Some findings on the behaviour of descender devices **Petzl Stop** and **Petzl Simple**

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ADMINISTRATION FOR CIVIL PROTECTION AND DISASTER RELIEF

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Tehnični zbor 12.1.2013

Background

- Much larger testing experiment.
- **EU PROTEUS** - Task H: Evaluation and recognition of possible hazards stemming from equipment and equipment-related techniques used in caving and cave rescue.
- Divided on:
  - Static testing;
  - Dynamic testing;
  - Functional testing.

FOCUS ON DESCENDER DEVICES ONLY.

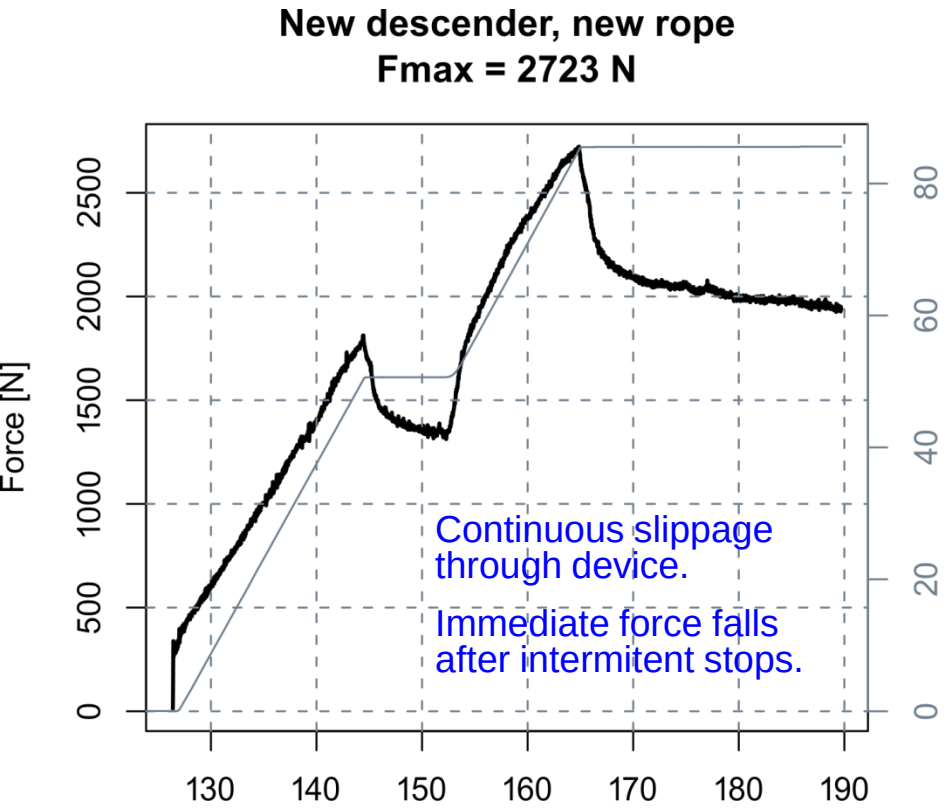
Descender-specific goals

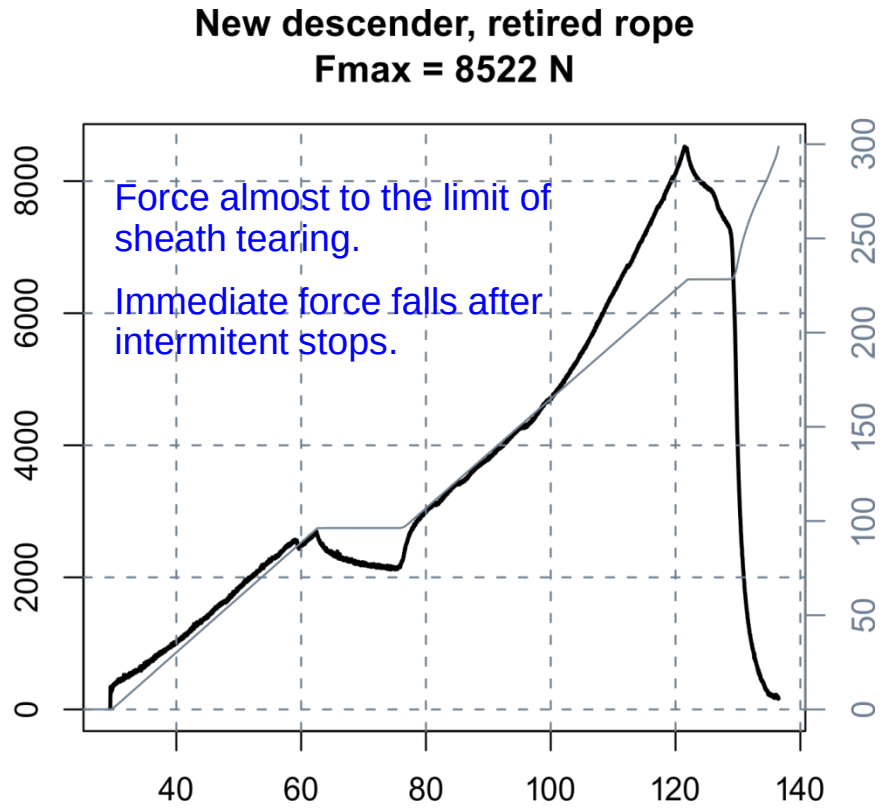
- To what extent do well used (retired) descenders distinguish from new ones?
- Stemming from that…
- Where are the boundaries of safety of the former and the later with respect to their load bearing capacities and functional performance.
- How do they perform in terms of safety when not everthing goes according to the plan (namely lost control of the descent)?

Tests on descenders

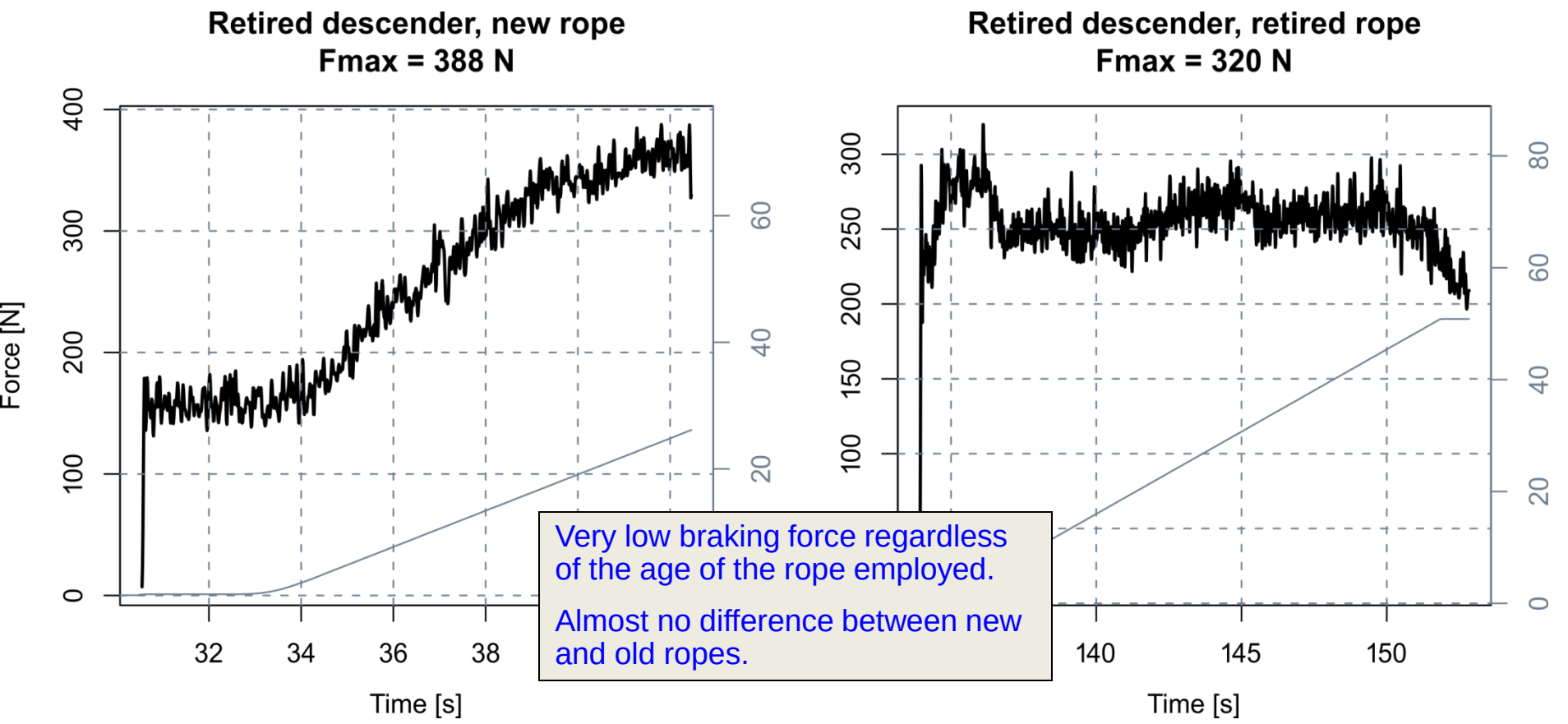
- **Static tests**:
  - Start of slippage on new and retired Petzl Stop descenders with new and retired ropes.
  - Loading capacity of new and retired Petzl Stop descender.
  - Breaking strength of Petzl Stop's upper pin: upwards pull.
  - Breaking strength of Petzl Stop's upper pin: outwards pull.
- **Functional tests**:
  - Used Petzl Simple, new 9 mm rope, with redirectional carabiner.
  - Used Petzl Simple, new 8 mm rope, with redirectional carabiner.
  - Used Petzl Simple, new 9 mm rope, with redirectional carabiner and initial hands off the free end of the rope.
  - Used Petzl Stop, new 9 mm rope, without redirectional carabiner.
  - New Petzl Stop, new 9 mm rope, with redirectional carabiner.

Start of slippage on new Petzl Stop descender with new and retired rope





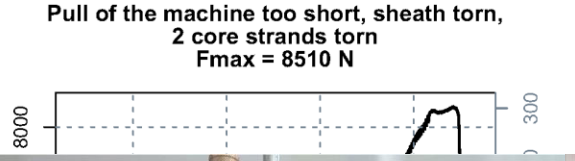
Start of slippage on used Petzl Stop descender with new and retired rope

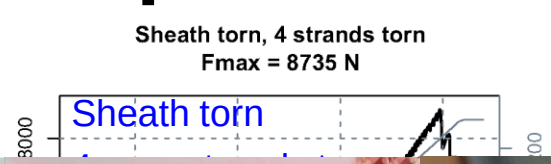


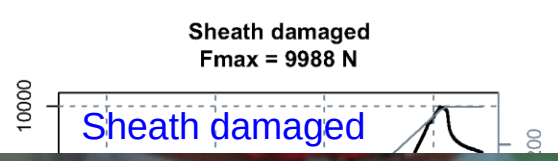
Very low braking force regardless of the age of the rope employed.

Almost no difference between new and old ropes.

Securing of a retired rope in new Petzl Stop descender



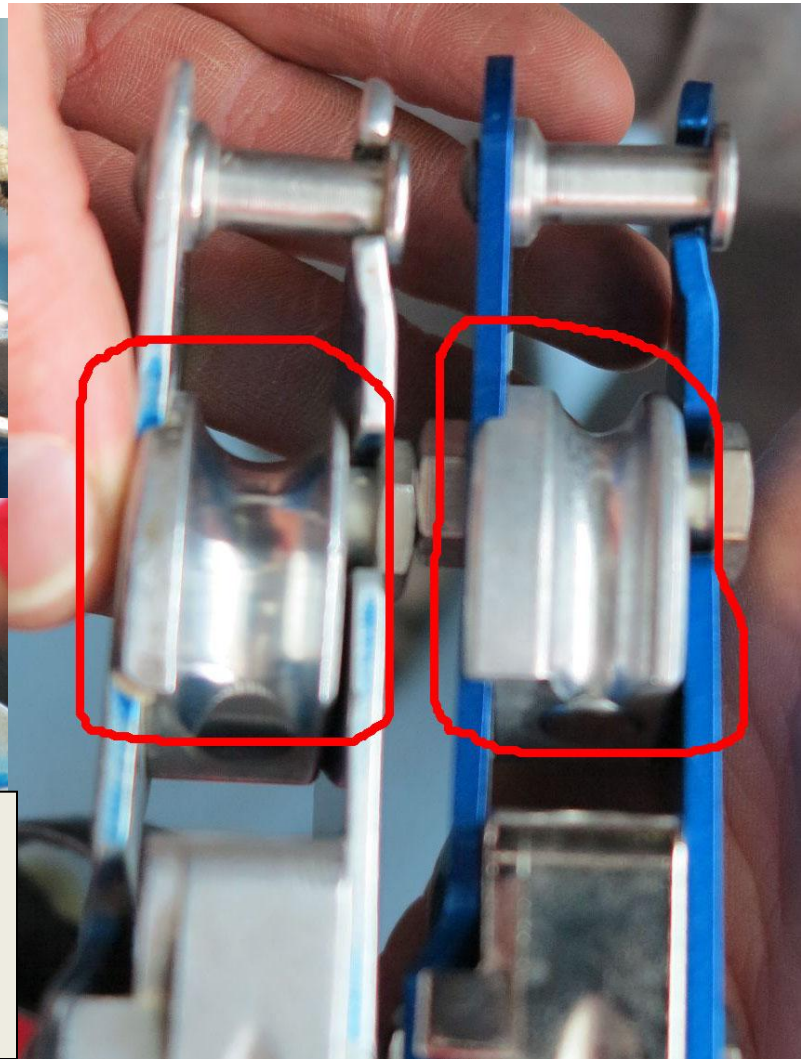




NEW DESCENDER

- Tears the sheath of the rope.
- Tears few strands of the core.
- It happens at the point of jamming between both bobbins.
- With forces between 800 and 950 daN.

Securing of a retired rope in a retired Petzl Stop descender

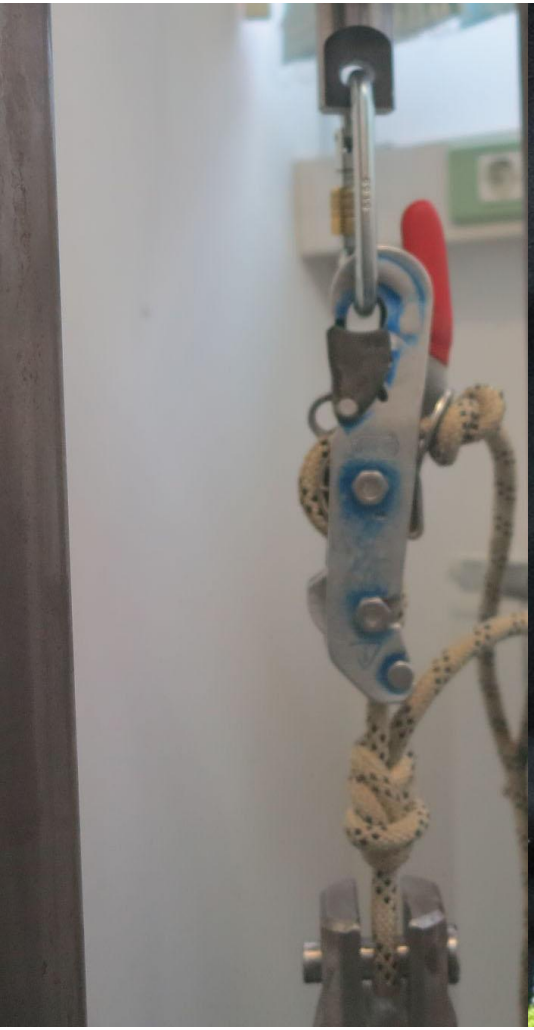


OLD DESCENDER

- The handle bends.
- Edge of upper bobbin breaks off.
- Rope is not damaged.
- With forces between 1050 in 1200 daN.

Test of upper pin – upwards pull

Tests of Petzl Stop upper pin



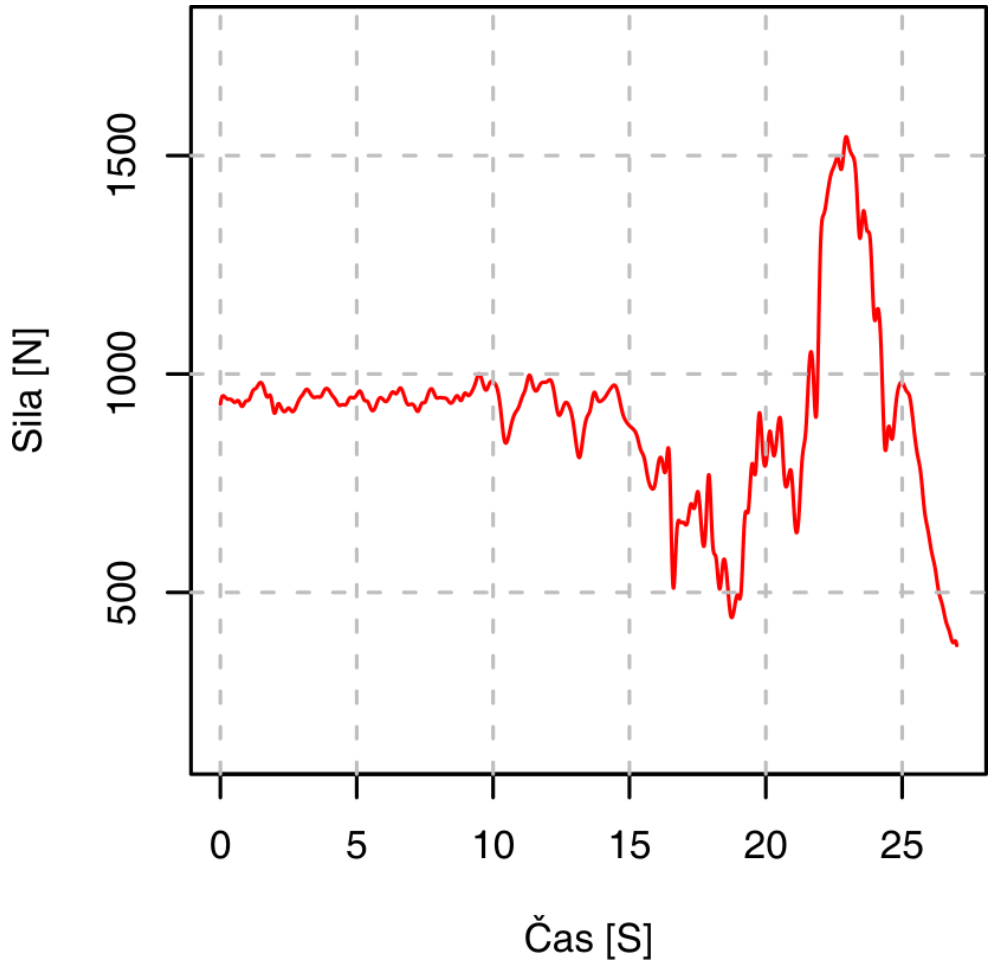
Functional testing

- Brigde.
  - 10 m height;
  - Ramp for high diving;
  - Suitable water depth.

- Descents with various combinations of descenders and ropes.

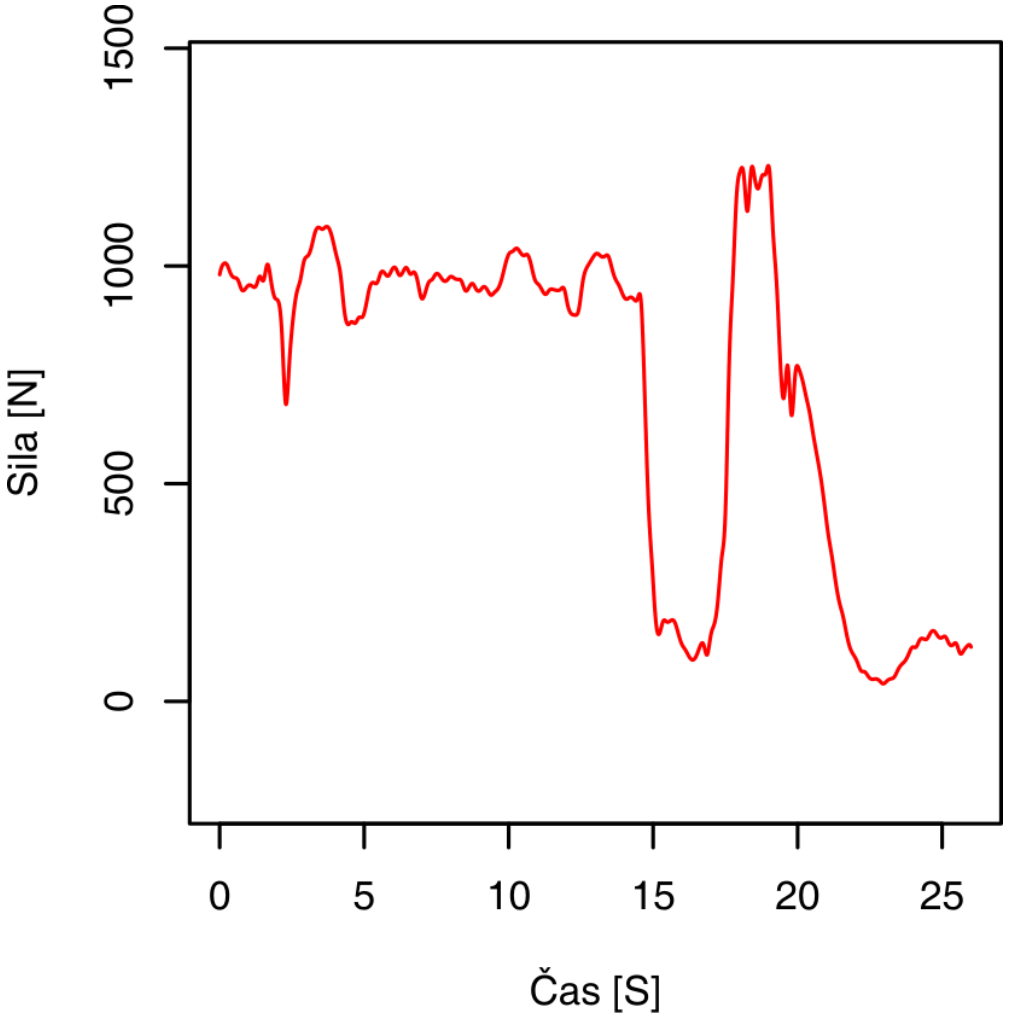
- Load cell measurement.

Petzl Simple – used, New 9 mm rope



Fmax = 178 daN

Petzl Simple – used, New 8 mm rope

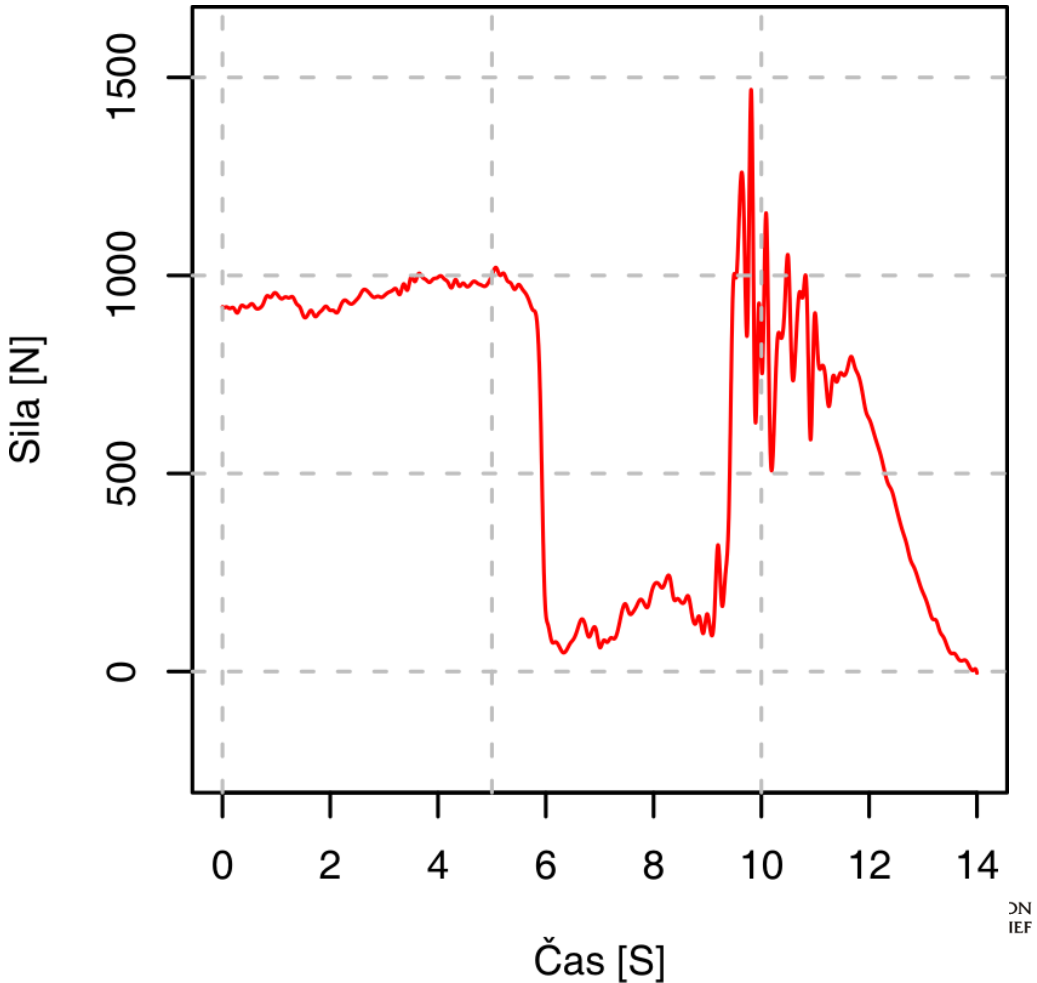


Fmax = 145 daN

Petzl Stop – used, new 9 mm rope, without redirectional carabiner

Without control of the free end of the rope. A few initial metres of pressed handle followed by a sudden release.

Fmax = 150 daN



Petzl Stop – new, 9 mm rope, with redirectional carabiner

Findings

- **All uncontrolled descents are dangerous regardless of the model and age of the descender used.**
  - Old Stop descender:
    - Start of slippage at very low levels regardless of the ropes employed;
    - Functional test (initial pressing of the braking handle subsequent release) ended in water;
  - New Stop descender:
    - Extremely high braking loads in the functional test may result in injury and damage of equipment.
  - All Simple descenders:
    - Results on the successful descent arrests are dubious and probably do not end equally for all experience levels of cavers.
    - Assertion supported by many accidents due to lost control during descent around the world.

Findings

- **There is a fundamental distinction in the behaviour of new and used Petzl Stop descenders.**
  - Arrest of a descent:
    - Used Petzl Stops do not necessarily block on the rope in the released handle mode. **In uncontrolled descents injury is probable.**
    - New Petzl Stops always block very efficiently. **In uncontrolled descnts rope damage and injury are probable**.
  - In the tie-off mode with equipment damaging forces :
    - New Petzl Stops damage the rope (8.5 kN < Fmax < 9.5 kN, retired 10 mm).
    - Used Petzl Stops damage themselves (Fmax ≈ 11 kN, retired 10 mm).

Safety factor

- If the acquired results are to be put into context, they have to be interpreted from the safety factor point of vew.
- The safety factor is the rate between minimum breaking strength and the maximum expected force on a component, or system.
  - Safety factor of individual components
  - Safety factor of a static system
  - Safety factor of a dynamic system

$$\mathbf{SF} = \frac{\text{min breaking strength}}{\text{max expected force}}$$

RESCUE GROUPS' STANDARDS:

SF_{stat} = 4 (USA mountain rescue)

FV_{stat} = 5

FV_{stat} = 10

FV_{stat} = 15 (some fire-fighter squads)