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Robotics — Performance criteria and related test methods for service robots —

Part 4: Lower-back support robots

Robotique — Critères de performance et méthodes d'essai correspondantes pour robots de service —

Partie 4: Robots de soutien du bas du dos

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Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Test conditions ... **3**
4.1 General ... 3
4.2 Environmental conditions ... 3
4.3 Operating conditions ... 4
5 Test method for assistive torque index and lumbar compression reduction ... **4**
5.1 Purpose ... 4
5.2 Relevant characteristics ... 4
5.2.1 General ... 4
5.2.2 Assistive torque index (ATI) ... 4
5.2.3 Lumbar compression reduction (LCR) ... 5
5.3 Test facility ... 7
5.3.1 Test apparatus ... 7
5.3.2 Reference movement and target trajectory ... 8
5.4 Test procedure ... 10
5.5 Test result ... 11
6 Test method for rate of assistance ... **11**
6.1 Purpose ... 11
6.2 Relevant characteristics ... 11
6.3 Test facility ... 12
6.4 Test procedure ... 15
6.5 Test result ... 18
Annex A (informative) **Time range of ATI and LCR** ... **19**
Annex B (informative) **Example of lower-back support robots** ... **23**
Annex C (informative) **Example table of test results** ... **25**
Annex D (informative) **Example implementation of a test apparatus** ... **26**
Bibliography ... **29**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 299, *Robotics*.

A list of all parts in the ISO 18646 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document is intended to facilitate understanding of performance of lower-back support robots (see Annex B). This document defines the important performance characteristics and describes how to specify them and how to test them.

The characteristics for which test methods are given in this document are those considered to affect robot performance significantly. The user of this document selects which performance characteristics to test, in accordance with the specific requirements.

The performance criteria specified in this document are not intended to be interpreted as the verification or validation of safety requirements. The verification and validation of safety requirements are specified in other standards developed by ISO TC 299.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of patents concerning the test apparatuses of the performance of wearable robots for lower-back support referred to throughout the document.

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Robotics — Performance criteria and related test methods for service robots —

Part 4: Lower-back support robots

1 Scope

This document describes methods of specifying and evaluating the performance of lower-back support robots.

This document applies regardless of the purpose and application of lower-back support robots and the driving methods (e.g. electric, hydraulic and pneumatic). This document does not apply to medical robots, although the test methods specified in this document can be utilized for medical robots.

This document is not intended for the verification or validation of safety 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.

ISO 8373, *Robots and robotic devices — Vocabulary*

ISO 13482, *Robots and robotic devices — Safety requirements for personal care robots*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8373, ISO 13482 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
robot
programmed actuated mechanism with a degree of autonomy, moving within its environment, to perform intended tasks

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

Note 2 to entry: The classification of robot into industrial robot or service robot is done according to its intended application.

[SOURCE: ISO 8373:2012, 2.6, modified — The words “actuated mechanism programmable in two or more axes” have been replaced with “programmed actuated mechanism”.]

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3.2
wearable robot
robot that supplements or augments personal capabilities while attached to a human during use

Note 1 to entry: Wearable robots are referred to as restraint-type physical assistant robots in ISO 13482:2014.

3.3
lower-back support robot
wearable robot to reduce the load in the lower back of the user by its assistive force or torque

3.4
user
person who wears a wearable robot on his/her body and directly receives its assistive force or torque

3.5
restraint part
part of the wearable robot binding a corresponding attached body part of the user to transmit an assistive force or torque

3.6
assistive torque
output torque of the wearable robot to assist a user to perform required tasks

3.7
attached body part
part of the user's body on which the restraint part of the wearable robot is attached

3.8
input method
interface allowing the user to control the assistive force or torque of the wearable robot by an appropriate input signal

3.8.1
biological input
input method where biological signals that are in correlation to the force or torque the user exerts at his/her body part intended for assistance are used as the input

Note 1 to entry: Biological signals include bioelectrical signals such as myoelectric signals.

3.8.2
kinematic input
input method where movement and/or posture of the user's body parts intended for assistance are used as the input

Note 1 to entry: Biological input and kinematic input are mutually exclusive.

3.8.3
command input
any input method other than biological input or kinematic input

Note 1 to entry: Command input includes the use of commanding devices, breath switches or voice input.

Note 2 to entry: Command input includes the use of biological signals that are not in correlation to the force or torque the user exerts at the body part intended for assistance.

Note 3 to entry: Command input includes movement and/or posture of the user's body parts not intended for assistance.

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3.9
assistive torque index
ATI
measure of how much the output torque of the user is reduced when the user performs a specific movement during a specific time range using the lower-back support robot

Note 1 to entry: ATI is an absolute quantity with respect to the average torque during the specific time period of a specific test motion profile. It can be helpful for the relative comparison between robots.

3.10
lumbar compression reduction
LCR
measure of how much the compressive force on the user's lumbar disks is reduced when the user performs a specific movement during a specific time range using the lower-back support robot

3.11
normal operating conditions
range of environmental conditions and other parameters which can influence robot performance (such as electrical supply instability, electromagnetic fields) within which the performance of the robot specified by the manufacturer is valid

Note 1 to entry: Environmental conditions include, for example, temperature and humidity.

[SOURCE: ISO 8373:2012, 6.1]

3.12
rate of assistance
measure of the reduced torque by a lower-back support robot integrated over the time period of a specific test motion profile

Note 1 to entry: Rate of assistance is a normalized quantity with respect to the integrated torque over the time period of a specific test motion profile. It can be helpful for the relative comparison for different test motion profiles within the robot.

4 Test conditions

4.1 General

The lower-back support robot shall be completely assembled, sufficiently charged and operational. All self-diagnostic tests shall be satisfactorily completed. It should also be ensured that the robot operates in a safe manner throughout the test.

The tests shall be preceded by the preparations for operation as specified by the manufacturer, including calibration of any relevant sensors that effect on the test results.

All conditions specified in Clause 4 should be satisfied for the tests described in this document, unless it is stated otherwise in the specific clauses.

Each test described in Clause 5 and Clause 6 of this document have different test configurations which require separate test apparatuses and test procedures.

4.2 Environmental conditions

The following environmental conditions shall be maintained during all tests.

— Ambient temperature: 10 °C to 30 °C

— Relative humidity: 0 % to 80 %

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