedded into the test carpet by carrying out ten double strokes over the carpet, parallel with the direction of the pile, using a roller in accordance with 7.3.6.1 (dust embedding roller) of IEC 62885-2:2016.

The speed of the roller over the **test area** shall be a uniform 0,5 m/s ± 0,02 m/s, with the forward stroke being in the direction of the pile. It is important to ensure that the **test area** is completely and evenly rolled. The carpet is then left for a period of 10 min to recover from rolling.

5.3 Test mode

5.3.1 General

The straight-line cleaning test requires the robot to move straight forward at a nominal speed calculated from the normal operation mode, see 8.3. There are some other functions required for the straight-line cleaning test, which shall be provided within a test mode.

This mode shall enable the robot to perform a repeatable test mode action in which it shall be driven forward in a straight line, at a fixed speed for the defined minimum distance (refer to 5.3.3). The test mode shall satisfy the entire relevant safety requirement.

This test mode action can then be repeated multiple times depending on the nature of the test (e.g. for multiple-**pass** testing).

In the absence of the test mode, the robot shall be tested with a mode (e.g. a remote-control mode) that generates a reasonably straight motion (**test area** coverage as close to 100 % as possible) in the straight-line test speed. The fact that the straight motion was generated by a mode other than the test mode shall be reported.

If a guiding method is used to ensure the straight motion of the robot, care shall be taken to minimize the effect on the mobile behaviour of the robot.

The test mode shall be readily available at no additional cost.

If a reasonably straight motion cannot be generated, then the test cannot be properly executed, and the test can be skipped.

5.3.2 Access to test mode

The precise nature of access to the test mode shall be clearly stated by the manufacturer and it shall be simple to execute. Once the access operation is complete, it shall leave the machine in an idle state.

NOTE Examples of access methods to the test mode could be to require the user to have a combination of buttons on the machine pressed when the robot is switched on or for a combination of buttons to be held for a period of time, which would not occur during normal robot operation. The only condition is that this access method is to be documented.

Once in the idle state, the user shall be able to initiate the execution of a single test mode action (refer to 5.3.3) at one of two speeds, s_{avg_hard} and s_{avg_carpet}, either by a method available on the robot (such as a button press) or a remote means. s_{avg_hard} and s_{avg_carpet} shall be calculated following the method described in 8.3.

Once the test mode action has been completed, then the machine shall return to its idle state, ready to execute another test mode action if required.

It shall be possible to pick the machine up and reposition it without the machine exiting the idle state.

It is expected that the user shall be able to exit this mode either via an instruction or via a power down/up cycle.

5.3.3 Test mode action

The test mode action involves the machine starting from a stationary pose and driving in a straight line before coming to a stop.

The straight-line cleaning speed of the robot, either s_{avg_hard} or s_{avg_carpet} shall be maintained through the **test area** and the pass-through area (equal to the longitudinal length of the robot), refer to Figure 1. The acceleration and deceleration areas are provided for the robot to accelerate up to the straight-line cleaning speed and decelerate down to a stop.

All efforts shall be made to achieve a straight-line path. It is, however, understood that the robot may not execute a precise straight-line path. If the resultant missed coverage of the **test area** is significant, the test may not be able to be run, and this fact shall be reported.

NOTE 1 The velocity and the distance mentioned above are the observed quantities, not the commanded input.

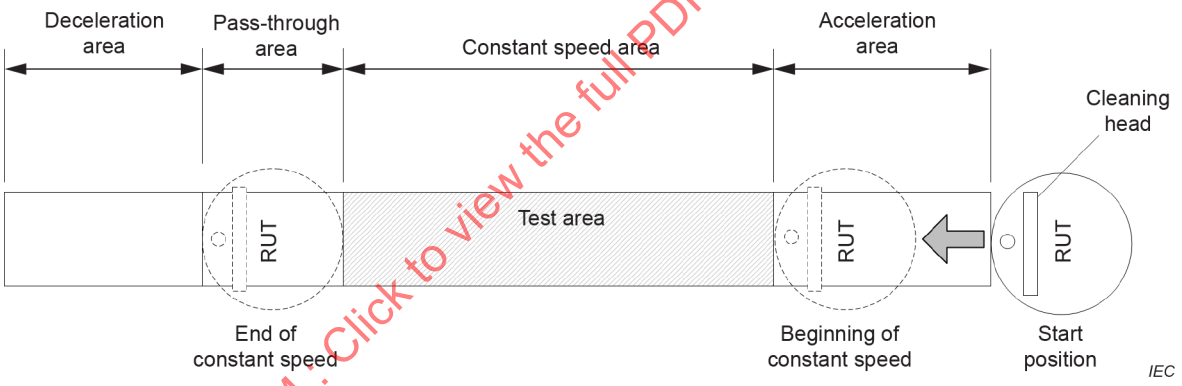


Figure 1 – Test mode action

During the execution of the test mode, the robot's basic cleaning systems shall be active in their standard operating mode. All other "enhanced" cleaning systems that would prevent the straight motion of the robot (e.g. dust sensor) shall not be active.

NOTE 2 Necessary steps to verify that the test mode is equivalent to the standard operating mode can be taken. For example, intake pressure and acoustic noise can be compared between the test mode and the standard operating mode.

5.3.4 Speed verification

It is understood that the actual motion executed by the robot will not be precisely as described above owing to various external influencing factors, such as slip on the traction systems or resolution of the guidance system. The actual observed speed at which the action is executed shall be the required speed ± 10 %.

If the speed does not comply to the conditions specified above, the non-compliance shall be reported.

The speed at which the test is performed shall be reported along with the results.

5.4 Dust removal from hard floor

5.4.1 Test bed

The test bed is identical to that described in 9.1.1.

5.4.2 Preparation of test

5.4.2.1 Preconditioning of test floor

Refer to 5.2.2.

5.4.2.2 Pre-treatment of cleaning robot

Refer to 5.2.1.

Replaceable filters and dust collection parts (e.g. dust pad) shall not be replaced within the same **trial**.

5.4.2.3 Speed of test pass on hard floor

The **pass**es shall be executed at the speed s_{avg_hard}, as described in 8.3.

Refer also to 5.3.4.

5.4.2.4 Distribution of test dust

Test dust Type 1 in accordance with 7.2.2.1 in IEC 62885-2:2016, shall be distributed with a mean coverage of (50 ± 0,1) g/m^2 as uniformly as possible over the **test area**. The amount of test dust to be used is calculated from the formula (W − 0,02) m × 0,7 m × (50 ± 0,1) g/m^2, where W is the **width of robot cleaning width** in metres and the length of the **test area** is 0,7 m.

NOTE 1 For uniform distribution of the test dust, a manual dust spreader as described in Figure 2 can be used.

NOTE 2 To ensure the distribution of the test dust only within the **test area**, a masking frame with size of the **test area** can be used. When such frame is used, testers need to make sure the dust attached on the masking frame gets dropped onto the **test area**.

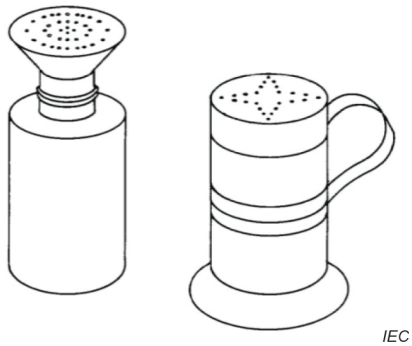


Figure 2 – Dust distribution devices

5.4.3 Test method

After the preparation process is completed in accordance with 5.4.2, the **dust receptacle** shall be weighed as specified in 4.9 (M_0).

The **cleaning robot** shall be switched on and placed into test mode using the method provided by the manufacturer (refer to 5.3.2).

The **cleaning robot** shall be placed at the start position specified in Figure 18, with the centre of the **cleaning head** aligned with the centreline of the **test area**.

It is important to ensure consistent alignment of the robot with the **test area** on the test bed. During the setup process, an alignment device such as a laser pointer can be used for the validation of a proper alignment. The **cleaning robot** shall perform a single **pass**.

After the movement of the **cleaning robot** has stopped, the receptacle shall be carefully removed and reweighed as specified in 4.9. The weight of the dust (M_i) shall be calculated as the difference between this value and M_0.

Without cleaning the robot and the receptacle, the next **pass** shall be performed. After each **pass,** the receptacle shall be carefully removed and reweighed as specified in 4.9.

A single cleaning **trial** consists of N **pass**es (straightforward motion), where the number N shall be chosen by the tester. The dust on the test bed (even outside of the **test area**) shall not be cleaned before the end of the whole **trial**. If any of the **pass**es does not fully cover the **test area**, the whole **trial** shall be discarded, and the **trial** shall be repeated.

The cleaning **trial** (with N **pass**es) shall be repeated twice more. Before each **trial**, the robot and the receptacle shall be conditioned in accordance with 5.2.1.

For the dust removal tests only, if the spread of any of accumulative dust pick-up rates p_i (defined in 5.4.4) from three **trials** is larger than 10 %, two more **trials** shall be added.

5.4.4 Determination of dust removal ability

The dust pick-up rate shall be calculated with

$$p_{i,k} = \frac{M_{i,k}}{M_k}$$

where

$p_{i,k}$ is the accumulated dust pick-up rate from the i-**pass** over the **test area** calculated from the k^{th} **trial** (percent);

M_k is the total weight of dirt initially distributed in the **test area** (g) for the k^{th} **trial**;

$M_{i,k}$ is the measured accumulative weight of dirt picked up after the i^{th} **pass** (g) for the k^{th} **trial.**

Upon completion of n **trials**, the final pick-up percentages for hard floor P_i is calculated as follows:

$$P_i = \frac{\sum_{k=1}^{n} p_{i,k}}{n}$$

where

P_i is the final accumulated i-**pass** pick-up rate (percent) where i = 1, 2, 3,…, N;

n is the number of **trials**.

NOTE There are two methods for reporting pick-up values from the straight-line test method: absolute pick-up and relative pick-up. Absolute pick-up is the dust picked up at the conclusion of a chosen number of **pass**es made by the robot, reported irrespective of the number of **pass**es that the robot's navigation system dictates during actual operation. For example, 1, 3, 5 or 10 **pass** cumulative pick-up measurements can be made, even if the robot's navigation system makes only two **pass**es during actual operation. This allows comparison of the vacuum system performance in isolation from the navigation system, and facilitates comparison to manually operated vacuum cleaners if required. Relative pick-up is the dust pick-up recorded after each **pass**, up to the total number of **pass**es reported for that product from the autonomous navigation/coverage test result (refer to Clause 7). This ensures that the pick-up capability reported is relative to the robot's navigation strategy, and therefore representative of actual operation when comparing robotic products. The limit for the number of additional cumulative **trials** to be measured is when less than or equal to 1 % pick-up change is measured between **trial** n and $n - 1$.

5.5 Dust removal from carpet

5.5.1 Test bed

The test bed is described in 9.1.2.

5.5.2 Preparation of test

5.5.2.1 Pre-treatment of test carpet

Refer to 5.2.3.

5.5.2.2 Conditioning of test carpet

Refer to 5.2.3.2.

5.5.2.3 Verification and preconditioning of test carpet

Refer to 5.2.3.3.

5.5.2.4 Pre-treatment of cleaning robot

Refer to 5.2.1.

5.5.2.5 Speed of test pass on carpet

The test **pass**es shall be executed at speed s_{avg_carpet} as described in 8.3.

Refer to 5.3.4.

5.5.2.6 Distribution of test dust

Test dust Type 2, in accordance with 7.2.2.2 of IEC 62885-2:2016, shall be distributed with a mean coverage of 125 g/m^2 ± 0,1 g/m^2 as uniformly as possible over the **test area**.

The amount of test dust to be used is calculated from the formula (W − 0,02) m × 0,7 m × 125 g/m^2, where W is the **width of robot cleaning head** in metres, and the length of the **test area** is 0,7 m. For uniform distribution of the test dust over the **test area**, a dust spreader as described in 7.3.5 of IEC 62885-2:2016 should be used. The adjustment of the device is checked by visual examination of the test dust on the carpet.

5.5.2.7 Embedding test dust into test carpet

Refer to 5.2.3.4.

5.5.3 Test method

Refer to 5.4.3 with exception of Figure 19 instead of Figure 18.

5.5.4 Determination of dust removal ability

Refer to 5.4.4.

5.6 Medium size debris removal from hard floor

5.6.1 Test bed

The test bed is described in 9.1.1.

5.6.2 Preparation of test

5.6.2.1 Preconditioning of test floor

The test floor shall be visually clean before each **trial**.

5.6.2.2 Pre-treatment of cleaning robot

Refer to 5.2.1

Exception: reusable dust receptacles shall be visually clean between consecutive trials. Replaceable filters and dust collection parts do not need to be replaced between consecutive trials.

5.6.2.3 Speed of test pass on hard floor

Refer to 5.4.2.3.

5.6.2.4 Distribution of debris

A mix in mass of 15 g/m^2 ± 0,1 g/m^2 of screws and 15 g/m^2 ± 0,1 g/m^2 of nuts (see Table 2 for details) shall be used.

The mix shall be uniformly distributed within the **test area** in random orientation and position.

NOTE To ensure the distribution of the test debris only within the **test area**, a masking frame with the size of the **test area** or marker can be used.

Table 2 – Medium size debris

Screw	Nut
Type: M3x6 slotted set screws with flat point	Type: M3, hexagon regular nuts (style 1)
Standard: ISO 4766	Standard: ISO 4032
Material: PA 6.6	Material: PA 6.6
Colour: natural	Colour: natural

5.6.3 Test method

Refer to 5.4.3.

5.6.4 Determination of medium size debris removal ability

Refer to 5.4.4.

5.7 Medium size debris removal from carpet

5.7.1 Test bed

Refer to 9.1.2.

5.7.2 Preparation of test

5.7.2.1 Preconditioning of test carpet

The carpet shall be visually clean. If the carpet was previously used for dust removal from carpet (see 5.5), it shall be cleaned in accordance with 5.2.3.2 and 5.2.3.3 prior to initiation of medium size debris tests.

5.7.2.2 Pre-treatment of cleaning robot

Refer to 5.2.1

Exception: reusable dust receptacles shall be visually clean between consecutive trials. Replaceable filters and dust collection parts do not need to be replaced between consecutive trials

5.7.2.3 Speed of test pass on carpet

Refer to 5.5.2.5.

5.7.2.4 Distribution of debris

Refer to 5.6.2.4.

5.7.3 Test method

Refer to 5.4.3 with exception of Figure 19 instead of Figure 18.

5.7.4 Determination of medium size debris removal ability

Refer to 5.4.4.

5.8 Large debris removal from hard floor

5.8.1 Test bed

Refer to 9.1.1.

5.8.2 Preparation of test

5.8.2.1 Preconditioning of test floor

The test floor shall be visually clean before each trial.

5.8.2.2 Pre-treatment of cleaning robot

Refer to 5.2.1.

Exception: reusable dust receptacles shall be visually clean between consecutive trials. Replaceable filters and dust collection parts (e.g. dust pad) shall not be replaced between cleaning trials.

5.8.2.3 Speed of test pass on hard floor

Refer to 5.4.2.3.

5.8.2.4 Distribution of test debris

The large debris specified in Table 3 shall be distributed using the stencil template as depicted in Figure 3.

Table 3 – Large Debris

Debris	Specification
Cap nut	Type: M4, hexagon domed cap nuts, high type Standard: DIN 1587 Material: PA 6.6 Colour: natural

Dimensions in millimetres

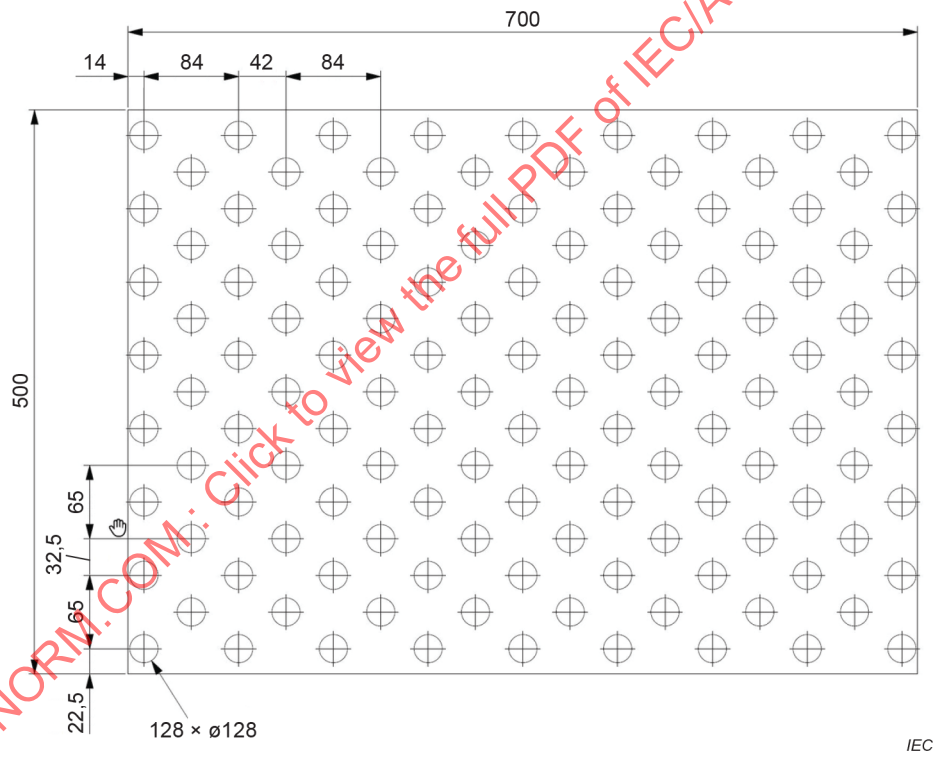


Figure 3 – Large debris template

The template shall be aligned so that a maximum number of rows are placed within (W – 20) mm, where W is the **width of robot cleaning head** in mm, and path (refer to Figure 4), and that the first row is one of the long rows (consisting of 9 holes).

The used holes shall be placed in the middle of the cleaning head area.

A single debris item shall be randomly oriented within each hole.

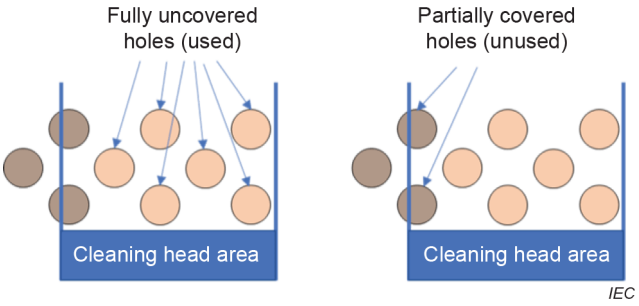


Figure 4 – Large debris template hole alignment

5.8.3 Test method

Refer to 5.4.3.

Exception: the **trial** is completed after the first **pass**. Rather than weighing the dust receptacle, count the number of large debris in the dust receptacle.

5.8.4 Determination of large debris removal ability

The pick-up will be calculated as

$$P_{\mathrm{d}} = \frac{D_{\mathrm{IB}}}{D_{\mathrm{D}}}$$

where

P_{d} is the pick-up rate, expressed in percentage;

D_{IB} is the number of large debris collected in the bin;

D_{D} is the number of large debris that were distributed.

NOTE As **cleaning robot**s in real life usage are using different obstacle detection systems, navigation patterns and could have different strategies in how to remove debris from the floor, it is important to also take these aspects into account when making the final judgement of the cleaning performance.

5.9 Large debris removal from carpet

5.9.1 Test bed

Refer to 9.1.2.

5.9.2 Preparation of test

5.9.2.1 Pre-treatment of test carpet

The carpet should be visually clean.

5.9.2.2 Pre-treatment of cleaning robot

Refer to 9.1.2.

Exception: reusable dust receptacles shall be visually clean between consecutive trials. Replaceable filters and dust collection parts do not need to be replaced between consecutive trials.

5.9.2.3 Speed of test pass on carpet

Refer to 5.5.2.5.

5.9.2.4 Distribution of test debris

Refer to 5.8.2.4.

5.9.3 Test method

Refer to 5.4.3.

Exception: The **trial** is completed after the first **pass**. Rather than weighing the dust receptacle, count the number of large debris in the dust receptacle.

5.9.4 Determination of large debris removal ability

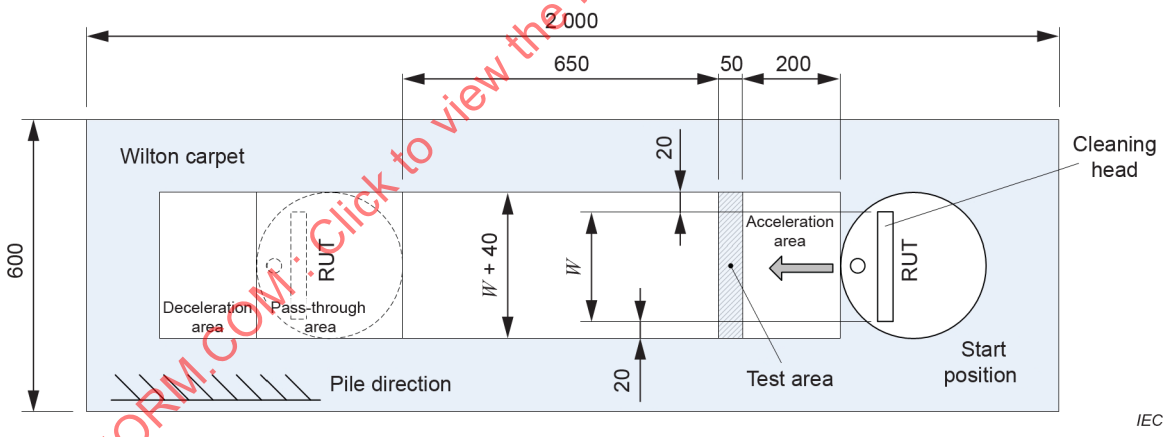
Refer to 5.8.4.

5.10 Fibre removal from carpet

5.10.1 Test bed

The test bed is defined in 9.1.2 and modified to have a smaller **test area** as described in Figure 5.

Dimensions in millimetres



Key

W **width of robot cleaning head**

Figure 5 – Straight-line fibre removal from carpet test bed configuration

5.10.2 Preparation of test

5.10.2.1 Pre-treatment of test carpet

Refer to 5.7.2.1.

5.10.2.2 Conditioning of test carpet

Refer to 5.2.3.2.

5.10.2.3 Pre-treatment of cleaning robot

Refer to 5.2.1. The robot, especially the cleaning head and **dust receptacle**, shall be visually free of remaining fibres.

5.10.2.4 Speed of test pass on carpet

Refer to 5.5.2.5.

5.10.2.5 Distribution of fibres

The template shown in Figure 6 shall be adjusted based on the robot's **width of robot cleaning head**. The **test area** shall be 0,05 m × (W + 0,04) m, where W is the **width of robot cleaning head** as defined in 3.4.

Fibre material, in accordance with IEC 62885-2:2016, 7.2.3, shall be plucked by hand and distributed as uniformly as possible over the **test area**. To ensure consistency of the test, the fibre shall not be forced into the carpet by hand.

Test fibre shall be distributed with a mean coverage of (4 ± 0,2) g/m^2 as uniformly as possible over the **test area**. The amount of test fibre to be used is calculated from the formula 0,05 m × (W + 0,04) m × 4 g/m^2, where W is the **width of robot cleaning head** in metres and the length of the **test area** is 0,05 m.

NOTE 1 For example, if the **width of robot cleaning head** is 0,16 m, the **test area** will be 0,05 m by 0,2 m, and 40 mg of fibre will be spread through the **test area**.

NOTE 2 The density of the fibre spread was determined by repeatability and differentiability of different products.

Figure 6 – Exemplary picture of fibre distribution

5.10.2.6 Embedding test fibre into test carpet

Refer to 5.2.3.4.

NOTE 1 The embedding process can lead to a movement of the fibres. After embedding the fibres, the **test area** is usually moved slightly in the pile direction of the carpet.

NOTE 2 The roller is the same as that used for embedding dust in accordance with this document. The roller for fibre pick-up test described in IEC 62885-2 does not meet the requirements.

5.10.3 Test method

Refer to 5.4.3.

Exception: rather than weighing the dust receptacle, visual comparison of the judgement area shall be made. Pictures shall be taken of the judgement area before the first pass and after each pass, up to N **pass**es, for comparison. Care shall be taken to take comparable pictures.

NOTE For the comparable pictures, the lighting condition and the location from which the pictures are taken are important.

5.10.4 Determination of fibre removal ability

Pick-up performance shall be evaluated based on visual inspection. Only the area that was covered by (W-0,02) m width where W is the **width of robot cleaning head** in m and 0,7 m along the travelling direction shall be considered for the judgement, called "judgement area", so the additional remaining fibre strips on each side of the cleaning head, are not part of the judgement.

A 5-level rating will be given consisting of the ratings shown in Table 4. Each level shows exemplary pictures of judgement areas (see Figure 7).

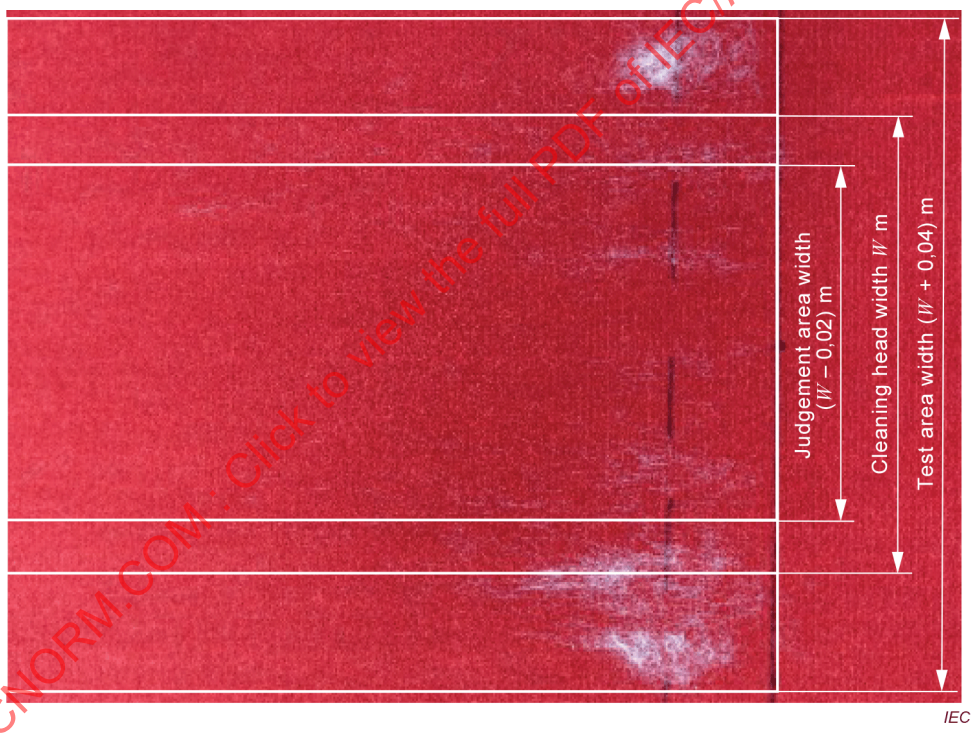
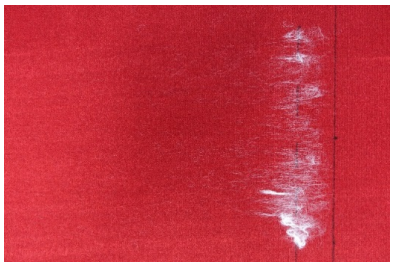
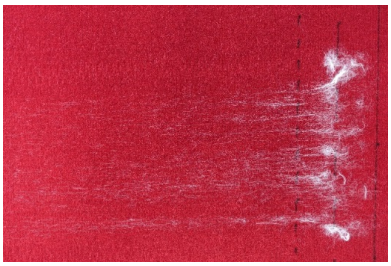
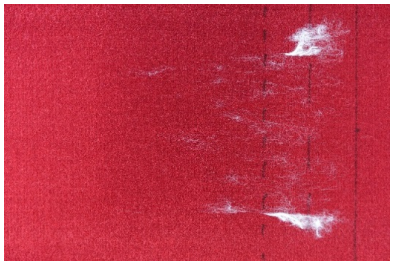
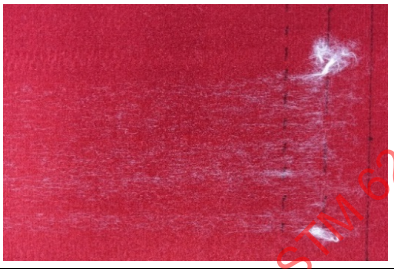
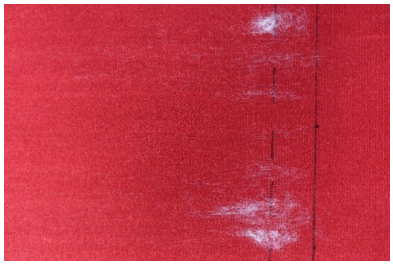
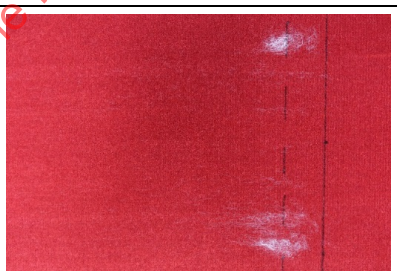
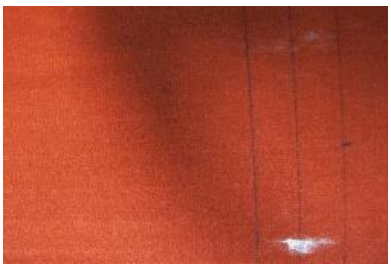


Figure 7 – Exemplary picture of judgement area

Table 4 – Rating system with exemplary pictures

Rating	Exemplary pictures		Description
1–Poor			Nearly no fibres in the robot or brush and nearly no pick-up in the **test area** and/or obvious smearing in the judgement area
2–Fair			Some fibres in the robot or brush and/or visible pick-up in the **test area** and/or obvious smearing in the judgement area
3–Good			Good pick-up in the **test area** and possibly some smearing in the judgement area
4–Very Good			Almost clean **test area** and nearly no smearing in the judgement area
5–Excellent			Clean **test area** and no smearing in the judgement area
For more detailed images, please see Annex C.			

6 Mobility

6.1 General

The purpose of these tests is to quantify the capability of a **cleaning robot** to move in standardized terrain. The specified mobility tests are listed in Table 5.

Table 5 – List of described mobility tests

Clause	Test
6.4.2	Minimum passable gap width
6.4.3	Minimum passable height
6.4.4	Maximum passable transition height
6.4.5	Maximum passable threshold height

6.2 Test bed

The test bed for these tests is specified in 9.2.1. Additional test equipment is described separately for each test in 9.2.2 to 9.2.5.

6.3 Preparation of test

6.3.1 Test conditions

The ambient temperature and humidity shall be recorded.

6.3.2 Preconditioning of test floor

The test floor shall be cleaned so that no dust remains prior to any subsequent test.

6.3.3 Pre-treatment of cleaning robot

The battery of the **cleaning robot** shall be fully re-charged prior to each **run** following the manufacturer's instructions.

6.4 Test method

6.4.1 General

For all mobility tests a single **trial** consists of a **run** from each of the two starting positions specified in Figure 8.

The autonomous operation of the **cleaning robot** shall be started following the manufacturer's instructions.

If the **cleaning robot** stops operating within 5 min or it moves to the other side of the test bed, the **run** is finished. The **cleaning robot** moving to the other side means that the entire body of the **cleaning robot** moves from area A to B or from B to A (depending on the starting position); see Figure 9 to Figure 14.

If the **cleaning robot** stops operation owing to contact with the test equipment, the **cleaning robot** is stuck, and the **run** is finished.

If the **cleaning robot** is still operating at 5 min, **the cleaning robot** shall be stopped and the run is finished.

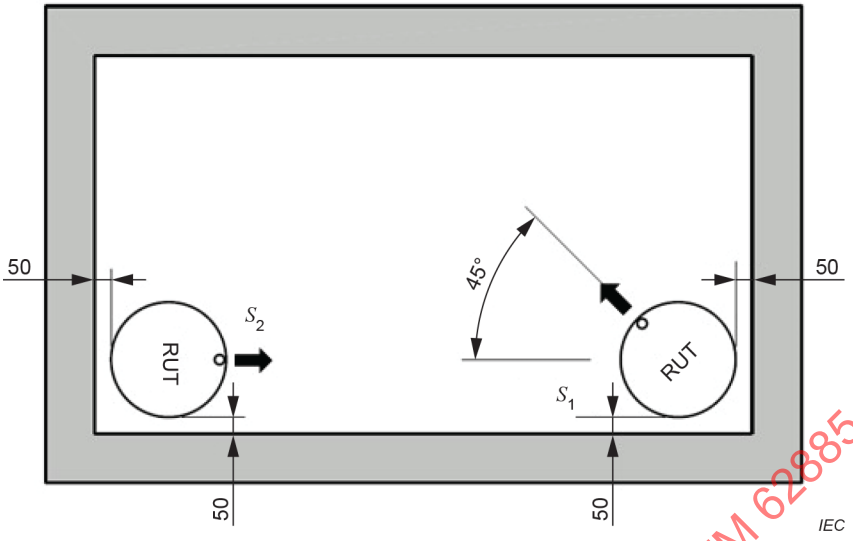
Prior to a subsequent **run**, the test bed and the **cleaning robot** shall be prepared for the next **run** in accordance with 6.3.

A mobility **trial** (with two **runs**) shall be repeated twice more. A complete set of tests for one sample **cleaning robot** consists of three **trials**, which gives a total of six **runs**.

Specific test equipment for different mobility tests is described in 6.4.2 to 6.4.5.

NOTE It is allowed to record the **runs** (e.g. by camera or PTS) and evaluate them after the **runs** are completed.

Dimensions in millimetres



The arrow indicates the forward direction of the **cleaning robot**.

RUT robot under test.

Figure 8 – Starting positions and orientations

6.4.2 Minimum passable gap width

The size of the gap is adjusted with the moveable part 2 of the wall, or equivalent equipment. The adjusted size of the gap is measured between the edge of part 2 and the surrounding wall, shown in Figure 9. The minimum increment of tested gap is 2 mm and shall be adjusted to the nearest 2 mm. When the desired gap size is adjusted, part 2 of the wall has to be fixed to part 1 (e.g. with a bar clamp or a bolt). Both parts of the wall should be fixed properly, and the tester shall ensure there is no movement or bending of the obstacle, even if a **cleaning robot** bumps into the wall.

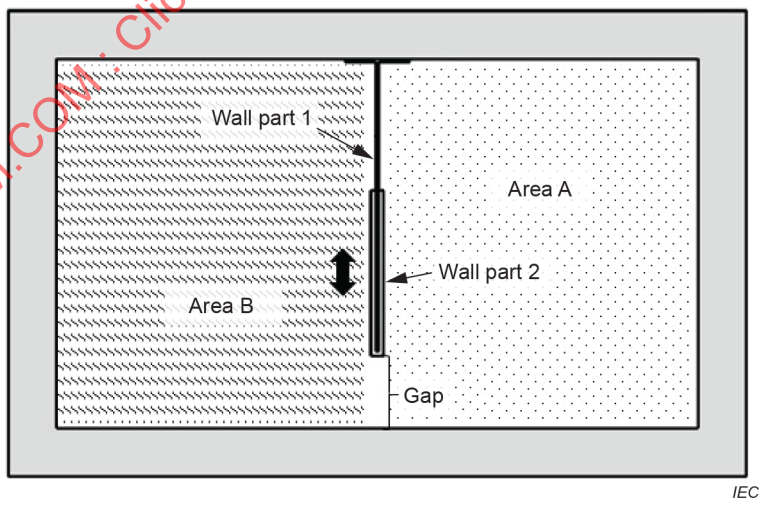


Figure 9 – Minimum passable gap width test

NOTE An example of a structured way to determine the minimum gap would be using the process described in Figure 10. The initial parameter d_0 is the width of the **cleaning robot** rounded up to the next 2 mm increment. For example, if the width of a **cleaning robot** is 381 mm, it shall be rounded up to the next increment of the parameter d_0 = 382.

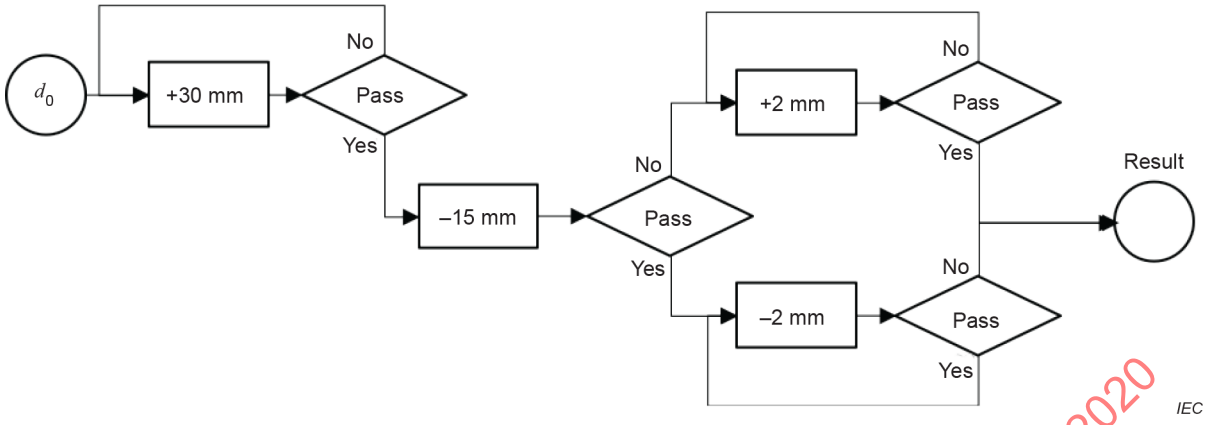


Figure 10 – Suggested process to determine the minimum passable gap width

6.4.3 Minimum passable height

The test bed and test equipment for this test is described in 9.2.3 and Figure 11. The size of the gap shall be adjusted with spacers or equivalent equipment. One spacer or a combination of spacers at each corner of the ceiling can be used. The increment of the tested gap is 2 mm.

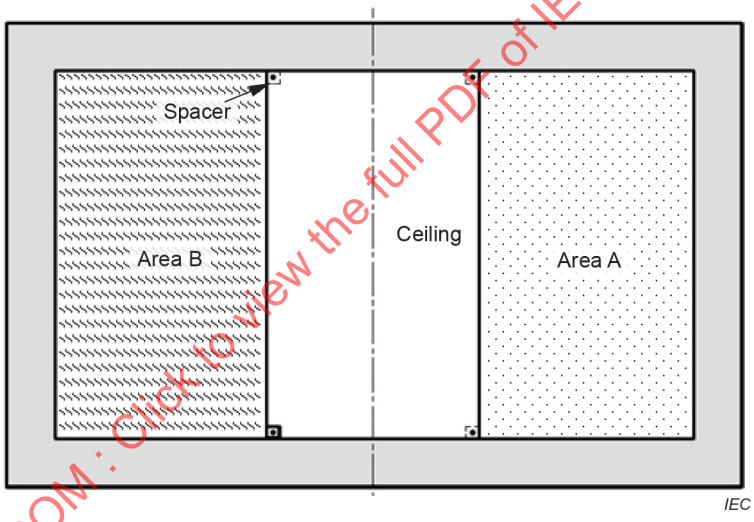


Figure 11 – Minimum passable height test

6.4.4 Maximum passable transition height

The test bed and test equipment for this test is described in 9.2.4 and Figure 12. The height of the transition shall be adjusted with additional sheets or equivalent equipment. The top surface (board of untreated laminated oak or equivalent) in combination with additional sheets can be used to realize different transition heights. To adjust the height of the transition, sheets of different thickness can be used. The increment of tested heights is 1 mm.

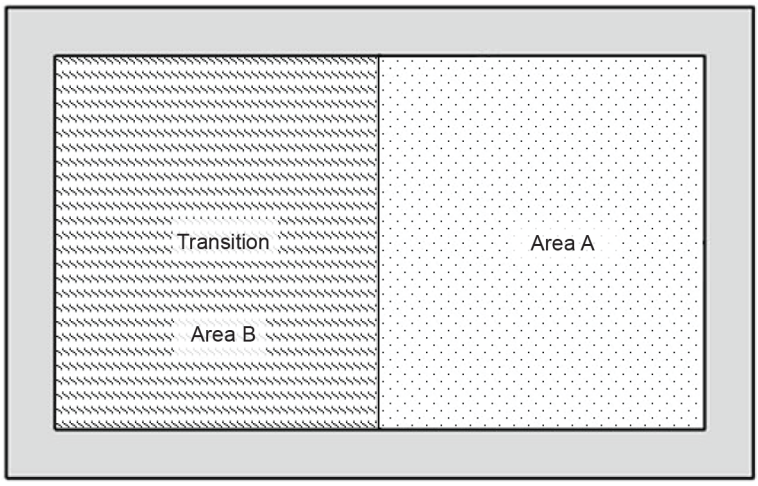


Figure 12 – Maximum passable transition height test

NOTE 1 An example of a structured way to determine the maximum transition would be using the process described in Figure 13. The initial parameter h_o of 17 mm is recommended.

NOTE 2 **Cleaning robots** could have a technology which prevents them from climbing certain heights. If this is stated in the manufacturer's instructions, it is allowed to skip these heights and state so in the recorded results. In this case, it could be necessary to deviate from the process described in Figure 13.

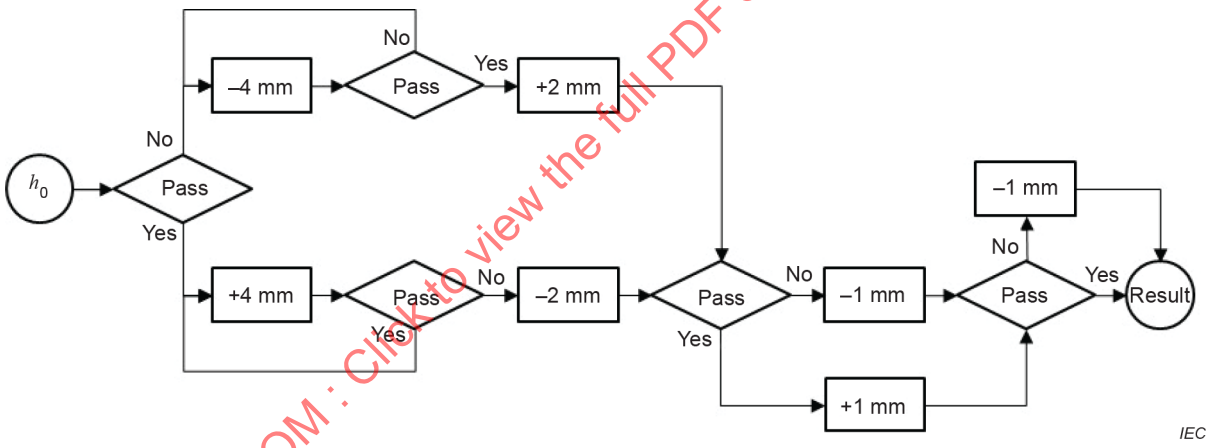


Figure 13 – Process to determine the maximum passable transition height

6.4.5 Maximum passable threshold height

The test bed and test equipment for this test is described in 9.2.5 and Figure 14. Before each test, the desired threshold type (see 9.2.5) and height shall be fixed to the test bed. The threshold shall be fixed so that it cannot move in any direction (e.g. rolling or bending). The increment of tested heights is 1 mm.

NOTE 1 An example of a structured way to determine the maximum passable threshold height would be using the process described in Figure 13. The initial parameter h_0 is recommended as 17 mm.

NOTE 2 **Cleaning robots** could have a technology which prevents them from climbing certain heights. If this is stated in the manufacturer's instructions, it is allowed to skip these heights and state so in the recorded results. In this case, it could be necessary to deviate from the process described in Figure 13.

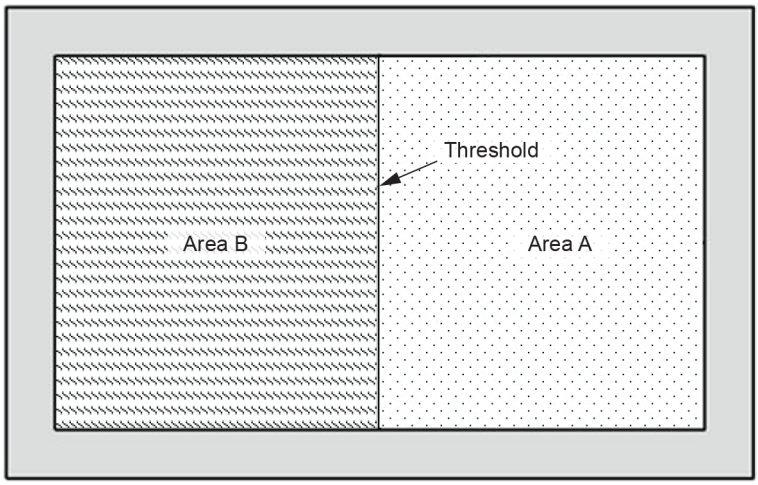


Figure 14 – Maximum passable threshold height test

6.5 Determination of mobility results

The final reported value for each specific mobility test shall be the result listed in Table 6. This value shall be determined from all results of the completed tests of the three separate samples.

For a single sample to pass an equipment setting (height/width) of a mobility test, six **runs** (three from each starting position) have to be passed. A **run** is passed if the **cleaning robot** moves from area A to B or from B to A (depending on the starting position); see Figure 9 to Figure 14.

If a **cleaning robot** does not overcome an equipment setting, the **cleaning robot** shall be restarted from the starting location and the result shall be discarded. However, a maximum of one restart per sample is allowed during testing of one equipment setting. If the **cleaning robot** does not pass the same equipment setting a second time, that equipment setting is not passed.

If the **cleaning robot** does not pass because it gets stuck (the **cleaning robot** stops operating owing to contact with the test equipment), the test for the current obstacle setting is failed and the test shall be terminated. The equipment setting at which the **cleaning robot** got stuck shall be documented and reported.

Table 6 – Reported results for each mobility test

Test	Clause	Reported result
Minimum passable gap width	6.4.2	Minimum width that was successfully passed
Minimum passable height	6.4.3	Minimum height that was successfully passed
Maximum passable transition height	6.4.4	Maximum height that was successfully passed
Maximum passable threshold height	6.4.5	Maximum height of the rectangular threshold that was successfully passed, and Maximum diameter of the cylindrical threshold that was successfully passed

7 Autonomous navigation/coverage test

7.1 General

The purpose of the autonomous navigation/coverage test is to measure the ability of **cleaning robots** to cover the available space in a standardized room configuration. The measure of performance for this test is the cumulative percent floor space traversed during a period of time. Multiple **pass**es of the robot over the same floor space are also measured in this test.

NOTE In order to reduce test effort, this test may be performed simultaneously with the energy consumption test (see 8.1).

7.2 Preparation of test

7.2.1 Test bed

The test bed is described in 9.3.

7.2.2 Test conditions

For this test, the ambient temperature and humidity shall be recorded.

NOTE Lighting conditions are defined in 9.3.3.

7.2.2.1 Preconditioning of test floor

The test floor shall be visually clean before each run.

7.2.2.2 Pre-treatment of cleaning robot

Refer to 5.2.1.

Exception: reusable dust receptacles shall be visually clean. Subclause 4.4 is not to be applied.

7.2.2.3 Pose tracking system (PTS)

During the test, the test bed shall be monitored using a pose tracking system (PTS). A proper PTS shall be installed, and the functionality of the PTS shall be verified to satisfy the specifications of 4.10.

7.3 Test method

A single **trial** consists of one **run** from each of the three starting locations. The starting locations and orientation specified in Figure 15 shall be followed.

Before each trial, the robot and the test bed shall be conditioned in accordance with 7.2.2.1 and 7.2.2.2.

Before each **run**, the battery of the robot shall be fully charged.

For each **run**, the robot shall be started in accordance with the manufacturer's instructions.

The use of the **docking station** is allowed for the two starting locations 1 and 2 if it is recommended by the manufacturer. The fact that the robot requires the **docking station** to be able to perform has to be stated in the report. If the **docking station** was used for the start of the test, it shall be kept at the same position throughout the **run**. Then, the footprint of the station shall be subtracted from the total reachable area.

For the starting location 3, the **cleaning robot** shall start without a **docking station**. If the robot cannot be started without the **docking station**, the **runs** from the position 3 shall be skipped and the fact shall be stated in the report.

It is important to ensure the proper consistent alignment of the robot with the wall on the test bed.

NOTE 1 During the setup process, an alignment device such as a laser pointer can be used for the validation of a proper alignment.

A backwall shall be installed as shown in Figure 15 behind position 1. The backwall shall be of untreated pine tree plate or similar with 300 mm height from the surface of the floor. The space behind the wall including the footprint of the wall itself shall be defined as unreachable.

The power cable from the base station shall be fixed on the wall.

The test shall be continued until the cleaning operation is terminated. The termination of the cleaning process shall be determined by the user manual.

NOTE 2 The termination of the operation can be determined based on one or more of the following events, for example.

- Reported termination message from the robot indicating the end of cleaning cycle (sound, light, text as described in the manual).
- Stopped motion on the floor for more than 3 min (not on the base station, because it might continue the operation after recharging).

If the robot is still in the middle of cleaning process at the end of the 2 h **run**, it is recommended to stop the robot and the test.

If it is needed to continue the **run** after 2 h for any reason, the tester's discretion shall be applied for the continuation of the test. The reason for the continuation of the test after 2 h shall be reported.

Visitation to the station for recharging during the **run** is allowed but the time used for recharging shall be included into the time of the **run**.

During the **run**, the area covered in terms of percentage covered by the **cleaning head**, and number of **pass**es, will be tracked and recorded using a **PTS**.

NOTE 3 It is suggested that three batteries are prepared before testing to avoid interrupting the test in order to recharge the battery.

The navigation **trial** (with three **runs**) shall be repeated twice more. A complete set of tests consists of three **trials**, which gives a total of nine **runs**.

If the robot fails for any reason other than the normal completion of **run**, the robot shall be restarted from the starting location and the failed result shall be discarded. However, a maximum of one restart per starting position is allowed throughout the whole test. Further failed results shall be included in the test results without restarting. The number of failures shall be reported.

Dimensions in millimetres

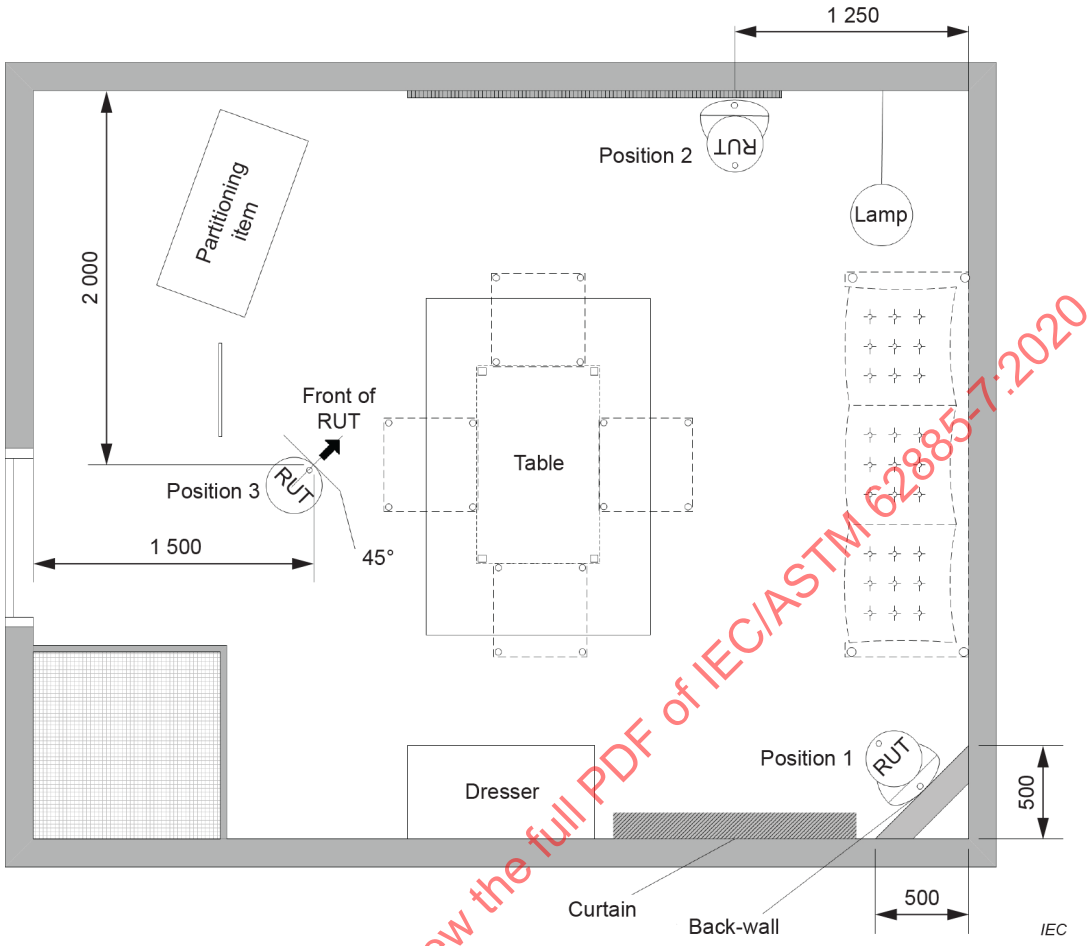


Figure 15 – Starting positions for navigation test

7.4 Performance measurement

The **cleaning head** coverage shall be obtained throughout the test. The **cleaning head** coverage is defined as the area covered by the **cleaning head** of the robot during a certain period of time. The percentage of **cleaning head** coverage over time is calculated using the following equation:

$$C_{i,j}(t) = [A_{i,j}(t) / A] \times 100$$

where

i is the start position index, 1, 2, and 3;

j is the trial index, 1, 2, and 3;

$C_{ij}(t)$ is the percentage of **cleaning head** coverage at time t for the **run** started from the ith position in jth **trial** (i = 1, 2 and 3, j = 1, 2, and 3) (%);

$A_{i,j}(t)$ is the area over which the **cleaning head** has passed at least one time at time t for the **run** started from the ith position in jth **trial** (m^2);

t is the **run** time (in minutes);

A is the total reachable area (m^2), which is computed by the total floor area minus the area occupied by the legs, heater skirting board, dresser, cylindrical bar, partitioning item, the base of the lamp, the backwall and the space behind the wall. The area under the sofa is considered reachable area. If the **docking station** was left in the test bed, the footprint of the station shall be subtracted from the total reachable area.

The number A shall be calculated based exactly on the actual setting of the test bed built in the test laboratory. If the setting changes (because of the tolerance, for example), the number shall be changed accordingly.

NOTE 1 By using a **PTS**, the percentage coverage for each **pass** at a certain time can be calculated with a simple image-processing program automatically.

NOTE 2 A detailed description and the usage of a **PTS** can be found in Annex A.

The percentage of multiple **pass** coverage over time is calculated using the following equations:

$$C_{ij\_\text{double}}(t) = [A_{ij\_\text{double}}(t) / A] \times 100$$

$$C_{ij\_\text{triple}}(t) = [A_{ij\_\text{triple}}(t) / A] \times 100$$

where

i is the start position index, 1, 2, and 3;

j is the trial index, 1, 2, and 3;

$C_{ij\_\text{double}}(t)$ percentage of area passed by the **cleaning head** at least two times at time t for the **run** started from the ith position in jth **trial** (percent);

$C_{ij\_\text{triple}}(t)$ percentage of area passed by the **cleaning head** at least three times at time t for the **run** started from the ith position in jth **trial** (percent);

$A_{ij\_\text{double}}(t)$ area over which the **cleaning head** has passed at least two times at time t for the **run** started from the ith position in jth **trial** (m^2);

$A_{ij\_\text{triple}}(t)$ area over which the **cleaning head** has passed at least three times at time t for the **run** started from the ith position in jth **trial** (m^2).

NOTE 3 Percentage of multiple **pass** coverage for more than three times can be obtained in the same way.

It is recommended that the percentage coverage over time $C_i(t)$ are reported in a graph with a 25th percentile and 75th percentile envelope. The percentage coverage for single **pass**, double **pass** and triple **pass** shall be presented in the same graph with a 25th percentile and 75th percentile envelope. The time resolution for the graph shall not be greater than 2 min intervals and the percentage resolution shall not be greater than 1 %.

For example, the 75th percentile point of $C_{ij}(t)$ for a given time t would be the 7th largest value among nine $C_{ij}(t)$. The 75th percentile envelop is the group of 75th percentile points connected by a line. The 25th percentile point of $C_{ij}(t)$ for a given time t is the second largest value among nine $C_{ij}(t)$. The 25th percentile envelope is the group of 25th percentile points connected by a line. The median point of $C_{ij}(t)$ for a given time t is the 5th largest value among nine $C_{ij}(t)$. The median envelope is the group of median points connected by a line.

For the **run** completed earlier than the longest **run**, the last coverage percentage value should be maintained for the calculation of the percentile envelope for the period beyond.

NOTE 4 It is recommended that all coverage calculations disregard the periods of time when the cleaning system is not running.

NOTE 5 All the curves can be placed in one graph or in separate graphs as the exemplary graph shown in Figure 16.

NOTE 6 A metric combining the coverage performance and the dust pick-up performance can be found in Annex B.

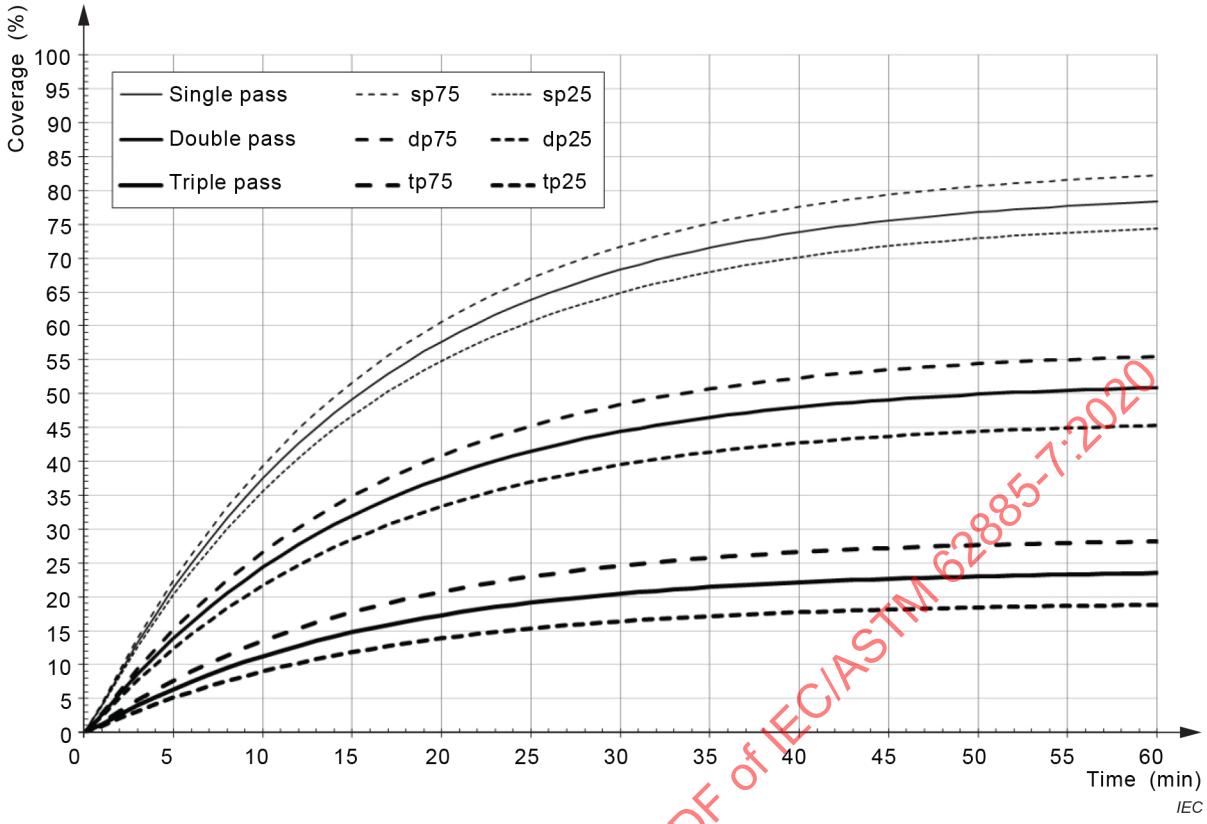


Figure 16 – Exemplary graph of coverage test result

8 Miscellaneous

8.1 Energy consumption of a cleaning robot

8.1.1 General

This test is a general method for measuring and calculating the energy consumption of **cleaning robot**s. This method should be the basis for further definitions of annual energy consumption for **cleaning robot**s, and also mobile household robots.

NOTE This test can be performed with the coverage test (Clause 7).

8.1.2 Test conditions

8.1.2.1 Test room conditions

For the energy consumption measurement tests, the ambient temperature and humidity shall be recorded.

NOTE Lighting conditions are defined in 9.3.3.

8.1.2.2 Charging of the cleaning robot

The duration of the charging and maintenance mode shall be determined by the items below. Proceed in order until a charging duration is determined.

1) If the battery charger, the robot, the battery itself, or any kind of user interface (e.g. app), has an indicator to show that the battery is fully charged, that indicator shall be used as follows:

   - If the indicator shows that the battery is fully charged within 19 h of charging, the test shall be terminated at 24 h.

- Conversely, if the full-charge indication has not appeared within 19 h of charging, the test shall continue until 5 h after the indication is present.

2) If there is no indicator, but the manufacturer's instructions indicate that charging this battery or this capacity of battery should be complete within 19 h, the charging shall be for 24 h. If the instructions indicate that charging may take longer than 19 h, the charging shall be run for the longest estimated charge time plus 5 h.

3) If there is no indicator and no time estimate in the instructions, but the charging current is stated on the charger or in the instructions, calculate the charging duration as the longer of 24 h or:

$$D = 1{,}4 \times \frac{C_C}{I_C} + 5\,\text{h}$$

where

D is the charge duration, in h;

C_C is the rated charge capacity, in Ah;

I_C is the charge current, in A.

4) If none of the above applies, the duration of the charging shall be 24 h.

8.1.2.3 Selection of selectable functions

The operation mode, accessories and user-selectable settings in which the tests are performed shall be reported. If this test is to be used for comparison, the mode and the setting shall be chosen as similar as possible.

8.1.2.4 Measuring equipment

All power measurements shall be made in accordance with IEC 62301.

8.1.3 Test method

The general states for measuring the energy consumption of **cleaning robot**s are defined as:

1) **Docking station** without **cleaning robot**.

Use case example: the robot is not connected to the **docking station** while operating and it is not ready to charge. The **docking station** is connected to the mains.

The energy consumption of the **docking station** shall be measured for a minimum of 1 h. After a warm-up period of 30 min, the average of the remaining 30 min shall be reported for the energy consumption. If, during the last 30 min, a spike or change in the power consumption is observed, the measurement period shall be increased until the power consumption is stable for 30 min. For devices without a **docking station**, the measurement shall be done by using the no-load power consumption of the adapter.

Definition of a spike: change of power with respect to average power consumption of > 20 % for longer than 1 min

Definition of stabilized: no spike within 30 min

For the state 1 "**Docking station** without **cleaning robot**", the average power consumption shall be calculated and reported. The average power consumption is defined by measuring the energy consumption divided by the measurement time of 30 min. During the 30 min measurement time, the robot shall clean in the presence of the docking station for the first 15 min and afterwards the robot shall be turned off for the remaining 15 min.

If there is no communication between the robot and the **docking station** during a cleaning process, then the robot is not required to be present for this part of test.

NOTE This is equivalent to the stand-by mode of the **docking station** without a robot.

2) Measuring the energy consumption during charging after operating in the coverage test bed in accordance with 9.3. Autonomous navigation/coverage test.

Start with a fully charged robot. If the robot has a docking station, place the robot on the docking station at position 2, otherwise place the robot at position 2, of the navigation test bed if the robot resumes operation. Wait for the robot to indicate that the operation is completed. If there is no indication and the robot returns to the **docking station**, wait 5 h to see if the robot resumes operation automatically.

If the robot resumes the operation, both the energy consumption measurement and the operation time shall include these in-between charge cycles. If the robot does not resume the operation, the operation time shall only include the time until the robot returned to the docking station.

If the robot does not have an automatic docking function, the robot shall be placed at the docking station at the indication of the end of the operation.

Energy consumption shall be measured for a duration as defined in 8.1.2.2.

State 2 energy consumption shall be the energy consumed from the time the robot reaches the dock for the first time up to the point where the power has stabilized in accordance with IEC 62301 to the average power level of state 3.

The beginning of state 2 is when the robot reaches the dock for the first time. The end of state 2 (or the beginning of state 3) is determined based on the average power level calculated from the energy consumption measured during the last 4 h.

NOTE Some robots may not start to charge or/and fully charge after the return of the robot to the docking station.

3) Fully charged robot at the **docking station**

State 3 power is the average power calculated based on the energy consumption measured during the last 4 h of a test, with a minimum charge duration as defined in 8.1.2.2.

The time period for measuring the energy consumption is defined in Table 7.

Table 7 – Overview of duration and the values that should be reported

State	Description	Duration of measurement	Reported values
1	**Docking station** without **cleaning robot**	30 min	Average power consumption $P_{B,avg}$
2	Measuring the energy consumption during charging after operating in the IEC navigation test room	Depending on charging and operating time	Overall energy consumption E_C Overall charging time t_C Overall operation time t_o
3	Fully charged robot at **docking station**	4 h	Average power $P_{C,avg}$

where

$P_{B,\ avg}$	Average power consumption (W) of the **docking station** without a **cleaning robot**
$P_{C,\ avg}$	Average power consumption (W) of the **docking station** with a **cleaning robot**
E_c	Overall energy consumption (Wh) during recharging (until **cleaning robot** is fully charged)
t_C	Time needed for recharging
t_o	Time spent operating in the coverage test bed (the time used for recharging during the operation shall be included)

NOTE 1 State 3 is an important part of the robot's use, but details about this state are not yet agreed. Methods for measuring state 3 are not yet included in the document because the associated technologies and complexities of charging systems make establishing an unbiased and consistent method difficult. The method is under consideration for a future revision.

NOTE 2 For state 3, the final 4 h of state 2 measurement can be used.

NOTE 3 The coverage and the run time during this test are expected to be similar to the test results in Clause 7 (coverage test).

8.2 Airborne acoustical noise

Where an airborne acoustical noise measurement is required, it shall be measured in accordance with IEC 60704-2-17 and IEC 60704-1.

NOTE 1 The possible procedure for the statistical determination of declared noise values is described in IEC 60704-3.

8.3 Straight-line cleaning speed

8.3.1 General

This test is a method for determining the average maximum straight-line cleaning speeds of the robot on carpet and on hard floor.

8.3.2 Preparation

8.3.2.1 Test bed

Refer to 9.3.

Exception: remove all legs (table, chairs, and sofa legs). Replace the carpet with a Wilton type carpet in accordance with the Wilton Carpet of IEC TS 62885-1.

8.3.2.2 Preconditioning of test floor

Refer to 5.2.2.

8.3.2.3 Pre-treatment of cleaning robot

Refer to 7.2.2.2.

8.3.2.4 Pose tracking system (PTS)

Refer to 7.2.2.3.

8.3.3 Test method

The robot shall be placed and started in the start position 2 as defined in Figure 15.

The **cleaning robot** should operate its active cleaning function until it comes automatically to a stop.

The entire duration of the test shall be monitored using the **PTS**. Upon completion of the **run**, the **PTS** shall provide the machine poses for the duration of the **run** at 500 ms intervals.

The straight-line cleaning speed, s_{avg}, measured on the hardwood floor is called s_{avg_hard} and the straight-line cleaning speed, s_{avg}, measured on the carpet floor is called s_{avg_carpet}. s_{avg_carpet} shall be obtained using poses that are on the carpet and s_{avg_hard} shall be obtained using poses that are in an area of the size of the carpet, which is 100 mm apart from the east of the carpet and vertically aligned with the carpet, see Figure 17. The speed of the robot shall be measured only when the whole body of the robot is inside of the relevant measurement area.

From this data, the average robot speed shall be calculated in accordance with 8.3.4.

8.3.4 Determination of straight-line cleaning speed

For three consecutive poses (x, y, θ), (x', y', θ') and (x'', y'', θ'') at times t, t' and t'', the translational velocity, $\hat{v}$, between the two points can be estimated by the following equations if the assumption is made that both the rotational and translational velocities are constant between them:

$$d = \sqrt{(x'-x)^2 + (y'-y)^2}$$

$$\Delta t = t' - t$$

$$\hat{v} = \frac{d}{\Delta t}$$

$$\hat{\omega} = \frac{|\theta' - \theta|}{\Delta t}$$

$$\hat{a} = \frac{\sqrt{(x''-2x'+x)^2 + (y''-2y'+y)^2}}{(t''-t')(t'-t)}$$

where

Δt is the time difference between the consecutive poses, expressed in s;

d is the distance between consecutive poses, expressed in m;

$\hat{v}$ is the translational velocity between consecutive poses, expressed in m/s;

$\hat{a}$ is the translational acceleration between consecutive poses, expressed in m/s^2;

$\hat{\omega}$ is the rotational velocity between consecutive poses, in °/s.

Only the average straight-line speed of the robot on hard floor and carpet is of interest. For this reason, it is necessary to extract only the sequential pairs of poses from the **PTS** track result that represent the machine when travelling in a straight line. This can be achieved by removing pairs that represent when the machine is stationary and when it is rotating, and when it is accelerating or decelerating

Pairs of poses shall be rejected when any of the following criteria are true:

$$\hat{v} \leq 2 \text{ cm/s}$$

$$\hat{\omega} \geq 10 \text{ deg/s}$$

$$\left|\hat{a}\right| \geq 2 \text{ cm/s}^2$$

Count the number of pose pairs remaining. Perform additional cleaning runs (following the preparation specified in 8.3.2 for each run) until you have gathered at least 250 pose pairs for carpet and 250 pose pairs for hard floor. This data can still have a lot of variation, especially on carpet (where pile direction can impact robot speed). To get more consistent results, sort the pose pairs by speed and select only the values that fall between the 85th and 99th percentiles (high speed).

NOTE For example, in a 100-data-point set, the 85th percentile would be the 85th datapoint when sorting low-high

From the remaining pose pairs, which now represent the times when the robot is performing straight-line motion at the maximum speed, the average straight-line speed can be calculated. s_{avg_hard} is the average of all remaining pose pairs in the hard floor **test area** and s_{avg_carpet} is the average of all remaining pose pairs in the carpet **test area**.

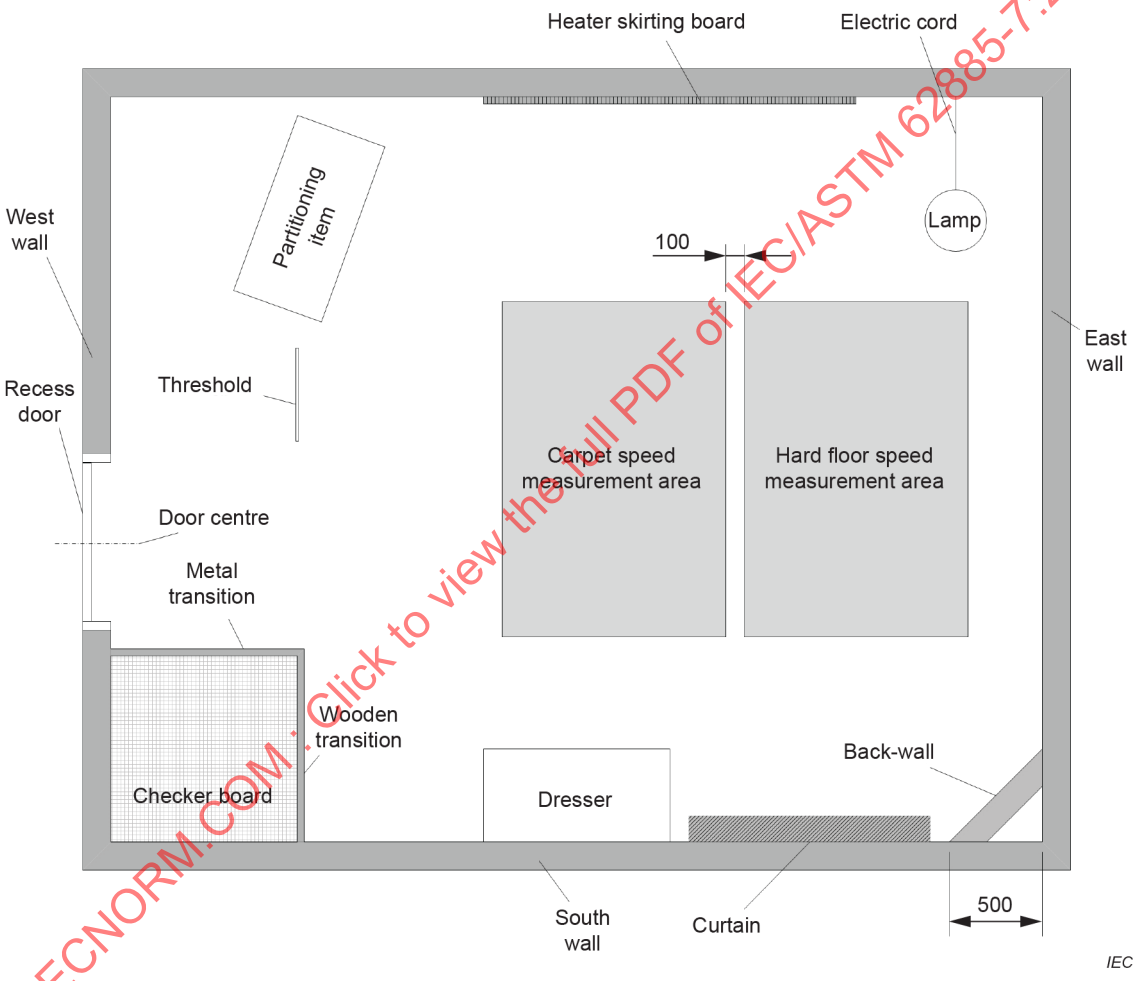


Figure 17 – Straight-line speed measurement areas

9 Test material and equipment

9.1 Straight-line test bed

9.1.1 Hard floor

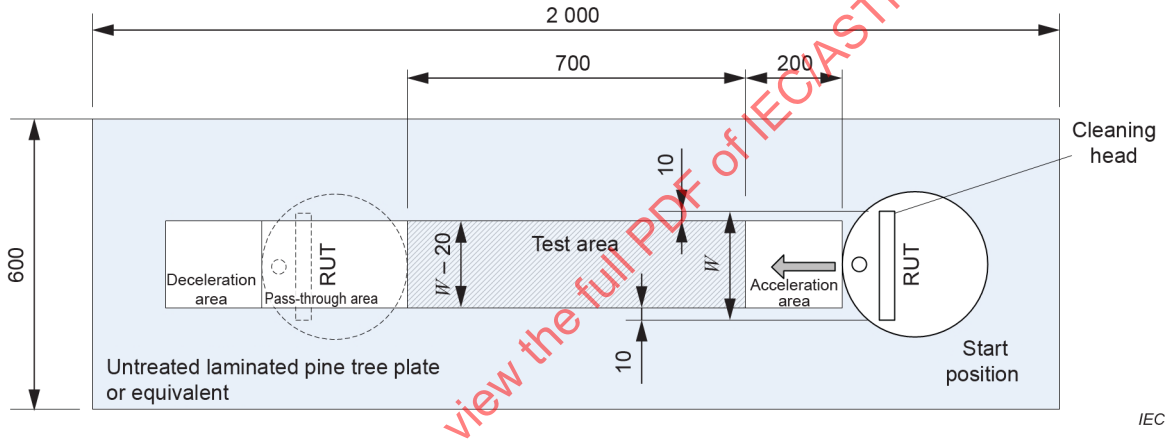
The length and the width of the test bed shall be 2 000 mm (minimum) × 600 mm, as specified in Figure 18.

The **test area** shall be 700 mm × (W − 20) mm, where W is the **width of robot cleaning head**.

NOTE The 20 mm reduction in width of the **test area** is to avoid spreading dust outside of reachable width by the robot. The additional 200 mm on each end of the **test area** is designed to enable the robot to reach its specified speed before it enters the **test area**.

The test floor shall be untreated laminated pine tree plate or equivalent, and its thickness shall be at least 15 mm.

Dimensions in millimetres



Key

W **width of robot cleaning head**

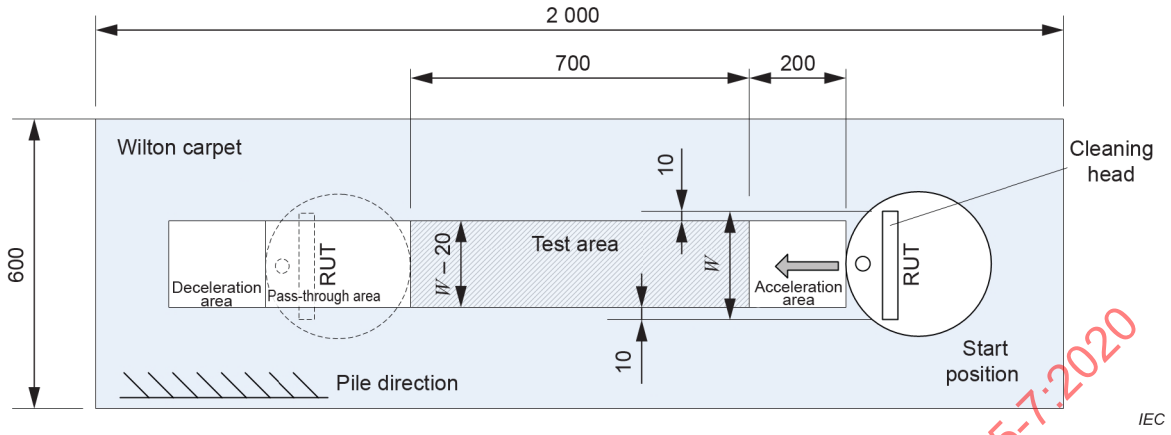
RUT robot under test

Figure 18 – Straight-line hard floor test bed configuration

9.1.2 Carpet

The test bed is identical to that defined in 9.1.1 except the floor is covered with test carpet, which is the Wilton type carpet in accordance with IEC TS 62885-1. Figure 19 shows the configuration of the test bed.

Dimensions in millimetres



Key

W **width of robot cleaning head**

RUT robot under test

Figure 19 – Straight-line carpet test bed configuration

9.2 Mobility test bed

9.2.1 Basic test bed configuration

The length and the width of the test bed shall be 2 000 mm × 1 150 mm, as specified in Figure 20. The height of the wall surrounding the test bed floor shall be 300 mm tall. The inner side of the wall shall be untreated pine wood colour. The ceiling height of the room in which the test is executed shall not be higher than 3 500 mm. The test floor shall be untreated laminated pine tree plate or equivalent, and its thickness shall be at least 15 mm. This box is the basic test setup for each mobility test. For the different mobility tests, additional equipment is added, which is described separately for each test.

Dimensions in millimetres

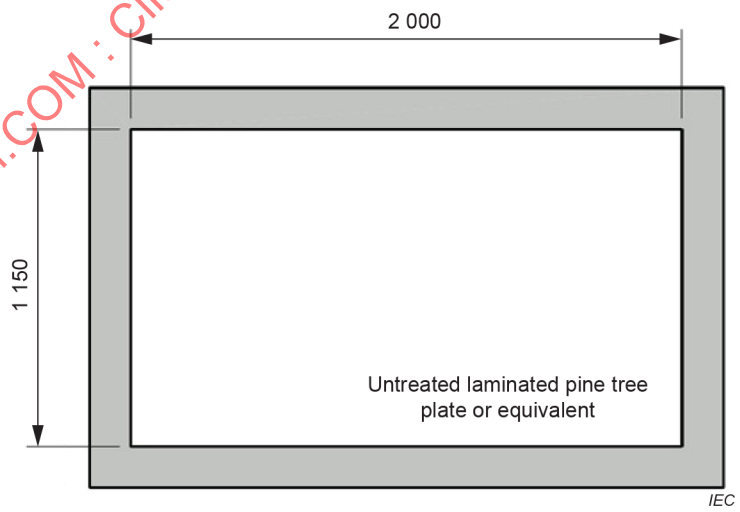


Figure 20 – Basic test bed configuration for mobility testing

9.2.2 Minimum passable gap width – additional equipment

For the minimum passable gap width an adjustable wall or equivalent equipment is added to the test box as shown in Figure 21. It shall be placed in the middle of the long side of the box. The height of each part of the additional wall is 300 mm and each is made of untreated laminated pine wood. As an example, the two parts of the wall are detailed in Figure 22. Part 1 of the wall shall be fixed to the surrounding box (e.g. with a bar clamp). The movable part 2 of the wall is guided by part 1. It has to be ensured that the wall does not bend, even if a **cleaning robot** bumps into it. Therefore, additional support can be added to the test bed as needed as long as it does not interfere with the behaviour of the robot.

Dimensions in millimetres

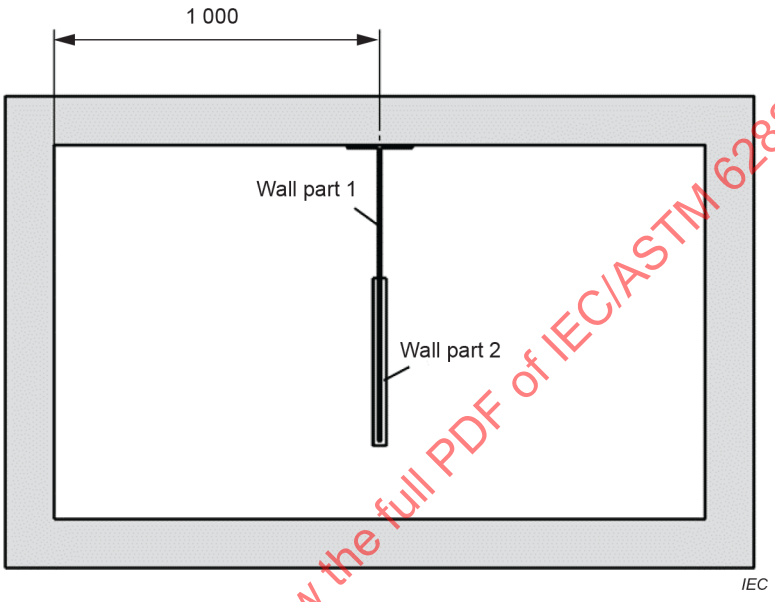


Figure 21 – Test bed with an additional adjustable wall

Dimensions in millimetres

Part 1 **Part 2**

Figure 22 – Part 1 and part 2 of the wall

9.2.3 Minimum passable height – additional equipment

For this test a tunnel is added to the test box as shown in Figure 23. The ceiling of the tunnel consists of untreated laminated pine wood with dimensions of 1150 mm × 665 mm × 20 mm. Both sides of the tunnel should have a front plate of 150 mm height. The ceiling shall be fixed to spacers with a length and width of 40 mm × 40 mm. The height of the spacers is variable and changes with the size of the gap. Equivalent test equipment can also be used to construct and adjust the tunnel. The tunnel is centred in the test box. The obstacle shall not be movable by **the cleaning robot** and the tunnel can be fixed to the surrounding wall if necessary.

To test all discrete gap sizes up to 200 mm, a set of spacers consisting of 4 × 100 mm, 4 × 50 mm, 8 × 20 mm, 4 × 10 mm and 4 × 5 mm is suggested. It is recommended to use the minimum number of spacers to construct a height.

NOTE To prevent the ceiling from significant bending, it is allowed to add, for example, additional ribs on the top side of the tunnel.

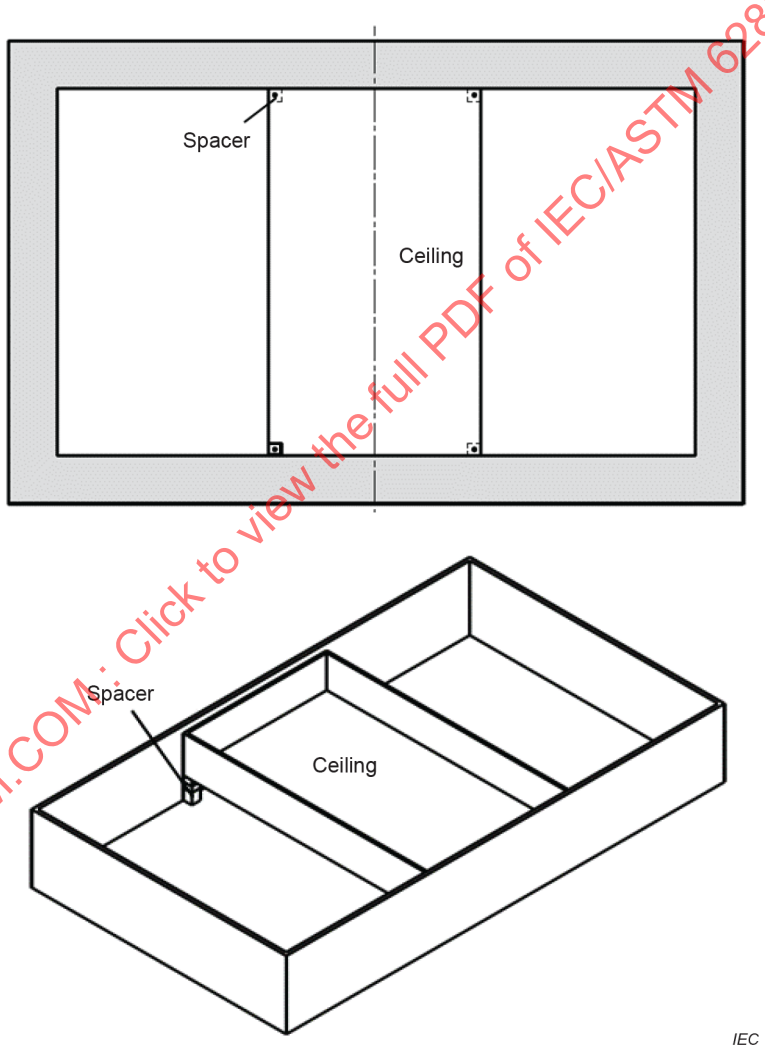


Figure 23 – Test bed with an additional tunnel

9.2.4 Maximum passable transition height – additional equipment

For this test, an additional transition is added to the test bed, as shown in Figure 24. The transition is placed in the left half of the test box. The transition shall be made of untreated oak or equivalent wood material. The outside edge of the transition shall have a radius of 3 mm. Equivalent methods of constructing and adjusting the transition can also be used.

NOTE It is allowed to use different layers to construct the different height h of the transition. The sheets for height do not have to be made of untreated oak or equivalent.

Dimensions in millimetres

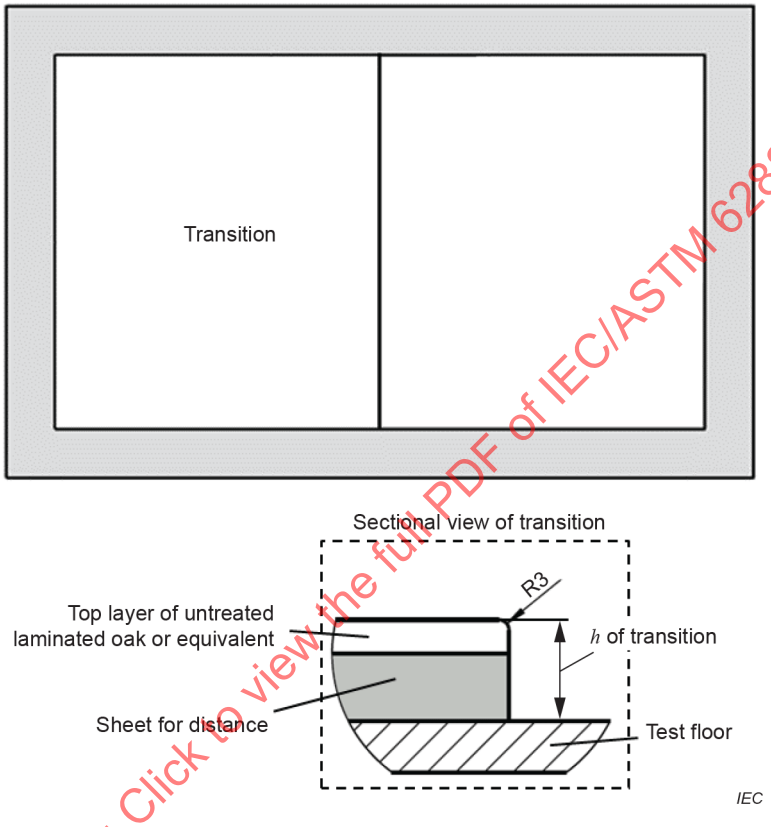


Figure 24 – Test bed with additional transition and its sectional view

9.2.5 Maximum passable threshold height – additional equipment

For this test, an additional threshold is added to the centre of the test bed, as shown in Figure 25. In this test, two different types of thresholds, cylindrical and rectangular, are used (see Figure 26). The test height h of the cylindrical threshold is the diameter of the full circle. The rectangular thresholds have a width of 40 mm and the edges have a radius of 3 mm. The thresholds are made of aluminium with unground or untreated surface. The additional threshold shall be fixed to the test box so that it cannot move in any direction (e.g. rolling or bending).

NOTE It is allowed to use different layers to construct the different height h of the rectangular threshold. The sheets for height do not have to be made of aluminium.

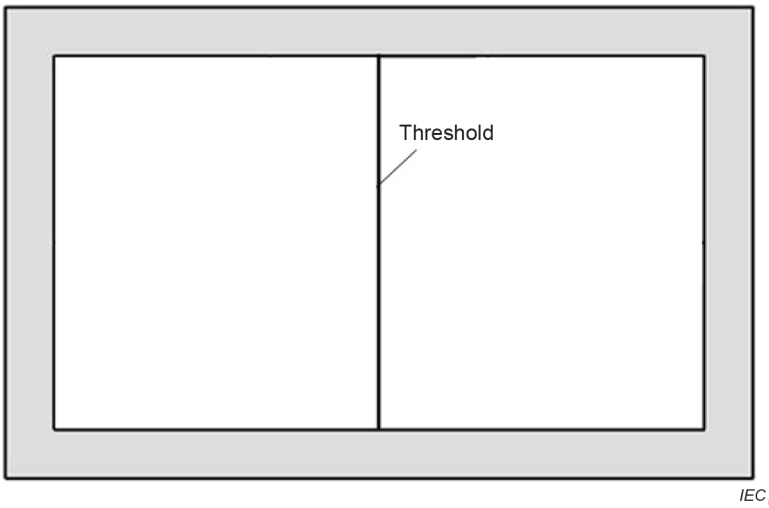


Figure 25 – Test bed with additional threshold

Dimensions in millimetres

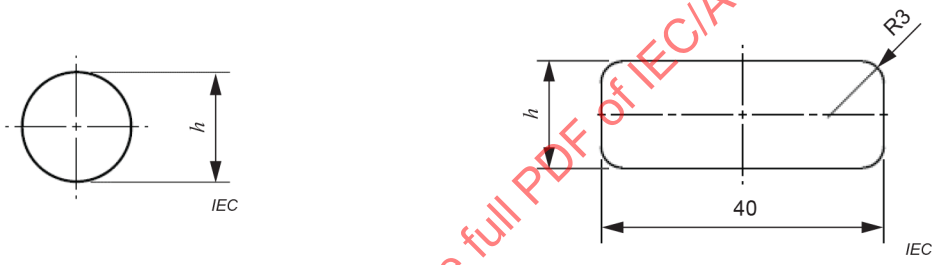


Figure 26 – Drawings of cylindrical and rectangular thresholds

9.3 Coverage test bed

9.3.1 Floor configuration

The **test area** shall consist of a space measuring 4 000 mm × 5 000 mm ($L \times W$) (tolerance ±50 mm) enclosed by four walls and a ceiling. The ceiling shall be at a height of 2 500 mm (±50 mm) from the surface of the test bed floor (not to be measured from the tile, rod, carpet, or other obstructions).

The floor shall be clear unfinished pine in the form of planks, laminate, or sheet goods. The surface should be continuous without knots, grooves and/or protrusions. Any voids between planks, laminate or panels shall be no greater than 1 mm. The floor shall be coplanar with not more then 0,5 mm between any segment of the floor surface unless specified within other clauses of this document (carpet, test rods, thresholds, tile, etc.). If the floor shifts to the point that the coplanar is no longer within tolerance, the floor may be finish sanded with 120-150 grit sand; however, in no place should a laminate or sheet be sanded through to expose glue and/or other layers of the floor.

The floor of the test bed for the navigation/coverage performance test shall be as described in Figure 27 to Figure 31. The furniture and obstacles shall be placed as shown in Figure 27. The dimensions and characteristics of the furniture and obstacles on the floor are specified in Table 8.

All coated surfaces defined within this document shall conform to gloss guidelines set forth in ISO 2813.

Dimensions in millimetres

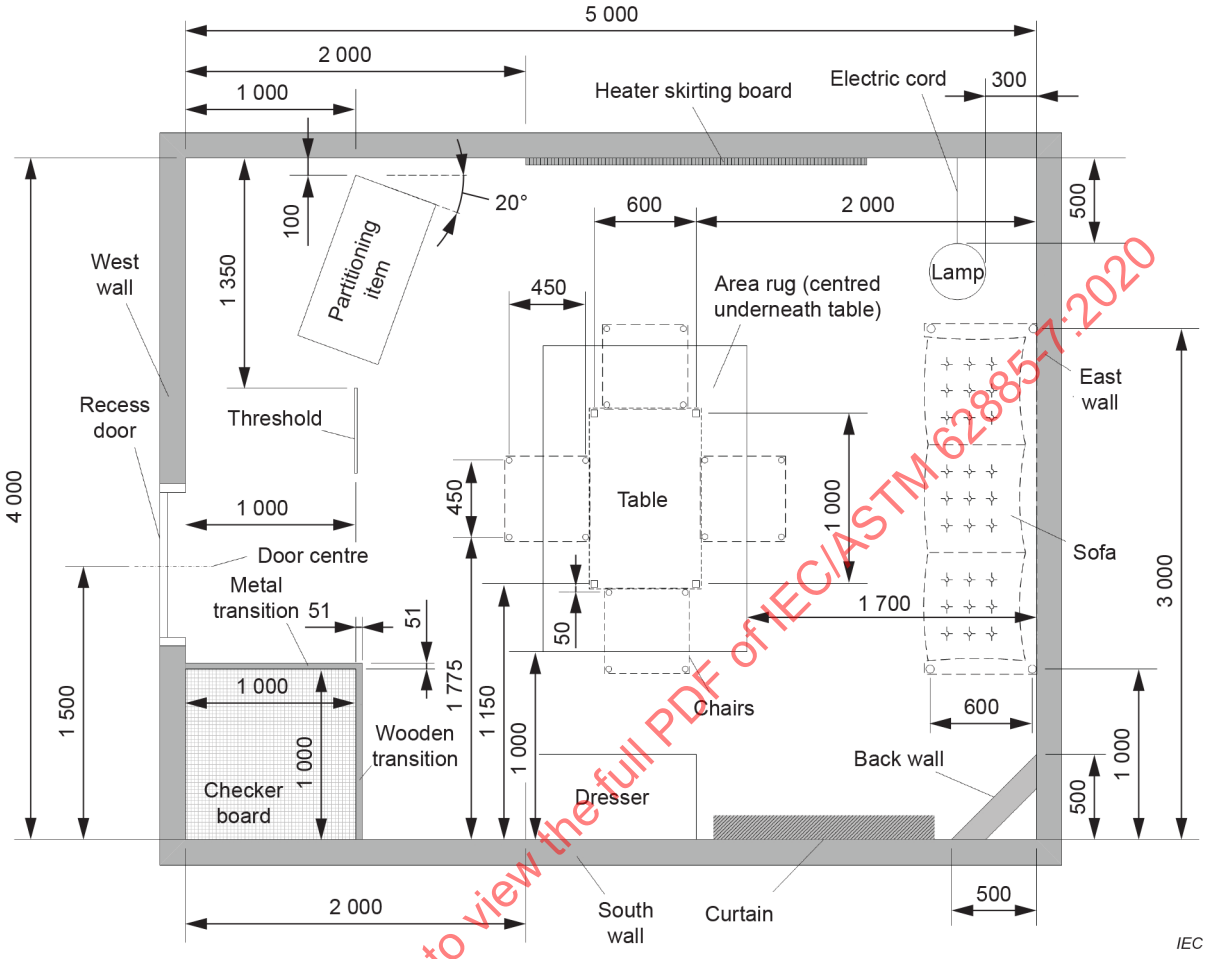


Figure 27 – Navigation/coverage test bed configuration

Dimensions in millimetres

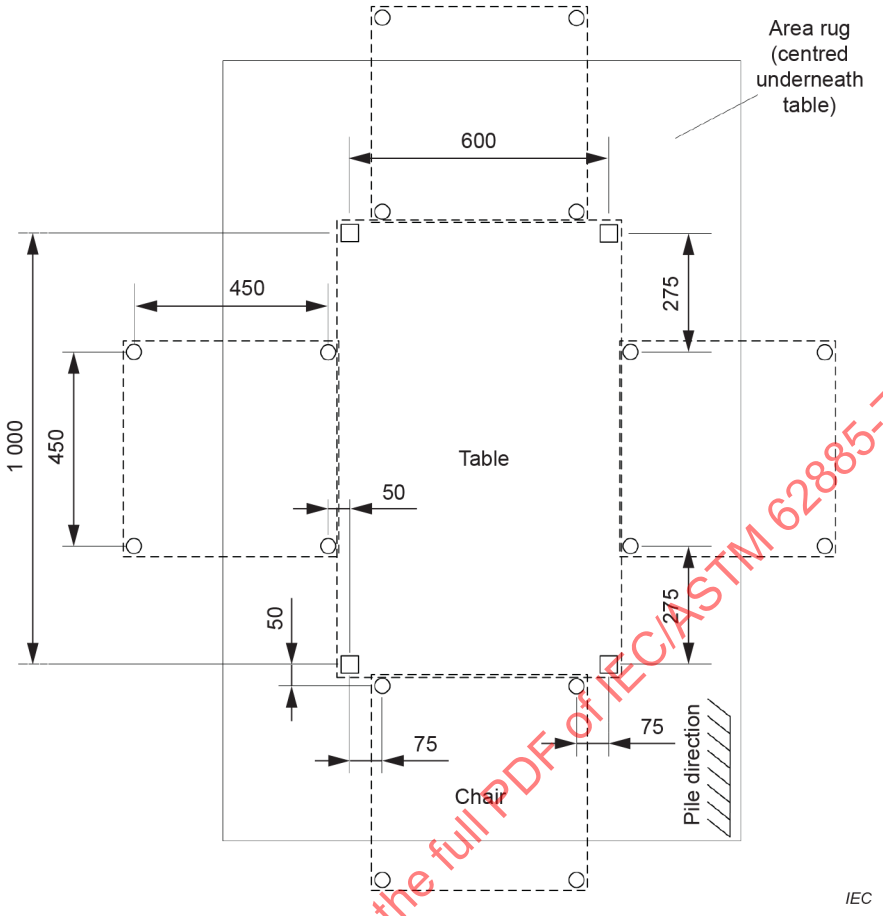


Figure 28 – Details of obstacles around table

Table 8 – Dimensions of furniture and obstacles

Item	Quantity	Dimensions (mm)	Surface/ Colour	Remarks
Dresser	1	1 000 (L) 500 (W) 300 (H)	White RGB #FFFFFF, 5 < Gloss <= 25 GU	It is fixed to the floor. Underneath of the dresser shall be blocked. No legs.
Table	1	1000 (L) 600 (W)	Natural Cherry wood (unfinished) or smooth surface with RGB #D2A273, 5 < Gloss <= 25 GU	4 legs of 40 mm (T) × 40 mm (W) × 300 mm (H) Distance of 1 000 mm (L) and 600 mm (W) are between centrelines of legs. Legs are fixed to the floor and shall not be able to rotate.
Chairs	4	450 (L) 450 (W)	Natural Cherry wood (unfinished) or smooth surface with RGB #D2A273 5 < Gloss <= 25 GU	4 legs of 35 mm (D) × 300 mm (H). Distance between centrelines of legs is 450 mm. Legs are fixed to the floor.
Sofa	1	2 000 (L) 600 (W)	White RGB #FFFFFF, 5 < Gloss <= 25 GU	4 legs of 48 mm (D) × 300 mm (H). Distance of 2 000 mm (L) and 600 mm (W) are between centrelines of legs. Legs are fixed to the floor.

Item	Quantity	Dimensions (mm)	Surface/ Colour	Remarks
Partition-ing Item	1	1 000 (L) 500 (W) 300 (H)	Grey RGB #767676, 5 < Gloss <= 25 GU	No legs. All sides are enclosed. It is fixed to the floor.
Floor lamp	1	330 (D) 300 (H)	White RGB #FFFFFF, 5 < Gloss <= 25 GU	Base is 5 mm (H) at the outer edge with 10° upward slope. Diameter of the pole at the centre is 30 mm. It is fixed to the floor.
Floor electrical wire	1	6 (D) 900 (L)	Black	One end is fixed at the plug on the north wall at height of 350 mm and the other end is fixed under the North side of the lamp base (notch the lamp base). It is not fixed on the floor and shall have an uninterrupted length of at least 850 mm but not more than 900 mm between the plug and the edge of the lamp. NOTE 1 If the outlet is power supplied, it's advised to cut the live blades of the plug or in any other way prevent personal injury or fire.
Cylindri-cal bar	1	15 (D) 500 (L)	Untreated or unground surface	It is cylindrical shape and made of aluminium. It is fixed to the floor. NOTE 2 It represents a cylinder shape support of chairs.
Heater base-board	1	2 000 (L) 40 (T) 300 (W)	Natural Cherry wood (unfinished) or smooth surface with RGB #D2A273, 5 < Gloss <= 25 GU	It is secured on the wall and floor. It is fixed on the floor.
Area rug	1	1 680 (L) 1 200 (W) 10 (H)	Ivory (colour of Wilton Carpet or similar)	Wilton carpet or similar. Fixed to the floor by means of the chair and table legs (see Figure 28) as well as in each corner (to avoid curling)
Checker board	1	1 000 (L) 1 000 (W) 8~10 (H)	Black and White	Each tile will be square and of the same size: 88 mm to 110 mm (width and depth) × 7 mm (height) White tile shall be glazed with gloss ≥ 70 GU Black tile shall be glazed with gloss ≥ 10 GU Tiles shall be placed tightly together with a tolerated gap of 0,5 mm to 1 mm and tightly bordered by the wood and metal transitions to ensure no movement of tiles. Tile may be glued to substrate beneath the tile. Tile cuts shall be against the south and west walls with full tile under the transitions. See Figure 31
Metal transition	1	51,0 (W) 12,5 (H)	Aluminium untreated or clear powder coated/ anodized	Aluminium It is M-D Building Products® [1] (36 in length × 2 in width, model #43858, polished) or similar. It is fixed to the floor. For the corner where the metal transition meets the wooden transition, both transitions shall be cut to 45° and have no sharp edges. See Figure 29 for dimensions and Figure 31 for installation.

Item	Quantity	Dimensions (mm)	Surface/ Colour	Remarks
Wooden transition	1	51,0 (W) 12,5 (H)	Unfinished clear maple or similar clear hardwood	Wood The wood transition shall be cut as shown in Figure 30. It is fixed to the floor. See Figure 30 and Figure 31 for installation.

Key

L Length
W Width
T Thickness
H Height
D Diameter

All colours are specified in web colour RGB format and intended to be an indicative guide of the colour. Colour can vary by ±5 in each RGB value.

All gloss levels are as per ISO 2813 and measured at 60°.

[1] Model #43858 is the trade name of a product supplied by M-D Building Products®. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named. Equivalent products may be used if they can be shown to lead to the same results.

Dimensions in millimetres

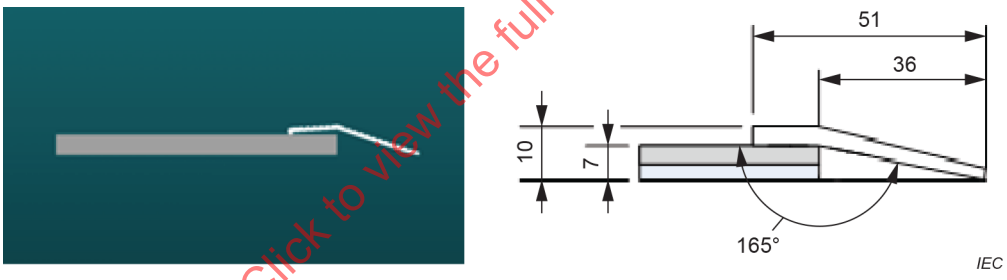
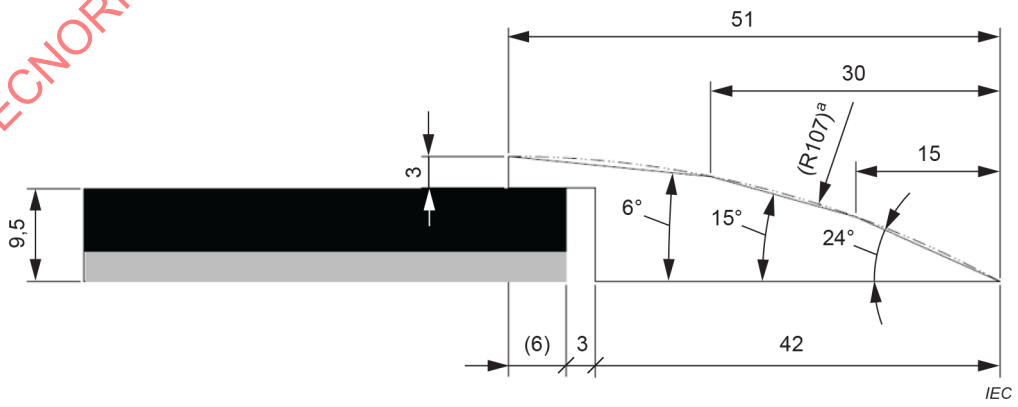


Figure 29 – Illustration of metal transition installation

Dimensions in millimetres



[a] Reference only

Figure 30 – Illustration of wood transition installation

Dimensions in millimetres

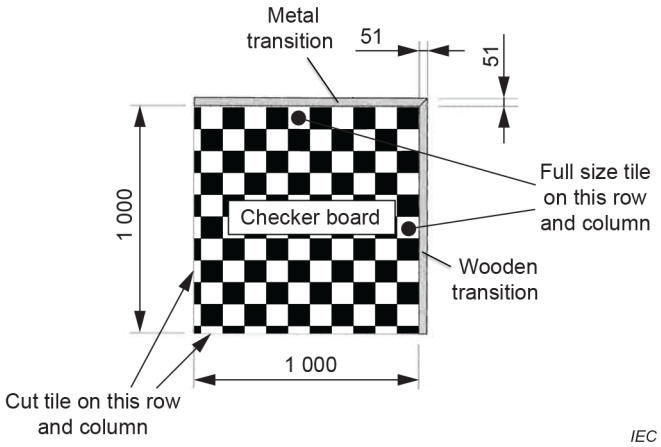


Figure 31 – Detail view of checkerboard and transitions

Dimensions in millimetres

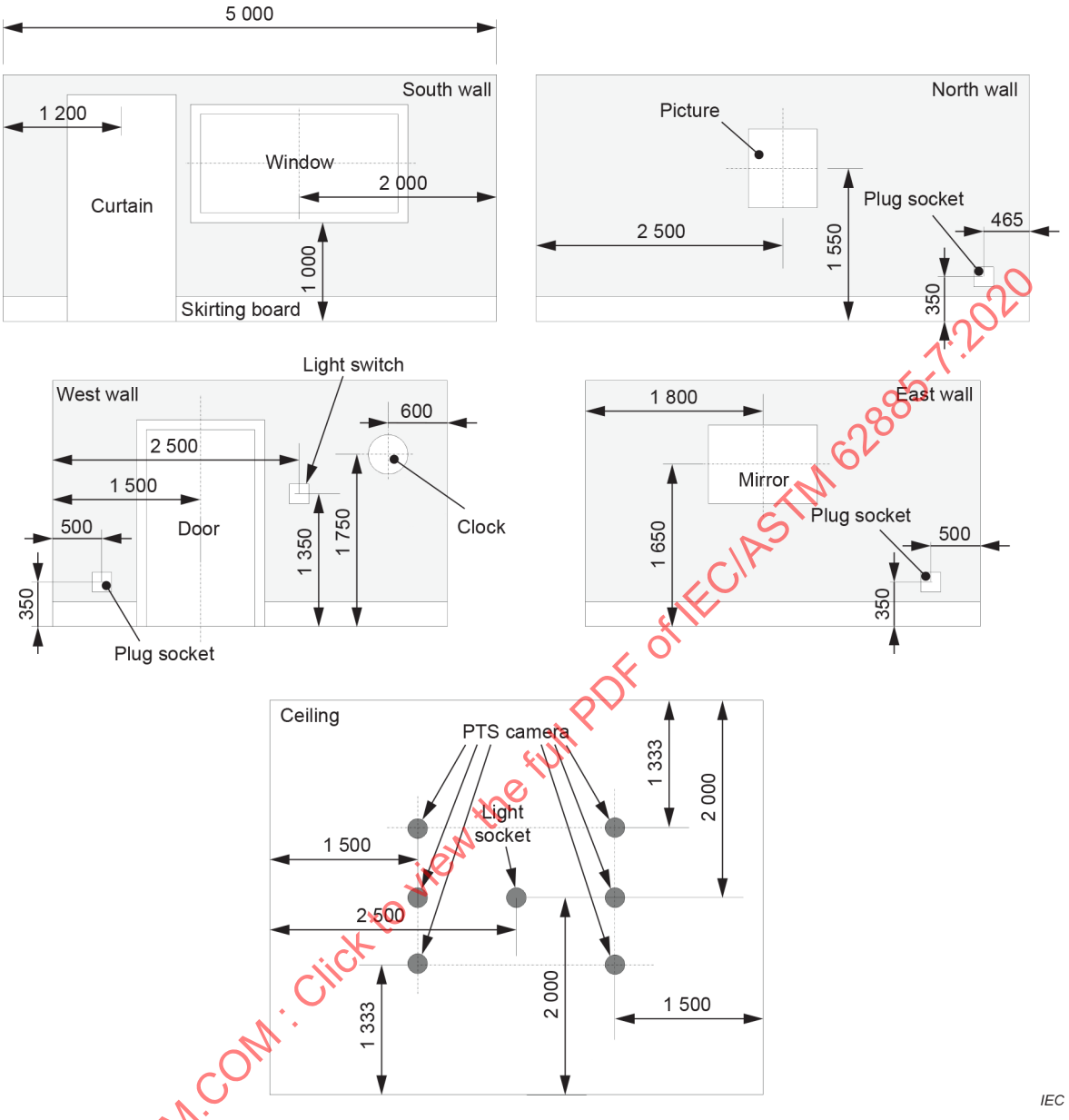


Figure 32 – Configuration of four walls and ceiling

9.3.2 Wall and ceiling configuration

9.3.2.1 General

The configuration of wall and ceiling of the test bed shall be in accordance with Figure 32. The ceiling shall be at a height of 2 500 mm (±50 mm) from the surface of the test bed floor (not to be measured from the tile, rod, carpet, or other obstructions). The ceiling shall be level and parallel to the floor within ±6 mm across the entire ceiling.

Table 9 contains a list of the objects and features that shall be present on the walls, no other visible features are permissible. This table also provides the dimensions, characteristics and locations for each item.

The walls shall be full height from floor to ceiling with no gaps or discontinuities other than those described in Table 9. The walls shall be plumb within 4 mm from celling to floor and be square to adjacent walls within 4 mm across the full wall.

The light socket shall be located in position described in Figure 32. Figure 32 figure also shows a suggested location for the PTS sensors in the ceiling, but these specific locations are not required to be used.

These additional ceiling features shall be installed as flush to the ceiling as possible and shall be the same colour as the ceiling wherever possible.

The walls and ceilings shall be covered or painted as described in Table 9. The surfaces of the walls and ceilings shall be level and have no discernible texture (maximum local geometric variation ±1 mm).

See ISO 2813 for defining and testing gloss levels.

Table 9 – Wall and ceiling furniture

Item	Quantity	Dimensions (mm)	Surface details	Remarks
North wall	1	5 000 (L)	Magnolia RGB #EEE8EB, Gloss <= 5 GU	All walls shall be constructed in such a manner that they do not move or deform in any way when the robot comes into contact with them
South wall	1	5 000 (L)	Magnolia RGB #EEE8EB, Gloss <= 5 GU	See above
East wall	1	4 000 (L)	Magnolia RGB #EEE8EB, Gloss <= 5 GU	See above
West wall	1	4 000 (L)	Magnolia RGB #EEE8EB, Gloss <= 5 GU	See above
Ceiling	1	4 000 (W) 5 000 (L)	Magnolia RGB #EEE8EB, Gloss <= 5 GU	See above
Door	1	750 to 850 (W) 1 950 to 2 050 (H)	White RGB #FFFFFF, 70 < Gloss <= 85 GU	Refer to Figure 33 and associated text With a silver door handle/knob
Door jam	1	19 to 26 (T) 100 to 166 (W)	White RGB #FFFFFF, 70 < Gloss <= 85 GU6	See Figure 33
Door stop	1	6 to 9 (T) 30 to 40 (W)	White RGB #FFFFFF, 70 < Gloss <= 85 GU6	See Figure 33
Rectangular casing	1	10 to 18 (T) 50 to 100 (W)	White RGB #FFFFFF, 70 < Gloss <= 85 GU	See Figure 33, and the thickness (T) of the casing shall be the same as the skirting board

Item	Quantity	Dimensions (mm)	Surface details	Remarks
Window	1	1 800 to 2 200 (W) 900 to 1 100 (H)	Frame: white RGB #FFFFFF, 70 < Gloss <= 85 GU The panel shall be mounted on the back of the window, behind the panes, which shall be painted blue (RGB #99CCFF Gloss <= 5 GU	Refer to Figure 34 and associated text
Skirting board	4	75 to 125 (H) 10 to 18 (T)	North and west sides: white RGB #FFFFFF, 70 < Gloss <= 85 GU East and south sides: untreated clear pine or equivalent grain depth and colour wood	Refer to Figure 35 and associated text
Backwall	1	300(H)	Untreated pine tree or similar	
Light switch	1	70 to 110 (W) 70 to 140 (H) 0 to 15 (T)	Plastic: white	Single switch. Does not have to be connected to the light in the **test area**
Plug socket	1	70 to 110 (W) 70 to 140 (H) 0 to 15 (T)	Plastic: white	Single socket. Does not need to be live.
Pendant light socket	1	250 to 300 (L)	White	Length indicates drop height from ceiling to base of bulb. Refer to Figure 36.
PTS sensor	2 to 4			Mounted flush to the ceiling
Clock	1	300 (D) 50-75 (T)	Frame: grey RGB #808080, 70 < Gloss <= 85 GU Face: White RGB #FFFFFF, Gloss <= 5 GU	The clock does not have to be a real clock. Refer to Figure 37.
Mirror	1	1 000 (W) 750 (H)	Frame: grey RGB #808080, 70 < Gloss <= 85 GU	Refer to Figure 38.

Item	Quantity	Dimensions (mm)	Surface details	Remarks
Picture	1	600 (W) 750 (H)	Frame: grey RGB #808080, 70 < Gloss <= 85 GU Face: Green RGB #99FF99, Gloss <= 5 GU	Refer to Figure 39.
Curtains	1	1 250 to 1 500 (W) 2 000 to 2 200 (H)	Dark green within 0,5 % of any red or green pigments deviation of one of the following 59621D, 4E5B31, 555025,	Material used shall be plain, opaque, and heavy enough to hang without creasing. Centreline of the curtain shall be 1 100 mm from the wall. Refer to Figure 40.

Key

L Length
W Width
T Thickness
H Height
D Diameter

All colours are specified in web colour RGB format in HEX and intended to be an indicative guide of the proposed colour. Colour can vary by an absolute tolerance of ±5 in each RGB value.

9.3.2.2 Door specification

The components and configuration of the door shall follow the guidelines set forth in Figure 27, Figure 32, and Figure 33. The door shall have four inset or moulded panels. The door shall have the following attributes:

1) Door (composite or solid wood)
2) Either 0 or 2 to 4 hinges. If hinges are used, they shall not be visible from within the test room when the door is closed.
3) Doorknob (cylindrical or lever style, silver, brushed or polished finish).
4) Door frame/jamb (wood, composite, or metal, suitable to hold the weight of the door and support the hinges).
5) Door stop (built into the frame or affixed to the frame). Installed within 1 mm to 1,5 mm against the door.
6) Casing (only needed on the interior of the room and shall be the same thickness as the skirting board).

Door configuration/specifications:

1) Door shall be of the left-hand configuration (hinges on the left as one swings the door away from them).
2) Door size shall follow the dimensions within Table 9.
3) Door location shall follow the dimensions/placement in Figure 27 and Figure 32.
4) Door shall be recessed from the interior wall surface a minimum of 50 mm and not more 70 mm.
5) Door can be fixed in place.
6) Door shall open outward from the **test area** (only applicable if the door is not fixed in place).