



EASA

European Aviation Safety Agency

Lessons learned in Structures on Rotorcraft STCs

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Objective

- This presentation is based on a recollection of issues and difficulties encountered by EASA Structure Experts and Applicants working on Rotorcraft STCs.
- The objective is:
 - to share this experience and,
 - to provide guidance and recommendations to STC holders on some of these issues.



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- Requirements/guidance-what is new?
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Note: List of abbreviations provided in appendix 2



Typical STC applications in Structure

Internal installation:

- Avionics equipment,
- EMS installation,
- Seats on pallets installation,
- Cabin equipment rack, etc...

External installation:

- Ext. load attachment means (hoist, cargo hook, platforms)
- Ext. equipment:
 - Antenna installation,
 - Camera installation,
 - Mirror installation,
 - Equipment box (buoyancy equipment, etc...)



Structures requirements-main developments

***CS29.571 amdt3	<ul style="list-style-type: none">• Fatigue Tolerance Evaluation of Metallic Structure
**CS29.573 amdt3	<ul style="list-style-type: none">• Damage Tolerance and Fatigue Evaluation of Composite Rotorcraft Structures (<i>CS27 amdt3</i>)
*FAR29.602 amdt45	<ul style="list-style-type: none">• Critical parts (<i>FAR 27 amdt38</i>)
*FAR29.865 amdt43	<ul style="list-style-type: none">• External loads (<i>FAR27 amdt36</i>)
*FAR29.625 amdt42	<ul style="list-style-type: none">• Fitting factors (<i>FAR 27 amdt35</i>)
*FAR29.351 amdt41	<ul style="list-style-type: none">• Yawing conditions(<i>FAR 27 amdt34</i>)
*FAR29.562 amdt41	<ul style="list-style-type: none">• Emergency landing dynamic conditions (<i>FAR 27 amdt32</i>)
*FAR29.631 amdt40	<ul style="list-style-type: none">• Bird strike substantiation
*FAR29.561 amdt38	<ul style="list-style-type: none">• Emergency landing condition (<i>FAR 27 amdt32</i>)
*FAR 29.952 amdt.35	<ul style="list-style-type: none">• Fuel system crash resistance (<i>FAR 27 Amdt30</i>)
*FAR29.307 amdt30	<ul style="list-style-type: none">• Proof of structure (<i>FAR 27 amdt26</i>)
*FAR29.613 amdt30	<ul style="list-style-type: none">• Material strength properties and design values (<i>FAR 27 amdt26</i>)

(*)JAR27/29 Ch1, (**)FAR29 amdt54, (***)FAR29 amdt55



Requirements/guidance: what is new?

• Certification Memoranda

(*)Can be used for CS27/29 applications.

Published

- CM-S-001: CS-25 Bird Strike Requirements(*).
- CM-S-002: CS 25.561 (c)(2) 1.33 'Wear and Tear' Factor(*).
- CM-S-003: Standard Fasteners (nuts and bolts).
- CM-S-004: Composite Materials - Shared Databases.
- CM-S-005: Bonded Repair Size Limits.
- CM-S-007: Continued Integrity of Rotorcraft Critical Parts (post-cert).
- CM-CS-005: H/C External Loads Personnel Carrying Device System.

To be issued

- CM-S-009: Cabin Interior Abuse Loads.
- CM-S-008: Additive Manufacturing_draft.
- CM-S-010: Composite Materials - Monocoque Sandwich Structures.
- CM-S-XXX: Compliance to CS27/29.952 a(4) for changes affecting surrounding structure.

- <https://www.easa.europa.eu/document-library/public-consultations/certification-memoranda>



General concerns with certification data

STC definition

Identification of:

- STC physical boundaries when combined with other approved designs,
- Affected rotorcraft structures.

Quality of technical documentation and justification

- STC consistency with DOA terms of approval,
- Substantiation and classification (PSE, critical parts) of affected rotorcrafts parts,
- Evaluation of repercussions at rotorcraft level,
- Technical capability to demonstrate compliance with the certification basis (analysis validation by test, fatigue substantiation, flight test...),
- Limited access to TC approach for compliance demonstration for affected rotorcraft structure (particularly for derivative rotorcrafts, MoC CRI),
- Access to OEM data /cooperation with OEM,
- Use of reverse engineering,
- Use of similarity without further compliance demonstration,
- Suitability of instructions for Continued Airworthiness



Lesson learnt - External installations

What is an external installation?



External equipment/fixture: A structure external to and in addition to the basic airframe that does not have true jettison capability and has no significant payload capability in addition to its own weight.

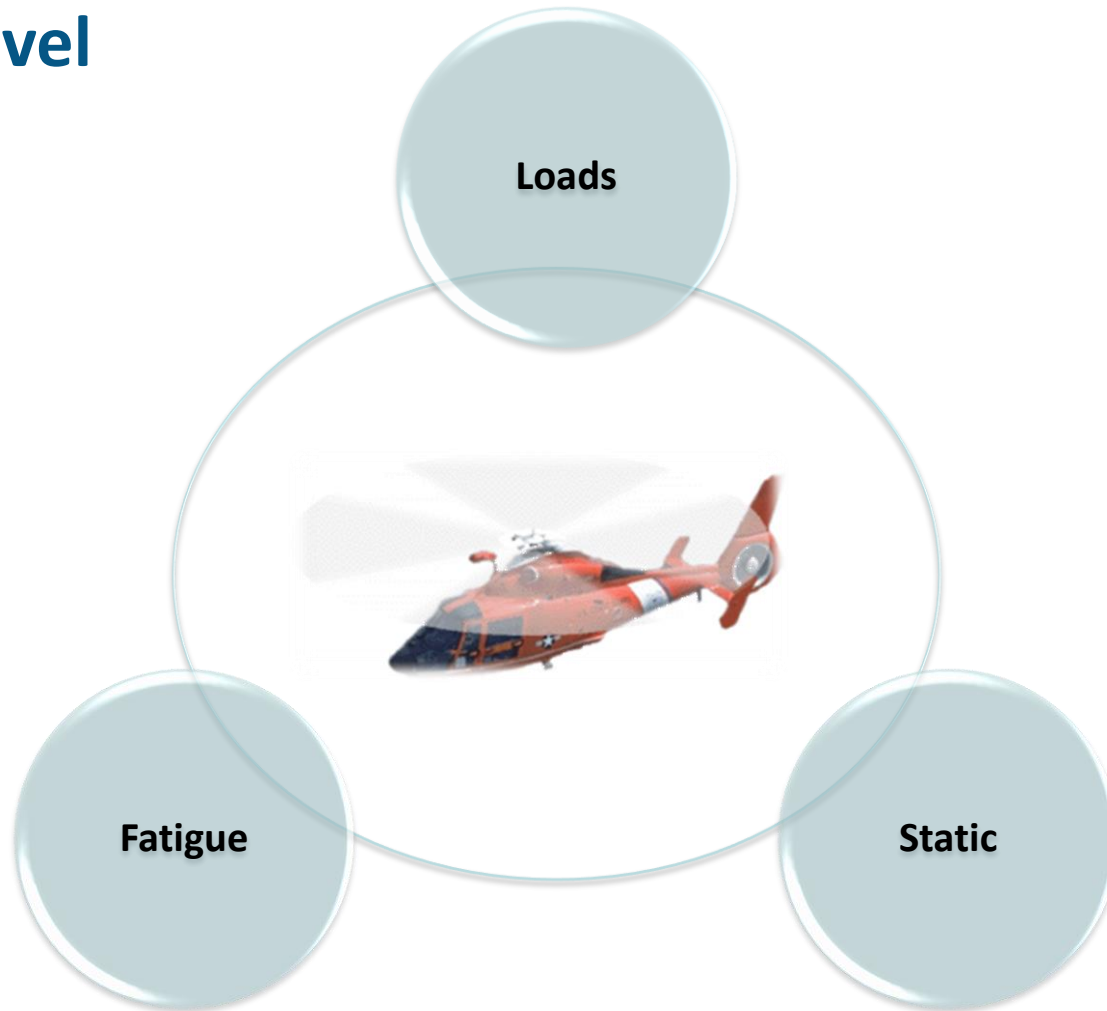


External loads attachment means are used for human and non human external cargo loads under specific certification (CS27/29.865) and operating rule. Some external load can be jettisoned in flight under specific conditions.



Lesson learnt - External installations

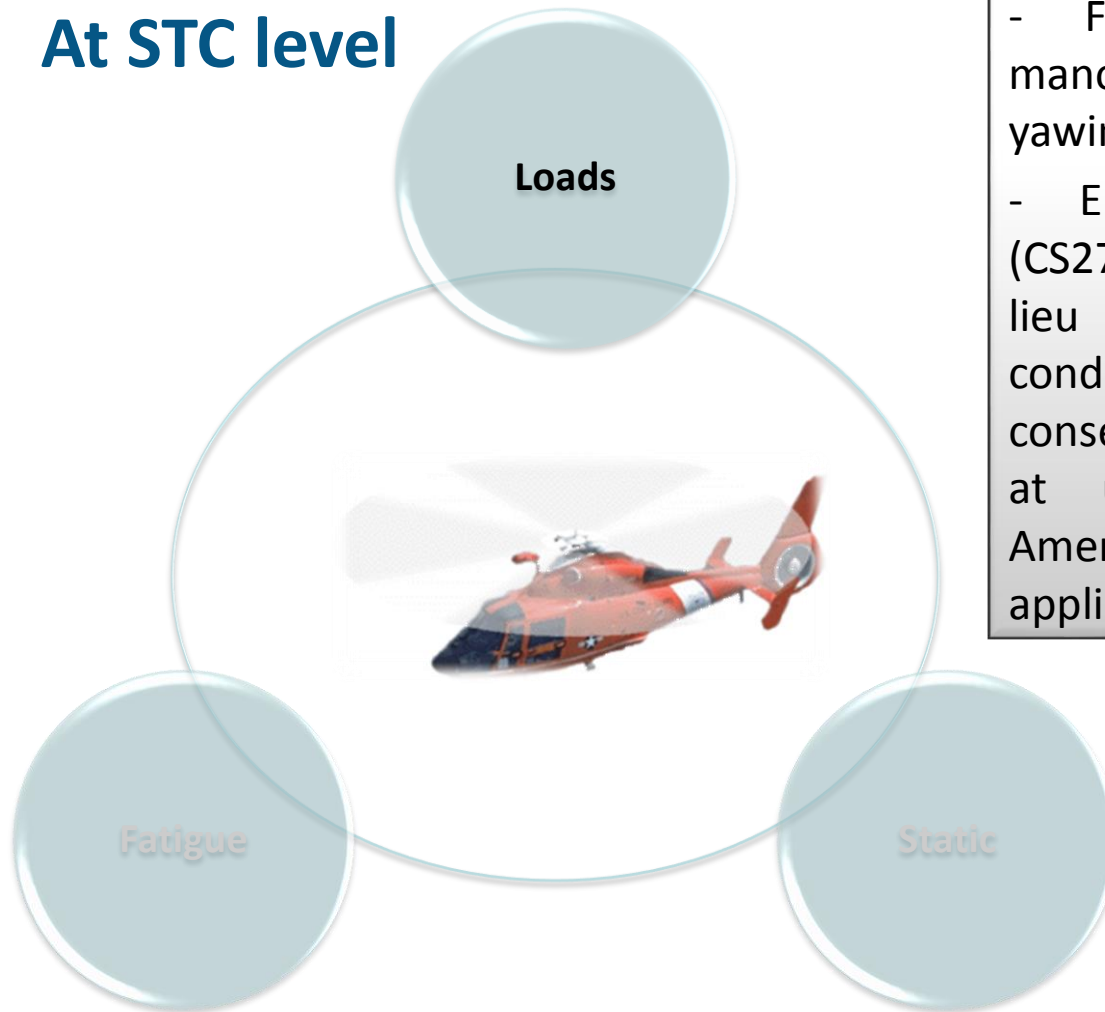
At STC level





Lesson learnt - External installations

At STC level

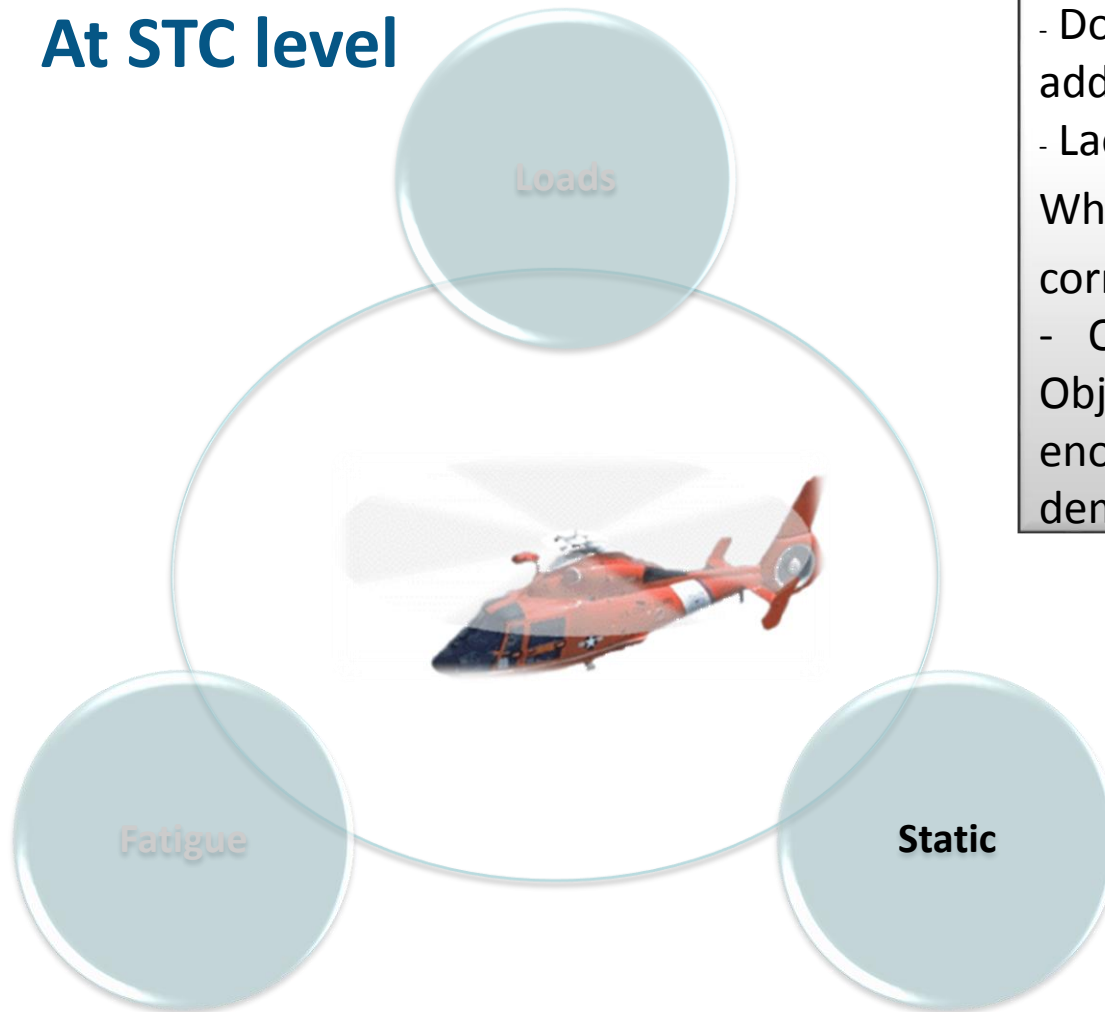


- Flight loads should include manoeuvre loads, gust loads and yawing condition.
- Emergency landing conditions (CS27/29.561) are sometimes used in lieu of flight loads as design conditions, but are not always conservative compared to flight loads at ultimate depending on the Amendment of FAR/CS which is applicable to the STC.



Lesson learnt - External installations

At STC level

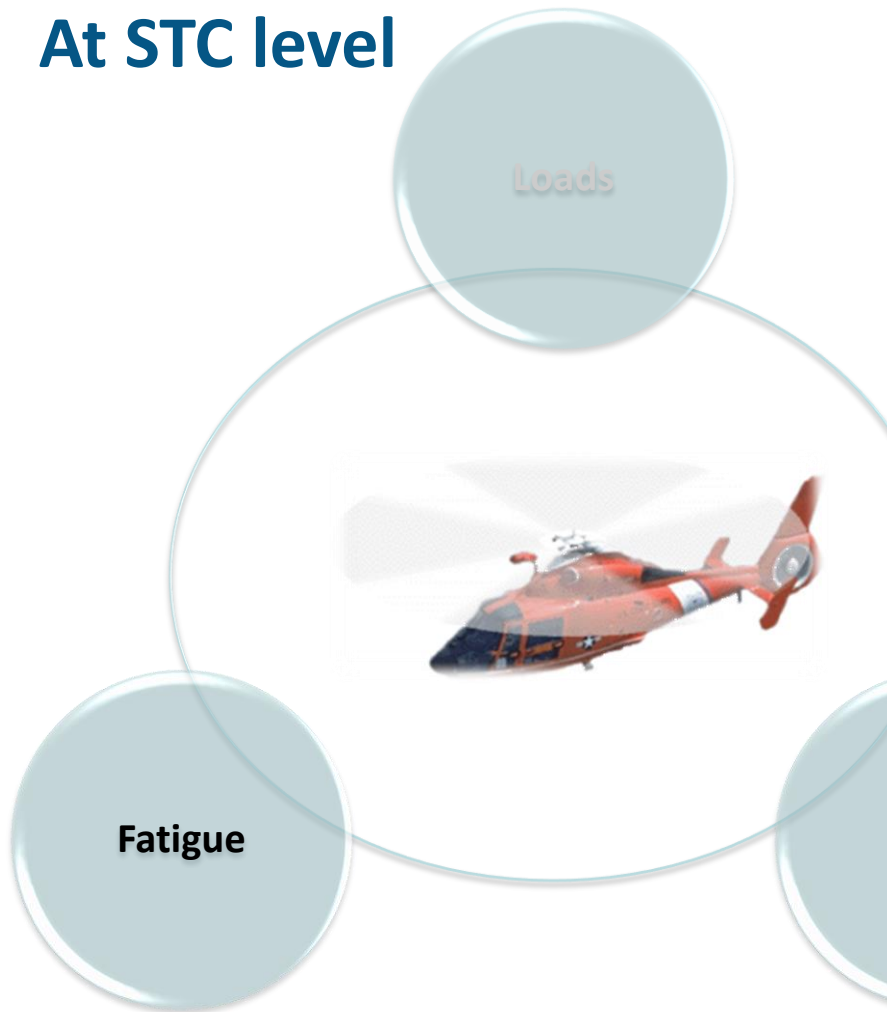


- Don't forget special factors in addition to safety factor.
 - Lack of supporting test evidence.
- When analysis is not shown reliable correlation by test is required.
- OEM position in Non-Technical Objection (NTO) should be detailed enough to read compliance demonstration through.



Lesson learnt - External installations

At STC level



- Lack of fatigue assessment due limited in house fatigue capability.
- If detachment of an external equipment can be a hazard to the rotorcraft, fatigue evaluation is necessary (AC27MG11§(e) provides acceptable guidance).
- Guidance for human and non human external loads applications is available in CS27/29.865(f).
- Impact on Instruction for Continued Airworthiness has to be evaluated (see AC27/29.865).
- For Personnel Carrying Device System (PCDS), the CM-CS-005 offers an alternative means of compliance for the certification of a simple PCDS .



Lesson learnt - External installations

Impact at Rotorcraft level



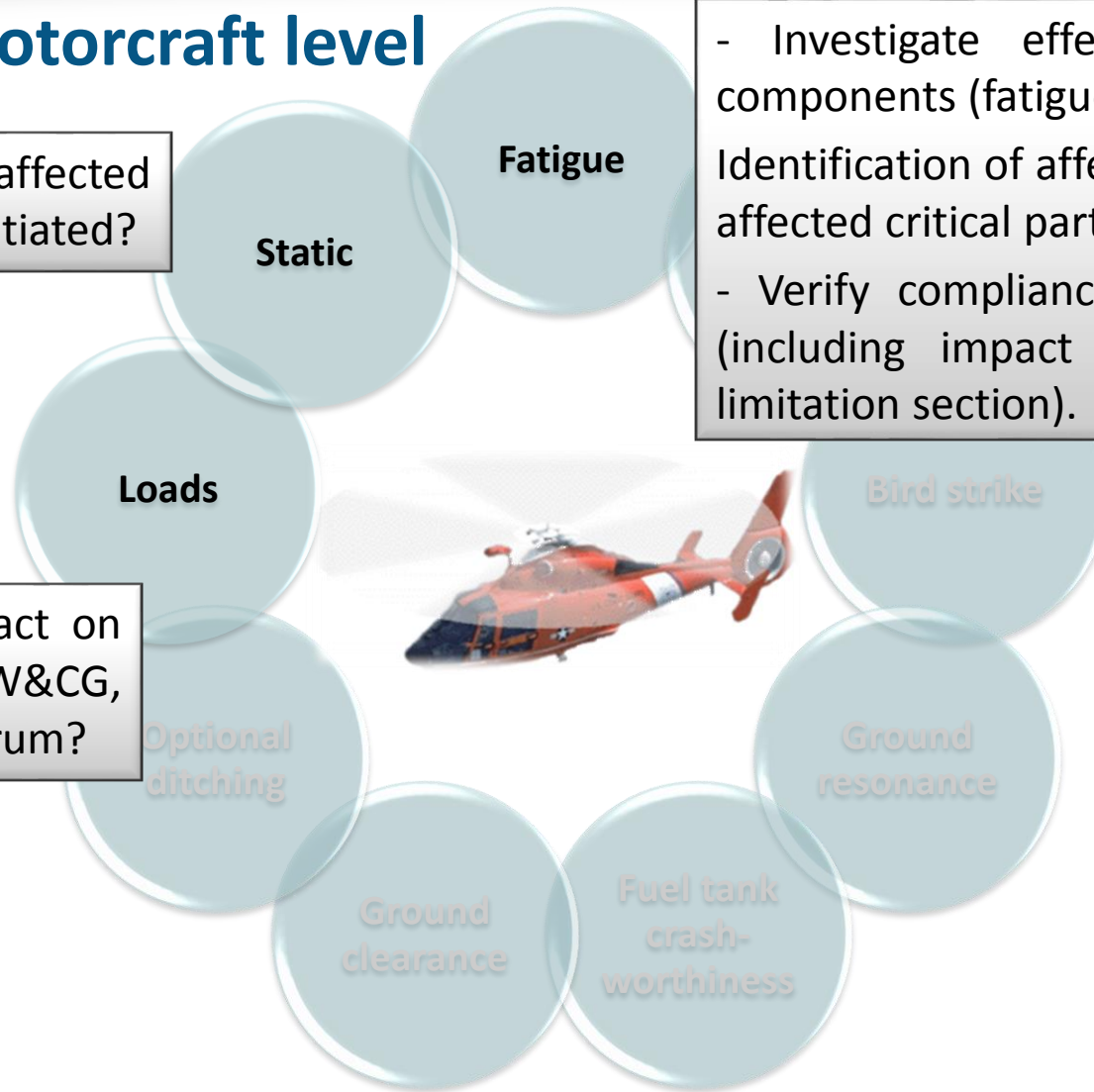


Lesson learnt - External installations

Impact at Rotorcraft level

Are the modified/affected structures substantiated?

What is STC impact on rotorcraft on W&CG, loads, flight spectrum?

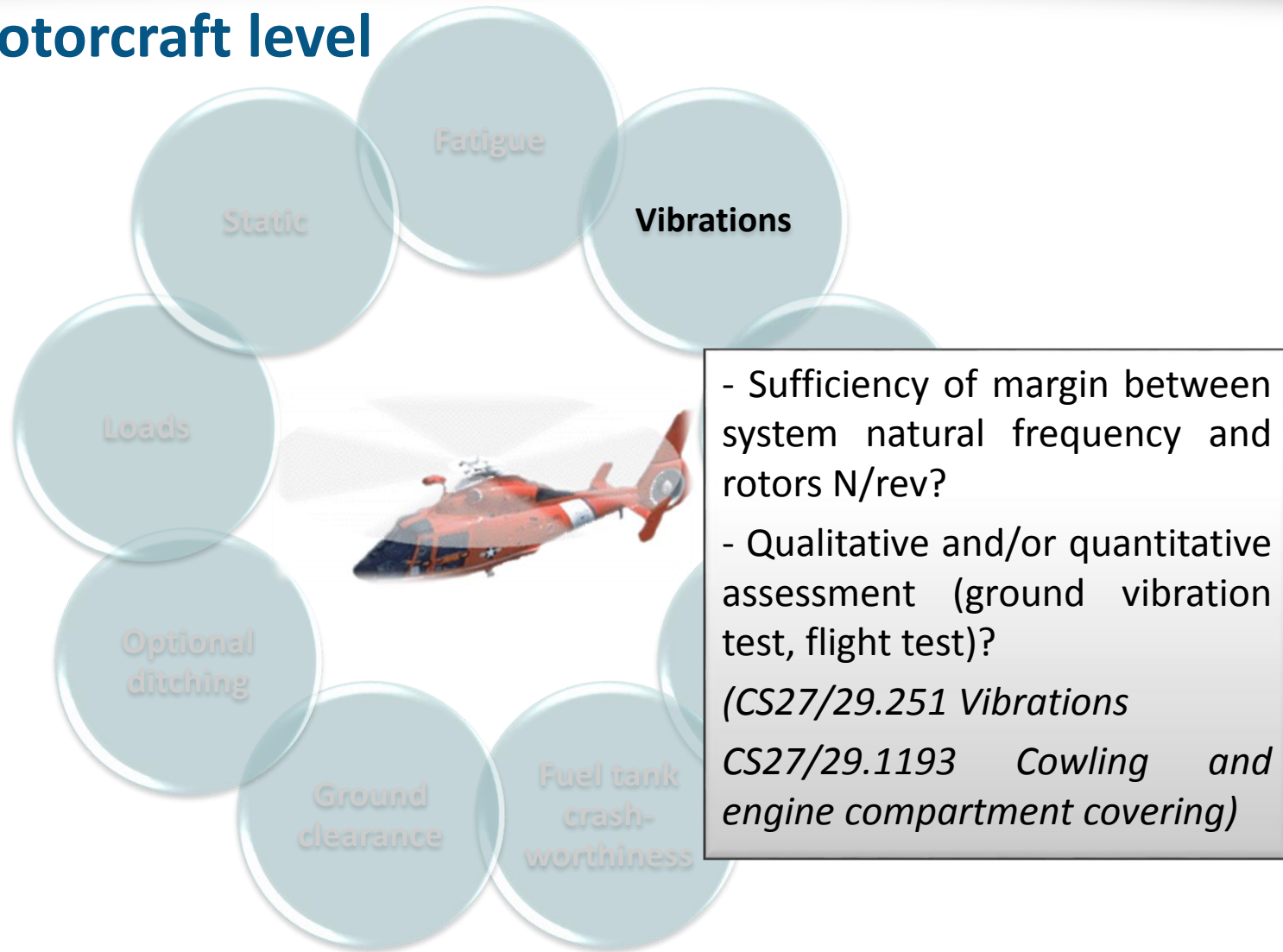


- Investigate effect on Rotorcraft components (fatigue spectrum).
Identification of affected/new PSE and affected critical part.
- Verify compliance to CS27/29.571 (including impact on Airworthiness limitation section).



Lesson learnt - External installations

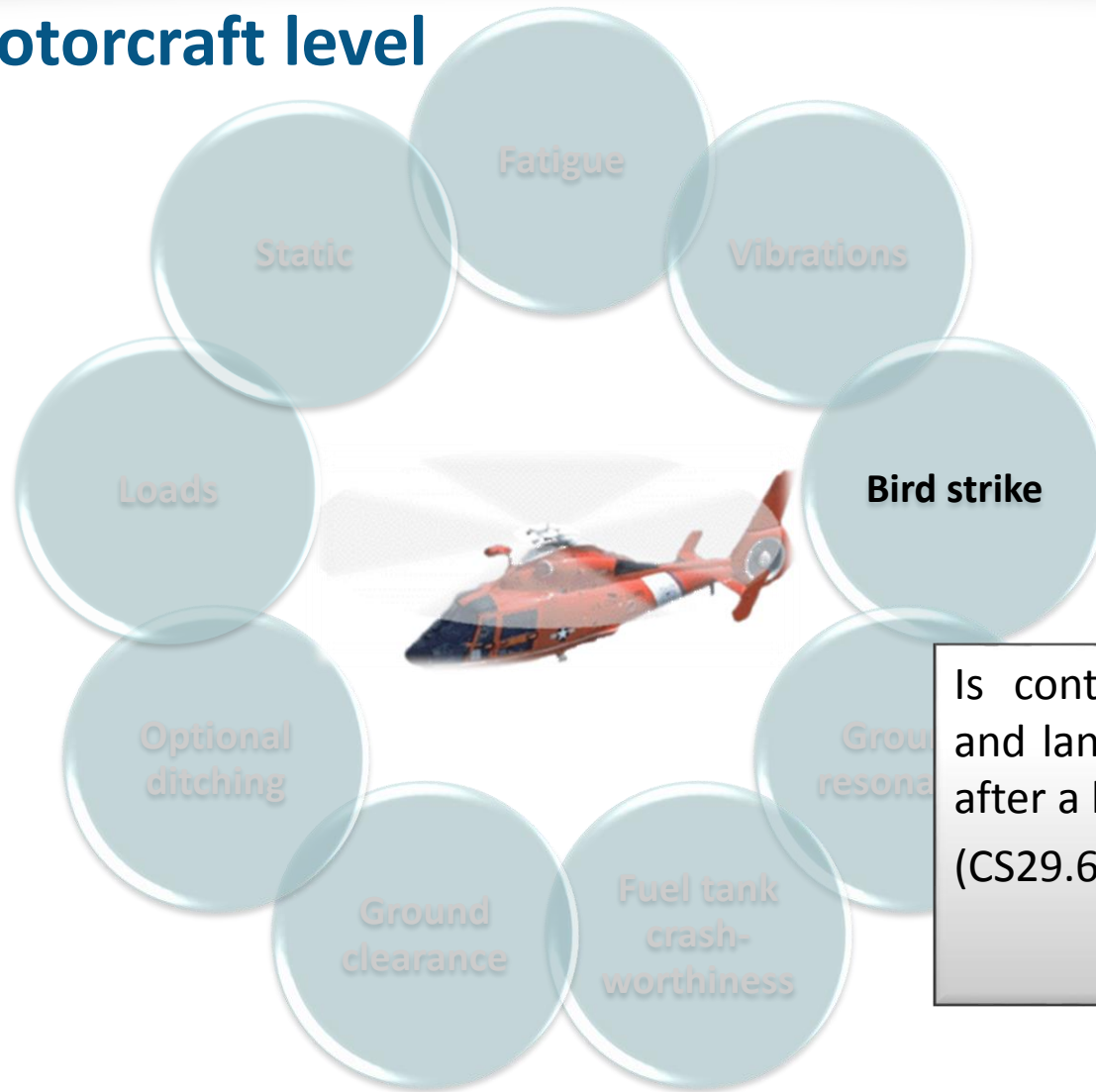
Impact at Rotorcraft level





Lesson learnt - External installations

Impact at Rotorcraft level

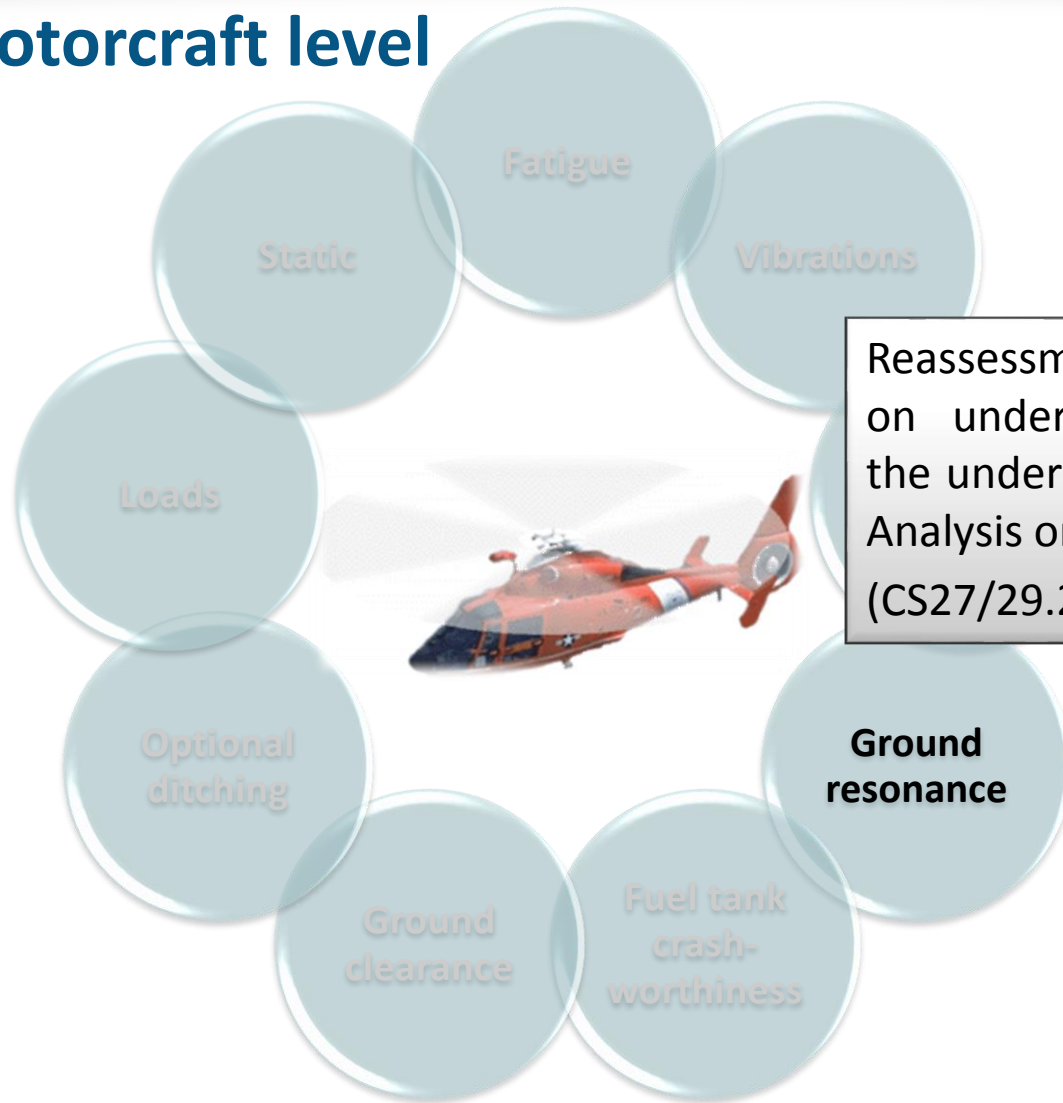


Is continuous safe flight and landing compromised after a bird impact?
(CS29.631 Bird strike).



Lesson learnt - External installations

Impact at Rotorcraft level

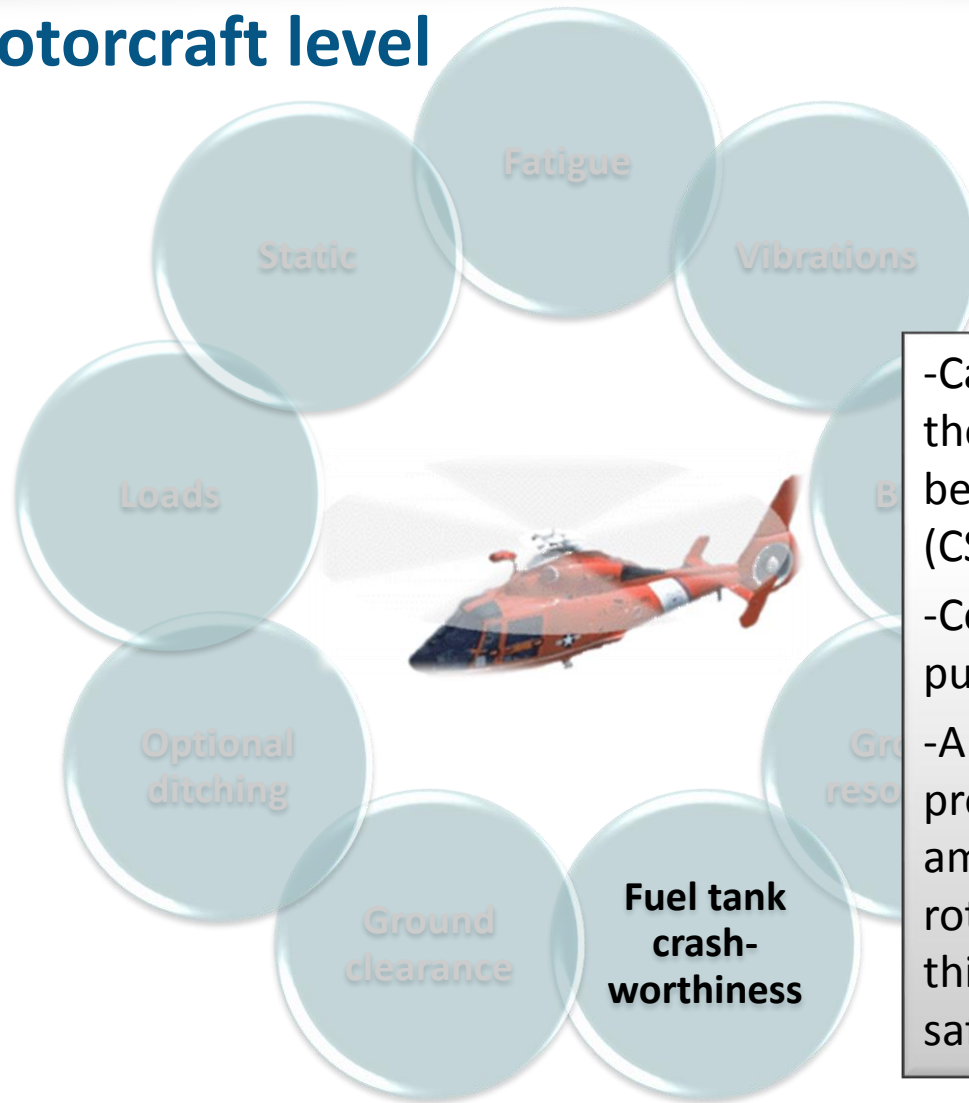


Reassessment for STC installed on undercarriage or affecting the undercarriage performance?
Analysis or test?
(CS27/29.241)



Lesson learnt - External installations

Impact at Rotorcraft level



-Can the STC installed in the vicinity of fuel tanks be a contributing hazard (CS27/29.952(a)(4))?

-Cert. Memo to be published.

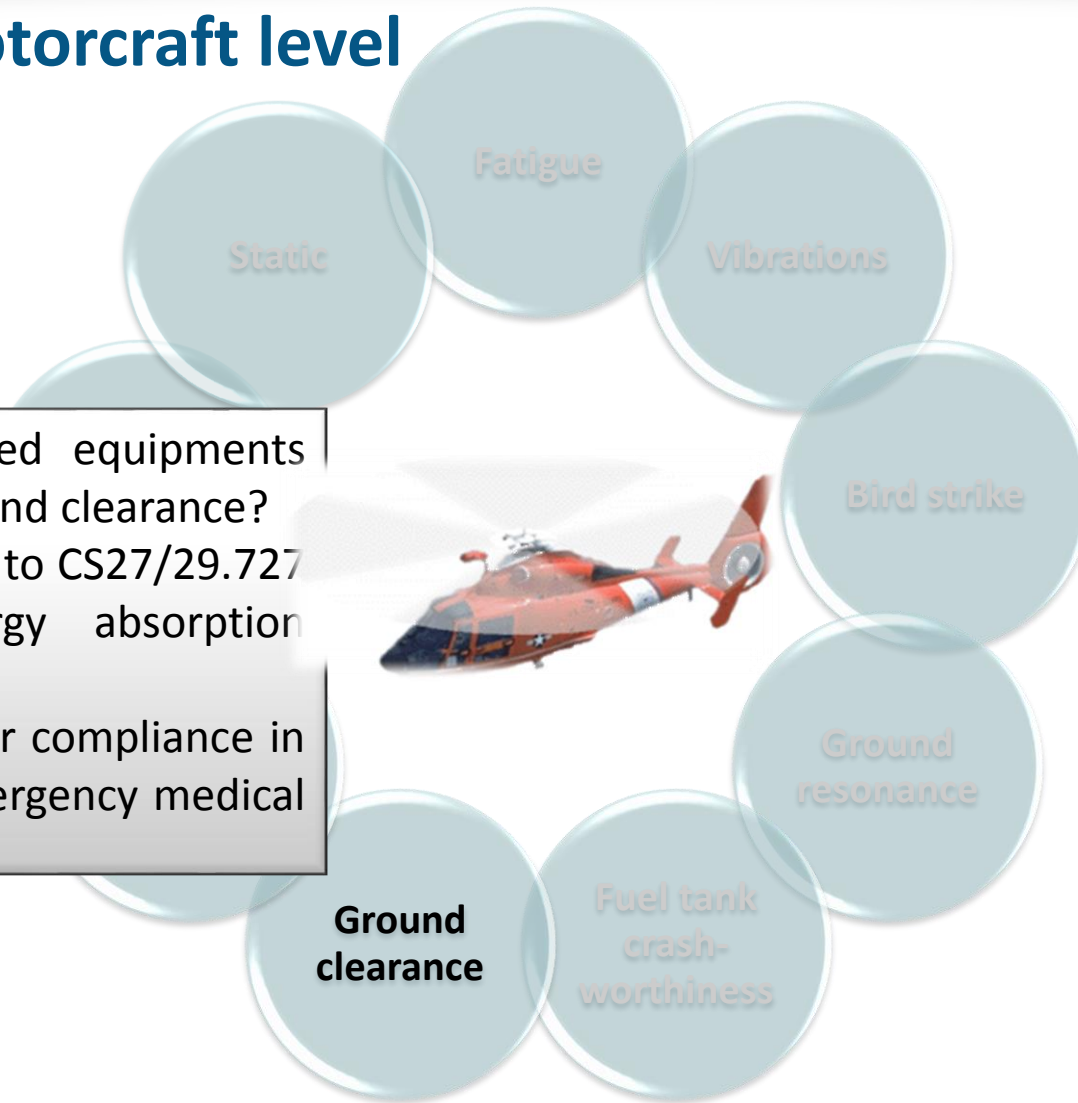
-ARAC working group project to have pre-amendment production rotorcraft compliant to this requirement for safety benefit.



Lesson learnt - External installations

Impact at Rotorcraft level

- Do belly mounted equipments have sufficient ground clearance?
- Verify compliance to CS27/29.727
- (c) Reserve energy absorption drop.
- Some guidance for compliance in AC 27/29 MG6 emergency medical service.



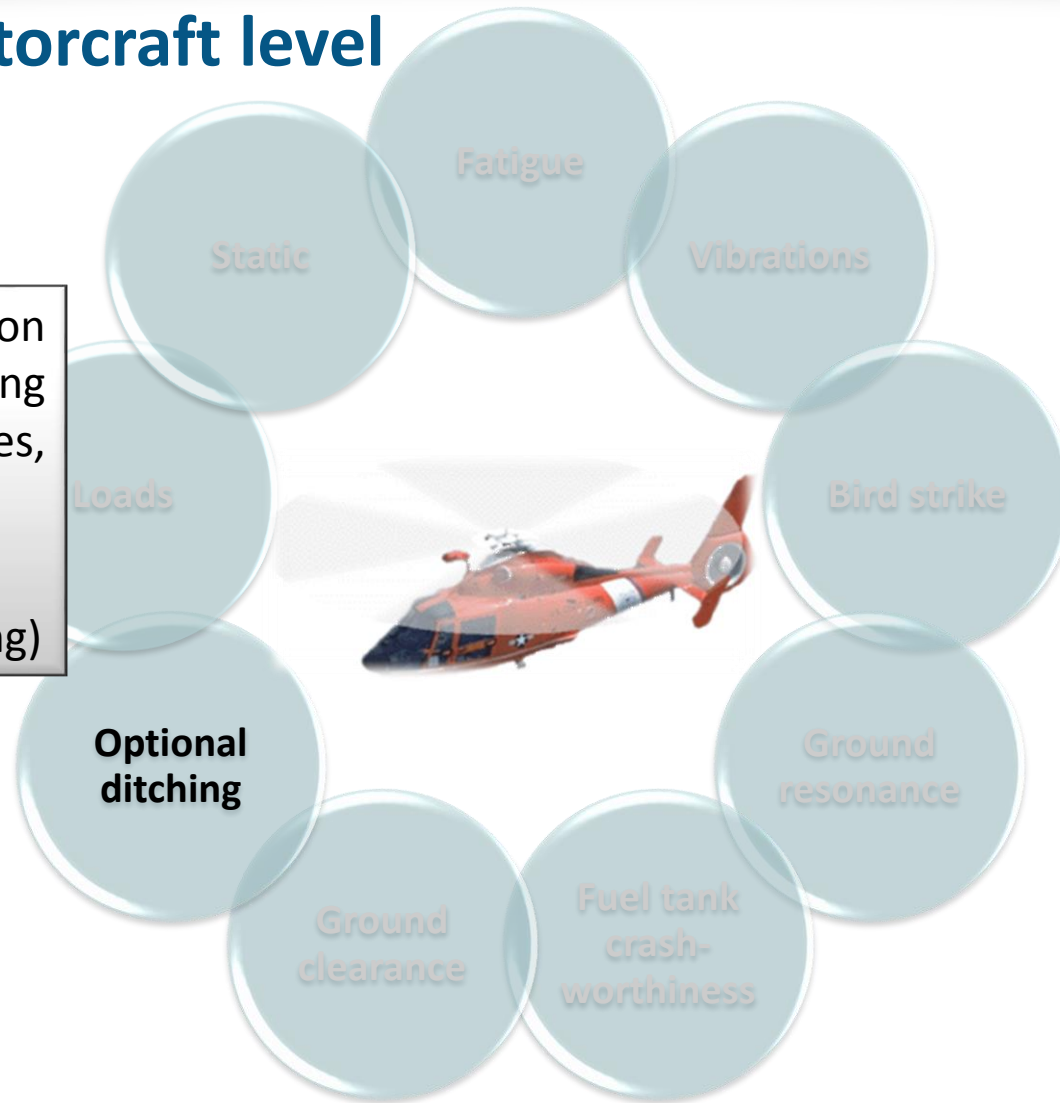


Lesson learnt - External installations

Impact at Rotorcraft level

Can STC installation compromise ditching provisions (structures, floats...)?

(CS 27/29.563,
CS 27/29.801 Ditching)





Lesson learnt - Internal installations

► Issues on:

- Seats installation with adapter plates to fit to the existing seat track layout (e.g. for EMS installation). See Wim Doeland's presentation on cabin lay outs (slides 16 to 20) for further guidance (Generic CRI...).
- Affected rotorcraft structure substantiation (§27/29.571 ...).



Conclusion and way forward

We hope that this presentation will help STC holders to improve the quality and effectiveness of the compliance demonstration and facilitate EASA review, in the interest of the project.

EASA is giving opportunities to STC holders to present novel designs at the Rotorcraft Symposium. It is an occasion for discussion.

<https://www.easa.europa.eu/newsroom-and-events/events/10th-rotorcraft-symposium>

STC holders are also welcome to address questions on EASA Internet web site: <https://www.easa.europa.eu/contact-us>





Questions?





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End slide

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Appendix 1

Static substantiation-Don't forget special factors (§619).

- Special factors to be applied in addition to safety factor of 1.5.
- Some special factors need not be combined.

CS27/29.621 Casting factor

- 1.0-2.0 (or greater)

CS27/29.623 Bearing factor

- Large enough to account for relative movement
- parts with clearance subject to pounding or vibration.

CS27/25.625 Fitting factor

- 1.15 except on tested joints
- 1.33 for seat, berth, litter, safety belt, and harness attachment
- 1.33 to address wear and tear due to frequent removal (CM-S-002)



Appendix 2

List of Abbreviations

AC	Advisory Circular
AMC	Alternative means of compliance
CRI	Cerification Review Item
CS	Certification Specifications (www.easa.europa.eu/document-library/certification-specifications)
EASA CM	EASA Certification Memorandum (www.easa.europa.eu/document-library/public-consultations/certification-memoranda)
EMS	Emergency Medical Service
FAR	Federal Aviation Regulations
IPC	Illustrated Parts Catalog
MoC	Means of Compliance
NTO	Non Technical objection
OEM	Original Equipment Manufacturer
PCDS	Personal Carrying Device System
PSE	Primary Structure element
STC	Supplemental Type Certificate (www.easa.europa.eu/document-library/type-certificates/supplemental-type-certificates)
W&CG	Weight and center of Gravity