Designation: F2491 – 05

Standard Guide for Determining Load Ratios for Technical Rescue Systems and Equipment[1]

This standard is issued under the fixed designation F2491; 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 covers the general concept of determining load ratios for technical rescue equipment and systems.

1.2 The values stated in SI units shall be considered as standard. Values in English units may be included for reference.

1.3 In the event of any conflict between the text of this guide and any references cited, the text of this guide takes preference.

1.4 *This standard may involve hazardous materials, operations, and equipment. 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *component*—an individual piece of equipment in its usable form, but unconnected and unencumbered by other pieces of equipment in a system.

2.1.2 *force multiplying situation*—a situation where the rigging causes a force on a component to be greater than caused by the load.

2.1.3 *load ratio*—ratio between a specified breaking strength and an anticipated load.

2.1.4 *strength reduction situation*—a situation where the rigging of the system causes a component to not perform at its minimum breaking strength. An example would be a carabiner with tri-axial forces.

2.1.5 *system*—a group of components integrally connected for the purpose of accomplishing work.

2.1.6 *system safety factor*—the ratio of the load at which something will fail and the load that is planned to be applied to the system at that point.

2.1.7 *user*—a person, agency, or representative who has authority to make safety-related decisions for rescue applications as discussed herein.

3. Significance and Use

3.1 This guide may be used to provide a consistent method for determining load ratios for technical rescue equipment and systems.

3.2 Use of this guide will help to maintain clearer, more consistent calculation and reporting of load ratios.

3.3 It should be acknowledged that, while component load ratios are fairly straightforward to calculate, they are of limited value for estimating system load ratios. System load ratios are usually desired for field applications, but are more difficult to calculate accurately.

4. Load Ratio

4.1 Load ratio refers to the ratio between the breaking strength of the item and the load that the item is intended to suspend.

4.2 Various load ratios may be used for different reasons for a particular piece of equipment.

4.2.1 A manufacturer may or may not have a specified design factor, representing the ratio between the breaking strength of the product and the working load (that is, the load that the product is designed to carry on a normal basis).

4.2.2 Users of equipment may specify a load ratio for equipment that will help them to maintain system safety factors that are acceptable within their own scope.

4.2.3 The load ratio specified by an equipment user shall be no lower than that specified by the manufacturer, if the manufacturer specifies this information.

4.3 Load ratio is applicable only to the component, and does not address how this component affects or is affected by other components in a system.

4.4 Load ratios, when used, should always be determined using minimum breaking strength as the foundation (rather than average or maximum or other)

5. System Safety Factor

5.1 System safety factor refers to the ratio between the strength of the calculated weakest point in a system and the anticipated load. This is to say that the weak point in a system is however many times stronger than the load that will be placed on the system at that point.

[1] This guide is under the jurisdiction of ASTM Committee F32 on Search and Rescue and is the direct responsibility of Subcommittee F32.01 on Equipment, Testing, and Maintenance.

Current edition approved April 1, 2005. Published April 2005. DOI: 10.1520/F2491-05.

5.2 System safety factors are, at best, a best guess estimate, and should be used conservatively.

5.3 The weakest point in a system should be determined by using minimum breaking strengths of components as a beginning point.

5.3.1 Other appropriate factors that should be included in estimating the weakest point in a system are limited, but not limited to:

5.3.1.1 Relationship between products (that is, how one product affects another).

5.3.1.2 Effects of age.

5.3.1.3 Effects of environment (wet, dirty, UV, and so forth).

5.3.1.4 Any other known or assumed factors which might affect strengths.

5.4 Anticipated load at any point in the system should reflect the amount of force that is calculated to be placed at that point in a static configuration. For the same scenario, anticipated load may vary at different points in the system.

5.4.1 In estimating anticipated load, consideration should be given to at least the following factors:

5.4.1.1 Mass of the load.

5.4.1.2 Angle of evacuation.

5.4.1.3 Directional loading.

5.4.1.4 Rigging angles.

5.4.1.5 Variations in the load mass (that is, addition of a patient at some point).

5.4.1.6 Friction in the system.

5.4.1.7 Any other known or assumed factors which might affect the load on the system.

5.5 It may be appropriate for an equipment user to specify different system safety factors for different systems. Appropriate safety factors for different operations may vary in accordance with the uncertainty of the anticipated load, or the uncertainty in the strength of the system, or consequences of a failure, or a combination of the three, among others.

6. Other Requirements

6.1 It is the responsibility of the user to determine acceptable load factors, whether system or component, to provide adequate safety factors for his/her use.

6.2 Manufacturers shall provide at least minimum breaking strength information for any component used in life safety applications, in order to provide a reasonable starting point for the user to calculate load ratios.

7. Keywords

7.1 equipment; load ratio; rescue; safety; safety factor