European Union Aviation Safety Agency

Notice of Proposed Amendment 2021-10

in accordance with Articles 6(3), 7 and 8 (Standard procedure: public consultation) of MB Decision No 18-2015

Prevention of catastrophic accidents due to rotorcraft hoist issues

RMT.0709

EXECUTIVE SUMMARY

The objective of this Notice of Proposed Amendment (NPA) is to mitigate the risks linked to the failures of rotorcraft hoists during hoisting operations.

This NPA proposes to enhance the improved industry standards for rotorcraft hoists that have been developed to address some of the existing design shortfalls that have been identified. This NPA proposes additional certification specifications for rotorcraft hoists that integrate and take into account these industry standards in the form of a dedicated European Technical Standard Order (ETSO).

The proposed amendments are expected to significantly reduce the risk of catastrophic accidents in human external cargo operations.

Domain:	Design and production		
Related rules:	CS-ETSO (European Technical Standard Orders)		
Affected stakeholders:	Design approval holders (DAHs)		
Driver:	Safety	**Rulemaking group:**	No
Impact assessment:	Yes	**Rulemaking Procedure:**	Standard

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1. About this NPA

1.1. How this NPA was developed

The European Union Aviation Safety Agency (EASA) developed this NPA in line with Regulation (EU) 2018/1139[1] (the 'Basic Regulation') and the Rulemaking Procedure[2]. This rulemaking activity is included in the European Plan for Aviation Safety (EPAS) 2021–2025 under rulemaking task (RMT).0709. The text of this NPA has been developed by EASA. It is hereby submitted to all interested parties for consultation[3].

1.2. How to comment on this NPA

Please submit your comments using the automated **Comment-Response Tool (CRT)** available at **http://hub.easa.europa.eu/crt/**[4].

The deadline for submission of comments is **13 October 2021**.

1.3. The next steps

Following the closing of the public commenting period, EASA will review all the comments received.

Based on the comments received, EASA will issue a decision in order to amend the Certification Specifications (CS) for European Technical Standard Orders (CS-ETSO).

A summary of the comments received will be provided in the explanatory note to the decision.

1 Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91 (OJ L 212, 22.8.2018, p. 1) (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1535612134845&uri=CELEX:32018R1139).

2 EASA is bound to follow a structured rulemaking process as required by Article 115(1) of Regulation (EU) 2018/1139. Such a process has been adopted by the EASA Management Board (MB) and is referred to as the 'Rulemaking Procedure'. See MB Decision No 18-2015 of 15 December 2015 replacing Decision 01/2012 concerning the procedure to be applied by EASA for the issuing of opinions, certification specifications and guidance material (http://www.easa.europa.eu/the-agency/management-board/decisions/easa-mb-decision-18-2015-rulemaking-procedure).

3 In accordance with Article 115 of Regulation (EU) 2018/1139, and Articles 6(3), 7 and 8 of the Rulemaking Procedure.

4 In case of technical problems, please send an email to crt@easa.europa.eu with a short description.

2. In summary — why and what

2.1. Why we need to amend the rules — issue/rationale

The certification requirements for external loads for rotorcraft conducting human external cargo (HEC) and non-HEC (NHEC) operations were developed and introduced into Federal Aviation Regulations (FARs) 27 and 29 in 1999. These were later incorporated into the EASA Certification Specifications for Small Rotorcraft (CS-27) and Large Rotorcraft (CS-29). However, most hoist designs are derived from models that predate the change in the certification specifications for external loads, and their compliance is potentially questionable. A recent review of in-service incidents/accidents by EASA has highlighted that the introduction of some design improvements could potentially mitigate some of the catastrophic occurrences. These occurrences have been happening with a probability at least an order of magnitude higher than the safety level required by the CSs. The current CSs and acceptable means of compliance (AMC) require that such occurrences should have a probability lower than 1×10^{-9} per flight hour (FH).

In light of the essential requirements contained in the Basic Regulation, the approach to the certification of hoists should now be revisited, as some failure modes are not consistently taken into consideration, and this is reflected in in-service experience.

There are no:

— safety recommendations (SRs) that are pertinent to the scope of this RMT;

— exemptions that are pertinent to the scope of this RMT;

— direct references to ICAO Standards and Recommended Practices (SARPs); or

— references to European Union (EU) regulatory material that is relevant to this RMT.

For a more detailed analysis of the issues addressed by this proposal, please refer to the IA Section 4.1.

2.2. What we want to achieve — objectives

The overall objectives of the EASA system are defined in Article 1 of the Basic Regulation. This proposal will contribute to the achievement of the overall objectives by addressing the issues outlined in Section 2.1.

The primary objective of this RMT is to reduce the likelihood of catastrophic occurrences during rotorcraft hoisting operations through improved designs and eliminating design features that have been shown to contribute to these in-service occurrences on the existing hoist models.

The specific objective of this proposal is to reduce the number of rotorcraft accidents and incidents caused by rotorcraft hoist issues along with the number of fatalities associated with these events.

Section 4.2 contains further details on the objectives of this RMT.

2.3. How we want to achieve it — overview of the proposals

In order to meet the objectives of this RMT, a dedicated ETSO has been prepared that addresses the safety concerns that have been identified on the current design of rotorcraft hoists.

2.4. What are the expected benefits and drawbacks of the proposal

The expected benefits and drawbacks of the proposal are summarised below.

The expected benefits are:

— the elimination or reduction of the safety issues related to rotorcraft hoists;

— the overall improvement in the safety of rotorcraft hoisting operations.

The expected drawbacks are:

— the additional costs for the design and certification of rotorcraft hoists;

— the technical challenges of complying with the design objectives.

For the full impact assessment of the alternative options, please refer to Chapter 4.

3. Proposed amendments

The text of the amendment is arranged to show deleted, new or amended, and unchanged text as follows:

— deleted text is ~~struck through~~;

— new or amended text is highlighted in blue;

— an ellipsis '[…]' indicates that the rest of the text is unchanged.

3.1. Draft ETSO-2C208 'ELECTRICAL HOIST EQUIPMENT'

ETSO-2C208

ELECTRICAL HOIST EQUIPMENT

1 Applicability

This ETSO provides the requirements for electrical hoist equipment that is designed and manufactured on or after the date of this ETSO.

To be eligible for the ETSO, the hoist equipment shall be equipped with an overload protection device.

Hoist equipment includes the hoist itself, load attachment means (cable, hook, etc.), control and monitoring interfaces, a structural interface to attach the hoist to the boom/rotorcraft structure and the overload protection device. The boom itself is not considered to be a part of the hoist equipment.

Electrical hoist equipment designed in accordance with this ETSO must be identified with the applicable ETSO marking.

This hoist ETSO covers articles which are intended to be operated in the complete range of possible hoist missions, including missions with high risk of entanglement.

2 Procedures

2.1 General

The applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 Specific

None.

3 Technical Conditions

3.1 Basic

3.1.1 Minimum Performance Standard

The applicable standard for hoist equipment is provided in SAE Aerospace Standard (AS) 6342, Minimum Operation Performance Standard for Helicopter Hoist Systems, dated December 2020, as modified by Appendix 1 to this ETSO.

Whenever the term 'hoist' is used in this SAE document, it is equivalent to the hoist equipment.

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.1.5 Development Assurance

See CS-ETSO, Subpart A, paragraph 2.4.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

The failure of the function defined in paragraph 3.1.1 of this ETSO is:

- Catastrophic for loss or malfunction of the hoist equipment (including the overload protection device), which could lead to serious injuries or a fatality (including the HEC).

In addition, no single failure of the hoist equipment shall result in a Catastrophic Failure Condition.

Supporting information is provided in AMC 27/29.865(c)(2) and CS 27/29.1309 Amendment 8.

3.2.2 Equipment Safety Assessment

The hoist manufacturer shall conduct an Equipment Safety Assessment, including a systematic, comprehensive evaluation of the hoist equipment to show that the safety objectives from the Functional Hazard Assessment (FHA) and the derived safety requirements are met.

The latest revision of SAE ARP4761 provides guidance for the safety assessment process. Any assumptions taken by the hoist manufacturer shall be documented in the safety assessment. See also CS-ETSO, Subpart A, paragraph 2.4.

Note: Particular aircraft installations will drive additional, and more stringent, safety requirements for the hoist equipment. The ETSO applicant may elect to comply with these more severe aircraft installation requirements in the ETSO article FHA. If this option is selected, this shall be identified in the ETSO Certification programme, and demonstrated within the ETSO data package. Compliance with non-ETSO requirements will also be assessed during the approval (TC/STC) of the installation.

3.2.3 Installation Manual

The applicant shall document in an installation manual all information needed to substantiate the installation of the hoist equipment on a rotorcraft, including the following:

— Electrical interface definition and structural interface loads from the hoist system to the rotorcraft hoist attachment;

— Definition of the control and monitoring interfaces (per Appendix 1, Section 3.4.1.1);

— Maximum permanent deformation of the hoist after the application of the crash load factor (per Appendix 1 — Table 1 Section 3.6);

— Impact speed for the bird strike test (per Appendix 1 — Table 1 Section 3.6);

— Control means for the PQRS and BQRS (per Appendix 1 — Table 1 Section 4.6).

4 Marking

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

The maximum rated load shall be marked on the equipment, and the placard shall be installed in a location easily visible for the hoist operation.

5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

Appendix 1 to ETSO-2C208 ELECTRICAL HOIST EQUIPMENT

Appendix 1 identifies sections, paragraphs, figures or sentences from the SAE AS 6342 standard that are not applicable as minimum performance standards (MPS), and identifies requirements that are applicable in lieu of the referenced SAE text, or that are added to some sections of the SAE AS6342 standard. The information is provided in the form of three tables:

— Table 1 presents the amended text or additional text.

— Table 2 presents the additional definitions necessary for the ETSO.

— Table 3 presents the additional list of acronyms.

Table 1 — Modifications of requirements for the ETSO

When reading SAE AS6342 section	Apply the following
2.3	*Add to the HOIST definition the following:* The hoist is equivalent to the hoist equipment. Hoist equipment includes the hoist itself, load attachment means (cable, hook, etc.), control and monitoring interfaces (including pendants, controllers and interconnecting wires), a structural interface to attach the hoist to the boom/rotorcraft structure and the overload protection device. The boom itself is not considered to be a part of the hoist equipment.
	Replace the HOIST SYSTEM definition as follows: The system, inclusive of the hoist and ancillary components. For clarification, the hoist system includes the hoist equipment and other systems needed for integration to the rotorcraft and operation of the hoist. This includes but is not limited to, displays, controls within the cockpit, boom, pendants, wiring in the rotorcraft and the power supply.
	Add at the beginning of the LIMIT LOAD definition the following: Limit load is the maximum load that is expected to occur once in the lifetime of a hoist.
	Add at the beginning of the ULTIMATE LOAD definition the following: Ultimate Load is the maximum load that is expected to occur once in a hoist population (all hoists in operation throughout their entire operational life).
	Add Table 2 of Appendix 1 (see further below) to the section.
2.4	*Add Table 3 of Appendix 1 (see further below) to the section.*
3.1	*Replace the section with the following:* Specific installation requirements additional to this minimum operation standard shall be defined in the ETSO certification programme.
3.3.2	*Replace the section with the following:* The hoist shall have a system to manage the reeling out and reeling in of the cable, minimising the possibilities of jamming, fouling, kinking, or excessive wear on the cable.

3.3.2.2	*Replace the section with the following:* The storage provision (e.g. drum) shall be able to attach the cable end, and store all the usable cable. The storage provision shall minimise wear affecting either the cable or the storage provision. Unravelling and damage of the cable on the drum shall be avoided. Potential environmental conditions such as vibration shall be taken into account. A means shall be provided to visibly check/inspect the storage of the cable. All reference to storage visibility shall be for maintenance on the ground, not necessarily for hoisting operations.
3.3.4 2nd paragraph	*Replace the paragraph with the following:* Cable rebound shall be characterised through testing by the hoist manufacturer, and a characterisation report shall be provided as part of the certification application. The rebound characterisation report shall include information about the influence of the different loading conditions and the influence of the different cable lengths related to the rebound behaviour.
3.3.4 3rd paragraph	*Replace the paragraph with the following:* For the structural substantiation, any damage threats and manufacturing flaws that can be encountered during manufacturing and in service, shall be taken into account.
3.3.4 6th paragraph	*Replace the paragraph with the following:* The cable is a life-limited part. Cable fatigue characteristics shall be determined by the hoist manufacturer. Methods for cable life calculation shall be defined. Cable inspection and acceptance criteria shall be defined by the hoist manufacturer and shall be provided in the maintenance manual. See 3.6.2.
3.3.5 1st paragraph	*Replace the paragraph with the following:* If a mis-wrap event can lead to a complete loss of hoisting function or to a loss of load, the hoist shall be provided with a cable foul/mis-wrap system that shall stop the hoist if a cable foul/mis-wrap develops. The system shall protect the cable from the effects of continued running when fouled or jammed.
3.3.5 2nd paragraph	*Replace the paragraph with the following:* Once initiated, the mis-wrap protection system may be capable of being overridden only when continued safe operation is ensured.
3.3.6	*Replace the section with the following:* Load Attachment Means A load attachment means, such as a hook, shall be part of the hoist equipment. The load attachment means (i.e. hook) shall be attached such that it can freely rotate through 360 degrees in either direction. The load attachment means assembly shall be designed to mitigate the risk of entanglement on obstacles. Mechanism(s) shall be incorporated to avoid the possibility of unintentional load release. The mechanism(s) shall be designed to prevent tip loading and dynamic rollout.
3.3.8	*Replace the section with the following:* The hoist shall be equipped with overload protection capability.
3.4.1.1	*Replace the section with the following:* The hoist equipment shall monitor the safe operation of the hoist, through specific parameters including but not limited to the weight of the load, the fleet angle, the temperature of the temperature-sensitive components. The hoist equipment shall provide the status information (I) to the aircrew.

	The hoist manufacturer shall define the recorded information (R) that is to be stored until the next scheduled maintenance and made available before the next flight. This recording may be performed either by the hoist equipment itself or be provided as an output to the aircraft systems for recording. The following information shall be provided by the hoist equipment: • Hoist active (I) • End of travel (I) • Caution zone (I) • Quick-release system status (I+R) • Fleet angle exceedance (R) As a minimum, the flight crew shall be made aware of a fleet angle exceedance during post-flight check. • Activation of overload protection (I+R) • Load exceedance (I+R) (sampling rates need to be sufficient to capture shock loads) All operating limitations and other information necessary for safe operation must be provided as an output of the hoist equipment. The monitoring (I and R) shall be described in the installation manual. The display or recording of this information may be handled by additional equipment provided by the hoist manufacturer or may be handled by the STC or TC applicant for the installation. Note: The additional display or recording of the I in the cockpit are not considered as part of the ETSO function.
3.4.1.2	*Replace the headline of the section with the following:* Hoist Display and Recording Equipment
3.4.1.2.3	*Replace the section with the following:* In addition to 3.3.5, if a mis-wrap event can lead to a hoist failure, the hoist equipment shall have a mis-wrap indicator, indicating and recording a cable foul/mis-wrap that has occurred.
3.4.1.2.4	*Replace the section with the following:* The hoist shall indicate and record when an over temperature condition is present. The hoist over temperature condition shall be defined by the hoist manufacturer, based on the specific design of the hoist equipment.
3.4.2 1st paragraph	*Replace the section with the following:* The hoist equipment shall be enabled to receive the following control signal inputs, with the following commands:
3.4.3 8th paragraph	*Replace the paragraph with the following:* The operator control shall meet the applicable environmental requirements for outside use.
3.4.3 End of paragraph	*Complete the section with the following:* The operator control may include a BQRS activation. The operator control shall minimise inadvertent activation during stowage.
3.4.4	*Replace the section with the following:* Minimum acceleration at rated load shall be 5 ft/s/s (1.5 m/s/s).

3.4.9 2nd paragraph	*Replace the paragraph with the following:* A means to protect the hoist equipment from over-current (motor over torque) conditions shall be provided.
3.4.10	*Replace the section with the following:* The hoist shall have a means to measure and record the usage of the system. The usage shall be calculated in operating hours (time while the hoist drive is active) and hoist cycles.
3.5.1.1	*Delete the section (covered by ETSO standard text Chapter 3.2.2).*
3.5.4	*Delete the section.*
3.5.5	*Delete the section.*
3.5.6	*Delete the section.*
3.6	*Complete the section with the following:* Single critical load paths should be minimised. <u>Additional structural requirements</u> The hoist shall be able to withstand the most critical load factor expected in service. The load factors shall cover the entire rotorcraft operational envelope in which hoisting is allowed, including rapid direction reversal and rapid stops. • Static flight load factor The static flight load factor shall not be less than 2.5 g for HEC applications. The substantiated load factor shall be stated in the hoist limitations. • Dynamic load magnification factors Any significant dynamic load magnification factors should be taken into account. A dynamic load magnification factor is the difference between the static load factor and the load factor at the load attachment means (e.g. hook). • Crash load factors The hoist equipment shall withstand the following load factors without failure for at least 3 seconds during a static load test. The 3 seconds do not apply if the tests are performed dynamically to simulate actual loading application. (1) Upward – 1.5 g (2) Forward – 12 g (3) Sideward – 6 g (4) Downward – 12 g (5) Rearward – 1.5 g The hoist cable is expected to be fully stowed during load factor tests. The maximum permanent deformation resulting from the application of the load factors shall be documented in the installation manual. <u>Hoist-Critical Parts</u> A hoist-critical part is a part, the failure of which could lead to serious injuries or a fatality (including the HEC), and for which critical characteristics have been identified and must be controlled to ensure the required level of integrity. If the ETSO article includes hoist-critical parts, a list of the critical parts shall be established. Procedures shall be established to define the critical design characteristics, identify processes that

	affect those characteristics, and identify the design change and process change controls necessary for maintaining compliance with the ETSO standard. Bird Strike If the hoist is intended to be installed on a CS-29 rotorcraft, an impact with a 1-kg bird, at a velocity compatible with the maximum allowed speed installed on a rotorcraft, shall not lead to the detachment of parts which could prevent continued safe flight and landing. Compliance must be shown by tests. The impact speed shall be documented in the installation manual. Cable attachment The cable shall be attached to the drum. The attachment shall be able to withstand limit load conditions, or if limit load carrying capability cannot be shown, alternative means shall be provided to minimise the possibility of losing the load after complete unspooling of the cable. Interactions Systems and Structures For ETSO articles equipped with systems that affect structural performance, either directly or as a result of a failure or malfunction, the influence of these systems and their failure conditions shall be taken into account when showing compliance with the requirements of this ETSO standard. Appendix K to the CS-25 Amendment that is current at the time of the application, or in any later revision, should be used to evaluate the structural performance of ETSO articles equipped with these systems.
3.6.1 End of chapter	*Complete the section with the following:* For static strength substantiation of composite structure, AMC 20-29 provides further guidance.
3.6.2 End of chapter	*Complete the section with the following:* For fatigue tolerance substantiation of composite structure, AMC 20-29 provides further guidance.
3.6.4.1 End of chapter	*Complete the section with the following:* Strength reduction factors such as environmental effects (see 3.6.4.3) or unwinding/bending of the cable can be included in the testing. Strength reduction factors that are used shall be established by individual tests. If separate strength reduction factors are used, they should not influence each other.
4.1	*Replace the section with the following:* The arresting system shall be designed to sustain ultimate load without cable reel out. If not otherwise protected, engaging the arresting system shall not lead to an overload of the hoist equipment structure and shall reasonably protect human cargo on the hook.
4.2	*Replace the section with the following:* The fairlead mechanism shall accommodate a 30-degree angle minimum in all directions from the vertical axis of the hoist. The fairlead mechanism shall be able to withstand a combination of angles not less than 30 degrees in all directions and with loads up to the static limit load without detrimental or permanent deformation or damage to the hoist or to the cable, and until ultimate load without failure.

4.3	*Replace the section with the following:* The load shall be applied in any direction making the maximum angle with the vertical axis within the helicopter reference coordination system, but not less than 30° (60° cone). The most critical fleet angle in the most critical direction shall be taken into account for the static strength substantiation (Limit and Ultimate Load). Note: It may be necessary to substantiate greater angles than the hoist operational envelope, since the hoist might be installed at different angles on different airframes.
4.6	*Replace the section with the following:* The hoist shall have the capability of performing an emergency quick release of the attached load in all operating conditions. This QRS shall consist of a primary quick-release subsystem (PQRS) and a backup quick-release subsystem (BQRS). The intention of the PQRS is an intentional, instantaneous release of NHEC or HEC in a pre-set sequence by the QRS that is normally in an emergency to prevent a significant reduction in the safety margins for continued safe flight and landing of the rotorcraft. The following design features shall be considered: • The PQRS, BQRS and their load-release devices and subsystems (such as electronically actuated guillotines) shall be separated (e.g. physically, systematically, and functionally independent). • The controls for the PQRS shall be installed on the ETSO article at a location readily accessible to the hoist operator (e.g. the control pendant). Additionally, an independent means to control the PQRS shall be provided to the installer (for instance, to allow connection to a cockpit control). • The control means for the BQRS shall be described in the installation manual. They may be less sophisticated than those of the PQRS (e.g. manual cable cutters). • The PQRS shall release the external load in less than 5 seconds. The BQRS shall release the external load in less than 30 seconds. This time interval shall begin at the moment an emergency is declared and shall end when the load is released. During HEC operations, both the PQRS and BQRS are required to have a dual activation device (DAD) for external cargo release. The switch design shall be evaluated by ground test. Additional safety precautions (such as the use of a lock wire) should be considered for a remote hoist console in the cabin.
4.7	*Replace the section with the following:* The purpose of the overload protection is to protect the aircraft, its occupants and the person being hoisted. It provides to the crewmembers the possibility to either stabilise the aircraft or to safely activate the PQRS and release the external load in less than 5 seconds after the declared emergency (i.e. snagging of the cable/hook), as requested in AMC 27/29.865. The hoist shall be equipped with an overload protection capability, which needs to comply to the following requirements: • The overload protection system shall be capable of reliably withstanding the dynamic loads and the sustained overloads, as defined by the hoist manufacturer. It shall be designed to hold any static load coming from the cable up to the static limit load. • For dynamic overload events, the overload protection system may allow limited unspooling of the cable at lower loads, as long as the dynamic load holding capability does not fall below the maximum operational load with an adequate safety margin. An example for such dynamic load holding capability is the capability to absorb shock loads.

	• The load shall be arrested within a maximum of 10 m during a cable unspooling event. Limited unspooling of the cable for functions other than overload protection could be also accepted (e.g. for cargo vibration reduction). • The person(s) being hoisted shall also be reasonably protected against serious injury (see 5.1.9.1.2). • An overload activation tolerance band shall be defined taking into account e.g. production and maintenance tolerances, variations due to the environment (e.g. temperature and humidity), and operations (i.e. length of cable paid out). The above-mentioned load holding requirements shall be met in the entire activation tolerance band. • With regard to aging effects, all functional elements of the overload protection that are subject to aging effects leading to potential degradation of the overload protection shall be considered. The corresponding tests in 5.1.9. provide the means of compliance for sustained overload and dynamic loads including demonstration that the person(s) being hoisted is (are) reasonably protected in the complete hoist envelope.
4.8	*Delete the section.*
4.9	*Replace the section with the following:* The hoist shall meet environmental test procedures per DO-160. For the DO-160 environmental standard, refer to Section 3.1.2 of the main part of the ETSO standard for acceptable ED-14/DO-160 revisions. The hoist shall meet all performance data included in Chapters 3.3, 3.4 and 4.1-4.7 under the below-stated environmental conditions. The operator control pendant shall meet the applicable environmental requirements for outside environmental conditions.
4.9.21	*Replace the section with the following:* The hoist equipment (including pendants, controllers, cable, and interconnecting wires) shall meet the requirements per RTCA DO-160 Section 25, Category A. Routing of electrical wires to the hoist interface shall include protection against chaffing or damage due to vibration introduced by the aircraft.
4.9.23	*Replace the section with the following:* The intent of the endurance requirement is to validate the interval for time between overhaul (TBO) and total time (TT). This shall be accomplished by running a full TBO test, with margin, that simulates actual use in a heavy usage environment. (See Chapter 5.1.3)
4.9.24	*Delete the section.*
5.1.3 1st paragraph	*Replace the paragraph with the following:* The hoist manufacturer shall perform endurance testing and provide a formal test report. The test results from this testing may be used by the hoist manufacturer to define the overhaul period (TBO and TT).
5.1.3 3rd paragraph	*Replace the paragraph with the following:* The test cycle may be made up of a series of hoist cycles and in a random order to minimise test set-up.

5.1.3 4th paragraph	*Replace the paragraph with the following:* Testing for endurance (the ability of parts moving relative to each other to continue to perform their intended function) should be sufficient to show: • that the assumptions used in demonstrating compliance with the required safety level are correct, and • via a test that the equipment is free from design errors, specifically when there is the introduction of a new technology to reach a compliance demonstration for full life, either by a full TT test or by X% TT test supported by analysis. Testing for performance can be included in endurance testing which should demonstrate the rates and responses required for proper system operation.
5.1.3 Table 2	*Delete the table.*
5.1.4	*Delete the section.*
5.1.7	*Replace the section with the following:* The mis-wrap detector shall be validated through test, and can be supported by analysis or simulations.
5.1.8 before 1st paragraph	*Complete the section with the following before the paragraph:* Jettison demonstrations, with different loading conditions, using the QRS shall be conducted. These demonstrations may be accomplished during ground or flight tests.
5.1.9.1	*Replace the section with the following:* The following tests shall be performed.
5.1.9.1.1	*Replace the section with the following:* To show arresting capability after a sustained overload (e.g. entanglement / extreme manoeuvre), the hoist equipment including the overload protection device (OLPD) shall be able to arrest the cable in accordance with the following test. The OLPD activation point for the test shall be set at the most detrimental setting within the tolerance range. The test sequence should be as follows: 1. Continuous pull with a speed of more than 2 m/s for 5 seconds. The load for the continuous pull must be between operational loads and limit load for the hoist equipment. 2. Deceleration of the cable to zero cable speed within 5 seconds by: a. reducing the pulling tension through the test equipment. The tension must always be greater than or equal to the rated load; or b. increase of the cable tension through the hoist. The cable tension must always be below limit load. 3. Hold limit load for a minimum of 30 seconds. The test shall be repeated 5 times. The OLPD can be reset after each pull. After the completion of the test, the hoist equipment including the OLPD shall function normally.
5.1.9.1.2	*Replace the section with the following:* The hoist equipment including the OLPD shall be able to arrest the load with a limited height loss after a shock load event.

	The arresting capability shall be demonstrated by an instrumented drop test in accordance with the following criteria: • Rated load solid block • Free fall factor of 1 on 71 inches (180 cm) • Height loss <197 inches (500 cm) • maximum arresting force <1 798 lbf (8 kN) for each hoisted person • A transient peak of 12.5 kN or limit load, whichever one is less, for a maximum of 30 ms is acceptable. The above test shall be repeated for a 100-kg solid block. The above test must be repeated for a total of 5 times for each load level (rated load and 100 kg). The OLPD can be reset after each test. After each set of 5 tests the cable and OLPD can be replaced. The most detrimental setting within the OLPD activation tolerance band must be tested. The hoist must function normally (i.e. continues to lift at the rated load and speed) after completion of each set of 5 tests.
5.1.11	*Replace the section with the following:* Using a milliohm meter measure the bonding resistance between the hoist bonding location as indicated by the hoist manufacturer and the appropriate connector mounting block screw as indicated by the hoist manufacturer. Verify that the reading is compatible with the bonding requirements in Chapters 4.9.25 and 4.9.26.
5.2	*Complete the section with the following:* The cable shall sustain limit and ultimate load conditions. The test shall be performed at the hoist (with the OLPD locked) or a mock-up representing all influencing factors of the installation on the hoist. The load attachment end of the cable shall be able to swivel freely. The cable shall be tested at its most critical length and most critical fleet angle if this influences the static strength characteristics. The cable being tested shall conform to the minimum manufacturing quality as specified by the cable manufacturer. This includes all damage and manufacturing flaws which are not inspectable or are allowed to remain in the cable. In addition, all material strength reduction factors shall be taken into account.
5.2.1 Headline	*Replace the headline of the section with the following:* Minimum Breaking (Rupture) Strength Test
5.2.2 Headline	*Replace the headline of the section with the following:* Cable Endurance and Fatigue Testing
5.2.2 1st paragraph	*Replace the paragraph with the following:* Fatigue and endurance testing of the hoist cable shall be conducted in laboratory tests. These tests shall be conducted to determine the suitability of the rescue hoist cable compared to several worst-case fatigue scenarios.
5.2.2 2nd paragraph	*Replace the paragraph with the following:* The manufacturer shall determine each hoist's maximum cable usage (MCU) which is a number used to determine the maximum number of hoist cycles, or maximum number of cable extensions, a cable can undergo in field usage before requiring replacement in order to preclude cable fatigue considerations. The manufacturer shall also determine and publish all inspection criteria related to the as-designed cable in the maintenance manual, and this inspection criteria shall be used in the following fatigue testing.

5.2.2 3rd paragraph	*Replace the paragraph with the following:* Cable fatigue testing shall be conducted in five separate sub-tests. Each test, considered an individual worst-case scenario, shall be performed using a new cable.
5.2.2 end of chapter	*Complete the section with the following:* 5.2.2.1 and 5.2.2.2 are acceptable as a fatigue test if it can be shown that cable bending and tension fatigue are independent and do not reduce the cable life if applied simultaneously.
5.2.2.1 1st paragraph	*Replace the paragraph with the following:* A cyclic bending fatigue test shall be performed. The test configuration must be representative of the specific hoist design configuration (including diameter of sheaves and number of sheaves, the pressure of the crowder, and the internal routing of the cable such as number of bendings and reverse bendings) planned for certification.
5.2.2.1 Figure 1	*Delete the figure.*
5.2.2.1 2nd to 4th paragraph	*Delete the paragraphs.*
5.2.2.1 5th paragraph	*Replace the paragraph with the following:* The total travel of the wire rope in one direction shall ensure that the test portion of the cable runs through the entire hoist configuration from the storage drum to the cable output. The application of lubricant to the fatigue test sample in addition to the lubricant applied during manufacture of the cable shall not be permitted.
5.2.2.1 6th paragraph	*Delete the paragraph.*
5.2.2.1 7th paragraph	*Replace the paragraph with the following:* Following the fatigue testing described above, the test sample shall be inspected for damage and tested for minimum breaking strength. The minimum breaking strength shall be greater than the hoist’s ultimate load (5.25 times the rated load).
5.2.2.2 1st paragraph	*Replace the paragraph with the following:* A cable sample including damages and flaws that can be encountered during manufacturing or in service shall be prepared with two end fittings identical to the cable assembly design requirements of the hook end and subjected to fluctuating cable loads between 1 to 2 g times the rated load in accordance with DIN EN14311-8 Section 5.2.2.3. The cable shall be tested for 75 000 test cycles (150 000 reversals) with one end of the cable attached to a free swivel.
5.2.2.2 2nd paragraph	*Replace the paragraph with the following:* Following the fatigue testing described above, the test sample shall be inspected for damage and tested for minimum breaking strength. The minimum breaking strength shall be greater than the hoist’s ultimate load (5.25 times the rated load).
5.2.2.3 headline	*Replace the headline of the section with the following:* Unloaded Endurance Testing within Hoist
5.2.2.4 headline	*Replace the headline of the section with the following:* Loaded Endurance Testing within Hoist

5.2.4	*Replace the paragraph with the following:* Cable robustness testing is intended to demonstrate the hoist load bearing wire rope (cable) robustness or resistance to catastrophic failure after unintended and incidental contact with ground objects and rotorcraft structure. The cable may sustain damage necessitating post-mission replacement but shall have residual structural integrity to safely complete the lift where the contact occurred, or safely return the HEC to the ground. The hoist manufacturer must test, and provide test results, for the scenarios identified below.
5.2.4.1 4th sentence	*Replace the sentence with the following:* The hoist cable may become damaged in such incident where the damage will be readily observable to the hoist operator or at post-flight inspection; however, the cable shall be of such construction as to provide robustness that it will not fail under load during the immediate rescue lift.
5.2.4.1.1	*Replace the section with the following:* The static cable (i.e. not reeling in or out) shall suspend the rated load. The cable shall be dragged over the A36 or equivalent standard steel plate edge for a total distance reasonably expected to occur in service with a load hanging freely on the hoist (note: multiple strokes may be used). The plate surface roughness and edge diameter should represent a severe scenario expected to be found in a ship construction. The angle between the vertical axis of the hoist and the cable should be at a minimum 30°. The force required to drag the cable shall be applied at least 1 foot (30 cm) higher than the edge. After exposure, damage is acceptable, if the cable damage is reliably detectable within a few hoist cycles, but the cable shall be able to support limit load without failure. The test shall be repeated with a load corresponding to the OLPD activation point to simulate an entanglement. The distance the cable slides along the steel plate shall reflect a distance which can be reasonably expected in such an event.
5.2.4.1.2	*Replace the section with the following:* The cable shall suspend a rated load below a A36 or equivalent standard steel plate edge. The plate surface roughness and edge diameter should represent a severe scenario expected to be found in a ship construction. The angle between the vertical axis and the cable should be at a minimum 30°. The cable shall be reeled in until achieving maximum speed (minimum cable reel-in length is 1.5 m) and then reeled out three times. After exposure, damage is acceptable, if the cable damage is reliably detectable within a few hoist cycles, but the cable shall be able to support limit load without failure.
5.2.4.2.1 Last sentence	*Replace the sentence with the following:* After testing the cable shall be demonstrated to support at least limit load without failure if cable damage is reliably detectable within a few hoist cycles. If no cable damage is detectable by operations or ramp maintenance personnel within a few hoist cycles, the cable shall be demonstrated to support ultimate load for at least 3 seconds without failure.

Table 2 — Additional definitions

Term	Definition
Backup quick-release subsystem (BQRS):	The secondary or 'second choice' subsystem used to perform a normal or emergency jettison of external cargo.
Cable	The means to lower and raise the external load. The cable can be made of metallic and/or other materials.
Dual actuation device (DAD):	This is a sequential control that requires two distinct successive actions (e.g. thumb movements) to be completed for actuation. Examples of a DAD are the removal of a lock pin or opening of a guarded cover followed by the activation of a 'then free' switch for load release to occur or opening of a cover and activate an additional guarded switch with a distinguished separate thumb movement. In this scenario, a simple covered switch does not qualify as a DAD. Familiarity with covered switches allows the operator to both open the cover and activate the switch in one motion. This has led to inadvertent load release. Cover = a means to mask or cover a switch that can be either moved up or to the side (sometimes called a 'flip-guard') Guard = fix activation protection around/for a switch or cover like a small wall, recess, lock pin or lock wire Switch = lever or push button
Dynamic Load	A dynamic load is a load which occurs in a rapid manner, such as shock loads or vibration.
Emergency jettison (or complete load release)	The intentional, instantaneous release of NHEC or HEC in a pre-set sequence by the quick-release system (QRS) that is normally performed in an emergency to prevent a significant reduction in the safety margins for continued safe flight and landing of the rotorcraft
Moving surface	A surface that is not fixed, such as heaving ships or water surface
Personnel-carrying device system (PCDS)	Is a device that has the structural capability and features needed to safely transport occupants external to the helicopter during HEC operations. A PCDS includes but is not limited to life safety harnesses (including, if applicable, a quick-release and strop with a connector ring), rigid baskets and cages that are either attached to a hoist or cargo hook or mounted to the rotorcraft airframe.
Primary quick-release subsystem (PQRS):	The primary or 'first choice' subsystem used to perform a normal or emergency jettison of external cargo.
Quick-release system (QRS):	The entire release system for jettisonable external cargo (i.e. the sum total of both the primary and backup quick-release

	subsystem). The QRS consists of all the components including the controls, the release devices, and everything in between.
Serious injury	According to Annex 13 to the Convention on International Civil Aviation: Aircraft Accident and Incident Investigation. Ninth Edition - July 2001. Chapter 1 - Definitions: *Serious injury. An injury which is sustained by a person in an accident and which:* *a) requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received; or* *b) results in a fracture of any bone (except simple fractures of fingers, toes, nose); or* *c) involves lacerations which cause severe hemorrhage, nerve, muscle or tendon damage; or* *d) involves injury to any internal organ; or* *e) involves second- or third-degree burns, or any burns affecting more than 5 per cent of the body surface; or* *f) involves verified exposure to infectious substances or injurious radiation.*
Stowage position	This is typically the hoist and/or cable position used when hoisting operations are not being performed.

Table 3 — Additional list of acronyms

Acronyms	Definition
AC	Advisory Circular (FAA)
AMC	acceptable means of compliance (EASA)
BQRS	Backup quick-release subsystem
CG	centre of gravity
CMR	certification maintenance requirements
CS	certification specification
DAL	design assurance level
ETSO	European Technical Standard Order
FMECA	Failure Modes Effects and Criticality Analysis
HEC	human external cargo
ICS	integrated communication system
kN	kilo Newton

4. Impact assessment (IA)

4.1. What is the issue

A description of the issue can be found in Section 2.1.

4.1.1. Safety risk assessment

EASA has collected worldwide data on occurrences related to rotorcraft hoisting operations. Only the occurrences that could be addressed by design improvements of the hoist system have been retained for inclusion in this assessment. Some of these design improvements could be addressed through the standard 'AS6342 - Minimum Operation Performance Standard for Rotorcraft Hoist' that has been published by the SAE International G-26 working group. Hoisting incidents or accidents that were caused by the fall of a rock or tree due to rotor downwash or impact of the aircraft with obstacles following loss of tail rotor effectiveness have been excluded from this safety assessment.

A number of these occurrences have only been reported through mandatory or voluntary reporting systems such as the European Co-ordination Centre for Accident and Incident Reporting Systems (ECCAIRS) and thus details on the occurrences cannot be provided to third parties (see here). EASA has, however, the duty to consider all of the occurrences that have been reported when performing a safety assessment. The full dataset has been provided to interested aviation authorities for which a Bilateral Aviation Safety Agreement exists with EASA. Please note that for the US, Civil Aircraft Operations are the only operations conducted in accordance with all FAA regulations (Reference AC 00-1.1A dated 2/12/14, Public Aircraft Operations).

The dataset consists of more than **250** occurrences, spanning from 25 February 1955 to the date of issuance of this NPA and does not claim to be exhaustive. Instances of fatalities and serious injuries, as defined in Regulation (EU) No 996/2010, have been included when known. A summary of the occurrences can be found below in Table 1:

Table 1: Summary of worldwide occurrences involving a rotorcraft hoists

Description	Instances	Instances in the 25-year period (1994–2018)
Loss of aircraft	8	4
Fatal accidents	47	39
Fatalities	73	62
Serious injuries	56	43

The frequency of serious injuries and fatalities since 1980 are plotted in the following graph:

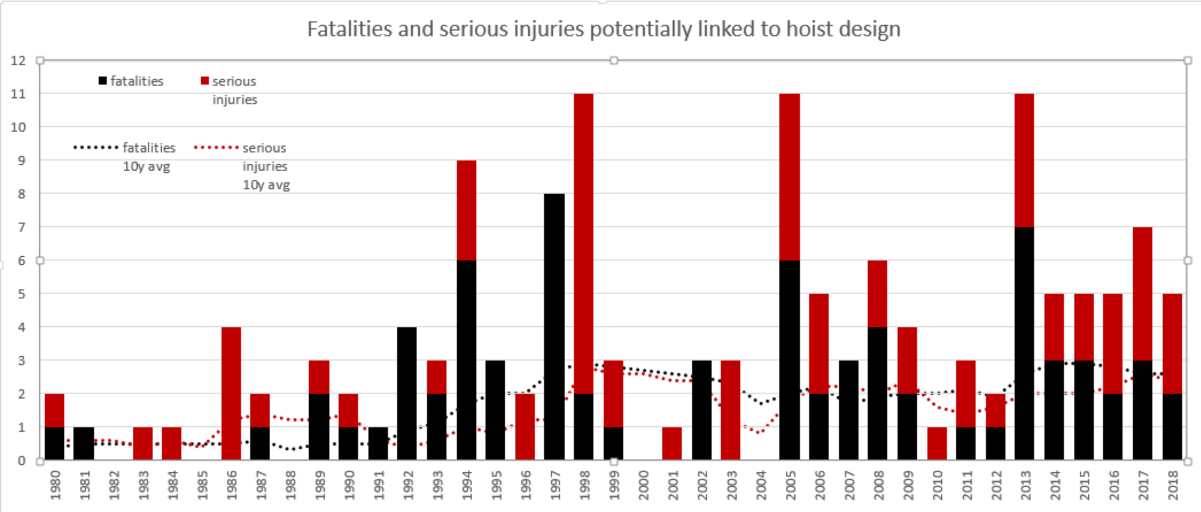

Figure 1: Frequency of worldwide serious injuries and fatalities for the period 1980-2018

A summary of the rate of occurrences has been plotted below in Figure 2 for a 5-year running average:

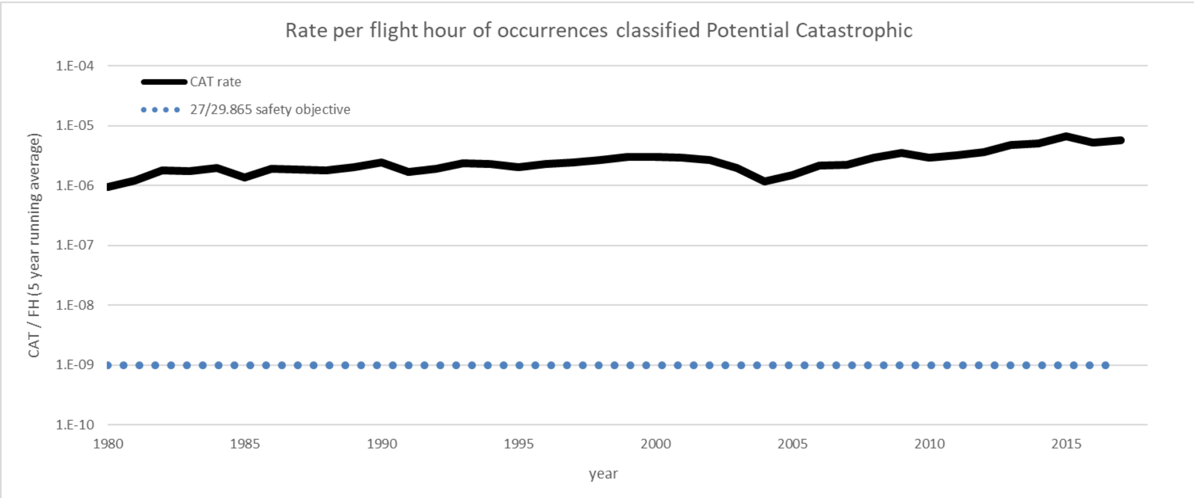

Figure 2: 5-year average rate of worldwide occurrences per FH for the period 1980–2018

A summary of the rate of occurrences has been plotted below in Figure 3 for a 10-year running average:

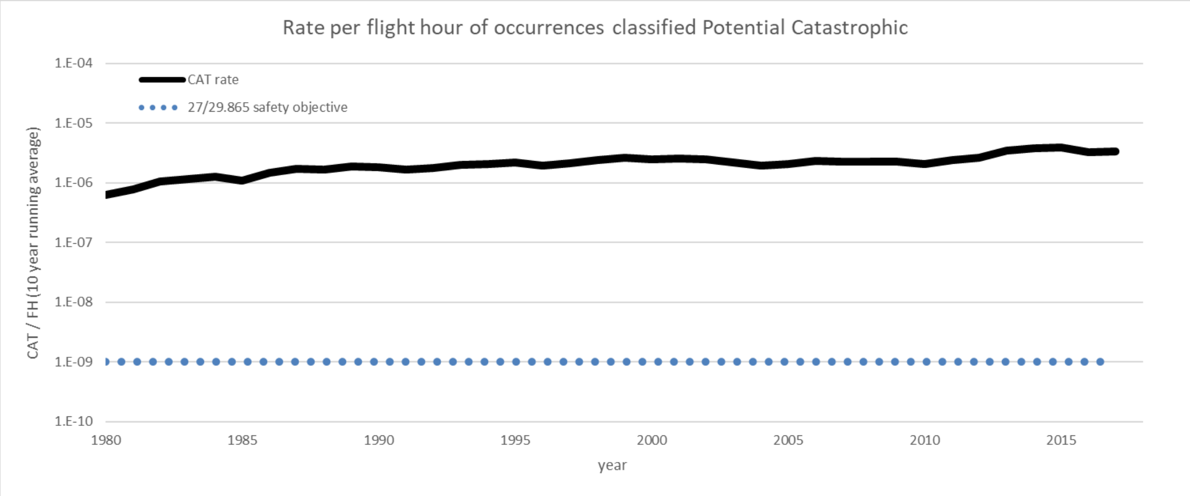

Figure 3: 10-year average rate of worldwide occurrences per FH for the period 1980–2018

From this dataset, the following averages can be extracted:

Last 25 years	2.48	fatalities per year
Last 10 years	2.50	fatalities per year
Last 5 years	3.00	fatalities per year

The narratives of the occurrences were reviewed to identify the causes and causal factors and a few examples are listed in Table 2 below:

Table 2: Summary of the causes and causal factors of occurrences that were reviewed

Entanglement	Cable rupture	PCDS[5]	Rebound
Hook detached	Dynamic rollout	Electrostatic discharge	Unintentional cable cut
Uncommanded cable cut	Cable mis-wrap	Cable detached from drum	Cable damage after contact with airframe
Controller failure	Pendant failure	Cockpit switches failure	Electrical failure/fire
Clutch failure	Fairing departs	Motor failure	Structural failure

[5] Personnel carrying device system.

The five most common factors that were identified are presented below in Figures 4 and 5:

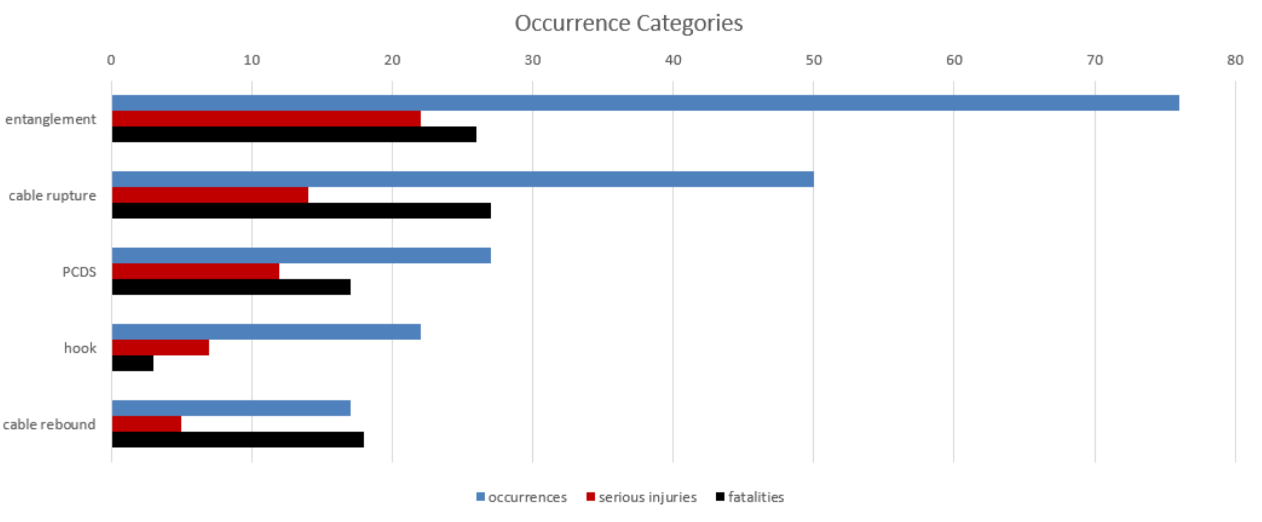

Figure 4: Most common factors that are only incidental to the serious injuries and fatalities shown (1980–2018)

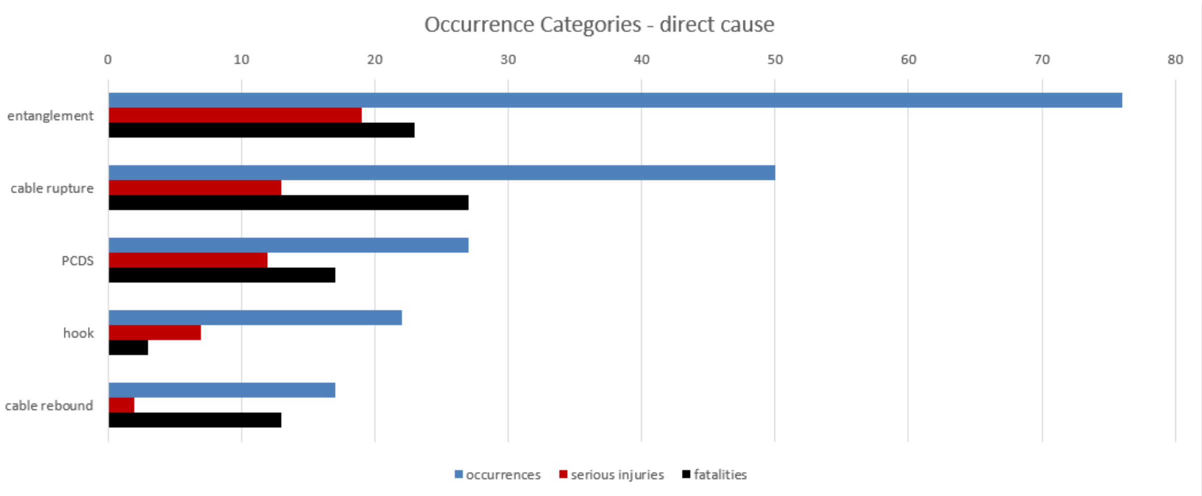

Figure 5: Most common factors that were a direct cause of the serious injuries and fatalities shown (1980–2018)

In some cases, more than one cause has been identified in a given occurrence; for example, cable rupture often follows an entanglement. PCDS appears in the third place on the list but as this aspect has already been the topic of dedicated EASA action (refer to Certification Memorandum CM-CS-005, issued on 8 December 2014, 'Rotorcraft External Loads Personnel Carrying Device System') it will not be further addressed. The following sections will focus on the three remaining most common occurrences.

4.1.1.1 Entanglement

Entanglement is the most common factor in the dataset of occurrences that was assessed, with a total of **61** instances. This stems from the very nature of the use of a rotorcraft hoist, to place and retrieve people and equipment from a confined, obstructed or moving area where a rotorcraft could not land. Remarks in the narratives from the accident investigation bodies support this position and include the following extracts:

— It highlights the ‘snagging’ dangers inherent with hoisting;

— Procedures and techniques are in place to minimise the problem but the nature of the job means that this sort of incident cannot be totally eradicated;

— This occurrence happened during a night search and rescue operation to recover a person from a fishing vessel and might be considered a normal risk of Search and Rescue (SAR);

— The winch cable wire came into contact with an unseen metal stay that was impossible to see from the air.

It has been previously argued that entanglements could be prevented with increased training and experience. The assessment of the occurrences, however, shows that entanglements also occur with the most experienced operators who dedicate significant resources to training such as the US Coast Guards, the US Army, US National Guards, the Royal Air Force, the Royal Canadian Air Force, the Gendarmerie, CHC, Bond, Bristow, Eliliguria, Rega, the German Bergwacht, etc.

An argument has also been made that the installation of a quick release system (QRS) is sufficient to prevent overload following an entanglement. The QRS is foreseen by the Certification Specifications for a different purpose, namely the means to jettison the external cargo with a ‘trajectory clear of the rotorcraft’. It could, however, allow in some limited cases to prevent an overload following entanglement, but only when the entanglement is recognised in time by the hoist operator or pilot and the entanglement point is static with respect to the rotorcraft. The assessment of the occurrences indicates that in a large number of occurrences this is not the case. Figure 6 below shows instances where the pilot(s) and operator did not recognise the entanglement in time and where the overload following entanglement was sufficient to result in a cable rupture:

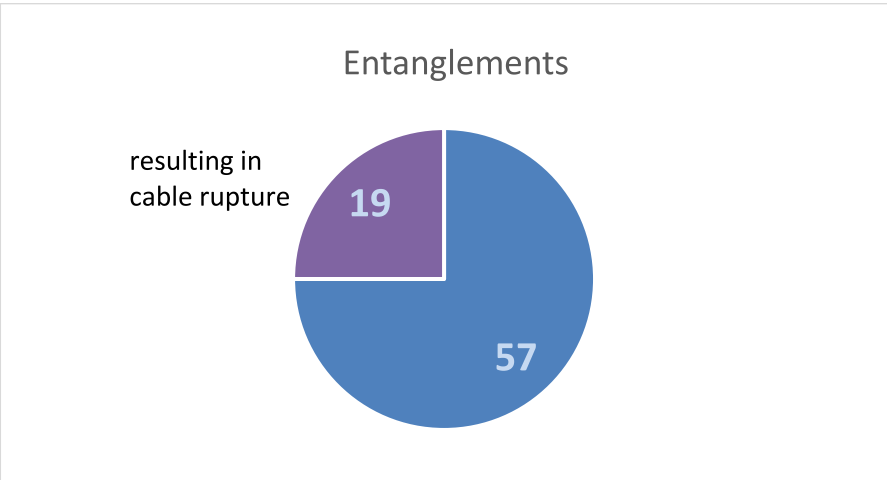

Figure 6: Graph showing the number of entanglements that resulted in cable rupture (1980–2018)

Dynamic situations make it especially difficult for the pilot or hoist operator to cut the cable in time due to the fact that, as per the Certification Specifications, the primary QRS may take up to 5 seconds to activate, the backup QRS up to 30 seconds. The following extracts from narratives contained in the reports confirm the issue:

— Both pilots indicated that they could not activate the emergency jettison as they were fully engaged in trying to fly the aircraft;

— Both the crew and a witness on the ship estimated that the elapsed time between the cable attaching to the rail and the aircraft hitting the sea was approximately 3-4 seconds;

— Neither of the crew had time to operate the emergency cable cutter before the aircraft hit the sea;

— Approximately 3 to 5 seconds passed between the cable snagging and the MA [Mishap Aircraft] impacting the terrain.

Below in Figure 7 is a graph of annual entanglement occurrences over time:

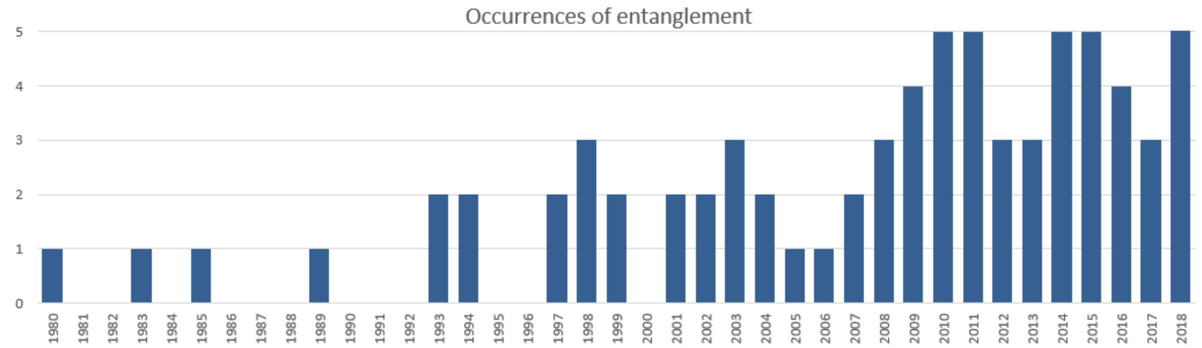

Figure 7: Number of entanglements per year for the period 1980–2018

4.1.1.2 Cable rupture

Hoist cables have a specific minimum breaking strength, typically 3 300 lb (1 500 kg) as per the MIL-DTL-83140 specification. Entanglements can clearly lead to exceeding the cable breaking strength and statistics in the assessment have shown that a number of cable ruptures follow an entanglement. Other events however can lead to exceeding the cable breaking strength, for example shock load of the cable from a fall. The dataset includes **15** instances of such falls, from the cabin, steps, skids, moving decks and from ledges.

In some of the occurrences that were reviewed in the dataset, the cable ruptured under loads greater than its breaking strength. By its very nature an entanglement, however, rarely occurs on a perfectly smooth surface of large radius. The cable when bent or contacting sharp edges will rupture below its theoretical breaking strength.

Below in Figure 8 is a graph of annual cable rupture occurrences over time:

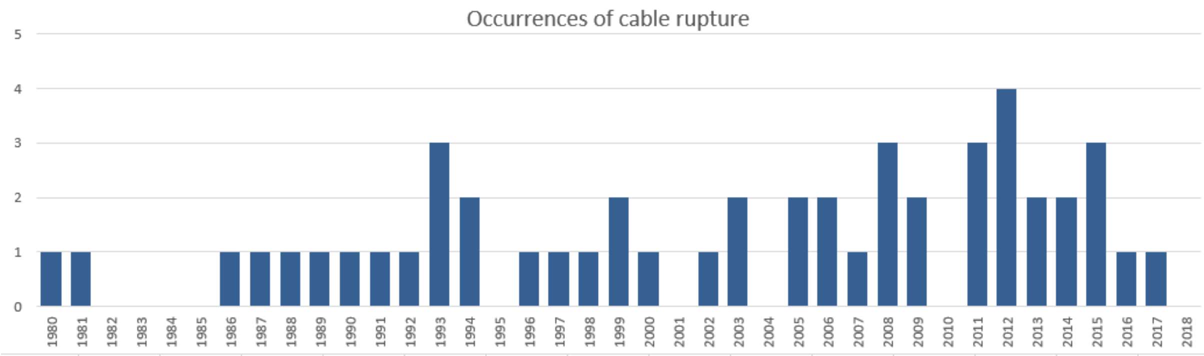

Figure 8: Number of cable ruptures per year for the period 1980–2018

4.1.1.3 Cable rebound

Rebound can occur during any sudden unloading of the cable, for example after failure of the hook or PCDS, but in most cases, it follows cable failure.

In the cases considered, the presence of an overload protection is not mentioned but this could have prevented a cable rupture and rebound particularly if the cable was entangled on a ship where the ship is pitching and heaving due to sea conditions. However, the review of other examples of cable rebound showed that they could not have been addressed through the overload protection. In some instances, it was shown that even with a functioning overload protection, the cable can rebound and strike the main and tail rotor.

Below in Figure 9 is a graph of annual cable rebound occurrences over time:

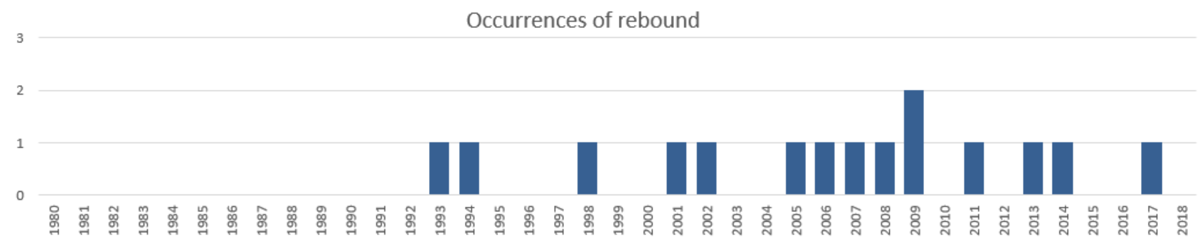

Figure 9: Number of rebounds per year for the period 1980–2018

4.1.1.4 Summary

Hoist operations are growing and the number of accidents, on average 3 fatalities per year over the past 5 years, can be expected to grow in the same magnitude. The above safety review highlights some of the key factors in hoist accidents and incidents that could be addressed by design and can guide the development of new standards such as SAE AS6342.

It should be emphasised that for each hoist installation certification, the presentation of a safety assessment of the proposed particular system is the responsibility of the applicant. CS 27/29.865 and the corresponding AMC and guidance material requests to consider all **potential** failure modes, regardless of in-service experience. Additionally, a specific quantitative objective is included in the AMC to CS 27/29.865 contained in FAA Advisory Circulars AC 27-1B and AC 29-2C:

'The failure of the external load system, including the PCDS where applicable, and its attachments to the rotorcraft should be shown to be extremely improbable (i.e., 1 x 10^{-9} failures per flight) for all failure modes that could cause a catastrophic failure, serious injury, or fatality anywhere in the total airborne system.'

As the number of hoist flights is unlikely to have reached a billion, **1** in-service failure signifies that the safety objective requested by the rule has not been met.

4.1.2. Who is affected

The following stakeholders are affected by the proposed regulatory change:

— Rotorcraft operators that conduct hoist operations (HEC and NHEC);

— Rotorcraft hoist manufacturers;

— Rotorcraft manufacturers;

— Onboard rotorcraft hoist operators and hoist users.

The current worldwide fleet of hoist equipped rotorcraft (civil and military) is estimated to be 6 000.

4.1.3. How could the issue/problem evolve

The use of rotorcraft hoists is a type of operation that is rapidly developing in Europe and the world particularly for offshore renewable energy and helicopter emergency medical services (HEMS). The following goal was included in Flightpath 2050, Europe's Vision for Aviation[6]:

'For specific operations, such as search and rescue, the aim is to reduce the number of accidents by 80% compared to 2000 taking into account increasing traffic.'

Rotorcraft hoisting operations provide a unique service to European citizens, with often no alternative available, and confidence in the safe operation should be ensured. Associated risks, hazards and failures include among others: entanglement, cable rupture, cable rebound, hook detaching, dynamic rollout, electrostatic discharge, unintentional and uncommanded cable cuts.

If no improvements are made to the design of hoists and cargo hooks and their associated systems, then the current 5-year rolling average of 3.00 fatalities per year will not change and may increase with the increased usage of rotorcraft hoists as foreseen above.

4.2. What we want to achieve — objectives

General objectives

— Reduce the number of rotorcraft accidents and incidents caused by rotorcraft hoists;

— Reduce the number of fatalities and serious injuries related to rotorcraft hoisting operations;

— Reduce the number of fatalities and serious injuries related to the transportation loads by rotorcraft.

[6] http://ec.europa.eu/transport/sites/transport/files/modes/air/doc/flightpath2050.pdf

Specific objectives

— Reduce the likelihood of a rotorcraft accident or incident caused by the entanglement of a hoist cable or external load;

— Reduce the likelihood of a rotorcraft accident or incident caused by a rupture of the hoist cable;

— Reduce the likelihood of a rotorcraft accident or incident caused by a rebound of the hoist cable;

— Reduce the likelihood of a rotorcraft accident or incident caused by unintended reel out of hoist cable due to malfunction of the overload protection system.

4.3. How it could be achieved — options

EASA considered several options to achieve the objectives in Section 4.2 but due to the fact that the primary causes of the safety issues that have been identified are technical in nature, improvements in training or safety awareness would not achieve the potential improvements in safety because they would not eliminate some failure modes.

Table 3: Selected policy options

Option No	Short title	Description
0	No change	**No policy change** (no change to the rules) Risks remain as outlined in the issue analysis. This option would continue the current situation and would not reduce the number of rotorcraft accidents caused by the design or reliability of the hoist. Due to the fact that the design of hoists has not fundamentally changed in 40 years, it is not foreseen that hoist manufacturers would be compelled to voluntarily redesign their hoists.
1	Introduction of specific rotorcraft hoist standards	Introduction of specific rotorcraft hoist standards This option would implement improvements to the current designs of rotorcraft hoists and would reduce the likelihood of some of the most significant failure modes which are not considered in current designs. This could be achieved through the development of a European Technical Standard Order (ETSO).

Options not considered further

Focused safety promotion

Safety promotion to improve rotorcraft operator's awareness of the hazards associated with operations that utilise hoist is already under way.

Focussed oversight of existing designs

EASA has already initiated continued airworthiness actions to address potential shortfalls in the reliability of current rotorcraft hoists. This has resulted in maintenance penalties in the reduction of the time between overall and also a reduction in the permitted service life of current rotorcraft hoists. Additional restrictions that are more stringent were not considered to be necessary and would not eliminate some of the failure mechanisms that have been identified.

4.4. Methodology and data

4.4.1. Methodology

The methodology applied for this impact assessment is the multi-criteria analysis (MCA), which allows all the options to be compared by scoring them against a set of criteria.

The MCA covers a wide range of techniques and combines a range of positive and negative impacts into a single framework to allow scenarios to more easily be compared. Essentially, it applies a cost–benefit assessment (CBA) to cases where there is a need to present multiple impacts that represent a mixture of qualitative, quantitative and monetary data, and where there are varying degrees of certainty. The key steps of an MCA generally include:

— establishing the criteria to be used to compare the options (these criteria must be measurable, or at least comparable in qualitative terms); and

— scoring how well each option meets the criteria; the scoring needs to be relative to the baseline scenario.

The criteria used to compare the options were derived from the Basic Regulation, and the guidelines for the impact assessment were developed by the European Commission. The principal objective of EASA is to 'establish and maintain a high uniform level of safety' (as per Article 2(1) of the Basic Regulation). As additional objectives, the Basic Regulation identifies environmental, economic, proportionality and harmonisation aspects, which are reflected below.

The scoring of the impacts uses a scale of –10 to +10 to indicate the negative and positive impacts of each option (i.e. from 'very low' to 'very high' negative/positive impacts). Intermediate levels of benefit are termed 'low', 'medium', and 'high', with also a 'no impact' score possible.

4.4.2. Data collection

For the dataset of occurrences and accidents for the safety assessment, this data has been sourced from available accident data and some has been reported through mandatory or voluntary reporting systems such as the ECCAIRS. This is better explained in the safety assessment Section 4.1.1.

4.5. What are the impacts

The various impacts of the options that have been identified have been considered below.

4.5.1. Safety impact

4.5.1.1 Option 0: No change

The 'no change' option would result in no improvement in the number of annual fatalities (3.00 fatalities per year (last 5 years) and loss of aircraft. The current rate of failures that result in fatalities is not compliant with the required probability of extremely improbable (i.e., 1×10^{-9} failures per FH) for failures that result in catastrophic outcomes. Even with the Airworthiness Directive (AD) (2015-0226R5) in place, the failure modes that could lead to the occurrences mentioned in Section 4.1.1 would not be mitigated if no changes in rotorcraft hoists standards are introduced.

4.5.1.2 Option 1: Introduction of specific rotorcraft hoist standards

The intent of this option is to mitigate through improved design the catastrophic occurrences that have been shown to occur in service on the existing hoist models. The safety assessment in Section 4.1.1 clearly shows that there are accidents and occurrences which could have been prevented by improvements in the design of rotorcraft hoists.

This has been achieved in the draft ETSO (see Chapter 3) by mandating additional design features and better qualification of the hoist. These improvements include: the provision of an OLPD; introducing system redundancies; providing an indication and recording of established limits; better cable and hoist testing; higher system reliability; and improved structural behaviour of both the cable and the hoist. The ETSO standard defines a clear perimeter of the hoist equipment and its interfaces, with technical requirements in line with expectations when installed in a CS-27/CS-29 type-certified rotorcraft.

It is expected that improvements in the design of rotorcraft hoists will significantly lower the number of annual fatalities (3.00 fatalities per year (last 5 years) and loss of aircraft. The level of safety improvement will increase over time as and when existing hoists are replaced by hoists with the design improvements.

Criterion	*Option 0: No change*	*Option 1: Introduction of specific rotorcraft hoist standards*
Safety impact	No safety improvement and no mitigation of the safety issues identified for rotorcraft hoists 0	Reduction in the number of occurrences and fatalities caused by rotorcraft hoists +6 (medium)

4.5.2. Environmental impact

No environmental impact has been identified with any of the options that are proposed.

4.5.3. Social impact

The social impact of the different options has been considered and summarised below:

4.5.3.1 Option 0: No change

The primary social impact of this option is the continued working conditions of personnel involved in hoisting operations. Personnel that conduct hoist operations are directly employed for this purpose (emergency workers, harbour pilots, etc.) and they have no direct control over the type of hoist or rotorcraft that is used by their employer. These personnel are put at risk when safety improvements to the equipment that they use are available but not implemented.

4.5.3.2 Option 1: Introduction of specific rotorcraft hoist standards

This option would greatly improve the safety of employees that are required to use hoist as part of their daily tasks. These personnel are the main source of fatalities during fatal accidents involving rotorcraft hoisting.

Criterion	*Option 0: No change*	*Option 1: Introduction of specific rotorcraft hoist standards*
Social impact	No change to the working conditions of personnel involved in hoisting operations. 0	Reduction in the risk of employees conducting rotorcraft hoist operations. +4 (low positive)

4.5.4. Economic impact

The economic impact of the different options must take into account a number of different factors, and the economic impacts are different for the various stakeholders. These factors will be considered below.

4.5.4.1 Option 0: No change

To address issues with the current designs of existing rotorcraft hoists, EASA has issued AD 2015-0226R5 to limit the TBO of existing hoists to 36 months. The cost of an overhaul of each rotorcraft hoist is in the order of €70K. The purchase price of a new hoist is in the order of €100K.

The AD has effectively reduced the TBO from a period of 10 years to 36 months. This means that the hoist has to be overhauled at least an additional 2 times compared to the original TBO at a cost of €70K for each overhaul.

Rotorcraft operators that use hoists for their operations have to bear the additional costs of the overhaul for the current hoists designs due to the reduced TBO. If no changes are introduced to the standards for hoists or the Certification Specifications, then this situation will continue as no alternative improved designs would be available for operators.

4.5.4.2 Option 1: Introduction of specific rotorcraft hoist standards

Historically, rotorcraft hoists have been certified as part of the overall rotorcraft design. This has resulted in the current situation where alternative hoists are not available to rotorcraft operators and a single hoist manufacturer has the predominant share of the rotorcraft hoist market across the majority of types.

The development and introduction of acceptable standards for rotorcraft hoists would enable the hoist to be treated as a ‘part’ in the context of Part 21. This would enable other manufacturers to enter the hoist market and design and then certify their improved hoist designs.

Rotorcraft hoists that are compliant with the improved standards would not be subject to the TBO restrictions that are applied to the current rotorcraft hoists.

EASA has confirmed that there would be no increase in the costs of designing a hoist to comply with the proposed improved hoist standards.

The improved rotorcraft hoist standards have been developed in such a way that new improved rotorcraft hoist designs could be retrospectively compatible with the interfaces of existing rotorcraft hoists (i.e. electrical, hydraulic, structure). Therefore, there are not expected to be any significant integration costs of exchanging an existing design hoist for an improved design hoist.

The economic impact of Option 1 can be summarised according to the stakeholders:

Existing rotorcraft hoist manufacturers:

— In order to comply with any new standard, existing rotorcraft hoist manufacturers would have to design a new hoist. The existing hoist designs have not fundamentally changed for the last 40 years.

— Redesigning or modifying an existing hoist is not considered to be viable as the degree of changes that are required would be too extensive.

— Existing rotorcraft hoist manufacturers would have the cost of developing and certifying a new hoist design. This is considered to be in the order of €1M. This would only affect the main rotorcraft hoist manufacturer that has the majority share of the current hoist market. The current situation of the restrictions on the TBO of existing hoists would most likely drive existing manufacturers to redesign their hoists regardless.

New manufacturers of rotorcraft hoists:

— By providing acceptable standards for rotorcraft hoists, EASA would enable new manufacturers to enter the market.

— The development and certification costs of a new rotorcraft hoist that complies with the new standard would not be higher for new manufacturers than the current costs of certifying the hoist as part of rotorcraft design. Therefore, the costs to new manufacturers would be neutral.

Rotorcraft operators with hoists:

— Rotorcraft operators currently have the additional cost of overhauling their hoists every 36 months.

— The purchase costs of a new hoist that complies with the new standards are expected to be the same as for existing hoists. It is expected that with increased competition in the market the purchase costs of a new rotorcraft hoist may be lower in the future if new standards are introduced.

— There would be a financial incentive for rotorcraft operators to purchase a new rotorcraft hoist to avoid the cost burden of periodically overhauling their hoists. This would reduce the overall costs for the operator whilst also improving safety.

Criterion	***Option 0: No change***	***Option 1: Introduction of specific rotorcraft hoist standards***
Economic impact	No additional financial costs to design new compliant rotorcraft hoists but continued operating costs of reduced overhaul period for existing hoists. 0	Increased costs for existing rotorcraft hoist manufacturers to design new hoists. No additional costs for new manufacturers. Reduced operating costs due to increased overhaul period. +2 (very low positive)

1. Question to stakeholders on the economic impacts

Stakeholders are invited to provide quantified justification elements on the possible economic impacts of the options proposed, or alternatively propose another justified solution(s) to the issue.

4.5.5. General Aviation and proportionality issues

No proportionality or General Aviation issues have been identified with any of the options that are proposed.

4.6. Conclusion

4.6.1. Comparison of the options

Table 4: Comparison of options

Criterion	*Option 0 — No Change*	*Option 1 — Introduction of specific rotorcraft hoist standards*
Safety impact	No safety improvement and no mitigation of the safety issues identified for rotorcraft hoists 0	Reduction in the number of occurrences and fatalities caused by rotorcraft hoists +6
Social impact	No change to the working conditions of personnel involved in hoisting operations. 0	Reduction in the risk of employees conducting rotorcraft hoist operations. +4
Economic impact	No additional financial costs to design new compliant rotorcraft hoists but continued operating costs of reduced overhaul period for existing hoists. 0	Increased costs for existing rotorcraft hoist manufacturers to design new hoists. No additional costs for new manufacturers. Reduced operating costs due to increased overhaul period. +2
Total	**0**	**+12**

Based upon a relative assessment of the options and the associated impacts, Option 1 would be the most advantagous option and achieve the objectives of this RMT. On the contrary, Option 0 would maintain the current situation and would not provide any safety benefits or improve the rate of occurrences and the number of fatalities.

It is considered that the small increase in costs associated with Option 1 are suitably offset by the improvements in safety, therefore Option 1 has been selected.

2. Question to stakeholders

Stakeholders are also invited to provide any other quantitative information they may find necessary to bring to the attention of EASA.

As a result, the relevant parts of the IA might need to be adjusted on a case-by-case basis.

4.7. Monitoring and evaluation

The effectiveness of the proposed amendments to CS-ETSO to include dedicated specifications for rotorcraft hoists will be evaluated as part of the standard process of monitoring the occurrences reported to EASA. As the improvements in the design rotorcraft hoists certified in accordance with the new specifications are expected to reduce or eliminate some of the failure causes, it is expected that the number of occurrences involving rotorcraft hoists will be reduced.

5. Proposed actions to support implementation

EASA is considering organising an information session after the publication of the decision amending CS-ETSO related to this RMT. The objective of this event would be to present the new specifications for rotorcraft hoists, and to provide clear guidance and best practices on how to implement them in future certification projects.

6. References

6.1. Affected decisions

— Executive Director Decision 2003/10/RM of 24 October 2003 on certification specifications, including airworthiness codes and acceptable means of compliance, for European Technical Standard Orders (« CS-ETSO »)

7. Quality of the NPA

To continuously improve the quality of its documents, EASA welcomes your feedback on the quality of this NPA with regard to the following aspects:

7.1. The regulatory proposal is of technically good/high quality

[Please choose one of the options below and place it as a comment in CRT; if you disagree or strongly disagree, please provide a brief justification.]
Fully agree / Agree / Neutral / Disagree / Strongly disagree

7.2. The text is clear, readable and understandable

[Please choose one of the options below and place it as a comment in CRT; if you disagree or strongly disagree, please provide a brief justification.]
Fully agree / Agree / Neutral / Disagree / Strongly disagree

7.3. The regulatory proposal is well substantiated

[Please choose one of the options below and place it as a comment in CRT; if you disagree or strongly disagree, please provide a brief justification.]
Fully agree / Agree / Neutral / Disagree / Strongly disagree

7.4. The regulatory proposal is fit for purpose (capable of achieving the objectives set)

[Please choose one of the options below and place it as a comment in CRT; if you disagree or strongly disagree, please provide a brief justification.]
Fully agree / Agree / Neutral / Disagree / Strongly disagree

7.5. The impact assessment (IA), as well as its qualitative and quantitative data, is of high quality

[Please choose one of the options below and place it as a comment in CRT; if you disagree or strongly disagree, please provide a brief justification.]
Fully agree / Agree / Neutral / Disagree / Strongly disagree

7.6. The regulatory proposal applies the 'better regulation' principles[1]

[Please choose one of the options below and place it as a comment in CRT; if you disagree or strongly disagree, please provide a brief justification.]
Fully agree / Agree / Neutral / Disagree / Strongly disagree

7.7. Any other comments on the quality of this NPA (please specify)

Note: Your comments on this Section will be considered for internal quality assurance and management purposes only and will not be published in the related CRD.

[1] For information and guidance, see:
- https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how_en
- https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox_en
- https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/better-regulation-why-and-how/better-regulation-guidelines-and-toolbox/better-regulation-toolbox_en