The Evolution of Climbing Equipment Standards

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finch images from Charles Darwin’s Voyage of the Beagle
are standards for the birds?

- climbers
- equipment manufacturers
- gym owners & operators
- safety folks
- regulation folks
- me
a history of climbing equipment standards

the physics behind climbing standards

examples of radiative adaptation in climbing

a peek at where gym climbing standards might go
causes of equipment &/or standards evolution

• accidents
• marketing
• demographics
• climbing developments
• developments in related sports
• research
• assorted climbing organizations
• government regulation
deep history

- not many climbers
- not much standardization
- no money to be made
- it was a stupid sport anyhow

very similar to the aid climbing scene today.
more climbers, accidents, & $$, lead to more attention to standards

- mid 60s, rope testing
- early 70s, UIAA safety commission
- 70s and 80s, research & standards
- 90s CEN, ASTM, etc.

research and standards effectively reduce “equipment failure” to zero.
research

with research, inadequate equipment becomes extinct quickly.

busted gear images from DAV Sicherheitskreis Taetigkeitsbericht 1980-1983

best practices become apparent.
standards organizations

UIAA
CEN PPE directive (CE)
ASTM/ANSI/ISO
CWA
(REI)
equipment standards
(individual components of the safety system)
systems theory makes pin the blame on the victim more difficult
physics basis for standards

climbers can tolerate ~10 G deceleration (18 G permitted on US Navy pilots during parachute deployment)

the Earth’s gravitational field is 1 G (9.8 m/s²)

safe fall arrest distance lies between 1/10 of fall distance (physics) and 1/5 fall distance (UIAA/CE dynamic rope standard)

\[ mg \cdot h + mg \cdot y = \frac{1}{2} ky^2 \]

\[ T = mg \left( 1 + \sqrt{1 + 2 \frac{MF}{mg}} \right) \]
where the energy goes during fall arrest

Fig. 1a.

Fig. 1b.
theory, experiment, and standards match well

95% of falls put less than 7 kN on the top anchor (minimum permitted open gate carabiner strength).

20 kN forces on anchors require inappropriate use or a very, very bad karma (20 kN is the minimum closed gate carabiner strength).

Maegdefrau Data
sqrt fall factor vs. anchor load

data from Helmut Maegdefrau’s PhD thesis

Maegdefrau Data
sqrt fall factor vs. anchor load
equipment still fails

misuse
fatigue
overuse
abuse
modification
chemical abuse

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current ice ax standards are based on the demands of mountaineering B and T blades? shaft strength? the remedy will be slow, probably by intended use.
via ferrata
via ferrata standards
lessons from standards history

Standards evolve. Standards are based on research & “physics”. Standards prevent equipment failure accidents. The evolution is slower than the evolution of the sport.

Expect:
Standards development to follow new climbing developments. Increased standardization of safety systems. Increased standardization of best practices for safety systems.
wild prediction: belaying will become a sport
best practice examples