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CMC RESCUE TECHNICAL REPORTS



NFPA 1983 - HARDWARE PERFORMANCE REQUIREMENTS

What is “3 σ MBS?”

You might think that answering the question, “How strong is that carabiner (or other item of rescue equipment)?” would be relatively easy. Yet, even with modern, high-tech alloys, two identical carabiners will break at slightly different forces. So a randomly selected sample from a population will perform within some range of break strengths. But to determine how wide that range is and, more importantly, what the lowest strength is, you would have to break every unit in the population. This would be an expensive project, and you’d end up with no useable units! The scientific solution is to use a statistical formula, referred to as three sigma (3σ). Sigma is the Greek letter used to denote standard deviation, a measure of how far a set of numbers (in this case, breaking strengths) is spread out around the mean.

To determine a product’s minimum breaking strength (MBS), a sample size is chosen and tested and the results analyzed. The MBS for the entire population is then calculated by subtracting three times the standard deviation (3σ) from the mean result of the tested samples. This provides an MBS that is very near the true lower limit of the population. The larger the sample size, the higher the level of confidence that any individual from the population will meet or exceed the calculated MBS. For testing rescue equipment the NFPA has selected a sample size of five.

To establish an industry accepted factor of safety, NFPA 1983 specifies a minimum performance standard for rescue equipment. For example, a General Use carabiner must have a 3σ MBS of at least 40 kN (8,992 lbf). So, how strong is your carabiner? Just look for the marking right on the product. The standard requires the manufacturer to label the product with either the specified MBS or any higher number that is not more than the actual 3σ MBS calculated from the most recent test results. As of 2011, CMC Rescue products compliant with NFPA 1983 are marked with the actual 3σ MBS rounded down to the nearest kN. For questions regarding 3σ MBS or product performance, call us at 800-235-5741 or visit www.cmcrecue.com.

NFPA 1983 defines three categories of performance for rescue equipment.

- **Escape “E”:** Immediate self-rescue of a single fire or emergency services person from a life-threatening emergency situation, generally above ground, using system components or manufactured systems designed for self-rescue escape.¹

TESTED. PROVEN. **TRUSTED.**

- **Technical Use “T”:** One designation of an equipment item or manufactured systems designed for Technical Use loads and escape based on design loads that are calculated and understood.¹ (Technical Use was previously defined as Light Use and prior to that as Personal Use).
- **General Use “G”:** One designation of an equipment item or manufactured systems designed for General Use loads, technical use loads and escape based on design loads that are calculated and understood.¹

Further explanation on General Use and Technical Use is provided in Annex A of NFPA 1983. “Rescue personnel can elect to use either Technical or General Use labeled equipment based on anticipated loads and acceptable safety margins as established by the authority having jurisdiction (AHJ). This choice should be based on the levels of operational capability of the organization. The AHJ should compile and evaluate information on the comparative advantages and disadvantages of the rope and equipment under consideration. For example, an organization at the operational level performing simple rescues might require the higher margin of safety offered by General Use equipment. The highly trained or specialized organization performing the more complicated rescue might benefit from the lighter weight of Technical Use equipment, but due to their level of training can maintain an acceptable level of safety and efficiency for the specified operation.”¹

Hardware Performance Requirements

NFPA 1983 (2012) Carabiner/Snap Link Performance Requirements

Technical Use “T”

- Major axis, gate closed 3σ MBS of not less than 27 kN (6,069 lbf)
- Major axis, gate opened 3σ MBS of not less than 7 kN (1,574 lbf)
- Minor axis, gate closed 3σ MBS of not less than 7 kN (1,574 lbf)

General Use “G”

- Major axis, gate closed 3σ MBS of not less than 40 kN (8,992 lbf)
- Major axis, gate opened 3σ MBS of not less than 11 kN (2,473 lbf)
- Minor axis, gate closed 3σ MBS of not less than 11 kN (2,473 lbf)

NFPA 1983 (2012) Pulley Performance Requirements

Technical Use “T”

- 3σ MBS of not less than 22 kN (4,946 lbf)
- 3σ MBS of a becket of not less than 12 kN (2,698 lbf)

General Use “G”

- 3σ MBS of not less than 36 kN (8,093 lbf.)
- 3σ MBS of a becket of not less than 19.5 kN (4,383 lbf)

NFPA 1983 (2012) Auxiliary Equipment Performance Requirements (Swivels, Anchor Plates, Roof Anchor)

Technical Use “T”

- 3σ MBS of not less than 22 kN (4,946 lbf)

General Use “G”

- 3σ MBS of not less than 36 kN (8,093 lbf)

NFPA 1983 (2012) Portable Anchor Performance Requirements (AZ Vortex, Tripods)

Technical Use “T”

- 3σ MBS of not less than 22 kN (4,946 lbf)

General Use “G”

- 3σ MBS of not less than 36 kN (8,093 lbf)

NFPA 1983 (2012) Descent Control Device Performance Requirements

Escape “E”

- 3σ MBS of not less than 13.5 kN (3,034 lbf)

Technical Use “T”

- 3σ MBS of not less than 13.5 kN (3,034 lbf)

General Use “G”

- 3σ MBS of not less than 22 kN (4,946 lbf)

NFPA 1983 (2012) Rope Grab & Ascending Devices Performance Requirements

Technical Use “T”

- No permanent damage to device or rope at 5 kN (1,124 lbf)

General Use “G”

- No permanent damage to device or rope at 11 kN (2,500 lbf)

New additions for 2012:

NFPA 1983 (2012) Escape Anchor Performance Requirements

Escape “E”

- 3σ MBS of not less than 13.5 kN (3,034 lbf)

NFPA 1983 (2012) Litter Performance Requirements

Must not fail or deform more than 50 mm at 11 kN (2,473 lbf)

NFPA 1983 (2012) Belay Device Performance Requirements

Technical Use “T”

- Maximum 1 m system extension and 15 kN peak impact force with 136 kg (300 lb) mass

General Use “G”

- Maximum 1 m system extension and 15 kN peak impact force with 200 kg (617 lb) mass

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¹ NFPA 1983 (2012 Edition) *Standard on Life Safety Rope and Equipment for Emergency Services*, 2012