



Designation: F3583 – 22

Standard Test Method for Exoskeleton Use: Beams¹

This standard is issued under the fixed designation F3583; 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 Purpose:

1.1.1 The purpose of this test method, as a part of a suite of exoskeleton use test methods, is to quantitatively evaluate an exoskeleton's (see Terminology F3323) safety (see 1.4) or performance, or both, when traversing beams.

1.1.2 Exoskeletons shall possess a certain set of allowable exoskeleton user movement capabilities, including user-motion adaptability, to suit operations such as: industrial/occupational, military, response, medical, or recreational.

1.1.3 Environments in these typical sectors often pose constraints to exoskeleton user movement to various degrees. Being able to traverse beams, as intended by the user or test requestor, while using an exoskeleton, is essential for exoskeleton deployment for a variety of tasks (for example, ascending/descending stairs, ramps, hills). This test method specifies test setup, procedure, and recording to standardize this beams task for testing exoskeleton user movement.

1.1.4 Exoskeletons need to function as intended, regardless of types of tasks and terrain complexities (for example, carpet, metal, masonry, rock, wood). Required movement capabilities may include, for example: walking, running, crawling, climbing, traversing gaps, hurdles, stairs, beams, slopes, various types of floor surfaces or terrains, or confined spaces, or combinations thereof. Standard test methods are required to evaluate whether or not exoskeletons meet these requirements.

1.1.5 ASTM Subcommittee F48.03 develops and maintains international standards for task performance and environmental considerations that include but are not limited to, standards for safety, quality, and efficiency. This subcommittee aims to develop standards for any exoskeleton application as exemplified as in 1.1.2. The F48.03 test suite consists of a set of test methods for evaluating exoskeleton capability requirements. This beams test method is a part of the test suite. The setup, procedure, and apparatuses associated with the test methods challenge specific exoskeleton capabilities in repeatable ways to facilitate comparison of different exoskeleton models or exoskeleton capabilities to tasks.

¹ This test method is under the jurisdiction of ASTM Committee F48 on Exoskeletons and Exosuits and is the direct responsibility of Subcommittee F48.03 on Task Performance and Environmental Considerations.

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1.1.6 The test methods quantify elemental exoskeleton use capabilities necessary for sector applications listed in 1.1.2 and perhaps others. As such, users of this standard should use either the entire suite or a subset based on their particular requirements. Users are also allowed to weight particular test methods or particular metrics within a test method differently, based on their specific requirements. The testing results should collectively represent an exoskeleton's overall safety or performance, or both, as required for the task. These performance data can be used: to guide procurement specifications, for acceptance testing, and for training to use exoskeletons intended for specified applications.

NOTE 1—Additional test methods within the suite are anticipated to be developed to address additional exoskeleton capability requirements, including newly identified requirements, and even for new application domains.

1.2 *Exoskeleton*—The exoskeleton shall be used as intended by the manufacturer to perform the test described in this test method. If the exoskeleton is not designed for beam traversing and the test requestor intends to use the exoskeleton to perform a beam test (for example, for research, development of beam-capable use by a manufacturer, beam training as in military applications), appropriate manufacturer approvals should be sought prior to performing the test method.

1.3 *Performing Location*—This test method shall be performed in a testing laboratory or in the field where the specified apparatus and environmental conditions are implemented.

1.4 *Units*—The values stated in SI units are to be regarded as the standard. The values given in parentheses are not precise mathematical conversions to inch-pound units. They are close approximate equivalents for the purpose of specifying material dimensions or quantities that are readily available to avoid excessive fabrication costs of test apparatuses while maintaining repeatability and reproducibility of the test method results. These values given in parentheses are provided for information only and are not considered standard.

1.5 *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.*

1.6 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

- F3323 Terminology for Exoskeletons and Exosuits
- F3427 Practice for Documenting Environmental Conditions for Utilization with Exoskeleton Test Methods
- F3443 Practice for Load Handling When Using an Exoskeleton
- F3444/F3444M Practice for Training Exoskeleton Users
- F3474 Practice for Establishing Exoskeleton Functional Ergonomic Parameters and Test Metrics
- F3517 Practice for Movement Tests When Using an Exoskeleton
- F3523 Test Method for Exoskeleton Use: Confined Space: Horizontal Movement
- F3527 Guide for Assessing Risks Related to Implementation of Exoskeletons in Task-Specific Environments
- F3528 Test Method for Exoskeleton Use: Gait
- F3613 Practice for Recording the Exoskeleton Fit to the User
- F3614 Practice for Recording the Exoskeleton User Information

2.2 ISO Standards:³

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

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>.

3. Terminology

3.1 General terminology for ASTM F48 standards is listed in Terminology F3323. Terminology specific to this standard is shown in this section.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *apparatus, n*—a structure, object, test component, or artifact thereof, found or placed in an environment and used for a test.

3.2.2 *beam, n*—a narrow horizontal bar, on or raised off the floor, on or over which a user traverses.

3.2.3 *platform, n*—a raised level surface, wider than a beam, on which a user can stand.

3.2.3.1 *Discussion*—The platform may be attached to a beam(s) as used in this test method.

3.2.4 *test suite, n*—designed collection of test methods that are used, collectively, to evaluate an exoskeleton's safety and/or performance.

4. Summary of Test Method

4.1 The task for this test method, exoskeleton-user traverses beam(s), is defined as the exoskeleton-user performing a beam traversal test, including a number of repetitions as set by the test requestor. Guidance on number of repetitions for the test is shown in Appendix X1. An in-situ beam (for example, a log) or a beam and platform (for example, a construction beam to a landing) can be used for this test method. For ideal test replication, standard beam apparatuses, which include: (a) a beam or (b) a beam and platform(s), can be used for this test method. See Fig. 1 for an illustration.

4.2 The test is described as follows:

4.2.1 This test can be used to assess aerobic function, endurance, beam traversal capability and speed, balance, or other parameters, or combinations thereof, as required by the test requestor.

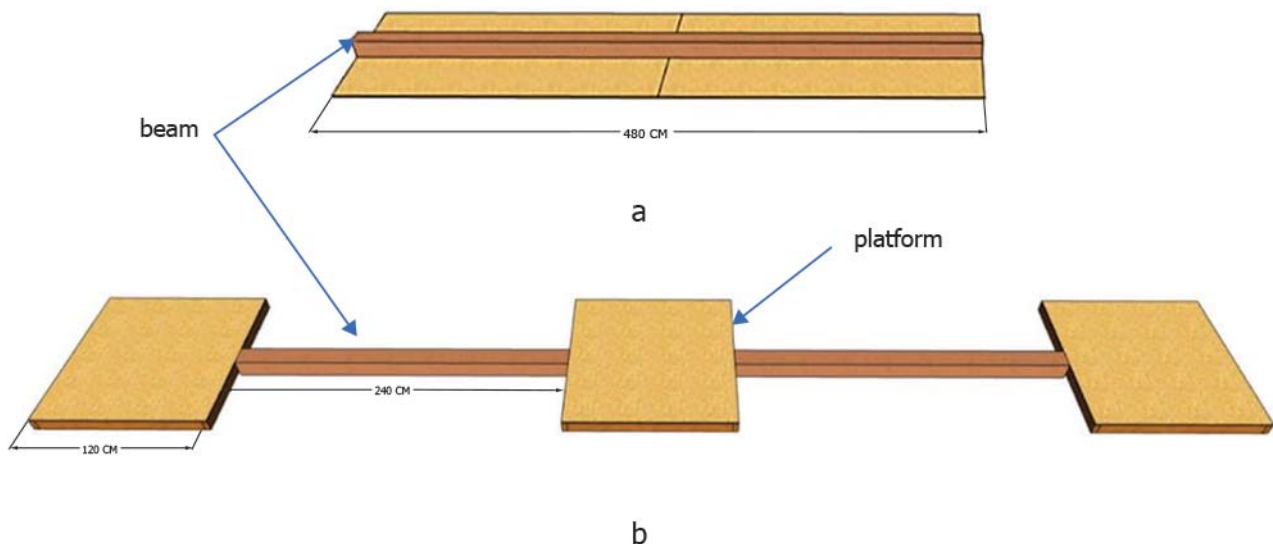


FIG. 1 Graphic of: (a) Beam Apparatus and (b) Beam-and-Platform Apparatus