European Aviation Safety Agency

Explanatory Note to Decision 2018/007/R

CS-27 and CS-29 — Amendment 5

RELATED NPAS/CRDS: 2016-01, 2017-07 — RMT.0120 (27&29.008), RMT.0128, RMT.0608

EXECUTIVE SUMMARY

The objectives of this Decision are to:

— mitigate the risks linked to the design of helicopters certified for ditching or emergency flotation and performing overwater operations;

— provide cost-efficient rules in the field of the certification of personnel carrying device systems;

— address a safety issue related to the ability of Category A rotorcraft to continue safe flight for an extended duration after suffering a loss of oil from a gearbox.

This Decision amends both CS-27 and CS-29. It:

— improves the probability of survival for occupants in the event of either a helicopter ditching or a survivable water impact. This is achieved by introducing a new flotation stability certification methodology that takes into account the sea conditions for which certification is requested. In addition, the structural ditching provisions have been refined and the physical requirements for emergency exits and seating have been improved to enable occupants to make their escape in the event of either a ditching or a capsize as a result of a survivable water impact. Furthermore, the provisions for emergency flotation systems (EFSs), emergency and survival equipment, and emergency locator transmitters have been enhanced;

— clarifies the certification specifications (CSs) for external loads that are applicable to personnel-carrying device systems (PCDSs) by clearly differentiating between simple and complex PCDSs, and that only complex PCDSs require certification. Furthermore, it provides acceptable means of compliance (AMC) for external loads, and includes a definition of complex PCDSs and guidance on the appropriate methodology for applicants to certify simple PCDSs if they elect to include simple PCDSs within the scope of type certification;

— Improves the safety assessment of pressurised lubrication systems and the certification and development testing specifications for the 'loss of lubrication' condition in order to substantiate a maximum period of continued operation which can be included in the rotorcraft flight manual (RFM) emergency procedures.

These amendments are expected to increase safety.

Action area:	Rotorcraft operations		
Affected rules:	CS-27 and CS-29		
Affected stakeholders:	Rotorcraft manufacturers and offshore operators		
Driver:	Safety	**Rulemaking group:**	Yes
Impact assessment:	Full	**Rulemaking Procedure:**	Standard

RMT.0120: 24.10.2012	23.3.2016	
RMT.0608: 22.5.2014	31.5.2017	14.6.2018
RMT.0128: 29.9.2016	24.3.2017	

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1. About this Decision

The European Aviation Safety Agency (EASA) developed ED Decision 2018/007/R in line with Regulation (EC) No 216/2008[1] (hereinafter referred to as the 'Basic Regulation') and the Rulemaking Procedure[2].

This rulemaking activity is included in the EASA 5-year Rulemaking Programme[3] under rulemaking task (RMT).0120 (27&29.008), RMT.0128 and RMT.0608. The scope and timescales of the task were defined in the related Terms of Reference[4].

The draft text of this Decision relating to helicopter ditching has been developed by EASA based on the input of Rulemaking Group (RMG) RMT.0120 (27&29.008). All interested parties were consulted through NPA 2016-01[5]. 406 comments were received from all interested parties, including industry and national aviation authorities.

EASA reviewed the comments received during the consultation of NPA 2016-01 with the support of Review Group (RG) RMT.0120 (27&29.008). The comments received and EASA's responses thereto are presented in comment-response document (CRD) 2016-01[6].

The final text of this Decision, along with the certification specifications (CS) and acceptable means of compliance (AMC), has been developed by EASA based on the input of RG RMT.0120 (27&29.008).

The draft text of this Decision relating to personnel carrying device systems has been developed by EASA and was consulted with the Advisory Bodies in accordance with Article 16 'Special rulemaking procedure: accelerated procedure' of MB Decision No 18-2015. Due to the nature of the amendments, which are considered to have a negligible impact, and the fact that the matter has been consulted and discussed with relevant stakeholders (through certification memoranda, airworthiness directives and direct discussions), EASA elected to utilise the 'accelerated procedure' to introduce these amendments to CS-27 and CS-29.

The draft text of this Decision relating to gearbox lubrication has been developed by EASA based on the input of Rulemaking Group (RMG) RMT.0608. All interested parties were consulted through NPA 2017-07[7]. 99 comments were received from all interested parties, including industry and national aviation authorities.

EASA reviewed the comments received during the consultation of NPA 2017-07 with the support of Review Group (RG) RMT.0608. The comments received and EASA's responses thereto are presented in Comment-Response Document (CRD) CRD 2017-07[8].

The final text of this Decision, along with the certification specifications (CS) and acceptable means of compliance (AMC), has been developed by EASA based on the input of RG RMT.0608.

The major milestones of this rulemaking activity are presented on the title page.

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1 Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p. 1) (http://eur-lex.europa.eu/legal-content/EN/TXT/ ?qid=1467719701894&uri=CELEX:32008R0216).

2 EASA Management Board (MB) Decision No 18-2015 of 15 December 2015 replacing Decision 01/2012 concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications, acceptable means of compliance and guidance material ('Rulemaking Procedure') (https://www.easa.europa.eu/sites/default/files/dfu/EASA%20MB%20Decision%2018-2015%20on%20Rulemaking%20Procedure.pdf).

3 http://easa.europa.eu/rulemaking/annual-programme-and-planning.php

4 http://www.easa.europa.eu/document-library/terms-of-reference-and-group-compositions/tor-rmt0120-2729008

5 In accordance with Article 52 of the Basic Regulation (EC) No 216/2008, and Articles 6(3) and 7 of the Rulemaking Procedure.

6 https://www.easa.europa.eu/document-library/comment-response-documents

7 In accordance with Article 52 of the Basic Regulation (EC) No 216/2008, and Articles 6(3) and 7 of the Rulemaking Procedure.

8 https://www.easa.europa.eu/document-library/comment-response-documents

2. In summary — why and what

2.1. Why we need to change the CS/AMC

RMT.0120: experience has shown that ditching/water impact events can lead to avoidable loss of life. In otherwise survivable water impacts, there have been avoidable drowning fatalities due to the inability of the occupants to rapidly escape from a capsized and flooded cabin or, after having successfully escaped, their inability to subsequently survive until the rescue services arrived. Even a successful helicopter ditching could still have catastrophic consequences due to the risk of a helicopter capsizing. Enhanced design standards have been developed to both reduce the likelihood of capsize and further improve the ability of occupants to escape and survive.

RMT.0128: when humans are transported under helicopter cargo hooks or hoists, the current CSs require all personnel-carrying device systems (PCDSs) to be approved and certified. However, the PCDS approval process using the current CSs that constitute the rotorcraft certification basis are not considered to be cost-effective, in particular when the PCDS is of a simple design.

EASA considers that if a PCDS is of a simple design and complies with European standards (that have been applied for the same devices when used to protect humans in non-flying activities), it will provide equivalent safety, there will not be a need to include this PCDS within the scope of the type certification of a rotorcraft, and it can be approved for use through other means such as Regulation (EC) No 965/2012 (the Air Operations Regulation).

RMT.0608: CS-29 currently requires a test to be performed to demonstrate that any failure that can result in a loss of gearbox lubricant will not impair the capability of the rotorcraft to operate under autorotative conditions for 15 minutes (Category B) or to continue safe flight for at least 30 minutes (Category A) unless such failures have a probability which is considered to be 'extremely remote'.

Service experience has highlighted a number of concerns with regard to the existing approach, including:

— the complexity of lubrication system failure modes can result in the potential for unforeseen variables which can make prediction of their associated criticality and frequency of occurrence very challenging.

— substantiation of gearbox loss of oil endurance through the completion of a 30-minute test simulating a 'loss of lubrication' condition will typically result in an associated rotorcraft flight manual (RFM) emergency procedure requiring that the rotorcraft be landed in a considerably shorter period of time. Taking into account the challenging environmental conditions associated with certain types of Category A rotorcraft operations, a substantiated capability for continued operation of at least 30 minutes after loss of lubrication, to be stated in the associated RFM emergency procedures, would improve the likelihood of a positive outcome of such an event.

— gearbox lubrication systems are currently not defined as part of the rotor drive system and are, therefore, not automatically subject to the safety analysis of CS 29.917(b), which requires a design assessment of the rotor drive system. Consideration of lubrication system safety via other approaches may not be fully representative as lubrication systems are typically an integral part of the rotor drive system.

2.2. What we want to achieve — objectives

The overall objectives of the EASA system are defined in Article 2 of the Basic Regulation. This proposal will contribute to the achievement of the overall objectives by addressing the issues outlined in Chapter 2.1.

The specific objective of this proposal are, therefore, to:

— RMT.0120: improve, with cost-efficient solutions, the safety of helicopter occupants in case of a ditching or a water impact event.

— RMT.0128:

- introduce improved provisions to support the certification of complex PCDSs and external loads;
- provide improved acceptable means of compliance for the certification of complex PCDSs and external loads; and
- provide guidance on the appropriate methodology for applicants who opt to include simple PCDSs within the scope of type certification.

— RMT.0608: minimise the risk of hazardous and catastrophic failures related to loss of lubrication from rotorcraft gearboxes using pressurised lubrication systems.

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

This Decision that amends both CS-27 and CS-29:

— Establishes a new flotation stability certification methodology by which a target probability of capsizing following a ditching is set. This target probability of capsizing is then verified in sea conditions chosen by the applicant, by following a defined wave tank test specification using a scale model and irregular waves.

— Clarifies the structural ditching provisions and the conditions and loads that the helicopter structure and emergency flotation system must be able to withstand.

— Extends to CS-27 the requirement that non-jettisonable doors must have a means to enable them to remain open and secure, and clarifies that the means must function in all sea conditions for which certification is requested.

— Requires emergency flotation systems (EFSs) to automatically deploy in the event of entry into water, and in CS-29, that the helicopter should not sink in the event of any float being lost.

— Improves the identification and actuation of flight crew and passenger exits in the event of a ditching.

— Increases the minimum size of underwater emergency exits and defines the minimum ratio of passengers to underwater emergency exits, resulting in an increase in the number of emergency exits.

— Requires information relating to the sea conditions for which ditching certification has been obtained to be included in the rotorcraft flight manual.

— Clarifies that emergency equipment required by operating rules shall be certified for the sea conditions for which ditching certification has been obtained.

— Requires lift rafts to be remotely deployable in all floating attitudes and to have suitable retaining lines, and survival equipment to be attached to each lift raft. In addition, it should be possible to directly enter the lift raft from a ditched helicopter (CS-27 Category A and CS-29 types).

— If required by an operating rule, it requires the emergency locator beacon to be crash resistant.

— Clarifies the certification specifications (CSs) for external loads that are applicable to PCDSs by clearly differentiating between simple and complex PCDSs, and that only complex PCDSs require certification.

— Provides acceptable means of compliance (AMC) for external loads, and includes a definition of complex PCDSs.

— Provides guidance on the appropriate methodology for applicants to certify simple PCDSs if they elect to include simple PCDSs within the scope of type certification.

— Improves the safety assessment of pressurised lubrication systems and the certification and development testing specifications for the ‘loss of lubrication’ condition in order to substantiate a maximum period of continued operation which can be included in the RFM emergency procedures.

In more detail:

CS 27/29.563

The terminology has been changed to align with new definitions, with the aim of clarifying terms used and ensuring compatibility both within the CS and between the CS and the Regulation (EU) No 965/2012[9] ('Air OPS Regulation').

The alleviation allowing the rotorcraft under consideration to have less than 30 kt forward velocity at water entry has been removed, although the need to consider the particle velocity of the wave has also been removed. These two changes, whilst making little change to the severity of the event to be considered, will simplify the showing of compliance.

The conditions that must be considered now include an emergency landing into the most severe sea conditions for which certification is requested by the applicant, and the provision defines the forward ground speed and vertical speed to be considered.

Means of compliance have been moved to Book 2 (AMC).

CS 27/29.783

It requires that non-jettisonable doors must remain open and secure in all sea conditions for which certification is requested.

In the case of CS-29, this requirement already existed, although it has been revised to clarify the sea conditions for which compliance is to be shown.

CS 27/29.801

The list of applicable CSs has been expanded.

The terminology has been changed to align with new definitions.

The new provision (c) has been added to mandate automatic deployment of emergency flotation systems and ensure their reliability and durability.

The text of (d) (former (c)) has been amended to establish an objective requirement that the rotorcraft does not exhibit unsafe characteristics during water entry.

Provision (e) (formerly (d)) is dedicated to post-ditching flotation stability. A new test objective has been added and the probability of capsizing in a 5-minute exposure to the sea conditions that must be demonstrated is defined. Text on compliance by computation has been removed as this is considered impractical within the present state of the art; however, it has been left open in the respective AMC. Text referring to the jettisoning of fuel has been removed. The jettisoning of fuel will not add to the buoyancy of the rotorcraft, but will likely raise the helicopter's CG, reducing stability, and may also create an additional hazard to occupants.

In the NPA, a new provision (g) was proposed to require high-visibility chevrons to be applied to the rotorcraft's undersurface to aid rescuers in locating the capsized rotorcraft and determining its orientation. Based upon the comments received during the consultation, EASA has decided to move this provision into the Air Operations Regulation.

[9] Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council (OJ L 296, 25.10.2012, p. 1).

In the NPA, a new provision (h) was proposed to require the sea conditions and any associated information (i.e. any mitigation used in determining the probability of capsizing to be identified in the performance information section of the RFM. After further consideration, EASA has decided that this provision would be better addressed in CS 29.1587. Please see the explanation there.

In the NPA, a new provision (i) was introduced as a design objective for enhanced post-capsize survivability provisions. After extensive consideration of the comments received, EASA has decided to not include this provision in this amendment of the CS due to the fact that the design solutions that have been identified are not sufficiently mature.

A new provision (g) (CS-29 only) has been added to address survivable water impact events and ensure that the rotorcraft will not sink following the loss of the largest flotation unit.

CS 27/29.802

In response to a comment on the NPA, it was decided that the provisions for helicopters that only need emergency flotation approval should be stated in a dedicated CS-27 and CS-29 provision, rather than via miscellaneous guidance (MG10) in the FAA AC.

For this reason, EASA decided to create CS 27/29.802.

Therefore, if certification of emergency flotation equipment is requested by the applicant, then the rotorcraft must be designed to:

— ensure that the flotation units and their attachments comply with the structural provisions of CS 27/29.563;

— additionally, ensure that the whole rotorcraft structure of a large CS-29 rotorcraft with a passenger seating capacity of 10 or more complies with the structural provisions of CS 29.563;

— provide the required post-ditching flotation stability and achieve the required probability of capsizing which is set at a higher allowable value than for ditching approval;

— ensure that a CS-27 Category A or CS-29 type rotorcraft does not sink following a functional loss of the largest flotation unit.

CS 29.803

The new provision CS 29.803(c) is introduced to require that a means be provided to allow passengers to step directly into the life raft(s) following a ditching in which the rotorcraft is in an upright position. Any doors used as (part of) this means must meet a certain number of the provisions for ditching emergency exits. These exits use the existing term ‘ditching emergency exits’, because, although this is a new requirement, with a new intent, this term best describes their purpose.

CS 27/29.805

The text has been reworded to clarify what is required when certification with ditching provisions is requested. Emergency exits are required to be useable with the rotorcraft upright or capsized (inverted).

Previously, flight crew emergency exits were not required to meet this fundamental requirement. The new term ‘underwater emergency exit’ is used to describe exits that meet this new requirement.

In addition, and to further improve the requirements for flight crew emergency exits, for CS-27, it is required that the device to operate flight crew ditching emergency exit (pull tab(s), operating handle, 'push here' decal etc.) be marked with black and yellow stripes and be accessible with the flight crew member's harness locked, and be accessible for the range of flight crew heights.

The introduction of these latter new requirements can be found in CS 29.811 for large helicopters.

CS 27/29.807

The number of emergency exits that are required, for a rotorcraft approved with ditching provisions, has been increased. This is because a successful escape from a capsized rotorcraft will only be feasible with appreciably more exits than were previously required. As with flight crew emergency exits (see above), the term 'underwater emergency exits' was introduced for these exits.

In the case of CS-29 passenger exits, this term also serves to differentiate between the required exits used to escape a rotorcraft in the event of a capsize (underwater emergency exit) and the emergency exits, as required by the new CS 29.803(c)(1), that are used in the event of a ditching (which are called 'ditching emergency exits'). However, if the two different evacuation situations can be covered by one and the same exit, this is acceptable.

For CS-27, additional provisions have been added to require seat rows to be located relative to ditching emergency exits to best facilitate escape, and to require handholds to be available to assist in the location and operation of the exit as well as to egress through it. Guidance on what constitutes a handhold is provided in the respective AMC.

The introduction of these latter new provisions can be found in CS 29.809 and CS 29.813 for large helicopters.

CS 29.809

Openable windows have been clarified as being an acceptable emergency exit provision.

The new provision (j)(1) reiterates the need to design ditching emergency exits for use following a capsize.

The new provision (j)(2) requires ditching emergency exits to not be blocked when a sliding door is in the open and locked position. Jamming of the door in any intermediate position need not be considered, as the compounded probabilities are small and no damage should arise in a ditching that would result in jamming (CS 29.783(d)).

The new provision (j)(3) has been created for the installation of handholds inside the cabin to assist in emergency egress.

CS 29.811

Emergency exit markings have been extended to include flight crew emergency exits.

The intent of the second sentence of (a) has been expanded and moved to the new (h)(1), especially applicable when ditching approval is requested by the applicant. Highly conspicuous illuminated markings that continue to function underwater are required. These markings are to be more conspicuous that those required by helicopters not approved with ditching provisions, i.e. so called 'Helicopter Emergency Egress Lighting Systems (HEELS)' markings.

(h)(2) has been added to make the operating devices for emergency exits more conspicuous underwater.

CS 29.812

Exterior emergency lighting is required for a ditching emergency exit.

CS 29.813

The new provision (d)(1) has been created to ensure that seat rows are located relative to ditching emergency exits so as to best facilitate escape from the rotorcraft.

The new provision (d)(2) requires handholds to be available to assist passengers in making a cross-cabin egress from a submerged cabin. Guidance on what constitutes a handhold for cross-cabin egress is provided in the respective AMC.

CS 29.865 External Loads

The provisions of CS 29.865 have been amended to clearly specify that only complex design PCDSs are required to be certified and included within the scope of type certification.

CS 29.917 Design

The provisions of CS 29.917(a) have been amended to include rotor drive system gearbox lubrication systems in the definition of the rotor drive system. This will result in these lubrication systems being considered within the scope of the design assessment of CS 29.917(b).

CS 29.927 Additional Tests

CS 29.927(c), addressing loss of lubrication for Category A rotorcraft, has been significantly changed. This is now a more objective-based CS and requires substantiation of the ability of the gearbox to continue safe operation for at least 30 minutes after indication of low oil pressure, followed by a safe landing. A test within the certification programme, simulating the most severe failure mode of the normal-use lubrication system. The most severe failure mode of the normal-use lubrication system is determined by the design assessment in CS 29.917.

CS 27/29.1411

The terminology has been changed.

Specific references to life rafts and life preservers have been transferred to CS 29.1415 to keep all ditching equipment provisions together and to preserve the general nature of this requirement as implied by its title.

CS 27/29.1415

Both CS 27.1415 and CS 29.1415 have been revised to better summarise the requirements for ditching equipment.

A clarification has been added that this is an optional provision.

Additionally, new requirements are added as follows;

Life rafts must be remotely deployable. The provision of deployment controls accessible to the flight crew, passengers in the cabin, and survivors in the water, is specified. Life rafts must be deployable with the rotorcraft in any foreseeable floating attitude.

The provision of a short and a long retaining line for each life raft is required. This brings the requirement into line with current practice.

It is required that each life raft be substantiated as being suitable for use in all sea conditions covered by the certification.

In the case of CS-29, it is specified that following the loss of any one life raft, the remaining life raft(s) must have sufficient overload capacity to accommodate all occupants.

CS 27/29.1470

This provision has been created to cover the installation of an emergency locator transmitter (ELT).

CS 27/29.1555

This provision has been amended to require emergency controls that may need to be operated underwater to be marked with black and yellow stripes.

CS 27/29.1561

The terminology has been changed.

It has been recognised that emergency controls may be operated by passengers.

All safety equipment requires both identification markings and a method of operation.

CS 29.1585

CS 29.1585 has been amended to add an additional powerplant limitation stating the need for the RFM emergency procedures to reflect the test evidence relating to the loss of gearbox lubrication.

CS 27/29.1587

This requirement was contained in CS 27/29.801 in the NPA. In response to a comment on the NPA, it was decided that that the requirement for the substantiated sea conditions and any associated information to be published in the rotorcraft flight manual would be more appropriately placed in CS 27/29.1587.

CS-27 Appendix C

Appendix C has been amended to require compliance with certain CS-29 provisions for CS-27 Category A rotorcraft certified for ditching, or having an emergency flotation system. In addition Appendix C is amended to include the references to the amended CS-29 provisions relating to loss of gearbox lubrication.

AMC 27/29.563 (replaces FAA AC 27/29.563A)

As a result of comments received during the consultation of the NPA, considerable discussion took place within the review group. This resulted in additional text to clarify what conditions should be considered, including:

— the worst sea conditions (for which certification is requested);

— the trajectory of the rotorcraft;

— the steepness of the plane of water that is impacted;

— the forward ground speed of the rotorcraft;

— how to address rotor lift.

In addition, AMC 29.563 also explains how the different configurations of floats should be addressed including fixed floats, floats intended to be deployed before water contact and floats intended to be deployed after water contact.

AMC 29.563 also explains how loads during flight should be applied to flotation systems.

AMC 27/29.801 (replaces FAA AC 27/29.801)

The definition of ditching has been amended and new definitions have been added. The current definition of ditching has been expanded to cover failures of other essential systems and not just engines. This would better align with ditching experience and RFM emergency procedures.

Terminology has been changed to align with new definitions.

This AMC reiterates that ditching certification is optional and is only applicable if requested by the applicant.

This AMC explains that all potential failure conditions that could result in a 'land immediately' action by the pilot are in the scope of ditching and this directly contributes to changes in the water entry conditions. The limiting conditions for water entry have been retained, however, it is no longer acceptable for the maximum forward speed to be demonstrated to be less than 15.4 m/s (30 kt).

Miscellaneous Guidance (MG) 10 has been superseded by CS 27/29.802 as an alternative means for the substantiation of an emergency flotation system.

This AMC explains the new design objective to establish a capsize probability. The water conditions on which ditching substantiation is based are selectable by the applicant.

The concept of a 'wet floor' is introduced where a portion of the ditched cabin is below the water line.

The need for the rotorcraft to not sink in the event of the loss of the largest flotation unit is re-affirmed.

A clarification has been provided that the life raft should be directly accessible from the cabin to allow direct transfer of occupants when the helicopter is floating upright.

Guidance on automatic EFS arming, actuation and good design practice has been added.

Guidance on information required by the RFM has been added.

AMC 27/29.801(e) (new AMC)

It includes a new model test specification for rotorcraft ditching certification in irregular waves.

AMC 29.803(c) (new AMC)

This AMC provides guidance and means of compliance on designating doors for use in a ditching.

AMC 27/29.805(c) (replaces FAA AC 27/29.805A)

The terminology has been changed.

Guidance has been included on the design of flight crew emergency exits.

It has been accepted that flight crew may not have direct access to life raft(s).

AMC 27/29.807 (supplements FAA AC 27/29.807 and replaces AC 27/29.807A and AC 27/29.807B)

It provides AMC/GM relating to the provision for underwater emergency exits and cabin layout.

This AMC also clarifies the difference between the newly introduced term 'underwater emergency exit' and a 'ditching emergency exit'.

AMC 29.809 (supplements FAA AC 29.809)

It provides AMC/GM relating to all emergency exits, and in particular, to features that would not be considered to meet the 'simple and obvious' provision of CS 29.809(c).

The provisions of the new item (j) include that exits should be useable underwater, escape from a capsized rotorcraft should be feasible in the case that any door(s) may be open, and handholds should be provided adjacent to exits.

The standardisation of the position for openable window operating mechanisms is also added as a new provision.

AMC 29.811(h) (supplements FAA AC 29.811 and AC 29.811A)

It provides AMC/GM relating to the marking of underwater emergency exits.

AMC 29.813 (supplements FAA AC 29.813)

It provides AMC/GM on the location of passenger seats in relation to the underwater emergency exits in order to best facilitate underwater escape.

AMC 29.865 External Loads

The AMC to CS 29.865 has been amended to clearly define what EASA considers to be a complex PCDS design and, therefore, requires it to be certified.

In addition, the AMC to CS 29.865 also contains appropriate guidance and means for an applicant to include a simple PCDS within the scope of type certification if they elect to do so, noting that this is not required.

AMC 29.917 Design

As the scope of this design assessment is currently limited to single hazardous and catastrophic failures, additional AMC is needed to supplement FAA AC 29-2C, supporting CS 29.917(b), specifically with regard to lubrication systems.

AMC 29.927 Additional tests

This supplementary AMC explains the methodology and conditions simulating the most severe failure mode of the normal-use lubrication system. It also explains the criteria that should be used to establish the maximum period of operation following loss of lubrication.

AMC 27/29.1411 (amended version of AC 27/29.1411)

The terminology has been changed to improve its clarity.

AMC 27/29.1415 (amended version of AC 27/29.1415)

The terminology has been changed to improve its clarity.

Guidance on life raft deployment has been added.

AMC 27/29.1470

A new AMC has been created to provide guidance on the installation of ELTs.

AMC 27/29.1555 (supplements FAA AC 27/29.1555)

A new AMC has been created to clarify the need for emergency controls for use following a ditching or water impact to be marked with black and yellow stripes, instead of them being coloured red.

AMC 27/29.1561 (amended version of AC 27/29.1561)

This is an amended version of AC 27/29.1561 to better align it with the changes to CS 27/29.1561.

AMC 27/29 MG 10 (amended version of AC 27/29 MG 10)

With the introduction of the new provision for emergency flotation systems in CS 29.802, the guidance contained in AMC 29 MG 10 is no longer required.

2.4. What are the stakeholders' views

Proportionality for rotorcraft that only require emergency flotation systems (CS 27/29.802)

The current operating rules only require a rotorcraft to be certified with full ditching provisions if it operates more than 10 minutes from land, over hostile sea areas. Ditching certification is performed only if requested by the applicant. Rotorcraft that operate more than 10 minutes from land, over non-hostile sea areas, are only required to have emergency flotation systems.

In the NPA, it was proposed to update the certification standards for both CS-27 and CS-29 in the associated FAA AC MG10 to set specific load requirements, and to require the water entry behaviour of the rotorcraft to be substantiated. This would make the resultant emergency flotation system more like that required for ditching certification.

Some commentators stated that this was excessive for rotorcraft that would only fly over non-hostile sea areas and that there was a need for greater proportionality. Furthermore, it was pointed out that the use of FAA AC material (MG10) as AMC to set certification requirements was inappropriate.

In response, EASA has created new (but optional) certification specifications CS 27/29.802 for emergency flotation systems.

In order to ensure proportionality for CS-27 rotorcraft and large rotorcraft with 9 or less passengers, emergency flotation systems are only required to meet the structural requirements of CS 27/29.563 for the flotation units and their attachments. Furthermore, rotorcraft certified with only emergency flotation systems are required to demonstrate a less stringent probability of capsizing compared to certification with full ditching provisions. Finally, the requirement for the behaviour of the rotorcraft upon water entry to be substantiated has been removed.

Irregular Wave Testing Specification (CS 27/29.801(e) and AMC 27/29.801(e))

Comments were received from industry relating to uncertainty as to how to implement the probabilistic capsize resistance test specification in practice. Although some uncertainty is to be expected with any new certification test method, it was decided to consult with several wave tank test facilities in order to identify further clarifications that could be made to the test specification contained in the AMC text and to gain independent opinions regarding the feasibility and ease of carrying out the required testing.

Fruitful discussions took place regarding the details and practicalities of testing scale helicopter models in a wave basin. Practical issues relating to long duration runs, and test durations made up from multiple short exposures to the waves were discussed. It was determined that there was a need to re-consider the acceptable and realistically achievable capsize probabilities when balanced against the total test programme duration.

This was also necessary in light of the decision to not include the provisions for post-capsize survivability features (CS 29.801(i)) at this time (see below).

This has resulted in pragmatic and realistically achievable allowable capsize probabilities, which can be demonstrated during wave tank testing.

The wave tank test specification was also amended in other ways to improve its clarity and usability, in accordance with this discussion and other comments received, and it now constitutes a specification that can be fully utilised.

Post-Capsize Survivability features (CS 29.801(i))

The proposed amendments to CS-29 in NPA 2016-01 included an objective-based provision (CS 29.801(i)) for 'post-capsize survivability features' that take into account occupant breath-hold time. The associated AMC 29.801 stated that a design that included an 'air pocket' (where a significant portion of the helicopter remains above the water line and provides air for survivors) would be one possible means to provide such features. The intention was that after capsize (as a result of a ditching or water impact) the emergency flotation system (EFS) of the helicopter would be specifically designed to assure a capsized floating attitude with an appreciable portion of the fuselage above water. This would provide an 'air pocket' in the passenger cabin, which would allow passengers/crew who had not managed to rapidly escape the aircraft to readily find a source of breathable air while they orientate themselves and make their escape.

The proposed AMC 29.801 also stated that provision of an emergency breathing system (EBS) to each helicopter occupant would not be seen as fully meeting the safety objectives required by the new CS. This was because although each EBS has been designed to provide the best achievable improvement in survival in a fully submerged cabin for existing helicopter types, its efficacy is highly dependent on individual performance, due to such issues as physiological differences and the ability to retain the benefits of relatively complex training.

A significant number of comments were received during the consultation of NPA 2016-01 regarding the 'post-capsize survivability features'. Some stakeholders considered that the proposed amendment was too prescriptive, as the only identified means of compliance in the AMC was the provision of an 'air pocket', and another design (EBS) was specifically ruled out.

Some stakeholders also challenged the technical feasibility of providing an 'air pocket' through the enhancement of the EFS. A number of technical challenges were identified, and these include the potential for:

— inadvertent deployment of the modified EFS, resulting in a catastrophic event (e.g. flotation units needing to be closer to the main rotor to achieve the required floating attitude);

— hot exhaust gases acting upon the flotation units' stowage location(s), setting unachievable standards for material selection;

— aerodynamic disturbance in the complex area close to the main rotor due to the protruding volume for the higher-mounted stowed flotation units;

— the need to design for potential damage to a high-mounted flotation unit by the main rotor immediately after inflation and before the main rotor has stopped turning.

In their comments, helicopter designers expressed serious concerns about the above items, and particularly in regard to the introduction of an additional catastrophic hazard. The main concern related to the potential for the inadvertent deployment of a high-mounted flotation unit close to the main rotor. Helicopter manufacturers stated that the technical challenge posed by needing to design a device with high integrity to prevent any inadvertent deployment in the vicinity of the main rotor was excessive.

In response to NPA 2016-01, helicopter manufacturers also proposed that emergency breathing systems should be deemed to be an acceptable means of compliance with the required 'post-capsize survivability features'.

Comments relating to the proposed CS 29.801(i) provision and its associated AMC text were the subject of much debate and discussion. Due to the members of the review group having appreciably different views, it was agreed that further discussions would be most unlikely to result in a resolution of the two opposing positions.

After considerable deliberation, EASA decided that the proposed 'air pocket' design solution was insufficiently technically mature to be presented as a possible means to achieve the improvement in safety intended by the proposed CS. EASA concluded that further research should be conducted with regards to the 'air pocket' solution, focussing on the areas of concern that had been raised by the adverse comments.

Due to the fact that a sufficiently mature design solution that can fully provide the required 'post-capsize survivability features' cannot be confirmed at this time, EASA has also decided that the CS 29.801(i) provision should not be included in the amendment to CS-29 at this time.

EASA will actively follow technological developments and related research into enhanced EFSs that could provide an 'air pocket' in the event of a helicopter capsize. EASA may reconsider the inclusion of certification specifications for 'post-capsize survivability features' if such research and technological developments reach a sufficient level of maturity.

<u>Definitions and Terminology</u>

Due to comments received, considerable discussion took place in the review group in relation to the definition of a ditching itself.

The original CS-29 definition of ditching was:

> *An emergency landing on the water, deliberately executed, with the intent of abandoning the helicopter as soon as practical. The helicopter is assumed to be intact prior to alighting on the water with all controls and essential systems, except engines, functioning properly.*

The proposed definition in the NPA was;

> *An emergency landing on water, deliberately executed in accordance with Rotorcraft Flight Manual procedures, with the intent of abandoning the rotorcraft as soon as practical.*

The outcome of the discussions is the now agreed definition for ditching;

> *A controlled emergency landing on water, deliberately executed in accordance with rotorcraft flight manual procedures, with the intent of abandoning the rotorcraft as soon as practical.*

Comments were received to clarify the use of the term 'Ditching Emergency Exit'. This term has existed for many years in CS-27 and CS-29 and is used when specifying the additional exit requirements for rotorcraft certified with ditching provisions.

The NPA proposed an increase in the number of emergency exits that are required, and also an entirely new requirement, for a means to facilitate a 'direct step into' life rafts. The NPA did not propose to give the exits employed for the latter operation a specific name.

Discussion took place in the review group as to whether it would be more logical to use the term 'ditching emergency exit' for the 'direct step into exits', as these are for use in a ditching (with the helicopter upright on the water, in which 'direct step into' life raft boarding is possible), and to designate the other exits 'underwater emergency exits', as it is the capsize case that demands the higher number of exits (possible in a ditching, but much more likely to be the result of a water impact). It should be noted that these two types of exits may be one and the same in some cases.

In summary, three types of emergency exits are now designated, as follows:

— 'Emergency exit', as currently required, for all rotorcraft, irrespective of whether they are approved for overwater flight more than 10 minutes from land.

— 'Ditching emergency exit' required for certification with ditching provisions only, for CS-29 types only (by CS 29.803(c)(1)), to enable 'direct step into' life-raft boarding for passengers. Although this term is currently used in both CS-27 and CS-29, it is to be noted that in its new usage, the associated exits will have a more focussed purpose, and no contradiction/confusion relative to the current usage is expected.

— 'Underwater emergency exit' required for certification with ditching provisions only, for flight crew and passengers of both small and large rotorcraft. An appreciable increase in the number of exits required provides a new and higher standard for survivability post-capsize. This is a new classification of exit, with a new safety intent, and thus the creation of a new term is considered to be appropriate.

<u>Structural aspects</u>

Due to significant comments received on the ability to interpret the structural ditching provisions, it was decided that there was a need to improve and better explain the overall approach intended by CS 27/29.563. Terms such as 'most critical wave', 'wave surface', and 'steepness' lacked detailed explanations. Furthermore, it was noted that the use of units was inconsistent (ft/s, fps, km/h, m/s, etc.).

Discussions in the review group also concluded that still further work was required in order to achieve a clear standard. Clarifications were required for which tests are needed for 'inflate EFS before vs after water entry' options, and detailed usage of the simplified 'stationary plane of water' approach as presented in the NPA. In addition it was agreed that the CS provision itself should be simpler and that more details should be provided in the AMC.

An appreciable revision to the requirement and AMC texts has been performed.

Under-fuselage chevrons

Comments were received on the appropriateness of a CS provision for under-fuselage chevrons on all rotorcraft certified for emergency flotation or full ditching.

There were some comments that this should be a helicopters used for offshore operations (HOFO) operational requirement within the Air OPS Regulation. This would alleviate the perceived negative cosmetic issue chevrons might pose for owners/operators of helicopters that are operated overwater in roles such as air taxis, private operations, etc.

Discussion took place in the review group on whether or not it would be more appropriate to include the need for chevrons in the Air OPS Regulation and to only require them for offshore operations (i.e. in support of oil/gas exploitation, wind farm operations, and sea pilot transfers only). It was considered that the air taxi/private operations sector is limited and that the majority of cases would be addressed by transferring the requirement into the operational regulations for HOFO.

Personnel carrying device systems

During the consultation of the draft Certification Memorandum entitled 'Helicopter External Loads Personnel Carrying Device System', which was launched on 3 December 2013, a number of comments were received from stakeholders stating that simple PCDSs should not be included in the scope of type certification due to the impracticalities and inflexibilities that are created by doing so.

During the consultation of the draft Decision with the Advisory Bodies, no adverse comments were received. Therefore, the amendments that are introduced by this Decision are considered to be in line with the general stakeholders' views, and they also clearly clarify the criteria for when a PCDS should be certified.

Rotorcraft gearbox loss of lubrication

The comments that were received during the consultation period were in general supportive of the proposed amendments. More detailed comments from stakeholders were taken into account to improve the certification specifications and AMC through changes in the structure of the text and additional clarifications. These included clarification of which gearboxes should be considered and refinement in the means to determine the maximum period of operation following loss of lubrication.

2.5. What are the benefits and drawbacks

As assessed in the RIA to NPA 2016-01, this amendment will have a positive safety impact, with a negligible economic impact for applicants. It should be noted that many of the subject safety enhancing features are already voluntarily implemented by the industry. This amendment formalises these opportunities to increase the safety of new designs and ensures there is no undue penalisation for those voluntarily applying the safety enhancing features.

Due to the decision to not include at this time the initially proposed CS 29.801(i) provision for 'enhanced post-capsize survivability features', neither the associated assessed negative economic impact, nor the associated appreciably positive safety impact, will be realised by these changes.

The benefits of the amended CSs for external loads are increased flexibility for rotorcraft operators and a reduced regulatory burden for manufacturers of simple PCDSs and rotorcraft.

The expected benefits from improved CS provisions for gearbox loss of lubrication will be that continued level flight at maximum take-off gross weight can be maintained for a defined duration after a loss of lubrication. This duration will be specified in the emergency procedures for loss of lubrication in the RFM. This provision will provide increased opportunity for the flight crew to optimise circumstances affecting the safety of the eventual landing.

2.6. How do we monitor and evaluate the rules

— RMT.0120: Events involving the ditching or water impact of helicopters will be actively monitored through EASA's safety data monitoring and analysis functions. Due to the relatively low frequencies of ditching and water impact events, it may be difficult to monitor any trend in occurrences. The loss of life in these types of event will be scrutinised, and the safety risk portfolios for rotorcraft operations will be closely monitored for any increased number of occurrences.

— RMT.0128: EASA intends to evaluate the effectiveness of the amended CSs through the monitoring of their application and usage for the certification of PCDSs. If necessary, additional guidance and clarification could be provided in the form of additional AMC material.

— RMT.0608: Events involving loss of gearbox oil which are hazardous and catastrophic will be monitored in Europe and the USA through the regulator's safety data monitoring and analysis functions. Due to the low frequency of events involving loss of gearbox oil, it may be difficult to monitor any trend data of occurrences. In addition, due to the fact that the amended certification specifications will be only applicable to new designs, it will be important to differentiate between occurrences involving pre- and post-CS-amendment designs. The safety risk portfolios for rotorcraft operations will be closely monitored for any increased number of occurrences relating to loss of gearbox lubrication.

3. References

3.1. Related regulations

N/A

3.2. Affected decisions

— Decision No. 2003/15/RM of the Executive Director of the Agency of 14 November 2003 on certification specifications for small rotorcraft ('CS-27')

— Decision No. 2003/16/RM of the Executive Director of the Agency of 14 November 2003 on certification specifications for large rotorcraft ('CS-29')

3.3. Other reference documents

N/A