Designation: F3519 – 21

Standard Guide for Establishing a Reporting Structure for Exoskeleton Analysis[1]

This standard is issued under the fixed designation F3519; 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 guide provides a structure for exoskeleton manufacturers to document their analysis. Furthermore, this guide should be used in conjunction with Practice F3474, Guide F3518, Standard Guide for The Application of Ergonomics to Prevent Injury During Exoskeleton Use[2] and other future documents.

1.2 *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.*

1.3 *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:*[3]

F3200 Terminology for Driverless Automatic Guided Industrial Vehicles

F3474 Practice for Establishing Exoskeleton Functional Ergonomic Parameters and Test Metrics

F3518 Guide for Quantitative Measures for Establishing Exoskeleton Functional Ergonomic Parameters and Test Metrics

3. Significance and Use

3.1 This guide describes a template of written considerations that should be provided by the manufacturer to the purchaser related to the documenting of exoskeleton analysis. Adherence to this guide allows analysis results of varied exoskeleton manufacturers to be compared by a purchaser with respect to their end user needs.

3.2 Not every element of this guide may be applicable to all exoskeleton components or configurations. It is the manufacturer's responsibility to determine which portions of this guide are applicable to their exoskeletons for analysis reporting.

4. Terminology

4.1 *Definitions:*

4.1.1 *analysis requestor (sometimes called analysis sponsor), n*—person or organization selecting the analysis and defining the conditions under which they are performed. **F3200 – 18a**

4.1.2 *analysis supervisor, n*—person responsible for setting up the apparatus, instrumentation, directing, and reporting results of the analysis according to the analysis requestor or analysis sponsor. **F3200 – 18a**

5. Report Structure

5.1 The main role of the report structure is to provide the reader with an outline of the report. The report structure should generally focus on the motivation and the reason for the report. A common structure of a report includes these subsections: scope, significance and use, procedure, interpretation of results, and conclusion.

5.1.1 *Scope*—This subsection highlights the motivation of the report.

5.1.2 *Significance and Use*—This subsection highlights details on why the report is being written.

5.1.3 *Procedure*—This subsection provides an overview of the tested conditions, test procedures, and equipment and statistical analysis tools used.

5.1.4 *Interpretation of Results*—The main findings of the report are reported in this subsection. In this subsection, results are interpreted and inferences are drawn.

5.1.5 *Conclusion*—This subsection provides the reader with the main conclusions drawn from the report according to the interpretation of the findings.

[1] This guide is under the jurisdiction of ASTM Committee F48 on Exoskeletons and Exosuits and is the direct responsibility of Subcommittee F48.02 on Human Factors and Ergonomics.

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[2] Standard under development.

[3] 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.

6. Scope Parameters

6.1 Include in this section information relating to the purpose of the report and to what it applies. Clearly state any limitations of the report.

6.2 Include in this section the system of units to be used in referee decisions.

7. Referenced Documents

7.1 In this section, any standards or adjuncts cited in the report are listed.

8. Significance and Use Parameters

8.1 *Introduction*—Include in this section information that explains the relevance and meaning of the report. State the practical uses for the report and how it is typically employed. Avoid repetition of information included in the scope.

8.1.1 Include separately any appropriate comments on limitations of the report. Indicate any means of recognizing cases in which the report may not be applicable.

8.1.2 Include, where applicable, comparisons of the report to other similar procedures.

8.2 In this section the problem to be addressed in the report is identified and this sets the foundation for the study hypothesis. This section can include three subsections: background, problem, and purpose of study.

8.2.1 *Background*—This subsection includes a review of previous research work relevant to the problem of concern and highlights different historical attempts to address the problem. The background should also include the minimum information about the problem such that a reader with no or little familiarity with the topic would understand the information delivered in the report. While the background text starts broad, it should gradually narrow down to the existence of a problem that needs to be addressed.

8.2.2 *Problem*—This subsection clearly identifies the problem and states the need for further research to address it. This subsection should also provide clear justifications of the need for further research to address the problem of concern and why findings of previous research are not sufficient.

8.2.3 *Purpose of the Report*—This subsection describes the overall objective of the report and the steps taken to achieve this objective. It can also provide a preview of the remainder of the report's structure.

9. Procedure Parameters

9.1 Include in this section detailed directions for performing the task outlined in the report. This section details the considered experimental procedures while justifying each of them (for example, tools, materials, and settings).

9.2 *Participants*—This subsection describes the tested population. It also provides information about the number and demographics of tested participants. In addition, it details any eligibility criteria used to select participants and explains the reasons behind considering these criteria. The way the participants are divided into subgroups (for example, experimental and control groups) should also be presented, if any.

9.3 *Design*—In this subsection, the treatments and measures of the experiment are described.

9.3.1 *Treatment*—A treatment is a combination of independent variable levels. An independent variable is a variable with one or more levels (variable values) whose effect is to be tested in an experiment.

9.3.2 *Measures*—A measure can also be called a dependent variable. A dependent variable is a variable that the effects of different treatments on its value are to be tested. For the effects of different treatments on a dependent variable to be evaluated, a dependent variable has to be measurable.

9.3.3 *Equipment*—This subsection describes all the test equipment used in the experiment and their associated settings. Choosing particular equipment or considering a specific equipment setting should be justified. Information about the manufacturer, model, and capacity of the test equipment are worth mentioning for replication purposes.

9.3.4 *Procedure*—This subsection describes the flow of the experiment (chronological order of treatments and experiment sessions, number of test sessions, rest period between sessions, and so forth).

9.3.5 *Statistical Analysis*—This subsection provides details about the statistical analysis technique(s) used in the report and the reasons behind choosing these particular technique(s) (why a particular statistical analysis technique was considered). Detailed information about any statistical analysis tools/software used in the report should be delivered as well.

10. Interpretation of Results Parameters

10.1 This section should include interpretations of the report results in a meaningful context. Interpretations of the findings should always be supported by the report results.

11. Report Parameters

11.1 Include detailed information as to calculating, interpreting, and reporting results in this section.

11.2 Depending upon the nature of the report, an entire section may, by necessity, be devoted to calculation or interpretation of results, or both.

11.3 When a report permits variance in conditions under which the analysis has been performed, these conditions should become part of the report.

12. Keywords Parameters

12.1 In this section, identify the words, terms, or phrases, that best represent the technical information presented in the report. Select the keywords from the title and body of the standard and include general, vernacular, and trade terms.

12.2 Select three or more keywords that describe the names of tests, procedures, special materials, or the specific application(s) that will facilitate the identification and retrieval of the standard.

12.3 All selected keywords shall be stand-alone terms; the type of standard, incomplete phrases, unattached adjectives, and so forth, shall not be used.