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Report

Accident on **4 August 2010**
at « Croisée d'Apatou » (French Guyana)
to the **AS 350 B2 helicopter**
registered **F-OIEL**
operated by Y**ankee Lima Helicopters**

BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile
Ministère de l'Environnement, de l'Enérgie et de la Mer

Safety Investigations

This report presents the conclusions of the BEA on the circumstances and causes of this accident.

In accordance with Annex 13 to the Convention on International Civil Aviation and with European Regulation (EU) 996/2010, the investigation is intended neither to apportion blame, nor to assess individual or collective responsibility. The sole objective is to draw lessons from this occurrence which may help to prevent future accidents or incidents.

Consequently, the use of this report for any purpose other than for the prevention of future accidents could lead to erroneous interpretations.

SPECIAL FOREWORD TO ENGLISH EDITION

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.

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Synopsis

Aircraft	AS 350 B2 helicopter registered F-OIEL
Date and time	4 August 2010 at 14 h 15 UTC[1]
Owner and operator	Yankee Lima Helicoptères
Place	In a forest, 1 NM south-east of Croisée d'Apatou. French Guyana
Type of flight	Aerial work, transportation of external load
Person on board	Pilot

[1]Except where otherwise stated, the times shown in this report are expressed in Universal Time Coordinated (UTC). Three hours should be subtracted to obtain the legal time applicable in French Guyana on the day of the accident.

SUMMARY

The pilot of the helicopter was transporting a flexible fuel tank with a sling above the Guyana equatorial rain forest. The load was prepared by a ground operator. The flexible tank was placed in a square net whose four corners were equipped with rope buckles. These four buckles were themselves placed in the sling hook, attached to a load release hook located under the helicopter One minute after takeoff, two of the four buckles from the net detached from the hook, which led to the flexible tank falling out. The loss of the load startled the pilot, leading him to release the net while the helicopter was flying at too high a speed to accomplish this manœuvre. The load net then made contact with the tail rotor, finally leading to the in-flight loss of control.

The investigation showed that the design and maintenance of the sling was not in compliance with the European Machine Directive, thus making the attachment of the load to the lifting accessory inadequate. . The condition of the sling showed that no maintenance operations had been undertaken on the sling and that wear on its components had not been detected. The investigation also showed that the ground operator's training did not provide him with any knowledge of the specific nature of transporting an inert external load with a helicopter. Thus, he apparently did not notice that the load was incorrectly secured.

The BEA addressed two Safety Recommendations to EASA and to DGAC relating to:

- 1. compliance with the European Machine Directive;
- 2. training on transporting inert external loads.

1 - FACTUAL INFORMATION

1.1 History of Flight

On 4 August 2010, the pilot was transporting flexible fuel tanks with a sling between the Croisée d'Apatou landing zone and the gold prospecting site at Saint Pierre.

At around 14 h 15, during the fourth rotation, he put the helicopter in a hover about 1.50 m above the ground vertically above the load. A ground operator attached the load to the hook located under the helicopter. The pilot lifted the load from the ground and the assistant checked that it was correctly positioned inside the net. He signalled to the pilot that everything was normal and the latter took off in the direction of Saint Pierre.

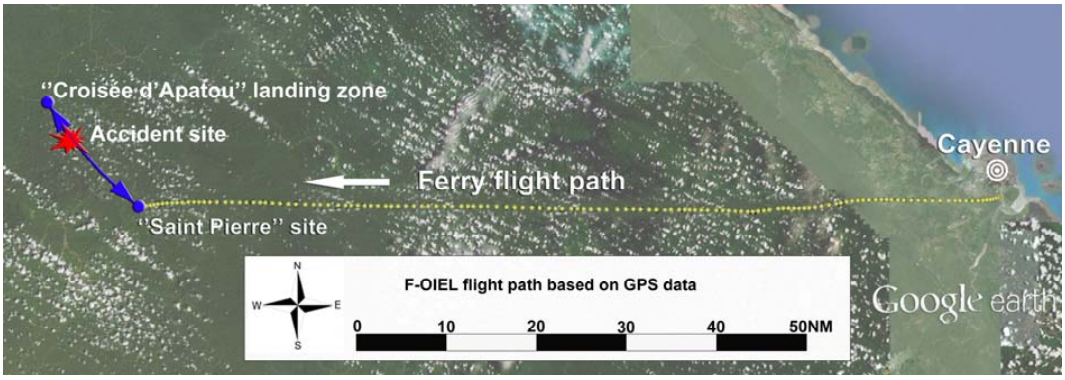


Figure 1- flight path based on GPS data

About one minute later, the helicopter crashed in the forest in an area that was difficult to access, around 1 NM from its departure point[(2)]. A few hours later the rescue services found the burnt-out wreckage.

[(2)] At co-ordinates: 5° 01'48'' N ; 54° 01'62''W, at a topographic altitude of about 400 ft.

1.2 Injuries to Persons

The pilot was killed.

1.3 Damage to Aircraft

The helicopter was destroyed.

1.4 Other Damage

There was no other damage.

1.5 Personnel Information

1.5.1 Pilot

Male, aged 44.

- Commercial Pilot's Licence/helicopter (CPL/H) issued on 24 February 1994
- AS 350 type rating obtained on 23 February 2007
- Certificate of competence for undertaking transportation of loads with a sling issued on 30 March 2009
- Class 1 medical certificate dated 25 February 2010

Experience:

- total: 5,395 flying hours
- on type: 1,395 flying hours
- in the previous three months: 129 flying hours

1.5.2 Ground operator

Male, aged 38.

- Qualification: logistics specialist, employee of the prospecting company.

Note: the ground operator did not have an aeronautical qualification. He was trained by the pilot in the preparation and the attachment of loads under the helicopter. According to the company's specific activities manual, he was authorized to undertake this work under the responsibility of the pilot.

1.6 Aircraft Information

1.6.1 Airframe

Manufacturer	Eurocopter
Type	AS350 B2
Serial number	9052
Registration	F-OIEL
Airworthiness Certificate	09 January 2002
Utilisation as of 04 August 2010	4,753 hours

1.6.2 Engine

Manufacturer	Turboméca
Type	ARRIEL 1D1
Serial number	9,647
Installation date	July 2010
Total run time	3,886 hours
Run time since installation	40 hours

1.6.3 Equipment for transporting loads for the AS 350 B2

The transport of external loads with F-OIEL was performed using a load release hook whose characteristics are:

Manufacturer	INDRAERO SIREN
Type	S1609-6
Serial number	277
Installation date	20 April 2007
Maximum load in use	1,400 kg

Locking of the hook is ensured by an electro-mechanical device.

The pilot can order the hook to open in two modes:

- normal, thanks to an electric control situated on the cyclic pitch stick;
- emergency, using a mechanical control located on the collective pitch control.

The material under the helicopter was made up of a load and a lifting accessory.

The load was a flexible container and a square net. The four corners of the net were equipped with rope buckles.

When the various parts of the load are assembled, the flexible container is filled with about 1,100 litres of petrol. The weight of the whole load was about 900 kg.

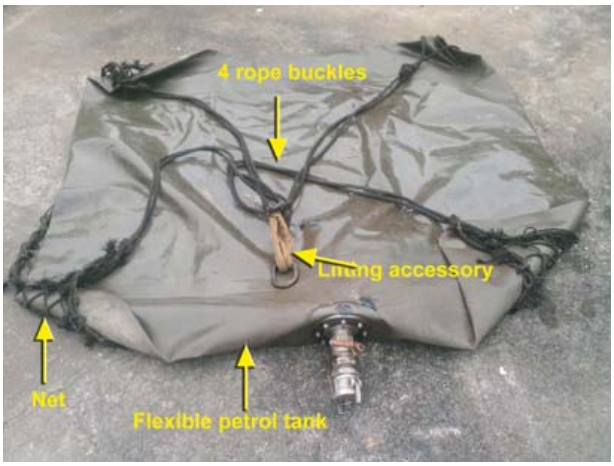


Figure 2 - assembled load and lifting accessory

The lifting accessory consists of five sling accessories. These sling accessories are assembled and make up what is commonly called a sling. It is about fifty centimetres long.

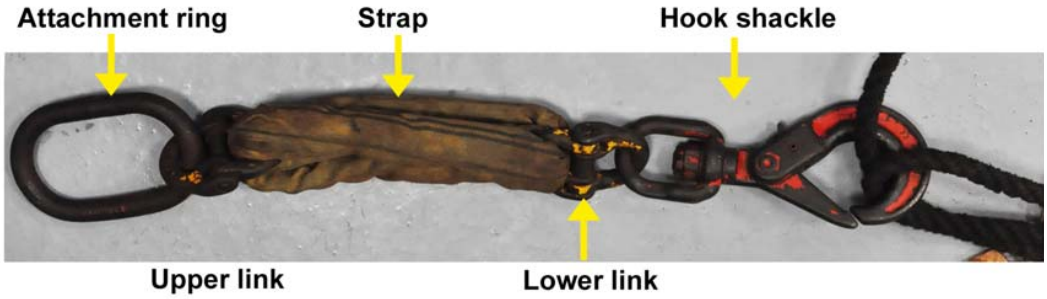


Figure 3 - sling used during accident flight

To lift, the pilot positions the helicopter in a hover above the load, about 1.50 m from the ground. The ground operator, in coordination with the pilot, positions himself under the helicopter and attaches the end of the sling to the load release hook.

The pilot then climbs vertically until the sling is extended. The ground operator checks the positioning of the flexible container inside the net, then makes a sign with his arm to the pilot that he can take off.

In flight, the pilot has a load indicator to check the weight transported. The helicopter is also equipped with 2 rear view mirrors used by the pilot to monitor the behaviour of the load during the flight.

Arriving at the destination, he puts the helicopter in a hover, places the load on the ground then releases it using the electrical control to open the release hook.

Figure 4 - transport of a load (takeoff phase)

The supplement to the AS 350 B2 flight manual states that the limit speed with a load attached is 80 kt indicated airspeed.

1.7 Meteorological Information

According to a witness present at the site: *''the weather was misty, with no wind, it was very hot''*.

1.8 Aids to Navigation

The pilot was using a GPS to accomplish his mission.

1.9 Telecommunications

The pilot was not in contact with any ATC organisation.

1.10 Aerodrome Information

Not applicable.

1.11 Flight Recorders

The helicopter was equipped with a flight recorder for maintenance purposes. As the device is not crash-protected, it was destroyed during the fire that followed the crash and the data could not be read out.

An onboard GARMIN - GPSMAP296 type GPS was found at the site. Readout of the data made it possible to reconstitute the flight paths followed during that day.

1.12 Wreckage and Impact Information

The wreckage was found on the side of a hill, in the middle of the equatorial forest.

Figure 5 - aerial photograph of the accident site

The wreckage was broken up and the debris was spread over 200 m.

The main parts were found along the flight path, in the following order:

- the flexible container;
- the net, which was laying on the forest canopy and a blade from the tail rotor, broken off at the root, found on the ground;
- the rear gearbox - tail rotor hub assembly connected to the second tail rotor blade;
- the vertical fin;
- the right door, at the top of a tree and the airframe on the ground, partially burned out.

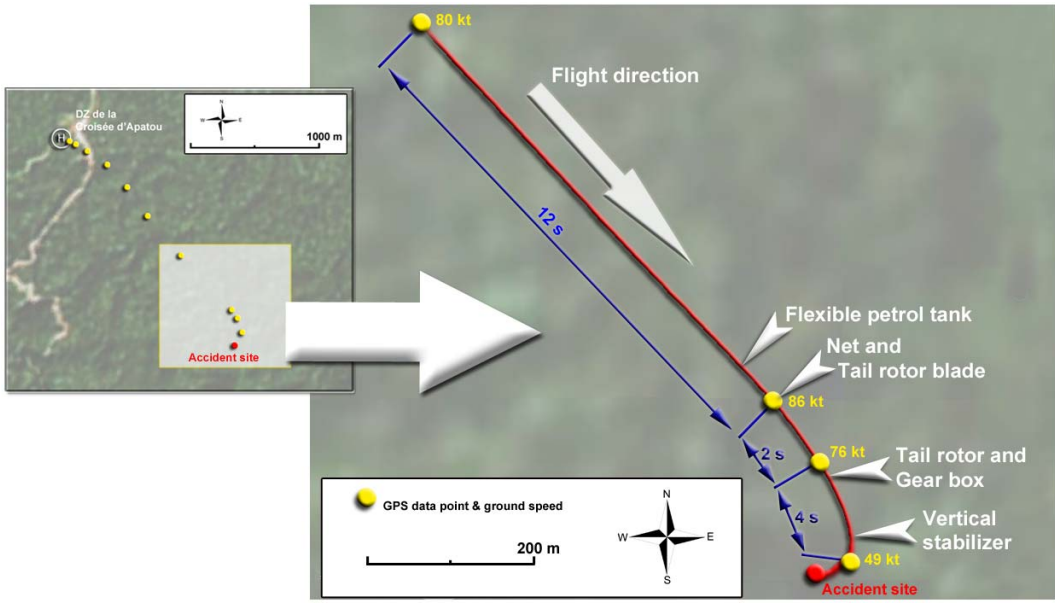


Figure 6 - localisation of the main parts of the wreckage found along the helicopter flight path

Analysis of the GPS data indicated that the average ground speed of the helicopter during the three load-carrying flights before the accident was about 90 kt.

In flight, the constraints on the lifting system depend on the weight of the load, added to the aerodynamic force that increases with the helicopter's translation speed.

1.13 Medical and Pathological Information

Medical examinations of the pilot did not bring to light anything that may have contributed to the accident.

1.14 Fire

A part of the airframe and the engine were burnt after the impact.

1.15 Survival Aspects

The force of the collision with the ground meant that the pilot had no chance of survival.

1.16 Tests and Research

1.16.1 Examination of the wreckage

Examinations of the wreckage and the engine did not bring to light any malfunctions that might have contributed to the accident. Observations showed:

- that the engine was supplying power at the time of impact;
- that the marks observed on one of the tail rotor blades corresponded to markings from the net (*see figure 7*);
- that the net showed some damage that could have been due to interference with the tail rotor and that two of the four buckles on the net were still linked to the lifting accessory, the two other buckles being free (*see figure 8*);
- that the damaged condition of the releaser did not make it possible to check on its operation (*see figure 9*).

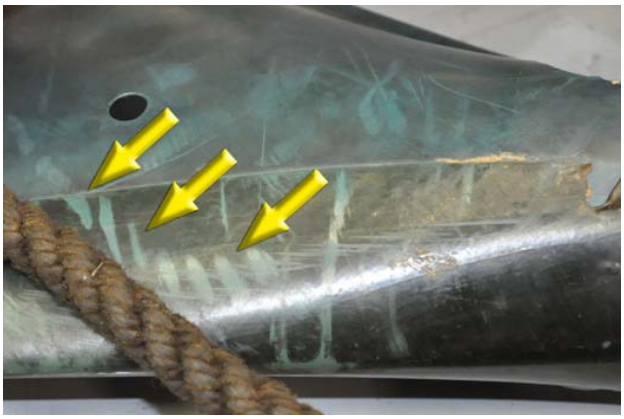


Figure 7 - marks from the net on the broken tail rotor blade

Figure 8 - damaged net attached to the lifting accessory via two buckles

Figure 9 - burnt load releaser

1.16.2 Examination of the sling assembly

Following an accident that occurred in 2001, the operator had changed the length of the sling/net assembly to avoid it interfering with the tail rotor in case of accidental release of the load in flight. This short sling, designed and assembled by the user in order to take into account operational constraints, was in use on the day of the accident.

A reconstitution confirmed that this length prevented any contact with the tail rotor, even when only two of the four buckles remained in place in the hook.

Figure 10 - configuration with 4 buckles in place

Figure 11 - configuration with the 2 buckles in place

1.16.3 Examination of the flexible container

The flexible container was found in the forest, torn into two parts. The refuelling valve was in the closed position.

1.16.4 Examination of the lifting accessory in the accident

Lifting accessories and lifting accessory components must be designed and assembled in accordance with article R4312-1 of the French Labour Code (an extract of the articles in the Labour Code is included in appendix 2). The observations made on the lifting accessories in the accident showed that:

- the sling was old and had no manufacturer's plate or markings;
- it included textile sling parts associated with metal sling parts;
- the textile strap was yellow, a colour associated with maximum strand load weight of 3,000 kg. There were no identifying marks;
- the connecting shackles were designed for metal slings with a diameter of 10 mm (maximum load weight 3.15 t). They were not designed for textile slings[3].
- the upper shackle had significant play at the level of the axle. The lower shackle had a crack in the ring around the axle;
- the hook shackle was designed to be used with a metal sling with an 8 mm diameter (maximum weight 2 t);
- the shackle was not equipped with a roller-ball type device that would allow it to turn round and limit the mechanical constraints during the flight;
- the hook shackle had a load-induced self-locking yoke. It could be unlocked by pulling the lock. Designed before 2001, it had not been manufactured since 2007.

[3]To protect the straps in the sling accessory, the shackles for textile slings have a flat body that allows the strap to "***stretch***" instead of being compressed.

Figure 12 - hook shackle

The hook found at the site of the accident had a residual opening of 7 to 8mm when locked. According to the manufacturer's documentation, the play must not exceed 3mm (*see appendix 1*).

A tomography examination of the hook showed that the body of the hook had suffered deformation of 0.5mm.

The lock was extremely worn. In places, the loss of material had reached 0.5 mm.

Note: A piece of cloth was found wrapped round one of the net buckles. It took up additional space inside the usable section of the hook and blocked a part of it. The investigation was not able to determine the cause of this.

1.16.5 Study of the concentration of stresses on a sample hook (photo-elasticimetry)

Figure 13 - visualisation of the stress zones on a sample hook

Photos taken under polarized light represented the behaviour of a sample hook, made of plexi-glass and subjected to various loads (no load, moderate and heavy loads). The coloured zones indicate the zones of the same value or the same stress orientation. It is notable that the tip of the hook suffers no stresses. Its role is to prevent the load from slipping.

In addition, a hook is designed and sized to work with a load applied at the base of the body. The maximum weight is calculated from traction tests performed under these conditions of use.

In the case of the assembly used during the accident, a part of the load was supported by the tip of the hook, which probably contributed to the deformation of the hook.

1.16.6 Test to position the four net buckles inside the hook

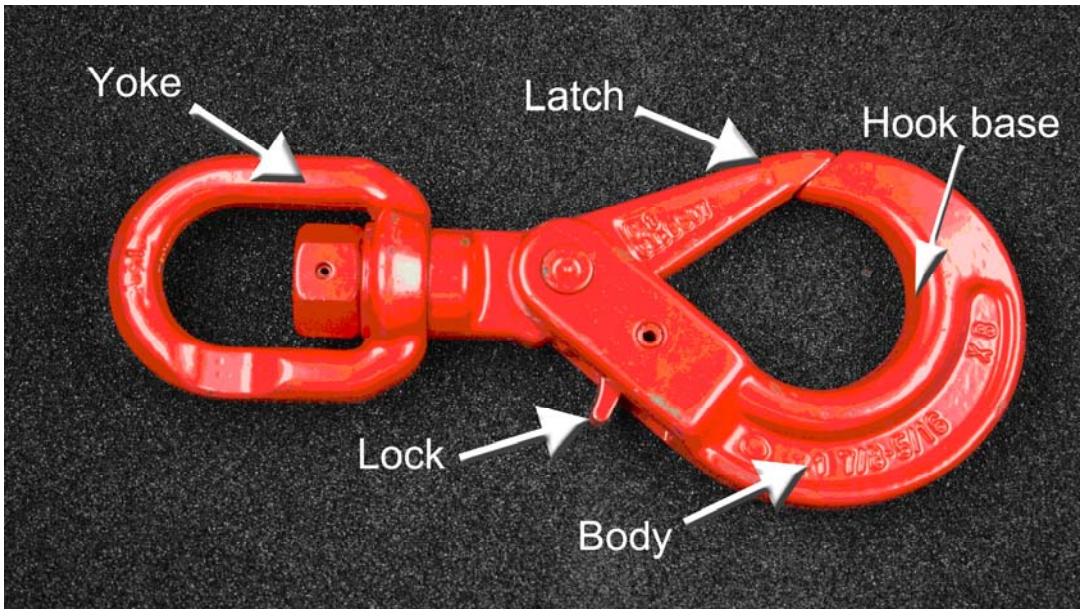


Figure 14 - constituents of a sample hook

Some tests were performed on a machine applying traction of the order of 800 kg.

They showed:

- that the four net buckles occupied all of the space available inside the hook and that the buckles cross over each other[4];
- that the buckles can end up lined up with the residual opening of the hook;
- that traction force is not only applied to the base of the hook body;
- that when a buckle is stuck between the catch and the body of the hook, a vertical force of 50 kg is enough to extract the buckle from the hook.

[4]The manufacturer's documentation recommends that with more than two bucklesF/cables, the operator must use links such as rings or shackles (appendix 1 – technical documentation on hooks)

1.17 Information on Organisations and Management

1.17.1 French regulatory framework

The decree of 24 July 1991 relating to the use of aircraft in general aviation defines specific activities in chapter III. The transport if inert external loads with a sling constitutes an aeronautical activity. Operators that undertake a specific activity must file a specific activities manual, and pilots must hold a competence level declaration issued by a training organisation selected by the operator. This decree applies to civil aircraft, whatever their registration may be, within French territory.

1.17.2 Specific activities manual

The Yankee Lima Helicopters company had a specific activities manual, an extract from which is included below:

2.4 Conduct of flight – specific procedures (lifting)

See Flight Manual supplement.

NOTE: This chapter is defined in the flight manual supplement: manual that is permanently on board and constantly and regularly updated (SUPP 11 and section 9.1 - transport of loads with sling).

The pilot must ensure that loads are transportable with a sling and that the weight is within the limitations specified in the flight manual.

He personally ensures that the nets and slings are in good condition and appropriate for the load to be transported.

An assistant is with him where possible to help him and attach the loads to the helicopter hook.

This assistant is allowed on board during transportation of external loads in order to guide him with lifting operations.)

1.17.3 Declaration of competence level

Flight crew with a specific activity must have competence corresponding to the activities of the operator, attested to through a ''*Declaration of level of competence*'' issued by a training organisation selected by the operator. The regulation requires that the training programme be appended to the reference form for organisations attesting the level of competence in a particular activity. This form must be filed with the DGAC. The 1991 decree relating to the conditions of use of civil aircraft in general aviation indicates that this filing is equivalent to certification of undertaking the training as described.

1.17.4 Machine directive, Labour Code

There is no specific regulation concerning the transportation of inert external loads by a helicopter. The aeronautical certification standards, in relation to transporting inert external loads, ''*stop*'' at the load release hook.

Nevertheless, lifting accessories are within the scope of a European Directive related to the design of machinery[(5)], called the ''*Machinery Directive*''. This directive was transposed into French law in the labour code (Code du Travail), by order 2008-1156 of 7 November 2008, and came into effect on 29 December 2009.

Before a lifting accessory is put on the market, its manufacturer must generate a technical dossier that it keeps under its responsibility. This dossier must respond to the essential health and safety requirements in the Machinery Directive.

When a user designs and assembles its own lifting accessory for an activity linked to operational constraints, it becomes the manufacturer. It must then satisfy the same requirements in the Machinery Directive or its transposition into French law in appendix 1 of the labour code (Code du Travail).

In both cases, the lifting accessory is designed with auto-certification. It must have a declaration of conformity as well as a manufacturer's plate containing the EC marking. The latter must mention the main characteristics of the lifting accessory, specifically a serial number as well as its maximum lift weight. An extract from the regulation on creating a technical dossier is included in appendix 3.

[(5)]Machinery: Lifting accessories are defined as « machinery » in Article 2 - d) of the Machinery Directive 2006/42/EC. The Machinery Directive includes machinery installed on air transport equipment: http://eur-ex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:157:0024:0086:en:PDF

In addition, during the entry into service of the lifting accessory, the user must undertake a conformity examination, in accordance with article 7 of the decree if 1st March 2004. This examination involves checking that the lifting accessory is appropriate to undertake the proposed work. In addition, keeping the lifting accessory in service is conditional on an annual examination.

1.17.5 Training

In France, there is no standardised mandatory training concerning the design and preparation of an inert external load intended for transportation by helicopter.

2 - ANALYSIS

2.1 Accident Scenario

One minute after takeoff, two of the four buckles on the net detached from the hook shackle. Examination of the wreckage showed that the method of attaching the load to the lifting accessory led to abnormal constraints on the hook shackle. The combination of the twisting of the body of the hook and the wear on the lock probably caused the partial opening of the hook and the loss of the two buckles. Opening of the hook led to the flexible container falling. Analysis of the wreckage distribution along the flight path showed that the pilot had released the net about two seconds after the load fell, at a ground speed of about 90 kt. The fact that the net cannot enter into contact with the tail rotor if it is still attached to the releaser hook confirms that the load was dropped.

The pilot had been undertaking transport missions in Guyana using a sling for over three years. On the day of the accident he had made three rotations with no problems. It is likely that he was surprised by the loss of the load and that he pressed the release button in a reflex action. The net then struck the tail rotor, from which a blade then broke off. The imbalance caused by the loss of the blade from the tail rotor led to the separation of the tail rotor gearbox then the vertical stabilizer, causing the loss of control in flight.

2.2 Regulations on transportation of inert external loads

Lifting accessories are excluded from the regulatory framework that governs aircraft airworthiness. They are the subject of a separate regulation. In practice, the differences in the quality of design and technical follow-up between a helicopter and lifting accessory equipment are considerable. However, from the moment when a lifting accessory is connected to an aircraft, it is the weakest link in the chain that defines the level of safety. As long as lifting accessories do not reach the safety level of a helicopter, it is likely that this type of accident will occur again.

If the preparation of the load on the accident flight had been undertaken in accordance with the Machinery Directive and the labour code, the lifting accessory would have included some intermediate mesh. Mandatory checks would have enabled the level of wear to be detected. In the context of transportation of an inert external load, the investigation showed that an aerial work operator should refer both to the aeronautical regulations as far as the load releaser was concerned and to the labour code regulations for the design, the conformity and the follow-up of the lifting accessories. It appears that the labour code aspect of this regulatory field is little known to the various actors in aerial work.

The investigation showed that in France the aeronautical certification standards do not take into account the characteristics of inert external loads transported. The mass of the load transported is the principal limiting criterion. The rules made by the professionals in inert external load transportation refer to systems put in place on the ground, where the speed of load movements is limited. In the context of transportation by helicopter, the load travels at a significant speed. The load moves around in three dimensions and is subject to accelerations as well as to aerodynamic effects that need to be studied. There are no design rules that take into account the particularities of an inert load transported by a helicopter. It is likely that if such rules existed, operators would be in possession of references that would help them to design lifting accessories that would be appropriate for the work to be undertaken.

In addition to this lack of regulation it must be added that in France there is no training specifically aimed at ground personnel. Over time, operators have developed methods based on their own experience and developed sling techniques based on empirical knowledge.

The training of the ground operator did not give him enough knowledge of the particularities of transporting inert external loads by helicopter. He thus likely did not notice the incorrect stowage of the load. The condition of the sling shows that no maintenance operations had been carried out on the sling, and that the state of wear of its components had thus not been detected.

Finally, the specific nature of the utilisation and environmental conditions associated with aerial work has not, in France[6], led to any specific publication. If the average level of knowledge of the various actors in aerial work was improved, the frequency of this type of accident should diminish.

[6]In Switzerland, among other places, there is a training course aimed at flight assistants. An extract from the documentation used during this training is in appendix 4.

3 - CONCLUSION

3.1 Findings

- the pilot possessed the requisite licences and ratings to carry out the flight;
- the helicopter had a valid airworthiness certificate; it was maintained in accordance with the regulations;
- the technical examinations did not bring to light any evidence of malfunctions that might explain the accident. The helicopter was airworthy;
- the marks found on the broken blade of the tail rotor were caused by contact between the net and this blade. This is only possible if the net has been released from the load hook releaser;
- the detailed examination of the various components of the sling showed that its design and assembly did not respect the technical rules relating to the ''*Design regulations*'' of a sling in accordance with Article R.4312-1 of the labour code (French Code du Travail);
- the method used to hook on the net was not in accordance with the instructions of the hook manufacturer;
- the lifting accessory showed signs of extensive wear;
- the body of the hook had a deformation;
- the hook had out of limits play in its opening between the catch and the body;
- the ground operator was not the person designated by the company and his presence was not mandatory according to the specific activity manual;
- the training of the ground operator did not give him enough knowledge of the particularities of transporting inert external loads by helicopter;
- the "*load preparation*" item in the DNC training programme followed by the pilot was not sufficiently developed to allow him to make an appropriate check on the attachment of the load before the flight.

3.2 Causes of the Accident

The accident was caused by the use of a sling whose design and maintenance were not in accordance with the Machine Directive. The use of inappropriate sling accessories to attach a load to the lifting accessory led to abnormal stresses on the hook shackle and then on two out of the four buckles that made up the assembly. The loss of the load obliged the pilot to release the net though the helicopter was flying at a speed that was too great to accomplish this manoeuvre. The net, which was supporting the load, then entered into contact with the tail rotor, resulting in the end in the in-flight loss of control.

The following factors contributed to the accident:

- the lack of any specific regulations for the design of a lifting accessory adapted for use in an aviation environment, contributed to the design of a lifting accessory that was not adequate for the work undertaken;

- the lack of any technical documentation detailing the specific difficulties associated with the behaviour of an inert external load transported by helicopter contributed to the design and development of a lifting accessory that was not adequate for the work undertaken;

- the lack of information for the pilot in the DNC training programme dealing with techniques for preparation of an inert external load contributed to the use of a lifting accessory that was not adequate for the work undertaken;
- the lack of any specific standardised training for ground operators dealing with techniques for preparation of an inert external load contributed to the use of a lifting accessory that was not adequate for the work undertaken.

4 - SAFETY RECOMMENDATIONS

Note: in accordance with the provisions of Article 17.3 of Regulation No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation, a safety recommendation in no case creates a presumption of fault or liability in an accident, serious incident or incident. The recipients of safety recommendations report to the authority in charge of safety investigations that have issued them, on the measures taken or being studied for their implementation, as provided for in Article 18 of the aforementioned regulation.

4.1 Compliance with the European Machine Directive

The investigation showed that:

- a part of the applicable regulations in the field of transportation of inert external loads is not known to operators;
- the lifting accessory designed and developed by the operator was not in accordance with the regulations in force;
- the lifting accessory used for the transportation of the inert external load was not adapted to the constraints of aerial work.

Consequently, the BEA recommends that:

- **EASA and the DGAC ensure that sling equipment to transport inert external loads be designed and used according to the safety standards defined by the European Directive on machinery (or its transposition into French law in the "Code du Travail"). [Recommendation FRAN-2012-028]**

4.2 Training for transporting an inert external load

The investigation showed that there is no specific training that enables the various participants in aerial work, in particular ground personnel, to acquire knowledge and techniques for the preparation of inert external loads intended to be transported by helicopter and to allow them to accomplish their missions safely.

Consequently, the BEA recommends that:

- **EASA and the DGAC define a specific training course aimed at the aerial work sector within the framework of the transportation of inert external loads, or ensure that operators define and apply training at an equivalent level. [Recommendation FRAN-2012-029]**

LIST OF APPENDICES

Appendix 1

Hook technical documentation

Appendix 2

Design rules

Appendix 3

Extract from chapter A of appendix 7 to the 2006/42/EC Machine Directive "*Technical dossier for machines*"

Appendix 4

Extract from a training document for flight assistants used in Switzerland

Hook technical documentation

⚠ Choix de l'assemblage

Éviter toute contrainte de torsion dans les élingues.

Assemblage avec cosse sur câble.

Autres : maillons A12 ou coupleur A4.

Conception de l'élingue et choix des composants : faire appel à une **personne compétente et expérimentée.**

⚠ Utilisation

Température d'utilisation : 0° à 200°. En dehors de cette fourchette de températures, nous consulter.

Éviter tous les chocs, les milieux acides.

Tout traitement (thermique ou de surface) est **formellement proscrit.**

Ne jamais faire porter le crochet sur un angle (risque de pliage) ❹.

Ne jamais dépasser les capacités de charge (attention aux cœfficients d'élingage) ou dimensionnelles du produit.

Ne jamais viller ou tordre les crochets en utilisation ❶ et ❹.

Veiller à ce que le corps du crochet puisse **s'articuler librement sur la charge** (risque de déformation du corps ou de rupture de verrou) ❸.

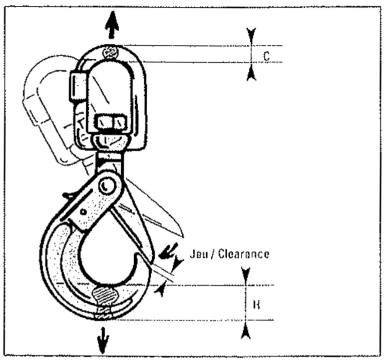
Ne jamais travailler avec un crochet non verrouillé (bloqué ouvert ou détérioré) ❺.

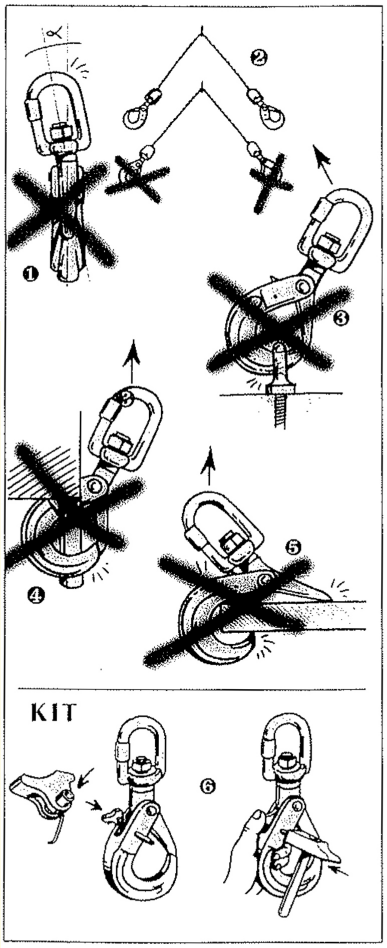
⚠ Maintenance

Ces vérifications doivent être effectuées par une personne habilitée.

Dans le cadre d'une utilisation intensive, nous recommandons d'inspecter les crochets 1 fois par semaine. Points à contrôler :

- Nettoyage (soigneux) sans démontage et contrôle d'aspect des pièces :
  - pliage ou traces de chocs violents,
  - usure du sertissage de l'axe (frottement sur des corps étrangers) et des autres pièces (voir tableau).
- Ouverture et fermeture sans blocage ni points durs ; verrouillage automatique en position fermée, présence et efficacité du ressort.
- Contrôle du jeu selon croquis, s'il dépasse les valeurs indiquées (tableau),remédier comme suit :
- Contrôle d'usure de ce crochet selon ces critères : 10 % maximum de sa dimension d'origine, sauf spécifications contraires dans la norme en vigueur. Au delà de 10 %, rebuter le crochet.
  - Inspecter la surface de contact, verrou sur linguet, si elle est matée, le verrou est à remplacer. Contactez votre distributeur SYSMA pour la fourniture d'un kit réparation verrou ❻.
  - Si le verrou est intact, le jeu provient de l'axe ou d'une déformation du crochet (usage abusif), le crochet est à rebuter.





⚠ Choice in assembling

Ensure that the legs of chain are not twisted prior to lifting.

Assembling with a thimble when fitted on a wire rope.

Others : A12 links or A4 Omega couplers.

Design of slinging + selection of components : **Consult a competent person.**

⚠ Directions for use

To be used between 0° and 200° C (please contact us for the use at temperature out of this range)

Avoid loading shocks and contacts with acids.

Any heat or surface treatment is strictly prohibited.

Never tip load the hook (risk of deformation). Never overload the hook, keeping in mind WLL.

Make sure the structure of the hook swivels freely when under load (otherwise structure might deform of the trigger fail) ❸. Never handle with (opened or damaged) unlocked hook ❺.

⚠ Maintenance

In case of intensive use, the hook should be checked at least once a week. What to check :

- Thorough cleaning without dissassembly as well as checking the appearance of the components :
  - Visible shock marks, sign of wear of other parts of the hook
  - Signs of wear and tear on the riveted fulcrum pin from rubbing against another object.

Check the wear out of the hook according to the following criterias : if the wear exceeds 10 % maximum of the original dimension of the hook (if not specified differently in the standards) the hook should be scrapped.

If the clearance of the latch exceeds the values of the table below the hook should be scrapped.

- Locking and unlocking without any blocking or resistance : automatic locking in secured position, presence and efficiency of spring.
- If either wear or play exceed the values in the below, check the following :
  - Inspect the surface finish and the trigger which is in contact with the latch. If worn smooth, the trigger kit should be replaced by your SYSMA Dealer ❻.
  - If the trigger is intact, it means that play is due to excessive wear on the riveted fulcrum pin or to distortion of the hook (overloading). In this case, the hook should be scrapped.
- Clean and check the **bronze washer.** If it is scratched or shows signs of wear and tear, scrap it (not repairable). Although it is self-lubricating, it should still be lubricated when being used in a corrosive atmosphere.

Check that the hook body and latch are aligned.

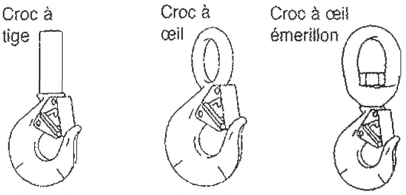
Spare part kit :

Latch, spring retaining pin, plastic insert.

Calibre crochet / Chain size (mm)	5/6	8	10	13	16	18/20
Marquage / Marking	CL0	CL1	CL2	CL3	CL4	CL5
Jeu maxi / Clearance maxi (mm)	3	3	3,5	3,5	4	5

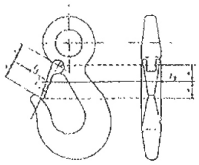
***Cas du BTP** : huiler abondament le dispositif de verrouillage pour limiter l'adhérence du béton.*
***Building site application** : frequently lubricate the locking mechanism to stop cement sticking to it.*

Toutes les caractéristiques mentionnées sur cette fiche n'ont qu'une valeur indicative. Elles peuvent varier en fonction des fabrications, sans altérer pour autant la qualité du produit.
Le fabricant se réserve le droit de modification sans préavis. Dessins non contractuels. Toute reproduction interdite.



- Une personne qualifiee doit périodiquement vérifier que les crochets ne présentent aucune fissure, entaille, usure ni déformation. Ce contrôle doit être effectué conformément aux normes. Cette inspection doit être complète et documentée.
- Faites annuellement une inspection magnétoscopique ou par ressuage des crochets et du filetage, ou plus souvent pour des conditions d'utilisation sévères. (Le démontage peut s'avérer nécessaire).
- Ne jamais utiliser un crochet dont l'ouverture de la gorge a augmenté ou si son extrémité est tordue de plus de 10° par rapport au plan du corps du crochet, ou encore si le crochet est tordu ou déformé d'une quelconque autre manière.
  Note : Un linguet ne se fermera pas normalement si la pointe du crochet est courbée ou usée.
- Ne jamais utiliser un crochet dont le degré d'usure dépasse les cotes données en figure 1.
- Retirer de la circulation les crochets qui sont fissurés, entaillés ou endommagés.
  Ne jamais percer, ou souder, ou transformer ou chauffer un crochet.
- Ne jamais réparer, modifier, refaire ou changer la forme d'un crochet en soudant, chauffant, brûlant ni en le pliant.
- Ne jamais appliquer de charge latérale sur le crochet ni à l'arrière ou sur la pointe de celui-ci (voir figure 2).
- Ne pas faire pivoter un crochet type 322 pendant qu'il soutient la charge, sauf s'il est monté sur roulement et dans ce cas en maintenant la charge et en vérifiant les abords
- L'emploi d'un linguet est obligatoire

Attention nouvelle disposition en cours :



Pour tous types de crocs avec linguet de sécurité :
Selon Pr EN 1677-5 XI-99, le linguet de sécurité à ressort doit pouvoir, étant en place, résister suivant le sens des flèches, à des efforts de 300 kg, et au moins à 10% de la CMU du croc, mais cependant avec une limite de 20 kN.

- Toujours s'assurer que c'est bien le crochet qui supporte la charge (voir figure 3) et jamais le linguet (voir figure 4).
- Quand on place deux (2) élingues dans un crochet, s'assurer que l'angle formé par le brin le plus éloigné et le plan vertical du crochet ne dépasse pas 45°. De plus, l'angle intérieur formé par les deux (2) brins ne doit pas dépasser 90° (voir figure 5). Les boucles de élingues ne doivent pas chevaucher au niveau du crochet (voir figure 6)

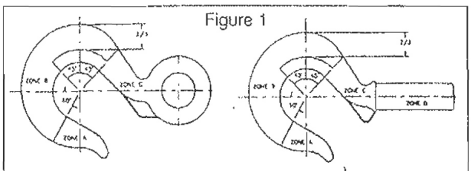
Quand les angles sont supérieurs à 90°, ou en présence de plus de deux (2) brins, une maille principale ou une manille tyre boulonnée et goupillée doivent être employées pour fixer les brins de l'élingue au crochet.

NB Se rapprocher de l'Afnor et des societes de contrôle pour de plus amples renseignements

IMPORTANT

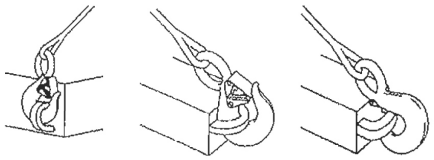
- **Les charges peuvent se détacher du crochet si l'on ne respecte pas les procédures appropriées.**
- **Une charge qui tombe peut blesser grièvement ou même tuer.**
- **Si les filetages sont oxydés ou usés, la charge risque de tomber.**
- **Le crochet doit toujours soutenir la charge. La charge ne doit jamais être supportée par le linguet.**
- **Ne jamais soulever de charges dont le poids dépasse la charge maximale d'utilisation (CMU).**
- **Lire et bien comprendre ces instructions avant toute utilisation de crochets ou de linguets.**

Figure 1



ZONE A . doit être en concordance avec le linguet
ZONE B danger si à 10 % de la dimension d'origine
ZONE C : danger si à 5 % de la dimension d'origine
ZONE D . filetages au moins de classe 2 sur une longueur équivalent au moins à une fois le diamètre de la tige. S'il est oxydé, rebuter le crochet.

Figure 2



3 montages incorrects

Figure 3

Figure 4

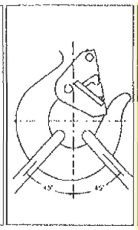


Figure 5

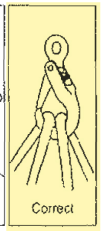


Figure 6

Appendix 2

Design rules

Article R4312-1 du Code du travail

Les accessoires de levage et composants d'accessoires de levage doivent être conçus et construits conformément à l'article R4312-1 du code du travail. Ce texte contient les obligations réglementaires de conception et traite notamment de la résistance mécanique, de l'aptitude à l'emploi, du marquage, de la notice d'instructions.

Examen d'adéquation de l'accessoire de levage

Article 7 de l'arrêté du 1er mars 2004

On entend par « Examen d'adéquation d'un accessoire de levage », l'examen qui consiste à vérifier :

- qu'il est approprié aux différents appareils de levage sur lesquels l'utilisateur prévoit de l'utiliser et aux travaux à effectuer, ainsi qu'aux risques auxquels les travailleurs sont exposés ;
- que les opérations prévues sont compatibles avec les conditions d'utilisation de l'accessoire définies par la notice d'instructions du fabricant.

Cet examen est obligatoire avant la mise en service d'un accessoire de levage.

Maintien en conformité du matériel

Article R4322-1 du Code du travail

Applicable dans le cas d'une modification de l'accessoire de levage. Les équipements de travail et moyens de protection doivent être maintenus en état de conformité avec les règles techniques de conception et de construction applicables lors de leur mise en service dans l'établissement.

Vérifications générales périodiques

Articles R4323-23 à R4323-27 du Code du travail

Les accessoires de levage sont soumis à des vérifications générales périodiques. Ces vérifications sont destinées à déceler en temps utile toute détérioration susceptible de créer des dangers. La réalisation de ces vérifications doit être confiée, sous la responsabilité du chef d'établissement dans lequel les accessoires sont utilisés, à du personnel qualifié, exerçant régulièrement cette activité, appartenant, soit :

- à l'établissement,
- à un organisme d'inspection appelé organisme de vérification ou organisme de contrôle.

Registre de sécurité

Article L4711-1 du Code du travail

Les résultats des vérifications réglementaires sont inscrits, sans délai, par le chef d'établissement sur le registre de sécurité prévu par l'article L4711-1 du Code du travail.

La mention des résultats doit refléter les conclusions de ces rapports qui devront lui être annexés.

Ce registre doit être tenu à la disposition des inspecteurs du travail ou agent du service de prévention des organismes de sécurité sociale conformément à l'article L4711-3

La durée d'archivage de ces rapports est de cinq ans.

Appendix 3

Extract from chapter A of appendix 7 to the 2006/42/EC Machine Directive
"Technical dossier for machines"

This part describes the procedure for compiling a technical file. The technical file must demonstrate that the machinery complies with the requirements of this Directive. It must cover the design, manufacture and operation of the machinery to the extent necessary for this assessment. The technical file must be compiled in one or more official Community languages, except for the instructions for the machinery, for which the special provisions of

Annex I, section 1.7.4.1 apply.

The technical file shall comprise the following:

1) A construction file including:

- ❒ a general description of the machinery;
- ❒ the overall drawing of the machinery and drawings of the control circuits, as well as the pertinent descriptions and explanations necessary for understanding the operation of the machinery;
- ❒ full detailed drawings, accompanied by any calculation notes, test results, certificates, etc, required to check the conformity of the machinery with the essential health and safety requirements.

2) The documentation on risk assessment demonstrating the procedure followed, including:

- ❒ a list of the essential health and safety requirements which apply to the machinery;
- ❒ the description of the protective measures implemented to eliminate identified hazards or to reduce risks and, when appropriate, the indication of the residual risks associated with the machinery;
- ❒ the standards and other technical specifications used, indicating the essential health and safety requirements covered by these standards;
- ❒ any technical report giving the results of the tests carried out either by the manufacturer or by a body chosen by the manufacturer or his authorised representative;
- ❒ a copy of the instructions for the machinery;
- ❒ where appropriate, the declaration of incorporation for included partly completed machinery and the relevant assembly instructions for such machinery;
- ❒ where appropriate, copies of the EC declaration of conformity of machinery or other products incorporated into the machinery.

Appendix 4

Extract from a training document for flight assistants used in Switzerland

ABC DES ASSISTANTS DE VOL

DISPOSITIFS DE LEVAGE

1ère Principe: choix du matériel

Les calculs décrits ci-après sont basés sur l'augmentation des forces lors du transport de charges sous élingue. Cette augmentation ne peut pas être comparée à celle qui s'applique en transportant des charges à l'aide d'un palan.

En général, les dispositifs de levage disponibles sur le marché (élingues, chaînes, câbles d'acier, cordes, manilles, etc.) ne répondent pas aux exigences spécifiques du service de vol.

L'utilisateur doit donc choisir le matériel approprié en fonction de ses besoins. Dans certains cas, l'entreprise de transport aérien devra toutefois choisir et renouveler le matériel en fonction des progrès techniques.

2ème Principe: méthodes de calcul pour évaluer la résistance du matériel

Il existe deux manières d'effectuer les calculs relatifs à la fourniture de matériel:

1. En fonction des charges spécifiques: cette méthode s'applique le plus souvent en cas de doute et lorsqu'il faut se procurer du matériel et des appareils de suspension spéciaux.
2. Pour les engagements de routine: dans ce cas, on se base sur la charge maximale prévisible afin de pouvoir dimensionner le matériel en conséquence.

Dans les deux cas, il faut tenir compte des paramètres suivant:

1. Arrondir le résultat, de préférence au chiffre supérieur (marge de sécurité).
2. Noter et conserver les calculs (documentation).
3. Ces méthodes de calculs sont invariables. S'adresser au fabricant pour obtenir les calculs nécessaires. Les informations du fabricant font partie intégrante de la documentation.

Etant basés sur la législation européenne en matière de technique de sécurité, selon laquelle les normes ont un caractère purement indicatif, les valeurs et calculs indiqués sont considérés comme des valeurs minimales. Des écarts de valeurs sont possibles, mais le fabricant est alors tenu d'en fournir une justification détaillée et cohérente.

3ème Principe: responsabilité du fait des produits

De par la loi sur la responsabilité du fait des produits (LRFP), les fabricants de produits, de matières premières ou de produits semi-finis sont tenus pour responsables (art. 1).

Les entreprises de transport aérien qui achètent des pièces détachées p. ex. dans le but de fabriquer une élingue à quatre points, sont considérées comme fabriquants (art. 2) et sont donc tenues pour responsables de ce produit dit "fini" pendant dix ans (art. 10).

Les études et les calculs sur lesquels reposent la fourniture de pièces détachées et le matériel "fait maison" doivent être conservés pendant dix ans (voir à ce propos le Droit européen de la technique de sécurité, DM 98/37/ EG, annexe V, paragr. 4.b).

4ème Principe: compétences

1. Pour la construction et la fabrication de **matériel destiné au transport de personnes lors d' opérations de sauvetage**, l'OFAC est competent (section certification de l'avion). Il convient en particulier de consulter la "Communication technique 50.605-20". Les charges externes largables, exclusivement destinées au transport de matériel, ne relèvent pas de l'OFAC (OAE, art. 1, *Eléments d'aéronefs).*
2. Les dispositifs de levage, le **matériel destiné au transport de personnes** (ex: positionnement) et le matériel destiné à assurer la sécurité des personnes relèvent de la LSIT. La Suva, qui fait office d'organe de surveillance et d'exécution, peut délivrer une attestation de type.

Pour tout renseignement complémentaire, veuillez vous adresser à: voir références bibliographiques, p. 1.0.

3 2 1 / 01.06.2000 PE **Page 3.2.1**

DISPOSITIFS DE LEVAGE

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En général, les dispositifs de levage disponibles sur le marché (élingues, chaînes, câbles d'acier, cordes, manilles, etc.) ne répondent pas aux exigences spécifiques du service de vol.

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2. Pour les engagements de routine: dans ce cas, on se base sur la charge maximale prévisible afin de pouvoir dimensionner le matériel en conséquence.

Dans les deux cas, il faut tenir compte des paramètres suivant:

1. Arrondir le résultat, de préférence au chiffre supérieur (marge de sécurité).
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Pour tout renseignement complémentaire, veuillez vous adresser à: voir références bibliographiques, p. 1.0.

CONSTRUCTION DES DISPOSITIFS DE LEVAGE

Evaluation des tests[1)]

Les résultats démontrent que les textiles dynamiques ne sont adaptés ni comme dispositifs de levage (élingue de fret) ni comme matériel d'élingage.

En cas de perte de la charge ou de rupture du câble, selon le profil et le diamètre du câble, le degré de descente et la vitesse d'avancement de l'hélicoptère, on est en présence de risques considérables.

Pour le matériel d'élingage il faut savoir que: plus l'allongement des sangles de levage ou des élingues rondes est grand, plus l'allongement à la traction des fibres est important = plus le frottement / le développement de chaleur / la réduction de la capacité portante sont grands!

Toutefois, le comportement linéaire du câble n'est qu'un indicateur parmi d'autres.

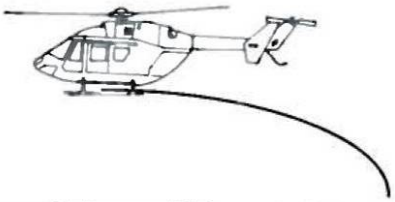
Sections transversales

La section transversale d'un câble a une influence considérable sur l'aérodynamique.

Les risques peuvent augmenter en combinaison avec les caractéristiques dynamiques. C'est la raison pour laquelle, en cas de vol en descente et de perte de la charge, un câble dynamique avec une section transversale ovale se contractera inévitablement vers le haut.

En revanche, dans la descente et en marche avant, le câble de construction statique, avec une âme rigide et une petite section transversale ronde, se balancera peu vers l'arrière et n'aura qu'une faible tendance à fouetter.

Toutefois, au cas où il heurterait un obstacle dans la descente ou en marche avant, un câble sera projeté vers le haut, même s'il s'agit d'un câble métallique lourd avec crochet.

Description	Représentation graphique (principe)
Section transversale ronde  Meilleur comportement aérodynamique.	
Section transversale ovale  Problématique. "Tremble" pendant le vol et produit une portance relativement haute.	
Section transversale rectangulaire  Emploi comme élingue de fret extrêmement problématique. Fortes oscillations (vibrations sensibles au Pitch ou Stick), accessoires et boucles peuvent être endommagés par les vibrations. Portance plus haute et fouettement plus fort.	
Sections transversales des élingues à plusieurs brins (ronde, ovale ou rectangulaire) Les élingues à plusieurs brins, la rallonge ou les brins du matériel d'élingage, vibrent fortement et engendrent une forte résistance = portance	

[1)] Source: Heliswiss 1983, H. Wyder, H. Stocker, A. Marty

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