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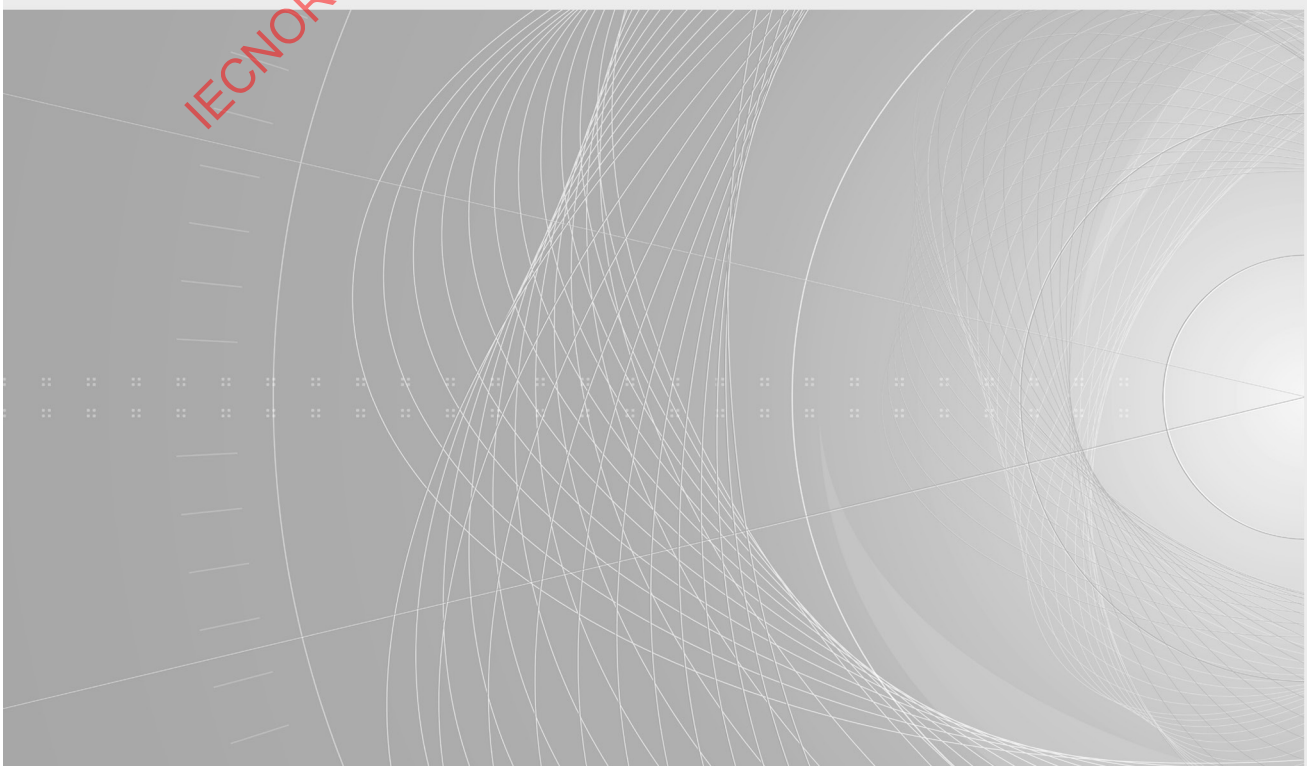
Edition 1.0 2025-01

INTERNATIONAL STANDARD

Functional performance criteria for AAL robots used in connected home environment



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FUNCTIONAL PERFORMANCE CRITERIA FOR AAL ROBOTS USED IN THE CONNECTED HOME ENVIRONMENT

FOREWORD

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IEC 63310 has been prepared by IEC SyC AAL: Systems Committee on Active Assisted Living. It is an International Standard.

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

Draft	Report on voting
SyCAAL/375/FDIS	SyCAAL/379/RVD

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

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

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

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

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The purpose of this document is to consider the needs and characteristics of an active assisted living (AAL) user and to integrate these into the development, design and evaluation of an AAL robot for use in the connected home environment (CHE).

With the increase of the global population aging, it is going to be increasingly difficult for family members or healthcare workers to adequately undertake home care duty. Personal service robots could be an option for addressing the resulting bottleneck in daily life and health care by supporting the independent living of the AAL user in their connected home environment. From a market perspective, global sales of robots have been increasing in recent years and this is expected to continue in the future. More and more autonomous robotic systems have been used widely by consumers in the home environment, especially in the AAL connected home environment (CHE). However, the gap analysis of standards shows that the current robots' functional performance standards do not focus on the characteristics and needs of the AAL user.

It is within the scope and responsibility of IEC SyC AAL to consider the needs and characteristics of the AAL user and to integrate these into AAL standardization work.

This document will make it possible to recognize and define AAL robots' function and performance and specific technical requirements in the CHE. This document will provide criteria and guidelines for the products design, testing and certification, and help to improve the quality of the robot products. AAL robots can be subject to additional relevant regulations and standards.

As a result, by providing AAL robots to the market that are in accordance with this document, the following benefits will be achieved:

- assist the AAL users (including AAL care recipients) to live more independently in their homes;
- increase AAL robots' market acceptance;
- facilitate AAL robots' industry scale acceptance.

FUNCTIONAL PERFORMANCE CRITERIA FOR AAL ROBOTS USED IN THE CONNECTED HOME ENVIRONMENT

1 Scope

This document deals with the functional performance criteria and guidelines for robots intended for use in the active assisted living connected home environment (AAL CHE).

This document does not cover safety requirements of robots.

This document is applicable to robots which provide the AAL user (or AAL care recipient) with one or more of the following services and support in the AAL CHE:

– information and data management;
– monitoring service;
– communication support;
– activity support;
– mobility support;
– other support.

AAL robots can be subject to additional relevant regulations and standards.

This document is not applicable to robots used for medical purposes.

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 60050-871, *International Electrotechnical Vocabulary – Part 871: Active Assisted Living (AAL)*, available at https://www.electropedia.org

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-871 and the following apply.

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

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

3.1
AAL
active assisted living
concepts, products, services, and systems combining technologies and social environment with the aim of improving the quality of people's lives

[SOURCE: IEC 60050-871:2018, 871-01-02]

3.2
AAL user
person who uses or benefits from, or uses and benefits from, AAL devices, systems or services

[SOURCE: IEC 60050-871:2018, 871-02-05, modified – The term "active assisted living user" has been omitted.]

3.3
AAL care recipient
person who receives and consumes AAL care services

Note 1 to entry: The concept denoted by the term "AAL user" (IEV 871-02-05) includes a wider range of people, including people who do not necessarily require AAL care services.

[SOURCE: IEC 60050-871:2023, 871-02-18]

3.4
connected home environment
CHE
home environment that provides a home network (IEV 732-10-01) so that devices within the home can communicate to one another and to devices outside the home

Note 1 to entry: AAL connected homes and smart homes share some commonalities.

[SOURCE: IEC 60050-871:2023, 871-05-10, modified – The abbreviated term "CHE" has been added.]

3.5
robot
programmed actuated mechanism with a degree of autonomy to perform locomotion, manipulation or positioning

Note 1 to entry: A robot includes the control system.

Note 2 to entry: Examples of mechanical structure of robots are manipulator, mobile platform and wearable robot.

[SOURCE: ISO 8373:2021, 3.1]

3.6
AAL robot
robot or robot system that provides AAL users with such services as monitoring, communication support, activity support, mobility support, and information and data management

3.7
functional performance
characteristics defining the ability of the products or systems to achieve the intended functions for which the products or systems are intended to be used

3.8
usability
extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use

[SOURCE: IEC 60050-871:2018, 871-01-08]

3.9
accessibility
extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of user needs, characteristics and capabilities to achieve identified goals in identified contexts of use

Note 1 to entry: Context of use includes direct use or use supported by assistive technologies.

[SOURCE: IEC 60050-872:2022, 872-04-01]

3.10
reliability
ability to perform as required, without failure, for a given time interval, under given conditions

Note 1 to entry: The time interval duration can be expressed in units appropriate to the item concerned, e.g. calendar time, operating cycles, distance run, etc., and the units should always be clearly stated.

Note 2 to entry: Given conditions include aspects that affect reliability, such as: mode of operation, stress levels, environmental conditions, and maintenance.

Note 3 to entry: Reliability can be quantified using measures defined in Section 192-05, Reliability related concepts: measures.

[SOURCE: IEC 60050-192:2015, 192-01-24]

3.11
independence
ability to perform an activity with no or little help from others, including having control over any assistance required rather than the physical capacity to do everything oneself

[SOURCE: WHO Ageing and Health Technical Report, Vol. 5]

3.12
ADL
activity of daily living
basic human action that involves physical self-maintenance ability

Note 1 to entry: ADL comprises the following six areas: transferring; bathing; eating; dressing; continence; grooming and toileting.

[SOURCE: IEC 60050-871:2023, 871-01-10]

3.13
IADL
instrumental activity of daily living
human action that involves physical/social/cognitive skills related to instruments for independent living in addition to ADL (IEV 871-01-10)

Note 1 to entry: IADL includes various actions: transportation; communication (i.e. use of telephone, e-mails); shopping; meal preparation; housekeeping; managing medications; managing personal finances.

[SOURCE: IEC 60050-871:2023, 871-01-12]

4 Independence level of AAL care recipient

According to the deterioration of independence levels of people over the course of their lives, the degrees of assistance needed by an AAL care recipient are divided into four levels:

- Level 0 – Independent: able to live independently with minimal assistance;
- Level 1 – Some assistance: able to live independently but some assistance is needed occasionally (not on a permanent basis);
- Level 2 – Assistance with IADL: assistance is needed with IADL (part time and/or full time);
- Level 3 – Assistance with ADL: assistance is needed with ADL (full time).

The degree of independence level of AAL care recipients should be considered throughout the entire process from design to operation of AAL robots.

5 General requirements

5.1 Power consumption

A manufacturer shall provide information on the power consumption of the product.

The power consumption of the robot shall include three parts:

a) power consumption of docking station without a robot;

b) power consumption (in W) or maximum current (in A) of the robot during charging with an almost empty battery;

c) power consumption of the fully charged robot at the docking station.

5.2 Airborne acoustical noise

The requirements for airborne acoustical noise emitted by the robot during operation for indoor use can be subject to national or regional requirements.

5.3 Usability

The performance of AAL robots shall meet the usability requirements of the AAL care recipient and of AAL users in general.

NOTE AAL users (including the AAL care recipient) in different AAL user domains have different usability requirements. At the same time, AAL users are not fixed to a specific AAL user domain, but rather change over from one domain to another.

5.4 Accessibility

AAL robots shall meet the accessibility needs for AAL users with different abilities and characteristics. Existing ISO/IEC guidelines and International Standards related to accessibility, such as ISO/IEC Guide 71, ISO/IEC 29138-1, IEC 63008, IEC 62944, etc., can be a reference.

5.5 Reliability

An AAL robot shall meet its performance characteristics for its expected service life under the specified conditions provided by the manufacturer. Reliability can be determined by mean time between failure (MTBF) or similar.

6 Functional performance requirements

6.1 Information and data management

6.1.1 General

Information and data management includes management that ensures the data security and the personalized data of the objects or groups supported by AAL robots.

National and regional regulations can apply as regards requiring the prior consent of the AAL user or the legal representative of the AAL user before obtaining the data of that user. These data should be obtained and used in a secure environment.

NOTE The environment includes the physical environment and the devices or robots interacting with the AAL robots in the physical environment.

6.1.2 Data security and privacy

6.1.2.1 Privacy

The protection of data privacy of the AAL user by AAL robots can be subject to national or regional requirements.

6.1.2.2 Encryption

AAL robots shall encrypt the data transmitted during the information transmission in the network.

6.1.2.3 Blocking unauthorized access

AAL robots shall prevent the unauthorized access, tampering and deletion of the information and data under their management, and they shall also be capable of identifying, evaluating and stopping the unauthorized access.

6.1.3 Personalized information and data management

AAL robots should be able to manage data based on supported object or group, supported activities and network deployment to provide personalized services.

For AAL robots, personalized information and data management can include all or part of the following content:

a) Supported object or group

AAL robots should be able to conduct personalized management of information and data on objects or groups based on user settings, data records and other related information, including living habits, individual hobbies, common activity support and personal information, etc.

b) Supported activities

AAL robots should be able to conduct personalized management of information and data based on the relevant information, such as type, time, and location, etc., of the activities of AAL robots.

c) Network deployment

AAL robots should be able to conduct personalized management based on information and data types of different network deployments, including the local terminal and non-local terminal.

NOTE Local terminal refers to home platform, non-local terminal refers to edge platform or cloud platform.

6.2 Monitoring

6.2.1 General

AAL robots with monitoring functions to detect emergencies such as user falls, fire, etc., and/or user long-term health issues (vital signs, medication status, etc.) should have at least one or more of the required monitoring functions such as vision, hearing, touch, and smell.

AAL robots should also be equipped with appropriate collection data storage functions, including records of monitored transmissions for the subject being monitored.

6.2.2 Vision

AAL robots with a monitoring function by vision should be able to perceive the dynamic objects and to identify the size, shape, colour, distance of the object.

6.2.3 Auditory sense

AAL robots with a monitoring function by audio should be able to locate sound source, recognize sound (including human speech) under noise interference, monitor for and identify abnormal sounds.

6.2.4 Touch

AAL robots with a monitoring function by touch should be able to provide sufficiently accurate and reliable data (e.g., physical data) in a timely manner.

6.2.5 Smell

AAL robots with a monitoring function by smell should be able to locate odour source, recognize odour, and monitor abnormal odour based on instructions.

6.2.6 Reminder and emergency alarms

AAL robots with a monitoring function should be able to analyse and identify abnormal conditions, such as monitored hazards, emergencies, and to accurately act as per the set reminder or alarm value, make timely responses and send out the reminder or alarm to transmit the abnormal information to AAL users, caregivers, relatives or AAL service providers, emergency centres, medical agencies, etc.

6.2.7 Interconnection and collaborative action

In addition to smart mobile terminals such as mobile phones, AAL robots with a monitoring function should be capable of direct or indirect interconnection with the devices in the AAL CHE, AAL information system or other information systems, to realize information exchanges or control, such as the interconnection with vital sign monitoring equipment. AAL robots can take collaborative action with other devices when an emergency protocol is triggered (e.g. due to falls, fire). In such a scenario, AAL robots should be able to take collaborative action remotely with other devices, e.g. in different local area networks. Normal and reliable communication function is required during the collaborative action, and the possibility for the delay, modification, replacement or loss of the signal or data should be minimized.

6.2.8 Data storage

The data obtained by the AAL robots with a monitoring function through a sensor should be uploaded to a cloud service or stored in the local storage. Data can also be stored in both the cloud and in the local storage.

6.3 Communication support

6.3.1 General

For AAL robots intended to provide communication support, reliable and effective data transmission and data processing should be ensured during communication of AAL robots with all relevant stakeholders, such as family members, friends and medical staff in the process of transactions and interaction with the system.

6.3.2 Audio

Through AAL robots, the AAL user should be able to clearly communicate with other users via audio with the normal communication network, without obvious distortion, noise, echo, etc.

6.3.3 Video

Through AAL robots, the AAL user should be able to clearly communicate with other users via video with the normal communication network, without obvious picture overlapping, distortion, flutter, delay, etc.

6.4 Activity support

6.4.1 General

AAL robots intended to provide activity support involves activities in multiple aspects, such as exercise, games, as well as the AAL connected home management.

AAL robots with the function of activity support should be able to execute the information received, to make suggestions or decisions through the algorithm, and be able to actuate the activities (actions) based on the given suggestions (decisions).

6.4.2 Diversity of activity support

The activities supported by AAL robots are available in such home spaces as the living room, kitchen, bedroom, study room, canteen and bathroom. Annex A shows examples of the activities supported by the AAL robots which provide the activity supporting function.

6.4.3 Operation

The maximum load, finger force, grip force, etc. should be considered for AAL robots with fetching, carrying and placing functions. Operational accuracy and efficiency should be considered and tested.

NOTE 1 Operational capacity means that the robot is able to complete the target tasks through the end effector with a motor.

NOTE 2 For test methods to evaluate the robots' performance of manipulation and grasping, see ISO 18646-3.

6.4.4 Interaction

AAL robots with the function of activity support should be capable of interaction with users through models such as the graphical user interface, voice, vision, gesture, electromyographic signal and/or brain-computer interface, etc.

NOTE Voice wake-up and visual wake-up are within the scope of interaction.

6.4.5 AAL connected home management

AAL robots intended for connected home management should be able to control or be controlled by the operations of other devices through wireless signal, so that the connected home management system will be achieved. For example, AAL robots can control surrounding devices such as intelligent switches, smart sockets, intelligent door locks, electric curtains and security alarms through the wireless signal.

6.5 Mobility support

6.5.1 General

For AAL robots with assisted mobility functions, their performance should be sufficient to achieve the pre-set goals and meet the needs of the AAL user. Mobility support includes walking assistance, location change assistance and lifting and/or mobility assistance, etc.

6.5.2 Wearable mobility assistance robots

Wearable AAL robots with a mobility support function should have one or more of the functions specified in their instructions for use, such as to facilitate and assist the wearer to stand up, sit down, walk on flat ground, go up and down a slope, go up and down stairs, to meet the mobility needs of AAL users in daily life.

6.5.3 Wheeled mobility assistance robots

Wheeled AAL robots with a mobility support function should be equipped with mobility ability on different travelling surfaces (such as on flat, uneven and sloping surfaces), and the traveling speed should be adjustable. In addition, they should have the ability to pass obstacles with a specific height and be able to avoid dynamic or static obstacles through the navigation and obstacle avoidance system.

6.5.4 Other mobility assistance robots

AAL robots with assisted mobility functions other than wearable or wheeled ones should have the ability to finish their intended tasks.

6.6 Other functions

Other important functions of AAL robots in the CHE can be considered in addition to those listed in 6.1 to 6.5.

7 General conditions for the tests

7.1 Environmental conditions, test equipment and materials

The test should be performed in an environment that is identical or similar to the environment where AAL users including AAL care recipients are expected to use the AAL robots.

The equipment and materials used in the test shall minimize the impact of electrostatic phenomena and other adverse conditions on the test.

7.2 Number of samples

All tests shall be carried out on a representative sample with its accessories and attachments (if any). If required, additional samples can be needed.

7.3 Preparation of the battery

Any unused battery shall be fully charged and fully discharged once prior to conducting the first test on a robot. Full discharge of the robot shall be done by carrying out normal operation as instructed by the manufacturer. There shall be no action of the robot after full discharging, and the signal with low battery capacity (if any) will occur at this time.

7.4 Robot operation

Unless otherwise specified in the relevant standards,

- the robot, charger, docking station and their attachments shall be assembled, operated and adjusted as per the normal operation requirements specified in the instructions for use of the manufacturer before test;
- the operation mode of the robot shall be selected and adjusted as instructed by the manufacturer before the test to adapt to the environment for operation;
- the robot and any of its safety-related devices shall be operated normally before the test;
- the installed software may not be modified or changed during the test except in cases where it is specifically needed and approved by the manufacturer;

  For instance, a description of the software operation shall be documented in the test report in electromagnetic compatibility (EMC) or other testing in order to monitor the operation of the equipment.
- The batch number, condition, and usage files of the product shall be recorded before the test.

8 Test methods

The test methods related to the requirements in Clause 5 and Clause 6 shall be carried out according to the specific ISO/IEC product standard which includes these test methods as applicable.

The related existing ISO/IEC International Standards which can be referred to are listed in Annex B.

9 Test report

The test report should consist of a cover sheet and one or more form(s) of test results. The cover sheet should include the general information about the AAL robot, measurement settings and test conditions as well as the tests conducted. The test result sheet shall contain the abstract about tests performed and the uncertainty of measurement.

The test reports should be disclosed to the AAL users including AAL care recipients.

10 Instructions for use and training

10.1 Instructions for use

In addition to referring to other existing standards, the instructions for use of AAL robots should consider the following aspects:

- the instructions for use should be simple to read and easily understood;
- instructions for use should be written taking into account the audience to whom they are addressed. If an AAL user is the addressee, the specific needs of AAL users or users with different abilities should be considered, such as persons with auditory or visual limitations, persons with limitations in dexterity or strength, and persons with early stage cognitive limitations;
- the instructions for use should contain the information of the organizations to be contacted for any problems or questions;
- the instructions for use should clearly specify the use scenario, user group and function of the product.

10.2 Training

In addition to the instructions for use, training opportunities should be provided to the AAL users, including the AAL care recipients.

Training materials should be available in compatible formats based on the AAL user's capabilities and characteristics.

Training may include but is not limited to the use, operation, system setup, troubleshooting and maintenance of AAL robots.

Annex A
(informative)

Examples of activities supported by AAL robots

Examples of activities supported by AAL robots are as follows:

– housekeeping
  - floor cleaning;
  - window wiping;
  - air cleaning;
  - laundry;
  - cooking;
  - carrying, delivering things.
– entertainment and education
  - audio playing;
  - video playing;
  - reading;
  - playing games;
  - chatting;
  - dance and yoga.
– home management
  - home appliance management;
  - video call;
  - lighting control;
  - time broadcasting;
  - plan reminding;
  - information searching;
  - guiding.
– caring
  - assisted turning over;
  - assisted feeding;
  - assisted toileting.