

Highline and Helicopter Rescue

Status, Difficulties, and next Steps



Initiated by: Jakob Bludau, Aaron Benkert, Lukas Irmler
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
- Hoist experiments by PGHM Annecy facebook.com
- Rescue, Martin Flugrettung, 2012. Linelength 40-50m



Towards an SOP for highline rescue

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

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

Functional Hazard Analysis

Risk assessment via FHA in every phase:

System:	Function:
Helicopter	Load transfer
	Positioning (by instruction of rescuer)
Rescuer	Positioning (self, translatory)
	Positioning (self, rotatory)
Longline	Attachment of patient's harness to longline
	Detachment of patient from highline
Longline	Load transfer
Highline	Load transfer
	Positioning
Leash (Connecting patient and highline)	Load transfer
Harness (Patient/Rescuer)	Load transfer

Most important risks

- Entanglement with backup loops of highline
- Twisting of hoist/longline and leash
- Highline between rescuer and patient
- Leash is cut with tension in highline

but

All of these can be mitigated for training

The background image shows a vast mountain range under a blue sky with scattered white clouds. A helicopter is flying in the upper right quadrant. Two thin lines, likely part of a longline system, stretch across the frame. In the foreground, there's a dark, rocky cliff face on the left and a forested hillside on the right.

Preparation:
Variable Longline
Rappel-Check

Slackline at 12

YouTube: helicopter-based, longline rescue

Discussion with operators at ICAR

Most operators don't use long lines but rescue hoists

- Thin steel cable
- Cable might damage/break the highline



Investigate the highline hoist contact in a lab setting



Investigation at Bergwacht ZSA

Experimental Setup

Different Highline Materials

- Polyamide
- Dyneema

Worst case setup

- ~50m line length, 3kN and 5kN pre tension
- 80kg patient at 20% of line length
- 100kg rescuer
- Contact of highline and cable at leash ring
- Helicopter 5m above line with 2m overshoot

Hoist vs Polyamide



Hoist vs Dyneema



Test sections vs hoist cable ($\varnothing 4.7\text{mm}$)



5kN

3kN, cable not at leash ring

3kN

3kN

5kN

3kN

1kN

Test sections vs climbing rope ($\varnothing 10\text{mm}$)



3kN

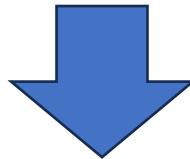
4kN

3kN

5kN

Results (Preliminary)

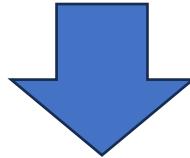
- Both Polyamide and Dyneema are critically damaged by the cable
- The higher the pre tension, the faster critical failure occurs



We would not recommend a direct hoist rescue
But: Climbing rope seems to inflict minimal damage

Next Steps

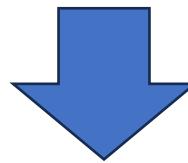
- Talk to heli operators about attaching a climbing rope to the hoist
- Define a procedure for a hoist based rescue with a climbing rope
- Create a safe training environment
- Test the procedure with an operator



If the procedure poses acceptable risk and is safely trainable it might be adopted by operators

Outlook

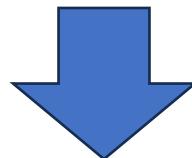
- Highliners at the site can help:
 - First aid
 - removing backup loops
 - get unconscious patient into upright position
 - move patient into hammock



Collaboration with ISA

Conclusions and a warning

- Procedure for a long line was analyzed and trained with promising results
- The procedure has inherent dangers and needs to be trained
- We are working on developing a safe hoist based procedure



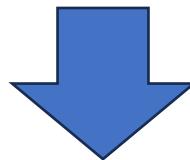
Do not rely on a helicopter rescue when highlining!

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=pfbid02sWnw5sw9NwDaeEFeYcuYyKSVAJYgy8ywcrCFLXdzoJWXtFgMN9PBq6J3geb6fonl&id=1139181036126918&sfn_sn=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)