EASA
European Union Aviation Safety Agency

Information Session on Human Factors in rotorcraft design and certification

25 and 27 October 2021

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General information

→ One info session divided in 2 parts

→ All presentations will be shared  as well as video 

→ For questions, please use **Q&A**

- Some responses will be given during the info session
- Remaining responses will be shared via email with participants
- Some questions will be published as FAQ in the EASA website

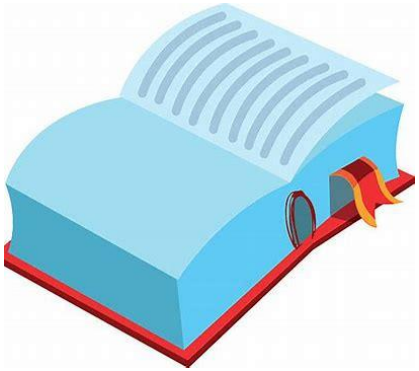
Scope of this info session

- → *Provide an overview of the newly introduced Human Factors (HF) considerations to be applied during rotorcraft design (CS 27/29.1302).*
- → *Describe best practices and possible difficulties that might be encountered by applicants.*
- → *Facilitate an effective implementation of these new certification specifications.*

The Journey of RMT.0713

TOR	Workshop	NPA 2019-11	EDD 2021/010/R	Info Session
31 Aug 2018	26 Mar 2019	24 Oct 2019	16 Jun 2021	25-27 Oct 2021

Where to find the published material



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RMT.0713: the team

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Senior Expert - Rotary Wing Flight Test

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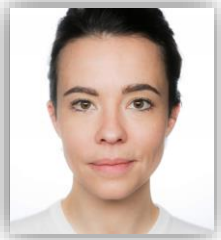
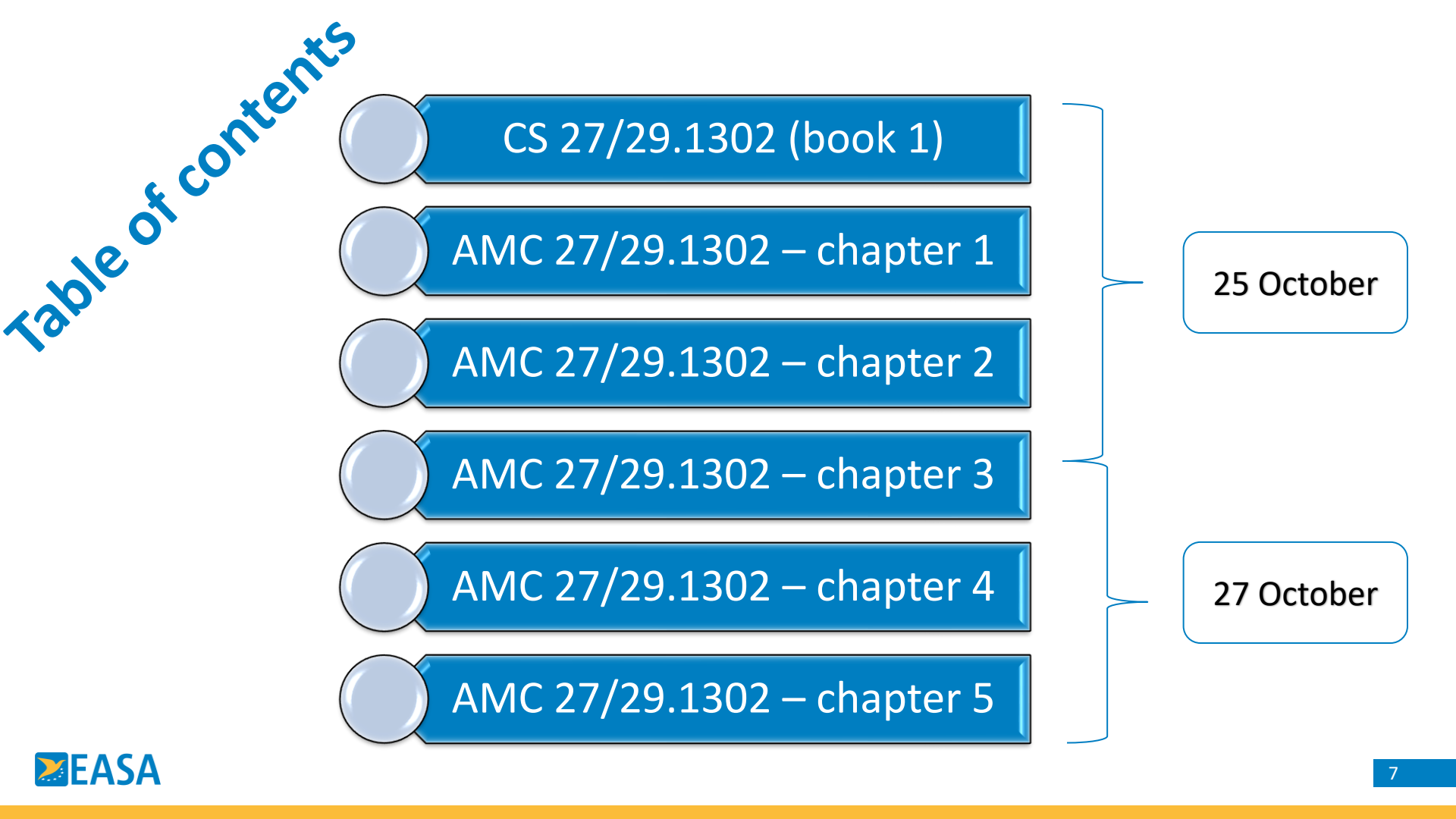
Flight Test Pilot & Human Factors Expert



Mathilde Labatut
Human Factors Expert

Julien Rocchi
Human Factors Expert

Table of contents



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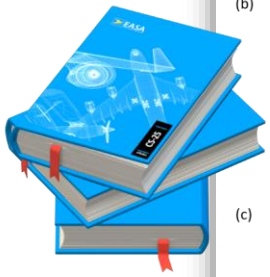
CS 27/29.1302

CS 27/29.1302



CS 27.1302 Installed systems and equipment for use by the crew

(See AMC 27.1302, GM No 1 and No 2 to 27.1302)

This point applies to installed equipment intended for use by crew members in the operation of the rotorcraft from their normal seating positions in the cockpit or operating positions in the cabin. This installed equipment must be shown, individually and in combination with other such equipment, to be designed so that trained crew members can safely perform their tasks associated with the intended function of the equipment by meeting the following requirements:

(a) All the controls and information necessary to accomplish these tasks must be provided;

(b) All the controls and information required by paragraph (a), which are intended for use by the crew, must:

(1) be presented in a clear and unambiguous form, at a resolution and with a precision appropriate to the task;

(2) be accessible and usable by the crew in a manner consistent with the urgency, frequency, and duration of their tasks; and

(3) make the crew aware of the effects that their actions may have on the rotorcraft or systems, if they need awareness for safe operation.

(c) Operationally relevant behaviour of the installed equipment must be:

(1) predictable and unambiguous; and

(2) designed to enable the crew to intervene in a manner appropriate to accomplish the task.

(d) Installed equipment must enable the crew to manage the errors resulting from the kinds of crew interactions with the equipment that can be reasonably expected in service, assuming the crew is acting in good faith. Paragraph (d) does not apply to skill-related errors associated with the manual control of the rotorcraft.

CS 27.1302

REDUCE DESIGN CONTRIBUTION TO HUMAN ERROR

SUPPORT ERROR MANAGEMENT

IMPROVEMENT OF HUMAN MACHINE INTERFACE

CS 27/29.1302

- CS 25.1302 used as a basis for the RMT.

- Slight wording differences at CS level:
  - Cabin operators considered as crew members
  - Change “flight deck” with cockpit
  - In paragraph (d) “*To the extent practicable*” has been removed.

- CS 27 & CS 29.1302 are strictly identical.

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AMC 27/29.1302 Chapter 1

Introduction

Main definitions

Assessment

The process of finding and interpreting evidence to be used by the applicant in order to establish compliance with a specification.

Cabin Vs Cockpit

Cabin: The area of the aircraft, excluding the cockpit, where the crew members can operate the rotorcraft systems.

Cockpit: The area of the aircraft where the flight crew members work and where the primary flight controls are located.

Crew Member

A person that is involved in the operation of the aircraft and its systems; in the case of rotorcraft, the operator in the cabin that can interfere with the cockpit-crew tasks

Main definitions

Design Feature vs Design Item

A design feature is an attribute or a characteristic of a design.

A design item is a system, an equipment, a function, a component or a design feature.

Design-related Human Performance issue

A deficiency that results from the interaction between the crew and the system.

Operationnally relevant behaviour

Sub-part of the system behaviour that is relevant and necessary for the crew to build the situation awareness, to plan the actions and operate the rotorcraft.

AMC 27/29.1302
Chapter 2

Relation between CS 29.1302 and other specifications and assumptions

Background

→ Before the introduction of 1302, CS 27 and CS 29 had already some **specific HF requirements with associated AMCs** (see next slides for more details).

→ To better support the implementation of these requirements, the MG 20 was introduced some years ago in the AC 29 and AC 27.

→ However, these requirements with their associated AMCs and the MG 20 are not providing a fully structured approach to address the HF issues in design.

→ In some European projects the gap was somehow filled through dedicated Means of Compliance CRIs. For US projects the FAA made use of the cockpit integration team tool.

HF elements already included in rotorcraft CSs (1 of 2)

- Physical ergonomic/anthropometric related criteria

  Controls located, designed and arranged so that:
  - The pilots can easily see (visible to the pilot) and reach (accessible)
  - The pilots can interact without interference from the cockpit structure or the pilot's clothing
  - To prevent inadvertent operation
  - To prevent confusion (between controls)
  - Easily readable and distinguishable
- External view:
  - Sufficiently extensive clear and undistorted view
  - Free from glare and reflections that could interfere with the pilot's vision

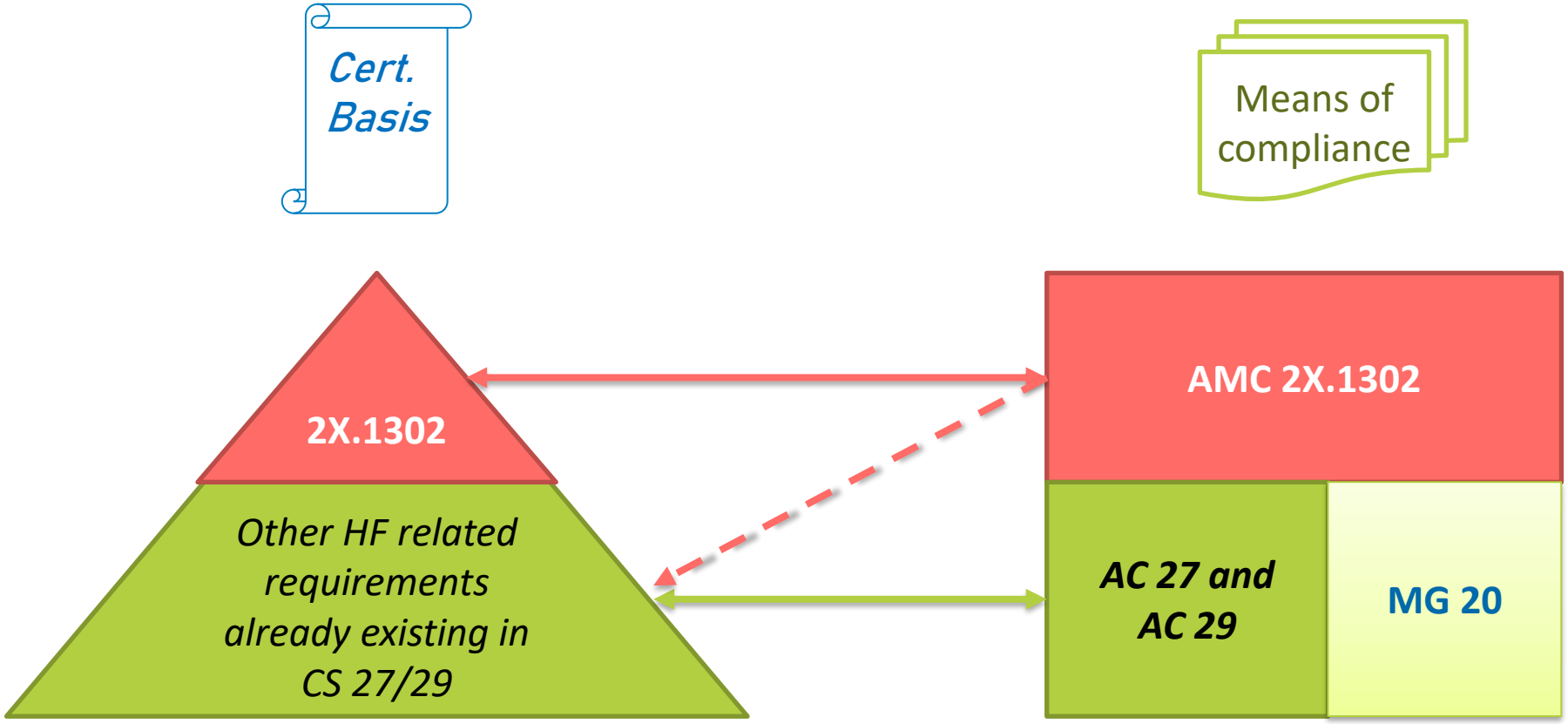
HF elements already included in rotorcraft CSs (2 of 2)

- Cognitive ergonomics related criteria
  - Workload issues:
    - Perform his duties without unreasonable concentration or fatigue
  - Usable:
    - Accessibility, ease and smoothness of operation
    - Properly labelled
  - Error management:
    - Be designed to minimise crew errors
    - To prevent confusion and inadvertent operation

Some points worth to be noted:

- → Compliance with HF elements already included in rotorcraft CSs is not sufficient to show compliance with the new 27/29.1302.
- → The material included in MG-20 is not sufficient to demonstrate compliance with CS 27/29.1302.
- → The new AMC 27/29.1302 provides also additional elements that the applicant should consider when showing compliance with the other HF related requirements. However, in case of conflict, for these requirements the related AMC take precedence.
- → Where means of compliance in other AMCs are provided for specific equipment and systems, those means are assumed to take precedence if a conflict exists with AMC 27/29.1302.

To summarise:



Fundamental assumptions behind the 1302:

Whenever a crew assessment is made, the crew members are assumed to be:

→ **Qualified crew members**

→ **Trained in the use of the installed systems and equipment**

This implies that the applicant has to fulfill these assumptions and to make the criteria for selecting the evaluators available to EASA .

What about FAA qualified crew members?

- In the EASA system a type rating is requested for all CS 27 rotorcraft. Therefore, any 1302 assessment may rely on the training required for the type rating. The type rating is not mandatory in US for this rotorcraft class. This may result in a different way to approach the assessment if not appropriately addressed;
- However, the training concept is mentioned within the AMC to guarantee that the evaluation is made by crew that know the system under assessment to the extent that there is no bias due to the lack of familiarity. It is therefore the applicant's responsibility to make sure that this achieved.


Q
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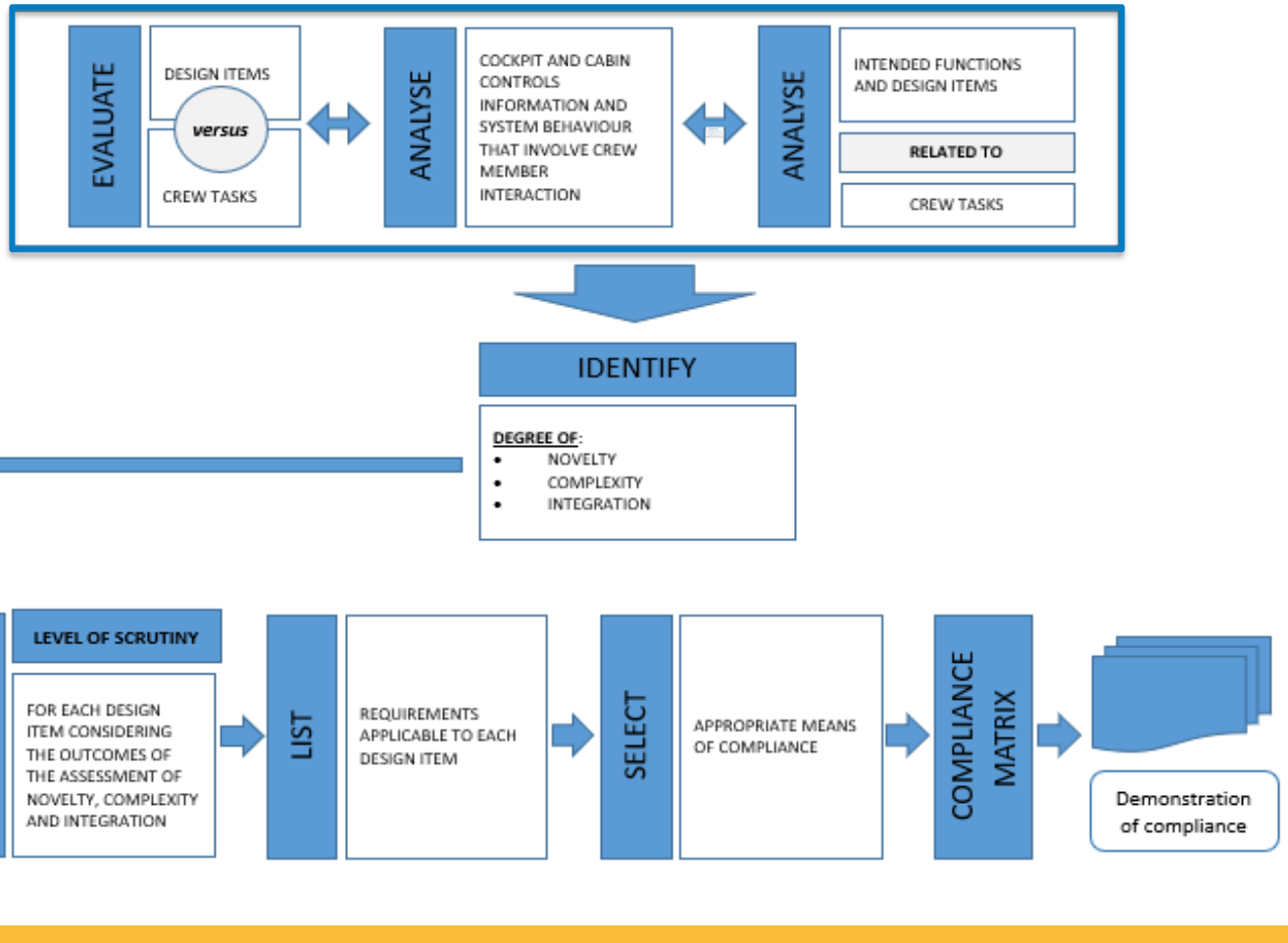
AMC 27/29.1302
Chapter 3

Human Factors Certification

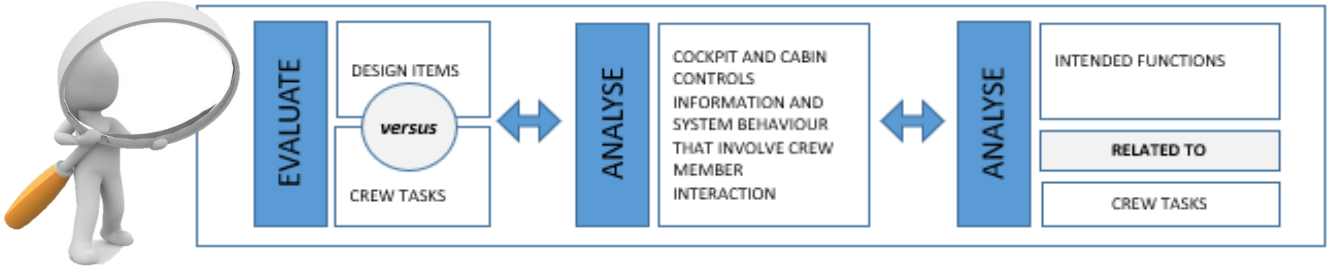
Chapter 3: Human Factors Certification

- Certification Steps & Deliverables
- Proportional Approach
- Strategy & Methodology

Overview of Certification Steps



Scope Definition



→ In order to define the scope of the investigation the applicant should complete three initial activities which does not need to be sequentially performed.

- Evaluate design items vs crew tasks
- Analyse all the design items used by the crew members with the aim of identifying the controls, information and system behaviour that involve crew member interaction.
- Analyse and document how the proposed design supports the ability of the crew members to perform the tasks associated with its intended function.

Scope Definition – TIPS & TRICKS

- Statement of the intended function should be sufficiently specific and detailed so that it is possible to evaluate whether the system is appropriate for the intended function(s) and the associated crew member tasks.

- Failing to provide a comprehensive description of the design item intended function is likely to invalidate the results that are obtained.

- The AMC provides a questionnaire that may help applicants to understand if the intended function has been sufficiently detailed (§3.2.2(d)).

Operational environment:

- Despite large aeroplanes that are always operated in IFR with a minimum crew of two pilots, helicopters may be operated in different operational scenarios (VFR, IFR) and in different types of operations (SAR, NVIS, aerial work with cargo hook and rescue hoist, …).
- This introduces an additional dimension that the applicants should take into account.
- The same design item can be used in a different way depending on the operational scenario or even not used at all.

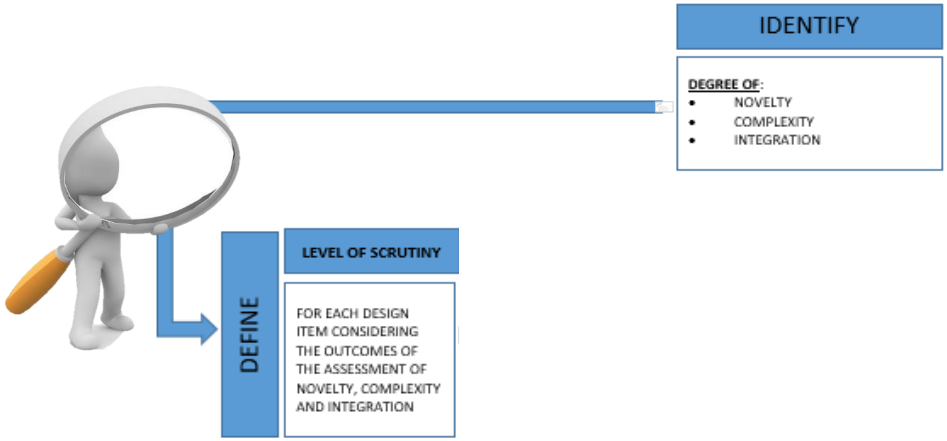
Overview of Certification Steps

EVALUATE
DESIGN ITEMS
versus
CREW TASKS
ANALYSE
COCKPIT AND CABIN CONTROLS INFORMATION AND SYSTEM BEHAVIOUR THAT INVOLVE CREW MEMBER INTERACTION
ANALYSE
INTENDED FUNCTIONS AND DESIGN ITEMS
RELATED TO
CREW TASKS

IDENTIFY
DEGREE OF:
- NOVELTY
- COMPLEXITY
- INTEGRATION

DEFINE
LEVEL OF SCRUTINY
FOR EACH DESIGN ITEM CONSIDERING THE OUTCOMES OF THE ASSESSMENT OF NOVELTY, COMPLEXITY AND INTEGRATION
LIST
REQUIREMENTS APPLICABLE TO EACH DESIGN ITEM
SELECT
APPROPRIATE MEANS OF COMPLIANCE
COMPLIANCE MATRIX
Demonstration of compliance

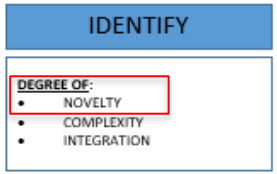
Novelty, Complexity, Integration



→ The applicant will then be required to analyse the design items using the following criteria:

- Integration
- Complexity
- Novelty

Degree of Novelty



→ The applicant should characterise the degree of novelty on the basis of the answers to the following questions:

(i) Are any new functions introduced into the cockpit design?

(ii) Does the design introduce a new intended function for an existing or a new design item?

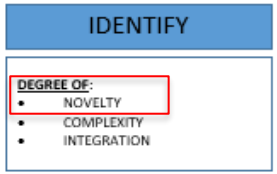
(iii) Are any new technologies introduced that affect the way the crew members interact with the systems?

(iv) Are any new design items introduced at aircraft level that affect crew member tasks?

(v) Are any unusual procedures needed as a result of the introduction of a new design item?

(vi) Does the design introduce a new way for the crew members to interact with the system?

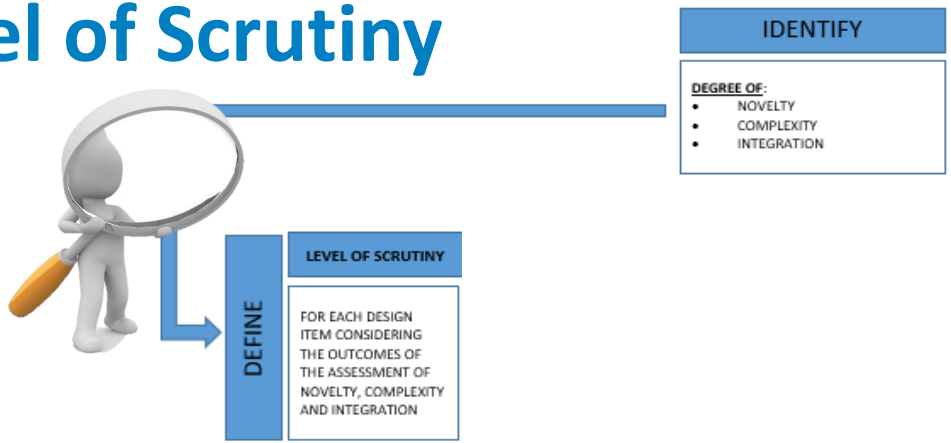
Novelty – Reference product



→ Each negative response should be justified by the applicant identifying the reference product that has been considered. The reference product can be an avionics suite or an entire cockpit previously certified by the same applicant.

→ The degree of novelty should be proportionate to the number of positive answers to the above questions.

Level of Scrutiny



→ The depth and extent of the HF investigation to be performed in order to demonstrate compliance with CS 27/29.1302 is driven by the level of scrutiny.

→ The level of scrutiny is determined on the basis of the Novelty, Complexity & Integrations analysis.

→ It is expected that the level of scrutiny should increase with higher degrees of novelty, complexity or integration of the design.

Level of Scrutiny – TIPS & TRICKS

- Do NOT overlook integration aspects: both design items and crew tasks should be considered when assessing the integration aspects
- Do NOT use a novelty aspect as an entry point. All design items need to go through integration and complexity analysis.
- The absence of in-service events should not be used to exclude an item from the scope of scrutiny.

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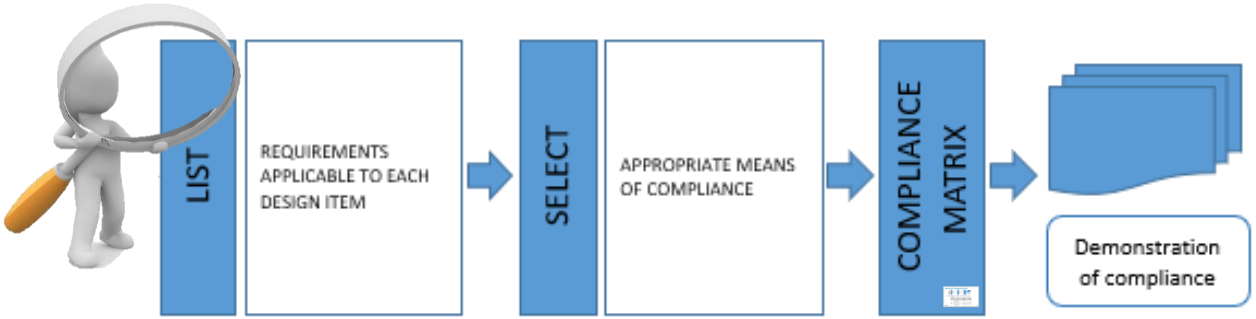
COMPLIANCE MATRIX

Demonstration of compliance

Applicable HF Requirements & MCs



→ HF design requirements applicable to each design item for which compliance must be demonstrated.

Level of Scrutiny = Demonstration of compliance effort.

Applicable HF Requirements & MCs

→ The following table is an example of a possible implementation.

Weather Radar						
Sub-Function	**HF issue**	**Test or evaluation objective**	**Requirement**	**HF attribute (if applicable) §4 AMC 29.1302**	**MOC**	**Reference to related deliverable**
Primary and secondary weather	Presentation of both primary and secondary weather info induce clutter on MAP and HSI and may confuse the crew	to ensure that design supports ease of identification between primary and secondary weather	CS29.1302(b)	CONTROLS (§4.2) INFORMATION (§4.3) INTEGRATION (§4.6)	MOC 8 All HFs simulator evaluations	HF analysis §XXX HF Test Report §XXX

HF Requirements & MCs – TIPS & TRICKS

- Avoid too high level HF Objective
- Do NOT make too much use of analysis (MOC2)
- Both abnormal/emergency and normal conditions should be considered
- Avoid using a single test aiming at covering too high number of HF objectives
- HF certification strategy based only on one assessment is generally not sufficient

Deliverables

HF Certification Program

- Certification process
- Tests Scheduling
- Outputs and agreements

HF Test Program

- Experimental protocol for each assessment
- HF objectives
- Expected crew member behaviour
- Scenarios expected to be run.

HF Test Report

- Summary of the test conditions
- Description of the data gathered with the link to the HF objectives
- In-depth analyses of the observed HF findings
- Conclusions / Mitigations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Chapter 3: Human Factors Certification

- Certification Steps & Deliverables
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Proportional Approach in the compliance demonstration

- The approach embedded within the AMC assumes that the first part of the HF exercise required by 2X.1302, the one that has as output the determination of the level of scrutiny and definition of the means of compliance, has to be applied for all new types and changes.
- As a matter of fact, this part of the exercise is the core of the approach and it applies independently from the aircraft characteristics.
- However, in order to take into account the wide range of rotorcraft that fall under CS 27 and CS 29, some alleviations have been introduced in the compliance demonstration process.
- Considering the applicability of CS 27 and CS 29, the two sets of alleviations are different.

Proportional Approach in the compliance demonstration

The underlying assumption behind the proportional approach is that for new types and for major changes the driving factors are different as summarized below:

- **New types.** The alleviations depends on the Category of approval (A or B) and kinds of operations (VFR or IFR). No alleviations are foreseen for Category A or IFR because of the complexity of the cockpit and of the crew tasks for these machines.

- **Major Changes.** In line with the general approach of Part 21, the alleviations depends on the change classification (significant or non-significant). The general approach is that for significant changes the applicant should follow the same process that is applicable for the type.

Proportional Approach for CS 27 rotorcraft

New Types: alleviations are allowed for the following cases:

- CS 27 to be approved only for ***Category B*** and ***VFR***.

Major Changes: alleviations are only allowed for:

- ***non-significant*** changes.

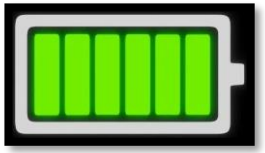
Three alleviations are possible:

- A dedicated HF test program is not required
- A single occurrence of a test is allowed
- A scenario based assessment can be carried out by a single crew

Alleviations for CS 27 new types

IFR or Category A → No alleviations

Category B and VFR → All alleviations apply

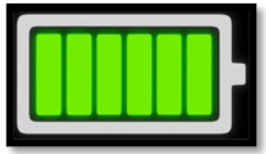


This is typically the case of single engine rotorcraft or rotorcraft whose design is not compatible with a future IFR approval

Alleviations for major changes to CS 27

Significant changes → The same alleviations applicable to new types apply

Non-significant changes → All the alleviations apply



Proportional Approach for CS 29 rotorcraft

New Types: alleviations are allowed for the following cases:

- CS 29 to be approved only for ***Category B*** and ***VFR, if the characteristics or types of operations justify it***.

Major Changes: alleviations are only allowed for:

- ***non-significant*** changes.

Two alleviations are possible:

- A dedicated HF test program is not required
- A single occurrence of a test is allowed

Alleviations for CS 29 new types

IFR or Category A → No alleviations

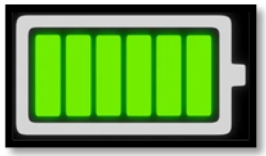
Category B and VFR → To be agreed on a case-by-case

This may be the case of rotorcraft designed for special purposes as fire-fighting or aerial work, typically not intended to be used for pax transportation

Alleviations for major changes to CS 29

Significant changes → The same alleviations applicable to new types apply

Non-significant changes → All the alleviations apply



Some practical examples (CS 27):

A CS 27 single engine rotorcraft to be approved at the time of the TC for VFR only ***may take*** advantage of all the 3 available alleviations for a CS 27.

However, if after the TC, the applicant wants to get EASA approval for IFR, this constitutes a significant change bringing the rotorcraft into the final status of Category B IFR.

Therefore, according to the proportionality criteria included in the AMC, for this second certification step, the applicant is not entitled to alleviations.

The applicant of a single engine helicopter should look for alleviations if and only if there is not plan to further develop the project to get IFR approval.

Some practical examples (CS 29):

A CS 29 dual engine rotorcraft was approved at the time of the TC for IFR with a minimum crew of two pilots. At the time of TC the 29.1302 was not yet published and therefore it was not part of the Certification Basis.

After the TC and after the date of entry in force of 29.1302, the applicant wants to get EASA approval for single pilot IFR; this constitutes a significant change even if the rotorcraft was already IFR approved.

Therefore, according to Part 21 and to the proportionality criteria included in the AMC, for this second certification step, the applicant has to apply 29.1302 and is not entitled to alleviations.


Q
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END of FIRST DAY

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Second part

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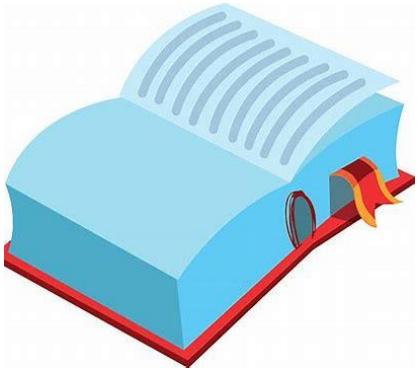

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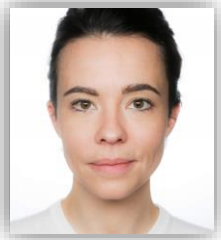

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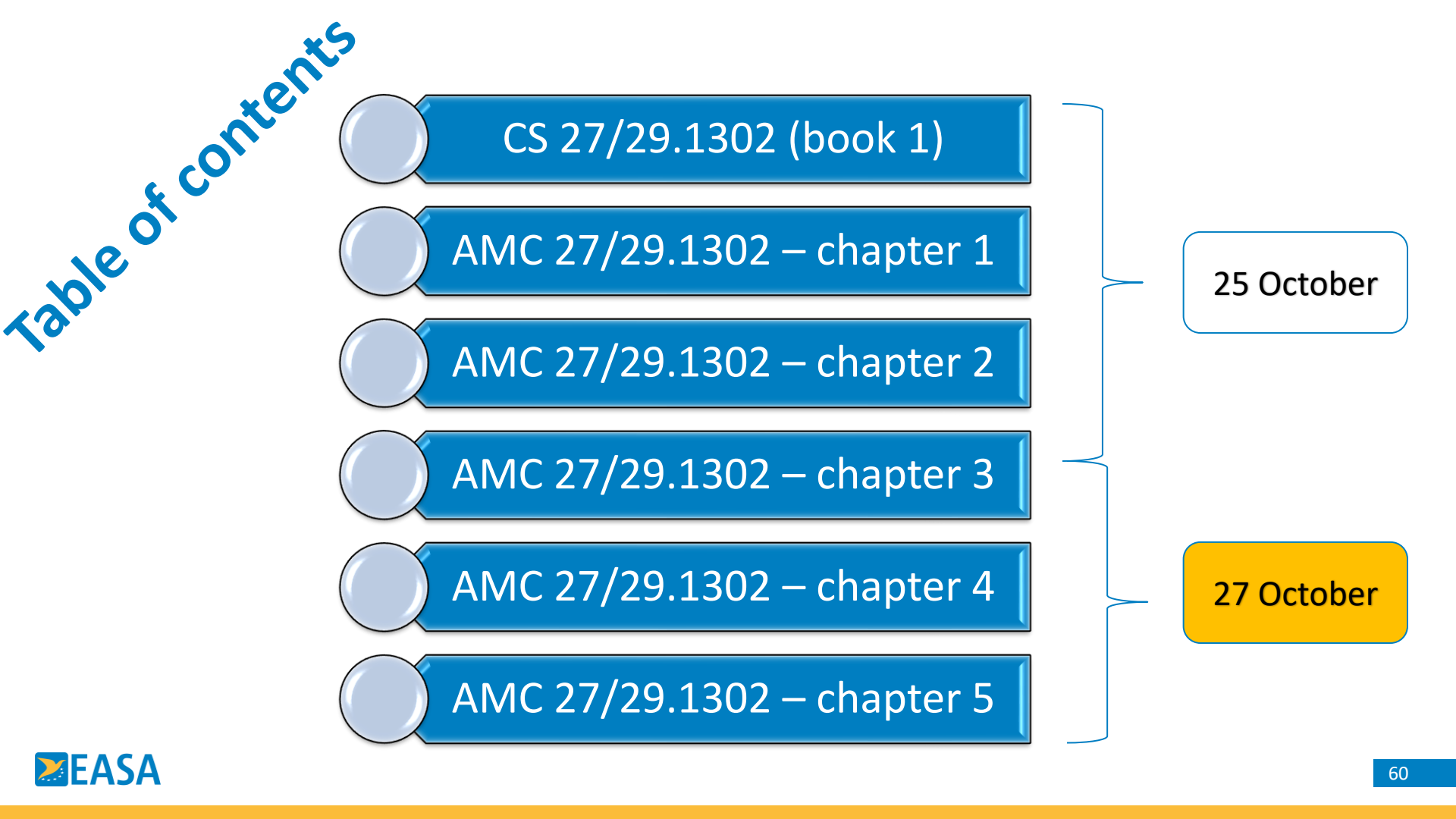
Table of contents

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Chapter 3

- Certification Steps & Deliverables
- Proportional Approach
- Strategy & Methodology

Certification Strategy

- Iterative process (design-assessment cycles).
- No strategy based on a unique final evaluation
- EASA to be involved as soon as possible during the development process
- Credits from supplier data

Methodology: Scenario-based approach

Sample of various crews: Representative of the future users.

No HF assessments performed with a single crew

Sterile environment

Methodology: Training & Briefing

- Adequate crew training prior to every assessment.

- An initial briefing should be given to the crew members:
  - Practical information,
  - Expectations wrt crew behavior,
  - Limitations of the facility.

- No briefing on failures and scenario details

Methodology: Data Collection

Objective Data

- Collected through direct observation
- Not limited to Human Errors

Non optimal strategies

Misunderstanding

Hesitations

Human errors

Subjective Data

- Collected during the debriefing
- Data that cannot be observed
- Facilitate understanding of the objective data.

Other Tools

- Questionnaire / rating scales → Complementary means only.
- No sufficient to rely solely on self administered questionnaires.

Methodology: Workload Consideration

Under 27/29.1523

- Objective of demonstrating minimum flight crew requirements.

Under 27/29.1302

- One parameters among others
- Highlight potential <u>usability problems</u>

Not limited to workload alone

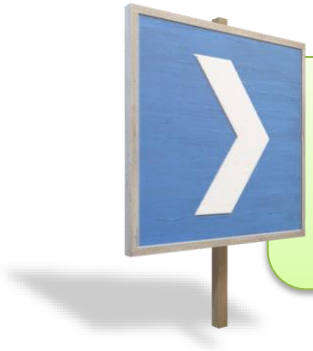
No direct conclusion

Methodology: Debriefings

Allow HF observers to gather all the necessary data to be used for HF analyses.

Non-directive / semi-directive interviewing techniques

Avoid experimental biases



All HF-related concerns should be recorded / investigated / analyzed


Q
A

EASA
European Union Aviation Safety Agency

AMC 27/29.1302
Chapter 4:

Design consideration and guidance

Introduction

→ The material presented in Chapter 4 provides the standards which should be applied in order to design a cockpit that is in line with the objectives of CS 27/29.1302.

→ Not all the criteria can or should be met by all systems. Applicants should use their judgment and experience in determining which design standard should apply to each part of the design in each situation.

SET THE SCENE…

The following provide a cross reference between Chapter 4 and the requirements listed in CS 29/27.1302:

- 4.2 ‘Controls’ mainly relates to 1302(a) and (b);
- 4.3 ‘Presentation of information’ mainly relates to 1302(a) and (b);
- 4.4 ‘System behaviour’ mainly relates to 1302(c); and
- 4.5 ‘Error management’ mainly relates to 1302(d).

Additionally, specific considerations on integration are given in paragraph 4.6.

4.2 Controls (1/2)

The clear and unambiguous presentation of control-related information

- ❑ Distinguishable and predictable controls

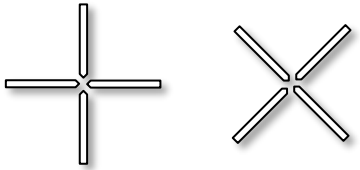
LG lever shape (wheel)

Rotor brake switch (mechanical vs/ electrical)

- ❑ Labelling

- ❑ Interactions of multiple control

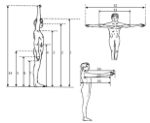
Priority logics for two cursor-control devices accessing the same display.



Coupling side feedback

The accessibility of controls

- ❑ Access to necessary controls by each crew member of the minimum flight crew



4.2 Controls (2/2)

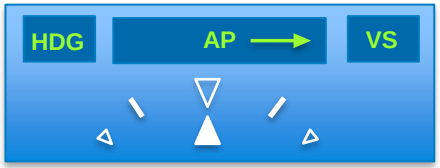
The use of controls

- ❑ Environmental factors affecting the controls
  - •Turbulence, fume, smoke
- ❑ Control display compatibility

Knobs rotation
motion vs/ effect on
display.

Provide an adequate feedback of the effects of the crew actions

- ❑ AP activation Light on control + mode annunciation on PFD



PARAMETER CHANGING

Rotator knob with small mechanical clicks felt when turning

Range changing linked to the velocity of the rotation of the rotator knob

4.3 Presentation of information (1/2)

The clear and unambiguous presentation of information

❑ Display formats include the type of information the crew member needs for the task, specifically with regard to the required speed and precision of reading.

VTOSS, VY, VNE
marks on Speed tape

Display readability

❑ Ensure information can be perceived in all environmental conditions (Vibration, Day/Night, sunrise/sunset)

Colors

❑ Reinforce the presentation of information through colour coding to reduce interpretation time: cockpit philosophy


HDG
ANAV
ALT
GPS
PILOT
ALT HOLD
GS 0
TAS 0
SAT 26
188
1022 HPA
GPS2
LFMI
312°
1,2 NM
VOR2
VOR1
GPS1
LFMI
312°
1,2 NM

4.3 Presentation of information (2/2)

Symbology, text, and auditory messages

❑ Use of established standards with conventional meanings

The accessibility and usability of information

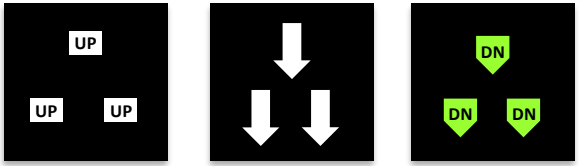
❑ Accessible and usable by the crew members in a manner appropriate to the urgency, frequency, and duration of their tasks.

❑ Clutter

- Prioritize information to avoid visual cluttering or auditory competition to reduce flight crew interpretation time and information confusion

❑ System response time

- Response to a control input is fast enough to allow the crew members to complete the task at an acceptable level of performance. If system response is delayed, feedback should be provided to the crew.

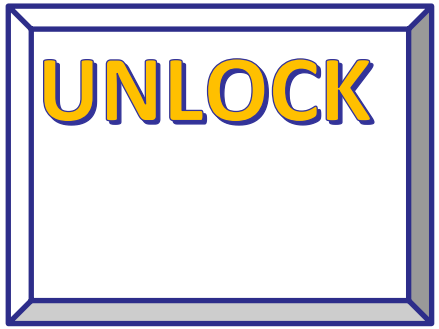


HIDDEN PARAMETER CHANGING


LPV
VNAV
FMS APPR
AP/YD
126
180
160
140
126
100
80
60
10000
25000
20000
15200
10000
05000
1500
29.92
IN
FMS1
MOLRE
066°
2.2 NM
0+01
03
066
E
018


LNAV V
FMS APPR
AP/YD
126
180
160
140
126
100
80
60
10000
25000
20000
15200
10000
05000
1500
29.92
IN
FMS1
MOLRE
066°
2.2 NM
0+01
03
066
E
018

Controls / System response time



Nose/tail landing gear locking device

Controls / System response time

Nose/tail landing gear locking device

4.4 System Behaviour

Avoid excessive complexity

❑ Ease understanding and enable adequate modes awareness

Guidance & upper modes annunciation on PFD

LNAV | VNAV | LNVA | VNVA

LNAV | VNAVb | LNV

Appropriate tasks allocation between system and flight crew

❑ **Adequate level of workload** in both normal and abnormal conditions:

- Auto hovering, low speed mode, TAC mode, **Automatic CAT A TKF**

❑**Support flight crew understanding**:

- enhanced AP modes (FBW mixed laws, TRC vs RC)
- Heading change vs rotorcraft turn

❑Allow **flight crew supervision and intervention**

The system behaviour should not necessarily reflect the functional logic but user needs

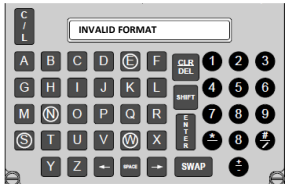
❑ Actual system status of a function in AUTO mode may not require crew awareness (e.g. anti-ice protection system, bleed valve).


HDG
PUSH SYNC
1
2
3

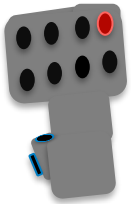
4.4 Crew Error Management

Error detection

❑ Feedback



❑ Alert



FAST CUT OFF
AFCS

Error recovery

❑ Reversible

❑ Mitigated

AP to SAS
GONG

SAS to AP

Error effect

❑ Evident to the crew

❑ Do not impact safety

SAS or advisory

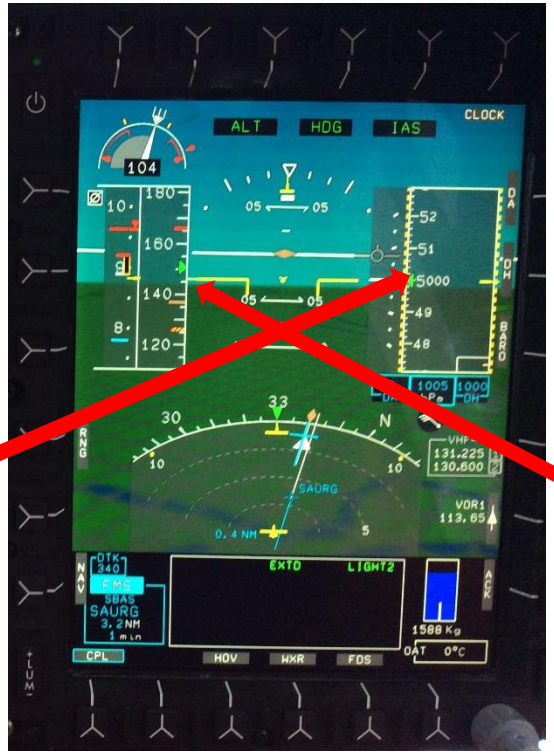
Precluding Error

❑ For irreversible errors with potential safety impact, means to prevent errors are recommended

- Switch guard, **double click**, interlock, **confirmation action**

Double click
OR
Confirmation

❑ Removal or alert on inaccurate or misleading information (crossed information or flag on PFD)


ALT
HDG
IAS
CLOCK
104
180
160
140
120
52
51
5000
49
48
1005
1000
33
30
N
10
10
SAURG
0.4 NM
5
VHF
131.225
130.600
VOR1
113.65
OTK
340
EMS
SAURG
3.2 NM
1 min
EXTD
LIGHT2
1588 Kg
OAT 0°C
CPL
HDV
WXR
FDS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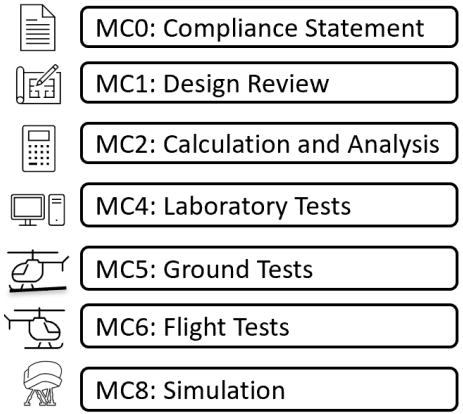
AMC 27/29.1302
Chapter 5

Means of Compliance

AMC Chapter 5 – Overview

- This chapter of the AMC provides specific guidance for the selection and use of the Means of Compliance (MC) in the Human Factors compliance demonstration process. Seven MCs are discussed in details:



- Credit from previous certification processes is discussed
- Representativeness of test article is addressed.

Certification Credit (1/2)

Two key elements need be assessed by the applicant when claiming certification credit from previous approvals:

→ The reference product

→ The certification basis applicable to the reference product

Certification Credit (2/2)

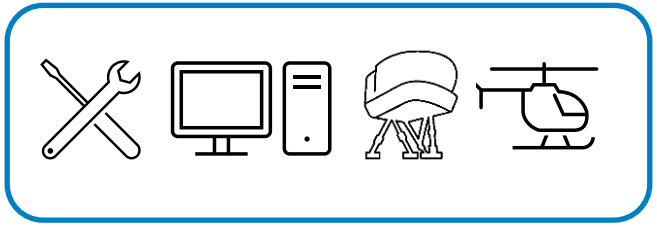
The reference product is expected to be another product certified by the same applicant in previous certification process with EASA

- As a general principle, no credit should be claimed if:
  - The design item was certified by another applicant or
  - The design item has not been previously certified by EASA

- However, on a "*case by case*", credit can be given to activities carried out by equipment suppliers if at the beginning of the process there is an agreement with EASA and a work share is established between the applicant and the supplier.

Test Article Representativeness

MCs



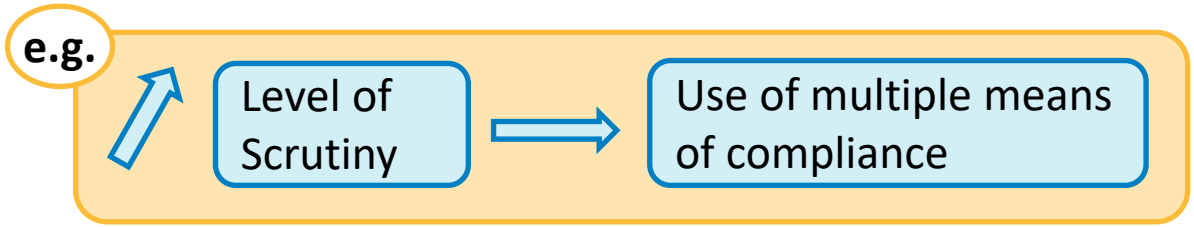
The representativeness in the early stage of the development:
Not a key driver!

Should not prevent the authority involvement

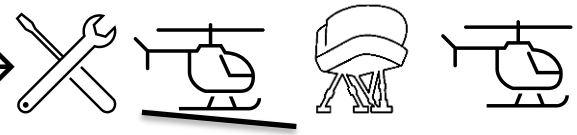
- Deviations from the intended final design need to be known and monitored.
- Deviations should not compromise the validity of the data to be collected.

Selection of the MCs

→ No generic method to determine the appropriate means of compliance for a specific project.

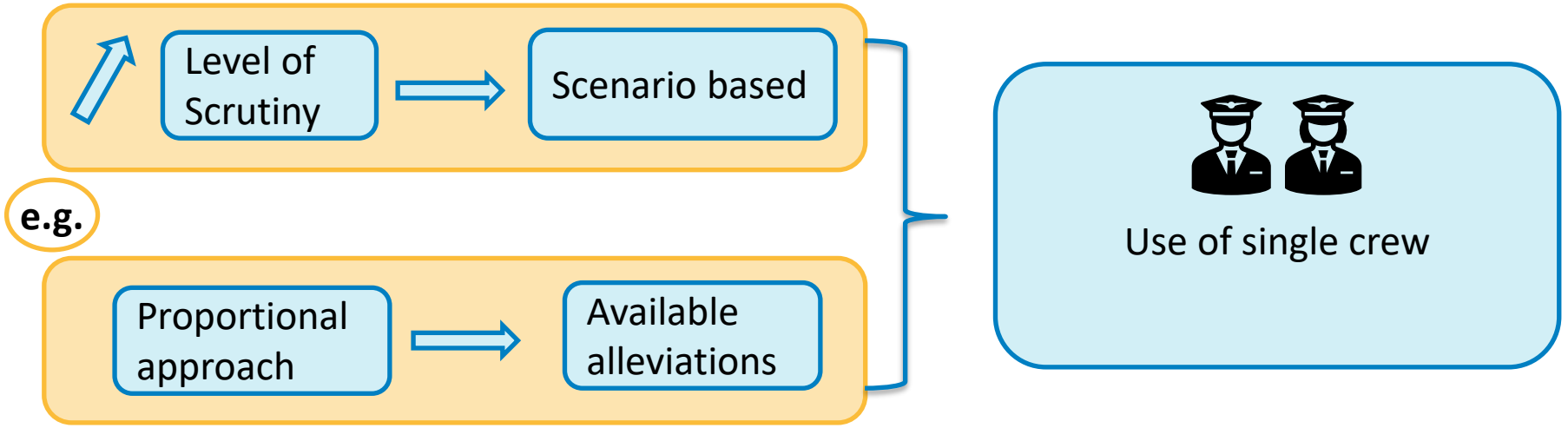


When scenario based methodology is used →



Assessment of Alleviations Applicability

→ Selected MC vs Available Alleviations



MC0: Compliance Statement based on similarity

Uses

- Similar design items already certified by the same applicant.
- Similarity can be claimed for the entire item or some parts.
- May be used in combination with other MCs.

Tips

- May not be enough to evaluate the integration criteria.
- Re-assessment may be required.

MC1: Design Review

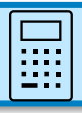
Uses

- Drawings
- Configuration Description
- Design Philosophy

Tips

- Use of MC1 as the sole means has to be carefully evaluated.
- Each of the described means has limits.

MC2: Calculation / Analysis



Uses

- Analysis of specific or overall aspects of the human interface of the product, system, cockpit.

Tips

- This MC should be complemented by other MCs when required.

MC4: Laboratory Tests

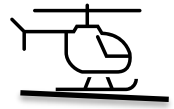
Uses

- **Mock-ups** for physical layout assessment.
- **Benches** for system's characteristics assessment.

Tips

- Do not use Bench tests or mock-ups to assess complex cognitive issues.

MC5: Ground Tests



Uses

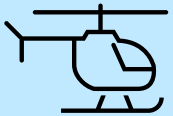
- An assessment conducted on a prototype (flight test article) on ground.

e.g. Windshield reflections

Tips

- Do not use Ground Tests to assess complex cognitive issues.

MC6 and MC8: Flight Tests and Simulation (1/2)

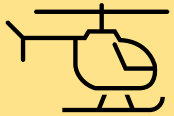


Uses

- At an early stage of the program or during the development
- Different types of simulators can be used (Static, Full motion…)
- Could be used for Scenario Based approach
- Close to real operational environment

- Simulator: Present an integrated emulation of the cockpit and the operational environment.
- In-flight testing is the most realistic testing environment.

MC6 and MC8: Flight Tests and Simulation (2/2)



Tips: Flight Test vs Simulator

Flight Test:
- Actual cockpit environment
- Actual level of system integration
- External conditions/inputs may be difficult to be replicated

Simulator:
- May not be fully representative of the entire cockpit but external conditions/inputs may be more easily replicated
- Some failure cases may only be assessed on MC8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Thanks for your attention

easa.europa.eu/connect

Your safety is our mission.

An Agency of the European Union