European Union Aviation Safety Agency

Comment-Response Document 2018-09

Regular update of AMC-20: AMC 20-152 on Airborne Electronic Hardware and AMC 20-189 on Management of Open Problem Report

RELATED NPA: 2018-09 — RMT.0643 — 23.7.2020

EXECUTIVE SUMMARY

This Comment-Response Document (CRD) contains the comments received on Notice of Proposed Amendment (NPA) 2019-02, and the individual responses provided to them by the European Union Aviation Safety Agency (EASA).

The summary in this CRD highlights the most substantial comments received and the corresponding EASA responses.

Based on these comments, EASA has made some changes to the proposed amendments to AMC-20.

Action area:	Regular updates/review of rules		
Affected rules:	EASA AMC-20: General acceptable means of compliance for airworthiness of products, parts and appliances; FAA AC 20-152: RTCA, Inc., Document RTCA/DO-254, Design Assurance Guidance for Airborne Electronic Hardware		
Affected stakeholders:	Aircraft and equipment designers and manufacturers		
Driver:	Efficiency/proportionality	**Rulemaking group:**	No
Impact assessment:	None	**Rulemaking Procedure:**	Standard

Table of contents

1. Summary of the outcome of the consultation

420 comments were made by 33 stakeholders from national aviation authorities, organisations, industry companies and associations, and certification service providers.

The commentators are in general supportive of the proposed new AMC 20-152A and AMC 20-189, and of the harmonisation effort.

None of the comments has expressed any disagreement with the proposal or raised any controversy.

Further to the comments received, the text proposed in the NPA has been modified in some parts, for improvement or clarification purposes.

The individual comments and EASA's responses to them are provided in Chapter 2 of this CRD.

2. Individual comments and responses

In responding to the comments, the following standard terminology has been applied to attest EASA's position:

(a) **Accepted** — EASA agrees with the comment and any proposed amendment is wholly transferred to the revised text.

(b) **Partially accepted** — EASA either partially agrees with the comment, or agrees with it but the proposed amendment is only partially transferred to the revised text.

(c) **Noted** — EASA acknowledges the comment, but no change to the existing text is considered to be necessary.

(d) **Not accepted** — The comment or proposed amendment is not agreed by EASA.

(General Comments)

comment	*4* comment by: *DGAC Deputy Head of aircraft and operations rulemaking department* Please note that DGAC France has no specific comments on this NPA.
response	Noted

comment	*10* comment by: *FAA* The proposed update to AMC-20 would significantly increase the harmonization between EASA and the FAA, have no safety, social or environmental impacts, and provide economic benefits by streamlining the certifcation process. The FAA concurs with the proposed changes, with no comment.
response	Noted

comment	*36* comment by: *Sikorsky Aircraft* Are the objectives defined in AMC/AC 20-152A (11 for custom devices, 6 for COTS IP, and 8 for COTS devices) considered additional to the guidance defined by DO-254? In other words, if an applicant elects to follow AC 20-152A as a means of compliance to the applicable airworthiness regulations, then must the applicant show evidence of meeting DO-254 objectives and the objectives defined within this AC?
response	Noted. As stated in **[**AMC**]/[**AC**]** 20-152A Section 1.3: 'This **[**AMC**]/[**AC**]** describes when to apply EUROCAE ED-80/RTCA DO-254, and it supplements EUROCAE ED-80/RTCA DO-254 with additional guidance and clarification for the development of custom devices, including the use of commercial off-the-shelf (COTS) intellectual property (IP), and for the use of COTS devices.'

comment	*37* comment by: *Sikorsky Aircraft* What is the plan for "Conducting Airborne Electronic Hardware Reviews Job Aid" (Rev -, February 28, 2008)? Will it be updated, revamped or sunset?
response	Noted. However, this question is not considered to be within the scope of this **[**AMC**]/[**AC**]**.

comment	*38* comment by: *Sikorsky Aircraft* Does this guidance supersede, cancel, supplement or have another impact upon DO-248C Discussion Paper (DP) #9?
response	Noted. DO-248C/ED-94C is supplemental information only and is not recognised as guidance by the FAA or EASA. EASA and the FAA recognise that the DP #9 classification scheme has been used by several companies, and therefore we have provided in GM/AC 00-71 a correlation between the DP #9 classifications and those recommended in A(M)C 20-189. EASA and the FAA consider that the classification scheme presented in A(M)C 20-189 is more intuitive than that in DP #9, and therefore encourage its adoption for consistency throughout industry.

comment	*48* comment by: *Airbus Helicopters* Airbus Helicopters concurs with ASD / GAMA and AIA comments and remarks for AMC 20-152 and AMC 20-189.
response	Noted

comment	*60* comment by: *General Aviation Manufacturers Association* Attachments #1 #2 The following comments are consolidated industry comments provided by members of AIA, ASD and GAMA (Reference: GAMA18-61 and GAMA18-62 dated October 3rd and 5th, 2018 respectively).
response	Noted

comment	*67* comment by: *General Aviation Manufacturers Association* Major Comment For the clarity of the document it must be paid attention to the use of "applicant" or "stakeholder" terms which are mixed. The consequence is the difficulty to understand for whom the guidance is applicable (e.g in section §5.2, "applicant" is used whereas section §7.1 states that PR management should be performed by the stakeholder at each level) Furthermore, in refining requirements from aircraft to system to AEH/Software items there are different stakeholders and there is a hierarchy of stakeholders involved in assessing problems. However, the notion of "next level" is unclear. The more appropriate term may be "upper level". Alternatively, there may be a case where the

	impact may be between different stakeholders at the same level e.g., AEH and Software processes for the same equipment. **Proposed resolution :** Check correct use of "Applicant" and "Stakeholder" and revise as necessary. Add a definition of "stakeholder" to section 4.1. Include a reference to the differing/hierarchical levels of stakeholder as defined in section 7, or move that section 7 descriptions into the definition of stakeholder.
response	Partially accepted. The text has been reviewed for consistent use of 'stakeholder' and 'applicant'. In particular: — Section 5.2 is confirmed to be applicable to all stakeholders, and has been reworded; — the notion of levels has been removed and replaced by a more generic notion of 'affected stakeholder(s)'; — certification authorities have been removed from the list of stakeholders; — a specific definition of stakeholder is not deemed to be necessary based on the revised Section 7.

comment	*111* comment by: *General Aviation Manufacturers Association*
response	Noted. Empty comment field.

comment	*124* comment by: *FAA Consulting, Inc.* There is no mention of traceability within the NPA. This presumably means that the extension of traceability into the design and implementation that was present in the EASA CM for DAL C but not reflected in FAA guidance reverts back to the content in DO-254/ED-80 per the notes in Appendix A. Please confirm that this was intended and is not an oversight.
response	Noted. Yes, the understanding is correct.

comment	*155* comment by: *UK CAA* Thank you for the opportunity to comment on this NPA 2018-09, please be advised that are no comments from the UK CAA.
response	Noted

comment	*160* comment by: *AIRBUS* **Airbus has contributed to, and fully supports, the comments made by ASD, GAMA and AIA.**
response	Noted

comment

229 comment by: *Bell Helicopter Textron Inc*

It would be helpful to provide a summary table of the objectives definined in this guidance, showing applicability/independence by DAL (similar to annex A tables in DO-178/DO-254).

response

Not accepted.
While EASA and the FAA understand the suggestion, the objectives of this AMC/AC are supplemental to ED-80/DO-254, and they are often associated with the related sections of ED-80/DO-254. Therefore, EASA and the FAA decided, to avoid confusion, to keep the objectives individually described in their sections.

comment

247 comment by: *General Aviation Manufacturers Association*

Major Comment
General - Objectives

A(M)C's consistently use "should" rather than "shall" to denote guidance. However, the appearance of defined objectives requires a treatment that more explicitly conveys to the applicant what airworthiness authorities expect to be achieved. Instead of using "should" language in an objective, the proposal is to use a form that is consistent with the one used for objectives as stated in ED-80/DO-254, ED-12C/DO-178C, and the CRI/IP for MCP.

In the interests of keeping the suggested rewording in a single comment, the extremely limited replacement for the text of all the objective definitions is as follows below. Note that only as much of the objective is stated to show the replacement, where unchanged text is addressed as "…" in the middle and "… etc.".

Objective CD-1
For each custom device, the applicant ~~should document~~ documents in the PHAC or any related document:… etc.

Objective CD-2
The applicant ~~should propose~~ proposes a process in the PHAC or any other appropriate hardware plan to develop simple custom devices that encompass:…etc.

Objective CD-3
The applicant ~~should validate~~ validates all the custom device requirements by following the ED-80/DO-254 validation process (ED-80/DO-254, sections 6 and 10).
…
For DAL A and B development, validation activities ~~should be~~ are performed with independence.

Objective CD-4
For hardware DAL A or DAL B, the applicant ~~should review~~ reviews the detailed design in order to demonstrate …etc.

Objective CD-5
Each verification case and procedure ~~should be~~ is reviewed to confirm that it is appropriate… etc.

Objective CD-6
The applicant ~~should verify~~ verifies the timing performance of the design accounting for the temperature and power supply variations applied to the device and the semiconductor device fabrication process variations …etc.

Objective CD-7
*For DAL A or DAL B hardware, the abnormal and boundary conditions and associated expected **[**behaviour**]/[**behavior**]** of the design ~~should be~~ are defined as requirements.*

Objective CD-8
For hardware DAL A or DAL B, where HDL code coverage is used to perform elemental analysis (ED-80/DO-254, Appendix B, section 3.3.1), the applicant ~~should define~~ defines in the planning documents the detailed coverage criteria of the HDL code elements used in the design. The criteria ~~should~~ are defined to ensure coverage over the various cases of the HDL code elements used in the design …etc.

Objective CD-9:
When the applicant intends to independently assess a tool output, the applicant ~~should propose~~ proposes an independent assessment that verifies the correctness of the tool output. The independent assessment ~~should justify~~ justifies sufficient coverage of the tool output. The completeness of the tool assessment ~~should be~~ has been based on the design/implementation and/or verification objectives that the tool is used to satisfy.

Objective CD-10:
When the applicant intends to claim credit for the relevant history of a tool, sufficient data ~~should be~~ is provided to demonstrate that… etc.

Objective CD-11
When an applicant and/or hardware developer proposes to reuse PDH, the applicant ~~should use~~ uses ED-80/DO-254, section 11.1 and its subordinate paragraphs. The applicant ~~should perform~~ performs the assessments and analysis required in ED-80/DO-254, section 11.1, in order to ensure that using the PDH is valid and that the compliance shown during the previous approval was not compromised by any of the following:

The results ~~should be~~ are documented in the PHAC or any other appropriate planning document.
In the context of custom device development, any one of these three points potentially invalidates the original development assurance credit for the PDH. In case of change or modification, the applicant is required to assess these changes using ED-80/DO-254 section 11.1 and its subordinate paragraphs. When the original design assurance of the PDH is invalidated by one of the above points, the custom device ~~should be~~ is upgraded based on the assessment per ED-80/DO-254, section 11.1. When upgrading the hardware, the applicant ~~should consider~~ considers the objectives of this document that are applicable per the assessment.

Objective IP-1
The applicant ~~should select~~ selects a COTS IP that is considered to be an acceptable solution, based on at least the following criteria: …etc.

Objective IP-2
The applicant ~~should assess~~ assesses the COTS IP provider and the associated data of the COTS IP based on at least the following criteria:

When these criteria cannot be completely met using the IP provider's data, the applicant ~~should define~~ defines an appropriate development assurance activity to address the associated risk of development error. The development assurance activity ~~should be~~ is based on ED-80/DO-254 objectives.

Objective IP-3
The applicant ~~should describe~~ describes in the PHAC, or any related planning document, a hardware development assurance approach for using the COTS IP that at least includes: … etc.

Objective IP-4
The applicant ~~should describe~~ describes in the hardware verification plan, PHAC, or any related planning document, a verification strategy that ~~should encompass~~ encompasses all three of the following aspects:…etc.

Objective IP-5
The requirements related to the allocated COTS IP functions ~~should be~~ captures to an extent commensurate with the verification strategy.
In addition, derived requirements ~~should be~~ are captured to cover the following integration aspects of the COTS IP into the custom device design:
Regarding validation aspects, the COTS IP requirements ~~should be~~ are validated as a part of the validation process of the AEH custom device.

Objective IP-6
For COTS IP used in DAL A or DAL B hardware, the applicant ~~should satisfy~~ satisfies ED-80/DO-254, Appendix B. …etc.

Objective COTS-1
The applicant ~~should assess~~ assesses the complexity of the COTS devices used in the design according to the high-level criteria of section 6.3 and ~~document~~ documents the list of relevant devices, including the classification rationale. …etc.

Objective COTS-2
The applicant ~~should ensure~~ ensures that an electronic component management process exists to address the selection, qualification, and configuration management of COTS devices. The electronic component management process ~~should~~ also ~~address~~ addresses the access to component data such as the user manual, the datasheet, errata, installation manual, and access to information on changes made by the component manufacturer.
As part of the electronic component management process, for devices contributing to functions with a hardware DAL A or DAL B, the process for selecting a complex COTS device ~~should consider~~ considers the maturity of the COTS device and, where risks are identified, they ~~should be~~ are appropriately mitigated. …etc.

Objective COTS-3
When the complex COTS device is used outside the device manufacturer's specification (such as recommended operating limits), the applicant ~~should establish~~

establishes the reliability and the technical suitability of the device in the intended application.

Objective COTS-4
If the microcode is not qualified by the device manufacturer or if it is modified by the applicant, the applicant ~~should ensure~~ ensures that a means of compliance for this microcode integrated within the COTS device is proposed by the appropriate process and commensurate with the usage of the COTS device.
Objective COTS-5
The applicant ~~should assess~~ assesses the errata of the COTS device that are relevant to the use of the device in the intended application, and identify and verify the means of mitigation for those errata. If the mitigation means is not implemented in hardware, the mitigation means ~~should be~~ is fed back to and verified by the appropriate process. …etc.

Objective COTS-6
For the usage of COTS devices contributing to functions with a hardware DAL A or DAL B, the applicant ~~should identify~~ identifies the failure modes of the used functions of the device and feed these back to the system safety assessment process.

For usage of COTS devices contributing to functions with a hardware DAL A, the possible associated common modes ~~should be~~ are fed back to the system safety assessment process.

Objective COTS-7
The applicant ~~should ensure~~ ensures that the usage of the COTS device has been defined and verified according to the intended function of the hardware. This also includes the hardware-software interface and the hardware to (other) hardware interface.
When a COTS device is used in a function with a hardware DAL A or DAL B, the applicant ~~should show~~ shows that the COTS device unused functions do not compromise the integrity and availability of the COTS device used functions.

Objective COTS-8
If the complex COTS device contributes to DAL A or B functions, the applicant ~~should develop and verify~~ develops and verifies a means that ensures an appropriate mitigation is specified in the event of any inadvertent alteration of the 'critical configuration settings' of the COTS device.

response

Not accepted.
EASA and the FAA understand the proposed change; nevertheless, the use of 'should' in the objectives is found to be consistent with other published AMC/AC material.

comment

352 comment by: *THALES AVIONICS*

THALES Avionics thanks EASA & FAA for the quality of the work performed jointly for the preparation of this NPA introducing new Acceptable Means of Compliance and Guidance material to show compliance with the applicable airworthiness regulations for the Airborne Electronic Hardware and the management of Open Problem Reports. The EASA/FAA harmonization on this new A(M)C/GM aiming to replace former Issue

	Papers and Certification Review Items represents a real opportunity to improve efficiency of certification activities for all stakeholders. *THALES Avionics reviewed these proposed materials and shared its comments with other industry stakeholders in order to build a consolidated set of comments with the objective to ease the task of FAA & EASA in assessing and preparing responses. So for this reason, THALES Avionics provides a unique comment to state that we concur with GAMA comments submitted on behalf AIA, GAMA and ASD associations.*
response	Noted

comment	*362* comment by: *External/industry comments submitted thru FAA* **Segment description: All Objectives** Avoid use of "should" in all objectives, replacing the phrases with "command sounding" language that avoids both "should" or "shall" but leaves applicants with an understanding of what is expected. For example CD-1 could be reworded as "For each custom device, the applicant documents…", CD-11 could be "When an applicant and/or hardware developer proposes to reuse PDH, the applicant uses ED-80/DO-254, section 11.1 and its subordinate paragraphs. The applicant performs the assessments", and "The results are documented in the PHAC", etc. This form is also consistent with the way that objectives are defined in ED-80/DO-254, ED-12C/DO-178C, and CAST-32A. *Comment submitted on behalf of Astronautics*
response	Not accepted. See the response to comment #247.

2. In summary — why and what | 2.1. Airborne electronic hard p. 4-5

comment	*114* comment by: *FAA Consulting, Inc.* This section notes that it is the intent that this NPA once converted to an AMC will replace the current SWCEH-001. No similar statement is made for FAA Order 8110.105A although through separate correspondence it has been noted that this order will be revised not cancelled. It would be helpful to the community to understand how EASA intends to deal with the sections of SWCEH-001 not addressed in this NPA. These include: the hardware review process, LOI, Supplier oversight and CIA.
response	Noted. FAA Order 8110.105A is planned to be revised to delete Chapters 3 to 6. This AMC 20-152A will supersede EASA CM-SWCEH-001. In the same manner as with EASA CM-SWCEH-002, EASA CM-SWCEH-001 will remain available on the EASA website for projects that refer to it, and with a Note indicating that it is superseded by the ED Decision that releases the publication of AMC 20-152A.

comment	*127* comment by: *Erkan TIZLAK (TAI)*

	Certification domains include just “large aeroplanes, rotorcraft, general aviation, engines, propellers, and European technical standards order (ETSO) articles”. What about Part 23 & Part 27 Aircraft (small aeroplanes and small rotorcraft)? Would AMC 20-152A be not applied to Part 23 & Part 27 Aircraft?
response	Noted. As stated in the NPA, this AMC/AC is usable in all certification domains, including rotorcraft (CS-27 & CS-29/14 CFR Parts 27 & 29), and general aviation, which includes CS-23/14 CFR Part 23.

comment	*168* comment by: *GEAS_UK* 'As stated in section 2.1.1 'The proposed AMC 20-152A would supersede the above mentioned EASA CM-SWCEH-001". EASA CM-SWCEH-001 Rev 2, section 6 references Guidance on Single Event Effects see EASA CM-AS-004. But, It is unclear why this AC/AMC or the best practices do not cover the SEE topic on Airborne Electronic Hardware.
response	Noted. EASA does indeed address Single Event Effects (SEEs) through EASA CM-AS-004. It is correct to use that CM as guidance to address SEEs.

comment	*170* comment by: *GEAS_UK* What do you mean by "The proposed amendments would significantly reduce or eliminate the number of CRIs or issue papers in the AEH domain"? Will you expect any additional CRIs for AEH development, if so what other topics will be?
response	Noted. The EASA generic CRI on ‘The use of Multi-Core processors’ is typically an additional CRI for AEH development.

comment	*287* comment by: *Alexandre Jordan* §2.1.2:"define objectives for the AEH domain that are generic for all projects so that AEH guidance is no longer defined project by project." => Does it mean that no more specific CRI or CAI will apply to Industry for completing / clarifying topics of DO254?
response	Noted. It is indeed the intent that when AMC/AC 20-152A is applied, there will be no specific CRI for AEH. This does not preclude the need for a CRI for any future novel technology that is not addressed by the AMC/AC.

2. In summary — why and what | 2.2. Open problem rep p. 5-6

comment	*128* comment by: *Erkan TIZLAK (TAI)* Certification domains include just “large aeroplanes, rotorcraft, general aviation, engines, propellers, and European technical standards order (ETSO) articles”. What

	about Part 23 & Part 27 Aircraft (small aeroplanes and small rotorcraft)? Would AMC 20-189 be not applied to Part 23 & Part 27 Aircraft?
response	Noted. In this sentence, the term 'rotorcraft' actually covers CS/Part-27 and 29 and 'general aviation' covers CS/Part-23. As a 20-series A(M)C, it will be applicable to CS/Part-23 and 27 through a reference in the associated AMC/AC material.

comment	*255* comment by: *General Aviation Manufacturers Association* Minor Comment 2.2.1 Replacing the material currently available through Certification Memoranda EASA CM-SWCEH-001,EASA CM-SWCEH-002, and FAA Order 8110.49 proposed text - replacing the material currently available through Certification Memoranda EASA CM-SWCEH-001,EASA CM-SWCEH-002,FAA Order 8110.49 and FAA Order 8110.105. Reason: FAA Order 8110.105_revA is missing.
response	Noted. Your comment is correct. However, the NPA 2018-09 text does not need to be modified, as that section of the NPA will not be included in the final AMC/AC material. Please note that FAA Order 8110.105 will be revised to 'rev B' upon the publication of AC 20-152A.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 1. Purpo p. 7-8

comment	*35* comment by: *FAA Consulting, Inc.* Proposed NPA Text addresses both simple and complex AEH (including COTS components). Suggest deletion of the word 'complex' in the first sentence of section 1.3.
response	Accepted

comment	*129* comment by: *Erkan TIZLAK (TAI)* 1. Purpose [of this Advisory Circular (AC)]: "AMC" is missing in Title.
response	Not accepted. The EASA AMC related title is '1. Purpose'. The text in brackets here is for the FAA AC only.

comment	*209* comment by: *Pratt & Whitney Canada*

	Is compliance to this document required effective as of the date of issue of this AMC, i.e. would it be retroactively applicable to ongoing projects that have certification bases already established?
response	Noted. In general, the applicability is for new projects. When the certification basis is already agreed/established, there is no intent to retroactively apply it in a systematic manner. Applicants may elect to apply it retroactively, and then applicants are invited to discuss it with their authority.

comment	*210* comment by: *Pratt & Whitney Canada* Is this document intended to cover all of the guidance related to custom devices contained in EASA CM-SWCEH-001?
response	Noted. Yes, AMC 20-152A will replace EASA CM-SWCEH-001, including the guidance related to custom devices. Please note that AMC 20-152A focuses on the development assurance aspects.

comment	*246* comment by: *General Aviation Manufacturers Association* Editorial 1.2 Missing “[AMC]/[AC]” after "This"
response	Accepted

comment	*356* comment by: *The Boeing Company* This comment applies to multiple section of the document. The proposed text states: "applicant" Requested Change: "applicant or equipment developer" Justification: In the context of descriptive material and objectives in AC 20-152A, the applicant will not be defining the activity, writing the plan or performing the activity. Boeing as an applicant may direct and oversee equipment developers (suppliers) in the AEH activity. Using terminology similar to “applicant or equipment developer” is used in other ACs that define means of compliance.
response	Not accepted. While EASA and the FAA understand the comment, the chosen approach has been maintained unchanged for the following two reasons: — The applicant is responsible for showing compliance with this AMC/AC. As a consequence, the suppliers and equipment developers have also indeed to address this AMC/AC when developing AEH, as already stated within the applicability in Section 2. — The readability of many sentences is improved by keeping ‘the applicant’.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 2. Applicabili p. 8

comment	*28* comment by: *GE Aviation* The Applicability is confusing since it indicates the AMC/AC is not required for circuit board assemblies, but the Appendix/AC 00-72 have section A.2.3/AC 00-72 3.3 for Electronic hardware that appears to have a method of compliance for evaluating an applicant's internal process. Moving something within a document does not make it go away. If the intent is to not have Board and Box from the EASA Cert Memo any more, then why have a section devoted to Electronic Hardware Assembly Development?
response	Accepted. A new Section 7 and objective CBA-1 have been added to clarify the need for the development assurance of CBAs.

comment	*39* comment by: *FAA Consulting, Inc.* Would suggest that the AC/AMC be made agnostic in terms of form of design approval of certification. Increasingly seeing DO-178 and DO-254 topics arise in PMA efforts yet ACs almost always exclude PMA as a form of design approval. Suggest adopting a more generalized approach to applicability in last sentence of first paragraph. Something like, "This applicability includes development of articles approved through other forms of design approval such as ETSO/TSO, and PMA." Note: the current AC 20-152 includes PMA within its scope.
response	Not accepted. Firstly, EASA has no PMA concept. The FAA considers that PMA is covered though the type certification process.

comment	*41* comment by: *FAA Consulting, Inc.* Do not agree with inclusion of the second sentence. First, an Applicant can always propose something other than what's in the AC/AMC and provide their ELOS argument. Second, by noting "a limited set of objectives may be applied" for DAL C, ambiguity is created with section 1.1 stating (for the AC) that if the AC is followed, all applicable aspects must be followed and this section suggesting something less than all. The committee that wrote DO-254/ED-80 did the broader community a great disservice (IMO) by leveling on data rather than objective. The Chicago meeting held to discuss the future of DO-254 produced a clear recommendation to move to a defined set of objectives applicable by level in any new guidelines. The language here for DAL C simply extends the confusion from the existing DO-254 to the new objectives contained herein.
response	Accepted. The applicability of the objectives to the DAL has now been clarified. Additionally, ‘a limited set of objectives may be applied’ has been replaced by ‘a limited set of objectives applies’.

comment	*42* comment by: *FAA Consulting, Inc.* Third paragraph - this effectively removes the CBA compliance that had been present in the EASA CM. This seems to be a step backward as it reintroduces a gap between the guidance in ARP4754A and DO-254 (as interpreted/extended by the objectives herein). I certainly understand that companies would like flexibility in addressing electronic hardware above the device level and that system-level development activities (requirements allocation and system verification in particular) may be adequate to address CBAs. Rather than excluding them from compliance, perhaps it would be better to frame compliance in the form of either/or, meaning you can either accomplish development assurance of CBAs via this AC/AMC guidance or utilize system-level processes as defined in ARP4754A.
response	Accepted. A new Section 7 and objective CBA-1 have been added to cover the development assurance of CBAs. A sentence referring to both the industry standards ED-80/DO-254 and ED-79/ARP 4754A has been added to the related section in the AMC Appendix B/AC 00-72.

comment	*52* comment by: *Arnaud Bouchet* According to documentary set for CBA, is DO254/Appendix A objectives being completly considered? Or can the ED-80/DO-254 objectives of Appendix A can be reduced as proposed in EASA-CM–SWCEH–001 §7.2?
response	Noted. A new Section 7 and objective CBA-1 have been added to clarify the development assurance of CBAs.

comment	*130* comment by: *Erkan TIZLAK (TAI)* 2. Applicability: It is stated that "for airborne electronic hardware contributing to functions with a hardware DAL C, a limited set of objectives may be applied." However, the objectives are given as applicable for DAL C also in AC20-152A. "may be applied" is confusing.
response	Accepted. See the response to comment #41.

comment	*161* comment by: *GEAS_UK* Generic Custom Logic dvelopments (also known as product line) are common nowadays. The previous applicant CRIs/IM had a objectives which are specific to user application for Generic Custom logic development. A guidance or objectives to follow for those practices within the AC/AMC or best practices could be beneficial for the industry.
response	Noted. It is not clear in the comment what is meant precisely by ‘Generic Custom Logic developments’.

	If it refers to the development of one generic custom device (physical hardware), the topic is addressed via the section on the reuse of previously developed hardware. This section also includes modification of the PDH. If it refers to generic RTL code development with various synthesis possibilities, the topic is considered to be part of RTL code development, and is addressed via the design and verification processes.
comment	*164* comment by: *GEAS_UK* Question for EASA, from ETSO perspective - GE Aviation would like to have some visibility as to why DAL D process objectives for CBA/LRU development are not considered as Acceptable Means of Compliance. In addition, for ETSO approval, only the best practices identify a number of activities which if performed equals to considering the internal structured process are acceptable. Should we expect any changes to the CS-ETSO following this AMC/AC to clarify this for ETSO approvals, including objectives of this internal structured process?
response	Noted. — The ED-80/DO-254 DAL D process objectives for CBA/LRU development are considered to be acceptable means of compliance (AMC), and correspond to what the GM material/AC 00-72 indicates with 'having a structured process to address the development of electronic hardware assemblies (boards or a collection of boards) that encompasses requirements capture, validation, verification, and configuration management activities.' — A new Section 7 and objective CBA-1 have been added to cover the development assurance of CBAs. — AMC 20-152A will be applicable to CS-ETSO.
comment	*197* comment by: *GEAS_UK* EASA CM-SW-CEH-001 Rev 2, section 11 references guidance for "Supplier oversight", but this has not been considered in AC/AMC. Unclear the objectives/expectations for this topic - or where these certification requirements will be covered in the future.
response	Noted. EASA and the FAA jointly agreed that supplier oversight is the responsibility of the applicant, and should be addressed by the applicant when applying their development assurance process. Supplier oversight is necessary, but outside the scope of the development assurance of AEH. Therefore, it has not been retained in the scope of this AMC/AC on the development assurance of AEH.
comment	*199* comment by: *GEAS_UK* Is there any plan to add Model Based Development in the AC/AMC or Best Practices?
response	Noted.

	Model-based development is considered to be a novel and emerging technology for AEH. This is not addressed in the current AMC/AC 20-152A, and it will be addressed on a project basis when the technology is proposed.
comment	*200* comment by: *GEAS_UK* EASA-CM-001 section 8.6 (and FAA Order 8110-105 Rev A) - modifiable aspects of Airborne Electronic Hardware Devices is not covered within the AC/AMC. Objectives or cross-references to DO-178B/C sections should be provided for these items.
response	Not accepted. Guidance for field-loadable hardware is not included because the loading function is more from a software point of view, and guidance already exists for software. See the latest revision of AMC/AC 20-115.
comment	*211* comment by: *Embraer S.A.* As this AMC/AC does not establish guidance for transitioning to it, Embraer understands that this AMC/AC is applicable only to new projects certifications. For modification of certified product, Embraer understands that the applicable CRIs and IPs will continue to be used. Suggestion is to establishes guidance for transitioning to AMC20-152A stating that this AMC/AC is applicable only to new projects certifications.
response	Not accepted. This AMC/AC 20-152A will be applicable to new certification projects. For the modification of certified products, the existing CRIs and IPs will continue to be used as long as they cover the technology that is introduced in the change. In any case, changes are discussed in a given project and with the respective authorities involved.
comment	*235* comment by: *Bell Helicopter Textron Inc* ·The following statement is not clear enough and will lead to mis-interpretation: "demonstration of compliance with the objectives described in this [AMC]/[AC] is not required for circuit board assemblies or for airborne electronic hardware contributing to functions with a hardware DAL D." · The problem is the statement only mentions the objectives defined in the AMC / AC. It should additionally state that demonstration of compliance with EUROCAE ED-80( ) and RTCA DO-254( ) are not required for circuit board assemblies or for airborne electronic hardware contributing to functions with a hardware DAL D in order to show compliance with the applicable airworthiness regulations for the electronic hardware aspects of airborne systems and equipment in [Product]/[Type] Certification or [ETSO Authorisation]/[TSO Authorization]. · Alternatively, or in addition, similar statements can be added to Section 1.1 or 1.2.
response	Partially accepted. The AMC/AC is the document that recognises ED-80/DO-254 and where/when to apply this industry standard. In addition, this AC/AMC provides objectives to supplement the industry standard.

	The AMC/AC has been updated to clarify the statement related to circuit board assemblies and DAL D hardware as follows: 'Demonstration of compliance with ~~the objectives described in~~ this AMC/AC is not required for circuit board assemblies or for airborne electronic hardware contributing to functions with a hardware DAL D.'

comment	*236* comment by: *Bell Helicopter Textron Inc* Also, the phrase "demonstration of compliance…" is ambiguous. The AMC / AC needs to clearly state whether compliance is required. Currently it only addresses whether demonstration is required.
response	Not accepted. Indeed, the phrase only refers to the demonstration of compliance. It is expected that a structured process exists to address the development of electronic hardware assemblies (boards or a collection of boards) that encompasses requirements capture, validation, verification, and configuration management activities.

comment	*248* comment by: *General Aviation Manufacturers Association* Minor Comment 2. The paragraph starting "This [AMC]/[AC] is applicable to airborne electronic hardware" mentions the applicability of objectives to DAL, but the notion of objectives and how to achieve them is not mentioned until section 4. Proposed text - Move the two sentences starting with "For airborne electronic hardware" to the end of section 4.
response	Partially accepted. The objectives are now introduced in Section 1.3, and the notion of a DAL C limited set has been kept in the applicability section.

comment	*250* comment by: *General Aviation Manufacturers Association* Major Comment 2. 3rd paragragh "is not required for circuit board assemblies or for airborne electronic hardware contributing to functions with a hardware DAL D." proposed text: "is not required for airborne electronic hardware contributing to functions with a hardware DAL D or for circuit board assemblies." reason – wording is ambiguous and could mean either a) CBA of DAL D only or b) CBA for all DAL. Plus, end of the paragraph doesn't help to understand.
response	Accepted

comment	*251* comment by: *General Aviation Manufacturers Association* Major Comment 2. 2nd paragraph Align the terminology "airborne electronic hardware" for applicability to the content in section 1.3.

	The first occurrence of “airborne electronic hardware” should be further refined by adding “that are custom devices, including the use of commercial off the shelf (COTS) intellectual property (IP), and complex COTS devices”.
response	Not accepted. Airborne electronic hardware (AEH) is not restricted to custom devices, including the use of commercial off-the-shelf (COTS) intellectual property (IP), and complex COTS devices. It is to be distinguished from the objectives introduced in this guidance that relate to custom devices, including the use of commercial off-the-shelf (COTS) intellectual property (IP), and complex COTS devices.

comment	*252* comment by: *General Aviation Manufacturers Association* Editorial AMC 20-152, Sec 2 Para 2 (Page 8) Issue: First letters of the acronym words in full form should be in upper case - "development assurance level" full form of the acronym in lower case. Solution: should be changed to "Development Assurance Level"
response	Not accepted. As regards the capitalisation of terms that are abbreviated (acronyms, initialisms), the convention followed by EASA and the FAA is to use initial capitals for proper names, titles and official names, and lower-case initials for common nouns (the existence of an acronym or initialism does not mean that initial capitals must be used when the corresponding expression is written out in full). Nevertheless, for PHAC, HCI, HAS, EASA and the FAA decided to follow the ED-80/DO-254 approach to name deliverable documents.

comment	*254* comment by: *General Aviation Manufacturers Association* Major Comment 2. Applicability, 1st paragraph “containing airborne electronic hardware (AEH)” to avoid confusion and misunderstanding for some readers, Add in Appendix A glossary an AEH definition (based on DO-254 hardware item).
response	Accepted. The definition has been added in the glossary.

comment	*271* comment by: *Embraer S.A.* The applicability section mention the term "Airborne Electronic Hardware" however it is not specified the meaning neither in the AC/AMC Appendix A. Glossary nor DO-254. Is it for Custom micro coded components and COTS devices only, or LRUs and CBAs are also included? Suggestion is to include in the Appendix A - Glossary of AC/AMC the meaning of the term "Airborne Electronic Hardware".
response	Accepted.

	See the answer to comment #254.

comment	*296* comment by: *Alexandre Jordan* If this AMC is not required for CBA and AEH contributing to function with DAL/IDAL D, do you confirm that EASA won't request (through a CRI or a CAI) the application of such guidance or equivalent for CBA and AEH contributing to DAL/IDAL D function?
response	Noted. A new Section 7 and objective CBA-1 have been added to clarify the development assurance of CBAs. It is intended that AMC 20-152A will replace CRI or CAI for board-level activities on new TC/STC projects.

comment	*363* comment by: *External/industry comments submitted thru FAA* **Segment description: 2. Applicability** The paragraph starting "This [AMC]/[AC] is applicable to airborne electronic hardware" mentions the applicability of objectives to DAL, but the notion of objectives and how to achieve them is not mentioned until section 4. Two alternative correction are proposed as follows. (A) Add a sentence in this paragraph about what is meant by "objectives" before the notion of tailoring by DAL is stated. (B) Move the two sentences starting with "For airborne electronic hardware" to the end of section 4. *Comment submitted on behalf of Astronautics*
response	Partially accepted. See the response to comment #248.

comment	*364* comment by: *External/industry comments submitted thru FAA* **Segment description: 2. Applicability** As this AMC/AC does not establish guidance for transitioning to it, Embraer understands that this AMC/AC is applicable only to new projects certifications. For modification of certified product, Embraer understands that the applicable CRIs and IPs will continue to be used. Suggestion is to establish guidance for transitioning to AMC20-152A stating that this AMC/AC is applicable only to new projects certifications. *Comment submitted on behalf of Embraer S.A*
response	Not accepted. See the response to comment #211.

comment	*365* comment by: *External/industry comments submitted thru FAA* **Segment description: 2. Applicability**

The third paragraph. The wording of the first sentence is unclear as to whether the guidance is not required for all CBAs and also for DAL D AEH or if the CBAs are also DAL D.

The paragraph starting “This [AMC]/[AC] is applicable to airborne electronic hardware” mentions the applicability of objectives to DAL, but the notion of objectives and how to achieve them is not mentioned until section 4. Two alternative correction are proposed as follows. (A) Add a sentence in this paragraph about what is meant by “objectives” before the notion of tailoring by DAL is stated. (B) Move the two sentences starting with “For airborne electronic hardware” to the end of section 4.

Comment submitted on behalf of Parker, G. Puckett
T.Reeve
Astronautics
Moog
BAE Systems
(thru US DO-254 User Group)

response

Partially accepted.
See the responses to comments #248 and #250.

comment

366 comment by: *External/industry comments submitted thru FAA*

Segment description: 2. Applicability

The applicability section mention the term "Airborne Electronic Hardware" however it is not specified the meaning neither in the AC/AMC Appendix A. Glossary nor DO-254. Is it for Custom micro coded components and COTS devices only, or LRUs and CBAs are also included? Scope and applicability are not clear enough. Wording leads one to believe all electronic hardware is applicable.

page 8, section 2, paragraph 2

Airborne Electronic Hardware should be further limited to “custom devices, including the use of commercial off the shelf (COTS) intellectual property (IP), and for the use of complex COTS devices” (copied from section 1.3)

Also, if Analog design is meant to be included under this applicability then the scoping section needs to also clarify that Analog devices are also now under DO-254 and this AC scope.

Comment submitted on behalf of
Embraer
T.Reeve
Moog
Boeing
BAE Systems
(thru US DO-254 User Group)

response	Partially accepted. See the answers to comments #251 and #254. See the answer to comment #44 regarding analogue devices.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 4. Backgrou p. 8-9

comment	*43* comment by: *FAA Consulting, Inc.* Suggest deletion of the term "complex" as the AC/AMC clearly addresses both simple and complex AEH. While it is clear the COTS Component objectives are primarily focused on complex devices, the process starts with component classification and therefore, by definition, the AC/AMC addresses simple components even if ultimately they are excluded from further consideration after the classification is accomplished. Getting the classification step right is the starting point for all that follows and must consider all devices not just those 'preselected' as being complex.
response	Accepted

comment	*256* comment by: *General Aviation Manufacturers Association* Major Comment 4. In the third paragraph, “(PHAC), or any other related document” would be better as “(PHAC) or any related planning document to be submitted”.
response	Accepted

comment	*347* comment by: *Rolls-Royce plc* Section 3.1.1 subsection 4 The last sentence states that "The applicant should document in the Plan for Hardware Aspects of Certification (PHAC), or any other related document, the process and activities that the applicant intends to perform to satisfy the objectives of this [AMC]/[AC]." This could be interpreted that company processes need to be copied into the PHAC. It is common practice to use references instead. Could the paragraph be re-worded to explicitly state that references to processes are acceptable. Suggestion: Add a clarifying sentence to the end of the paragraph: "The applicant should document in the Plan for Hardware Aspects of Certification (PHAC), or any other related document, the process and activities that the applicant intends to perform to satisfy the objectives of this [AMC]/[AC]. If the process to be followed is the applicant's published procedure then it is sufficient to provide a reference to this procedure in the planning document."
response	Not accepted.

While it is understood that there are some processes that are described in an applicant's internal procedure, it is not sufficient to provide only a reference to this procedure in the planning document. The PHAC or any other related planning document (submitted) should be self-explanatory on the process and activities that are proposed by the applicant to comply with the AMC/AC and satisfy the objectives.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5. Custom Device Developme p. 9

comment	*131* comment by: *Erkan TIZLAK (TAI)* 5. Custom Device Development: Add "for complex custom devices" to the following expression: Sections 5.5 through section 5.10 provide clarifications on ED-80/DO-254 for complex custom devices.
response	Partially accepted. The sentence has been amended to clarify that some sections are applicable to simple devices, per the content of Section 5.4.

comment	*253* comment by: *General Aviation Manufacturers Association* Editorial AMC20-152 Sec 5 Para 1 (Page 9) Issue: Full forms for PLDs, FPGAs and ASICs in all lower case. Solution: Change the first letters of the words in full form to upper case.
response	Not accepted. See the answer to comment #252.

comment	*261* comment by: *General Aviation Manufacturers Association* Minor Comment 5. For programmable logic devices (PLDs), field programmable gate arrays (FPGAs), Propose text to be simplified: for programmable logic devices (PLDs), Reason - keep PLD and ASIC because FPGA is a kind of PLD as per ED80/DO254 definition.
response	Not accepted. While it is understood that ED-80/DO-254 regroups FPGAs under PLDs, it is preferred to keep those independent in the definition of applicability for more clarity, and for consistency with the AC 20-152 revision. The industry differentiates between FPGAs and PLDs in their PHACs, in general.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.1. Applicabili p. 9

comment

44 comment by: *FAA Consulting, Inc.*

There is nothing inherently 'digital' about the custom Device objectives that follow. Therefore, it is unclear why this AC/AMC is explicitly excluding purely analog ASIC? Current literature is strongly suggesting that AI will require some 'reintroduction' of analog computing to the mainstream. It is already inherent in many machine learning algorithms. Suggest deletion of "digital or mixed-signal: and making 'device' plural.

response

Not accepted.
The risk of non-compliance due to a lack of a development assurance process is considered to be reduced for analogue devices in comparison with digital and mixed-signal devices.

comment

132 comment by: *Erkan TIZLAK (TAI)*

“2. Applicability” & “5.1. Applicability”:
There are two different “Applicability” chapters and confusing. Chapter “5.1. Applicability” can be embedded to Chapter “2. Applicability”.

response

Partially accepted.
Section 4, Background, explains that each separate topic contains an applicability section. EASA and the FAA have updated the title of the applicability section to the related scope to avoid confusion.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.2. Simple/Complex Classificati p. 9-10

comment

13 comment by: *Williams International*

The criteria in the following text is subjective and will distract from the determination of simple/complex which is adequately defined earlier in the paragraph.
“The following criteria should be used for assessing whether a device should be classified as simple:
— Simplicity of the functions and their number,
— Number of interfaces,
— Simplicity of data/signal processing or transfer functions,
— Independence of functions/blocks/stages.

Additional criteria specific to digital designs include:
— Whether the design is synchronous or asynchronous,
— The number of independent clocks,
— The number of state machines, number of states, and state transitions per state machine,
— The independence between the state machines.”

	Recommend the deletion of the text quoted above.
response	Not accepted. The criteria are given to provide guidance on a definition. The need for criteria is found to be necessary to provide guidance on the simple/complex classification of PLDs/FPGAs/ASICs, based on the experience collected from more than a decade from projects that applied ED-80/DO-254.

comment	*14* comment by: *Williams International* DAL level is already specified as a requirement in the PHAC in paragraph 10.1.1 bullet 3 in DO-254. Recommend deletion of bullet 1 from Objective CD-1
response	Not accepted. Indeed, ED-80/DO-254 already requests DAL information in the PHAC, but adding it in this objective also clarifies that it is needed for simple custom devices.

comment	*15* comment by: *Williams International* Objective CD-1 provides additional requirements for the PHAC. PHAC requirements are specified in section 10.1.1 of DO-254. Recommend changing CD-1 from an objective to clarification or addition to paragraph 10.1.1 bullet 3 of DO-254.
response	Not accepted. Section 5.3 applies ED-80/DO-254 to the development of complex devices, whereas Section 5.4 does not request ED-80/DO-254 to be applicable to simple devices. Therefore, EASA and the FAA cannot consider that Section 10.1.1 of ED-80/DO-254 also applies to simple devices. It justifies the necessity for an objective for CD-1.

comment	*49* comment by: *Arnaud Bouchet* Some designs may request a large amount of interfaces for simple function realisation. For instance, considering adress decoder with input 32 bits adress and output 24 bits adress and 8 chip select. Decoding of "chip select" is performed using the total combination of IO states on the component so (excluding reset and enable signals) 2^32 combinations are to be considered, even if function realized is very simple. So do we consider then each signal per separate blocks individually? Or can we considered also group of interfaces (for example in the case of digital bus)?
response	Noted. It is not the purpose within this CRD to assess a given simple/complex classification. The applicant is invited to develop criteria using the guideline introduced in Section 5.2 of the AMC/AC. From the example, it is obvious that some consideration may be given to the number of interfaces, as opposed to the number of signals, when the applicant develops their criteria.

comment	*50* comment by: *Arnaud Bouchet*

	Is the component itself to be evaluated outside or inside its usage domain. For example if some functions are desactivated and unused in the component, do they still contribute to the complexity analysis?
response	Noted. EASA and the FAA do not see the link between the question and Section 5.2. If the deactivated and unused functions relate to custom devices, all the embedded functions in the custom device are to be considered in the simple/complex classification. These functions should be addressed by the development assurance process.

comment	*133* comment by: *Erkan TIZLAK (TAI)* 5.2. Simple/Complex Classification: Assessment of the criteria for device simplicity should be based on quantitative attributes, not qualitative. So, it may not be possible to determine “simplicity of data/signal processing or transfer functions”. Also, it will be a confusing issue with the suppliers.
response	Noted. Classifying a device as simple needs a justification that uses a qualitative and a quantitative assessment, as the classification of a device as simple leads to a greatly reduced development assurance process. ED-80/DO-254 mentions that ‘When an item cannot be classified as simple, it should be classified as complex.’ As a consequence, if the applicant cannot justify its simplicity, then the device cannot be classified as simple.

comment	*156* comment by: *GE Aviation* Change from: ED-80/DO-254 has two definitions of a simple hardware item. Change to: ED-80/DO-254 provides a definition of a simple hardware item. Rationale: I can only identify a single definition for ‘simple HW item’ in DO-254 and I feel the presently proposed statement will cause confusion for readers of the proposed AMC/AC.
response	Partially accepted. The sentence has been amended, also considering comment #263.

comment	*242* comment by: *Dassault-Aviation* **Existing text:** "The following criteria should be used for assessing whether a device should be classified as simple" **Comment**: The added criteria for simple/complex classification add uncertainty to the definition. Criterias to be used for assessing whether a device should be classified as simple are consistent; otherwise the absence of threshold related to these criterias can be confusing

Proposed text:
"Simplicity of the functions and their number,
— Number of interfaces, (< Number or Yes / no; Evidence is given that interface description and data processing description are fully understood by the applicant);
— Simplicity of data/signal processing or transfer functions, (Yes / no, data flow process containing data processing ? Example : “reception, storage and transmission” could be simple ; data processing (computations, filtering, extractions, algorithm…) might be considered as complex.
— Independence of functions/blocks/stages. (Yes / no, Example :unidirectional transfer between blocks (no loop).)
Additional criteria specific to digital designs include:
— Whether the design is synchronous or asynchronous, (Yes / No; If the design contains asynchronous features, then it might be considered as complex.)
— The number of independent clocks, (1, If there is more than one clock domain, the design might be considered as complex)
— The number of state machines, number of states, and state transitions per state machine, (<10; If a state machine contains more than 10 states, the design might be considered as complex, The set of state machines should be understandable by a person.)
— The independence between the state machines.(Yes / No, Two state machines are dependent if a transition in one state machine is a function of the state(s) of another state machine. In case of dependent state machines, the amount possible conditions are much more larger and potentially impossible to be 100% covered.
If the state machines are dependent, the design might be considered as complex.If the design contains state machines with overlapped loops, then it might be considered as complex.)"

response

Partially accepted.
An example of criteria has been added into GM/AC 00-72, still leaving the responsibility to applicants to define their own criteria per their development process.

comment

257 comment by: *General Aviation Manufacturers Association*

Minor Comment
Objective CD-1
“or any related document”/“or any related planning document” would be better as “or any related planning document to be submitted”

response

Partially accepted.
The text has been amended with ‘or any related planning document’. The submission of a PHAC or any related planning document is already introduced in Section 4 and it does not need to be repeated each time.

comment

262 comment by: *General Aviation Manufacturers Association*

Minor Comment
5.2
Additional criteria specific to digital designs include:

	Proposed text: Additional criteria specific to digital part of designs include: Reason: be available for mixed signal designs
response	Accepted

comment	*263* comment by: *General Aviation Manufacturers Association* Minor Comment 5.2 ED-80/DO-254 has two definitions of a simple hardware item. Proposed text: ED-80/DO-254 defines a simple hardware item. Reason: It is not easy to find the second definition in DO-254. The fact that there are multiple definitions is not important to the content in this section of the A(M)C.
response	Partially accepted. See the response to comment #156.

comment	*264* comment by: *General Aviation Manufacturers Association* Minor Comment 5.2 In the second paragraph, first bullet list “Number of interfaces” would be better as “Number and simplicity of interfaces”.
response	Accepted

comment	*321* comment by: *Alexandre Jordan* "The applicant may propose other or additional criteria for the technical assessment of simplicity" =>If any, the other or additional criteria should be submitted to EASA/FAA for agreement?
response	Noted. The criteria should be documented in the PHAC or any related planning document, so submitted (per Section 4).

comment	*367* comment by: *External/industry comments submitted thru FAA* **Segment description: 5.2 Simple/Complex Classification** Any guidance for how many clocks, inputs, etc. make it simple vs. complex? More examples will help here. Consider using the COTS IP Simple examples to also support this section. *Comment submitted on behalf of* *Parker,G. Puckett* *T. Reeve* *(thru US DO-254 User Group)*

response	Partially accepted. See the response to comment #242.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.3. Development Assurance for Complex Custom Devic p. 10

comment	*134* comment by: *Erkan TIZLAK (TAI)* 5.3. Development Assurance for Complex Custom Devices: Sections “defining the additional objectives or clarifications in the [AMC]/[AC]” should be given (e.g., Sections 5.5, 5.6, 5.7, 5.8, 5.9, & 5.10).
response	Partially accepted. We have added ‘from Section 5.5 through 5.11’ to the sentence.

comment	*265* comment by: *General Aviation Manufacturers Association* Minor Comment 5.3 "The applicant should comply with ED-80/DO-254 and …" Proposed wording: "The applicant should satisfy ED-80/DO-254 and …".
response	Accepted

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.4. Development Assurance for Simple Custom Dev p. 10-11

comment	*16* comment by: *Williams International* Objective CD-2 item 1 is already defined in DO-254 as a requirement in the PHAC. See section 10.1.1 bullet 2. Recommend deletion of item 1 from the objective.
response	Not accepted. See the response to comment #15.

comment	*17* comment by: *Williams International* Objective CD-2 item 3 DO-254 currently requires configuration management of devices. Recommend deleting item 3 from objective CD-2.

response	Not accepted. See the response to comment #15.

comment	*45* comment by: *FAA Consulting, Inc.* Just an observation. This objective with only minor wording change would seem to be ideal to close the gap created by excluding CBAs from consideration back in section 2. Something like the following as a separate section in this AC/AMC: *The applicant should propose a process in the PHAC or any other appropriate certification plan to develop circuit board assemblies that encompass:* *1. Definition of the CBA's functions (excluding those of custom devices treated separately)* *2. Complete verification of the CBA through tests and analyses* *3. Configuration management of the CBA's design defintion (through drawing control or similar)* The following text could similarly be modified.
response	Accepted. See the response to comment #42. The text has been added to address the comment, but with different wording.

comment	*224* comment by: *Pratt & Whitney Canada* It is suggested to include a table which lists all the Objectives in this document against their applicability to simple and/or complex custom devices; for example, CD-2 is only applicable to simple custom devices.
response	Partially accepted. We have added a sentence in Section 5 that clarifies how to use Section 5.4 and the applicability of some sections in the AMC/AC to the development of a simple device.

comment	*225* comment by: *Pratt & Whitney Canada* Objective CD-2 (Section 5.5.1) mentions the need for a validation exercise for derived requirements. This is interpreted as validation of requirements in the same light as per ARP4754 wherein the validation is not via test but by an alternate means to ensure the requirement is correct. It is suggested that this be clarified to state explicitly that this is only for derived requirements and not for all requirements, i.e. if a requirement is not derived, a validation of that requirement need not be conducted.
response	Not accepted. The intent is to have the validation process applied to all requirements, both derived and not derived, as in ARP 4754A.

comment	*259* comment by: *General Aviation Manufacturers Association* Minor Comment Objective CD-2

	"or any other appropriate hardware plan"/"or any other appropriate planning document" would be better as "or any related planning document to be submitted".
response	Partially accepted. The text 'or any other appropriate planning document' provides more flexibility for defining the planning activities for simple devices.

comment	*266* comment by: *General Aviation Manufacturers Association* Major Comment 5.4 In the paragraph above Objective CD-2, the words "reproduced and conformed" are words from ED80/DO254 that are related to the third objective of Process Assurance, even though not mentioned as a supporting process in previous paragraph. Proposed text: in objective CD-2, add a 4th bullet, "Build conformance assessment of the device."
response	Accepted. A fourth bullet has been added to mention 'conformance assessment of the device', and 'the instructions to reproduce the device' has been added to the third bullet, with configuration management.

comment	*267* comment by: *General Aviation Manufacturers Association* Minor Comment 5.4 Objective CD-2 does not explicitly refer to a Problem Reporting process for the simple custom devices. Shall we understand that Problem Reports management is included inside the bullet3 "Configuration management of the device"? PR management is included in DO-254 section "configuration management process". Proposed text: in objective CD-2, bullet 3, add "including problem reporting".
response	Accepted

comment	*368* comment by: *External/industry comments submitted thru FAA* **Segment description: 5.4 Development Assurance for Simple Custom Devices** Section above Objective CD-2, the words "reproduced and conformed" are addition of words from ED80/DO254. These two specific items are related to objectives/activities of Process Assurance, even though not mentioned as a supporting process in previous paragraph. Add additional item to CD-2 to require a conformity review/First Article Inspection to cover Process Assurance objectives. *Comment submitted on behalf of Astronautics*
response	Accepted. See the response to comment #266.

comment	*369* comment by: *External/industry comments submitted thru FAA*

Segment description: 5.4 Development Assurance for Simple Custom Devices

Section above Objective CD-2, the words reproduced and conformed are addition of words from DO254. These 2 specific items are related to objectives/activities of Process Assurance, even though not mentioned as a supporting process in previous paragraph. Minimally should be a consideration of a conformity review/First Article Inspection required to assure these items are addressed.

Comment submitted on behalf of Astronautics

T.Reeve
Boeing
(thru US DO-254 User Group)

response

Accepted.
See the response to comment #266.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.5. Clarifications to ED-80/DO-254 Validation and Verification Proce p. 11-13

comment

46 comment by: *FAA Consulting, Inc.*

The approach taken in sections 5.5.1 and 5.5.2 seems quite uneven. 5.5.1 appears to add a requirement above and beyond DO-254/ED-80 by extending the concept of validation to all hardware requirements. In practice, I have generally found that this happens today by using the same peer review checklists for all requirements and by including the completeness and correctness criteria as part of the requirements review. However, as noted in 6.3.3.1 of DO-254/ED-80, requirements reviews address other requirements characteristics as part of the review activity under the heading of requirements verification (not validation). Why was it decided that a 'new' objective was needed for validation criteria but not one to drive peer review of requirements for other characteristics, especially since CD-4 is added to drive peer review of detailed design? In other words, both requirements reviews and design reviews are already treated in DO-254 and ED-80 - why add an objective for one but not the other in this AC/AMC?

response

Noted.
In general, new objectives are added when there is a gap in DO-254 or a recurring misinterpretation, as stated in Section 1.3 of the AMC/AC. EASA and the FAA agree on the importance of the review of the requirements as explained in 6.3.3.1. In the opinion of the authorities, there is no source of misinterpretation in this section, so supplemental guidance is not needed.

comment

135 comment by: *Erkan TIZLAK (TAI)*

5.5. Clarifications to ED-80/DO-254 Validation and Verification Processes:
It is not clear whether this section is applicable to Complex Devices or not.

response

Partially accepted.
A sentence has been added in Section 5. Nevertheless, Section 5.4 already identified the applicability of all subsequent sections to custom devices.

comment

136 comment by: *Erkan TIZLAK (TAI)*

5.5.1 Validation Process:

According to "Objective CD-3", the requirements allocated to custom devices without any change should be validated also. Since these kinds of requirements are validated at the upper level (e.g., system level), they should not be validated at the lower (device) level also. The objective can be updated to exclude the allocated requirements without any change.

response

Not accepted.
The objective is generic, and it is not intended to phrase particular detailed cases. For those that do not need to be further refined, the validation activity is obviously reduced.

comment

18 comment by: *Williams International*

Objective CD-4 is already covered in DO-254 by objective 6.2.1-1 which states "Evidence is provided that the hardware implementation meets the requirements." Also the text of CD-4 is not stated as a requirement with the use of the word 'should'. The text of CD-4 does provide helpful guidance.

Recommend integrating CD-4 into the preceding paragraph as the closing sentence

response

Not accepted.
In general, new objectives are added when there is a gap in DO-254 or a recurring misinterpretation as stated in Section 1.3 of the AMC/AC. EASA and the FAA agree that DO-254 already provides some guidance, but there is variability in the interpretation, so supplemental guidance is needed. The text has been significantly amended to address other public comments and to be even more precise.

comment

47 comment by: *FAA Consulting, Inc.*

WRT 5.5.2.2, unlike the prior comment where CD-4 was noted as being somewhat duplicative with existing DO-254/ED-80 contents, here the implication is that synthesis and place and route report review are inherent in the implementation verification and thus no new objective has been introduced. DO-254/ED-80 does not present any explicit verification objectives or activities associated with the implementation phase, especially as it relates to resolving issues arising from synthesis or P&R activities. In other words, there is no equivalent to section 6.3.5 in DO-178C where issues arising from the last steps of integration are caught. Dispositioning tool warnings is a must as is resolving issues with the hardware/software interface, especially register definition and utilization (e.g., R/W timing). For consistency, suggest adding this objective to close what has been a longstanding gap in DO-254. This could be added in section 5.5.2.2 or as a second objective in 5.5.2.4.

response	Accepted. A new objective has been added. See the response to comment #212.

comment	*137* comment by: *Erkan TIZLAK (TAI)* 5.5.2.1 Detailed Design Review: “Objective CD-4” is given as applicable to hardware DAL A or DAL B. So, it may cause that development review (or design review or SOI#2) is not required for DAL C. If hardware development review is required for DAL C, a clarification should be made.
response	Noted. The convention for the applicability to the DAL is clearly indicated in Section 2.0.

comment	*138* comment by: *Erkan TIZLAK (TAI)* 5.5.2.2. Implementation Review: It is specified that since physical implementation step is considered part of the verification of the implementation, no separate objective exists. Does it mean that the objectives required by ED-80/DO-254 § 5.4.1 are not applicable.
response	Noted. A new objective has been added. See the response to comment #212.

comment	*182* comment by: *GEAS_UK* The definition of "derived requirement" for the AC/AMC should be defined within the glossary. Are "decomposed requirements" also considered "derived requirements"? (decomposed = traced to parent level requirement but with further decomposition of the specification). Please clarify if the AC/AMC is talking about "derived requirements" as those that cannot be traced to a system level requirement. Note that Section 6.1 of DO-254 talks about derived requirements (and validation) of requirements that are both traceable and not traceable to a higher level requirement - (which could be understood as a different meaning to the AC/AMC). Solution: Clarify "derived requirement" meaning (for the AC/AMC) in the glossary.
response	Partially accepted. Even though DO-254 defines a ‘derived requirement’ as being not directly traceable to the higher level requirements, some clarifications have been introduced into the introduction text of CD-3 in Section 5.5.1.

comment	*183* comment by: *GEAS_UK* DO-254 talks about "derived requirement", "derived hardware requirement" and "hardware derived requirement" throughout the document w/out detailing the differences, if any, among them. As this AC/AMC is clarifying DO-254 objectives, can this be added to the document? (or within best practices)

	Solution: Clarify DO-254 terminology in AC/AMC.
response	Not accepted. It is commonly understood that these terms all refer to derived requirements in the hardware domain. Nevertheless, it is not the intent to address all the wording inconsistencies of ED-80/DO-254 in this AMC/AC. EASA and the FAA have consistently used the wording 'derived requirement' in this AMC/AC.

comment	*184* comment by: *GEAS_UK* With respect to Objective CD-4, It is unclear why an objective for review of the conceptual design has not been incorporated into the AC/AMC, in line with the specific information for detailed design reviews. DO-254 section 6.3.3.2 defines design reviews done at multiple times, with examples at conceptual, detailed design and implementation reviews.
response	Partially accepted. A separate paragraph that addresses the review of the conceptual design has been added, without an objective.

comment	*212* comment by: *Embraer S.A.* An objective should be specified as this section establishes Implementation Review activity to be executed and demonstrated.
response	Accepted. An objective has been added to reflect the necessity of the implementation review topic.

comment	*232* comment by: *Bell Helicopter Textron Inc* Objective CD-3, for DAL A and B development, validation activities should be performed with independence; Change to "… validation activities should be performed with independence (system engineering)". It would be beneficial that the system engineer rather than software/AEH engineer perform this independence since he/she would know if these requirements are valid for the system and minimize error during the requirement phase.
response	Not accepted. It is not the purpose of this AMC/AC to prescribe the qualifications needed by personnel to perform an activity to satisfy an objective.

comment	*268* comment by: *General Aviation Manufacturers Association* Minor Comment 5.5.1 "…following the ED-80/DO-254 validation process (ED-80/DO-254, sections 6 and 10)."

	Proposed text: "… following the ED-80/DO-254 validation process (ED-80/DO-254, section 6)." Reason: DO-254 section 10 (life cycle data) is not relevant here.
response	Accepted

comment	*269* comment by: *General Aviation Manufacturers Association* Minor Comment 5.5.1 Objective CD-3, The reading of this implies 'ALL' requirements (derived and (traceable to upper level = non-derived)). If this is the intent wording should be changed to "derived and non-derived". If not the intent clarification is required.
response	Accepted

comment	*270* comment by: *General Aviation Manufacturers Association* Major Comment AMC20-152 Section 5.5.2.1 Objective CD-4 states: *For hardware DAL A or DAL B, the applicant should review the detailed design in order to demonstrate that it satisfies the custom device requirements, the conceptual design, and the hardware design standards.* It is unclear how a design review can demonstrate that the detailed design satisfies the requirements, unless this indicates to review the tracing between them. Avoid including tracing to conceptual design in this objective because of varied definitions of conceptual and detailed design. It is suggested to change this as follows: *For hardware DAL A or DAL B, the applicant should review the detailed design (e.g. HDL, schematics, models) with respect to the design standards, and review the tracing between the detailed design and custom device requirements, in order to demonstrate that the detailed design covers the custom device requirements, is consistent with the conceptual design and is compliant to the hardware design standards.*
response	Partially accepted. Detailed design is introduced in the section and does not need to be repeated in the objective.

comment	*273* comment by: *General Aviation Manufacturers Association* Editorial 5.5.2.1 Issue: Add comma between words "schematic constraints"

	Solution: Change to: "...schematic, constraints..."
response	Accepted

comment	*274* comment by: *General Aviation Manufacturers Association* Major Comment 5.5.2.1 If the intended meaning of paragraph 1 of 5.5.2.1 is that 3 items are generated: • Design source such as HDL or schematic • Constraints to be used during implementation • Hardware/Software interface data Then, suggest rewording the paragraph as: "Detailed design is the process of generating, from conceptual design and requirements, a hardware description language (HDL) or analog schematic representation of the design, constraints for implementation (e.g. timing constraints, pinout, I/O characteristics), and hardware-software interface description."
response	Accepted. We have removed the schematic as a typo.

comment	*275* comment by: *General Aviation Manufacturers Association* Major Comment AMC20-152 Section 5.5.2.2 The second sentence of 5.5.2.2 states that it is necessary to review the design tool reports. Several equipment developer companies consider synthesis to be a part of the design process (rather than the implementation process) and are accustomed to performing this review during a design review. The second paragraph of 5.5.2.1, specifically "supporting the implementation process", suggests this activity of a design review. The fourth sentence of 5.5.2.2 states that there is no objective for this review since it is covered by the verification of the implementation (5.5.2.4). However, section 5.5.2.4 does not mention anything about the design tool report review, but instead covers how to perform timing analysis on the implementation result. Suggested wording Section 5.5.2.2: Within a custom device development process, tools are used to convert the detailed design data into the physical implementation. While ED-80/DO-254 does not explicitly address it, a review of the design tool reports (e.g. synthesis and place and route reports) is good practice to ensure that the tool execution to generate its output was performed correctly. This step may be considered part of a design review

	(reference 5.5.2.1) or part of a review during the verification of the implementation (reference 5.5.2.4), and thus no separate objective exists.
response	Partially accepted. Section 5.5.2.4 does not address the review of the design tool report, but instead covers the verification of timing performance of the implementation. Therefore, the title of the section was changed to be more specific to its content. Because of a number of other comments, an objective has been added to specifically address the implementation review. See the response to comment #212.

comment	*185* comment by: *GEAS_UK* Section 5.5.2.2 (Implementation Review) and the activities therein described are not adequately covered by the implications of the verification of the implementation and objectives listed. For example, Objective CD-6 addresses STA and timing issues, but without referring to other synthesis & p-r reports that may need review (and have connection but can't be said that everything is OK just looking to the STA). Remaining objectives of section 5.5.2.4 do not have specific links to the review of such reports either.
response	Accepted. See the response to comment #212.

comment	*276* comment by: *General Aviation Manufacturers Association* Minor Comment 5.5.2.3 Objective CD-5. Replace the end of the sentence “covered by the verification case and procedure” with “covered by verification cases and procedures”. Rationale: requirements are covered by possibly multiple cases and procedures and not a single case/procedure, as stated in the objective.
response	Accepted

comment	*277* comment by: *General Aviation Manufacturers Association* Minor Comment 5.5.2.3 Test Cases and Procedures Correction is requested for title - ‘Verification cases and procedures’ Reason - The title of the section appears to limit the topic to “ verification testing”, but the CD-5 objective is larger and addresses ‘verification case and procedure’, which may be testing, analysis or review as defined in ED-80/DO-254.
response	Accepted

comment	*51* comment by: *Arnaud Bouchet*

	Can verification tests can, upon justification, combine tests (temperature vs low power supply for example)?
response	Noted. EASA and the FAA are not sure of the intent of the question. Verification tests can combine different environmental/operating conditions.

comment	*278* comment by: *General Aviation Manufacturers Association* Editorial 5.5.2.4 "signal timing characteristics over normal and worst-case conditions" Proposed text: "signal timing characteristics under normal and worst-case conditions" Reason: "over" should be replaced by "under" as per DO-254.
response	Accepted

comment	*348* comment by: *Rolls-Royce plc* Objective CD-5 It is unclear to what level the review of the test cases and procedures should be performed. For example, is this requiring that the detailed verification data (such as testbench code, assertions, test scripts) is completely reviewed, or is it asking for a review of the verification documentation (i.e. the verification intent, such as a detailed plan document) to confirm that the proposed verification fully covers the requirements? Suggestion: Add clarification to the guidance material as to the inputs to the review and the modulation with DAL (if any) Objective CD-5 Linked to previous comment. Is their some modulation with DAL with respect to the level of detail that the verification review is performed to? Suggestion: If different levels of detail are required for differing DAL, then this modulation should be stated in 20-152
response	Not accepted. The depth of description is provided by ED-80/DO-254 in 10.4.3 and 10.4.4, and it is input data for review. 'Detailed instructions for conducting the test' (analysis/review) 'procedures', 'pass–fail criteria', 'identification of the hardware test setups, software and test equipment setup instructions required for each hardware test', are necessary information to review whether the verification case and procedure covers the requirements to which it is traced. In ED-80/DO-254, the level of description as well as the review of verification cases and procedures is not dependent on the DAL allocated to the device (DAL A to D) — see Appendix A. Only independence differs.

comment

353 comment by: *Håkan Forsberg*

Section 5.5.2.2. Implementation Review does not include a separate objective but instead refers to Section 5.5.2.4. Verification of the implementation. But Section 5.5.2.4. does not cover this kind of review making it unclear if it is necessary to perform it or not.

response

Accepted.
See the response to comment #212.

comment

359 comment by: *Diego PALMA (ANAC Brazil)*

	Commenter	Section # and Page #	Comment	Suggested Change and Rationale
1.	Diego Palma (ANAC)	A(M)C 20-152A, section 5.5.2, page 11 of NPA 2018-09	The section 5.5.2 addresses the additional guidance for some types of design reviews (e.g. “detailed design review” and “implementation review”), but it is not mentioned any additional guidance for the “conceptual design review”.	Considering that DO-254 has just a few references to the “conceptual design review” (as a note in section 5.2.2 and as an example in section 6.3.3.2), it is suggested to evaluate the need to provide additional guidance for the “conceptual design review”, in the same way that is been clearly provided for the “detailed design review” and “implementation review” in this AC/AMC.

response

Accepted.
See the response to comment #184.

comment

361 comment by: *Diego PALMA (ANAC Brazil)*

	Commenter	Section # and Page #	Comment	Suggested Change and Rationale
2.	Diego Palma (ANAC)	A(M)C 20-152A, section 5.5.2.2, page 12 of	It is missing the corresponding objective for the implementation review.	It is suggested to include an objective for the implementation review as follows: “**Objective CD-5**

		NPA 2018-09		The applicant should review the design tool reports in order to ensure that the tool execution to generate its output was performed correctly.”

response

Accepted.
See the response to comment #212.

comment

370 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.1 Validation Process

One thing that needs to be addressed in this AC is when DO-254 is imposed at the PLD/device level and not imposed at the card and LRU levels. In this situation there will be a significant disconnect in the design assurance flow that can seriously compromise design assurance and the integrity of both the system and the PLD.

Validation is conducted only on derived requirements because DO-254 is intended to be used at all levels of the system, which supports the notion that directly flowed (non-derived) requirements are validated at the higher level at which they were introduced. If DO-254 is not applied at the higher levels, this validation of non-derived requirements most likely will not occur. This can significantly compromise the design assurance of the system.

The way to fill in this gap is to validate ALL PLD requirements if DO-254 is not implemented at higher levels. Without this extra validation it will be very difficult to ensure that all of the PLD requirements are correct and complete.

Therefore section 5.5.1 should be expanded to address validation when DO-254 is applied at the device level and not at higher levels, and an additional objective should be added to require validation for all custom device requirements, regardless of type, if DO-254 is not applied to all levels of the hardware.

Comment submitted on behalf of Roy Vandermolen

response

Partially accepted.
CD-3 requires validation of all the custom device requirements, and the text has been further clarified. Therefore, there is no need to add an objective at the custom device level.
In addition, a new Section 7 and objective CBA-1 have been added to cover the development assurance of CBAs.

comment

371 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.1 Validation Process Objective CD-3

The second sentence of CD-3 states, "This validation activity covers the derived requirements and the requirements which are traceable to the upper-level requirements." This wording implies that derived requirements are identified using the software/DO-178 definition, in which derived requirements are those that do not trace to parent requirements. However, it is well established that the SW/DO-178 definition is not only different than the HW/DO-254 definition, but that it is incompatible with AEH and DO-254, and if used will create a significant gap in design assurance by forcing designers to sacrifice either traceability or validation (which Objective CD-3 is intended to fill).

DO-254 does not define derived requirements in terms of traceability as DO-178 does in its section 5, and unfortunately there are a large number of cert authorities and SMEs who do not understand the difference nor appreciate the potential adverse effects of this difference on hardware design assurance. DO-254 defines a derived requirement as a requirement that is created as part of the design process, and does not prohibit them from tracing to the parent requirements from which they were derived. In fact, DO-254 explicitly states that derived requirements can and should trace to parent requirements. This traceability is essential for correctly tracing system functions down the levels of hardware to their implementation. If the DO-254 definition is used (as it should, and to the exclusion of the DO-178 definition), there will never be a conflict between traceability and validation, and system functions can be traced down to their hardware implementation while still allowing validation to cover all of the requirements that need it. This is not possible when traceability is used to define derived requirements, as DO-178 does, hence the need for Objective CD-3.

Section 5.5.1 does refer to a third class of requirements (refined or restated) that must be validated, but this reflects yet another issue that is due to the misuse of the SW definition of a derived requirement. Refined/restated child requirements must trace to their parents, but rather than define them as non-derived, they should simply be identified as derived requirements (i.e., a requirement that needs to be validated) and and then be validated (as they should). If the DO-254 definition of a derived requirement is used, objective CD-3 won't even be necessary because every requirement that should be validated will be validated by the normal DO-254 validation process.

To avoid confusion and the perpetuation of one of the most egregious and potentially harmful injustices inflicted upon AEH, section 5.5.1 should address the pitfalls of using the SW definition of derived requirement with DO-254, and cite Objective CD-3 as being the means to mitigate the problems that can arise IF they use the SW definition. In other words, it should acknowledge that the DO-178 and DO-254 definitions differ (which they do), and caution against using the DO-178 definition with HW and DO-254 because it <u>will</u> compromise design assurance by excluding refined/restated requirements from validation, so if developers insist on using the SW definition then they must comply with Objective CD-3.

Please note that it is important to make it clear that derived requirements are defined differently in DO-178 and DO-254, and that <u>using the DO-178 definition</u> is what necessitates the extra assurance in Objective CD-3.

	Comment submitted on behalf of Roy Vandermolen
response	Noted. EASA and the FAA did not intend to redefine the term 'derived requirement', which is defined in the ED-80/DO-254 glossary: 'Additional requirement resulting from the hardware design processes, which may not be directly traceable to higher level requirements.' The terms refined/restated refer to the requirement capture process on the requirements that are flowed down from the board level to the custom device level.

comment	*372* comment by: *External/industry comments submitted thru FAA* **Segment decsription: 5.5.1 Validation Process Objective CD-3** Objective CD-3, The reading of this implies 'ALL' requirements (derived and (traceable to upper level = non-derived)). If this is the intent wording should be changed to "derived and non-derived" or simply "ALL" requirements. If not the intent clarification is required. *Comment submitted on behalf of Astronautics*
response	Accepted. See the response to comment #269.

comment	*373* comment by: *External/industry comments submitted thru FAA* **Segment decsription: Validation Process Objective CD-3** Objective CD-3, The reading of this implies 'ALL' requirements (derived and (traceable to upper level = non-derived)). If this is the intent wording should be changed to "derived and non-derived" or simply "ALL" requirements. If not the intent clarification is required. Since SRU/CCA/Board processes are not required to follow DO254 any longer this leaves a big gap of validated requirements at the hierarchical level. Requirements which trace up to a already validated board or system level requirement should require no additional "validation" other than a review to ensure they are correct, consistent, complete, testable and don't conflict with other requirements. *Comment submitted on behalf of Astronautics* *T. Reeve* *Boeing* *BAE Systems* (thru US DO-254 User Group)
response	Partially accepted. See the responses to comments #269 and #136.

comment

374 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.2.1 Detailed Design Review

Detail design can be in the form of HDL, Schematic, C- code or Models.

If this section is meant to only discuss constraints on the implementation then it is not clear. Maybe this should just say "schematic with constraints (e.g. timing, etc...) What is meant by analog schematic constraints?

Also, if Analog design is meant to be included under this applicability then the scoping section needs to also clarify that Analog devices are also now under DO-254 and this AC scope.

Comment submitted on behalf of

B. Brinson
T. Reeve
Moog
Boeing
Astronautics
BAE Systems
(thru US DO-254 User Group)

response

Partially accepted.
A comma was missing between analogue schematic and constraints. See also the response to comment #274.
Analogue is not included in the applicability. See the response to comment #44.

comment

375 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.2.1 Detailed Design Review

“analog schematic constraints” is misleading and confusing. Since the context of this paragraph is the review of an HDL/digital design, “analog schematic constraints” should be changed to “constraints” or “design constraints”. If this section is also intended to address analog or mixed signal devices, they should be addressed separately in a different section or paragraph.

Comment submitted on behalf of Roy Vandermolen

response

Partially accepted.
A comma was missing between analogue schematic and constraints. See also the response to comment #274.
Analogue is not included in the applicability. See the response to comment #44.

comment

376 comment by: *External/industry comments submitted thru FAA*

Segment decsription: 5.5.2.1 Detailed Design Review Objective CD-4

By focusing only on DALs A and B, Objective 4 implies that detailed design reviews are not required for DAL C and D PLDs. Is that the intent of this objective? If not, it should be changed to address DAL C and D as well as DAL A and B. DO-254 does not waive design reviews for DAL C and D designs.

Comment submitted on behalf of Roy Vandermolen

response

Partially accepted.
See the response to comment #137.

comment

377 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.2.2 Implementation Review

Last sentence of a paragraph stating the step is considered a part of the verification; if this guidance had to be added to identify this type of review that is not explicitly addressed in ED-80/DO-254, it indicates something that may not be clearly defined or not part of an applicant's verification process. Even if it is considered part of the verification of the implementation, the need to include this guidance suggests that there is a need to identify a specific CD-x objective to ensure that such a review is addressed.

Comment submitted on behalf of Astronautics

response

Accepted.
See the response to comment #212.

comment

378 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.2.2 Implementation Review

An objective should be specified as this section establishes Implementation Review activity to be executed and demonstrated.
Last sentence of a paragraph stating the step is considered a part of the verification; if this had to be added to identify this type of review then it is not clearly defined or is not part of an applicant's verification process. This should be identified as an objective then to assure it is complied with.

For this activity it should be sufficient to review the output of the warnings, and errors and document this review.

Comment submitted on behalf of

Embraer
Astronautics
T.Reeve
Moog
Rockwell

B.Brinson
BAE Systems
(thru US DO-254 User Group)

response

Accepted.
See the response to comment #212.

comment

379 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.2.3 Test Cases and Procedures

Objective CD-5. Replace the end of the sentence “covered by the verification case and procedure” with “covered by verification cases and procedures”. Rationale: requirements are covered by possibly multiple cases and procedures and not a single case/procedure, as stated in the objective.

Comment submitted on behalf of Astronautics

response

Accepted.
See the response to comment #276.

comment

380 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.2.4 Verification of the Implementation

The second sentence of 5.5.2.4 states, “Implementation is the process to generate the physical custom device from the detailed design data.” This statement, while true, is for the implementation process, but not for the implementation. The implementation of the design is the programmed PLD. Since this section is about the verification of the implementation (and not about the implementation process), I suggest that the second sentence be removed or modified to refer to the implementation rather than the implementation process.

Comment submitted on behalf of Roy Vandermolen

response

Accepted.
The sentence has been changed to read: ‘Implementation results from the process to generate the physical custom device from the detailed design data.’

comment

381 comment by: *External/industry comments submitted thru FAA*

Segment decsription: 5.5.2.4 Verification of the Implementation

First sentence of second paragraph of 5.5.2.4: This statement should be worded more strongly. Verification of a programmed PLD by physical test should be expected, not recommended.

Comment submitted on behalf of Roy Vandermolen

response

Not accepted.
The term 'recommended' leaves the possibility for other verification means, particularly where the physical test is unrealistic. In addition, the same paragraph also clarifies the importance of physical test with the following sentence: 'In such cases, the coverage of the requirements by means other than a physical test should be justified.'

comment

382 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.2.4 Verification of the Implementation

If this section is meant to address environmental robustness it needs to be renamed. Where is the emphasis on Target verification of the device on the airborne target hardware?

"it is recommended to test the implementation in its intended environment" This AC20-152 provides no emphasis on target testing and actually can be read to in a way to say that full simulation with back annotated testing is sufficient for meeting all the verification of the functions of the device. More emphasis needs to be on the target platform verification and how this relates to the correctness of the verification related to the simulation testing and analyses environment. Previous guidance and DO-254 emphasis that simulation alone is not sufficient and that you must justify testing not performed on the physical device in the airborne target.

Comment submitted on behalf of

T.Reeve
Embraer
Moog
B.Brinson
(thru US DO-254 User Group)

response

Noted.
The title has been modified to read 'Verification of the Implementation Timing Performance' to be more specific to the content of the section.
This section provides emphasis on the completeness of verification of timing performance, which would not be achieved if only physical testing is performed. This section was not intended to cover the overall verification activities, and as such, was not intended to diminish the role of physical testing in the verification strategy.

comment

383 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.5.2.4 Verification of the Implementation

Top of page 13: should "timings" be "timing"?

Comment submitted on behalf of Roy Vandermolen

response

Accepted

comment	384 comment by: External/industry comments submitted thru FAA Segment description: 5.5.2.4 Verification of the Implementation on Objective CD-6 The Note in CD-6 can be interpreted to imply that static timing analysis alone is adequate to verify the timing of a PLD. While this is true for many cases, it should emphasize that STA is not a substitute for verification of the functionality and integrity of the PLD signals. It is common for an STA to indicate perfect timing, while simulations of the same design reveal transients and other signal anomalies despite meeting all timing specifications. Comment submitted on behalf of Roy Vandermolen
response	Noted. The note refers to STA for this specific objective and only for digital designs. The note does not imply that STA is a stand-alone means for timing verification. Verification of the PLD functionality goes far beyond the STA.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.6. Clarifications to ED-80/DO-254 robustness asp p. 13

comment	*11* comment by: *United Technologies Aerospace* If requirements are to be developed, then does expectation for robustness testing, seperate from requirements based testing, dissappear? What would be unique? What would it be covering?
response	Noted. Indeed, there are requirements to cover robustness aspects, but this does not preclude situations in which an applicant or a developer needs/wishes to perform robustness tests.

comment	*22* comment by: *Luftfahrt-Bundesamt* The performance of the design under abnormal or worst-case conditions might have a safety effect. Therefore, these (derived) requirements should be fed back to the SSA process.
response	Noted. Indeed, robustness requirements that are 'derived requirements' should be fed back to the SSA, per ED-80/DO-254 Section 5.1.2, item 5.

comment	*30* comment by: *GE Aviation* Robustness in terms of design of the Complex Device under DO-254 is at the higher board level in terms of SEU/Environment/Voltage, etc. The intent of this updated guidance was to remove the board and box level items. While it is good to have robustness, the Objective CD-7 is confusing based on the Applicability statement in Section 2. The lower level requirements of the Complex AEH device will be in terms

	of registers and digital data. What robustness aspects are captured at the register level?
response	Noted. EASA and the FAA have observed requirements at the device level that address robustness aspects.

comment	*157* comment by: *GE Aviation* Recommend that some guidance or expectation be provided regarding how far beyond 'normal operating conditions' the 'abnormal and boundary/worst-case' operating conditions should go. Possible wording options: 'any operating condition that could conceivably occur', 'any operating condition that could reasonably be expected to occur during the service life of the HW item'.
response	Partially accepted. To identify robustness requirements, it is indeed not realistic to imagine 'any' condition that could occur, but rather the plausible ones. Text has been added into the introduction of the objective in Section 5.6.

comment	*213* comment by: *Embraer S.A.* As the objective CD-7 does not mention activity applicable to DAL C Hardware, Embraer understands that abnormal and boundary tests are applicable only to DAL A and B Hardware.
response	Noted. It is the correct understanding.

comment	*349* comment by: *Rolls-Royce plc* Section 5.6 and objective CD-7 Robustness is an overloaded term and requires clarification in the guidance material. Suggestion: Add a section to the guidance material giving examples of expected robustness requirements, i.e. clash condition behaviour, error detection logic, etc rather than how much margin is there on the operating frequency above that already specified.
response	Not accepted. Robustness conditions can be seen from various angles: related to the device function, related to internal design aspects, related to the power/frequency, etc. Providing illustrations has the risk of giving a limited orientation, whereas the developer/applicant is better positioned to envisage those aspects.

comment	*385* comment by: *External/industry comments submitted thru FAA* **Segment description: 5.6 Clarifications to ED-80/DO-254 robustness aspects**

As the objective CD-7 does not mention activity applicable to DAL C Hardware, Embraer understand that abnormal and boundary tests are applicable only to DAL A and B Hardware.

CD-6 describes abnormal conditions for environmental related testing for temp and power. This CD-6 appears to apply to DAL A, B and C but CD-7 says Robustness only applies to DAL A and B. These appear to be in conflict with each other.

Comment submitted on behalf of

Embraer
T.Reeve
Moog
Astronautics
(thru US DO-254 User Group)

response

Noted.
See the response to comment #213 for robustness testing.
CD-6 does not refer to abnormal conditions, but to normal and worst-case operating conditions. Therefore, CD-6 is applicable to DALs A, B, and C.
CD-7 is related to robustness aspects and, following a risk-based approach, it has been decided to limit its applicability to DAL A and DAL B. An applicant may choose to extend its applicability to DAL C on a voluntary basis.

comment

386 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.6 Clarifications to ED-80/DO-254 robustness aspects Objective CD-7 and Appendix A Glossary

"Abnormal" should be explicitly defined, presumably as "signal conditions outside or beyond normal input tolerances and expected behavior". Some people define "abnormal" as inputs that are not ideal but are still within expected input tolerances.

Comment submitted on behalf of Roy Vandermolen

response

Partially accepted.
Definitions for abnormal conditions have been added to the glossary.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.7. Recognition of HDL Code Coverage Me p. 13-14

comment

139 comment by: *Erkan TIZLAK (TAI)*

5.7. Recognition of HDL Code Coverage Method:

	It seems that there are no difference in criteria for HLD code coverage between DAL A and DAL B. According to EASA CM SWCEH-001 Section 8.4.2.1.(g), decision coverage is only required for DAL A design. What is the difference of HDL Code coverage criteria between DAL A and DAL B?
response	Noted. There are no differences in the AMC/AC between the elemental analysis applied to DAL A and DAL B hardware. ED-80/DO-254 does not provide any modulation of Appendix B according to the DAL. One could also ask what are the reasons and justifications for not detecting code elements that are not covered in the case of DAL B hardware.

comment	*214* comment by: *Embraer S.A.* The objective CD-8 should establish distinct coverage criteria to hardware DAL A and DAL B, similarly as specified by DO-178C.
response	Noted. See the response to comment #139.

comment	*233* comment by: *Bell Helicopter Textron Inc* The sentence “As such, it does not represent an… “ contradicts the prior statements and does not seem true as written. It should be changed to “As such, it does represent an assessment of the completeness of requirements-based testing activities and the effectiveness of requirement coverage.”
response	Not accepted. Code coverage supports the assessment that the HDL code elements are fully covered by requirements-based simulations. The fact that a code element is covered doesn’t mean that the code fulfils the requirements. Therefore, the code coverage ‘does not represent an assessment of the completeness of requirements-based testing activities or the effectiveness of requirement coverage’.

comment	*279* comment by: *General Aviation Manufacturers Association* Editorial AMC20-152 Section 5.7 Issue: The 3rd paragraph states "When performed during requirements-based verification (per ED-80/DO-254 Section 6.1).,". DO-254 Section 6.1 is the Validation Process; requirements-based verification is performed per DO-254 section 6.2, Verification Process. Solution: Change Section 6.1 to Section 6.2.
response	Accepted

comment	*280* comment by: *General Aviation Manufacturers Association* Major Comment

	5.7 In Objective CD-8 second para, clarify - additional analysis for any hardware items. Proposed text: change “hardware items” to “elements”. Proposed text: change “COTS IP instantiations” to “COTS IP or other element instantiations”.
response	Partially accepted. ‘Hardware items’ is more precise in the context of this sentence. Code elements that are not covered are now addressed in the last sentence of objective CD-8. COTS IP instantiations is a typical example, and should not be confused with reachable code elements.

comment

360 comment by: *Diego PALMA (ANAC Brazil)*

	Commenter	Section # and Page #	Comment	Suggested Change and Rationale
3.	Diego Palma (ANAC)	A(M)C 20-152A, section 5.7, pages 13 and 14 of NPA 2018-09	The Objective CD-8 does not modulate the rigor of the HDL Code Coverage methods according to the DAL allocated to the custom device. For instance, the code coverage criteria only exemplify some elements used in the design (e.g. branches, conditions, etc.), but it has not even mentioned to “expressions”. The main idea is to provide an equivalent level of assurance according to the DAL allocated to the custom	It is suggested to establish the following example of modulation of the code coverage criteria according to the DAL:

HDL Code Coverage Criteria	Applicability by Custom Device Level		
	A	B	C
Condition/Expression coverage			
Decision/Branch coverage			
Statement coverage			
State/Transition coverage (for FSM)			

			device, in the same way that is established for software by the DO-178C (e.g. MC/DC for DAL A software).	

response

Not accepted.
See the response to comment #139.
Additionally, it has been jointly decided that the AMC/AC would not call for metrics that are considered as of today to be tool dependent, but instead to set the target of the code coverage in a qualitative manner. GM/AC 00-72 provides some description of types of criteria that could be used.

comment

387 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.7 Recognition of HDL Code Coverage Method Objective CD-8

The objective CD-8 should establish distinct coverage criteria to hardware DAL A and DAL B, similarly as specified by DO-178C.

The wording for this needs to be made clearer. If it is expected that for DAL A more types of coverage are applied then the types should be identified . For example. Toggle coverage is not an effective coverage for identifying test gaps and really should not be required. Branch and Decision coverage can be different between different tool vendors as to what is reported. I agree that for DAL A and B more than statement coverage of HDL should be expected, this section does not go far enough to be clear and ensure consistency among certification authorities and applicants.

Comment submitted on behalf of

Embraer
T.Reeve
(thru US DO-254 User Group)

response

Not accepted.

	See the response to comment #139.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.8. Clarifications to ED-80-DO-254 Tool Assessment and Qualificati p. 14-15

comment	*29* comment by: *GE Aviation* Typo - Should be ED-80/DO-254 instead of ED-80-DO-254
response	Accepted

comment	*140* comment by: *Erkan TIZLAK (TAI)* 5.8. Clarifications to ED-80-DO-254 Tool Assessment and Qualification Figure 11-1 Item 1. - Identify the Tool: -What is the meaning of “environment”? Does it mean operating system?
response	Noted. ‘Environment’ is already introduced in the related text in ED-80/DO-254 as the host environment, and in this AMC/AC, we have extended it to the environment required for tool operation. The question on operating systems is too vague to be answered in this CRD.

comment	*141* comment by: *Erkan TIZLAK (TAI)* 5.8. Clarifications to ED-80-DO-254 Tool Assessment and Qualification Figure 11-1 Item 9. – Design Tool Qualification: - There is a contradiction. According to “Figure 11-1 Item 5”, If the tool have relevant history no further tool assessment or tool qualification is required. However, it is informed here that “*tool history should not be used as a stand-alone means of tool assessment and qualification.”*
response	Noted. Indeed, the FAA and EASA do not agree that if the tool has relevant history, no further tool assessment or tool qualification is required. Therefore, the related text has been added for clarity: ‘In ED-80/DO-254, the supporting text for Figure 11-1 Item 5 can be misinterpreted to suggest that when the tool has been previously used, no further tool assessment is necessary. Item 5 should be understood as the applicant will provide sufficient data and justification to substantiate the relevance and credibility of the tool history.’ Objective CD-10 should be satisfied if the applicant wishes to use tool history.

comment	*186* comment by: *GEAS_UK* The AC/AMC should acknowledge DO-178C and DO-330 for tool qualification - as DO-254 calls out the superseded DO-178B for tool qualification.

	The Guidance Material should provide best practices when performing basic tool qualification (can basic tool qualification be treatened as TQL 5?).
response	Partially accepted. A reference to DO-178C and DO-330 for tool qualification has been added as acceptable guidance for tool qualification. No example has been added in GM/AC 00-72.

comment	*243* comment by: *Dassault-Aviation* **Text** page 15 "If test cases or procedures are automatically generated by a tool and this tool uses coverage to determine the completion of requirements verification" **Comment:** Confusing and/or redundant the case described here could be misunterpreted or may have various interpretation In the context of this section "coverage" means "structural coverage" (e.g. elemental analysis) and "completion of requirement verification" means "functional coverage" : contradiction with 5.7 last sentence of the introduction : "it[HDL code coverage] does not represent an assessment of the completeness of requirements-based testing" This sentence looks like describing a non recommended practice. **Proposed text:** Clarify or remove
response	Accepted. The confusion comes from the sentence referenced in ED-80/DO-254. The paragraph has been moved to the correct place, with some editorial changes for clarity.

comment	*281* comment by: *General Aviation Manufacturers Association* Minor Comment 5.8 Figure 11-1 item 2 “objectives/activities” Proposed text: “purpose or activity within the hardware development process the tool satisfies”. Current wording can be interpreted to mean DO-254 objective and activities, whereas the intended meaning is the proposed text.
response	Accepted

comment	*282* comment by: *General Aviation Manufacturers Association*

	Major Comment 5.8 Under Coverage Tool, second bullet: “If test cases or procedures are automatically generated by a tool and this tool uses coverage to determine the completion of requirements verification, then the coverage tool should be considered a verification tool and should be assessed as such.” Proposed text (delete coverage before tool): “If test cases or procedures are automatically generated by a tool and this tool uses coverage to determine the completion of requirements verification, then the tool should be considered a verification tool and should be assessed as such.”
response	Accepted

comment	*283* comment by: *General Aviation Manufacturers Association* Minor Comment 5.8 Coverage Tool discussion is not placed correctly within section 5.8. Create a subheader “**Figure 11-1 item 4 - Is the Tool a Level A, B or C Design Tool or a Level A or B Verification Tool?**”, between item 3 and item 5. Then, move the Coverage Tool content under Figure 11-1 item 4 subheader.
response	Accepted

comment	*284* comment by: *General Aviation Manufacturers Association* Minor Comment 5.8 Figure 11-1 Item 9. – Design Tool Qualification Precede “For design tools, …” with “NOTE”: Proposal – “NOTE: For design tools, …”
response	Not accepted. The text is not considered to be a note.

comment	*285* comment by: *General Aviation Manufacturers Association* Editorial 5.8 Objective CD-10: “should be provided” would be better as “should be provided as a part of the tool assessment”, to define where to provide the information.

response	Accepted

comment	*339* comment by: *Alexandre Jordan* *"sufficient coverage of the tool output. The completeness of the tool assessment should be based on the design/implementation and/or verification objectives that the tool is used to satisfy. "* => the term sufficient "as is" seems ambiguous. How can we justify a "sufficient" coverage? What is an acceptable average for EASA? Otherwise, do we understand that "sufficient" means 100% coverage of output used for a given design/implementation and/or verification?
response	Noted. There is no quantitative target expressed in this AMC/AC, to avoid making a statement that is too prescriptive. The term 'sufficient' would mean high coverage of the tool output, in opposition to low. This remains still a qualitative notion, which we have attempted to better specify by the sentence that follows: 'The completeness of the tool assessment should be based on the design/implementation and/or verification objectives that the tool is used to satisfy.'

comment	*340* comment by: *Alexandre Jordan* Objective CD-10: => What "sufficient data" means? What is acceptable for EASA? EASA may propose at least the list of data type that are requested to justify relevant and sufficient tool history.
response	Noted. Sufficient data *to demonstrate that there is a relevant and credible tool history to justify that the tool will produce correct results for its proposed use. This clarifies the term 'sufficient'*. Note: Qualitative targets are found to be more appropriate to define objectives, which are intended to cover large numbers of cases of tools.

comment	*350* comment by: *Rolls-Royce plc* Additional item 'Coverage Tool' For modern verification methodologies (such as assertions) the verification tool generates a constrained random test vectors and the tool also provides coverage for the assertions associated with the test. My understanding is that, in this case, because the assertions are manually written, then the second bullet point does not apply. However I don't think that the document is explicit enough, which may preclude the use of assertions by some applicants. Suggestion: Add clarifying statement to the guidance material. If constrained random vectors are generated, so long as these are used with manually written assertions then the coverage tool does not require tool assessment.

response | Not accepted.
The request is to add a specific example. Note that the example does not describe whether the test cases or procedures are automatically generated by a tool or not.

comment | *388* comment by: *External/industry comments submitted thru FAA*

Segment description: 5.8 Clarifications to ED-80/DO-254 Tool Assessment and Qualification Figure 11-1 Item 3

What does "fail to detect in verification with an independent means" mean? Shouldn't is just say "fail to detect in verification"?

Comment submitted on behalf of
B Brinson *(thru US DO-254 User Group)*

response | Accepted.
The sentence has been clarified.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.9. Clarifications to ED-80/DO-254 Previously Developed Hardwa p. 15-16

comment | *142* comment by: *Erkan TIZLAK (TAI)*

5.9. Clarifications to ED-80/DO-254 Previously Developed Hardware:

If a custom-developed hardware device approved previously through a military certification project (ED-80/DO-254 not applicable military project) is used in a civil certification, can we consider it as PDH? Which guidance should be followed in this case?

response | Noted.
This type of device is not considered to be PDH, as described in Section 5.9. A definition has been added in the glossary. The device might be considered to be another previously developed item that didn't particularly follow an ED-80/DO-254 development assurance process. There is no generic answer to the question, as the device development process that is followed can be very different from one case to another.

comment | *143* comment by: *Erkan TIZLAK (TAI)*

5.9. Clarifications to ED-80/DO-254 Previously Developed Hardware:

	Objective CD-11: The results should be documented in the PHAC or any other appropriate planning document. The following correction could be made: It will be more appropriate to use "any other other appropriate compliance document" since a single compliance (e.g HAS) document may be enough.
response	Noted

comment	*158* comment by: *GE Aviation* Under Objective CD-11, item 2. 'Change to the function, change to its use, or change…' : I understand the statement 'change to its use' to include a change in the application environment (temperature, EMI, radiation exposure). If this is correct, a clarification to the 'change to its use' statement should be considered. One option could be to add a parenthetic statement to item 2. as follows: "2. Change to the function, change to its use *(e.g. thermal, EMI, radiation environment)*, or change to a higher…"
response	Not accepted. Change to its use also covers the usage of the device on its previous application board. It is preferable to keep the generic statement.

comment	*201* comment by: *GEAS_UK* Reuse of PDH content / module / IP is nowadays common to reduce the cost and effort on certification. A guidance or objectives to follow for those practices should be necessary.
response	Not accepted. The current material is considered to be extensive enough to provide sufficient guidance to applicants. Applicants have the flexibility to create ED-80/DO-254 life-cycle data at the module/IP level to ease straightforward reusability.

comment	*215* comment by: *Embraer S.A.* It seems that this section and objective CD-11 describe the same information already presented in DO-254. Is this objective needed? Suggestion is to remove section 5.9 and objective CD-11 due to the content of this section and objective is already covered by DO-254.
response	Not accepted. Even though some information comes directly from ED-80/DO-254, there are some additions throughout the document that provide additional guidance when there is a gap in DO-254 or a recurring misinterpretation. From authority experience, and as requested by some industry stakeholders, this topic has been clarified and an objective has been added.

comment	*223* comment by: *Pratt & Whitney Canada*

	Objective CD-11 provides guidance on the applicability of this document to modifications of previously developed hardware (PDH). Is this equally applicable to modifications to existing hardware devices that have been already approved using DO-254?
response	Noted. The answer is 'yes'. The objective addresses the modification of PDH. See the definition of PDH in the glossary.

comment	*286* comment by: *General Aviation Manufacturers Association* Major Comment 5.9 ED-80/DO-254 § 11.1 may be suitable for previously developed hardware that has not been previously approved in a civil certification. For example, a custom device may have been developed for an airborne product which was approved using a military certification process. As another example, a custom device may be developed for an airborne product, using plans that meet the ED-80/DO-254 objectives, in anticipation of a future civil airplane program/installation. In these cases, the guidance of § 11.1.4 may be applied with the understanding that safety analysis will be required to assign a design assurance level, that ED-80/DO-254 objectives need to be satisfied, that existing life cycle data will need to be analyzed for applicability, that additional life cycle data may need to be created (possibly reverse engineered). Proposal, three parts: (1) complete the PDH definition of § 5.9: "Previously developed hardware (PDH) is defined as a custom-developed hardware device that fulfills at least one of the following conditions: • it has been approved through a certification process (i.e. type certificate (TC)/supplemental type certificate (STC)/(E)TSO), • it has been approved for an airborne application but not through a certification process, (e.g. aircraft military application) • it has been previously developed to hardware plans that satisfy ED-80/DO-254 objectives" The section providing clarification on the use of PDH also covers PDH that has been developed and approved prior to the use of ED-80/DO-254 in civil certification. (2) in objective CD-11, add a 4th item: "4. upgrade to the design baseline or new civil certification for the PDH" (3) in objective CD-11, last paragraph: change "any one of these three points potentially" to "any one of these points potentially".
response	Not accepted.

A PDH device should have been approved through a civil TC/STC/(E)TSO process. When ED-80/DO-254 life-cycle data exists, it can obviously be used during the first civil certification process.

comment

351 comment by: *Rolls-Royce plc*

objective CD-11 The requirement is that the PHAC contains the assessment and analysis showing that PDH compliance is still valid for the new application. This may not be complete at the point of writing/agreeing the PHAC.

Suggestion: It is proposed to reflect the same approach to this as objective COTS 1 page 24. Using the guidance material for the COTS 1 objective on pages 40/41 it recognises that the data may evolve during the lifecycle so permits the final data to be captured in the HAS. This would seems to be an appropriate position for PDH.

response

Not accepted.
There should be a plan of activities to address the reuse and modification aspects as a means of satisfying CD-11. Therefore, it is required to be in the PHAC or any related planning document. If there were changes in the planning, an update would be necessary.

comment

389 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.9 Clarifications to ED-80/DO-254 Previously Developed Hardware

It seems that this section and objective CD-11 describe the same information already presented in DO-254. Is this objective needed?
Suggestion is to remove section 5.9 and objective CD-11 due to the content of this section and objective is already covered by DO-254.

Comment submitted on behalf of Embraer S.A.

response

Not accepted.
See the response to comment #215.

comment

390 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.9 Clarifications to ED-80/DO-254 Previously Developed Hardware

The original DO-254 only covers PDH from the point of view that it is being used for another application as is or with some changes. There is lack of guidance on "Obsolescence" or obsolete PLD device. In particular, legacy product developed pre-DO-254 with limited life cycle data. I noticed that the NPA still do not address this

	pressing issue on how to deal with legacy PLD designs that the original device is being obsolete *Comment submitted on behalf of Charles Moy, BAE (thru US DO-254 User Group)*
response	Partially accepted. Obsolescence management has been added to CD-11, and ED-80/DO-254 Section 11.1 applies.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.10. Clarifications to ED-80/DO-254 Appendix p. 16

comment	*54* comment by: *FAA Consulting, Inc.* A Top Level Drawing, often referred to as an Envelope Drawing, is not the same as an HCI as noted here. TLDs or Envelope Drawings generally sit at the top of a drawing tree and fully lock down the entire product. This is easily shown by comparing section 10.3.2.2.1 of DO-254/ED-80 and the new content captured in the draft GM/AC 00-72 later in this NPA. The previous guidance suggested that an HCI could be used in lieu of a Top level Drawing to fully capture the AEH definition. This makes much more sense and is keeping with the scope of application of DO-254 as recognized by this NPA. Suggest rewording to note that an HCI can be substituted for the TLD as defined in DO-254.
response	Accepted

comment	*56* comment by: *FAA Consulting, Inc.* It would be helpful to include a single sentence noting that HDL Coding standards are one example of Hardware Design Standards.
response	Accepted

comment	*181* comment by: *GEAS_UK* Why are Hardware Design Standards required for DAL C? The AC/AMC does not require review of detailed design for DAL C devices. The standards are typically the basis for review activities. Note that there is no introductory text/justification to understand why these standards are required for DAL C - when neither DO-254 nor this AC/AMC requires further activities for DAL C devices. Solution: Clarify reasons behind this clarification to DO-254.
response	Noted. New text in objective CD-4 has been added to reflect the necessary demonstration that the detailed design satisfies the hardware design standards. For DAL C hardware, the applicant is not required to review the detailed design to demonstrate that the requirements are met.

comment	*216* comment by: *Embraer S.A.* As this section adds requirements that are not specified in the DO-254 ("Hardware Design Standard" to DAL C and HCI / HECI), an objective should be established.
response	Accepted. Text has been added to objective CD-4 for DAL C.

comment	*244* comment by: *Dassault-Aviation* **Text:** The row corresponding to 10.2.2, 'Hardware Design Standard' in Table A-1 should also indicate HC2 for Level C. **Comment:** The HPAP document need to identied as HC2 for DAL C component Definition of reviews, clear activities related to quality assurance are needed for a DAL C AEH **Proposed text:** To add: the row corresponding to HPAP in Table A-1 should also indicate HC2 for Level C
response	Accepted

comment	*260* comment by: *General Aviation Manufacturers Association* Minor Comment Objective CD-11, second paragraph "or any other appropriate hardware plan"/"or any other appropriate planning document" would be better as "or any related planning document to be submitted".
response	Partially accepted. Submission of 'any other appropriate planning document' is requested via Section 4.0 of the AMC/AC.

comment	*289* comment by: *General Aviation Manufacturers Association* Major Comment 5.10 The first clarification item regarding having design standard for DAL C; Objective CD-4 required detailed design to be reviewed against a design standard for only DAL A and B. Requiring the design standard to exist at HC2 for DAL C without having to review that a detailed design actually met a standard seems inconsistent. Proposed solution: A*ddition to Objective CD-4: "For hardware DAL C, the applicant should demonstrate that the detailed design satisfies hardware design standards".*
response	Accepted

comment

391 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.10 Clarifications to ED-80/DO-254 Appendix A

As this section add requirements which are not specified in the DO-254 ("Hardware Design Standard" to DAL C and HCI / HECI), an objective should be established.

Comment submitted on behalf of

Embraer
T.Reeve
BAE Systems
(thru US DO-254 User Group)

response

Accepted.
See the response to comment #216.

comment

392 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.10 Clarifications to ED-80/DO-254 Appendix A

Address the following additional items:

1. Row 10.1.6 (Process Assurance Plan) not required for DAL C, but row 10.8 requires have Process Assurance Records for DAL C;

2. Row 10.4.2 (Hardware Review and Analysis Procedures) is not required for DAL C or D however, the Review and Analysis Results (row 10.4.3) are required for DAL C and D.

3. Detailed Design Data (row 10.3.2.2) has a note 5 "If the applicant references this data item in submitted data items, it should be available." The expected hardware configuration classification of this referenced data has not been identified in ED-80/DO-254 . Revise to address defining that data item as HCx per DAL like all other data items in Table A-1.

Comment submitted on behalf of Astronautics

response

Accepted

comment

393 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.10 Clarifications to ED-80/DO-254 Appendix A

The first clarification item regarding having design standard for DAL C; Objective CD-4 required detailed design to be reviewed against a design standard for only DAL A and B. Requiring the design standard to exist at HCL2 for DAL C without having to review that a detailed design actually met a standard seems inconsistent. Provide additional clarification to this document either here in CD-4.

Comment submitted on behalf of Astronautics

response

Accepted.
Text has been added to CD-4. See the response to comment #289.

comment

394 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.10 Clarifications to ED-80/DO-254 Appendix A

The first clarification item regarding having design standard for DAL C; Objective CD-4 required detailed design to be reviewed against a design standard for only DAL A and B. Requiring the design standard for DAL C with no further objective or guidance for the change is not clear.

Comment submitted on behalf of Astronautics

T. Reeve
BAE Systems
(thru US DO-254 User Group)

response

Accepted.
Text has been added to CD-4. See the response to comment #289.

comment

395 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.10 Clarifications to ED-80/DO-254 Appendix A

Currently, Table A-1 in DO-254 fails to assign a hardware control category to Detailed Design Data, and instead refers only to Note 5, which in turn has nothing to do with the hardware control category. This oversight in Table A-1 is causing confusion in the industry, and this AC should correct the oversight by classifying detailed design data as HC1.

Comment submitted on behalf of Roy Vandermolen

response

Accepted.
See the response to comment #392.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 5.11. Use of COTS IP in Custom Design Developme	p. 16-22

comment	*55* comment by: *FAA Consulting, Inc.* In keeping with an earlier comment concerning the need to address analog ASICs, the note in section 5.11.2 presumably limiting coverage of analog COTS IP to that IP instantiated in mixed-signal designs should be deleted.
response	Not accepted. Refer to the answer to comment #44. The applicability is limited to analogue COTS IP that is instantiated in mixed-signal designs, as noted.

comment	*5* comment by: *MGHILL* Before the bullet points it notes that COTS IP should “at least” follow the given criteria. It would be more helpful to replace “at least” with “other evidences relevant to selection of the COTS IP as an acceptable solution”
response	Not accepted. The criteria reflect the minimum set, so ‘at least’ seems to be adequate wording for that notion. The proposed change is found to be confusing.

comment	*19* comment by: *Williams International* Objective IP-2 uses the phrase ‘…following a trustworthy and reliable process, …’ The word trustworthy is subjective. Recommend changing the phrase to ‘…following a reliable process, …’
response	Not accepted. The assessment of the COTS provider’s process by the COTS IP user is based on engineering judgement. We agree that this may lead to a subjective result. Nevertheless, it is found to be essential to assess the confidence that the IP user can obtain from the IP provider’s process.

comment	*57* comment by: *FAA Consulting, Inc.* Would like to better understand what the FAA/EASA means when referencing "source format" or "combination of source formats" in IP-1. Assume this is referring to RTL, netlist, or some variant of HDL. If any of these, then this is really a reference to the underlying representation of the IP itself rather than an architectural aspect contained within that representation. Just seems somewhat strange to have these two things married together as 'architecture.' Might suggest moving this aspect from item 2 to item 4.
response	Accepted. The word ‘architecture’ has been replaced by the word ‘description’.

comment	*118* comment by: *FAA Consulting, Inc.* The inclusion of service experience for soft and firm IP is highly problematic since timing and constraints used in earlier designs are unlikely to match those in a new design. Previously the FAA certainly had taken a position that such service

	experience was simply invalid given the need to accomplish synthesis and place & route activities again. Any such service experience 'credit' should be limited to hard IP only IMO.
response	Not accepted. Service experience in IP-2 Item 5 is to be assessed '*for the applicant's specific use case for the COTS IP*'. If earlier designs do not match with the applicant's specific use case, than the criterion is not met. Additionally, this is not said to give absolute 'credit'. This is part of the assessment step, and assessing service experience can still provide valuable information: for instance, an item of Soft IP having been used in hundreds of physical circuits.

comment	*144* comment by: *Erkan TIZLAK (TAI)* 5.11.3.4 Requirements for the COTS IP Function and Validation Objective IP-5: "3. Correct control and use of the COTS IP." What is the meaning of "correct control"? Re-wording could be made.
response	Accepted. The sentence has been clarified to mention 'control' in accordance with the COTS IP provider's data.

comment	*202* comment by: *GEAS_UK* Is it necessary that the supplier should explain their process for continually monitoring COTIP Provider data (such as IP specifications and errata sheets) for COTSIP?
response	Accepted. IP-2 Item 4 has been updated accordingly.

comment	*245* comment by: *Dassault-Aviation* **Text:** § 5.11.3.2-5 page 19 The COTS IP has service experience data that shows reliable operation for the applicant's specific use case for the COTS IP. **Comment:** COTS IP experience shall not be a mandatory criteria to assess COTS IP & COTS IP Data All section 5.11 defines objectives to ensure that COTS IP used are safe and to reduce the risk of errors. All these objectives, by themselves, should ensure a high level of confidence in the COTS IP. By requiring systematically a service experience for the COTS IP it reduces the possibility to use innovative items. As objectives defined allow to ensure that COTS IP has been developed and verified with a high level of confidence and also allow to ensure that all data necessary for

	certification and design/verification are available, requiring systematically a service experience is not necessary. At the opposite, using a COTS IP with a important service experience should allow to propose a reduction of activities to perform. **Proposed text:** In case of COTS Ip with low service experience, the text is too limitative by requiring to define an appropriate development assurance activity. In that case the applicant should propose substantiation to mitigate the criteria not achieved (not only by defining another development assurance activity).
response	Partially accepted. The text has been amended to link the appropriate development assurance activity to the mitigation of the criteria that were not met. Service experience is not 'required', but it is considered to be part of the assessment.

comment	*258* comment by: *General Aviation Manufacturers Association* Minor Comment Objective IP-3 and Objective IP-4 "or any related document"/"or any related planning document" would be better as "or any related planning document to be submitted"
response	Partially accepted. This is addressed in Section 4.

comment	*290* comment by: *General Aviation Manufacturers Association* Minor Comment 5.11 Custom Design Development Proposed text: Custom **Device** Development
response	Accepted

comment	*291* comment by: *General Aviation Manufacturers Association* Editorial AMC20-152, Section 5.11.1, second list, last item Issue: Capitalize "integrator" to be consistent with other items. Solution: Change to "Integrator..."
response	Accepted

comment	*292* comment by: *General Aviation Manufacturers Association* Minor Comment Section 5.11.3.1, Objective IP-1, item 4

Issue: Remove phrase at beginning: "It is feasible, and".

This phrase isn't needed and the rest of the statement still makes sure there is a valid implementation.

Solution: Change to "Information exists…".

response

Partially accepted.
The sentence has been modified, removing 'feasible', and focusing on the ability of the IP user to create a physical implementation from the existing information.

comment

293 comment by: *General Aviation Manufacturers Association*

Major Comment
5.11.3.1

Objective IP-1, criterion 5:

"fulfils its intended function to commensurate with the hardware DAL of the custom device."
What is the link between demonstration of intended function and the DAL?

Proposed text: "fulfils its intended function." (delete "to commensurate with the hardware DAL of the custom device").

response

Accepted

comment

294 comment by: *General Aviation Manufacturers Association*

Major Comment
5.11.3.1

Objective IP-1, criterion 1:

It is not clear what differences would exist in a COTS IP that would be more or less suitable based on the DAL of the custom device. The paragraph preceding the objective states that the criteria are considered the minimum acceptable and saying "commensurate with the DAL" precludes the designer adding mitigation such as EDC on memory or additional monitoring on an interface.

Proposed text: "… technically suitable for implementing the intended function;" (delete commensurate with the DAL of the custom device).

response

Accepted

comment

295 comment by: *General Aviation Manufacturers Association*

Editorial
5.11.3.2, Objective IP-2, item 1

	Issue: Remove word "further" from statement. Word adds no value to objective statement. Solution: Change to "…to support implementation of the …".
response	Accepted

comment	*297* comment by: *General Aviation Manufacturers Association* Editorial 5.11.3.3.2, Objective IP-4, Note 3 Issue: Capitalize "the" and the beginning of the sentence. Solution: Change to: "Note 3: The verification…".
response	Accepted

comment	*298* comment by: *General Aviation Manufacturers Association* Major Comment 5.11.3.3.2 Clarification is needed on what is meant in objective IP-4, item 1, “verification of the COTS IP itself”; and how is this item different from objective IP-2, item 3, “The COTS IP has been verified following a trustworthy and reliable process, and …”
response	Accepted. The section IP-2 assessment has been updated to split the assessment part from the complementary activities to address the risk identified through IP-2. The part of IP-2 that was removed is now in a new objective. This helps to clarify that the purpose of IP-2 is the assessment, and the purpose of IP-4 Item 1 is to address the risk. For clarity, the ‘planning’ objective has now been moved to the end of Section 5.11.3.3.

comment	*300* comment by: *General Aviation Manufacturers Association* Major Comment 5.11.3.4 “When the applicant chooses a verification strategy (see section 5.11.3.3.2) that solely relies on requirements-based testing, a complete requirement capture of the COTS IP following ED-80/DO-254 is necessary”. This sentence is redundant with the second paragraph in section 5.11.3.4 and brings confusion. Propose to move to GM.
response	Not accepted. Nevertheless, the sentence has been modified to link it ‘clearly’ to the objective of the related section.

comment	*301* comment by: *General Aviation Manufacturers Association* Major Comment 5.11.3.6 Reformat objective IP-6 to show the distinct steps of safety specific analysis. The applicant may choose the safety-specific analysis method to satisfy Appendix B on the COTS IP function and its integration within the custom device functions. This safety-specific analysis should identify the safety-sensitive portions of the COTS IP and the potential for design errors in the COTS IP that could affect hardware DAL A and DAL B functions in the custom device or system. For unmitigated aspects of the safety-sensitive portions of the IP, the safety-specific analysis should determine what additional requirements, design features, and verification activities are required for the safe operation of the COTS IP in the custom device. Any additional requirements, design features, and/or verification activities that result from the analysis should be fed back to the appropriate process.
response	Accepted

comment	*342* comment by: *Rolls-Royce plc* Note 1 to Objective IP-4 contains the term "reliable and trustworthy test data". This term is ambiguous and unclear. Suggestion: Remove subject term and replace with something which is more deterministic, such as "thoroughly documented test data, cases or procedures".
response	Not accepted. In the sentence, these test data, cases or procedures are those of the COTS IP provider. The concept is not to request from the IP provider 'thoroughly documented test data, cases or procedures', but to have assessed whether they can be considered to be reliable and trustworthy.

comment	*354* comment by: *Håkan Forsberg* In Section 5.11.3.1 on Page 19, in Objective IP-1, #4, consider to change "It is feasible, ..." to "The COTS IP is feasible, ..." to explicitly address the correct item.
response	Partially accepted. The sentence has been modified and 'It is feasible' has been deleted. See the response to comment #292.

comment	*355* comment by: *Håkan Forsberg* In Section 5.11.3.1 on Page 19, in Objective IP-1, #1, while it is indirectly understood what is meant by "The IP is technically suitable for implementing the intended

	function, commensurate with the DAL of the custom device;" it may require further explanation to be fully understood.
response	Accepted. The sentence has been modified; see also the response to comment #294.
comment	*396* comment by: *External/industry comments submitted thru FAA* **Segment description: 5.11 Use of COTS IP in Custom Design Development** Where is the clarification related to "simple building blocks" which we identified in several CRI and Issue papers related to COTS IP as being able to be tested through there use in the overall design. Block Memory for example. IEEE libraries *Comment submitted on behalf of T.Reeve* *(through US DO-254 User Group)*
response	Noted. The COTS IP section in the AMC/AC is a completely new approach compared with the previous guidance. Complexity considerations are not found to be appropriate in the new guidance. Block memory is often hard IP, and is considered together with COTS PLDs under Section 6.
comment	*397* comment by: *External/industry comments submitted thru FAA* **Segment description: 5.11.2 Applicability** There seems to be some conflating of the Hard IP definition. Soft IP = RTL, Firm IP = Netlist, Hard IP = embedded components in the silicon. I thought it was always IP that is embedded in the silicon. What is the other definition? *Comment submitted on behalf of* *B Brinson* *(through US DO-254 User Group)*
response	Noted. EASA and the FAA are unsure about what is meant by 'other definition' in the comment. For development assurance purposes, there is a distinction between Hard IP that is inserted within a custom device by the applicant and Hard IP that is embedded in the silicon of an FPGA or a PLD by the FPGA/PLD device manufacturer.
comment	*398* comment by: *External/industry comments submitted thru FAA*

Segment description: 5.11.3.1 Selection of COTS IP to Implement the Function Objective IP-1

Objective IP-1, criterion 5. This criterion lacks clarity about the expectations for demonstrating the COTS IP fulfilling its intended function "commensurate with the hardware DAL". Revise with a note to clarify the expectations of this criterion. *Comment submitted on behalf of Astronautics*

response

Partially accepted.
The sentence has been modified; see also the response to comment #293.

comment

399 comment by: *External/industry comments submitted thru FAA*

Segment description: 5.11.3.2 Assessment of the COTS IP Provider & COTS IP Data

Item 3 and item 5; These are highlighted as a risk and concern in section 5.11.1. and is very hard to get this information from certain vendors if it exists. It is not clear then as to why require this as part of the criteria when stating the assessment should be based on "at least" the following criteria.

Comment submitted on behalf of Astronautics
(through US DO-254 User Group)

response

Noted.
When the information is not available to the user, the assessment should show that the criteria are not met. Per IP-3, development assurance activities should be defined accordingly.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 6. Use of Commercial-Off-the-Shelf Devic p. 22-23

comment

189 comment by: *GEAS_UK*

Question to EASA, from ETSO perspective. The EASA-CM-001, section 10, was addressing system considerations when dealing with graphical processors (i.e. outside the normal scope of COTS use, errata management). The AC/AMC does not identify where the non-DO254 information related (and currently avaiable in CM-001) will be considered for ETSO applicants.

response

Noted.
AMC 20-152A will replace EASA CM-SWCEH-001. Indeed, some of the topics of EASA CM-SWCEH-001 are not within this AMC.
EASA and the FAA consider COTS graphical processors to be complex COTS from the hardware perspective. System aspects are not covered in AMC 20-152A.

comment

302 comment by: *General Aviation Manufacturers Association*

Editorial
Section 6, paragraph 1.

	Issue: Capitalize "section 6.2…" at the beginning of the sentence. Solution: Change to: "Section 6.2…".
response	Accepted

comment	*113* comment by: *FAA Consulting, Inc.* While increasingly uncommon, there are projects that still make use of true microprocessors, often a MicroChip PIC controller or similar. These have always had an 'out' for DO-254 compliance by way of the DO-178B or C software development assurance. This is covered by the note in the current AC 20-152. There is no such note in this proposed NPA. Are such devices now subject to COTS-1 through COTS-8?
response	Noted. No, there is no longer any note referring to DO-178. This AMC/AC provides a generic approach to any COTS device. As a first step, the AMC/AC provides guidance to classify simple and complex COTS through COTS-1. As depicted in 6.2, the objectives described in Section 6.4 are only applicable to complex COTS.

comment	*303* comment by: *General Aviation Manufacturers Association* Minor Comment 6. Harmonization should be sought on the terms “circuit card assembly” in chapter 6, “circuit board assembly” in chapter 2, and “Electronic Hardware assembly” in GM A.2.3. Proposed text: Replace every instance by “Circuit Board Assembly”.
response	Accepted

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 6.1 Backgrou p. 23

comment	*58* comment by: *FAA Consulting, Inc.* Minor point but do not understand the inclusion of the words "based on the consumer market" in first paragraph. Am seeing considerable use of parts designed for the automotive market and for which there is a functional safety pedigree per ISO 26262. Suggest wording be changed to something like, "...industry qualification based on their intended market." Related issue in second paragraph. Do not believe it is appropriate to make such a sweeping statement that all such devices have not been demonstrated to address safety risk. First suggestion is simply to delete this paragraph. If retained, focus the language on the real issue which is the COTS manufacturer's development process

	may not provide sufficient evidence to show compliance with the DO-254/ED-80 objectives or those found within this guidance.
response	Partially accepted

comment	*59* comment by: *FAA Consulting, Inc.* Really have issues with the tone throughout this section. Last sentence, fourth paragraph. Just because multiple functions have been combined in a single device, it cannot be asserted that the risk of meeting intended function has necessarily increased. Such packaging decisions may actually reduce risk given shorter timing delays, better integration, and more efficient and accurate testing of the device's performance. What makes sense to say here given the preceding text is that additional development assurance may be required to ensure highly integrated COTS devices are appropriately verified for their intended use.
response	Not accepted. The text mentions 'there are clearly some benefits of integrating more functions within a device'. Compared with discrete devices, generally speaking, a highly integrated device does not allow the user to access to internal signals for its verification. The commentator's remark focuses on one part of the sentence, recalled below, where 'in particular use cases' is of importance: 'Since these devices are more complex and highly configurable than the older separate devices, the risk is greater that the COTS device will not achieve the intended function in particular use cases over the required operating conditions.'

comment	*163* comment by: *GEAS_UK* Please avoid using the term 'highly complex'. The complexity assessment results in only two outcomes, complex or simple. There is no concept of 'highly complex' anymore.
response	Not accepted. Some devices are highly complex, but this is just the introduction text, which does not confuse the simple/complex assessment of Section 6.3.

comment	*188* comment by: *GEAS_UK* Is it possible to produce a list on the best practices for the hardware life-cycle data of equipments with only COTS devices (no FPGAs/ASICs)?
response	Partially accepted. A new Section 7 and objective CBA-1 have been added to cover the development assurance of CBAs. This addition should provide sufficient clarification, and it is left to the applicant to define the life-cycle data.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 6.2 Applicabili p. 23-24

comment	*187* comment by: *GEAS_UK* EASA/FAA IM/CRIs or FAA/EASA guidance never had a development assurance objectives for the hybrid IC. Why the COTS design assurance scope was extended to Hybrid IC? Solution: A note could be added in FAA AC 00-72, why hybrid IC was considered in the COTS design assurance scope.
response	Not accepted. After consulting some groups of industry representatives, EASA and the FAA have considered Hybrid ICs to be complex enough to merit attention for development assurance. No sentence will be added to justify the topic.

comment	*231* comment by: *Bell Helicopter Textron Inc* · The COTS Devices guidance is written for microprocessors as well as AEH devices. However, the guidance scope in section 2 does not seem to account for microprocessors. If an LRU uses a microprocessor (software) but no CPLDs/FPGAs (AEH) then it would seem that this guidance as a whole (AC 20-152) is not applicable (it applies to supplement DO-254 for AEH devices). · The scope of this guidance (or the definition of AEH) needs to be clarified to include microprocessors for the "COTS Devices" objectives only (COTS-1 through COTS-8). · Alternatively, or in addition, the Software guidance should reference this content (i.e. reference COTS Devices guidance from AC 20-115).
response	Not accepted. Section 2 mentions 'This **[**AMC**]/[**AC**]** is applicable to airborne electronic hardware that contributes to functions with a hardware development assurance level (DAL) A, DAL B, or DAL C.' As a consequence, this guidance is applicable to microprocessors, which are known to be physical hardware. This AMC/AC supplements ED-80/DO-254 to cover COTS, COTS IP, and some aspects of development assurance for custom devices. To address hardware aspects of microprocessors, please refer to AMC/AC 20-152A. For microprocessors that are classified as complex, the applicant should follow the objectives for 'COTS Devices'.

comment	*240* comment by: *Bell Helicopter Textron Inc* The objectives in section 6 should only be required for introduction of new COTS Devices. Should not be required if an applicant is re-using devices from previously certified applications.
response	Not accepted. The analysis for reusing a COTS device in a new application board is not considered to be an activity that requires no development assurance. Reusing a COTS device on a new application board does not exempt the applicant from presenting the means of compliance with the objectives for COTS devices. The applicant is able to reuse previously approved data, when relevant, when proposing the Plan for Hardware Aspects of Certification.

comment	*400* comment by: *External/industry comments submitted thru FAA* **Segment description: 6.2 Applicability** Not accounting for the specific FPGA/PLD device level, I find it hard to show compliance for many of the objectives below. In past compliance the level of effort, activities and credit taken was performed at the CCA perspective when DO-254 was applied at the CCA level (EASA). Since DO254 is no longer in scope for CCA, these items are out of scope of the FPGA/PLD perspective and in cases for micro-controllers fall under DO178 in practical usage. *Comment submitted on behalf of Astronautics* *(through US DO-254 User Group)*
response	Not accepted. Due to the extensive growth in the complexity of microcontrollers, multicore processors, and switching devices, DO-178 and software development do not provide sufficient assurance for the development of the hardware and the use of complex COTS. This section focuses on complex COTS, the usage of which necessitates some development assurance. An objective has been added for CBAs to clarify the necessary structured development process.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 6.3 COTS Complexity Assessme p. 24

comment	*31* comment by: *GE Aviation* 2. Offers a significant number of functional modes - Significant is a subjective number and will be open to interpretation. In this case, I could not come up with better wording for guidance material, but at least pointing to the examples would be good from this section since the Examples of what is 'significant' may help guide the applicant.
response	Accepted. A reference to the examples in GM Appendix/AC 00-72 has been added.

comment	*61* comment by: *FAA Consulting, Inc.* The definition given here, especially item 3 is contradictory to the examples given for simple devices in the Best Practices/GM that appears later in the CM and which is slated to be published in parallel to this AC/AMC. Just about ALL microprocessors and microcontrollers on the market allow configurability via register content. For many of the higher end devices, these registers can easily number in the hundreds. Even common protocols like SPI and PCIe have configuration registers that could be argued as affecting data and signal flows. The Best Practices/GM appear to accept these as being simple and therefore if present as an on-chip peripheral, not sufficient to drive the entire device to a complex designation. The more this guidance tries to be prescriptive in drawing a line between simple and complex, the more counter examples can be shown. Not sure how to solve this, but

	softening the language here to read, "A COTS device may be complex if the device:" as a lead-in here would be a start.
response	Not accepted. While EASA and the FAA agree that it is difficult to define the criteria, there is a need to provide guidance and ensure a level playing field. Concerning Item 3, the configurability is not the only criterion. All three parts are taken into consideration: the configurability of the functions, and allowing different data/signal flows and different resource sharing within the device. Additionally, the device is complex when criterion 1 and criterion 2 and criterion 3 are all met. The comment only refers to criterion 3.

comment	*75* comment by: *FAA Consulting, Inc.* Do not understand the intent of Note 1. The EASA CM was much clearer on this point. If it is an integrated circuit, then it should be assessed. It takes very little time to scan the BOM for each board, ID the ICs, filter out the truly simple stuff (e.g., op amps, MOSFETs, etc.), and then focus in on what is important to assess in more detail. The language here is just ripe for endless debates over why someone didn't go through the complete design. It's either required or its not. Sometimes trying to be kinder, gentler just sets up the conditions for endless conflict. This may be great for consulting companies like mine but doesn't help focus limited resources on what matters most... Note 2 is just as problematic. This so-called boundary is highly subjective. Worked a case of a temperature-compensated pressure transducer that on its surface was little more than an op amp with configurable resistive elements surrounding it. The configurability was accomplished via a series of LUTs plus a free-form memory block for device identification. Arguably a simple device but still required some verification as gaps or step functions in the LUTs could cause anomalous pressure readings. Simple devices should have a rationale provided period IMO.
response	Not accepted. EASA and the FAA have decided to put the focus on what matters most. It is considered to be overdemanding to document the assessment of the full BOM including resistance, capacitors, op ams, MOSFETs, etc. Note 1 clarifies what is meant by ‘relevant devices’ in the objectives. Note 2 has been updated to further clarify what is meant by ‘boundary’. Simple devices that meet some of the criteria should be assessed and documented.

comment	*145* comment by: *Erkan TIZLAK (TAI)* 6.3 COTS Complexity Assessment: Examples for the first three (1, 2, 3) items should be added in order to make it more clear. Also, simple COTS examples given in EASA CM SWCEH-001 § 1.4 could be added.
response	Not accepted. Examples already exist in GM/AC 00-72 that go beyond the EASA CM.

comment	*146* comment by: *Erkan TIZLAK (TAI)* 6.3 COTS Complexity Assessment: Objective COTS-1: What is the meaning of boundary? It should be clarified in AC/AMC. If the device is in boundary, what should be the classification (Simple or complex)? Is Section 6.4 applicable to the devices in boundary?
response	Noted. Text has been added to Note 2 to clarify the boundary. See the response to comment #304. If the device is at the boundary, the justification should be provided using the criteria to determine the simple or complex classification. Section 6.4 only applies to those devices that are classified as complex.

comment	*190* comment by: *GEAS_UK* In section 6.3 and the supporting guidance, further detail is required to distinguish between Simple COTS devices and out-of-scope COTS devices. The guidance focusses on the boundary between Simple/Complex and not the lower end of Simple. This is needed as the document states that some of the activities are best practice for Simple devices, even though only mandated for Complex devices. E.g. applies to page 44 Additional Information for COTS Section 6.4.2 COTS Device Malfunction, where it states that errata for Simple COTS devices should be assessed.
response	Partially accepted. Text has been added to Note 2 to clarify the boundary. See the response to comment #304. No activities are required for simple COTS.

comment	*194* comment by: *GEAS_UK* In section 6.3 there is the statement "For complex COTS devices, it is impractical to completely verify all possible configurations of the device and it is difficult to assess or identify all the failure modes.". However, in Objective COTS-6 it states: "... the applicant should identify the failure modes of the used functions...". This seems to be contradictory and needs clarification or rewording.
response	Accepted. The last sentence of Section 6.3 has been reworded. The identification of failure modes is not equivalent to the identification of all failures. One failure mode, such as erroneous data on a given data path, can be caused by numerous failures. COTS-6 focuses on the failure modes and not on the failures.

comment	*217* comment by: *Embraer S.A.* Notes 1 and 2 from Objective COTS-1 should be moved to AC 00-72.
response	Not accepted.

	Notes 1 and 2 are considered to be part of the overall objective. The objectives describe what to achieve, and the notes provide necessary clarifications to avoid misinterpretation.
comment	*230* comment by: *Bell Helicopter Textron Inc* It seems the intent of the list of 3 items beginning with "A COTS device is complex when the device:" is intended to be an "AND" of all 3. However it should be more clearly worded for consistent interpretation by stating "A COTS device is complex when all 3 of the following are true for the device:"
response	Partially accepted. The text has been changed to add the missing 'and' between the first and second item, and the formatting has been improved.
comment	*234* comment by: *Bell Helicopter Textron Inc* This should be removed. It is not practical/reasonable to meet since these COTS devices keeps changing every week including bug fixes and new functions. It is not practical/reasonable to analyze what functions are used and not used. Most of the suppliers do not have the expertise to determine if there are any interferences from unused functions. These devices should be recognized as qualified as part of system level tests (DO-160) and system/software test (DO-178B/C) tests and the COTS supplier tests. Requiring this does not add value.
response	Not accepted. As stated in the background Section 6.1, COTS devices continue to increase in complexity and are highly configurable. Since these devices are generally not developed for airborne system purposes, assurance has not been demonstrated that the rigor of a COTS manufacturer's development process is commensurate with the aviation safety risks. In addition, with the increased complexity, the risk is greater that the COTS device will not achieve the intended function in particular use cases over the required operating conditions. An overall system approach will not address the detailed and sometimes numerous errata that affect the functions of the COTS device. ED-80/DO-254 introduces a basis for the development assurance for the use of COTS devices in Section 11.2, 'COTS components usage'. EASA and the FAA consulted industry stakeholders before defining the objectives, and the proposed development assurance objectives for the use of complex COTS devices address the associated safety risk.
comment	*304* comment by: *General Aviation Manufacturers Association* Major Comment Section 6.3, Objective COTS-1, Note 2 This comment is related to a comment for AMC20-152 Appendix - Guidance Material to AMC 20-152A Section A.2.2.1. Note 2 states, "devices that are on at the boundary". The wording, "the boundary" is ambiguous.

It is suggested to make the notes less ambiguous.

Delete final sentence of note 1 and update note 2, “A classification rationale is required to be documented for devices that meet some of the high-level criteria and yet are classified as simple.”

response

Partially accepted.
Text has been added to clarify the boundary. The final sentence of Note 1 has been retained to ensure that the classification of complex devices is still provided.

comment

305 comment by: *General Aviation Manufacturers Association*

Editorial
6.3, Objective COTS-1

Typo in Note 2: "are on at".

Either the word ‘on’ or ‘at’ should be deleted from the note.

response

Accepted

comment

306 comment by: *General Aviation Manufacturers Association*

Minor Comment
6.3

clarification is needed - relevant devices seems to refer to note 1 below.

Proposed text: “document the list of relevant devices (see note 1). Change relevant by candidate.”

response

Partially accepted.
‘See note 1’ has been added. The term ‘relevant’ is then explained by the note.

comment

307 comment by: *General Aviation Manufacturers Association*

Major Comment
6.3

“1. Has multiple functional elements that can interact with each other; 2. Offers …”.

Proposed text:

1. Has multiple functional elements that can interact with each other; and
2. Offers …

Reason: add “and” to the end of item 1 to make it clear that high-level 1 and 2 and 3 all need to be met.

response	Accepted

comment	*308* comment by: *General Aviation Manufacturers Association* Major Comment 6.3 Complexity assessment: It may be useful to declare that the complexity assessment is performed considering all the features proposed by the COTS device whether these features are used or not used in the scope of the applicant development. Reason: A complex COTS containing a lot of unused complex features should be assessed as complex, prior to application usage in order to be sure that unused functions are correctly deactivated/disabled. Proposed additional sentence after first sentence of first paragraph of 6.3: "In order to define which COTS devices are complex, the following high-level criteria should be used. Consider all functions of the device including functions intended to be unused."
response	Accepted

comment	*309* comment by: *General Aviation Manufacturers Association* Minor Comment 6.3 Add "to the PHAC or any related hardware planning document to be submitted "after "document the list of relevant devices".
response	Accepted

comment	*401* comment by: *External/industry comments submitted thru FAA* **Segment description: 6.3 COTS Complexity Assessment** The criteria to determine if a COTS device is complex is too vague. With the proposed definition all electronic components other than resistors, capacitors, etc. would qualify. Does an ADC chip count as complex? What is a functional element? An ADC has the analog input side and the interface to the processor. Does this make it two functional elements and thus complex? The ADC is usually configurable as to the range of the inputs and other features that can be chosen based on configuration registers. Based on the proposed assessment a typical ADC would be complex. Consider adding some examples here to help to clarify this section. *Comment submitted by*

	Parker, G. Puckett *T. Reeve* *BAE Systems* *(through US DO-254 User Group)*
response	Partially accepted. The definition of complex COTS has been updated to include the missing 'and' between items 1, 2 and 3. This might have misled the above commentators to conclude that ADCs would be classified as complex. Per EASA and the FAA's awareness, the typical current ADCs would not meet all three criteria, and would therefore be classified as simple.

comment	*402* comment by: *External/industry comments submitted thru FAA* **Segment description: 6.3 Complexity Assessment** Notes 1 and 2 from Objective COTS-1 should be moved to AC 00-72. *Comment submitted by Embraer S.A.*
response	Not accepted. See the response to comment #217.

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — 6.4 Development Assurance for Use of Complex CO p. 24-30

comment	*12* comment by: *United Technologies Aerospace* There is no mention of publicly hidden features (commonly referred to as undocumented features). Is this intentional?
response	Noted. Yes. The developer assesses the content of the COTS when developing it. It was decided not to mention 'undocumented features'. The means of compliance with the COTS-6, COTS-7 and COTS-8 objectives could be one of the means to address the risk associated with unknown features.

comment	*32* comment by: *GE Aviation* The recognized industry standards would be nice to add here to support the Note: in Objective COTS-2 so that the reader has an understanding of what can be used to support the ECMP. Since there are industry standards in mind, listing them would be beneficial.
response	Partially accepted. The AC 00-72/Appendix B GM references the industry standards. Text has been added to refer to the AC 00-72/Appendix B GM.

comment	*76* comment by: *FAA Consulting, Inc.* The obvious question for COTS-3 is going to be whether DO-160G Qualification of the system as a whole is adequate to show compliance with this objective. Here a note is very much needed This note should address both the DO-160G question and note that part derating may be one way of ensuring suitability.
response	Partially accepted. The term 'qualification of a device' was available in the glossary, and is considered to be different from the qualification process at the system level, which is addressed by DO-160. A reference to the definition has been added within the text.

comment	*77* comment by: *FAA Consulting, Inc.* WRT COTS-4, unclear of the meaning for the words "proposed by the appropriate process" toward the end of the objective. Suggest rewording the sentence to something like, "If microcode is to be integrated within a COTS device that is not qualified by the manufacturer or has been modified by the applicant following any such qualification activity, then a means of compliance for this microcode should be identified in the PHAC and those means accomplished during the product development."
response	Partially accepted. Clarifications have been added through a note.

comment	*78* comment by: *FAA Consulting, Inc.* WRT to COTS-5 - note is overly specific. Errata can arise from any number of issues including physical limitations due to the device's packaging. Would suggest modifying the last part of the note to simply say "or an error in the devices implementation."
response	Accepted. The sentence has been deleted.

comment	*79* comment by: *FAA Consulting, Inc.* WRT COTS-6: this would seem to duplicate the FMEA and/or FTA requirements out of ARP4754A and ARP4761 covering all hardware components. Is there something else intended iby this objective?
response	Noted. This objective requests applicants to identify the failure modes of the used functions of the device, so covering the internal functions of the device. This is to be fed back to the system safety assessment process, which includes the FMEA.

comment	*33* comment by: *GE Aviation*

	In 6.4.2 Objective COTS-6, the associated common modes is not well understood. Is this to apply to functions that are not used, but could have a common path back to ones that are used? What is the intent?
response	Noted. It refers simply to common modes between different hardware functions. It does not refer to the unused functions of the device. See also the response to comment #193.

comment	*96* comment by: *FAA Consulting, Inc.* For both COTS-7 and COTS-8, might suggest adding a note regarding tool assessment and qualification similar to that appearing in item 5 at the end of objective IP-3. It is interesting to note that the only appearance of HW/SW interface confirmation comes in a note to COTS-7. Verification of this interface data straddles the line between DO-254 and DO-178C and is not well addressed in either document. By only mentioning it here, it almost seems to suggest this is the only place it comes into play. Would encourage consideration of a similar note back in the section for custom devices. Should such a note be added, would also suggest that it be accompanied by the same tool callout given the existence of tools such as OneSpin's 360 EC-FPGA and especially Agnisys' IDesignSpec for confirming register content and configuration.
response	Not accepted. EASA and the FAA do not understand the need to address tool assessment in relation to COTS-7 and COTS-8. If it is related to verification, as the hardware–software interface involves software, this should already be covered through the software development process. For complex custom devices, the hardware–software interface is defined and addressed in ED-80/DO-254, which is applicable to custom devices. Additionally, referring to existing tools is considered to be prescriptive, and would be inappropriate in the AMC/AC.

comment	*6* comment by: *MGHILL* In the first “Note:” for objective COTS-7 it is unclear why it is only “recommended” that an effective deactivation means is used. For levels A and B it should be mandated that an effective deactivation means shall be used.
response	Not accepted. While EASA and the FAA understand the commentator’s reasoning, it has been concluded that mandating a means of deactivation is not always appropriate and is not always possible. In some cases, it is completely acceptable to leave an interface unconnected, which effectively ensures the deactivation. While it is recommended to use a deactivation means when available, mandating it may lead to the unreasonable conclusion to either not use a device, or to not accept an alternative development assurance approach such as robustness testing of the effective non-activation of a channel, an interface, etc.

comment	*147* comment by: *Erkan TIZLAK (TAI)* 6.4 Development Assurance for Use of Complex COTS

	For each objective from “Objective COTS-1 to Objective COTS-8”, which compliance data should be prepared? Or In which document the required data should be summited for each objective? Could you make it clear in AMC/AC?
response	Partially accepted. See also the response to comment #188. Similar to CBA Section 7, it is left to the applicant to define the life-cycle data. The life-cycle data related to the fulfilment of the COTS objectives might be combined with some CBA life-cycle data.

comment	*159* comment by: *GE Aviation* Under Objective COTS-8, first sentence. Recommend: Change from: *“If the complex COTS device contributes to DAL A or B functions, the applicant should develop and verify a means that ensures an appropriate mitigation is specified in the event of any inadvertent alteration of the ‘critical configuration settings’ of the COTS device.”* Change to: *“If the complex COTS device contributes to DAL A or B functions, the applicant should develop and verify a means that ensures an appropriate mitigation is **provided** in the event of any inadvertent alteration of the ‘critical configuration settings’ of the COTS device.”* Rationale: clarification of the intent of this objective; definition of (or specification of) the means is described well in the note that is included in this objective.
response	Not accepted. While EASA and the FAA understand the background of the proposal, the term ‘specified’ was preferred to also cover mitigation means that are not ‘provided’ by the hardware development process. The hardware development process is responsible for ensuring that a means is specified.

comment	*191* comment by: *GEAS_UK* It is then foreseen that Simple COTS devices with embedded microcode are not under the scope of objective COTS-4, section 6.4?
response	Noted. Yes, it is not required. Nevertheless, it is obviously seen as a good practice that the applicant pays attention to embedded microcode.

comment	*193* comment by: *GEAS_UK* With respect to COTS-6 , paragraph: "For usage of COTS devices contributing to functions with a hardware DAL A, the possible associated common modes should be fed back to the system safety assessment process.". a) The scope of "common modes" is unclear. Does it refer to "common modes within one COTS device" or "common modes between multiple instances of the same COTS device"? Does it refer to "both cases"? The scope should be clarified within the objective. b) ARP4754A section 5.1.4 requires "“ In particular the CCA identifies individual

	modes or external events that can lead to a Cat or Haz/Severe-Major failure condition". It is unclear why only DAL A are within consideration for COTS devices.
response	a) Accepted. This objective refers to common modes between several hardware functions to which a COTS device contributes. The common modes between multiple instances of the same device are considered to be covered by the current MoC with ARP 4754A. b) Partially accepted. This is now requested for COTS devices that contribute to functions with a hardware DAL A or DAL B.

comment	*237* comment by: *Bell Helicopter Textron Inc* Objective COTS-5 should clarify that the objective only applies if there is errata available.
response	Not accepted. No update is needed for COTS-5. By definition, the objective is met when the applicant can confirm that there are no errata at all for the complex COTS.

comment	*238* comment by: *Bell Helicopter Textron Inc* Objective COTS-6 – this is not necessary and should be removed. Existing safety assessment guidance and practices already cover this.
response	Not accepted. ARP 4754A Section 5.1.4 requires this, but this does not particularly mean addressing the failure modes of the device functions themselves. For complex COTS, the request is to go deeper than the board level to have more accurate feedback to the safety assessment process.

comment	*239* comment by: *Bell Helicopter Textron Inc* Objective COTS-8 is not reasonable in all environments. It seems that the guidance is related to Single Event Upsets. If this is the case, it should be stated that the objective only applies for applications where SEU are a concern, or at least state that the applicant should determine / propose whether SEU (and this objective) are applicable during the planning phase. Should not a concern for Part 27 / 29 applications with lower max altitudes.
response	Not accepted. This objective is not only for SEUs, but also for robustness in case of potential design errors.

comment	*310* comment by: *General Aviation Manufacturers Association* Major Comment 6.4

	The title of the section 6.4 clearly refers to "Complex COTS". However, some objectives COTS-x refer to C "complex COTS device" while other refer to "COTS device" that brings doubts about the applicability. In fact only COTS-3 and 8 refer to "Complex COTS devices". What about the others? Are they also applicable only to Complex COTS or to all COTS devices? Propose: In each "Objective COTS-x" ensure wording "Complex COTS device" is used.
response	Not accepted. Section 6.2 'Applicability' drives the applicability of the objectives, and clearly explains that Section 6.4 only applies to complex COTS devices. A similar approach is chosen for simple and complex custom devices.

comment	*311* comment by: *General Aviation Manufacturers Association* Editorial 6.4.3, Note 1 and Note 2: Why note 1 and 2 are not italic? In general there is no logic about the way to put in italic the note.
response	Partially accepted. Note 1 is in italics as part of the objective. Note 2 is now just text.

comment	*312* comment by: *General Aviation Manufacturers Association* Major Comment 7. (b): Issue: Is there any reason for not mentioning 23.1309 and 25.1309 here? This AC is not specific rotorcraft. This AC/AMC is applicable to all aircraft types. Solution: Suggested to add AC 23.1309-1 and AC 25.1309-1A.
response	Accepted

comment	*313* comment by: *General Aviation Manufacturers Association* Editorial 7. (c) EASA Acceptable Means of Compliance (AMC) (1) AMC 20-152(), Development Assurance for Airborne Electronic Hardware. Remove? Reason: This document (no previous issue exists).
response	Not accepted.

	This reference is to be in the FAA AC only, indicating the equivalent EASA AMC.

comment	*314* comment by: *General Aviation Manufacturers Association* Editorial 7. (d) Industry Documents (1) SAE International Aerospace Recommended Practice (ARP) 4754A Proposed text: Add "ED-79A" reference. Reason: ED79A not referenced by FAA? (consistency with EASA list that reference ARP4754A and ED-79A).
response	Accepted

AMC 20-152A/AC 20-152A Development Assurance for Airborne Electronic Hardware — Appendix A. Glossa p. 31-32

comment	*7* comment by: *MGHILL* In the glossary definition of “Objective” it is unclear why there is the use of the word “should” (which implies no mandating) rather than the use of the word “shall” (which implies mandating). It is recommended to use “shall” rather than “should”.
response	Not accepted. ‘Shall’ is not to be used in an AMC/AC document, as it reflects a means of compliance and not a regulatory requirement. An applicant may propose a means other than the AMC/AC.

comment	*112* comment by: *FAA Consulting, Inc.* Given the content of COTS-6, would suggest adding ARP4761 to the list of Industry Documents.
response	Accepted

comment	*195* comment by: *GEAS_UK* The definition is not strictly correct when it states that a COTS device is not only for airborne systems. We use many COTS devices that have only been design for aircraft applications. The wording in brackets should be deleted. Also later in the paragraph where there is reference to "for the commercial market"
response	Partially accepted. The definition has been updated to include COTS devices that are developed for the airborne domain.

comment	*196* comment by: *GEAS_UK*

	This refers to "Critical Function". A definition of what is intended by critical function should be provided so that the scope of the analysis can be determined. E.g. is this only safety-related functions? Is this related to the failure modes of 6.4.2?
response	Noted. The term 'critical' has been removed. See the response to comment #315.

comment	*198* comment by: *GEAS_UK* Definition of microcode needs clarifying. Is this only applicable to code that is loaded on startup or is it also pre-loaded code in NVM? If the latter, what is out of scope, e.g. configuration tables, calibration values?
response	Not accepted. Microcode, by virtue of its name, is code. This cannot be reduced to a table or a value. The definition refers to '*hardware-level set of instructions*' and '*typically stored in the COTS device's high speed memory and microcode instructions are generally translated into sequences of detailed circuit-level operations*'. It is the opinion of EASA and the FAA that there is no confusion with configuration tables or calibration values.

comment	*315* comment by: *General Aviation Manufacturers Association* Editorial Critical configuration settings Issue: Delete "critical" from end of definition. The word does not add value and it is not clear what a 'critical function' is. The intent remains the same. Solution: Change to: "…its intended function"
response	Accepted

comment	*316* comment by: *General Aviation Manufacturers Association* Editorial "a/the COTS IP'" Typo in the definition of COTS IP
response	Not accepted. It is not a typo. It explains the convention to cover both cases: 'a' COTS IP or 'the' COTS IP.

comment	*317* comment by: *General Aviation Manufacturers Association* Major Comment COTS device usage – This is defined as an exhaustive list of conditions/constraints… associated with performance characteristics of implemented COTS functions.

	Proposed text: 'COTS device usage - This is defined as an exhaustive list of conditions/constraints... associated with performance characteristics of used COTS functions. Explanation: It is only a definition (it is not requested to produce this exhaustive list. The definition as proposed (with "used") will better align with the meaning of COTS-7.
response	Accepted. Additional text has been added to the definition to avoid misinterpretation.

Appendix - Guidance Material to AMC 20-152A | 1.0 Purpose p. 34

comment	*203* comment by: *GEAS_UK* It should be clarified in NPA best practices to demonstrate Hardware Process Assurance Records(DO-254 Table A-1 Data Section 10.8) without mandating a Hardware Process Assurance Plan(DO-254 Table A-1 Data Section 10.1.6) for Level C hardware.
response	Partially accepted. This inconsistency in ED-80/DO-254 has been corrected in AMC/AC 20-152A, but it requests an HPAP for DAL C. See the response to comment #244.

comment	*204* comment by: *GEAS_UK* Is it possible for the NPA to contain references to (public) material(best practices) which the examples or applications of Safety Specific and Functional Failure Path Analysis?
response	Noted. The comment does not propose specific material to reference. Therefore, EASA and the FAA cannot provide an answer to the question.

comment	*218* comment by: *Embraer S.A.* Titles of section 3.0 for the AC and AMC are not harmonized. While the AC says "Best Pratices" the AMC says "Guidance Material". This difference may cause confusion if the content of this AC 00-72 is required or not. Suggestion is to harmonize the title to "Best Practices for Airborne Electronic Hardware Design Assurance Using EUROCAE ED-80( ) and RTCA DO-254( )" as specified by AC.
response	Not accepted. EASA and the FAA use different terminology, and the titles respect each authority's system. In the FAA system, a '00' series AC provides general information and is not required. In the EASA system, the term 'guidance material (GM)' differs from the content of an AMC, which is an acceptable means of compliance.

comment	*272* comment by: *General Aviation Manufacturers Association* Minor Comment AC 00-72 Industry WG is willing to offer new content for AC-00-72/GM to include varied definitions of conceptual design and detailed design, and express trade-off of traceability to requirements for DAL A and DAL B for each option. Can be delivered soon after the public comment period while comments are being considered by the authorities.
response	Noted

comment	*288* comment by: *General Aviation Manufacturers Association* Major Comment AC 00-72/ GM Address the following frequent points of confusion with DO-254/ED-80 Table A-1 in AC 00-72/GM: 1. Row 10.1.6 (Process Assurance Plan) not required for DAL C, but row 10.8 requires have Process Assurance Records for DAL C; 2. Row 10.4.2 (Hardware Review and Analysis Procedures) is not required for DAL C or D however, the Review and Analysis Results (row 10.4.3) are required for DAL C and D. 3. Detailed Design Data (row 10.3.2.2) has a note 5 "If the applicant references this data item in submitted data items, it should be available." The expected hardware configuration classification of this referenced data has not been identified in ED-80/DO-254. Revise to address defining that data item as HCx per DAL like all other data items in Table A-1.
response	Partially accepted. The information has been added, but in the A(M)C part for consistency with other Table A-1 clarifications. See the response to comment #392.

comment	*403* comment by: *External/industry comments submitted thru FAA* [<AMC> A.1] [<AC>1.0] Purpose Titles of section 3.0 for the AC and AMC are not harmonized. While the AC says "Best Practices" the AMC says "Guidance Material". This difference may cause confusion if the content of this AC 00-72 is required or not. Suggestion is to harmonize the title to "Best Practices for Airborne Electronic Hardware Design Assurance Using EUROCAE ED-80( ) and RTCA DO-254( )" as specified by AC. *Comment submitted on behalf of Embraer S.A.*

response	Not accepted. See the response to comment #218.

Appendix - Guidance Material to AMC 20-152A | [A.2.1.1.1] [3.1.1.1] Hardware Environment Configuration Index (HECI) p. 34

comment	*148* comment by: *Erkan TIZLAK (TAI)* [<AMC> A.2.1.1.1][<AC> 3.1.1.1] Hardware Environment Configuration Index (HECI): The following correction could be made: "*The HECI may be included or referenced in the Hardware Configuration Index (HCI) or Top-Level Drawing*."
response	Not accepted. The A(M)C clarifies that an HCI is clearer than a top-level drawing, and is the preferred terminology.

comment	*173* comment by: *GEAS_UK* The term "hardware design tools" should be used instead of "hardware development tools", to align with section DO-254 11.4. In page 37 of this AC/ACM, the term development is used to convey both design and verification tools, however this is already accounted in page 35 bullet 3. Solution: Use term "design tools" rather than "development tools" to distinguish design from verification.
response	Accepted

Appendix - Guidance Material to AMC 20-152A | [A.2.1.1.2] [3.1.1.2] Hardware Configuration Index (HCI) p. 35

comment	*171* comment by: *GEAS_UK* Typo: Bullet 5 should refer to Table A-1 (instead of Table A1).
response	Accepted

comment	*172* comment by: *GEAS_UK*

	Contents for HCI do not include "procedures and methods for loading the bitstream file into the target hardware". FAA Order 8110.105 Rev A pointed out to DO-178C section 11.16. This content should be added to the HCI (tabulated list).
response	Accepted

comment	*318* comment by: *General Aviation Manufacturers Association* Minor Comment A.2.1.1.2 The purpose of the HCI is to identify the configuration of the hardware product. The HCI should include: proposed text - The purpose of the HCI is to identify the configuration of the hardware device. The HCI should include: Reason: To avoid confusion I propose to replace "Product" by "device".
response	Partially accepted. 'Product' has been replaced by 'item(s)'.

comment	*319* comment by: *General Aviation Manufacturers Association* Major Comment A.2.1.1.2 4. Identification of previously developed hardware (e.g. Intellectual Property, macrocells): Proposed text: "4. Identification of Intellectual Property and COTS Intellectual Property" Reason: Its confusing: "macro cell" is used in IP library definition (glossary) : not clear what is "macrocell" and what is "macro cell" . For FPGA (glossary) "macro cells could be CLB or whatever the name of the elemental cell of a FPGA ... ? It is not clear what should be identified in HCI ... Intellectual Property that is not COTS is considered to be design content that was internally developed.
response	Partially accepted. The text has been updated to remove 'microcell' and include 'COTS IP' specifically. Nevertheless, the identification of PDH has been kept as a separate bullet.

comment	*320* comment by: *General Aviation Manufacturers Association* Major Comment A.2.1.1.2

Proposed text for #2:

2. media used to produce the physical component (e.g. PLD/FPGA programming file or ASIC netlist/GDSII),

Proposed text for #6:

6. Archive and release media (e.g. for the source data)

There is an overlap between item 2 and item 6 that is reduced or eliminated with the proposed change.

response: Accepted

comment: *404* comment by: *External/industry comments submitted thru FAA*

[<AMC> A.2.1.1.2] [<AC> 3.1.1.2] Hardware Configuration Index

guidance here needs to add to 3. that the version of the individual files should be included or identified which make up this final configuration. This version should be tied to the means of HC1 control used to manage the individual files under problem reporting.

A best practices tip to be suggested is to avoided putting the source code and design along with the test bench code and scripts in the same HCI. This later leads to issues with final conformity related aspects and baselining of the design and tests for certification credit when they are managed both in this document. Suggestion that test bench files and test source code be managed in a similar means but in a separate document such as a VCI.

Item 5 requesting the life cycle data list here should be limited to the data which the source code is developed from. The accomplishment summary should be used for the final life cycle data table including the verification tests and results. When the tests procedures, results and SAS are listed in the HCI it creates a circular reference and issues with baseline of the source design for formal testing.

Comment submitted on behalf of T.Reeve
(thru US DO-254 User Group)

response: Partially accepted.
The text has been modified to include individual files and versions, and the test bench source code and scripts.

Appendix - Guidance Material to AMC 20-152A | [A.2.1.2] [3.1.2] Additional information for Objective CD-1 on Simple/Complex classification p. 35

comment	*322* comment by: *General Aviation Manufacturers Association* Editorial A.2.1.2 GM / AMC AC 00-72 Section 3.1.2 (GM/ Appendix), AMC headings Issue: AMC - Appendix A is already used for Glossary items. There are two Appendix A's in the AMC. Solution: For the AMC, change GM to use Appendix B references.
response	Accepted

comment	*405* comment by: *External/industry comments submitted thru FAA* [<AMC> A.2.1.2][<AC> 3.1.2] Additional Information for Objective CD-1 on Simple/ Complex Classification This clarification provides the rationale for why a complex device that is exhaustively tested by formal analysis or tool would not be classified as simple. However, this goes beyond the purpose of this document as a “best practice” that is “intended as guidance but rather as complementary information”. In reality, this is a clarification that serves to make a specific point about 3.1.1 section 5.2 regarding aspects of classifying the complexity of a hardware item. Strike this section and move the content to a note within 3.1.1 section 5.2 before identifying objectives. *Comment submitted on behalf of Astronautics*
response	Not accepted. The text in the AMC/AC part introducing the CD-1 objective highlights the need to consider the design content. The objective is worded to explain what to achieve, and does not focus on the criteria that are not to be used. GM/AC 00-72 provides a clarification to avoid any misinterpretation.

Appendix - Guidance Material to AMC 20-152A | [A.2.1.4] [3.1.4] Additional Information for Objective CD-6 on Verification of the Implementation p. 36

comment	*115* comment by: *FAA Consulting, Inc.* The last sentence seems to start a thought without finishing it. Suggest adding an additional sentence along the lines of, "Additional verification may be needed to address such delays as well as things like false paths in the design."
response	Accepted. Some similar text has been added in the section.

comment	*323* comment by: *General Aviation Manufacturers Association* Editorial A.2.1.4

	"… process variations, , an analysis …" Typo – remove extra comma.
response	Accepted

Appendix - Guidance Material to AMC 20-152A | [A.2.1.5] [3.1.5] Additional Information for Objective CD-8 on HDL Code Coverage Analysis p. 37

comment	*116* comment by: *FAA Consulting, Inc.* The inclusion of item 3, condition coverage, goes beyond what previously appeared in SWCEH-001. Theoretically, this should not represent a major increase in effort as a) most tools support focused expression coverage (implied here by the wording), and b) this is a Best Practices / GM item as opposed to being included in the AMC. Presumably, an applicant could establish some of these types of coverage as being 100% required while others could be stated as a design goal as part of addressing their approach to compliance to CD-8. However, the wording of CD-8 is such that it implies all of these types will be addressed. Is that truly the intent?
response	Noted. GM/AC 00-72 suggests some criteria for defining HDL code coverage. These criteria are qualitatively described. It is up to the applicant to define the criteria to associate with the tool used for HDL coverage. The chosen approach should cover the target defined in objective CD-8, which does not refer to a specific metric from a specific tool vendor.

comment	*149* comment by: *Erkan TIZLAK (TAI)* [<AMC> A.2.1.5][<AC> 3.1.5] Additional Information for Objective CD-8 on HDL Code Coverage Analysis The criteria to cover HDL code seems the same for DAL A and DAL B. According to EASA CM SWCEH-001 Section 8.4.2.1.(g), decision (branch) coverage is only required for DAL A design. What is the difference of HDL Code coverage criteria between DAL A and DAL B?
response	Noted. Objective CD-8 in A(M)C 20-152A does not differentiate between DAL A and DAL B. The criteria to cover HDL code have to be developed by the applicant. GM/AC 00-72 illustrates the type of criteria, and they are indeed identical for DAL A and DAL B.

comment	*324* comment by: *General Aviation Manufacturers Association* Editorial [<AMC> A.2.1.5][<AC> 3.1.5] Section 5.7 "Recognition of HDL Code Coverage Method":

Add in GM ([<AMC> A.2.1.5][<AC> 3.1.5]) "The HDL code coverage measurement at sub-function level may alleviate the HDL code coverage measurement at device level"

response

Not accepted.
The text that is proposed in the comment addresses different aspects from those that objective CD-8 covers.

comment

406 comment by: *External/industry comments submitted thru FAA*

[<AMC> A.2.1.5][<AC> 3.1.5] Additional Information for Objective CD-8 on HDL Code Coverage Analysis

Item 4 in this list should be highlighted specifically in CD-8. In the past only EASA CM identifies coverage of state machines and state transitions. With FAA this has not been a requirement or even discussed. Defining this only in the best practice allows for the possibility of this best practice that is not guidance but only complementary information to be regarded by applicants as not required. If ignoring this "additional information" was not the intent of this document, then item 4 and possibly other items should be moved to 3.1.1 section 5.7 as a note before the objectives.

Comment submitted on behalf of Astronautics

response

Not accepted.
Objective CD-8 already covers the state machine within '*the criteria should ensure coverage over the various cases of the HDL code elements used in the design*'.

comment

407 comment by: *External/industry comments submitted thru FAA*

[<AMC> A.2.1.5][<AC> 3.1.5] Additional Information for Objective CD-8 on HDL Code Coverage Analysis

Item 4 in this list should be highlighted specifically in CD-8. In the past only EASA CM identifies coverage of state machines and state transitions. With FAA this has not been a requirement or even discussed. Defining this only in the best practice would not consistently have it applied and a case can be made that it is not required.

This is new objective and needs to be clearer in AC20-152 CD-8 as new . Appendix B of DO-254 clearly states that elemental analysis need only be achieved at the level you design to and if you design at the HDL level then one could reasonably assume this implies statement coverage which has been accepted. DO-254 Section 2 says to consider more than one appendix B technique for DAL A and additional coverage matrix like decision and finite state machine have been required by the EASA CM . this is a new objective and should be adjusted by DAL.

	Comment submitted on behalf of Astronautics *T. Reeve* *(thru US DO-254 User Group)*
response	Not accepted. See the response to comment #406.

Appendix - Guidance Material to AMC 20-152A | [A.2.1.6] [3.1.6] Additional Information for Objective CD-9 on Tool Assessment and Qualification p. 37

comment	*150* comment by: *Erkan TIZLAK (TAI)* [<AMC> A.2.1.6][<AC> 3.1.6] Additional Information for Objective CD-9 on Tool Assessment and Qualification; It is stated that “a significant and representative set of custom device requirements is covered by both simulation and physical tests”. Instead of saying “a significant and representative set of custom device requirements”, it is better to request a “percentage (or ratio) of requirements” to be covered by both simulation and physical tests. Otherwise, it will cause many discussions since it is subjective.
response	Not accepted. Percentages or ratios do not necessarily better reflect the original idea of a ‘significant’ set of custom device requirements.

comment	*325* comment by: *General Aviation Manufacturers Association* Minor Comment <AMC> A.2.1.6 <AC 00-72> 3.1.6 "- the resulting outputs are identical". The word identical is too restrictive. Comparison of the results for the verification of the same requirements in the simulation and physical test environment should show that the expected results were achieved in both cases. Suggestion for the second bullet: “- results for simulation and physical test of the same requirement are equivalent”.
response	Accepted

comment	*326* comment by: *General Aviation Manufacturers Association* Minor Comment

	GM <AMC> A.2.1.6 Add this case: "Confidence in verification tools can also be gained through independent assessment". Reason: Would it be an acceptable alternative to re-run simulation tests on a dissimilar simulation tool and compare the results?
response	Accepted. The proposed example has been added.

comment	*327* comment by: *General Aviation Manufacturers Association* Minor Comment A.2.1.6 Confidence in design tools can be gained through the fact that the outputs from the design tools are independently verified by simulation and physical tests Proposed text - Confidence in design tools can be gained through the fact that the outputs from the design tools are independently verified by "after implementation" simulation and physical tests. Clarification suggested because only relevant simulation to assess design tool results is post layout simulation (or post synthesis) [tools here are limited to synthesis and place and route tools].
response	Partially accepted. Post-layout simulation has been added to reflect common practice.

comment	*408* comment by: *External/industry comments submitted thru FAA* [<AMC> A.2.1.6] [<AC> 3.1.6] Additional Information for Objective CD-9 on Tool Assessment and Qualification the resulting outputs are identical". The word identical is too restrictive. The comparison needs to be based on equivalency criteria. Proposed change: the resulting outputs are equivalent. *Comment submitted on behalf of Rockwell* *BAE Systems* *(thru US DO-254 User Group)*
response	Accepted

comment	*409* comment by: *External/industry comments submitted thru FAA*

	[<AMC> A.2.1.6] [<AC> 3.1.6] Additional Information for Objective CD-9 on Tool Assessment and Qualification Tool Assessment and Qualification section need to go further with regard to allowing for independent assessment of verification tools "thorough physical tests re-run as part of the simulation test sequences that allows for confirmation of the results". Some authorities and DERs/UMs have required this to be identical tests and results for all simulation test in order for this to count as sufficient. This is not reasonable or in alignment with what is done in other areas such as software. Software under DO-178C is verified in many different environments and we do not require all the software "unit tests" or "simulation tests" to be re-run identically on the target hardware in order to independently verify the simulator or unit test environment. There is guidance in DO-248 that does not require emulators and simulators to be qualified unless there is automation of pass fail or test generation with no manual review of the tool output. *Comment submitted on behalf of* *B Brinson* *T.Reeve* *BAE Systems (thru US DO-254 User Group)*
response	Accepted. The text has been clarified accordingly.

Appendix - Guidance Material to AMC 20-152A | [A.2.1.7] [3.1.7] Additional Information for Objective CD-10 on Tool Assessment and Qualification	p. 38

comment	*117* comment by: *FAA Consulting, Inc.* It is unclear why the second paragraph is present in this GM/draft AC. If a tool has been on the market for a sufficient period of time and has a confirmable, defensible market share, there should be no reason why a service history argument cannot be made even if the tool has not been used previously by the applicant.
response	Noted. While some tool history can be an asset for choosing the tool, it is still important for the user to gain experience in the usage of the tool, and to evaluate tool issues and existing problems/bugs. The second paragraph is a recommendation. The applicant may still wish to present the service history within the overall tool assessment effort.

comment	*328* comment by: *General Aviation Manufacturers Association* Minor Comment A.2.1.7

It would be helpful if the text was clear about whether different versions or releases of the same tool constitute the same tool. If using a different version of the tool, should differences between tool versions be analyzed? Sometimes, the tool algorithm changes significantly.

If bullet item, "stability/maturity of the tool linked to the change history of the tool" is not meant to include similarity of tool operation across used versions or releases, then add criterion "- similarity of tool operation for the versions linked to the tool service history."

response

Accepted.
Clarifications have been added as suggested in the comment.

comment

410 comment by: *External/industry comments submitted thru FAA*

[<AMC> A.2.1.7] [<AC> 3.1.7] Additional Information for Objective CD-10 on Tool Assessment and Qualification

The text should make clear whether different versions, releases, etc., of the same tool constitute the same tool. If using a different version of the tool, additional analysis needs to be performed. Provide the clarification for different versions of the same tool.

Comment submitted on behalf of Rockwell
(thru US DO-254 User Group)

response

Accepted.
See the response to comment #328.

Appendix - Guidance Material to AMC 20-152A | [A.2.1.8.1.1] [3.1.8.1.1] Assessment of the Service Experience of COTS IP p. 38

comment

119 comment by: *FAA Consulting, Inc.*

As noted in my comment to IP-2, the idea of service experience for soft and firm IP makes no technical sense given the need to re-synthesize and route the design.

response

Not accepted.
See the response to comment #118.

comment

151 comment by: *Erkan TIZLAK (TAI)*

[<AMC> A.2.1.8.1.1][<AC> 3.1.8.1.1] Assessment of the Service Experience of COTS IP:

	It is stated that “some additional development assurance needs to be defined to address the risk of insufficient or unrelated service experience.” What could be the contents of “some additional development assurance” in case of insufficient or unrelated service experience data?
response	Noted. Service experience is one part of the full assessment of the COTS IP information and deliverables (see IP-2). The additional development assurance varies on a case-by-case basis, and it needs to be defined to cover the gaps identified in IP-2. Objectives IP-4 to IP-6 have been written to address the gaps and the further development by the IP user (‘synthesis’ and ‘place and route’).

Appendix - Guidance Material to AMC 20-152A| [A.2.1.8.1.2] [3.1.8.1.2] Assessment of the COTS IP Provider & COTS IP data p. 39

comment	*20* comment by: *Williams International* Second bullet, the sentence “There is insufficient evidence of complete verification to make it trustworthy.” The word ‘trustworthy’ is subjective and subject to unnecessary debate. Recommend changing to “There is insufficient evidence of complete verification.”
response	Not accepted. See the response to comment #19.

comment	*329* comment by: *General Aviation Manufacturers Association* Editorial Page 39, second paragraph of section 3.1.8.2 last sentence has "...performing a for a [" where the "for a" is not needed and is confusing. Delete "for a" to improve clarity of the sentence.
response	Accepted

Appendix - Guidance Material to AMC 20-152A | [A.2.1.8.3] [3.1.8.3] Clarification of Objective IP-5 on Requirements for the COTS IP Function and Validation p. 40

comment	*120* comment by: *FAA Consulting, Inc.* Odd wording - end of second paragraph. What does "including unused ones for deactivation" mean? It would seem it would be better to say, "including the requirements for isolating or deactivating unused functions."
response	Accepted

comment	*330* comment by: *General Aviation Manufacturers Association*

	Minor Comment A.2.1.8.3 ".... including unused ones for deactivation." Proposed text: Including means to deactivate unused functions.
response	Accepted

Appendix - Guidance Material to AMC 20-152A | [A.2.2]/[3.2] COTS DEVICES p. 40

comment	*121* comment by: *FAA Consulting, Inc.* We have steadily moved from a PHAC that summarizes provides an overview of the hardware and associated life cycle to one that is now required to have detailed information on the parts complement. This is a problem. Would rather see this language be reworded (from the second sentence of <AMC>A.2.2.1/<AC>3.2.1 onward) to read along the lines of the following: "The list of Complex COTS should be made visible to the regulatory authority, either via the PHAC if known at the time of initial submittal or via a PHAC update once the parts selection process is completed. It is understood..." This change is suggested since it would seem determination of the appropriate DAL for the hardware and any major AMoC discussions should not be held up waiting on the parts list to be finalized.
response	Accepted. The text has been modified to cover the comment, but in a slightly different manner.

Appendix - Guidance Material to AMC 20-152A | [A.2.2.1][3.2.1] Additional information for COTS Section 6.3 and Objective COTS-1 on COTS complexity assessment p. 40-42

comment	*122* comment by: *FAA Consulting, Inc.* No doubt that a lot of time and energy went into trying to provide clear examples on simple vs. complex. However, the rationale for arriving at the contents of the table included here has not been captured and thus the reader is left to draw their own conclusions why the various scenarios have ultimately landed on one side or the other of the complexity decision. The examples clearly depart from earlier guidance and what I have seen and experienced over the last five years. The various COTS research reports put out by the FAA help explain some of the reasoning but still the inclusion of any FPGA and even the microcontrollers with on chip peripherals are a departure from where things have been for some time. More explanation is needed here or the FAA and EASA should be prepared for a lot of discussion and negotiation over these classifications.
response	Noted.

	EASA and the FAA have added introductory text to clarify that the examples provide some characteristics of complex and simple devices for illustration. Those were assessed against the generic criteria identified in Section 6.3 to provide the resulting complexity classification. EASA and the FAA acknowledge that the criteria might lead to classifying certain microprocessors as simple, whereas a different approach was maybe taken in previous. That is the intent: in a risk-based approach, the focus is put on more complex devices.
comment	*205* comment by: *GEAS_UK* Please correct the typo in the below sentence "An example of a 32 nit reduced instruction set computing (RISC) microcontroller with:"
response	Accepted
comment	*331* comment by: *General Aviation Manufacturers Association* Editorial Section A.2.2.1, 2nd entry in table, 2nd bullet Issue: Font appears to be different. Solution: Make font consistent.
response	Accepted
comment	*332* comment by: *General Aviation Manufacturers Association* Editorial Section A.2.2.1, 3rd entry in table, 1st bullet Issue: Add semicolon prior to list of functions. Solution: Change to: "…with each other: PCI interface…".
response	Accepted
comment	*333* comment by: *General Aviation Manufacturers Association* Editorial A.2.2.1, 3rd entry in table, 3rd bullet Issue: Delete word "different". Word adds no value and creates confusion. Solution: Change to: "There is no resource sharing…".
response	Accepted

comment	*334* comment by: *General Aviation Manufacturers Association* Minor Comment A.2.2.1, 3rd entry in table Examples table, third example: It is not clear how the example distinguishes the device as simple. Suggest replacing the example with: "— Several functional elements that interact with the single core processor but not with each other - PCI interface, timers, SPI, I2C, JTAG — Significant number of functional modes where each interface has few modes of operation; and — Limited configurable functions using one major internal data path and using a limited number of discretes on SPI or I2C. There is limited resource sharing in the device."
response	Accepted

comment	*335* comment by: *General Aviation Manufacturers Association* Editorial A.2.2.1, 4th entry in table, 1st sentence: Issue: Fix misspelling "32-nit". Solution: Change to: "An example of a 32-bit reduced…"
response	Accepted

comment	*341* comment by: *Rolls-Royce plc* Page 41, section 3.1.2 Typo - "32 nit" correct to "32 bit"
response	Accepted

Appendix - Guidance Material to AMC 20-152A | [A.2.2.2.2] [3.2.2.2] Clarification of Objective COTS-3 on Using a Device Outside the Ranges of Values Specified in its Datasheet p. 43-44

comment	*336* comment by: *General Aviation Manufacturers Association* Minor Comment A.2.2.2.2 / 3.2.2.2 Is an uprating process considered to be part of the environmental qualification or a part of the hardware development process? Please reword the second paragraph to express intended meaning.

response	Accepted. The second paragraph has been revised to explain that uprating differs from the ED-14/DO-160 environmental qualification testing.

comment	*337* comment by: *General Aviation Manufacturers Association* Minor Comment A.2.2.2.2 / 3.2.2.2 Is an uprating process considered to be part of the environmental qualification or a part of the hardware development process? Please reword the second paragraph to express intended meaning.
response	Accepted. See the response to comment #336.

Appendix - Guidance Material to AMC 20-152A | [A.2.2.3] [3.2.3] Additional information for maCOTS Section 6.4.2 COTS Device Malfunction p. 44

comment	*123* comment by: *FAA Consulting, Inc.* This is the first time that the idea of periodically or continuously monitoring of errata has been mentioned: "entire life cycle of the product (before and after certification)." While this makes sense and larger organizations often have Component Engineers who have this monitoring as one of their job functions, this would seem to be suggesting a type of CMR for COTS devices. If this is the case, then it belongs in the AC/AMC rather than GM/Best Practices.
response	Noted. The quoted sentence addresses access to errata information. Access to errata is covered in the AMC/AC Section 6.4.1 related to ECMPs.

comment	*338* comment by: *General Aviation Manufacturers Association* Minor Comment A.2.2.3 / 3.2.3 At the end of the first bullet it looks like the text "and for each of the applicable errata," is part of the bullet due to the indentation. From committee draft this text is a lead-in to the following two bullets. Clarity would be improved if this lead-in text was moved back out to the left margin for the paragraph so it does not appear to be part of the first bullet.
response	Accepted

Appendix - Guidance Material to AMC 20-152A | [A.2.3] [3.3] Electronic Hardware Assembly Development p. 45

comment	*34* comment by: *GE Aviation*

	What is the intent of this section? In the Applicability section of AMC 20-152A it indicates that the board and box process is removed, but the way this section is written (AC 00-72 for the FAA) it seems to be setting an Acceptable Means of Compliance to the regulation "An applicant's internal structured process that encompasses these activities is an 'acceptable' development assurance approach..." So is the intent that the delegated authority audit records for their system to board level V-model to show 'requirements capture, validation, verification, and configuration management activities'? Per Note 3, if they are not found at the hardware assembly level, is the next higher level of intergration then evaluated for compliance? This is confusing guidance.
response	Accepted. A new Section 7 and objective CBA-1 have been added to cover the development assurance of CBAs. AMC Appendix B/AC 00-72 has also been updated to remove the term 'acceptable'.

comment	*152* comment by: *Erkan TIZLAK (TAI)* [<AMC>A.2.3][<AC>3.3] Electronic Hardware Assembly Development: What is required for "Electronic Hardware Assembly Development" is not clear. It is stated that "the structure of the process life cycle data is at the discretion of the applicant's internal procedures." If the applicant says that "according to internal company procedures there is nothing to do for electronic hardware assembly development", there will be nothing to do for electronic hardware assembly development.
response	Noted. A new Section 7 and objective CBA-1 have been added to cover the development assurance of CBAs. AMC Appendix B/AC 00-72 has also been updated.

comment	*153* comment by: *Erkan TIZLAK (TAI)* [<AMC>A.2.3][<AC>3.3] Electronic Hardware Assembly Development: According to the AC 20-152A, there is no requirement for the validation derived requirements at LRU level hardware & circuit board assembly (CBA) levels. It means that these derived requirements will be allocated to lower levels (CBA and/or PLD/FPGA level) without doing any validation activity. I think that there should be requirement for the validation of derived requirements at all levels (LRU level hardware, CBA, PLD/FPGA).
response	Accepted. A new Section 7 and objective CBA-1 have been added to cover the development assurance of CBAs, and it includes validation.

comment	*166* comment by: *GEAS_UK* Is it intentional not to mention process assurance in the first paragraph?

response	Noted. Yes, it is intentional.

Appendix - Guidance Material to AMC 20-152A | [A.2.4] [3.4] Development of airborne electronic hardware contributing to functions with a hardware DAL D p. 45

comment	*249* comment by: *General Aviation Manufacturers Association* Minor Comment [<AMC>A.2.4][<AC> 3.4] Identifies acceptable means of compliance for airborne electronic hardware contributing to functions with a hardware DAL D. Clarify that airborne electronic hardware includes both custom micro-coded devices and complex COTS devices. Reason - Some understand current policy to be limited to custom micro-coded devices with a hardware DAL D. However, in this A(M)C 20-152A, both section 2 and this section of the best practices (guidance material) are understood to apply to all airborne electronic hardware and are not limited to custom micro-coded components. Proposed text – "For airborne electronic hardware contributing to functions with a hardware DAL D (including custom devices and complex COTS devices),"
response	Not accepted. Airborne electronic hardware (AEH) in this document is no longer limited to custom devices, so EASA and the FAA do not expect any misunderstandings. Making a clear distinction in this section would bring more confusion.

Appendix A. GLOSSARY [of GUIDANCE MATERIAL] p. 47

comment	*299* comment by: *General Aviation Manufacturers Association* Page 34. AC 00-72/GM - General: Verification of the COTS IP as a standalone (or a hierarchical) function. It could be based on provider evidences, on additional activities based on independent check (e.g. Ethernet compliance), or based on full reverse eng. (requirement based verification) part1. It is not related to verification of requirements allocated to IP that are part of the complex custom device (the IP user). These requirements may be functional (an Ethernet link must exists and have such performances), may be related to usage domain and so on (part 3). Part 2 is related to test of the IP implementation as part of the physical verification (physical test and implementation review).
response	Noted.

It is unclear which section the comment is referring to and what update is proposed or requested.

3.2. Draft AMC and GM (EASA AMC/FAA AC) on OPRs p. 49

comment	*53* comment by: *Textron Aviation* System level guidance for development assurance, ARP4754A/ED-79A, specifically addresses the PR process along with its interface and alignment with Software and AEH processes. The ARP or the regulatory guidance which uses it to call for system level processes should be the source of such guidance. ARP4754A/ED-79A, an industry consensus document, does not provide the same level of detail regarding PR Management as the Software guidance, AEH guidance, or this guidance. While it does discuss the interface and handoffs between itself and the Software and AEH processes, the detailed level of alignment described in this AMC is not recommended by the ARP. Specifically, ARP4754A does not discuss the following details of Problem Reporting: classifications, assessment, reporting, and stakeholder responsibilities. Therefore, this guidance will directly contradict the ARP and cause confusion in the industry. We suggest to Update ARP4754A, system level guidance, to reflect these needs ahead of publication of this guidance, or rewrite this guidance only in the context of Software and AEH.
response	Not accepted. This A(M)C 20-189: 1) describes an acceptable process for the three domains (system, software and AEH); 2) provides consistent guidance across these domains; and 3) complements but does not alleviate the project-applicable system, software and AEH guidance. ARP 4754A addresses problem reporting (PR); however, it is merged with the change control (CC) guidance, but it contains no specific guidance on the PR process.

comment	*226* comment by: *Pratt & Whitney Canada* Is compliance to this document (A(M)C 20-189) required for existing projects or modifications to approved projects?
response	Noted. This AMC/AC will become applicable at the date of its publication and it will apply to new certification projects after that date. For modifications of existing products, existing processes may be used, provided that those processes have been evaluated and found to be acceptable on a previous certification project, and they cover the open problem Report (OPR) management topic. Applicants, of course, have the possibility to apply this guidance on a voluntary basis on existing products.

comment	*227* comment by: *Pratt & Whitney Canada* Based on the OPR classification provided, should requirement traceability issues be classified as Type 'Process'?
response	Noted. If the OPR is confirmed to have no potential safety or functional effects, then two categories could apply to traceability issues: either 'Process' or 'Life-cycle data'. [Note that the category 'Documentary' has been changed to 'Life-cycle data'.] A deficiency in traceability that would be caused by a shortcoming in the development or verification process should be classified as 'Process', whereas an isolated missing trace link would be classified as 'Life-cycle data'.

AMC 20-189/AC 20-189:Management of Open Problem Reports — 1. Purpo p. 49

comment	*125* comment by: *FAA Consulting, Inc.* Do not understand the exclusion of PMA from the scope of this guidance. It should be added IMO.
response	Noted. PMA depends on having a type certificate, therefore it is not necessary to specify it separately.

AMC 20-189/AC 20-189:Management of Open Problem Reports — 2. Applicabili p. 49

comment	*1* comment by: *BRUN* 3.2.1 - 2.Applicability: As it is done for AEH section it should better to clearly identify for which DALs the OPR management is applicable instead of indicating not applicable for electronic equipment contributing only to minor failure conditions.
response	Not accepted. Since this A(M)C applies to all CSs/14CFR Parts, there are certain conditions where the required assurance level differs for certain failure conditions.

comment	*70* comment by: *General Aviation Manufacturers Association* Major Comment 2 Commented text: *This [AMC]/[AC] is not applicable to electronic equipment embedded in airborne systems which could cause or contribute only to Minor failure conditions* Comment: What about software and AEH? What means "electronic" equipment? **Proposed resolution:**

This [AMC]/[AC] is not applicable to electronic equipment embedded in airborne systems, software and AEH embedded in those systems, which could cause or contribute only to Minor failure conditions or to failure conditions having No Safety Effect

response

Noted.
Paragraph 2 on applicability has been reworded due to another comment, to remove the portion of 'non-applicability' of the [AMC]/[AC].
The sentence you commented on has been removed, and the issue is no longer applicable.

comment

88 comment by: *General Aviation Manufacturers Association*

Major Comment
2
Commented text:
is also not applicable to component partitions which could

Comment:
component partitions is ambiguous

Rationale:
Component refers to electronic component (device), to AEH … ?
To be clarified

Proposed resolution : Remove component
This [AMC]/[AC] is also not applicable to ~~component~~ partitions which could cause or contribute only to Minor failure conditions or to failure conditions having No Safety Effect.

response

Noted.
Paragraph 2 on applicability has been reworded due to another comment, to remove the portion of 'non-applicability' of the A(M)C.
The sentence you commented on has been removed, and the issue is no longer applicable.

comment

105 comment by: *General Aviation Manufacturers Association*

Editorial
Sec. 2
Change last sentence in section 2 to:
"This [AMC]/[AC] is not applicable to electronic equipment software, and AEH, embedded in airborne systems which could cause or contribute only to Minor failure conditions or to failure conditions having No Safety Effect."

response

Noted.
Please refer to the response to comment #70.

comment

110 comment by: *General Aviation Manufacturers Association*

Editorial

	2 To improved clarity: Recommend editorial change as follows. "Hazardous" should be replaced with the text "Severe- Major/Hazardous" as it is referenced that way in ARP4761.
response	Not accepted. 'Severe-Major' is not used consistently in EASA and the FAA's regulatory and guidance material. Additionally, the drafts of ARP 4754B and ARP 4761A do not use 'Severe-Major'.

comment	*174* comment by: *GEAS_UK* General Comment: After reading through this proposed AC, it is clear that the intent is to set up two distinct problem report processes, one for product development/verification and post approval (see section 5) and the other to address open problem reports. This doesn't make sense since an open problem report was recorded in the PR system that section 5 speaks to. Solution: Make it clear in this AC that a singular PR process, that addresses the concerns and guidance PRs (section 5) and OPRs (section 6) is acceptable
response	Accepted. It is not the intent of the AMC/AC to enforce two distinct systems, and nothing in the current material states that it is. However, to clarify your concern, the wording 'based on the PR management process' has been added in the first sentence of Section 6.

comment	*219* comment by: *Embraer S.A.* As this AMC/AC does not establish guidance for transitioning to it, Embraer understands that this AMC/AC is applicable only to new projects certifications. For modification of certified product, Embraer understands that the applicable CRIs and IPs will continue to be used. Suggestion is to establish guidance for transitioning to AMC20-189 stating that this AMC/AC is applicable only to new projects certifications.
response	Noted. This AMC/AC will become applicable at the date of its publication and it will apply to new certification projects after that date. For modifications of existing products, existing processes may be used, provided that those processes have been evaluated and found to be acceptable on a previous certification project, and they cover the OPR management topic. Applicants, of course, have the possibility to apply this guidance on a voluntary basis on existing products.

comment	*344* comment by: *Rolls-Royce plc*

	3.2.1 Applicability states that the AMC is not to be used for systems/equipment that can only result in a Minor effect. The Applicant could choose to use this AMC; indeed as a single applicant may integrate systems/equipment with multiple DAL levels it would surely be beneficial to use a consistent classification. It is also possible that during a development programme the worst consequence of an item of equipment may change, hence using a consistent classification would be sensible. Suggestion: Remove this constraint for systems with a Minor effect.
response	Accepted. It has been decided to only make this A(M)C applicable to systems/equipment that contribute to Major, Hazardous or Catastrophic failure conditions. However, nothing should prevent an applicant from using this AMC/AC material for other systems/equipment. It is up to the applicant to decide whether to use it or not. Therefore, EASA and the FAA agree with your proposal to remove the 'non-applicability' statements.

AMC 20-189/AC 20-189:Management of Open Problem Reports — 3. Backgrou p. 49

comment	*97* comment by: *General Aviation Manufacturers Association* Editorial 3.1 There is a formatting issue. Section labeled as 3.1 should be on a new line.
response	Accepted. The formatting has been corrected in the final AMC/AC.

AMC 20-189/AC 20-189:Management of Open Problem Reports — 4. Definitio p. 49-51

comment	*8* comment by: *MGHILL* Section 4.3. There is concern over which category is used for failures not visible to the flight crew. In many cases first failures are now invisible to the flight crew since software can counteract the failure. Such failures lead to reduced robustness and should be resolved by a supplier. Under the proposed OPR classification it appears that such failures would be classified within category "other". But this category implies a low level of concern. It is recommended that a further category related to "reduction in robustness" with a higher level of importance be introduced to cover such situations as given above.
response	Partially accepted. If the OPR is confirmed to have no potential safety or functional effects (after mitigations have been accounted for) and not to be linked to a process deficiency, then such robustness issues would be classified as 'Life-cycle data'.

	[Note that the category 'Documentary' has been changed to 'Life-cycle data' and therefore is more adapted to cover this type of issues that do not have any impact on the system/aircraft level.] This OPR could, alternatively, fall into a dedicated subcategory of 'Life-cycle data' proposed by the applicant, if deemed necessary.
comment	*357* comment by: *Bombardier* Bombardier supports the development of harmonized standards on problem reporting. The methodology proposed in the NPA is consistent with our current practices.
response	Noted
comment	*21* comment by: *Ultra Electronics Precision Control Systems* Please clarify whether PRs associated to the build configuration of an item with no aircraft/equipment level functional effect need to be classified as "functional". For example, PRs raised for the following reasons: 1. Software coding deviates from coding standards/guidelines e.g. MISRA C, and either rectified, or a deviation is requested (if there are valid reasons for the deviation). 2. A component in a PWBA has become obsolete and needs to be replaced. In both cases the PR resolution will involve a change of build configuration (i.e. new software build and new hardware build respectively), with the consequence that the PR may be classified as functional. For example, with the software coding case, in the event that "functional" is defined as "issues that can only be resolved with a change to the code". This prevents a PR from being classified as "Other" (since "Other" is associated with no potential functional impact). However, the PR may have no actual or potential impact on a function at the product, system, or equipment level. Please consider an additional classification of "Build Configuration Deviation" for PRs associated with the build configuration of the equipment with no functional effect. Alternatively, please clarify that the above cases fall into the "Other" classification.
response	Noted. 1. If it is confirmed that the OPR is not linked with a process deficiency, then such coding standard deviation issues would be classified 'Life-cycle data'. [Note that the category 'Documentary' has been changed to 'Life-cycle data'.] 2. The second example is not a PR per the definition in this AMC. Nothing prevents an applicant from creating additional classification categories for obsolescence management or future improvements, but those PRs are not strictly within the scope of this AMC/AC. This OPR could, however, alternatively fall into a dedicated subcategory of 'Life-cycle data' proposed by the applicant, if deemed necessary.

comment	*23* comment by: *Luftfahrt-Bundesamt* The definitions (or a reference to the definitions) of Minor, Major, Hazardous and Catastrophic failure conditions should be added.
response	Not accepted. Failure conditions are defined in the applicable regulations and guidance material issued by the relevant certification authority.

comment	*71* comment by: *General Aviation Manufacturers Association* Major Comment 4.3 Commented text: *Note: The 'potential safety effect' in this definition is based on Initial Airworthiness* Comment: Not sure it helps external reader to better understand the definition **Proposed resolution :** remove this note
response	Accepted. The note has been removed, as suggested.

comment	*72* comment by: *General Aviation Manufacturers Association* Major Comment 4.3 Commented text: 'Process': a PR recording a process non-compliance, deficiency or deviation Comment: Deviation is outside the scope of this AMC Justification: Why having a dedicated OPR for a deviation : either a deviation is accepted (method used is not the one described in plans but the objective is covered): so nothing to do, just trace it in the HAS or the next issue of PHAC. No OPR Or a deviation is not accepted, because it does not fully cover the failed objective (e.g. verification is not complete) then it becomes an OPR with a potential safety impact ("safety") ?It is no more a deviation At the very beginning (when process deficiency is detected) it could be a PR. When analyzed and after decision it becomes either a deviation or a PR (that could be solved: complement of verification to fill the gap) or becomes an OPR of type "safety" if not solved **Proposed resolution:** Check if deviation is used elsewhere in the doc and propose to delete all references to deviations in the text (except "significant deviations" , see GM 4.2.3 & 4.2.4)
response	Accepted.

	It is true that a deviation should be, at first, managed through the certification liaison process (SAS/HAS). If the deviation is accepted, a process change tracking OPR might still be opened. If the deviation is not accepted, your statement is correct, the OPR may even be classified as 'Significant'. Therefore, EASA and the FAA agree to remove the word 'deviation' from the 'Process' definition.
comment	*80* comment by: *General Aviation Manufacturers Association* Minor Comment 4.1 Definition of Problem Report: It is assumed that a Problem Report is a class that includes both closed and open Problem reports. If this assumption is correct, the word "resolution" in this definition of Problem Report implies that the correction is recorded with the report. If the Problem Report is open, you wouldn't necessarily have a resolution at the time of recording a Problem. **Suggested revision:** "A means to identify and record the description and potential resolution of anomalous behavior, process non-compliance…"
response	Not accepted. Since a problem report (PR) has various states as described in Section 4.2, the resolution is not expected to be recorded until it has reached the state of 'Resolved'.
comment	*84* comment by: *General Aviation Manufacturers Association* Minor Comment 4.3 Commented text: *"'Other': a PR having no potential safety impact, no potential functional impact, and not linked to a process deficiency or a deviation or to a documentary deficiency."* **Comment:** It is unclear what could be classified "other" based on the definition of the other PR types, since as per definition, "Other" do not sound like an issue. May a bad behavior on an item part not activated (i.e. unused/deactivated SW/HW function) be considered as "Others"?
response	Accepted. To address this and other related comments, EASA and the FAA have removed the category 'Other' and changed the text of the AMC/AC consistently to open up the possibility for stakeholders to create additional classifications or subclassifications as needed. Moreover, 'Documentary' has been changed to 'Life-cycle data', and the associated definition has been reworked.

comment	*89* comment by: *General Aviation Manufacturers Association* Minor Comment 4.2 aim of this section is not clear It is not clear that PR/OPR may have many other states depending on configuration management process and tool used by the applicant (initiated, analysed, assigned, reviewed, implemented, re-analysed …). **Proposed resolution:** To move it as sub-definitions of “problem report(PR)” in section 4.1
response	Accepted. It is clear that these are not the only states to be considered. The word ‘possible’ has been removed for clarity.

comment	*91* comment by: *General Aviation Manufacturers Association* Minor Comment 4.3 & 6 The definitions for OPR "Functional" and "Process" classifications discussed in Sections 4.3 and 6 leave a gap in coverage of Verification Procedure deficiencies that affect requirements and/or requirement verification, but do not necessarily directly affect implementation or functional behavior. This is presumably of sufficient magnitude that A[M]C 00-71 Section 4.2.3 specifies "An example of an OPR that should not be classified as a ‘Process’ PR is one related to a requirement that was not completely verified because of a process deficiency." Suggest that the issue of OPR classification for deficiencies uncovered in Verification activities (such as Procedure deficiencies or errors), which are also specified in SAE ARP4754A Section 5.5.6.4, should be clarified in the classification guidance of the A[M]C 20-189 text, without sole reliance on the A[M]C 00-71 content.
response	Not accepted. The use of ‘potential impact’ as well as clarification in the guidance material is deemed sufficient enough to avoid any gaps. Indeed, if an OPR that is linked to deficiencies in the verification procedures has any potential safety or functional impact, then it should be classified as ‘Significant’ or ‘Functional’. If not, unless it is linked to a process issue, it may end up being seen as a ‘Life-cycle data’deficiency.

comment	*98* comment by: *General Aviation Manufacturers Association* Editorial 4.1 Definition of Open Problem Report- there should be a space added after ‘Closed’.
response	Accepted. A space has been added after ‘Closed’.

comment	*100* comment by: *General Aviation Manufacturers Association*

Editorial
4.2

Change the definition of "Resolved" to "A problem report that has been corrected or fully mitigated, but for which resolution has not been reviewed and confirmed."

response

Accepted.
The modification has been implemented as proposed, with the addition of 'has been verified but not formally reviewed and confirmed' for absolute clarity.

comment

101 comment by: *General Aviation Manufacturers Association*

Editorial
4.3
Change the definition of "Documentary" to "a PR linked to a deficiency in a life cycle data item but not linked to a process deficiency or deviation. This includes typographical or editorial defects in life cycle data items."

response

Noted.
The proposed change would be correct; however, this second sentence in the definition has been removed.
Note: The 'Documentary' classification has been changed to 'Life-cycle data'.

comment

109 comment by: *General Aviation Manufacturers Association*

Editorial
2
To improved clarity: Recommend editorial change as follows. "Hazardous" should be replaced with the text "Severe- Major/Hazardous" as it is referenced that way in ARP4761.To improved clarity: Recommend editorial change as follows. "Hazardous" should be replaced with the text "Severe- Major/Hazardous" as it is referenced that way in ARP4761.

response

Not accepted.
Please refer to the response to comment #110.

comment

162 comment by: *GEAS_UK*

The Term "Potential Safety" is a little misleading. Why not just use the term "Safety". Whilst the definition takes in to account that this applies to PRs during initial airworthiness stages where the actual end effect may not be known initially, with safety it is always better to assume worst case until proven otherwise.

response

Partially accepted.
The term 'Potential Safety' has been changed to 'Significant' to avoid confusion.
Whatever the terminology, it is anticipated that these PRs should be closed or mitigated prior to reaching the highest stakeholder level. If not, each one requires justification per paragraph 6.3.

	Moreover, paragraph 6.1.4 does highlight the need for lower-level stakeholders to consider the variability in the classification (= worst-case effect).
comment	*175* comment by: *GEAS_UK* Definition of OPR is to restrictive. A problem recorded after approval is an open PR. Solution: Change the definition to: A problem report that has not reached the state 'Closed'
response	Not accepted. From a logical perspective, your statement is correct. However, it is intentional that the definition of 'OPR' is focused on the time of approval, as this is the time when OPRs are requested and are assessed. Therefore, no change is proposed.
comment	*220* comment by: *Embraer S.A.* The Sections 4.2 and 4.3 should consider the possibility of mapping the states and classifications proposed to the current ones already used by the applicants.
response	Noted. It is up to the applicant to create their own mapping and demonstrate that it meets the definitions from this AMC/AC in terms of classification and PR states. Some guidelines are provided in GM2/AC00-71 4.2; however, it is important to note that the new classification scheme removes some ambiguities from the former scheme (per DO-248A/ED-94A DP#9), and therefore direct mapping may not always be the optimal solution.
comment	*228* comment by: *Bell Helicopter Textron Inc* The concern is that the guidance asks for specific categorization names 'Potential Safety', 'Functional', 'Process', 'Documentary' and 'Other.' The guidance should allow customization of these names, and should therefore state "or equivalent" or it should allow an applicant to provide a mapping of the actual/selected PR categories to the category names in this guidance. Also – it does state "at a minimum" meaning additional categories can be chosen – however, this conflicts with the definition of the "other" category. In summary, the guidance as written will lead to non-value-added adjustments to PR databases, CM Plans, etc (or findings written against those). The guidance should simply require that a PR categorization scheme be proposed & agreed to in the applicable planning documents during the planning phase. The provided list of categories should be clarified as "recommended" or "example" category names.
response	Partially accepted. The AMC/AC suggests a common scheme that can be used across industry in order to maintain consistency and avoid confusion. However, it is not the only means, and the applicant is free to provide their own classification scheme within the framework provided in the classification definitions.

	Implementing this new guidance is likely to require some initial adaptations to existing processes; however, full flexibility is given in the choice of names and the mapping from existing schemes. EASA and the FAA agree that the definition of 'Other' raises some issues. To address this and other related comments, we have removed the category 'Other' and changed the text of the AMC/AC consistently to open up the possibility for stakeholders to create additional classifications or subclassifications as needed. Moreover, 'Documentary' has been changed to 'Life-cycle data', and the associated definition has been reworked.

comment	*345* comment by: *Rolls-Royce plc* 4.3 ''Potential safety' classification describes the effect on the 'aircraft', yet for consistency this should state 'product' (as it is not only aircraft that are awarded Type Certificates). Suggestion: Change from 'aircraft' to 'product'.
response	Accepted. The definition has been modified as suggested. Note: The term 'Potential Safety' has been changed to 'Significant'.

AMC 20-189/AC 20-189:Management of Open Problem Reports — 5. Problem Report Manageme p. 51

comment	*24* comment by: *Luftfahrt-Bundesamt* It is unclear why there is no PR managment process on a/c level? Systems might comply with there individual specifications but generate problems on a/c level, e.g. due to incompatibilities or inhomogeneous HMI behaviour.
response	Noted. The intent of this AMC/AC is to encompass three domains: system, software and AEH. The aircraft-level PR management is outside the scope of this document. However, please note that PR and OPR management are focused on the aircraft-level effects of any PR/OPR.

comment	*62* comment by: *General Aviation Manufacturers Association* Major Comment 6.1.2 & 6.1.3 *Mitigations that are controlled by a higher-level stakeholder, including any operational mitigation, should not be considered in the current level stakeholder's classification.* *Stakeholders other than the type certificate (TC)/supplemental type certificate (STC) level applicant should consider the potential worst-case effect (as anticipated by the stakeholder) of the OPR in the classification.*

Classifying OPR pending on their impact on the aircraft without considering any higher-level stakeholder mitigation is a significant change in the current practices and a burden for industry and authorities : OPR classification for impact on aircraft and operations should be performed at relevant product/article levels

Proposed resolution :
Remove sections 6.1.2 & 6.1.3

response

Partially accepted.
Paragraph 6.1.2 (now 6.1.3) has been reworded to open up the possibility to use mitigations that are not under the control of a stakeholder, provided it has been validated with the affected stakeholder and remains acceptable in the frame of the approval/authorisation.
Paragraph 6.1.3 (now 6.1.4) has been changed to remove the notion of 'potential worst-case effect' and to clarify what is expected to be anticipated by a stakeholder other than the aircraft TC/STC-level applicant: they should consider the variability of the classification between 'Functional' and 'Significant' that may occur at the installation level.

comment

413 comment by: *External/industry comments sumbitted thru FAA*

Paragraph: (3.2.1) 5.1

The need to address the review and resolution of PR's that impact transition to other development assurance processes is a topic for the "best practice" guidance rather than an expectation of the airworthiness authorities. It is indisputably a good practice to identify problems at the appropriately earliest time to preclude a cascade of additional problems in different development assurance processes. However, the point of this A(M)C is to address the handling of problems that are still in an un-Closed state at the time of approval or subsequent to that time. The management of PR's in the course of transitioning between development assurance processes should be a best practice. Move this paragraph to section 3.2.2.

Comment submitted on behalf of Astronautics

response

Not accepted.
One purpose of the AMC/AC is to establish equivalent expectations for problem reporting management across all three domains. This includes the need to manage PRs during the development activities without postponing the resolution of issues that impact on other processes.
Relocating this paragraph to the GM/Best Practices would diminish this intended purpose.
In order to keep track of the working group discussions and the rationale behind the whole of Section 5 of the A(M)C, EASA and the FAA have added a sentence at the beginning of Section 5.

comment

66 comment by: *General Aviation Manufacturers Association*

Major Comment
5.2

"Additionally, an applicant should identify and correct any related systemic process issues."

This implies that systemic issues must be fixed right away, however, should this instead be clarified to have the fix occur in the next change/update? In addition, this could work with AC 20-115D Sections 5. and 9. to guide updates regarding process into being fixed before or as part of legacy updates that decide to upgrade development to DO-178C.

Suggested revision:
Update the wording to: "Additionally, an applicant should identify any systemic process issues and establish a plan to correct the issues in a future update."

response

Not accepted.
5.2 does not specify any timing to correct the issue.
The correction should be dependent on the potential safety effect of the issue on the product.
Additionally, even if they are not safety related, systemic process issues are best addressed in a timely manner to avoid further similar issues (without waiting for the next update).

comment

73 comment by: *General Aviation Manufacturers Association*

Major Comment
5.2

OPR after approval should be managed as per EASA part 21.A.3B(b).It could be inconsistent with the definition of Intital airworthiness as mentioned in 4.3

Proposed resolution:
To be removed or to indicate that the existing continued airworthiness processes apply

response

Not accepted.
This requirement in 5.2 does not cover the continuing airworthiness aspects, but it ensures the complete capture of PRs during the life cycle of the product, in order to support subsequent OPR management steps (e.g. upon an application for a major change).

comment

358 comment by: *Bombardier*

Section 5.3: "For PRs that cannot be resolved at the current stakeholder level and that have an impact on the next level stakeholder, the current stakeholder should report the PR in a manner that is understandable to the next level stakeholder."

The description used in the proposed AMC/AC is vague as far as defining "have an impact on the next higher level stake holder". In some cases it may difficult for the

	current stakeholder to fully understand how their problem report might impact the nextr level stakeholder. Bombardier recommends adding text to the effect that "the higher-level supplier is responsible for establishing the criteria on what requires notification to be sent to them".
response	Partially accepted. The sentence in 5.3 has been reworded for clarification. Nevertheless, since a stakeholder may not know who the other affected stakeholders are, it is the responsibility of the stakeholder to provide a summary and a description that are understandable by other stakeholders.

comment	*93* comment by: *General Aviation Manufacturers Association* Minor Comment 5.3 What is meant by a PR that “cannot be resolved at the current stakeholder level” as distinguished by a PR that currently has not yet been resolved at the current stakeholder level but ultimately will be at a future time? If there really is a distinction, add a note to clarify the meaning. Otherwise, replace “PR that cannot be resolved” with “PR that is not resolved”.
response	Not accepted. The word ‘cannot’ opens up the capability for the current stakeholder to decide what should be reported in terms of PRs. ‘Are not’ would imply that all the ones that were still not resolved should be reported. Nevertheless, the sentence has been reworded to simplify and clarify it.

comment	*414* comment by: *External/industry comments sumbitted thru FAA* **Paragraph: (3.2.1) 5.3** In refining requirements from aircraft to system to AEH/Software items there are different stakeholders and there is a hierarchy of stakeholders involved in assessing problems. However, the notion of “next level” is unclear. The more appropriate term may be “upper level”. Alternatively, there may be a case where the impact may be between different stakeholders at the same level e.g., AEH and Software processes for the same equipment. Add a definition of “stakeholder” to section 4.1. Include a reference to the differing/hierarchical levels of stakeholder as defined in section 7, or move that section 7 description into the definition of stakeholder. *Comment submitted in behalf of Astronautics*
response	Partially accepted. Please see the response to comment #67.

comment	*415* comment by: *External/industry comments sumbitted thru FAA* **Paragraph: (3.2.1) 5.3**

What is meant by a PR that “cannot be resolved at the current stakeholder level” as distinguished by a PR that currently has not yet been resolved at the current stakeholder level but ultimately will be at a future time? If there really is a distinction, add a note to clarify the meaning. Otherwise, replace “PR that cannot be resolved” with “PR that is not resolved”.

Comment submitted on behalf of Astronautics

response

Not accepted.
Please see the response to comment #93.

comment

126 comment by: *FAA Consulting, Inc.*

There has been a longstanding gap in the existing PR guidelines and guidance that I feel should be closed as part of this new guidance. Nowhere in DO-178C, DO-254, or any of the associated guidance is there a requirement for applicants to consider the effects of PRs newly discovered on other in-work or previously approved systems that may share the same problem as a result of PDS or PDH usage. This general section would seem to be a good place to add something to address this. Here is a candidate 5.4 to address this concern:

"5.4 Product families that share either software or hardware create a situation where a PR raised against one product may need to be evaluated to determine if the same issue exists in other members of the product family. Applicants should provide a means for notifying other possible affected product teams (e.g., spawning a related PR for the affected product) so that any necessary corrective actions can be taken."

response

Accepted.
The proposed text has been reworded to ‘5.4 For PRs that may have an impact on other products or articles that are developed within an organisation, a means should be established for sharing PR information so that any necessary corrective actions can be taken.’

comment

169 comment by: *General Aviation Manufacturers Association*

Minor Comment
5.2
"Identification of the affected configuration item(s) (for example, the item part number) or of the affected process(es);"

PRs may be shared across more than one product line that affects more than one part number that are fixed at differing times, using part numbers in OPR listings then becomes more maintenance than using common names. The example should be expanded to consider title or something besides just part numbers to identify the affected items.

Recommended change:
Update the wording to: "Identification of the affected configuration item(s) (for example, the item part number, component name, artifact name) or of the affected process(es);

response	Accepted. While agreeing with the proposed change, please note that 'For example' implies that the list was not exhaustive.

comment	*206* comment by: *GEAS_UK* Section 5.2 - Last sentence: Additionally, an applicant should identify and correct any related systemic process issues. If the PR is recored after "approval" and there is no follow-on or update program scheduled, the correction of any related systemic process issues might not be adressed; since there would be no plans to update any "process" documents. Solution: delete this sentence.
response	Not accepted. 5.2 does not specify any timing to correct the issue. The correction should be dependent on the potential safety effect of the issue on the product. Additionally, even if they are not safety related, systemic process issues are best addressed in a timely manner to avoid further similar issues (without waiting for a next update).

AMC 20-189/AC 20-189:Management of Open Problem Reports — 6. OPR Manageme p. 51-53

comment	*9* comment by: *MGHILL* Section 6.4.4. For the description of the OPR it is recommended that the following four sub-categories should be used as part of the documentation of the description: i) functional impact ii) safety impact iii) root cause iv) safety mitigations.
response	Noted. These topics are all addressed in Section 6.4. However, they are not required for all classifications of OPRs, as some do not apply to some classes (e.g. safety mitigations are not applicable for life-cycle data deficiencies).

comment	*25* comment by: *Luftfahrt-Bundesamt* chapter 6.2 could be combined with chapter 6.4.6
response	Partially accepted. 6.2 is with respect to the activity of assessing OPRs, whereas 6.4.6 is in the context of what is to be included in the OPR summary report. So, the two sections cannot be merged. However, Section 6.4.6 is also about the reporting of the OPR classification. This has been clarified in the title of 6.4.6.

comment	*26* comment by: *Luftfahrt-Bundesamt*

	chapter 6.3, chapter 6.4.6 (4) and (5): The term "safety impact" is not defined in chapter 4 Definitions. In accordance with ARP4761, "failure condition effect" might be better.
response	Partially accepted. All occurrences of 'safety impact' have been changed to 'safety effect' for consistency. 'Safety effect' is used consistently in AMC/AC XX.1309.

comment	*27* comment by: *Luftfahrt-Bundesamt* chapter 6.4.6 (5), 2nd bullet: The term "Minor safety effect" is not defined. ARP4761 differs between Catastrophic Effect, Hazardous Effect, Major Effect, Minor Effect and No Safety Effect.
response	Not accepted. 'Minor safety effect' is not a stand-alone term. 'Catastrophic', 'hazardous', 'major', and 'minor' are all qualifiers to the term 'safety effect'. The definition comes from established guidance material (e.g. AMC/AC 25.1309). Even if it is not formally defined or referred to in this A(M)C, this is deemed to be sufficiently straightforward, as this is the reference that is given for CAT, HAZ, and MAJ failure conditions.

comment	*63* comment by: *General Aviation Manufacturers Association* Major Comment 6.4 *Reporting: an OPR summary report (e.g. **as** contained in Software/Hardware Accomplishment Summaries or system-level OPR reports) should be prepared and provided to the affected stakeholder(s), and to the certification authority upon request* One can understand that all OPRs coming from all the different levels of development and integration have to be escalated at applicant level. Compiling all the OPRs at aircraft level will be a huge burden for applicant and authorities. **Proposed resolution:** an OPR summary report (e.g. as contained in Software/Hardware Accomplishment Summaries or system-level OPR reports) should be prepared and provided to the affected stakeholder(s), and to the certification authority upon request. The OPR summary should focus on the OPRs affecting the next integration level (Potential Safety and functional). In addition when OPRs are mitigated at one level they should remain identified at this level and not escalated. The summary report should contain the following information for each OPR:
response	Partially accepted. Paragraph 6.4 has been reworked to clarify that a summary report may be an aggregation of previous summaries. Filtering OPRs in higher-level summaries is not an issue; however, full visibility into the lower-level summaries is required.

	The ultimate goal is that all OPR information should be available to the applicant and to the certification authority.
comment	*65* comment by: *General Aviation Manufacturers Association* Major Comment 6.2 Item 3. The determination of underlying cause may not always be required to be able to identify the mitigation of accepting the OPR, and in reality may be much more time consuming than the actual resolution itself. However, the applicant can understand the nature of the problem sufficiently as to be define a sound operational mitigation or acceptable justification, even without fully understanding the underlying cause. **Suggested revision**: 3. For 'Potential Safety' and 'Functional' OPRs, the applicant should have sufficient understanding of the underlying technical cause of the problem to be able to define a sound operational mitigation or acceptable justification.
response	Not accepted. The underlying cause assessment is requested for OPRs (not for PRs). It may be possible to close an OPR without having determined the underlying technical cause. It could happen that a mitigation for a problem is acceptable even without having found the underlying cause; however, this should be assessed on a case-by-case basis. However, in the general case, for 'Significant' and 'Functional' OPRs that are presented for assessment at the time of approval, it is the intent of the AMC/AC that this underlying technical cause analysis should have been performed.
comment	*69* comment by: *General Aviation Manufacturers Association* Major Comment 6.4.6 items 4 & 5 For clarity and completeness: **Recommend change as follows:** OPR assessment results (per paragraph 6.2), including: 1. For all OPRs: 1.a The classification of each OPR 1.b Relationships that are known to exist for other OPRs 2. For OPRs classified as "Potential Safety": 2a Description of any mitigations or justifications used to substantiate the acceptability of the safety impact (per paragraph 6.3) 2b Functional limitations and operational restrictions, if any 3. For OPRs classified as "Functional": 3a Description of any mitigations or justifications used to reduce the safety impact to Minor or No Safety Effect 3b Functional limitations and operational restrictions, if any

	4. For OPRs classified as "Process", description of the extent or nature of process non-compliance or deficiency that might contribute to not satisfying the applicable development assurance objectives 5. For OPRs classified as "Other", description of justification that the error cannot cause a functional failure.
response	Accepted. The proposal has been implemented as suggested. Some changes have been made due to the impact of other comments (e.g. the removal of the category 'Other').

comment	*74* comment by: *General Aviation Manufacturers Association* Major Comment 6.5.1 & 6.5.2 These two sections are addressing topics already addressed and covered by the existing Continued airworthiness processes **Proposed resolution:** To be removed or to indicate that the existing continued airworthiness processes apply
response	Accepted. It is considered that 6.5.1 is covered already in Section 5. Section 6.5.2 is indeed more related to CAW considerations, and is covered by AC 21-46a §3.10.6 and EASA Part 21 A.3. Consequently, those two subparagraphs have been removed. The remaining part of 6.5 has been reworked for consistency with the previous paragraphs.

comment	*85* comment by: *General Aviation Manufacturers Association* Minor Comment 6.1.4 Commented text: *"The classification of an individual OPR may differ from one stakeholder level to another, depending on the known mitigations at the time of classification."* Context is missing for this sentence (mitigation at what level? What type of OPR ...). So no added value and may add confusion **Recommended change:** Sentence to be removed
response	Partially accepted. The context is in the previous paragraphs. For clarity, this text has been inserted in a note under paragraph 6.1.2.

comment	*86* comment by: *General Aviation Manufacturers Association* Minor Comment 6.5.2 It is more related to new OPRs
response	Noted. Item 6.5.2 has been removed, based on another comment.

comment	*87* comment by: *General Aviation Manufacturers Association*
response	Noted. There is no comment.

comment	*92* comment by: *General Aviation Manufacturers Association* Minor Comment 6. The definitions for OPR "Functional" and "Process" classifications discussed in Sections 4.3 and 6 leave a gap in coverage of Verification Procedure deficiencies that affect requirements and/or requirement verification, but do not necessarily directly affect implementation or functional behavior. This is presumably of sufficient magnitude that A[M]C 00-71 Section 4.2.3 specifies "An example of an OPR that should not be classified as a 'Process' PR is one related to a requirement that was not completely verified because of a process deficiency." Suggest that the issue of OPR classification for deficiencies uncovered in Verification activities (such as Procedure deficiencies or errors), which are also specified in SAE ARP4754A Section 5.5.6.4, shou91ld be clarified in the classification guidance of the A[M]C 20-189 text, without sole reliance on the A[M]C 00-71 content.
response	Not accepted. Please refer to the response to comment #91.

comment	*95* comment by: *General Aviation Manufacturers Association* Minor Comment 6.5 Add following text to section 6.5: "The OPR summary report as described here is acceptable for use in a DO-178B/C Software Accomplishment Summary or a DO-254 Hardware Accomplishment Summary."
response	Not accepted. As now mentioned in Section 6.4, the OPR summary may be an aggregation of SAS/HAS or system-level summary reports. So, the format is open, and EASA and the FAA do not feel the need to add the suggested information.

comment	*102* comment by: *General Aviation Manufacturers Association* Editorial

	6.1.1 Editorial change as follows. Change "5. 'Other' Impact" to "5. 'Other' "
response	Noted. The proposed change would be correct; however, EASA and the FAA have removed the category 'Other' and changed the text of the AMC/AC consistently to open up the possibility for stakeholders to create additional classifications or subclassifications as needed.

comment	*106* comment by: *General Aviation Manufacturers Association* Editorial Sec. 6.4.6 Editorial change as follows. Use consistent capitalization convention of the five PR states throughout AC 20-189 and AC 00-71.
response	**Accepted.** Capitalisation has been consistently reviewed and ensured.

comment	*165* comment by: *General Aviation Manufacturers Association* Minor Comment 6.4.6 - item 4 The phrase "..any mitigations implemented…" implies that the mitigations have been implemented, when sometimes the mitigations are available to apply by configuration or use. An example would be to not configure a particular feature, or to take an action to reset a page. Suggested revision: change "…any mitigations implemented…" to "…any mitigations available or implemented…"
response	Partially accepted. The wording has been changed to 'any mitigations or justifications used to reduce the safety effect to Minor or No Safety Effect'. Note: Paragraph 6.4.6 has been extensively reworked, based on other comments.

comment	*176* comment by: *GEAS_UK* Sections 6.1.2, 6.1.3, and 6.1.4 should be subsections under 6.1.1, since these sections further explain a singular classification for the OPR
response	Not accepted. The intent of these subparagraphs is to provide a complete process for determining a single classification. Therefore, these subparagraphs have all been kept at the same level.

comment	*221* comment by: *Embraer S.A.*

According to the last bullet of item 5 of Section 6.4.6, Embraer understands that justifications for OPRs Type "Other" is not required, considering the classification definition of section 4.3, this type of OPR has no potential safety impact, has no potential functional impact, and has no linked to a process deficiency or a deviation or to a documentary deficiency.

Suggestion is to remove the last bullet of item 5 of section 6.4.6 which states "For 'Other' OPR, it should be justified that the error cannot cause a functional failure".

response

Noted.
The 'Other' classification has been eliminated, and paragraph 6.4.6 has been reworked based on other comments. The original Item 5 has been replaced with a statement that for OPRs that are not classified as 'Significant' or 'Functional', a justification should be provided which shows that the error cannot have a safety or functional effect.

comment

241 comment by: *Rodrigo Magalhaes (ANAC)*

There is no item to address the concern about a **significant number of open problem reports** as provided in the current guidance used for management of problem reports. Besides being more difficult to analyse all in conjunction, a significant number of OPRs may indicate lack of maturity and may require either more activities to achieve certification or an OPR burndown plan for the following changes after certification. ANAC suggests to add an item about this concern so we can reference it anytime as necessary.

response

Partially accepted.
EASA and the FAA fully agree with this concern.
The choice that was made in this document is to reinforce the guidance on PR management in order to manage the growth in terms of PRs as early in the process as possible.
In order to capture and make this rationale visible in the AMC/AC, EASA and the FAA have added an introductory paragraph in Section 5.
If this proves not to be sufficient, then an OPR burndown plan may still be requested on a case-by-case basis.

comment

346 comment by: *Rolls-Royce plc*

6.1.2 It is stated that the effect of the PRs should take into account all the mitigations that are under the control of the stakeholder. This can lead to assumptions being made about the continued existence of those mitigations without this being checked (e.g. a dependency on hardware behaviour that is later changed without the PR being re-assessed).

Suggestion: Add a clarification that mitigation can be used to justify the acceptability of the PR, but should not be used to alter the classification.

response

Noted.
The intent of this AMC/AC is to allow reliance on all known mitigations when classifying an OPR. Otherwise, most OPRs would end up as 'Significant', which would lower the visibility of the essential OPRs.

Note, however, that paragraph 6.1.3 limits the mitigations to those that are controlled by the stakeholders, or to those that are validated with the higher-level stakeholders. This limits the risk of reliance on assumptions that may be invalidated. It is the responsibility of the applicant and the involved stakeholders to record and maintain those mitigations in place.

AMC 20-189/AC 20-189:Management of Open Problem Reports — 7. Stakeholder Responsibiliti p. 53

comment	*40* comment by: *Sikorsky Aircraft* This paragraph might better define the applicant's responsibility for review and concurrence of OPRs (at each stakeholder level).
response	Noted. It is not the intent of this AMC/AC to describe how applicants should fulfil this responsibility.

comment	*68* comment by: *General Aviation Manufacturers Association* Major Comment 7.1 This paragraph includes the statement, "The applicant has responsibility for the overall PR process for all involved stakeholders." This statement should recognize that some stakeholder levels (e.g. [ETSO]/[TSO]) will have an approved PR management process that does not require oversight by an applicant at a higher stakeholder level. By stating that an applicant is responsible for the PR process of all stakeholders, the A(M)C implies that oversight is required by the applicant for all lower level stakeholders. At the 24-25 July 2018 EASA/FAA//Industry SW/AEH Harmonization/Streamlining Steering Committee Meeting, industry demonstrated that (E)TSO approval holders with accepted development assurance processes are subject to multiple audits of the same processes by higher level applicants. The 24-25 July 2018 meeting resulted in agreement on Objective #10- the acceptance of previously approved data (established Means of Compliance) against the same requirements. A(M)C-189 is intended to cover multiple stakeholder levels with the same means of compliance, and therefore is a good place to recognize this objective. **Proposed resolution:** "The applicant stakeholder has responsibility for the overall PR process for involved stakeholders without a previously approved PR process**.**"
response	Not accepted. The applicant's responsibility is based on regulatory compliance, and does not imply the level of oversight. If an applicant has confidence in the way a stakeholder completely and understandably reports OPRs, no further oversight would be needed. This is the case, in particular, for ETSO/TSO holders whose PR/OPR process has been evaluated in the frame of the ETSOA/TSOA. If a stakeholder is new to the process, oversight may be the only way for an applicant to gain this confidence.

	It is not the intent of this AMC/AC to describe how applicants should fulfil this responsibility.

comment	*90* comment by: *General Aviation Manufacturers Association* Minor Comment 7.1 *PR management (per paragraph 5) should be performed by the stakeholder at each level.* It is not applicable to authorities (that are considered as stakeholder according to 7. list)
response	Accepted. 'Certification authorities' has been removed from Section 7.

comment	*94* comment by: *General Aviation Manufacturers Association* Minor Comment 7. Because the certification authority is identified as one of the stakeholder levels, this section implies that the certification authority has the responsibility for performing a PR management and OPR management. Certainly, this is not really the case. Revise the responsibility section to exclude certification authority even if they are a kind of stakeholder.
response	Accepted. 'Certification authorities' has been removed from Section 7.

AMC 20-189/AC 20-189:Management of Open Problem Reports — 8. RELATED REGULATORY, ADVISORY, AND INDUSTRY MATERI p. 54-58

comment	*103* comment by: *General Aviation Manufacturers Association* Editorial Sec. 8(c) Editorial changes as follows: 1) Add () after AC 20-115, AC 20-152 as is done in section 8(b) for the AMCs. 2) Add AC 23.1309 and 25.1309 as is done in AC 00-71 section 5(b)
response	Accepted. 1) The proposed change has been implemented as proposed. 2) Section 8(c) to which you refer is located in the EASA AMC text. Since EASA uses its own AMC material for CS-23 and CS-25 aircraft, AC 23.1309 and AC 25.1309 are not referenced there. The references are, however, consistent throughout the Section 8 text that is located in both FAA AC 20-189 and AC 00-71.

AC 00-71:Best Practices for Management of Open Problem Reports — 2. Audien p. 60

comment *416* comment by: *External/industry comments sumbitted thru FAA*

Paragraph: (3.2.1) 6.1.2, 6.1.3, 6.1.4

These three paragraphs together hint at the possibility of some exchange between stakeholders about the classification of an OPR, but the current format appears more as a "silo'd" waterfall of OPR management rather than an interchange between stakeholders at different levels. For example, an equipment supplier may have a software OPR with a classification of Potential Safety with "Major" impact when "strapped" for a particular configuration, but realizes that the OPR can be classified as Functional with "Minor" impact with the mitigation that this configuration is not to be used. Of course, there needs to be a recorded agreement/acceptance of this mitigation with the higher level stakeholder, but the classification and mitigation is still made by the current stakeholder level. In another example, the current level stakeholder may be seeking a ETSO/TSO, and the mitigation for the OPR classification appears in a record of installation limitations. In that case, the current level stakeholder has made the determination without the upper level stakeholder.

Revise the format of 6.1.2, 6.1.3, and 6.1.4 to recognize the possible interchanges that may take place between differing levels of stakeholder in determining the ultimate classification of an OPR.

Comment submitted on behalf of Astronautics

response Accepted.
Those paragraphs have been reworded to recognise the possible interchange between stakeholders.
Paragraph 6.1.2 (now 6.1.3) has been reworded to open up the possibility to use mitigations that are not under the control of a stakeholder, provided that they have been validated with the affected stakeholder and remain acceptable in the frame of the approval/authorisation.
Moreover, the notion of 'levels' among stakeholders has been removed and replaced by the notion of 'affected stakeholder(s)'.

comment *417* comment by: *External/industry comments sumbitted thru FAA*

Paragraph: (3.2.1) 6.2

Item 3. The determination of underlying cause may not always be required to be able to identify the mitigation of accepting the OPR, and in reality may be much more time consuming than the actual resolution itself. However, the applicant can understand the nature of the problem sufficiently as to be define a sound operational mitigation or acceptable justification, even without fully understanding the underlying cause.

	Suggested revision: "the applicant should have sufficient understanding of the underlying technical cause of the problem to be able to define a sound operational mitigation or acceptable justification". *Comment submitted on behalf of Astronautics*
response	Not accepted. Please refer to the response to comment #65.

comment	*418* comment by: *External/industry comments sumbitted thru FAA* **Paragraph: (3.2.1) 6.4** "for each OPR". For non-TSO/ETSO equipment, the OPR summary report could contain potentially hundreds of OPR's that are Process, Documentary, or Functional OPR's with Minor safety impact. Furthermore, such OPR's may be may be such software or AEH related that they cannot be "formulated in a manner understandable to the next level stakeholder" (6.4.4). Revise 6.4 to allow for means to aggregate OPR's that have little to no interest to upper level stakeholders with less detail than is described in 6.4.1-6.4.6. *Comment submitted on behalf of Astronautics*
response	Partially accepted. Paragraph 6.4 has been reworked to clarify that a summary report may be an aggregation of previous summaries. Filtering OPRs in higher-level summaries is not an issue; however, full visibility into the lower-level summaries is required. The ultimate goal is that all OPR information should be available to the applicant and to the certification authority. However, the large number of OPRs and the difficulty in formulating their descriptions in an understandable manner should not be used as barrier to reporting.

comment	*419* comment by: *External/industry comments sumbitted thru FAA* **Paragraph: (3.2.1) 6.4.3, 6.4.4** Replace "next level" with "next upper level" (this is associated with comment #2, i.e. to add the definition of "stakeholder" and their hierarchical nature) *Comment submitted on behalf of Astronautics*
response	Partially accepted. EASA and the FAA have removed the concept of levels and its implied hierarchical nature. EASA and the FAA have introduced the more generic notion of 'affected stakeholder(s)'.

comment	*420* comment by: *External/industry comments sumbitted thru FAA* **Paragraph: (3.2.1) 7**

Consider moving the identification of the different levels of stakeholder into the definition section of 4.1 along with the definition of stakeholder.

Comment submitted on behalf of Astronautics

response

Partially accepted.
The notion of 'level of stakeholders' has been removed.
However, it is not deemed to be necessary to include a definition in Section 4.1 based on the revised Section 7.

comment

421 comment by: *External/industry comments sumbitted thru FAA*

Paragraph: (3.2.1) 7

Because the certification authority is identified as one of the stakeholder levels, this section implies that the certification authority has the responsibility for performing a PR management and OPR management. Certainly, this is not really the case.

Revise the responsibility section to exclude certification authority even if they are a kind of stakeholder.

Comment submitted on behalf of Astronautics

response

Accepted.
Please refer to the response to comment #94.

comment

107 comment by: *General Aviation Manufacturers Association*

Minor Comment
AC 00-71
Sec. 2

Editorial changes as follows. Change last sentence in section 2 to:
"This AC is not applicable to electronic equipment software, and AEH, embedded in airborne systems which could cause or contribute only to Minor failure conditions or to failure conditions having No Safety Effect."

response

Noted.
Please refer to the response to comment #70.

AC 00-71:Best Practices for Management of Open Problem Reports — 3. Definitio p. 60-61

comment

83 comment by: *General Aviation Manufacturers Association*

Minor Comment

	AC 00-71 Sec. 3.1 to 3.3 For consistency, ensure the definitions in AC 00-71 identically match the corresponding definition in AC 20-189.
response	Accepted. Consistency between the definitions in the two ACs has been reviewed and ensured.

comment	*167* comment by: *General Aviation Manufacturers Association* Minor Comment AC 00-71 Sec. 3.1 to 3.3 For consistency, ensure the definitions in AC 00-71 identically match the corresponding definition in AC 20-189.
response	Accepted. Please refer to the response to comment #83.

comment	*177* comment by: *GEAS_UK* These definitions are a cut and paste from section 4.1, 4.2 and 4.3 of the draft AC-189 (see page 49 and page 50 respectively). Defining the same terms in two documents is not recommended. This AC should reference the draft AC-189
response	Not accepted. While we recognise that there may be reasons to only include the definitions in AC 20-189, EASA and the FAA believe it is beneficial for users of AC 00-71 to have easy access to these definitions while understanding the best practices.

comment	*178* comment by: *GEAS_UK* If the definitions stay in this document then "[categorised]/[categorized]" should be changed to "categorized" to remain consistent with this document (all other EASA harmonization text was removed).
response	Accepted. The proposed change has been implemented as suggested.

comment	*343* comment by: *Rolls-Royce plc* Use of the category "Other" should be avoided as this is a vague term. From the guidance material this is intended to cover all non-functional PRs that are not due to a process non-compliance. Why not call this category "Non-functional"? Consider amending the definition to "Non-functional" or an equivalent definition.
response	Partially accepted.

	To address this and other related comments, EASA and the FAA have removed the category 'Other' and changed the text of the AMC/AC consistently to open up the possibility for stakeholders to create additional classifications or subclassifications as needed.

AC 00-71:Best Practices for Management of Open Problem Reports — 4. BEST PRACTIC p. 61-63

comment	*2* comment by: *BRUN* Page 62: [<AMC> GM2 to AMC 20-189:]/[<AC> 4.2] OPR classification.: Additional explanation could be added to clarify between Major failure and safety impact. Typically refering to the EASA CM – SWCEH – 001, it was clear that any safey effect/impact (even so minor) lead to classify the OPR as 0. The categories 1A, 1B considering there is no safety impact. In this current NPA , in my opinion, a confusion is introduced while the category 1A can address OPR with safety impact.
response	Noted. Per the former classification scheme, OPRs with minor safety impacts may have been classified as type 0, 1A or even 1B, depending on the understanding of the various applicants. The purpose of this AMC/AC is to clarify the scheme by clearly segregating between the safety effects (CAT, HAZ MAJ for 'Significant' and MIN, NSE for 'Functional').

comment	*3* comment by: *BRUN* Page 61: 3.3 Classification of PRs/OPRs.: There are existing notions of operational and functional while in this NPA only the functional impact is addressed. Often in current the classification of OPRs, OPR that have functional (defect in code) but no operational effect (not visible by the crew) are classified type 2. With this new proposal, I feel that some current OPR type 2 will have to be newly classified type 1 (as these OPR address functional defects).
response	Noted. This statement is correct. As OPRs that have operational impacts may be shared between the 'Significant' and 'Functional' categories, EASA and the FAA chose to focus on those two categories because they avoid overlaps in classification. Creating an additional 'Operational' category would create an ambiguity that EASA and the FAA tried to remove from the former classification scheme. The former type 2 is now addressed either by 'Functional' (if it has an effect at the aircraft level) or by the new category 'Life-cycle data' that replaces the 'Documentary' one (following other comments). If the applicant wants to put more focus on the operational effect of OPRs, it is up to them to propose further subclassifications for 'Significant' and 'Functional'.

comment	*422* comment by: *External/industry comments sumbitted thru FAA* **Paragraph: 4.3** The open PR classification for "documentary" or "other" has me concerned. With this definition, many of my clients would consider missing requirements or incorrect

requriements a "document" or "other" category. it does not seem appropriate for tthese to be considered no effect if the overall function of the software or AEH is defined by the requirements and they are incorrect this should automatically be a "functional impact" . We we allow this then we would have to allow schematics which are incorrect for hardware to be "documentation" deficiency also, however the schmeatic represents the design of the PCB or hardware adn is part of the conforming data for the design. Also is a concern that many companies have a category they call "product improvement" or "enhancment" where they have requiremetns which are part of the requiremetns documetn and baseline but that they never got around to fully impelemtning or testing , but because it was not "required" for the aircraft functions expected they hide this under the cateory of "product enhancment" when really this is a unimplented requirement and should be a PR which identfies a missing implementation.

Comment submitted on behalf of T. Reeve

response

Accepted
To address this and other related comments, we have removed the category 'Other' and changed the text of the AMC/AC consistently to open up the possibility for stakeholders to create additional classifications or subclassifications as needed. Moreover, 'Documentary' has been changed to 'Life-cycle data' and the associated definition has been reworked.
As per definition, 'product improvements' and 'enhancements' are not PR/OPRs and so do not fall within the classification scheme. In any case, nothing prevents an applicant from creating additional classifications for future improvements, but those are not within the scope of this AMC/AC.
Nevertheless, requirements that would not have been fully tested should be addressed through a PR.

comment

423 comment by: *External/industry comments sumbitted thru FAA*

Paragraph: 6.4

All Non-Closed PRs should be dispossited and provided. Currently I have had many clients create "hidden" classifications which do not show up in the CM plan and you would not know about if you didn't witness them run a "non-closed" specific report. Many functional and non-compliance issues are hidden under "deffered PRs" or "product imprement" or "enhancment" and never made avaiable for review or concurrance with the certificaiton authority. The clients state there CCB is in a possition to make this determination, but this shold only happen when the CM plan and the definisions for when and how these classifications are applied are reviewed and agreed to by the certificaiton authority.

Comment submitted on behalf of T. Reeve

response

Noted.
No OPR classification should be hidden, and the applicant should describe their full classification scheme to the authority.
If the AMC/AC proposed classification scheme is followed adequately, no OPR that is relevant to the certification should be hidden.

	However, per definition, ‘product improvements’ and ’enhancements’ are not PRs and so do not fall within the classification scheme. In any case, nothing prevents an applicant from creating additional classifications for future improvements, but those are not within the scope of this AMC/AC.
comment	*64* comment by: *General Aviation Manufacturers Association* Major Comment [<AC>4.2.]1 Type ‘Potential Safety’: the term "contributing to" increases significantly the scope of OPRs belonging to the class 'Potential Safety'. E.g. an OPR having a minor effect standalone can, combined with another one, lead to a Major or higher FC. Assessment of combined OPR may be a burden for industry and authorities **Proposed resolution:** Remove “contributing to”
response	Not accepted. The applicability section of AMC/AC 20-189 uses the wording ‘cause or contribute to’ in relationship to failure conditions. Both terms are needed to ensure the consistent applicability of the AMC across domains. Therefore, this same statement in the GM is appropriate. The assessment of combined OPR effects is addressed in Section 6.2.
comment	*81* comment by: *General Aviation Manufacturers Association* Minor Comment AC 00-71 [<AC>4.2] para 5 DO-248C does not define Type 4 as including non-functional faults (type 2) and clearly provides an example of typographical errors. We have seen some organization use this logic to categorize problems within the code such as non-compliance to standards as ‘Type 4’ and justify not reviewing with the OEM AR based on categorization of ‘Other’. **Recommended change:** [<AC>4.2.]5. Type ‘Other’: this ~~typically~~ maps to ~~‘type 2’ and~~ ‘type 4’ PRs, ~~but may not be limited to those types~~. It serves as a default class to cover any remaining PRs that do not relate to any potential safety, potential functional, process or documentary impact.
response	Noted. Based on this and other comments, the category ‘Other’ has been removed from the AMC/AC. Therefore, the proposed clarification is no longer necessary.
comment	*82* comment by: *General Aviation Manufacturers Association* Minor Comment AC 00-71 [<AC>4.1.]3

To improved clarity: **Recommend editorial change as follows**. Change "Typical review boards used for PRs classified as 'Potential Safety', 'Functional' or 'Process' PRs may not be needed for PRs that are classified as 'Documentary' or 'Other', where peer reviews may be sufficient."
to:
"PR assessment of PRs classified as 'Potential Safety', 'Functional' or 'Process' would typically be assessed by a review board. PR assessment of PRs classified as 'Documentary' or 'Other' may be performed within the peer review process instead of a review board."

response

Accepted.
The proposed change has been implemented as suggested.
[Note: 'Documentary' has been changed to 'Life-cycle data].

comment

99 comment by: *General Aviation Manufacturers Association*

Editorial
AC 00-71 [<AC>4.2] para 2
The last sentence is also grammatically incorrect
Recommend changes:
[<AC>4.2.]2. Type 'Functional': this ~~typically~~ maps to 'type 1A' or 'type 1B'. That is, a problem (with any Level of software) that results in a failure with no adverse impact on safety. ~~One way of creating the link between these two types and the [AMC]/[AC] 20-189 classification scheme is to consider 'type 1A' for~~ Functional PRs whose consequences can potentially lead to a Minor failure could be categorized as 'type 1A' and ~~'type 1B' for~~ Functional PRs having No Safety Effect could be categorized as 'type 1B'. ~~Two separate classes could therefore be created in the applicant's classification scheme to ease the mapping: problems having an operational impact leading to a Minor failure condition could be classified separately (e.g. 'Functional 1') from the ones having No Safety Effect (e.g. 'Functional 2').~~

response

Partially accepted.
The proposal has been implemented with the exception of the removal of the guidelines for creating two separate subclasses, which EASA and the FAA consider to be a helpful clarification.

comment

108 comment by: *General Aviation Manufacturers Association*

Editorial
AC 00-71
[<AC>4.1.]1

Editorial changes as follows. Change [<AC>4.1]1 to "PR Recording: a means to document problems during the life cycle processes."

response

Accepted.
The proposed change has been implemented with the addition of 'execution of' before 'life-cycle processes'.

comment	*179* comment by: *GEAS_UK* With respect to the paragraph "PR Recording: a means to document problems resulting from development activities.", RTCA/DO-178x has the software verification process separate from the software development process, (see figure 1-1 of RTCA/DO-178C). Solution: change "development" to "lifecycle"
response	Accepted. The text has been changed to 'resulting from the execution of life-cycle processes'.

comment	*180* comment by: *GEAS_UK* ']' should be deleted from the section header; its an extraneous character.
response	Not accepted. The ']' referred to closes the '[' at '[<AC> AC 00-71: Best Practices for Management of Open Problem Reports'

comment	*207* comment by: *GEAS_UK* Delete the last sentence: "The PR resolution process may depend on the classification of the PR; for example, shorter closure loops could be set for PRs with only 'Documentary' impact. This is highly subjective and the sentence offers no substance value to the document.
response	Not accepted. This is best practice to make sure that low-criticality issues can be closed in a quicker loop, otherwise experience shows that such 'life-cycle data' issues are unduly kept open forever and contribute in the growth in the number of OPRs.

comment	*208* comment by: *GEAS_UK* Last sentence states, A PR can be closed only when the problem has been effectively resolved. This seems to be in conflicst with the definition of the closed state (section 3.2 of this AC). This section seems to imply that a review and confriation of the effective resolution is not needed to close the PR. Solution: delete this sence, avoiding potential conflict in defining PR closure twice.
response	Accepted. The sentence has been removed.

comment	*222* comment by: *Embraer S.A.* Embraer requests to clarify the meaning of the terms "simple cases" and "more complex cases".

response	Partially accepted. The notion of simple or complex in this GM very much depends on the use case, and cannot be easily clarified. Ambiguities cannot be fully removed; therefore, EASA and the FAA prefer to remove this part of the GM, which can be in any case sorted out on a case-by-case basis.

AC 00-71:Best Practices for Management of Open Problem Reports — 5. Related Publicatio p. 63-65

comment	*104* comment by: *General Aviation Manufacturers Association* Editorial AC 00-71 Sec. 5(b) Editorial change as follows. Add () after AC 20-115, AC 20-152 as is done in section 5c for the AMCs.
response	Accepted. The proposed change has been implemented as suggested.

6. References p. 69

comment	*154* comment by: *Erkan TIZLAK (TAI)* Revision of "EASA CM No.: EASA CM-SWCEH-001" should be "Issue 01, Revision 02".
response	Noted. Your comment is correct. However, the NPA 2018-09 text does not need to be modified, as that section of the NPA will not be included in the final AMC/AC 20-152A.

3. Appendix A — Attachments

GAMA18-61 NPA 2018-09 A(M)C 20-189 OPR - Consolidated Industry Feedback_2018Oct3rd.pdf
Attachment #1 to comment #60

GAMA18-62 Consolidated Industry Feedback to NPA 2018-09 AMC 20-152_2018Oct5th.pdf
Attachment #2 to comment #60