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# Dyneema during mountain and air rescue operations



dos – don'ts – critically uses



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[www.air-work.com](http://www.air-work.com)



We produced LongLines/FixRopes  
for Logging, Transport/Construction work  
and AirRescue with Dyneema  
since 18 years



Logging is the hardest job for Dyneema  
do you can think of

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2010, springtime

EC-certification ECD 2006/42/ECC

Personell carrying device for rescue and  
Intervention up to WLL 800 kg



called MERS2 (sec. Gen.)

**Air Zermatt operates MERS since 18 years**





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## MERS2 for Special Forces GSG9 by German Federal Border Police

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# 1. What is "Dyneema"

- 1.1 Dyneema® is a trade mark of the Dutch company DSM Dyneema® and consists of high modulus polyethylene **HMPE**
- 1.2 HMPE is a high-strength material with positive, negative and potentially dangerous characteristics
- 1.3 Trade names are: e.g. DynaTec®, DynaOne®, DynaOne HS®
- 1.4 Other HMPE materials are: e.g. Spectra® fiber by Honeywell, Plasma®
- 1.5 Not to be confused with Kevlar®: Kevlar is a trade mark of DuPont's Aramide® and indicates an **HMPA** material (HM Polyamide). Other trade names are: Nomex®, Twaron®, Technora®

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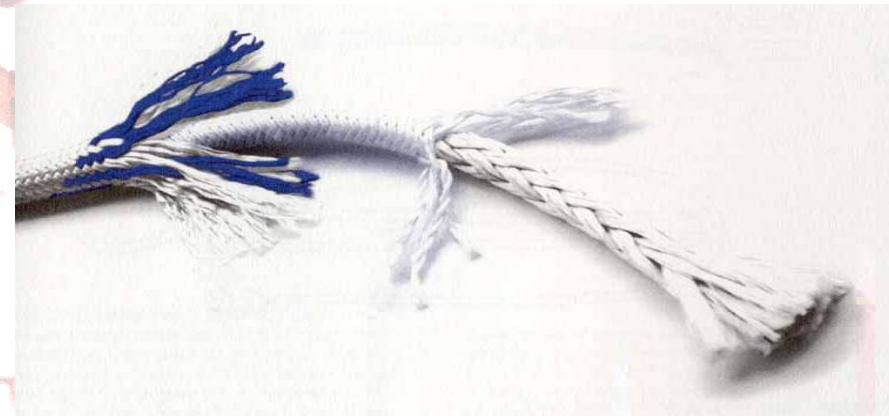
## 2. Constructions



12-strand braid  
100% Dyneema® SK75

Ø 0.8 – > 100 mm  
UL 0.1 kN > 500 kN

Ø 8 mm, 50 kN, 4 kg/100 m



Core 12-strand braid  
100% Dyneema® SK75  
Intermediate cover PES staple fiber  
24- or 32 plait cover PES  
Ø 2 – > 60 mm  
UL 0.15 kN > 1600 kN

Ø 8 mm, 30 kN, 4 kg/100 m



# 3. Comparison

Material	HMPE	HMPA	PES	PA	Titanium	
Trade names	Dyneema	Aramid	Trevira	Nylon	--	
E-modulus	105	130	10-15	0.25-3.5	105	kN/mm <sup>2</sup>
Melting point	140	500	225	215-260	1668	°C
Heat resistance	70 !	350	170	130	--	°C
Elong. at break	3.8	3.4	10-17	18-24	--	%
UV resistance	++++	+	+++	++	n/a	
Breaking load of self weigh	400	235	--	85	25	km

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## 4.a +

Light-weight (8 - 10 times lighter than steel)

High strength (3.6 kN/mm<sup>2</sup>; higher than titanium)

Low elongation 50% UL < 1% (PA: 50% UL > 20%)

Resistant to UV, alkali, acids and petroleum-based products

Relatively easy to splice when without cover





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## 4.a + (continued)

No water absorption in the material (only between the braids)

Lighter than water (specific gravity  $0.97 \text{ g/cm}^3$ )

**Dyneema ropes are high performance ropes**



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## 4.b -

Slippage between rope core and cover (smooth surface)

Temperatures  $> 50^{\circ}\text{C}$

Decrease in strength shortly after start of use

Ropes equipped with covers are difficult to splice

Instability of rope diameter  $\varnothing$

Rotation without swivel

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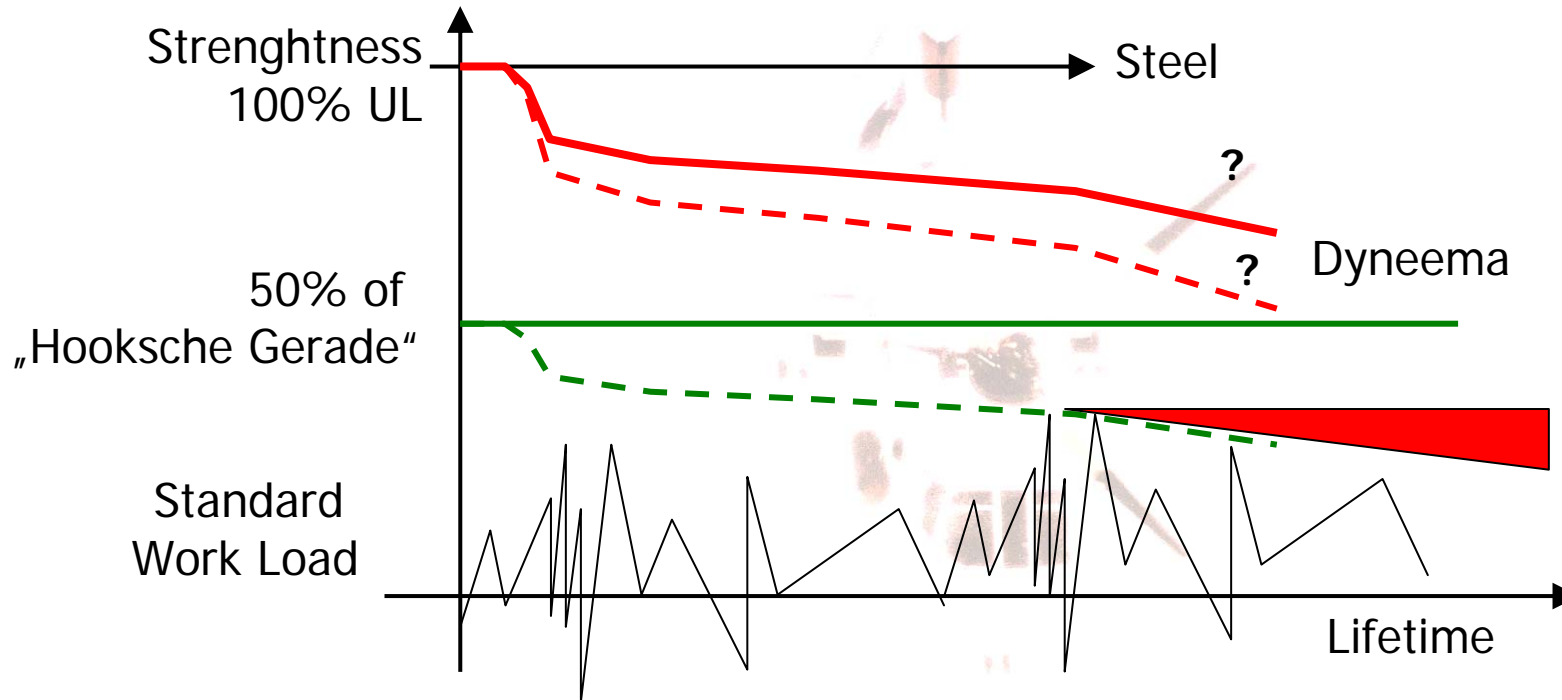
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# 4.b - Decrease in strength





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## 4.b - (continued)

Recognition of discard criteria (replacement state of wear)

Kink-bands (swellings inside the rope; only with core cover ropes)

**Danger: minimal deviations have maximum impact!**

Not certifiable as a rope generally used for rescue or climbing  
EN 892 (dynamic ropes) or EN 1891 (semi-static ropes)

**Dyneema isn't as good-natured as polyamide or polyester!**



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## 4.c +/-

Abrasion resistance (when slipping over rocks)

Creep at long term load

Pollution (fine particles)

Rope behaviour: static

Water between the braids – long time for drying!

**We can do a lot – but not everything!**

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## 5.a **Dos** (examples)

Fix rope for air rescue (in CH up to 200 m)

- + alternating loads, small diameter, lightweight
- + e.g 14 mm DY1 = 800 kg HEC, 10.5 kg /100m
- + EC certified for HEC (system certification)

### Splicing

- + high performance rope end fitting (deviation < 10%)
- + long end-to-end splicing is possible



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## 5.a **Dos** (examples)

Traction winch (manually operated)

+ slow traction, no piling (no pressure on the first rope layer)

Long longitudinal ropes (400 m or more)

+ lightweight, small diameter, high performance

+ e.g. 8 mm DY1 = 4 kg/100m, UL 50 kN gross, net 42 kN)

Outdoor operations, speleo, in water (long term exposure)

+ UV resistant, lighter than water, no water absorption

+ no diameter variance, cooling by water (rope clips)



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## 5.b **Don'ts** (examples)

### Climbing

- impact force (dynamic shock), slipping of rope clips, slipping of knots, slippage between rope core and cover

**High risk of injury!**

### Outdoor splicing of ropes

- 30% loss of strength between a well-made and a bad splice





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## 5.b **Don'ts** (examples)

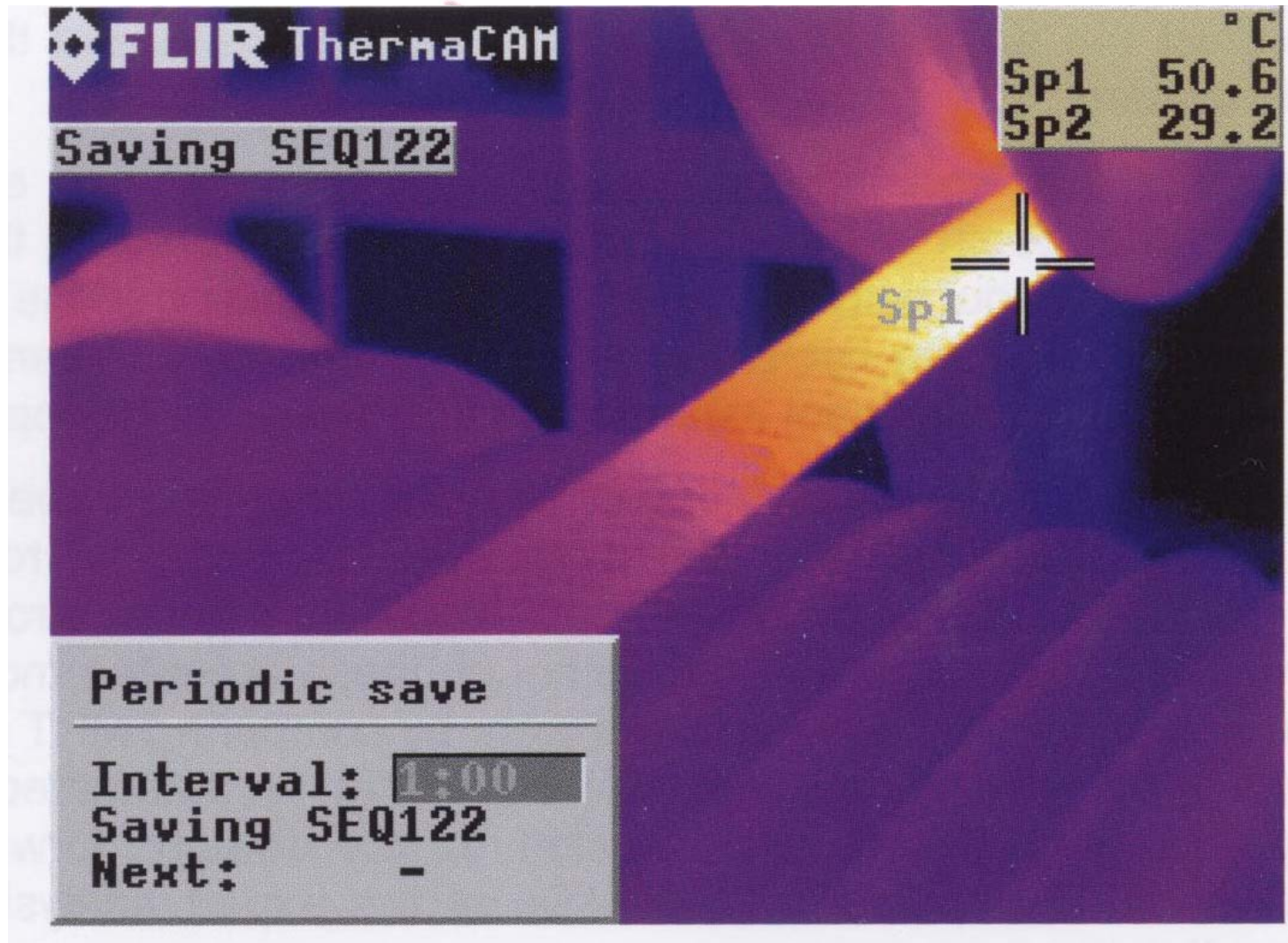
Stack winch (high speed rappelling or high speed winches)  
- pressure on the first rope layer, heating at winch output,  
jamming among rope layers on the winch

Hot surfaces (TARMAC, hot tar, hot exhausts), shrink tubes  
- temperatures  $> 50^{\circ}\text{C}$  are very critical  
- temperatures  $> 70^{\circ}\text{C}$  are absolutely destructive

**Heat-damage are imperceptable to the eye.**



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## 5.c **Critically uses** (examples)

Work on rope

+/- body joints and soft tissue are stressed (no dynamics absorption)

Traction over rocks

+/- rope abrasion, pollution by small particles

**Sharp edges, crevices and the like  
reduce rope life dramatically**



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## 6. Conclusion

Dyneema is

- a very efficient material when correctly used
- a very dangerous material when incorrectly used.