

EUROPEAN ROTORS 2023

ESPN-R Sling Load Operations Safety Promotion

28-30 of November



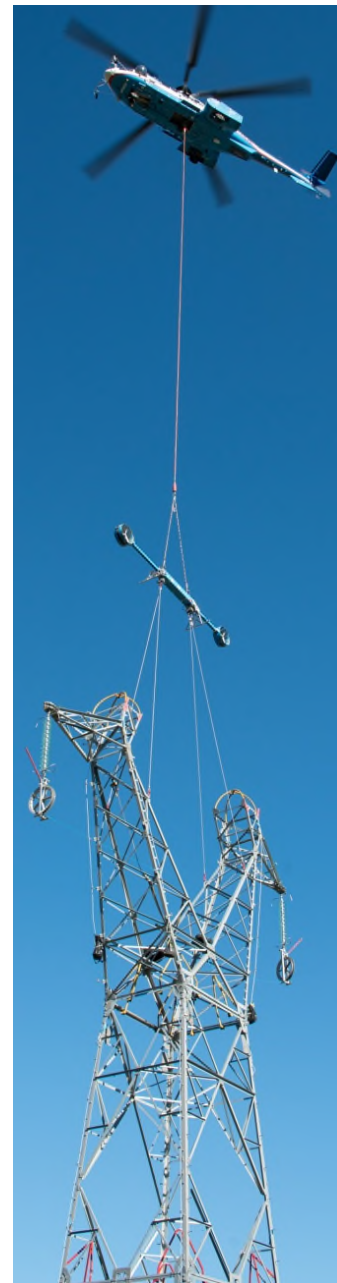
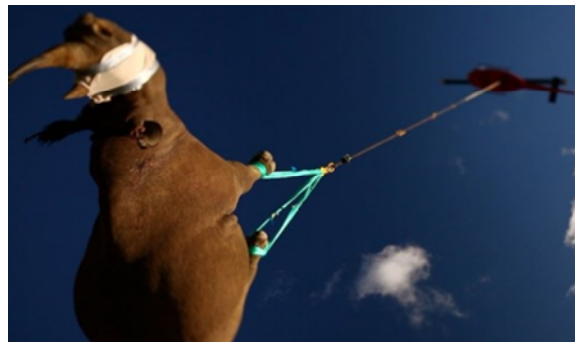
HELICOPTERS

Jonathan Hall ESPN-R
M. Behrens ESPN-R
28-30.11.2023
Export Control - Not technical

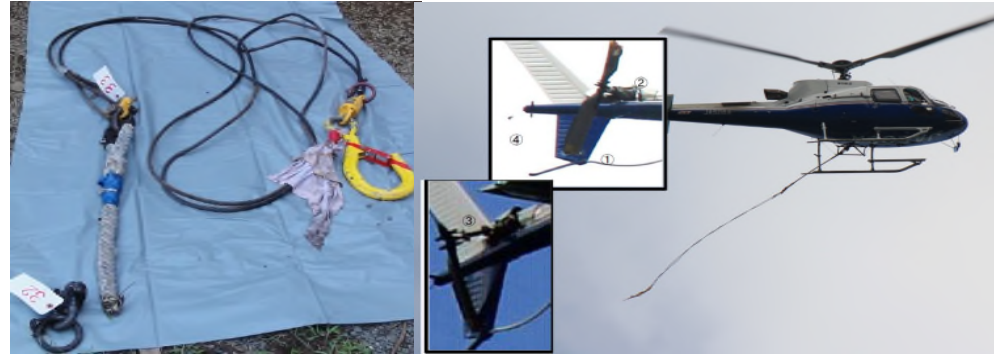
Aerial Work

Cargo Hook System Overview

What is Helicopter External Sling Load Operation



Issues related to Sling Load Operation Overview



Source: BEA; Number 2019-0023



Source: NTSB; Number WPR20LA244

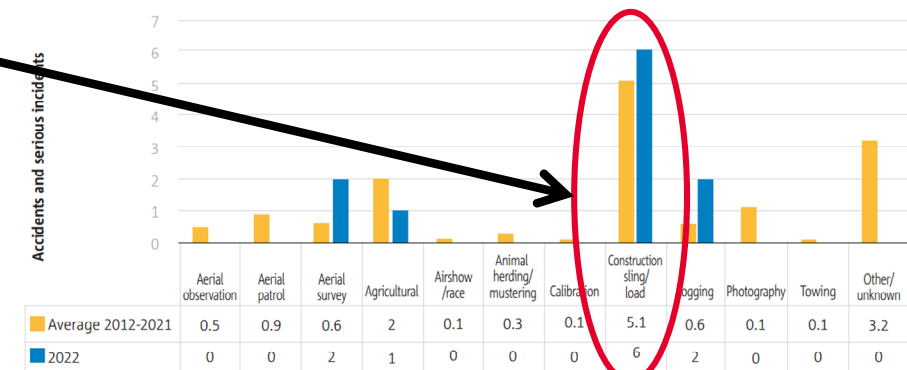
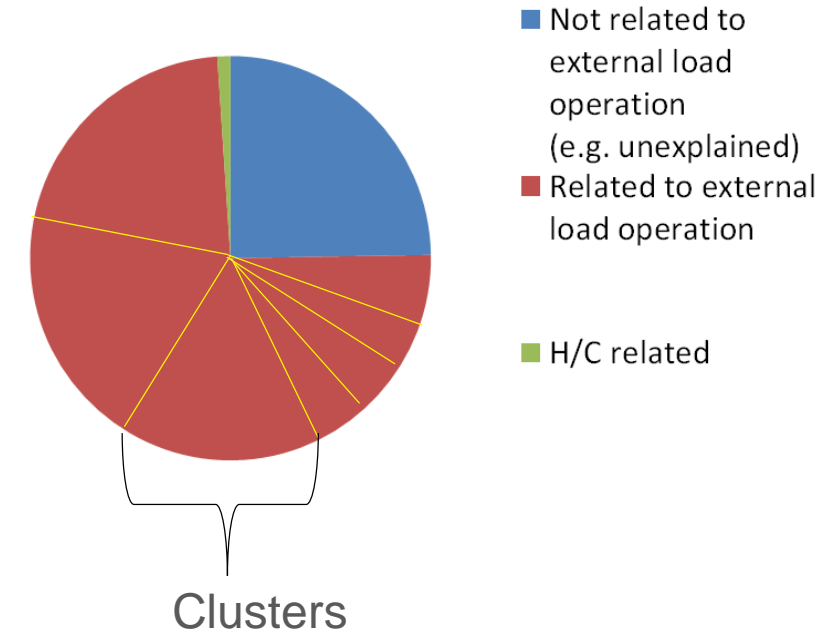


Figure 7: Impact damage to the pitch control mechanism

Need for an ESPN-R Sling Load Operations Safety Promotion

- An assessment has been performed in order to show the distribution of operational events.
- **This chart confirms that most of the occurrences are related to operational aspects.**
- **Clusters were identified of where it was considered further operational advice could be advantageous.**
- In the “ANNUAL SAFETY REVIEW 2023” from the EASA the following statement for the “Operation type” has been made:
In 2022, construction and sling-load operations were, once again, by far the most affected.
- **Note: None of these findings should not be read as apportioning blame or liability to any particular organisation or individual.**

External Load Incidents/Accidents



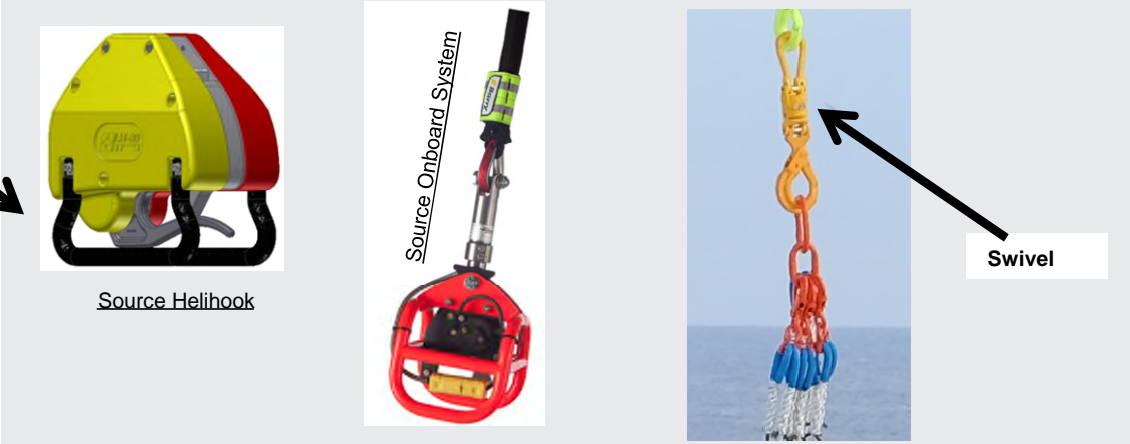
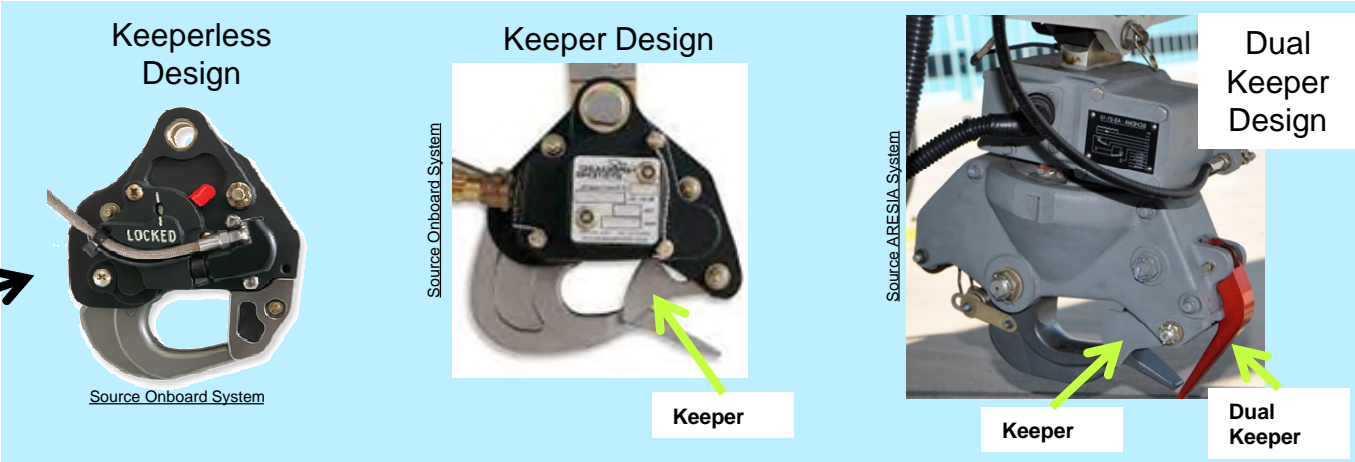
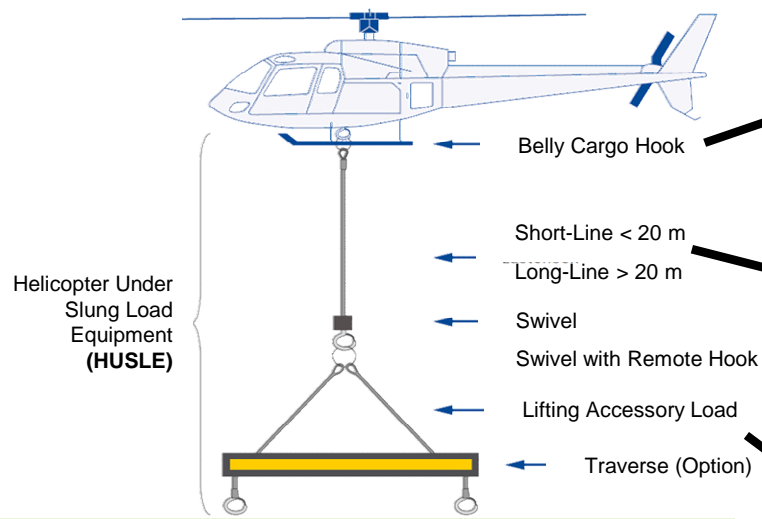
Source: HP EASA “ANNUAL SAFETY REVIEW 2023”

ESPN-R & LinkedIn Group

- The ESPN-R Sling Load Operations Safety Promotion is part of the European Plan for Aviation Safety.
 - Task force team has been established with a mixed community from
 - Authorities
 - Industry (H/C manufactures and Operators)
 - This ESPN-R task force gathers all safety related operational scenarios specific to helicopters flying with external sling load, for both human and non-human cargo, which can contribute to an unsafe outcome.
- ESPN-R Sling Load Operations Safety Promotion LinkedIn Group has been established.
 - The task force achieved a big leap and is very pleased to see that the LinkedIn Group now **counts 215 members**.



External Load System Overview





Helicopter External Sling Load

Bowden cable rigging

A Bowden Cable is one release means for a cargo hook, as requested by the airworthiness regulation.



Operational topics: Bowden cable rigging

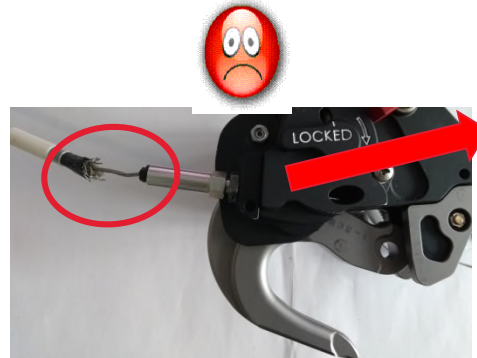
- At least prior the first flight of the day with external load or change of any part, the cargo hook Bowden cable* must be inspected for
 - broken or kinked conduit/inner cable
 - cable routing to avoid strain on the cable (within the complete cargo hook swing envelope and collective lever travel)
 - correct rigging, with proper free play
 - Further details are defined within the appropriate flight manual



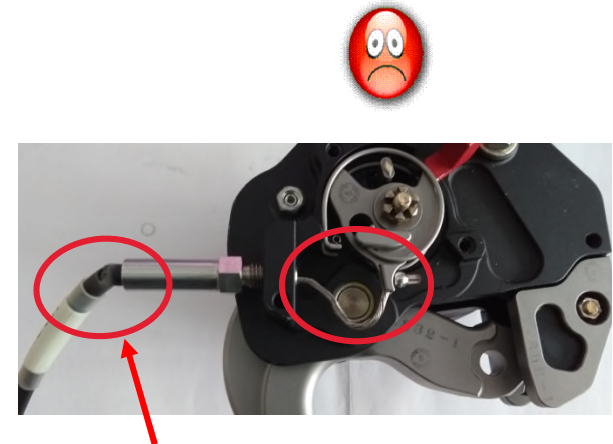
Play between Ground Release Lever and Bowden Cable End



No Play between Ground Release Lever and Bowden Cable End



Strained Bowden Cable



Broken or **kinked** conduit

This advice is common to all cargo hooks with Bowden cable, not only the design shown on the picture

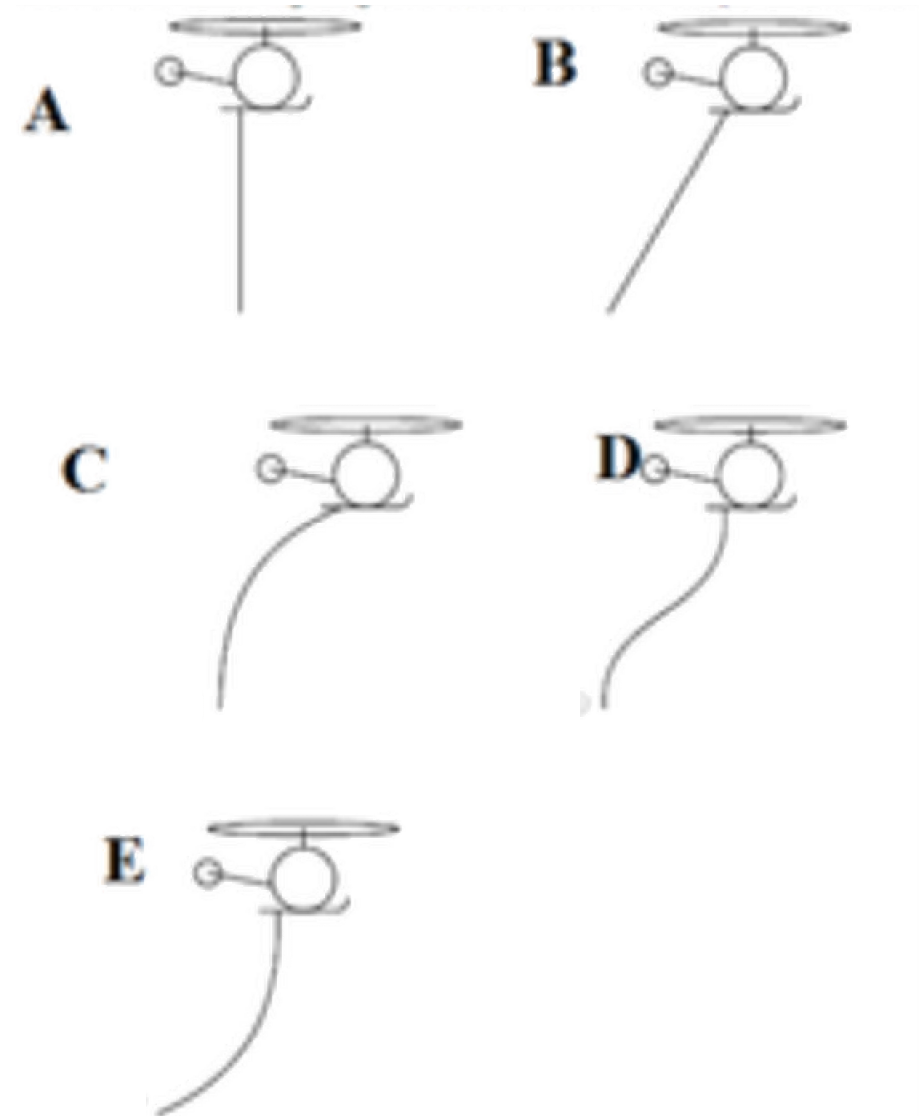
* The Bowden cable by design is a proven and acceptable means to release the load.

Aerial Work

Flying with insufficient ballast

Operational topics: Long Line behaviour in forward flight

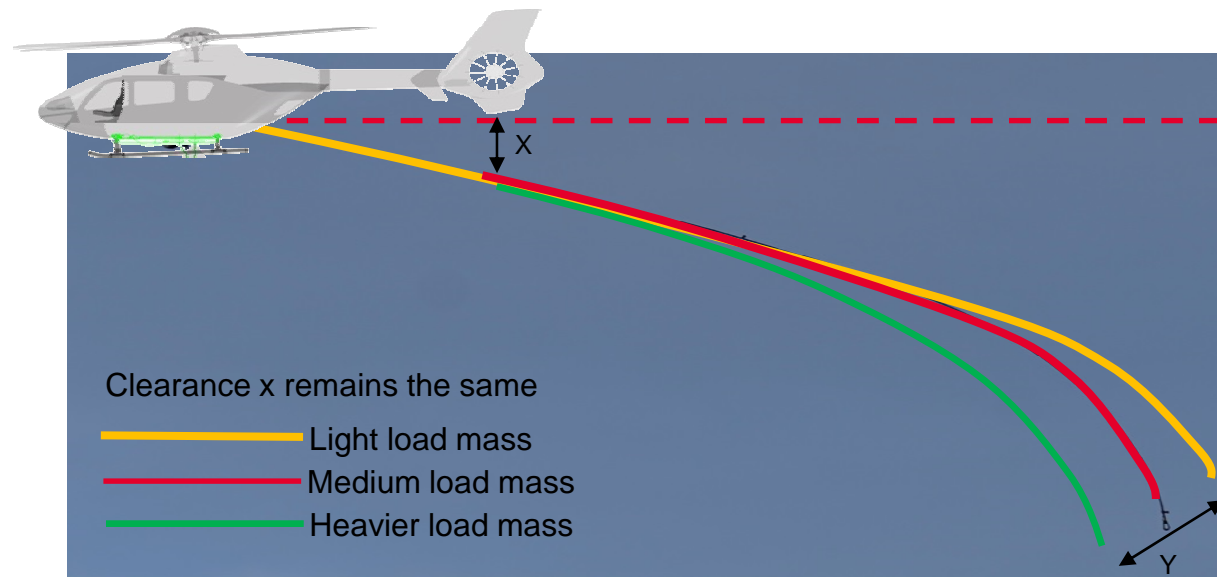
- A H/C is flying horizontally at constant speed (e.g. 80 kts). A flexible sling with a low weight at the end (e.g. 10 kg) is suspended underneath the H/C.
- Which of the following diagrams best shows the shape of the cable as the helicopter flies through the air to the right?



Operational topics: Risk for tail rotor strike with short or long line

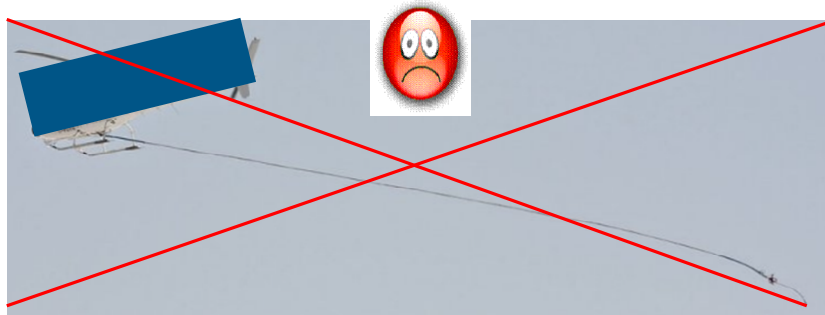
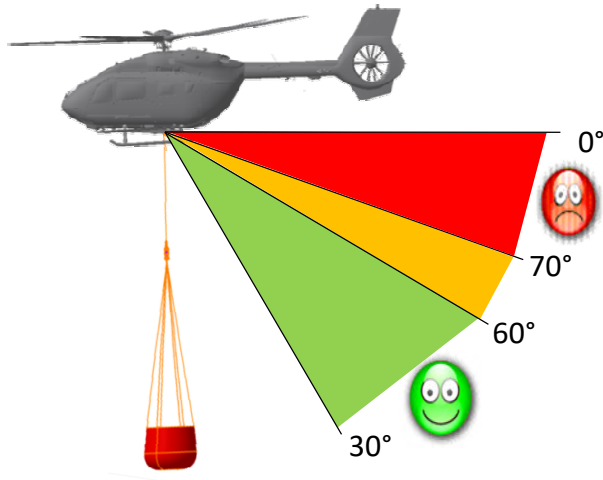
- When changing or removing the ballast weight potential hazard exist to strike the tail rotor.
- The ballast weight is less efficient for longer lines.
- Specially for a long line the clearance to the H/C becomes less dependent on the ballast weight. Other factors e.g. forward speed become dominant. Hence less reliance can be placed on the ballast weight of the long line.

- If the ballast weight has been changed from a short line to a long line a potential hazard exist to strike the tail rotor.



Operational topics: Flying with insufficient ballast

- The risk associated is impact to the rotorcraft, especially the tail rotor.
- The tail rotor clearance depends on:
 - Ballast weight, in combination with
 - Vne (Velocity Never Exceed)
 - Length of the rope
 - Shape of the rope cross section => resulting drag
 - RoD (Rate of Descent)
- A comprehensive risk assessment should be conducted for all such operations.



Aerial Work

Fire Fighting Water Container

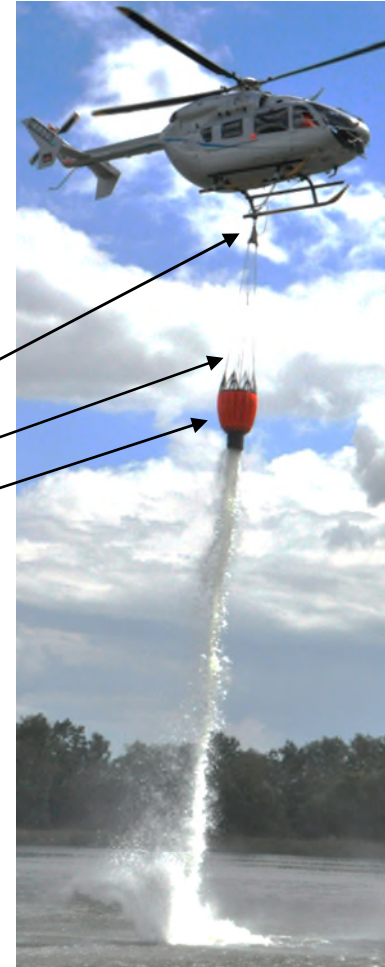
Operational topics: Operational topics: Fire Fighting Water Container

- A helicopter is an established means to extinguish the fire in remote areas.
- Based on the operational occurrence distribution, a focus should be made on the fire fighting with the H/C.
- Due to the climate change more and more wild fires are happening.
- More and more H/Cs are equipped with this capability.
- The operation with the Fire Fighting Water Container is more prone to make mishaps, by its fundamental nature.
- Based on this, the different cases have been identified and presented on the following pages.



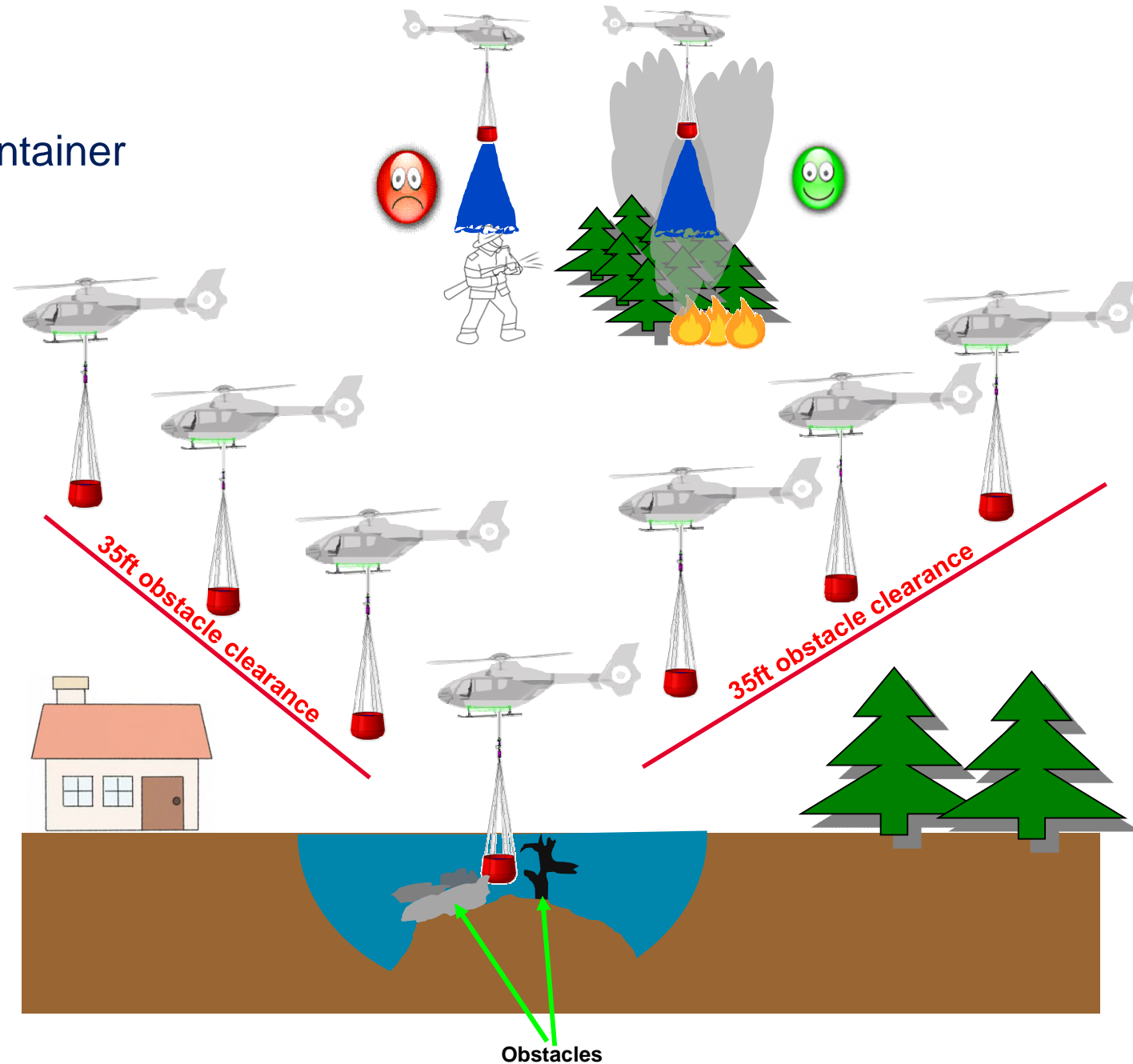
Operational topics: Fire Fighting Water Container

- The Fire Fighting Water Container often used for fire fighting with the H/C.
- Fire Fighting Water Container are available with a capacity of 270 to 9800 liters.
- The Fire Fighting Water Container typically consists of
 - **Control Head with interface to the Cargo Hook.**
 - **Suspension lines to hold the Container.**
 - **Container with the water release valve.**



Operational topics: Fire Fighting Water Container

- Filling up the water could be dangerous
 - Visibility
 - Water on the windscreen
 - Smoke or hot air
 - Mid-Air Conflicts
 - Obstructions
 - Obstacles below the water surface
 - Large and loose items may be stirred up by the downwash
 - Trees
- Twisted suspension lines from the container
- A long line could be used to reduce the impact of the downwash.
- Care is also needed when taken water from a moving water course.
- Water dropping can hit person on ground.

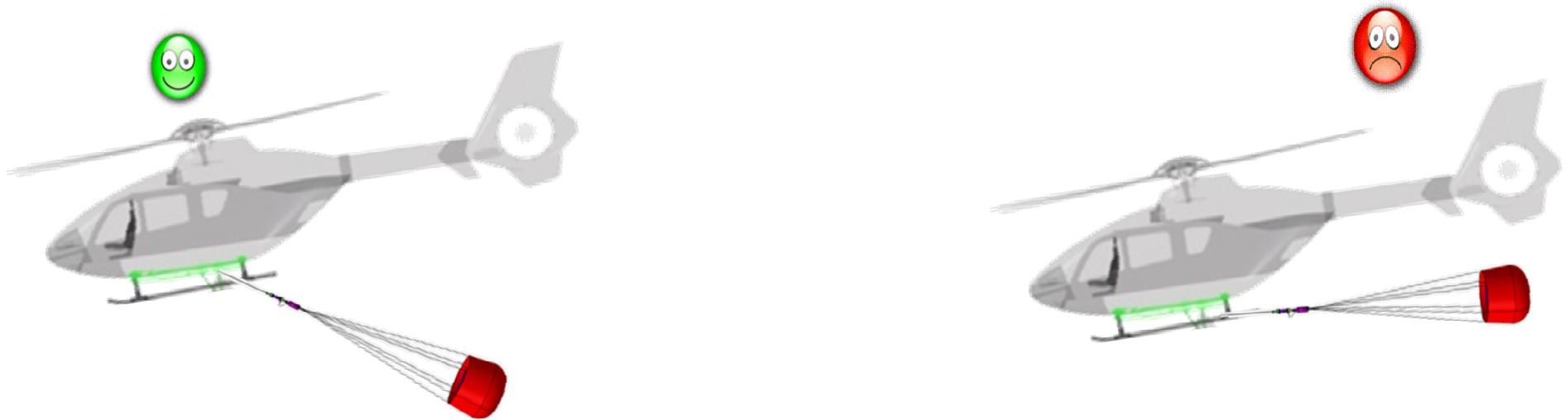


Operational topics: Fire Fighting Water Container

“ V_{ne} ”

- A highly critical flight situation is with the empty Fire Fighting Water Container because
 - It has a high drag
 - It has a low mass

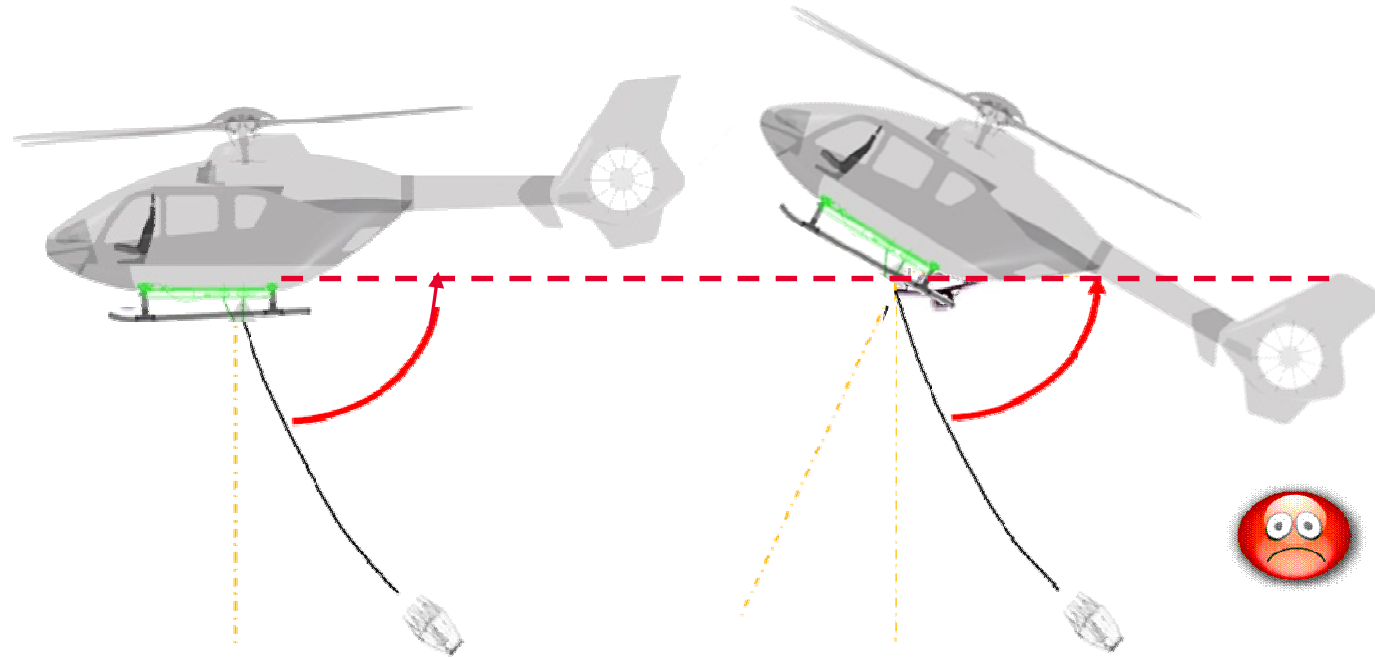
Which leads to a high aft sling load angle



Note: Very similar to “Flying with insufficient ballast” on page 13.

Operational topics: Fire Fighting Water Container “Flare”

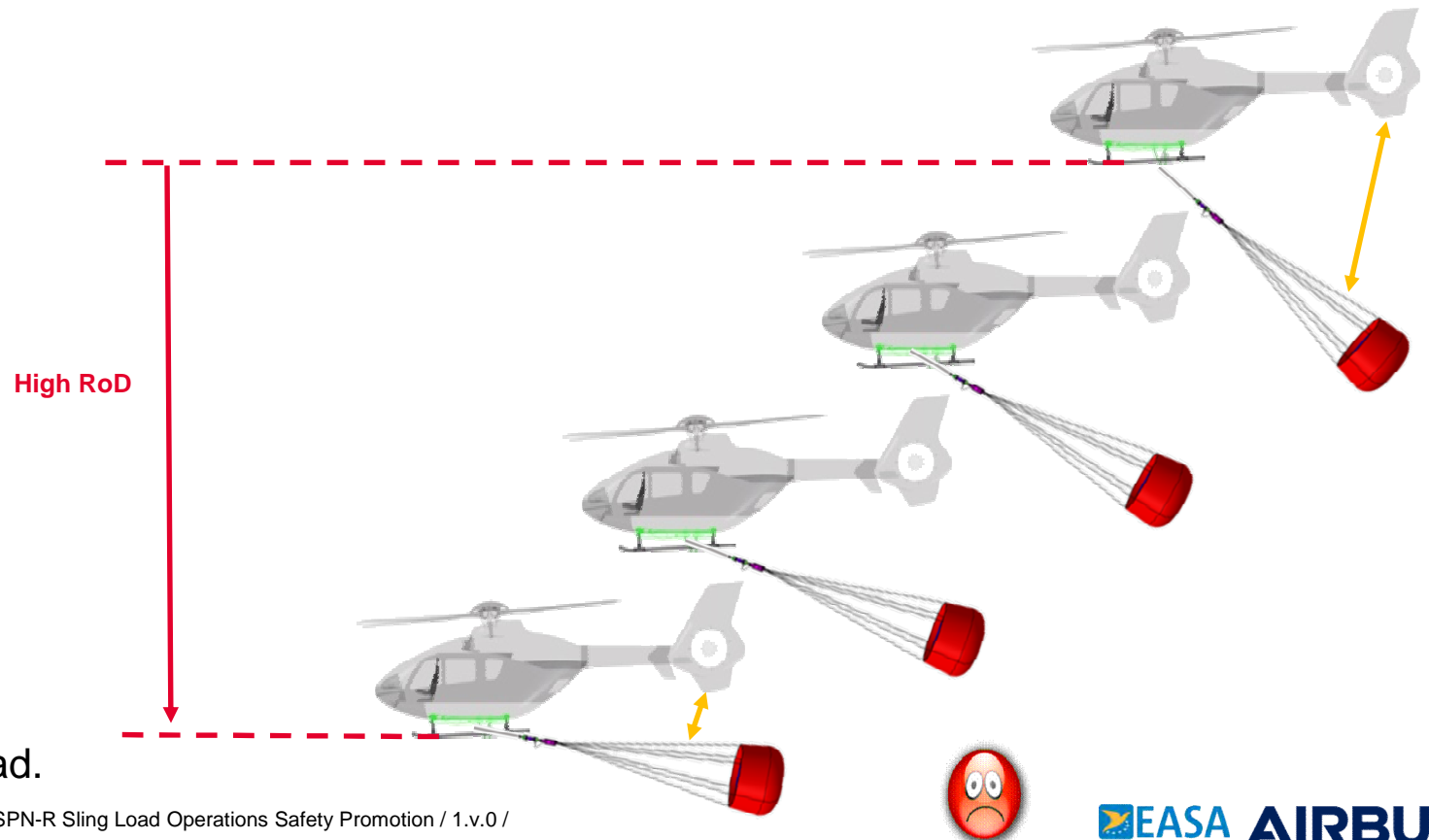
- The following scenario needs to be considered especially with empty Fire Fighting Water Container:
 - **Flare**
 - As the Fire Fighting Water Container already has a high sling load angle, with less clearance to the tail rotor during forward flight, a flare can reduce the clearance even more.



Note: This is also applicable for any other sling load.

Operational topics: Fire Fighting Water Container “RoD”

- The following scenario needs to be considered especially with empty Fire Fighting Water Container:
 - **RoD** (Rate of Descent)
 - During high RoD the downforce of the Fire Fighting Water Container gets less which leads to a lower tail rotor clearance.

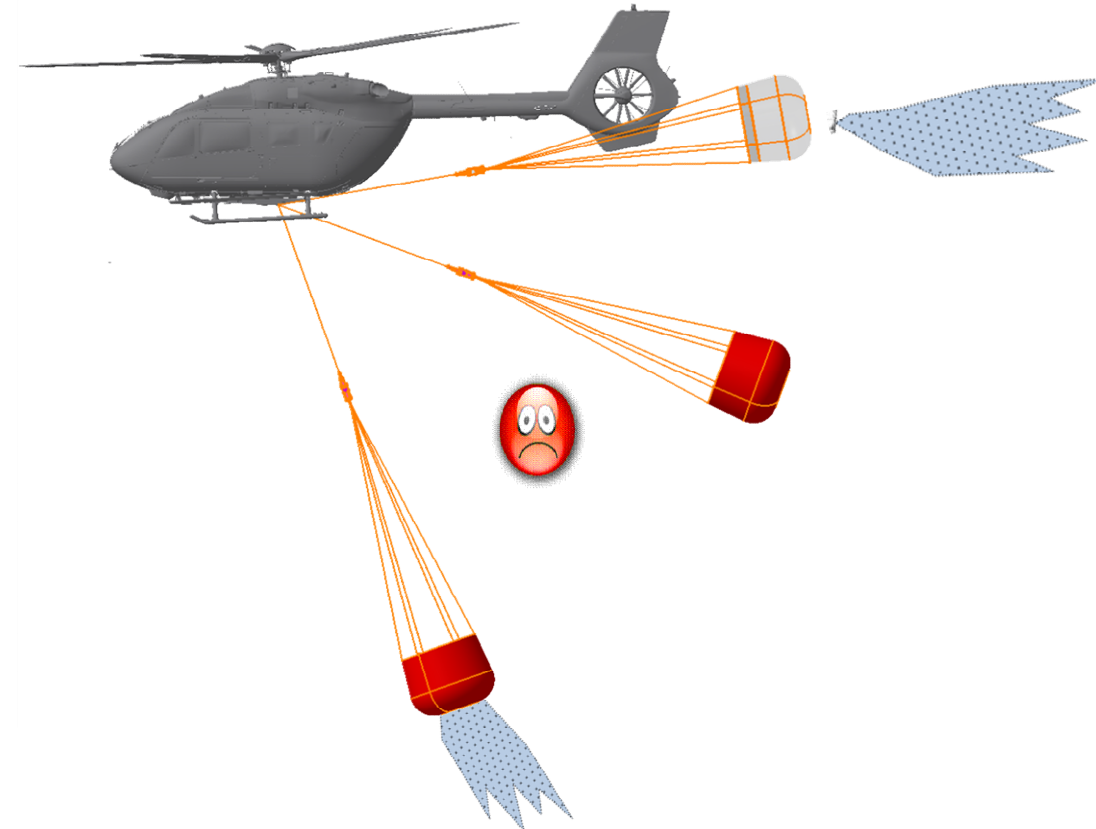
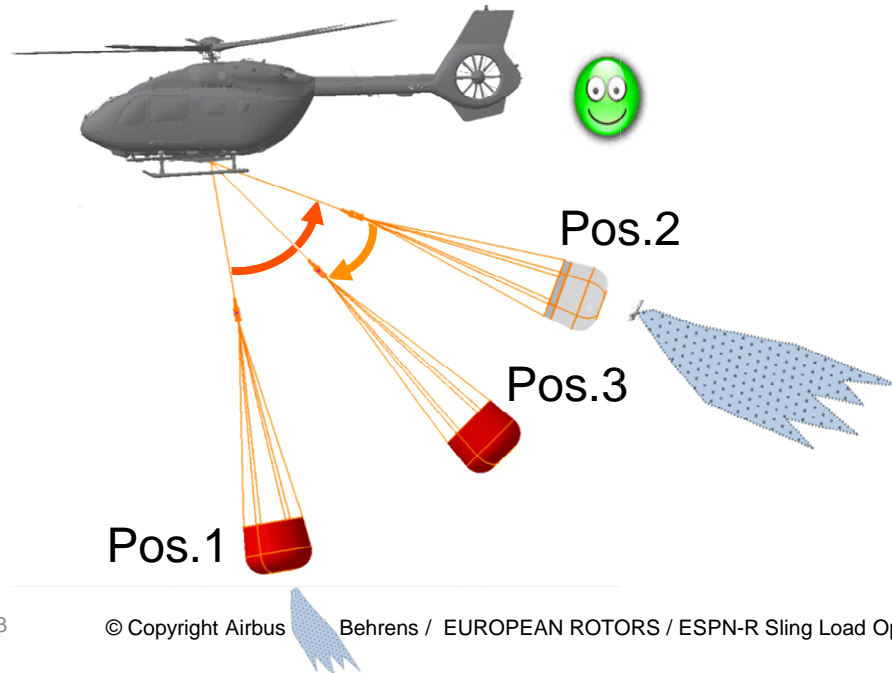


Note: This is also applicable for any other sling load.

Operational topics: Fire Fighting Water Container

“Dumping of water”

- Service evidence suggests that there can be an over-swing effect as water is released.
- Some preliminary simulation has been done which suggests the presence of over-swing effect.
- The simulation also suggest that the over-swing effect is more pronounced with a shorter rope length.
- The following scenario needs to be considered specially when using a Fire Fighting Water Container:
 - During forward speed water dumping the FFWC may move upwards from
 - Pos. 1 => Pos. 2 => Pos. 3
 - The Pos. 2 is higher than the Pos. 3 of the flight with an empty Fire Fighting Water Container.

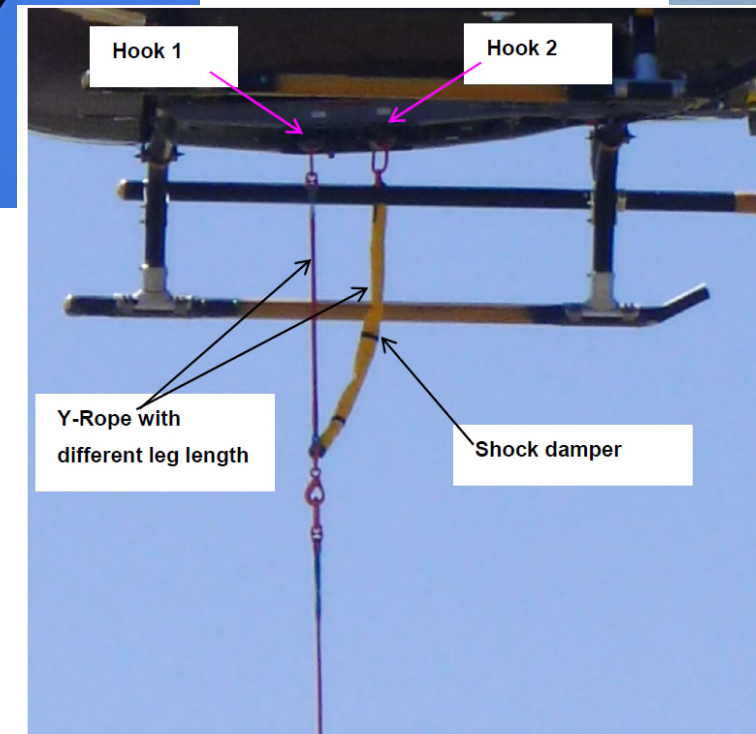
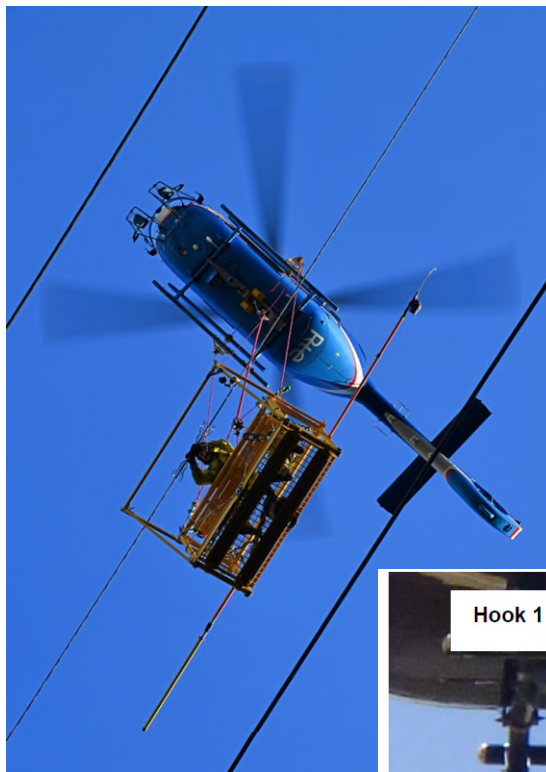


Human External Cargo

Cargo Hook System Overview

Sling Load Operation Human External Cargo (HEC)

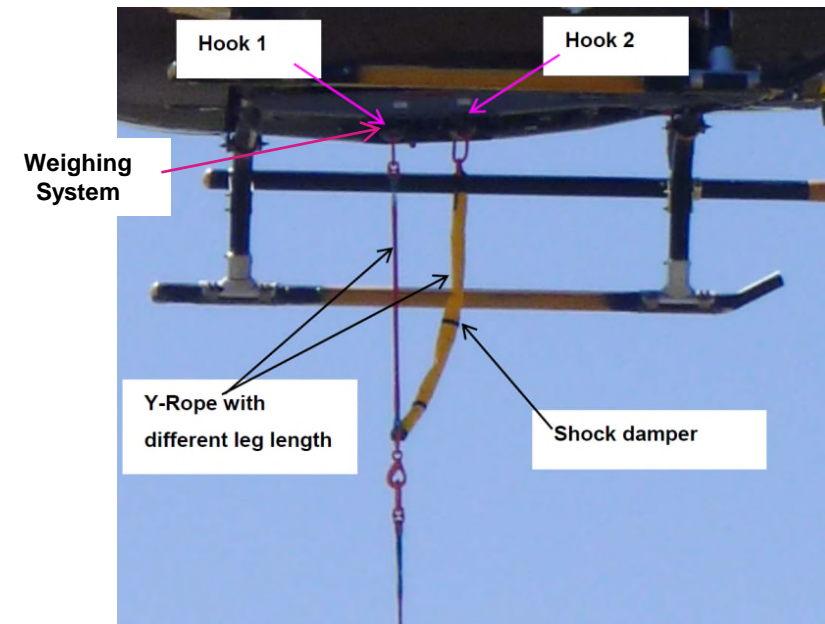
- Depends on the operation procedure but it is more and more common to perform HEC (Human External Cargo) with the Cargo Hook instead of a Hoist (Direct Maintenance Cost, DMC).
- Y-Rope commonly used to secure the load via the HEC hook (second hook).
 - The HEC hook is needed due the likely loss of life if one hook releases.



Operational topics: Y-Rope designs

Asymmetric Y-Ropes

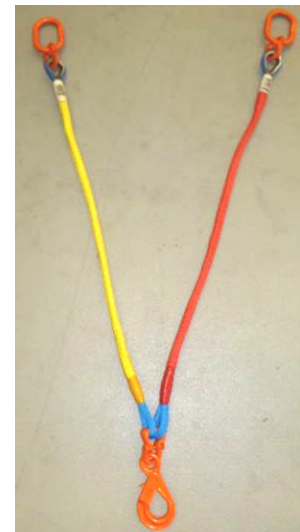
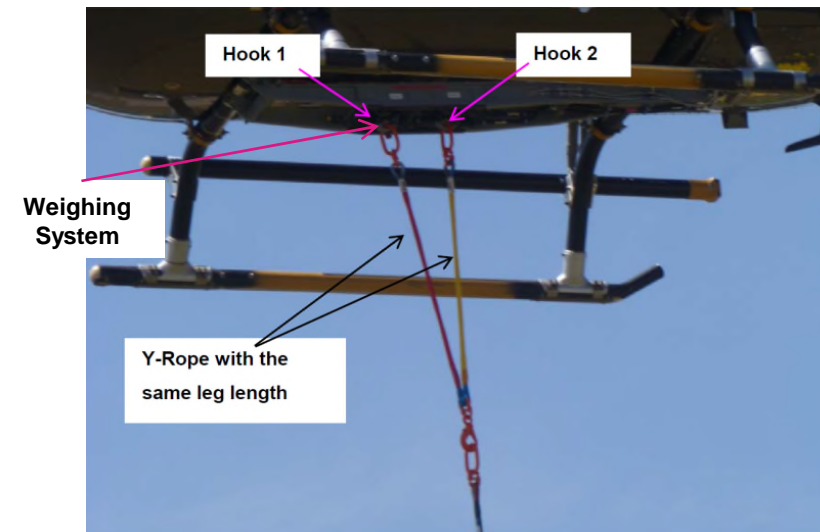
- The short leg needs to be attached on Hook 1 and the long leg on Hook 2 (HEC Hook).
- A damper should be included in the longer leg of Hook 2.



Asymmetric Y-Rope

Symmetric Y-Ropes

- The use of Symmetric Y-Ropes is not recommended.
- The external load mass would be distributed on both Cargo Hooks in a static flight.
- However the weighing system is only installed in Hook 1 (rear one).
- There would be a difference between the actual load attached and the indicated load on the MFD (Multi-Functional Display).



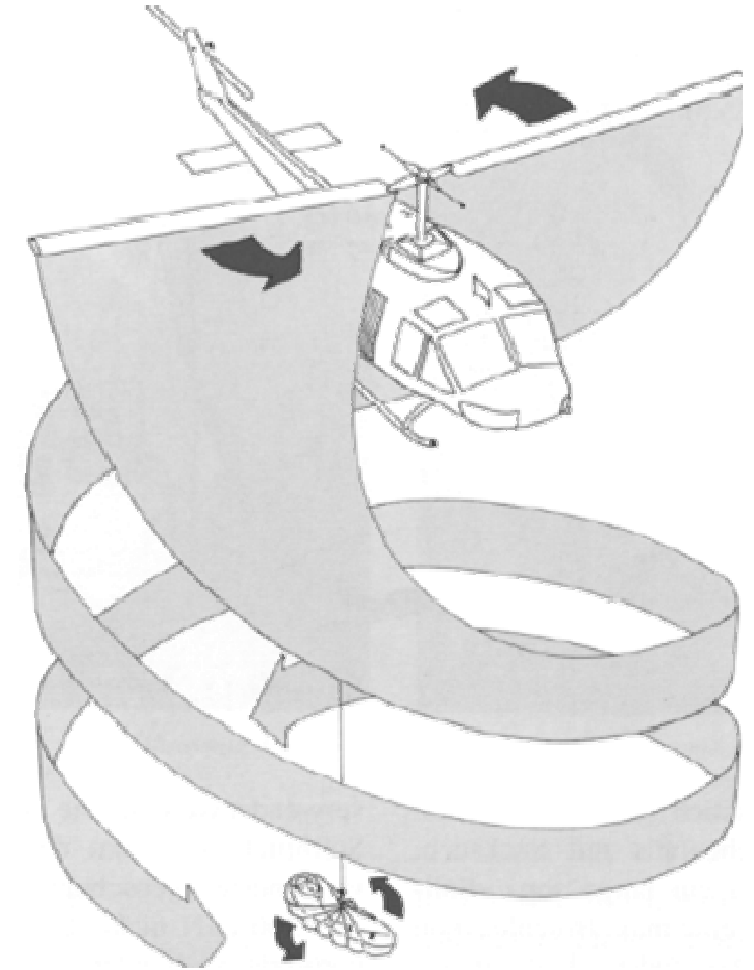
Symmetric Y-Rope

Human External Cargo

Spinning of HEC loads

Operational topics: Spinning of HEC loads

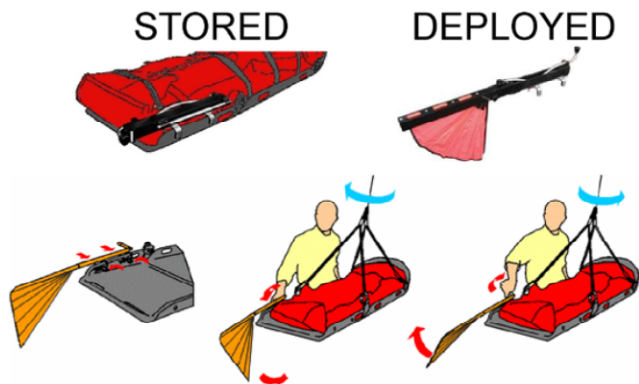
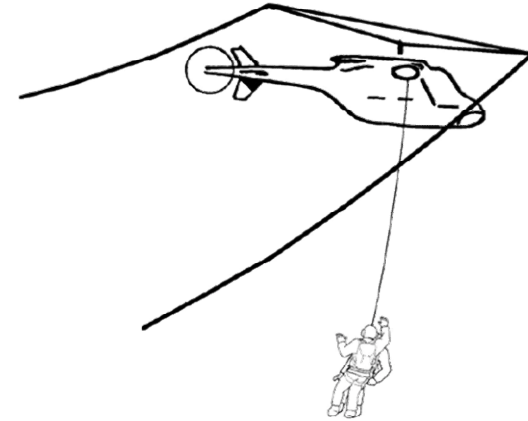
- The operator should be aware of the potential for a load to spin and the associated risks, especially (though not exclusively) for human external cargo.
- Operation shall only be performed with trained rescuers.
- Perform training as experience is needed to damping the rotation.



Reason for spinning is
the inner vortex sheet of
the rotor downwash

Operational topics: Spinning of HEC loads

- The following procedures/products can reduce the spinning:
 - If possible increase forward speed of rotorcraft.
 - Shorter ropes make the load more vulnerable to the downwash of the rotor which can induce spin. Hence if possible select ropes with a length of at least 1.5 times the rotor diameter.
 - The person assisting the lift should mostly in vertical position, the person(s) being lifted by stretcher should preferably put in front and not behind the person assisting to lift. Backpacks etc to be attached so as not to upset the correct attitude of the lifted person. Any equipment (such as the aforementioned heavy backpacks) could be fixed on a separated rope attached on the hook.



ESPN-R Sling Load Operations Safety Promotion

ESPN-R & LinkedIn Group

- ESPN-R Sling Load Operations Safety Promotion LinkedIn Group has been established under
<https://www.linkedin.com/groups/8989107/>

- **Feel free to join**



Thank you

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