Designation: ~~F3323 – 20~~ F3323 – 21

Standard Terminology for Exoskeletons and Exosuits[1]

This standard is issued under the fixed designation F3323; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This terminology covers terms associated with exoskeletons and exosuits. By providing a common and consistent lexicon, the purpose of this terminology is to facilitate communication between individuals who may be involved in the research, design, deployment, and use of exoskeletons and exosuits in applications, including but not limited to industrial, military, emergency response, recreational, and medical areas.

1.2 For the terminology to be harmonious with the practices in the fields, definitions have been drawn from other standards, the literature, or other public sources when possible. When no definition is available, is similar but requires change for use within standards produced by Committee F48, or in dispute, a consensus-based approach will be used to resolve definitions and add them to the lexicon. The development of this terminology is taking place in close coordination with corresponding efforts in all Committee F48 subcommittees to ensure comprehensive and consistent coverage.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F3200 Terminology for Driverless Automatic Guided Industrial Vehicles

2.2 *Other Standards:*

ANSI/ITSDF B56.5 Safety Standard for Driverless, Automatic Guided Industrial Vehicles and Automated Functions of Manned Industrial Vehicles[3]

IEC 60601-1-8:2012 Medical electrical equipment – Part 1–8: General requirements for basic safety and essential performance – Collateral standard: General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems[4]

ISO 8373:2012 Robots and Robotic Devices—Vocabulary[5]

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[1] This terminology is under the jurisdiction of ASTM Committee F48 on Exoskeletons and Exosuits and is the direct responsibility of Subcommittee F48.91 on Terminology.

Current edition approved ~~March 1, 2020~~Dec. 1, 2021. Published ~~March 2020~~January 2022. Originally approved in 2018. Last previous edition approved in ~~2019~~2020 as ~~F3323 – 19a.~~F3323 – 20. DOI: ~~10.1520/F3323-20.~~10.1520/F3323-21.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from International Electrotechnical Commission (IEC), 3, rue de Varembé, 1st floor, P.O. Box 131, CH-1211, Geneva 20, Switzerland, https://www.iec.ch.

[5] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

ISO 13482:2014 Robots and robotic devices – Safety requirements for personal care robots[5]
ISO/DIS 18646-4 Robotics — Performance criteria and related test methods for service robots — Part 4: Lower-back support robots[5]
MIL-HDBK-1908:1995 Definitions of Human Factors Terms[6]
29 CFR 1910.132 Occupational Safety and Health Standards, Personal Protective Equipment, General Requirements[6]

3. Terminology

activity—execution of a task or action by a user or their exoskeleton or exosuit, or both.

adaptive control, *n*—control scheme whereby the control system parameters are adjusted from conditions detected during the process. **ISO 8373:2012**

alarm condition—state of the alarm system when it has determined that a potential or actual hazardous situation exists for which operator or user awareness or response is required.

DISCUSSION—
An alarm condition can be invalid, that is, a false positive alarm condition.

DISCUSSION—
An alarm condition can be missed, that is, a false negative alarm condition. **IEC 60601-1-8:2012**

anthropometric dimensions—measured dimensions that describe the size and shape of the human body. These dimensions are often presented in the form of summary statistics that describe the range of body dimensions that are observed in a population. **MIL-HDBK-1908 11 December 1995**

assistance, caloric—degree to which the exoskeleton changes the user's total caloric energy consumption while the user is attempting and/or performing a task compared to not using an exoskeleton (see also **metabolic assistance**).

assistance, metabolic—degree to which the exoskeleton changes the user's rate of metabolism while attempting and/or performing a task compared to not using an exoskeleton (see also **caloric assistance**).

assistant, *n*—anyone who is not the user or the operator involved in enabling and within reach of the exoskeleton for it to function as intended.

assistive product, medical—any product (including devices, equipment, instruments, and software), especially produced or generally available, used to aid a person with an injury or disability: (*1*) for participation in activities of daily living, (*2*) to protect, support, train, measure, or substitute for body functions/structures and activities, or (*3*) to prevent impairments, activity limitations, or participation restrictions.

developmental test and evaluation (DT&E)—test and evaluation performed to (*1*) identify potential operational and technological limitations of the alternative concepts and design options being pursued, (*2*) support the identification of cost-performance trade-offs, (*3*) support the identification and description of design risks (for example, human safety, functional risk), (*4*) substantiate that contract technical performance and manufacturing process requirements have been achieved, and (*5*) support the decision to certify the system ready for operational test and evaluation. **MTL-HDBK-1908 11 December 1995**

domain, *n*—a field of action, thought, influence, etc.; a realm or range of personal knowledge, responsibility, etc.

exoskeleton—wearable device that augments, enables, assists, and/or enhances physical activity through mechanical interaction with the body.

DISCUSSION—
An exoskeleton may include rigid or soft components, or both (see exosuit).

[6] Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, http://www.access.gpo.gov.

DISCUSSION—
Physical activity may be static or dynamic.

exoskeleton system, *n*—exoskeleton and all associated components, equipment, software, and communications necessary to make it fully functional.

DISCUSSION—
Personnel who support the device that are necessary may also be considered part of the exoskeleton system.

DISCUSSION—
Sometimes called exosystem.

force, gripping—magnitude of the contact force applied by an exoskeleton, user, or combination thereof, to seize and hold (also known as grasping force).

force, maximum—peak force that can be applied by, to, or combination thereof, the exoskeleton without causing any damage to the exoskeleton while the user is wearing it.

harm—physical or psychological injury or damage to health.

hazard—potential source of harm. **ISO 13482:2014**

hazard, acute—hazard that has an obvious and immediate impact.

hazard, chronic—hazard having a hidden, cumulative, or long-term impact.

hazardous motion—motion that is likely to cause harm.

industrial domain, *n*—a field of action related to a paid job or a profession.

DISCUSSION—
While the term "work domain" is more descriptive of this field, the term "industrial domain" is already in wide use and will be used here to avoid confusion. This field includes workers not just working in factories; examples include medical professionals performing work other than rehabilitation and military members performing logistical work.

military domain, *n*—a field of action related to warfighting.

DISCUSSION—
While the term "warfighting domain" is more descriptive of this field, the term "military domain" is already in wide use and will be used here to avoid confusion. As mentioned above, military professionals performing work other than warfighting, such as logistics work, are covered under the term "industrial domain."

moment/torque, maximum—peak moment/torque that can be applied by, to, or combination thereof, the exoskeleton without causing any damage to the exoskeleton while the user is wearing it.

motional input—input method where motion and/or posture of the user's body parts intended to be assisted are used as the input. **ISO/DIS 18646-4**

personal protective equipment—protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers used wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact. **29 CFR 1910.132(a)**

qualified person, *n*—person who, by possession of a recognized degree or certificate of professional standing or extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work. **ANSI/ITSDF B56.5**