

Highline and Helicopter Rescue

Status, Difficulties, and next Steps



Initiated by: Jakob Bludau, Aaron Benkert, Lukas Irmeler
Help: Martin Flugrettung, Bergwacht Bayern, Raed-Slacklines

Why air rescue off highlines

- Highlines can be in alpine terrain with corresponding anchors
- Terrestrial rescue is limited to rappelling directly from the line or getting to one of the anchors first
- All terrestrial rescue requires long periods of hanging in a harness



A direct air rescue off the highline can drastically improve the medical prognosis

Previous rescues with longline/hoist

- Hoist experiments by GMSP26, Crew of Dragon38 at Roi Gros Nez [facebook.com](https://www.facebook.com)
- Hoist experiments by PGHM Annecy [facebook.com](https://www.facebook.com)
- ...
- Rescue, Martin Flugrettung, 2012. Linelength 40-50m



Towards an SOP for highline rescue

Regulation (EU) No 965/2012, ..., 2023/1020:

- SPA.HERMS.105 HERMS HEC operations:
 - ensure that sling technical crew members are adequately equipped, trained, checked and briefed;
 - develop specific HERMS HEC SOPs, following the risk assessment referred to in point SPA.HERMS.140;
 - ensure that all flight crew members involved in HERMS HEC operations are experienced, trained and checked for HERMS HEC operations, and have recent experience with such activity;
- SPA.HERMS.140 Information, procedures and documentation:
 - The operator shall assess, mitigate, and minimise the risks associated with the HERMS environment as part of its risk analysis and management process. The operator shall describe the mitigating measures, including operating procedures, in the operations manual.

Plan for helping develop a SOP

- Help operators with risk assessment
- Strategies for risk mitigation to allow flight training
- Show main risks and mitigation in experiments
- Procedure for longline and rescue hoist
- Develop strategy how highliners can help in rescue
- Help interested operators train the procedure

What happened so far?

- Functional Hazard Analysis for direct air rescue with a longline (German only)
- Series of flight rescue trainings in a risk-mitigated setting with Heli Austria using a longline
- Presentation at ICAR 2023 and ISA 2024
- Teaming up with Bergwacht Bayern for hoist cable vs webbing contact experiments

Video of rescue



Where are we going?

- Longline based rescue worked in training
- Risk can be mitigated to create a safe environment
- Experiment showed contact with hoist cable critically damaged the webbing
- Most helicopter operators are transitioning to hoist rescue procedures



- Way of mitigating contact of highline and hoist cable required
- Mitigation has to be within what crews are used to handle
- Mitigation should not need to modify hoist or anything bolted onto the fuselage/hoist (otherwise EASA/FAA require certification)

Now for the update since ISA 2024!

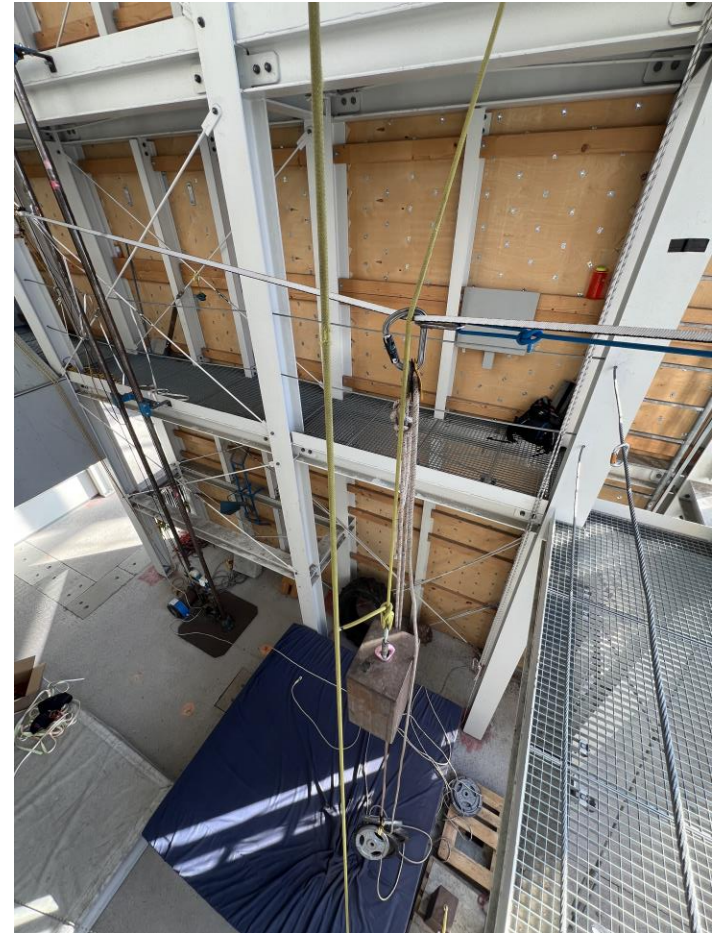
- Labwork:
 - Test contact climbing rope vs webbing
 - Presentation of contact experiments at ICAR 2024
 - Destructive testing of contact damaged webbing @ ISA
 - Translation of our documents to English
 - Public website with versioning and our raw data (open science)
- Flight test planning/preparation for experiments with rescue hoist
 - Time restrictions of key personnel
 - Internal discussion/questions of Heli Austria



Flight test with hoist rescue pushed to next year

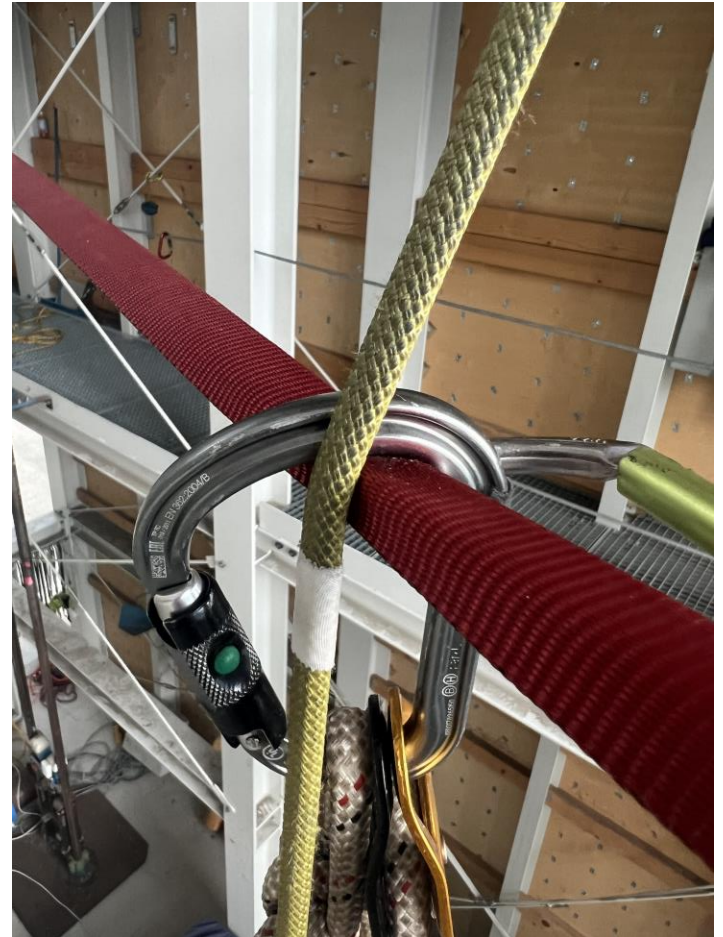
Climbing rope vs highline webbing

- 6.8m Length
- 3.38 – 4.2 kN with 70 kg Patient “dummy”
- Patient at 20% linelength from anchor
- 100 kg Flight rescuer “dummy”
- 8,9mm Edelrid Swift climbing rope
- 25 cycles @ 2m -> 100m of moving in contact
- Same angles and load as in previous hoist experiment (see our mechanics document)



Climbing rope vs highline webbing

- Weak side of webbing where webbing contacts the rope
- Large Petzl ball lock as leash ring
- Hoist with same roughly same speed as on H-145 helicopter with hoist
- Used climbing rope (rather towards end of life)
- Same section of climbing rope used for all experiments
- Dyneema (Dyneemite PRO)
- PA (MOTM)
- PES (Aurora)
- All new webbing



Microscopy after experiment

Dyneemite PRO



New



Damage

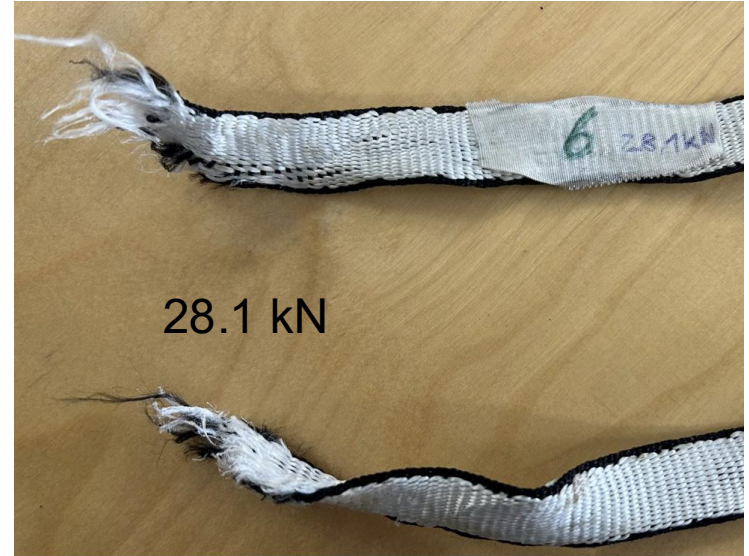
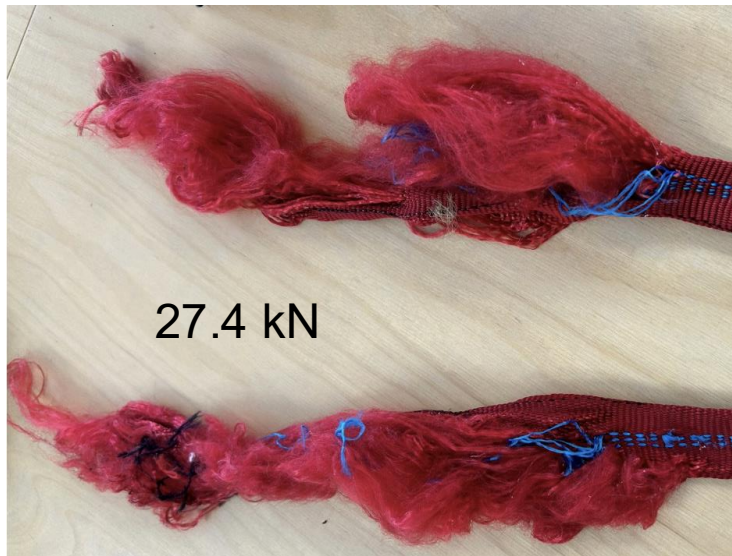


Damage(zoom)

- All webbings show damage of friction in contact point
- Due to bending of webbing at contact is spread over larger area
- Damage seemed to occur in the first few meters of movement in contact and leveled off after (just a visual observation, not verified)

Presentation @ ICAR 2024

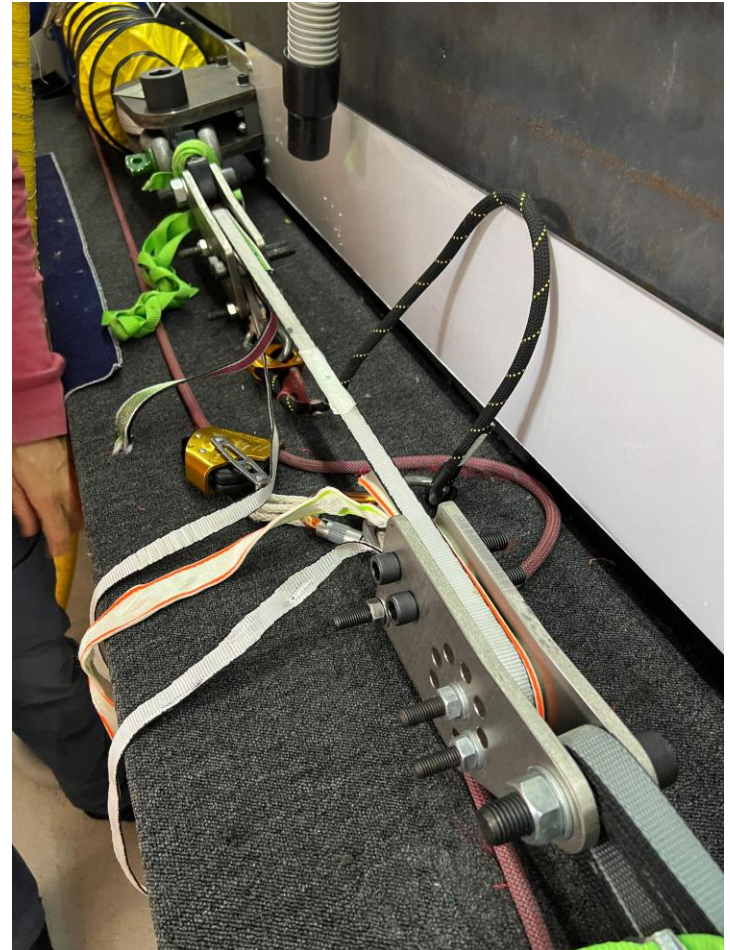
Break strength tests @ BW ZSA



- We were invited by them to give an update
- Results of hoist vs highline and climbing rope vs highline presented
- Presentation done by Stefan Blochum of BW

Destructive testing of contact damaged webbing @ ISA Bern

- Testing @ ISA test lab
- Standard: ISA:41:2024
- Some problems with dyneema having too little friction in anchors
- All samples broke at damaged point
- One reference of same production batch for each material



Destructive testing of contact damaged webbing @ ISA Bern

Number	Material	Breaking strength (kN)	Testlab	Difference to spec (%)
1	Dyneema	21.63	ISA Lab Bern	-36.38
2	Dyneema	21.02	ISA Lab Bern	-38.17
3	Dyneema	24.85	ISA Lab Bern	-26.91
4	Dyneema	28.65	ISA Lab Bern	-15.73
5	Dyneema	25.31	ISA Lab Bern	-25.55
6	Dyneema	28.1	BW ZSA	-17.35
Reference	Dyneema	34.63	ISA Lab Bern	1.85
7	PA	26.77	ISA Lab Bern	2.96
8	PA	25.61	ISA Lab Bern	-1.5
9	PA	26.83	ISA Lab Bern	3.19
10	PA	27.4	BW ZSA	5.38
11	PA	26.3	ISA Lab Bern	1.15
Reference	PA	27.66	ISA Lab Bern	6.38
12	PES	25.27	ISA Lab Bern	-12.86
13	PES	26.4	BW ZSA	-8.96
14	PES	26.16	ISA Lab Bern	-9.79
Reference	PES	30.04	ISA Lab Bern	3.58

Climbing rope vs highline

- Contact of climbing rope and webbing seems to be less critical than contact with the hoist cable
- Climbing rope and rappel device is included in the crew's equipment
- Exiting the helicopter in flight via hoist is still possible
- Landing will require extended hoist cable (no way to get back into cabin mid flight)
- No modification to hoist or helicopter necessary (thus no certification of equipment)
- UIAA certified equipment for rappel with increased load available



- Transfer of our previous experience to hoist rescues looks reasonable

Translation and website

Thanks @ Michael Seemann

- Functional Hazard Analysis translated into English
- Publication of our simulation models, documents, planning, presentations on an open access website
- Github for automatic versioning

Open project on github



Flight test planning for 2025

- Personnel planning difficult:
 - Aaron in final year of med school and Ph.D
 - Lucas travelling in South America
 - Jakob moved to Tennessee for a Post-doc
- Heli Austria internal discussion:
 - Only recently bought helicopters with hoist
 - Some technical uncertainties

Conclusion and a warning

- Project has made progress even though resources were scarce
- Quite some international interest but please help spread the information
- Effort to make our documents as easily accessible as possible
- We hope to do hoist based rescues in 2026

Do **not** rely on a helicopter rescue when highlining!

Contact

Any help with this is welcome

We gladly share our documents and experience

We gladly connect you to helicopter crews that have trained this



Just contact anyone of us:

Jakob.bludau@tum.de

a.benkert@campus.lmu.de

contact@Lukas-irmler.com

Thanks for your attention
We hope for an exciting discussion



Bibliography

- Slide 3:

https://m.facebook.com/story.php?story_fbid=pfbid02sWnw5sw9NwDaeEFeYcuYyKSVAJYgy8ywcrCFLXdzoJWXtFgMN9PByq6J3geb6fonl&id=1139181036126918&sfn=scwspmo (accessed on 6.10.2023)

<https://www.facebook.com/groups/100447203334294/permalink/6945902935455319/> (accessed on 17.10.2023)

- Slide 4:

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02012R0965-20231002&qid=1696594818528> (accessed on 6.10.2023)

Backup Slides