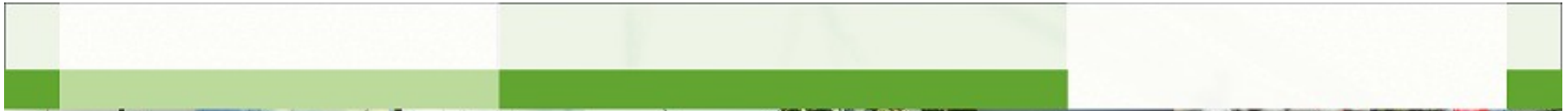


ERCA-Safety-Commission & Edelrid Laboratory

Test Of Synthetic Slings

(according to EN-566 and UIAA-104)

ERCA European Ropes Course Association

08.04.2010

- Why do we have tested slings?
- Relevance for ropes course industry
- Experimental design
  - Tested groups
  - Messurement results
  - Interpretation of the results
- What does it mean for the usage in ropes courses?
- Guidelines

Why Do We Have Tested Slings?

- Several years ago there was an accident occured by a broken sling. The sling was the connection between the flying-fox-pulley and the participant. The sling is broken while using the flying fox and the participant was falling to ground and heavy injured. Maybe the sling was knotted and wet. No special problems were explained. The accident is not cleared up respectively there is no information published till today.

Preface

- We are not in the official examination process, but we want to provide unbiased information about the sequence of events and the causes of accidents. We are neither in the position to, nor do we have the intention of, undertaking in-depth on-the-spot investigations.

Why Is That Sling Broken?

If there are no hazardous factors (like acid, sharp edges etc.), in our opinion there is no reason why this sling should break. Using a flying fox should not cause forces over 300 ... 600 daN in this connection sling. And the sling should withstand these forces whether it is knotted (minus 50% of strength) or wet. So we were concerned about this situation.

Why Is That Sling Broken?

Two hypotheses remain open:

- Are there other hazardous factors (wetness, freeze, long-term use) decreasing the tensile-strength?
- Can the interaction of various factors lead to decreasing of the tensile-strength? Are these effects such enormous that a sling could tear at 300 to 600 daN?

Relevance For Ropes Course Industry

- Answering these questions is very important for us, because in ropes courses we use slings under other conditions (every day, all over the year, in tensioned security systems, etc.) than the slings were originally made for (doing sport climbing/ rock climbing sometimes).
- So we have decided to start a pilot experiment concerning the unanswered questions. Edelrid was the partner for the first tests.

Experimental Design

- Laboratory test of the tensile strength of slings under different environmental factors.
- We also have tested a control group of new slings.
- 2 tearing tests per tested group.
- Tested material:
  - 19mm polyamid sling (Edelrid Supertape)
  - 11mm dyneema sling (Edelrid Dyneema-Schlinge)

Experimental Design

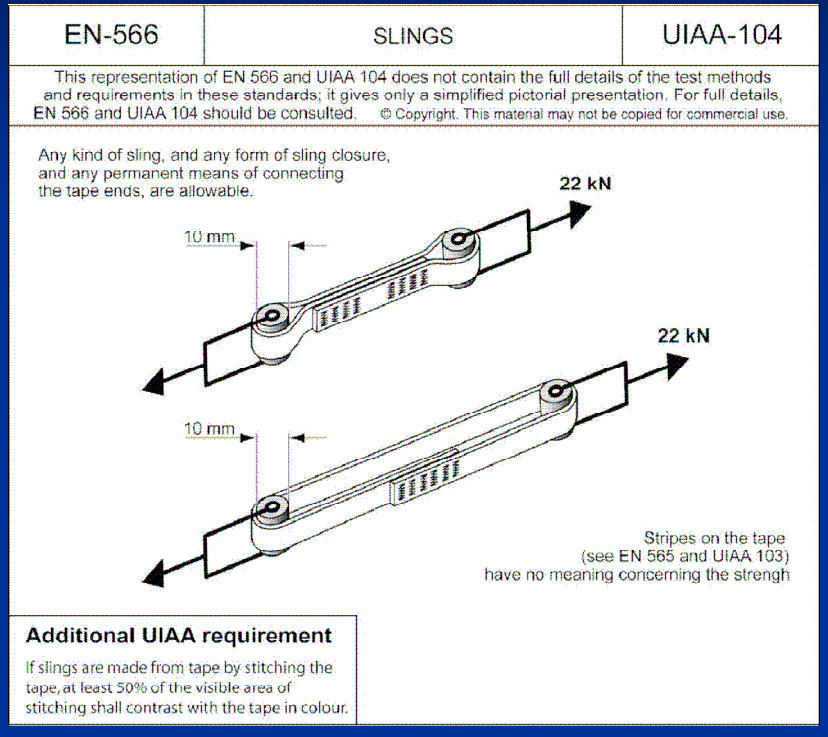
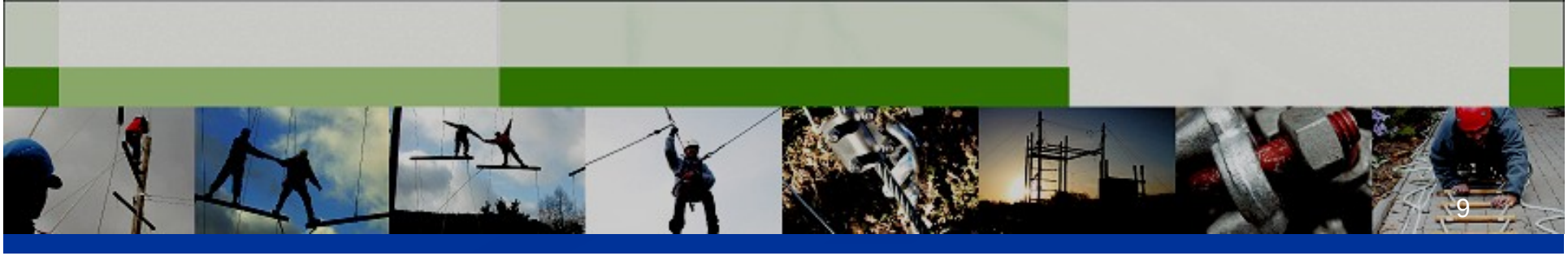


Illustration: http://www.theuiaa.org

Illustration: scheme of the test set-up, Edelrid



Tested Groups

1. Sling knotted with overhand knot. Loaded on the ends.

2. Sling knotted with overhand knot. Loaded in the loop.

3. Wet sling.
4. Frozen sling (-20° C)

Tested Groups

5. Slings with abrasion (abrasion was technically generated in the laboratory).

Illustrations: scheme of the test set-up, Edelrid

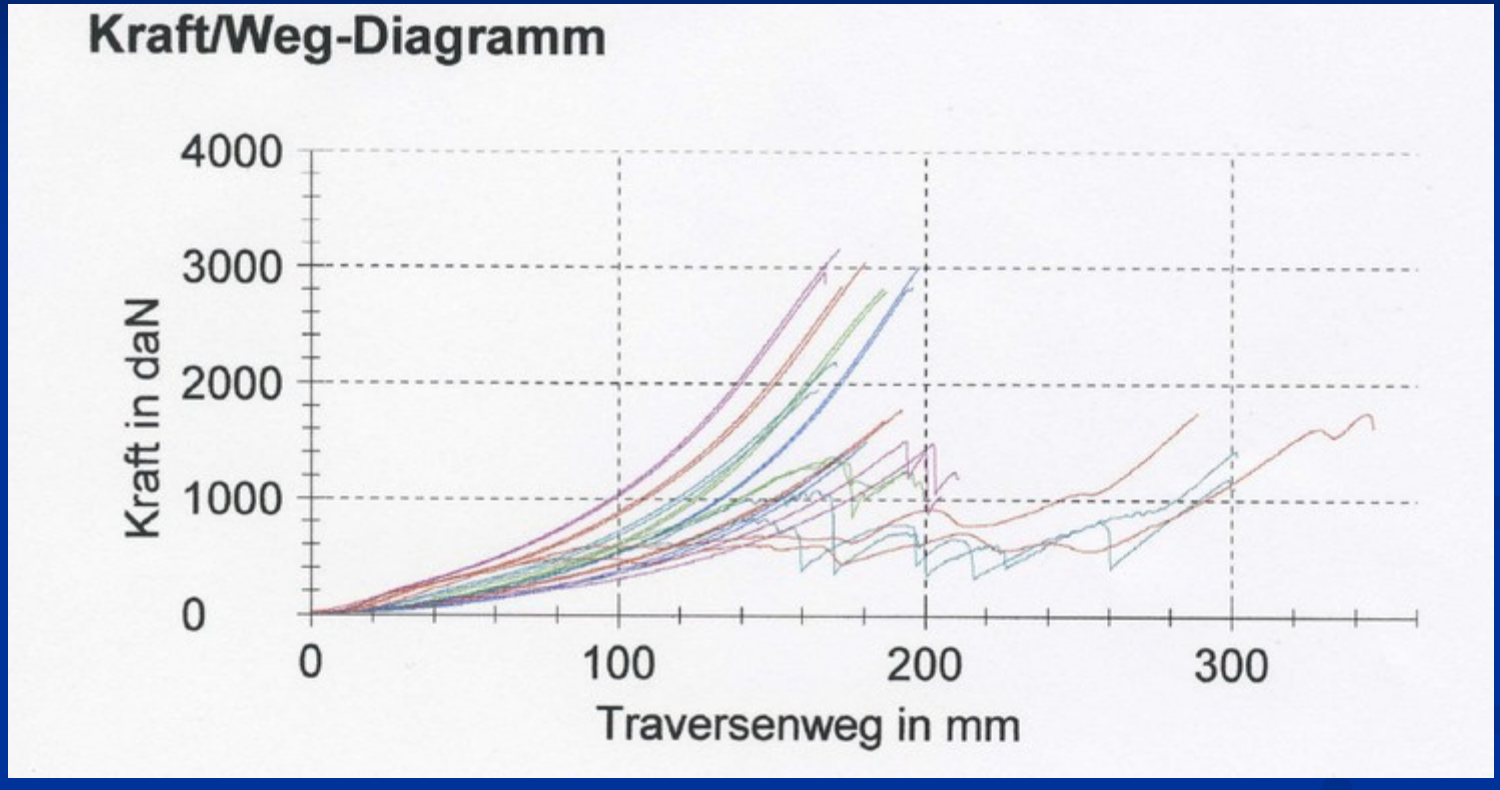
Dyneema before after Polyamid before after

Tested Groups

6. Slings after continuous running with load (technically generated). 1800 succeeding cycles with a load of 225 daN.

Messurement Results

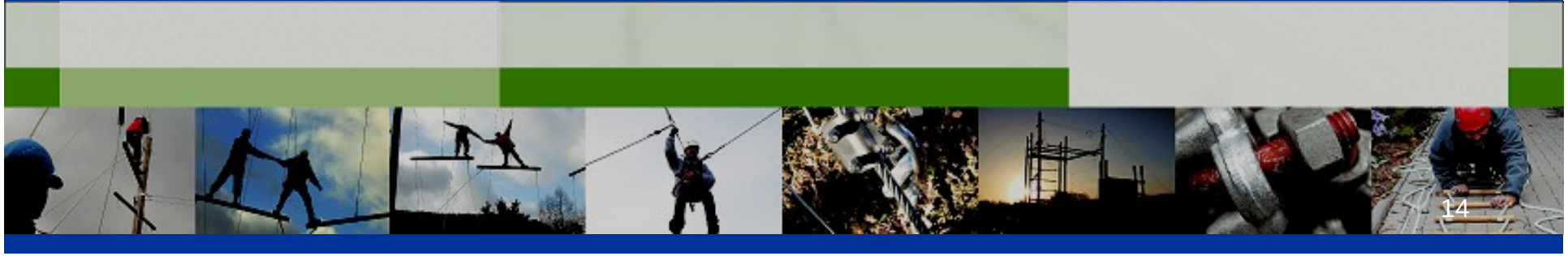
19mm polyamid sling (Edelrid Supertape)



Messurement Results

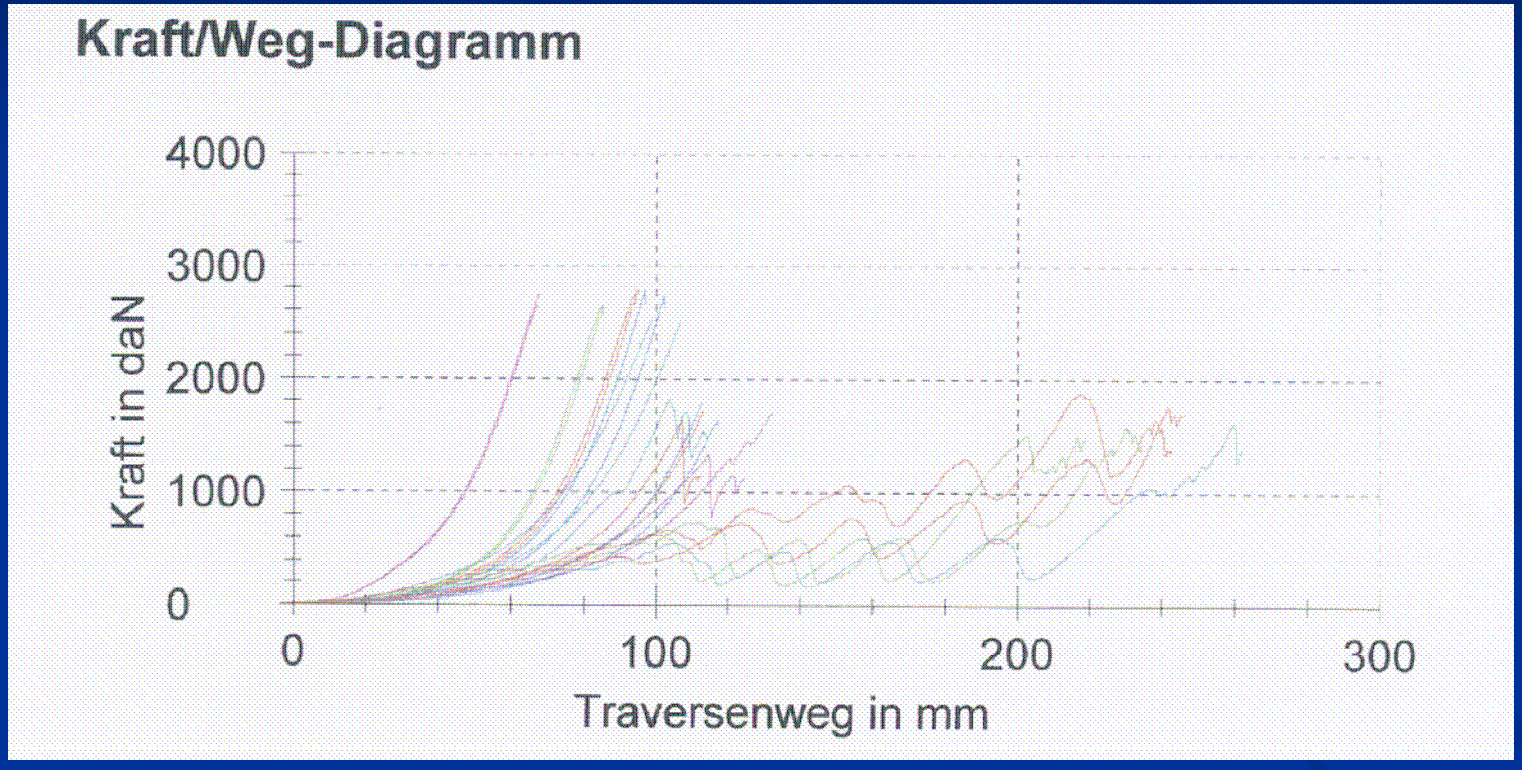
19mm polyamid sling (Edelrid Supertape)

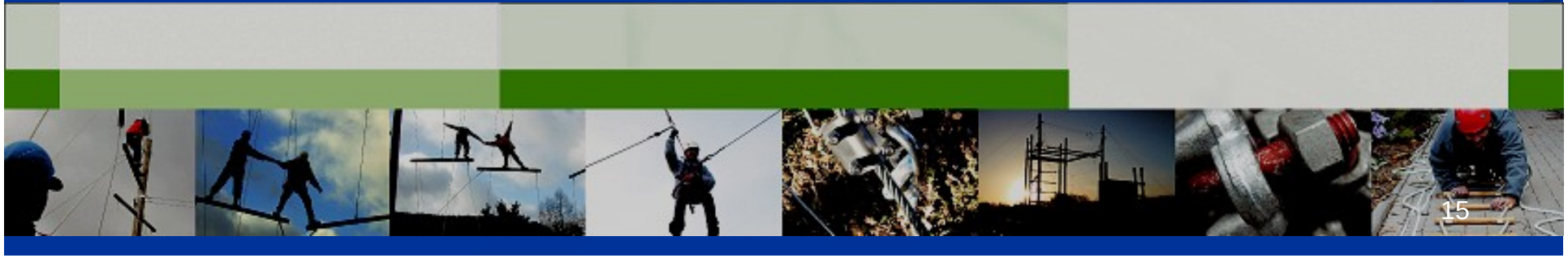
Legende	Nr	Bemerkungen	Höchstzugkraft daN
	1	19 mm PA-Schlinge neu	2828
	2	19 mm PA-Schlinge neu	3049
	3	19 mm PA-Schlinge nass 2 Tage	2819
	4	19 mm PA-Schlinge nass 2 Tage	2784
	5	19 mm PA-Schlinge 1 Tag gew./1 Tag -20°C	2831
	6	19 mm PA-Schlinge 1 Tag gew./1 Tag -20°C	3004
	7	19 mm PA-Schlinge gealtert 2 * 500 Zykl.	1935
	8	19 mm PA-Schlinge gealtert 2 * 500 Zykl.	2181
	9	19 mm PA-Schlinge 1800 Zykl. 225 daN	3158
	10	19 mm PA-Schlinge 1800 Zykl. 225 daN	2957
	11	19 mm PA-Schlinge neu Knoten Vers. 1	1682
	12	19 mm PA-Schlinge neu Knoten Vers. 1	1769
	13	19 mm PA-Schlinge neu Knoten Vers. 2	1363
	14	19 mm PA-Schlinge neu Knoten Vers. 2	1322
	15	19 mm PA-Schlinge 2 Tage gew. Knoten Vers. 1	1420
	16	19 mm PA-Schlinge 2 Tage gew. Knoten Vers. 1	1498
	17	19 mm PA-Schlinge 2 Tage gew. Knoten Vers. 2	1422
	18	19 mm PA-Schlinge 2 Tage gew. Knoten Vers. 2	1177
	19	19 mm PA-Schlinge 1 Tag gew./1 Tag -20°C Knoten Vers. 1	1480
	20	19 mm PA-Schlinge 1 Tag gew./1 Tag -20°C Knoten Vers. 1	1508
	21	19 mm PA-Schlinge 1 Tag gew./1 Tag -20°C Knoten Vers. 2	1748
	22	19 mm PA-Schlinge 1 Tag gew./1 Tag -20°C Knoten Vers. 2	1741



Messurement Results

11mm dyneema sling (Edelrid Dyneema-Schlinge)

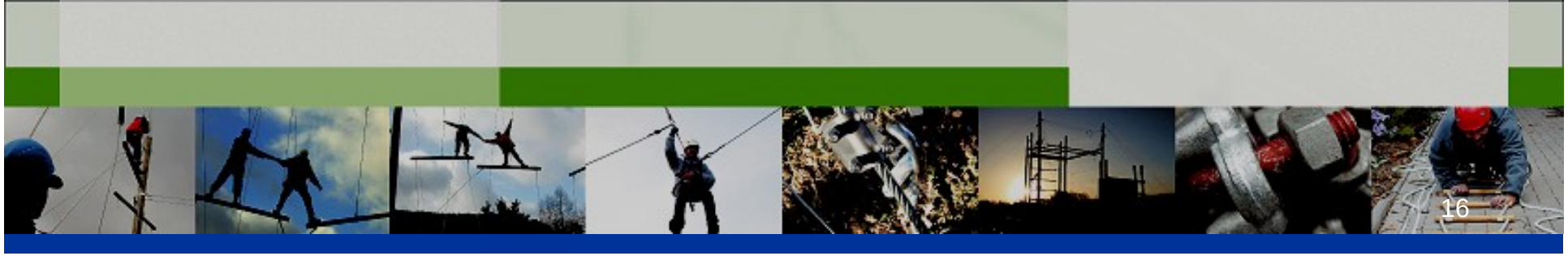




Messurement Results

11mm dyneema sling (Edelrid Dyneema-Schlinge)

Legende	Nr	Bemerkungen	Höchstzugkraft daN
	1	11 mm Dyn.-Schlinge neu	2794
	2	11 mm Dyn.-Schlinge neu	2788
	3	11 mm Dyn.-Schlinge nass 2 Tage	2618
	4	11 mm Dyn.-Schlinge nass 2 Tage	2647
	5	11 mm Dyn.-Schlinge 1 Tag gew. / 1 Tag -20°C	2733
	6	11 mm Dyn.-Schlinge 1 Tag gew. / 1 Tag -20°C	2782
	7	11 mm Dyn.-Schlinge gealtert 2 * 500 Zykl.	2535
	8	11 mm Dyn.-Schlinge gealtert 2 * 500 Zykl.	2511
	9	11 mm Dyn.-Schlinge 1800 Zykl. 225 daN	2755
	10	11 mm Dyn.-Schlinge 1800 Zykl. 225 daN	2644
	11	11 mm Dyn.-Schlinge neu Knoten Vers. 1	1717
	12	11 mm Dyn.-Schlinge neu Knoten Vers. 1	1637
	13	11 mm Dyn.-Schlinge neu Knoten Vers. 2	1581
	14	11 mm Dyn.-Schlinge neu Knoten Vers. 2	1499
	15	11 mm Dyn.-Schlinge 2 Tage gew. Knoten Vers. 1	1792
	16	11 mm Dyn.-Schlinge 2 Tage gew. Knoten Vers. 1	1628
	17	11 mm Dyn.-Schlinge 2 Tage gew. Knoten Vers. 2	1608
	18	11 mm Dyn.-Schlinge 2 Tage gew. Knoten Vers. 2	1806
	19	11 mm Dyn.-Schlinge 1 Tag gew. / 1 Tag -20°C Knoten Vers. 1	1339
	20	11 mm Dyn.-Schlinge 1 Tag gew. / 1 Tag -20°C Knoten Vers. 1	1709
	21	11 mm Dyn.-Schlinge 1 Tag gew. / 1 Tag -20°C Knoten Vers. 2	1879
	22	11 mm Dyn.-Schlinge 1 Tag gew. / 1 Tag -20°C Knoten Vers. 2	1770



Please Note: No General Validity !!!

- This pilot experiment should deliver first tendencies and hints at hazardous factors.
- Survey sample size and spectrum of products (e.g. different manufacturers, other types of slings, etc.) was to small to draw any wider conclusions.
- All tests were performed in the laboratory, but not in the field.
- Only a bigger sample of datas and field experiments (e.g. with 1 year old ropes course gear) can lead to valid results.

Interpretation Of The Results

- All knots extremely decrease the tensile strength of slings. (see also the publication of german alpine club)
- Abrasion leads to a significant decrease of the tensile strength of the tested slings.
- Wetness and freeze leading to changes in the slip characteristic of slings. Only a minor decrease of tensile strength of the tested slings is proved.
- The tensibility of polyamid and dyneema is different.
- Continuous loading, as done in the test, has no effects to the tensile strength of the tested slings.

What Does This Mean For The Usage Of Slings (EN-566, UIAA-104) In Ropes Courses

- In accordance with the principle* of best safety for participants in commercial ropes course industry following guidelines should be performed.

* As an industry, we were subject to a special care for our participants because they are commonly layman. Contrary to that we have e.g. rock climbing done by two experienced climbers in their freetime.

Guidlines For The Usage Of Slings In Ropes Course Industry

- Only use stitched and tested slings. For usage please follow the instructions in the users manual.
- Do not tie any knots in a sling, because that manipulation enormously decrease the tensile strength of a sling. And please note: the girth hitch is a knot, too.
- Do not put slings on sharp edges.

Guidlines For The Usage Of Slings In Ropes Course Industry

- Avoid putting slings on rough surface. Otherwise abrasion will wear out your sling in a short time.

- Carefully check and maintain all slings regularly and follow instructions given by manufacturers. Frequency of inspection depends on usage and can be shorter than one year/ half year/ some month – especially when used in permanent installations or in day-by-day use.

Guidlines For The Usage Of Slings In Ropes Course Industry

- Slings used under heavy load or in tensioned security systems should be „back-uped“ (principle of redundancy).

We Thank The Edelrid-Team For Professional Support