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A Comparison of Civil and Military, European and United States Regulations and Standards for the Certification of Helicopter Structure

Christopher Dore

Air Vehicles Division
Defence Science and Technology Organisation

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ABSTRACT

A comparison of a range of civil and military, United States and European regulations and structural certification standards for the fatigue substantiation of rotary wing aircraft structure was conducted. The comparison utilised a graphical hierarchy-based methodology developed as an improvement on text-based and spreadsheet-based methodologies identified in a review of relevant literature. The result of the comparison activity was a thorough, updateable, user-friendly, interpretive and current comparison product that will be used to guide the Technical Airworthiness Authority and Defence Science and Technology Organisation researchers on the intent of the subject documents and the similarities and differences between them.

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Air Vehicles Division
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506 Lorimer St
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Telephone: (03) 9626 7000
Fax: (03) 9626 7999

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A Comparison of Civil and Military, European and United States Regulations and Standards for the Certification of Helicopter Structure

Executive Summary

The Australian Defence Force Airworthiness Authority relies on the Technical Airworthiness Authority to interpret technical airworthiness regulations. To achieve this, a thorough understanding of the similarities and differences between regulations and certification standards is required. Such an understanding can be gained through a structured comparison of the relevant regulations and certification standards.

This report details a comparison of a range of civil and military, United States and European regulations and structural certification standards for the fatigue substantiation of rotary wing aircraft structure. The comparison utilised a graphical hierarchy-based methodology developed within the 'Rationale™' critical thinking software program and was designed as an improvement on text-based and spreadsheet-based methodologies identified in a review of relevant literature.

The result of the comparison activity was a thorough, updateable, user-friendly, interpretive and current comparison product that will be used to guide the Technical Airworthiness Authority and Defence Science and Technology Organisation researchers on the intent of the subject documents and the similarities and differences between them.

The greater understanding of the regulations and structural certification standards gained from the comparison activity described in this report will improve the ability of the Technical Airworthiness Authority, and Defence Science and Technology Organisation researchers, to conduct airworthiness certification activities for Australian Defence Force rotary wing aircraft.

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Abbreviations

AA	Airworthiness Authority
AC	Advisory Circular
ADF	Australian Defence Force
CS	Certification Specifications
DGTA	Directorate General Technical Airworthiness
EASA	European Aviation Safety Authority
FAR	Federal Aviation Regulations
MG	Miscellaneous Guidance
OEM	Original Equipment Manufacturer
TAA	Technical Airworthiness Authority
US	United States

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1. Introduction

A fundamental responsibility of the Australian Defence Force (ADF) Airworthiness Authority (AA) is "… the establishment, management and monitoring of a regulatory framework for type certification …" [1]. To meet this responsibility, the ADF AA relies on the Technical Airworthiness Authority (TAA) "… to interpret technical airworthiness regulations …" [1].

For the Australian military type certification of new aircraft, the TAA must interpret the certification basis for the aircraft to ensure the type achieves a standard of safety acceptable to the ADF AA. As the number of aircraft being certified by Original Equipment Manufacturers (OEMs) under different regulatory frameworks increase, this task becomes more difficult.

While the TAA has received some assistance through the outsourcing of aircraft structural integrity program activities[1], this assistance predominantly focuses on in-service airworthiness management.

Hence, the role of the ADF AA and TAA in the type certification of new ADF aircraft remains unchanged [1-3]. This ensures an ongoing requirement for Directorate General Technical Airworthiness (DGTA) staff to interpret airworthiness regulations and standards on behalf of the TAA.

A thorough understanding of the similarities and differences between the full range of applicable regulations and certification standards would assist the TAA's interpretation activities, and ultimately, the AA's ability to ensure the airworthiness of State aircraft. Such an understanding would be gained through a structured comparison of the relevant regulations and certification standards.

This report follows the Research Proposal [4] included as Appendix A. It details a comparison of a range of civil and military, United States (US) and European regulations and structural certification standards for the fatigue substantiation of rotary wing aircraft structure. The comparison utilised a graphical hierarchy-based methodology developed within the 'Rationale™' critical thinking software program and was designed as an improvement on text-based and spreadsheet-based methodologies identified in a review of relevant literature.

[1] To Authorised Engineering Organisations contracted by the Directorate General Technical Airworthiness in the case of legacy platforms, or to the OEMs or their representatives in the case of more recent through life support based platform acquisitions.

2. Background

2.1 Delimitations of the comparison

Due to the vast number of certification standards and regulations and the breadth of their coverage it was necessary to restrict the focus of the comparison.

The standards selected for the comparison were therefore those that had a greater applicability and relevance to the ADF rotary wing fleet. These documents included DEFSTAN 00-970 Part 7 Section 2, Federal Aviation Regulations (FAR) 27 and 29, and the European Aviation Safety Authority (EASA) Certification Specifications (CS) 27 and 29, as well as the associated guidance material within the relevant Advisory Circulars (AC).

These documents were selected as they covered the certification of some existing ADF rotorcraft, as well as being the most likely regulations to apply to new rotorcraft produced by the US and European OEMs. The most recent amendments of these documents at the beginning of the work activity were selected for the comparison[2]. Table 1 lists the documents and their revision and amendment numbers.

Table 1: Delimitations for the regulation and certification standard comparison

Document	Section	Amendment status
DEFSTAN 00-970 [5]	Part No: 7, Section No: 2 - Chapter 201 (Paragraphs 1 to 3) - Leaflet 201/1	Issue 3 (29/01/2010)
FAR 27 [6]	- Paragraph 571	Amendment No. 27-46 (as of 08/08/2011)
FAR 29 [7]	- Paragraph 571	Amendment No. 29-53 (as of 08/08/2011)
AC 27 [8]	- Paragraph 571 - MG[3] 11	Number 27-1B, Change 3 (30/09/2008)
AC 29 [9]	- Paragraph 571 - MG 11	Number 29-2C, Change 3 (30/09/2008)
EASA CS-27 [10]	- Paragraph 571	Amendment No. 2 (17/11/2008)
EASA CS-29 [11]	- Paragraph 571	Amendment No. 2 (17/11/2008)

In addition to a restriction of the applicable documents, the focus was narrowed within these documents to the fatigue substantiation of rotary wing critical structure[4]. Fatigue substantiation of critical structure is fundamental to the ongoing airworthiness of ADF helicopters. This focus area also complemented previous efforts of the Airworthiness Standards Group regarding the fatigue substantiation of fixed wing aircraft.

[2] Since the beginning of this activity, both FAR 27 and 29 have had amendments released.
[3] Miscellaneous Guidance (MG).
[4] The relevant parts of each standard are detailed in Table 1.

2.2 Literature review

A literature review [12] was conducted to inform the development of the standardised comparison methodology. The review identified the methodologies applied within previous comparisons and assessed the benefits and limitations of these methodologies. The review is included as Appendix B; and is summarised below.

The review identified the predominant methodologies to be either text-based or spreadsheet-based comparisons. The text-based methodology, while thorough, was not very user-friendly and was less likely to be current due to the long lead time required for publication in the DSTO report series. The work was also not dynamic, and represented only a single snapshot in time; however, it did allow for interpretation of the impact of differences between the documents.

The spreadsheet-based methodology was superior regarding its currency and user-friendliness. The methodology meant that the comparison could be updated if required. The drawback of the methodology was that it was not suited to the incorporation of an interpretation of the differences between the documents reviewed.

The conclusion drawn from the literature review was that a standardised methodology was required that combined the benefits of the text-based and spreadsheet-based methodologies to ensure the resulting comparison was thorough, updateable, user-friendly, inclusive of interpretive guidance and current.

3. Standardised Methodology

To combine the text-based and spreadsheet-based comparison methodologies so that the benefits of each could be realised a graphical approach was utilised. A commercially available software program, Rationale™[5], was selected for the purpose. Rationale™ is a critical thinking software program with a mind mapping capability (the 'grouping tool') considered appropriate for this activity.

The implementation of the comparison activity within Rationale™ required a number of stages and these are discussed below.

3.1 Content maps

Before the comparison could be undertaken, it was necessary to build 'content maps' of the regulations and standards that were included in the study. The content maps were built using the grouping tool within Rationale™ and were a context sensitive graphical

[5] http://mindmuse.com.au/Thinking_Skill_Solutions/Rationale.html. Reference to this software does not constitute an endorsement.

representation of the content of each of the documents. The development of the content maps consisted of three stages which are discussed below.

3.1.1 Stage one

The first stage of the process was to construct a hierarchical structure based on the heading levels within each document. The number of levels used depended on the complexity of the document with the lowest level determined when the headings became inseparable from the requirements. The requirements themselves, including any relevant supporting information, were then extracted from the document and placed in their appropriate positions under the heading structure. An example of a stage one content map is shown in Figure 1.

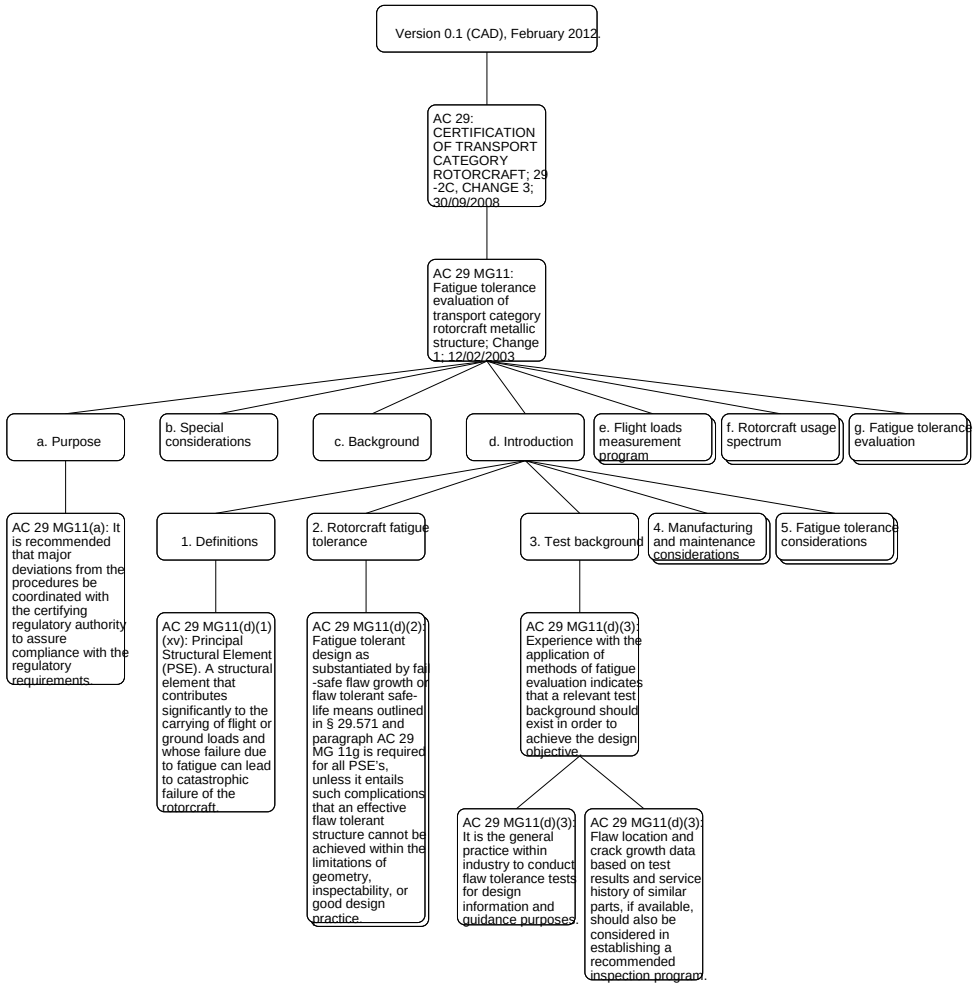

Figure 1: Example of a stage one content map – AC 29 MG11

Note within Figure 1 the inclusion of descriptive header boxes that identify the current version of the map, as well as the parent standard and relevant sub-section of the standard represented. The version header box includes the version number, initials of the author, date of production and any applicable comments describing modifications incorporated

within the current version[6]. Within the standard and sub-section header boxes, the amendment status of each is included.

Throughout the map, dependent requirements were organised into a sub-hierarchy of requirements under the relevant parent requirement[7].

Where the document referenced requirements in another document, i.e. another regulation or associated guidance material, the reference was included as if it were a requirement.

Where the extraction of a requirement resulted in a loss of context - more likely to be the case with dependent requirements - small amounts of text were inserted within square brackets to help clarify the requirement's intent. On rare occasions, additional text was required to ensure the meaning of an independent requirement was clear.

In each case, the additional text represented the author's interpretation of the requirement's intent. The use of square brackets highlights this to other users to avoid confusion between regulation content and author interpretation.

Additionally, all requirements extracted were tagged with a paragraph reference to ensure that each individual requirement was traceable to the paragraph in the regulation from which it came. Hence, as amendments to the regulations are produced, amended paragraphs may be reviewed and the relevant requirements updated (modified, added or removed) in the content map without the need to review the entire document from scratch. Instructions to this effect were included on the content maps.

The first stage of the content map development process ensured that all of the regulatory requirements and guidance within the documents were addressed within the comparison; thus it ensured that the comparison was thorough.

3.1.2 Stage two

The requirements, as well as the overarching heading-based hierarchical structure, were then re-organised into a hierarchical structure consisting of four main levels (viz Scope, Required activities, Acceptable methods, and Requirements). In doing so, some requirements were split into multiple requirements so they could be placed at the correct level of the structure.

The levels reflect four key elements identified within the regulations included in this comparison activity; however, they are not subject specific. These levels should be applicable to any structural regulation or standard, regardless of the inclusion of explicitly defined activities or suggested methods.

An example of a stage two content map is shown in Figure 2.

[6] The inclusion of comments becomes more relevant as the content map is developed through a process of review.
[7] For example, the requirements under the 'Test background' heading in Figure 1.

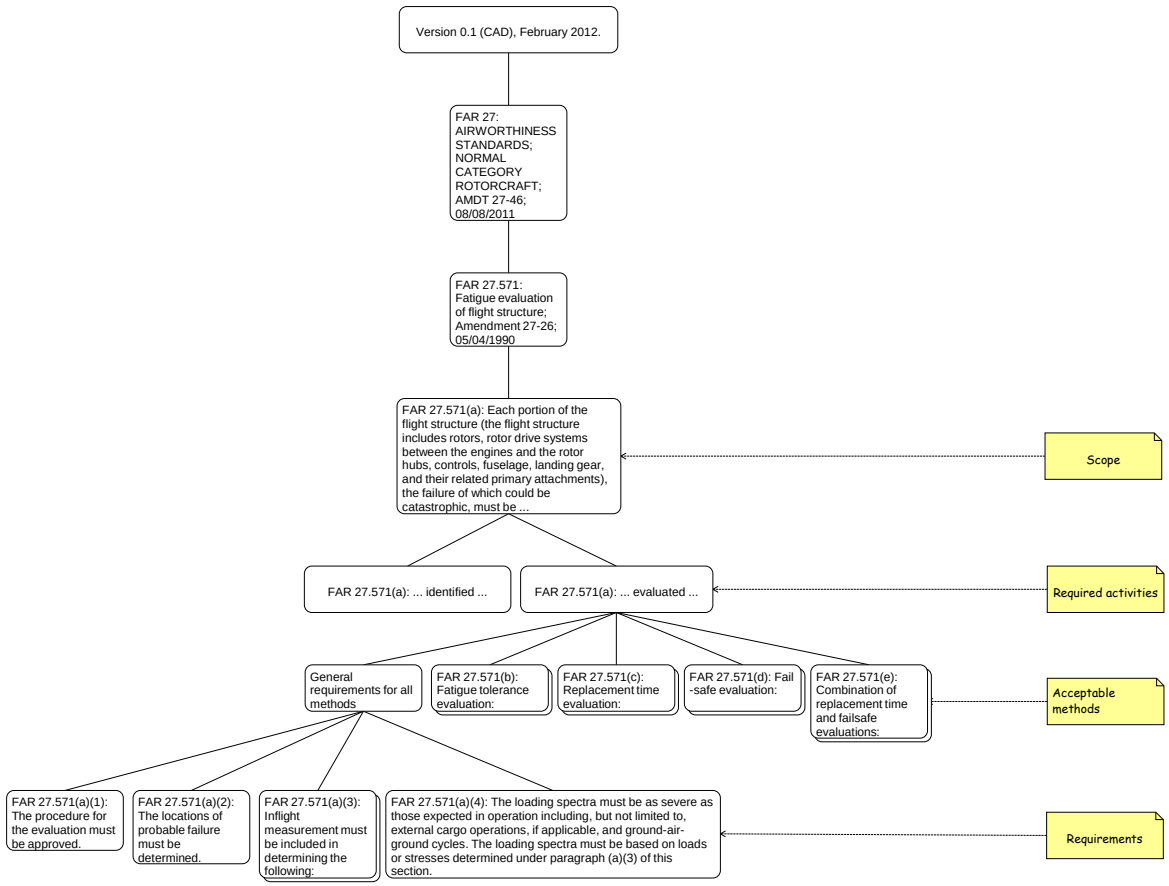

Figure 2: Example of a stage two content map – FAR 27.571

The first level, 'Scope', referred to the definition of what was subject to the requirements within the regulation. Generally this was 'critical structure', but in some instances it was referred to as 'rotorcraft elements'. In addition to the identification of the type of elements to be included, the 'Scope' also included the criteria specified (if any) for determining the cut-off for a particular type of element or structure.

The 'Required activities' level detailed the broad activities required by the regulations. For example, the required activities generally included the identification of elements that fit within the scope of the regulations and a high level statement of the required fatigue substantiation.

The 'Acceptable methods' level indicated all of the methods considered suitable for achieving the aims of the 'Required activities'. These included methods such as the Safe Life and Fail Safe methodologies.

Finally, under each of the 'Acceptable methods' sat the 'Requirements'. At this level, the requirements within the regulation were spelled out for each of the 'Acceptable methods'[8].

Requirements specific to particular 'Acceptable methods' were included under that method; whereas requirements that applied to all 'Acceptable methods' were located under the heading 'General requirements for all methods'. This heading was positioned at the 'Acceptable methods' level.

Requirements that addressed a similar issue were generally grouped together; sometimes under descriptive headings[9] where there were numerous related requirements.

Any duplicate requirements were summarised in the clearest fashion (or the best of the duplicate requirements were used as extracted); however, each paragraph reference was maintained in the header to the requirement in the content map. That way, updates to the document for a particular requirement could still be traced to the correct location within the Rationale™ content map. Where the requirements could not be combined without affecting the context, they were left as a chain of dependent requirements.

Requirements with a large number of qualifying elements in sub-paragraphs (i.e. a long list of elements for which a method is applicable) were compressed into one dependent requirement. The paragraph reference header for the compressed requirement was edited to include all of the relevant paragraph headings.

As per the initial extraction, the relocation of requirements (and in some cases their sub-division) also necessitated the interpretation of the requirement's intent. The definitions for each of the four levels provided a framework for the conduct of this interpretation.

3.1.3 Stage three

The third stage of the process was to assign all the requirements to a relevant thematic category. This was done to make the content maps more user-friendly and approachable but also to provide an additional, finer grouping of requirements to enable a clearer and more targeted comparison.

For the current comparison activity four thematic categories were used with each category based on one of the key stages of the helicopter fatigue substantiation process, identified during the review of the regulation documents as well as from general knowledge of the helicopter structural integrity field. The categories were; 'Overall Process', 'Aircraft Usage', 'Loads and Flight Tests' and 'Materials and Structural Testing'.

An example of a stage three content map is shown in Figure 3.

[8] To accommodate the difference between requirements and guidance as presented in the regulations and advisory material, respectively, a slight change to the four levels was made for advisory material documents. In this instance the four levels used were 'Scope', 'Activities', 'Methods' and 'Guidance'.

[9] These descriptive headings were generated as required and were not extracted from the subject regulation. Hence, the heading text was placed in square brackets and no paragraph reference was required.

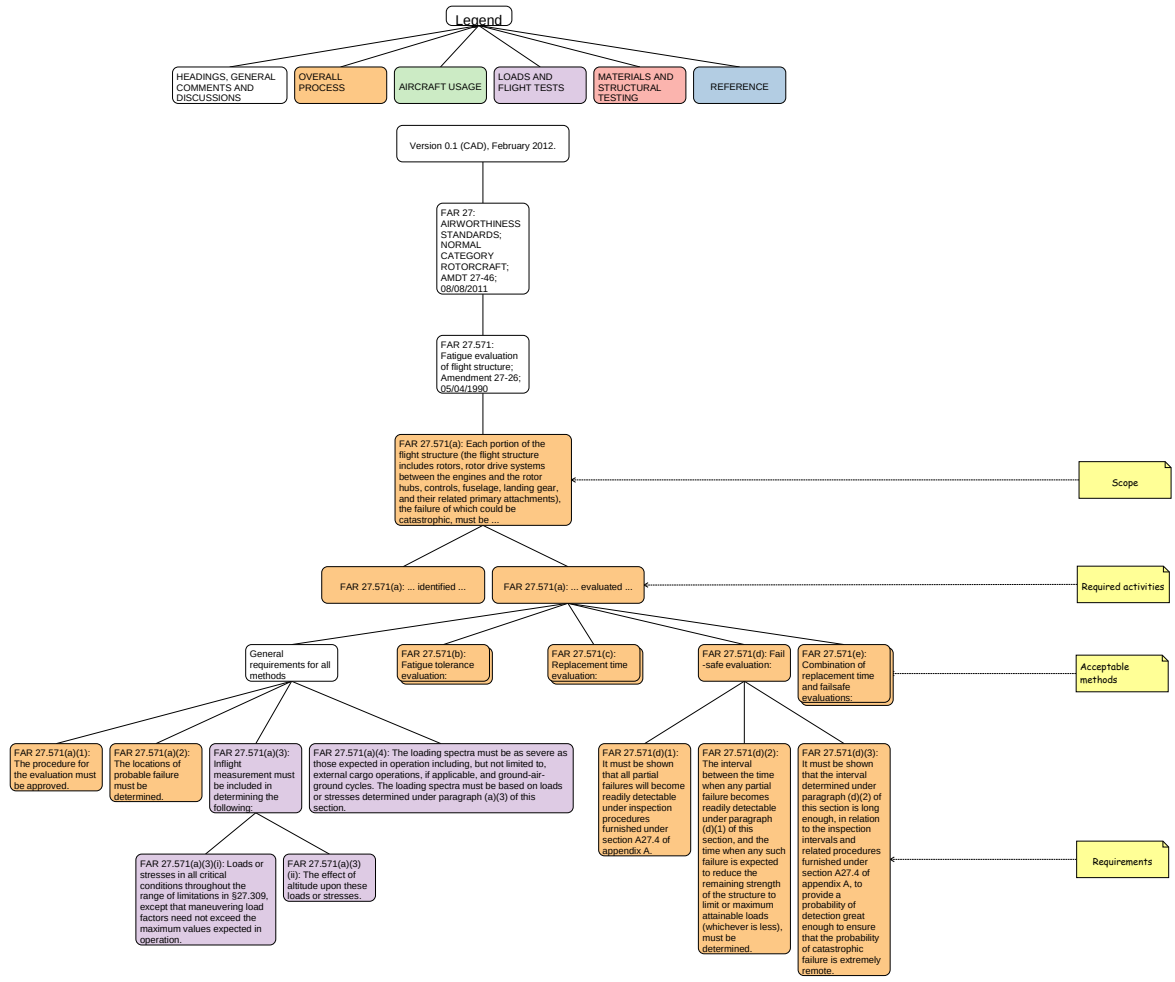

Figure 3: Example of a stage three content map – FAR 27.571

The 'Overall Process' category included requirements that related to the overall fatigue substantiation methodology as well as those that described how the requirements in the other categories fit together.

The 'Aircraft Usage' category included the requirements that detailed the construction of the usage spectrum.

The 'Loads and Flight Tests' category included all content concerning the determination of the loads spectrum, which included minor flight tests and flight strain surveys.

The 'Materials and Structural Testing' category included requirements that related to the categorisation of the materials used, including measures to account for variability, as well as testing of coupons or actual structure.

Two additional non-technical categories were used to assist in the presentation of the content map; 'Headings, general comments and discussions' covered non-specific content such as headers and instructional text relating to the format of the maps, while 'Reference'

was used for the requirements that referred a reader to another document for further requirements.

Each category was assigned a different colour within the content map. The use of colours enabled a top to bottom categorisation of requirements without making any changes to the hierarchical structure of the content maps developed in stage two. It also made the content maps user-friendly to negotiate as, at a glance, each requirement could be identified in terms of its categorisation as well as the distinct level of the regulation it represented (i.e. Scope, Required activities, Acceptable methods, Requirements).

For future applications of this methodology, the categories applied here may not be suitable. Where this is the case, the user should select categories specific to their application. The validity of the methodology does not depend upon the specific categories selected; only that requirements are classified into categories, that the categories are relevant to the application being considered and that they are applied consistently throughout the comparison activity.

As per the previous stages, the categorisation of requirements necessitated the interpretation of the requirements intent. The selection and definition of the categories are a necessary part of a content maps development to provide a framework for the conduct of this interpretation.

3.2 Comparison maps

With the content maps completed, the comparison could be conducted. Like the content maps, the comparison maps utilised the grouping tool within Rationale™.

Two separate comparison maps were created; one for the regulations and one for the guidance material. The primary reason for this was that the requirements within the regulations were just that – requirements for achieving certification against a particular standard – hence they were mandatory. On the other hand, the guidance within the advisory documents were only suggestions; that if followed represented a way, and not the only way, to meet the requirements in the regulations.

Additionally, the advisory documents were subsidiary to the regulation documents; hence comparisons between the two could potentially be meaningless. Omissions from one document to the next might be due to an avoidance of repetition, rather than the result of an actual difference.

Finally, the significant difference in the size of the regulatory and guidance documents meant that a comparison between them might tend to be dominated by the non-compulsory guidance within the advisory documents rather than compulsory requirements from the regulatory documents.

The comparison itself was conducted from top to bottom, focussing on one level at a time. At each level, the comparison was conducted in boxes, coloured appropriately for the

category of requirements being compared. Each category had only one comparison box at each level, except for at the 'Requirements' level where separate sets of comparisons were conducted for each of the 'Acceptable methods'.

Excerpts to illustrate the comparison maps are shown in Figure 4 and Figure 5.

The comparison identified the similarities and differences between the documents and provided an interpretation of the implications of any differences. Where it was deemed appropriate, general comments were provided on the content itself and on some occasions the absence of content.

The text within each comparison box was contained under three headings; 'General Comments', 'Similarities' and 'Differences'. Where there was no relevant discussion under a heading, that particular heading was excluded.

Interpretive comment was tagged with an 'I' contained in square brackets, as well as the initials of the author of the comments; e.g. [I-CAD]. This enabled interpretive comment from multiple authors to be contained and identified within the comparison text. This collaborative functionality makes it possible for the comparison product to draw on the experience and perspective of numerous technical experts and researchers.

The amount of comparison text required was a function of the number of requirements within each category, at a particular level. In some instances a category at a particular level had no related requirements and hence no comparison was completed.

Where a requirement consisted of a reference to requirements from another document, the comparison could be completed in one of two ways. Where the referenced document was itself included within the delimitations of the comparison, the relevant requirements were addressed as part of that document[10]. Where this was not the case, the requirements were extracted from the referenced document and the comparison was then conducted as if the referenced requirements actually resided in the subject document[11].

Like the content maps, the comparison maps incorporated a number of header boxes. These included a version box as well as regulation sub-section and content map boxes for referencing purposes. The content map header boxes contained hyperlinks to the relevant maps on Kahuna, the Aircraft Structures Branch Knowledge Management system [12].

[10] This was the case for the reference within 00-970 to test related requirements from Leaflet 201/1.
[11] This scenario did not occur in the Helicopter Standards Comparison activity.

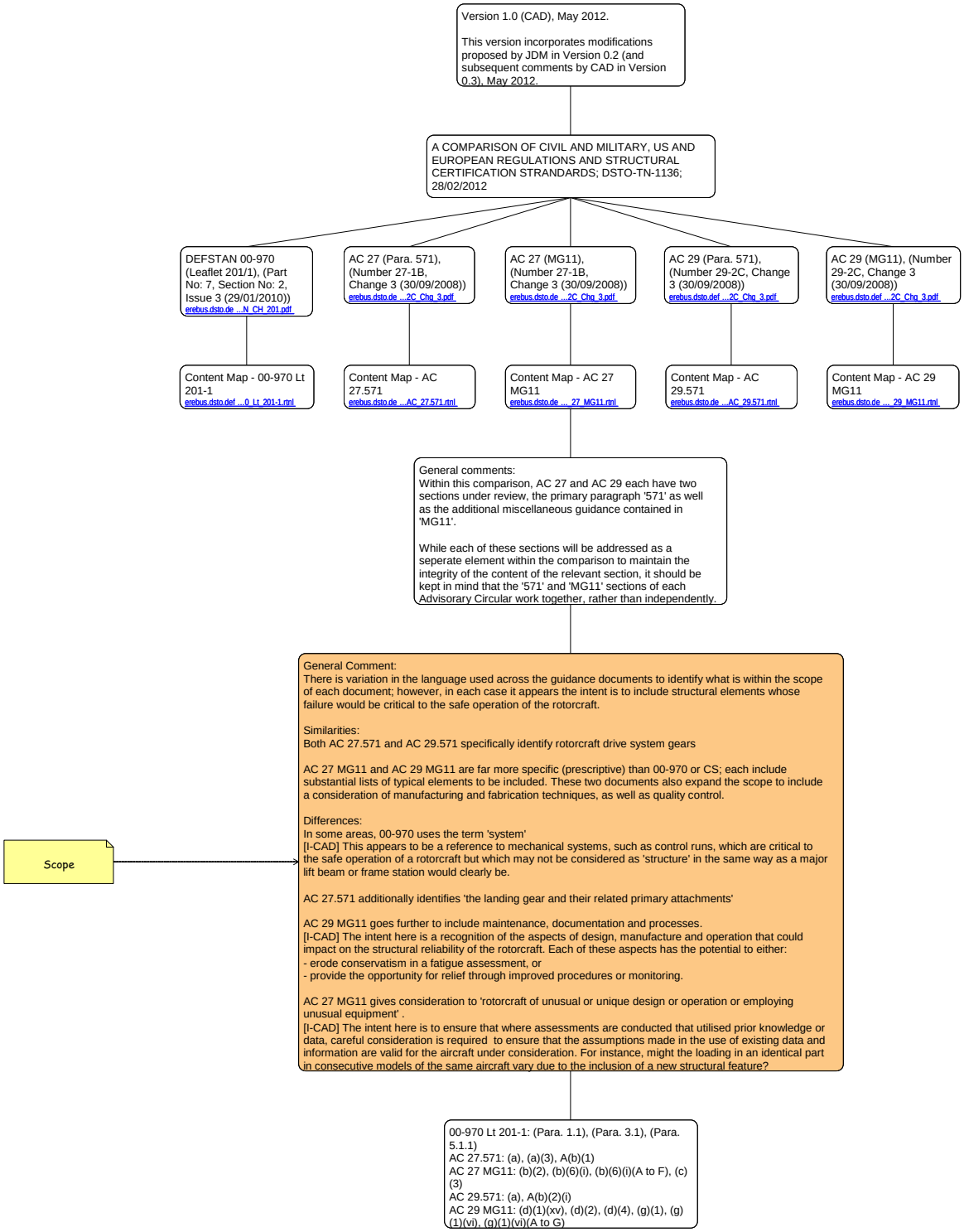

Figure 4: A guidance material comparison map showing the comparison at the 'Scope' level

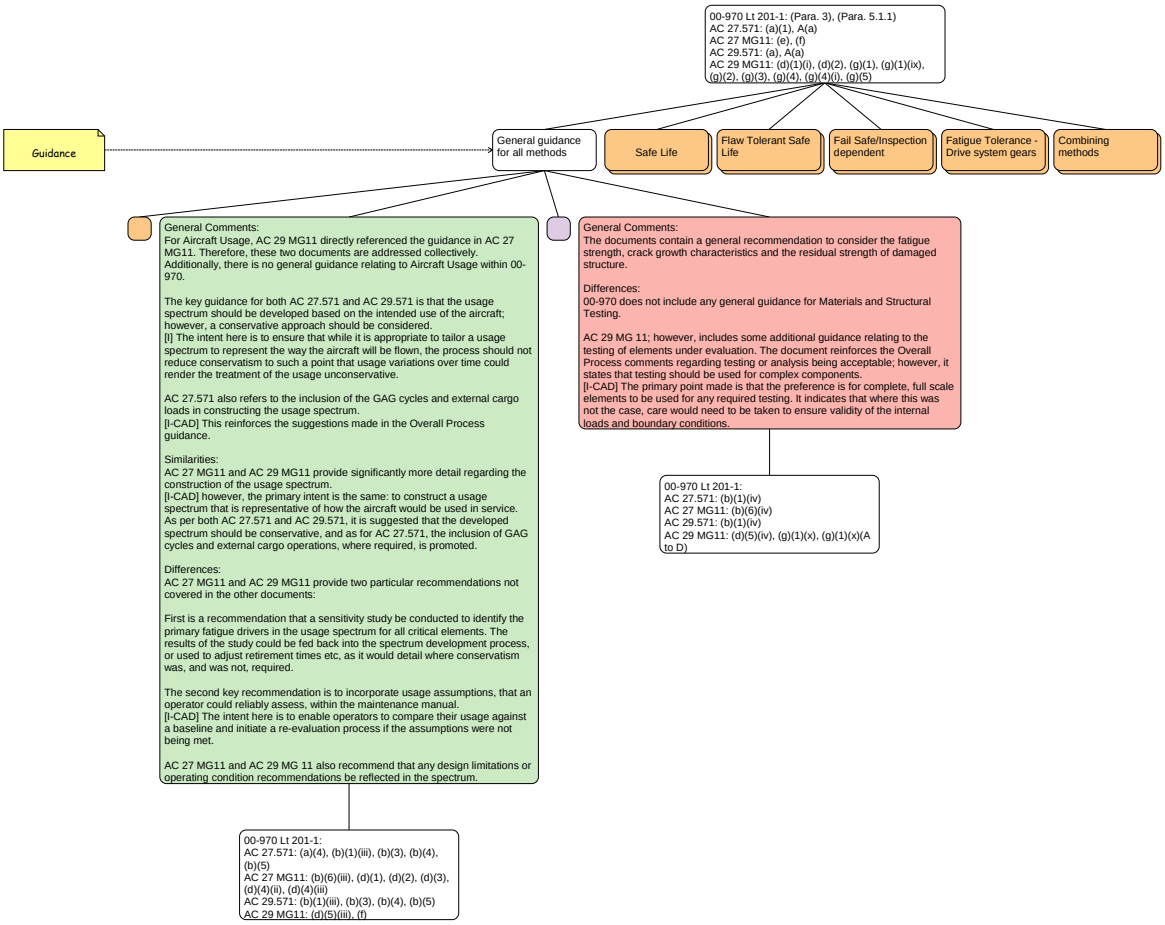

Figure 5: A guidance material comparison map showing the comparison at the 'Guidance' level

In general, the comparison maps looked very similar to the content maps. The main differences were the inclusion of general comments relevant to the comparison in a white box above the 'Scope' level, and the inclusion of the paragraph cross-references in a white box underneath each comparison box.

The referencing of requirements carried through from the content maps function as a cross-referencing tool for the regulations and standards included in the comparison. They enable a user to simply refer to a comparison map to identify sections within each of the compared documents that relate to a particular level and category.

Following amendments to the subject standards, comparison maps are updated simply by revisiting the comparison at each level and category combination affected by the amendments to the standard. As per the content maps, guidance on the process for updating the comparison maps was included within the comparison maps themselves.

3.3 Methodology validity

The methodology, as described above, was developed to be applicable to comparisons of regulations and standards beyond the delimitations of the present activity. In this context, the validity of the methodology could be assessed based on the systems engineering principles of repeatability, internal validity and external validity.

3.3.1 Repeatability

The methodology is not complex and the step by step presentation in Section 3, within the context of the Helicopter Standards Comparison activity, should enable it to be applied by other researchers to additional comparison activities.

The method is not dependent on the use of the Rationale™ tool. Any graphical presentation tool could be used (However, they may not be as efficient as Rationale™).

Instructions for the appropriate updating of content and comparison maps are included within the maps.

The four hierarchical levels specified for the structure of the content and comparison maps are defined and examples of their application are provided.

The definitions of the categories used within the comparison methodology are not specifically set (unlike the four hierarchical levels); hence different users applying the methodology to the same application may specify different categories. However, the validity of the methodology does not depend upon the specific categories selected; only that requirements are classified into categories, that the categories are relevant to the application being considered and that they are applied consistently throughout the comparison activity.

Interpretation throughout the content and comparison map development process formed a crucial part of the comparison product. Guidance at each step of development was provided to ensure this process was repeatable.

3.3.2 Internal validity

The separation of the content of the comparison documents into the four distinct levels, as well as the categorisation of the requirements at each level provided a framework, under which, the content being compared could be correctly aligned.

While the criteria used to categorise the content of each document can vary depending on the application, the criteria selected by the user should be relevant to the application being considered and be applied uniformly for each of the documents in the comparison activity.

The application of a heading based hierarchy in the first stage of the content map development process assisted the user in understanding the intent of the requirements within each document in the comparison. The use of square brackets where text was

added acted as a sign post for review such that the validity of the interpretation could be more efficiently checked.

Similarly to the content map development process, the procedural requirement to tag interpretive comment during the comparison, i.e. [I-XXX], declared the degree of consensus (where more then one review takes place) and indicated who had made the interpretation - so its utility could be assessed by the reader.

3.3.3 External validity

The categorisation criteria used within the comparison methodology are subject specific. It may be that they are not transferable to other applications. However, as discussed above, the validity of the methodology does not depend upon the specific categories selected.

The four levels of the hierarchical structure are not subject specific and they should be applicable to any structural regulation or standard, regardless of the inclusion of explicitly defined activities or suggested methods.

4. The Comparison Product

The comparison was conducted following the methodology presented in the previous section. The product of the comparison, two comparison maps separately addressing the regulations and guidance material, was published within an artefact on 'Kahuna'[12]. Each content map developed during the process was also published.

The publication of the comparison product in this way resulted in a more current product than if it were published within a formal DSTO report, due to the significantly reduced lead time.

Users can access the content and comparison maps via Kahuna to assist with work in the field of helicopter fatigue substantiation or to contribute to the comparison maps by including their own interpretative comment, thus improving the comparison product.

Additionally, the publication of the comparison in an open forum was required so that it could be updated as amendments to the subject regulations and standards are produced[13].

[12] Readers of this report with Defence Restricted Network connectivity can view both Rationale™ files and scalable image files of the comparison maps by accessing the following link: http://erebus.dsto.defence.gov.au/kahuna/index.php/Helicopter_Standards_Comparison. Note a copy of Rationale™ is not required to view the scalable image files.

[13] The updating process was explored further as a separate activity incorporating the recently released amendment to FAR 29 as the test case. For ease of reference, a review on the activity has been included in Appendix C. Further details of the work can be found at the following link: http://erebus.dsto.defence.gov.au/kahuna/index.php/A_Standardised_Methodology_for_the_Comparison_of_Standards

For the convenience of the reader, example content and comparison maps from the comparison activity have been included in Appendix D; however, the reader is reminded that these examples are valid for a single point in time and will not be updated. For current versions of these maps, it will be necessary to consult the Helicopter Standards Comparison artefact page on Kahuna.

5. Conclusions

The purpose of this work was to conduct a comparison of regulations and standards relevant to helicopter structural fatigue substantiation utilising a standardised approach that incorporated the benefits of both the text-based and spreadsheet-based methodologies. The ideal methodology was considered to be one that would be thorough, updateable, user-friendly, inclusive of interpretive guidance and current.

The methodology applied was considered to be thorough due to the development of the content maps from the ground up, with a focus on individual requirements. The four levels and the categorisation of requirements at those levels ensured the comparison could be conducted in a targeted fashion, increasing the likelihood of a thorough product.

The paragraph references included within the content maps meant that the methodology produced a comparison product that could be more easily updated when the subject regulations and guidance documents were amended.

The division of the content of the documents into the four levels, and the subsequent categorisation of the requirements at these levels also had the benefit of making the comparison product user-friendly. The hierarchical structure and colour coded requirements enable rapid identification of subsections of the documents included in the comparison that may relate to a particular area of interest for a user. The structure of both the comparison and content maps also enable a user to gain an immediate appreciation of the content of the comparison and each of the regulatory documents, respectively, which is more difficult to achieve from the document alone. The cross-referencing boxes included under each comparison box in the comparison maps also enable users to quickly refer back to the subject standards as required.

Crucial to any comparison activity is the inclusion of interpretive comments. For the presented methodology, this interpretation was conducted both in the development of the content maps - an interpretation of the intent of the requirements within each document - as well as in the comparison itself - an interpretation of the differences between requirements from each of the documents.

The publication of the comparison and content maps within the Aircraft Structures Knowledge Management System, Kahuna, ensured that the time between completion of the comparison activity and publication of the product was minimised. This enabled the publication of a product that was far more likely to be current than a product embedded within a formal DSTO report.

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Appendix A: Research Proposal

Research Proposal:

A comparison of civil and military, European and US regulations and structural certification standards

Airworthiness Standards Group

Air Vehicles Division

November 2011

Research Proposal: A comparison of civil and military, European and US regulations and structural certification standards

The importance of the study:

A fundamental responsibility of the Australian Defence Force (ADF) Airworthiness Authority (AA) is "… the establishment, management and monitoring of a regulatory framework for type certification …" [1]. To meet this responsibility, the ADF AA relies on the Technical Airworthiness Authority (TAA) "… to interpret technical airworthiness regulations …" [1].

For the Australian military type certification of new aircraft, the TAA must interpret the certification basis for the aircraft to ensure the type achieves a standard of safety acceptable to the ADF AA. As the number of aircraft being certified by Original Equipment Manufacturers (OEMs) under different regulatory frameworks increase, this task becomes more difficult.

While the TAA has received some assistance through the outsourcing of aircraft structural integrity program activities[1], this assistance predominantly focuses on in-service airworthiness management.

Hence, the role of the ADF AA and TAA in the type certification of new ADF aircraft remains unchanged [1-3]. This ensures an ongoing requirement for Directorate General Technical Airworthiness (DGTA) staff to interpret airworthiness regulations and standards on behalf of the TAA.

A thorough understanding of the similarities and differences between the full range of applicable regulations and certification standards would assist the TAA's interpretation activities, and ultimately, the AA's ability to ensure the airworthiness of State aircraft.

Such an understanding would be gained through a structured comparison of the relevant regulations and certification standards.

[1] To Authorised Engineering Organisations contracted by the Directorate General Technical Airworthiness in the case of legacy platforms, or to the OEMs or their representatives in the case of more recent through life support based platform acquisitions.

The hypotheses:

A structured comparison of the relevant regulations and certification standards that would generate an understanding of the similarities and differences between the full range of applicable regulations and certification standards can be achieved by a combination of the text-based and spreadsheet-based approaches identified in the literature review below.

The statement of the problem and sub-problems:

The purpose of the proposed study is to conduct a comparison of standards relevant to helicopter structural fatigue substantiation utilising a standardised approach developed from methodologies identified in the literature review.

The problem as stated covers three sub problems:

1. The combination of the text-based and spreadsheet-based approaches into a standardised approach that incorporates the benefits of each, but none of the limitations;

2. The generation of a meaningful comparison across a large range of regulations and certification standards, with different origins, development paths and occasionally, different objectives; and finally

3. Assuming sufficient regulatory comparability, the completion of a valid generic interpretation of the differences between the regulations in the absence of a practical context for the comparison.

The delimitations:

The scope of this comparison will be limited in two ways.

Firstly, the regulations and certification standards (including relevant guidance documentation) to be included in the comparison are those relevant to ADF Rotary Wing aircraft and are listed below:

DEFSTAN 00-970 (Chapter 201 (Paragraphs 1 to 3), Leaflet 201/1), (Part No: 7, Section No: 2, Issue 3 (29/01/2010)) [5]
FAR 27 (Para. 571), (Amendment No. 27-46 (as of 08/08/2011)) [6]
FAR 29 (Para. 571), (Amendment No. 29-45 (as of 25/10/1999)) [7]
AC 27 (Para. 571, MG-11), (Number 27-1B, Change 3 (30/09/2008)) [8]
AC 29 (Para. 571, MG-11), (Number 29-2C, Change 3 (30/09/2008)) [9]
EASA CS-27 (Para. 571), (Amendment No. 2 (17/11/2008)) [10]
EASA CS-29 (Para. 571), (Amendment No. 2 (17/11/2008)) [11]

Secondly, the comparison of the above documents will focus on the fatigue substantiation of rotary wing critical structure[2]. Fatigue substantiation of critical structure is fundamental to the ongoing airworthiness of ADF helicopters. This focus area would also complement previous efforts of the Airworthiness Standards Group regarding the fatigue substantiation of fixed wing aircraft[3].

The definitions of terms:

The terminology used in this proposal conform to the meanings defined in DEF STAN 00-970 [4], and FAR 27/29.571 [5, 6] (and its associated Advisory Circulars AC27/29.571 [7, 8]).

The assumptions:

N/A

A review of the related literature:

A preliminary review of recent[4] DSTO literature on comparisons of airworthiness standards was conducted. The review identified the scope of previous comparisons (which documents were included and the content of those documents reviewed) and identified the comparison methodologies applied.

Maxfield, K. [11]

This report focussed on a comparison of the European Aviation Safety Agency (EASA) and Federal Aviation Authority (FAA) Certification Specifications of Large Aeroplanes with a focus on paragraph 25.571 - Damage Tolerance and Fatigue Evaluation.

After introducing the content of each of the regulations, the report compared each of the main categories, using a text-based comparison approach, and provided some interpretive comment on the effect of the differences identified.

The benefit of this approach is that it is simplistic and thorough; however, considering the scope of the review the result is text heavy and as the sole output is a formal DSTO report, the results are not dynamic or user-friendly. Due to the long lead time for publication, the results are also more likely to be out of date.

[2] The relevant parts of each standard are detailed in the above list.
[3] This existing work is discussed in more detail in the literature review below.
[4] Documents within the DSTO report series published after 2000.

Jackson, P. et al [12]

This report focussed on the FAR 25, DEFSTAN 00-970 and JSSG 2006 Aircraft Design Guides and Airworthiness Standards with a focus on fatigue and damage tolerance requirements.

In a similar manner to Ref. [11], this report compared the documents using a text-based comparison approach. The report also includes extensive background chapters on the history of standards development and the use of standards within the RAAF, including examples. The end result of this additional content from a standards comparison perspective is to further exacerbate the issues of timeliness and dynamic content mentioned in regard to Ref. [11].

Morrish, J. [13]

This work focussed on the FAR 25, DEFSTAN 00-970 and JSSG 2006 Aircraft Design Guides and Airworthiness Standards as well as the Draft USAF structures bulletins. The focus was again on fatigue and damage tolerance requirements.

This work, utilising Excel Spreadsheets, differed from the previous references in that it focussed more on a dynamic and timely presentation of the comparison across the focus documents. The work does not include an interpretation of the impact the differences between the documents may have.

The approach is more user-friendly and accessible than the text-based comparison and has the potential to be more up to date, and more easily kept up to date, than the text-based approaches. The absence of an exploration of the impact of any differences limits the applicability of the work.

The intent of this work appears geared towards the generation of a 'living' comparison tool to assist users in identifying areas of relevance to their work that they would then explore further as their particular situation required.

Callus, P. [14]

This report focussed solely on the requirements for the Design and Airworthiness of Composite Aircraft Structure contained in DEF STAN 00-970.

While this report did not contain a comparative focus, it was interesting in the way it identified and rearranged applicable text within DEF STAN 00-970 into an order that made sense for composite structures. In effect the work tackled the issue of interpreting standards content into a more user-friendly format which is of interest to the work under this research proposal.

As for Refs [11, 12], the text-based approach of the work limited the output in regard to being dynamic, user-friendly and current.

Summary

A text-based approach, while thorough, is not very user-friendly and is less likely to be current due to the long lead times required for publication in the DSTO report series. The work is also not dynamic, and represents only a single snapshot in time; however, it does allow for interpretation of the impact of differences between the documents.

The spreadsheet-based approach was far superior in regards to its currency and user-friendliness. The approach also allows for continuous updates to the tool to ensure it remains up to date. The drawback of the approach is that it does not provide a medium for the interpretation of the differences between the documents reviewed.

The standardised approach for use within the standards comparison detailed in this research proposal will combine the benefits of the text-based and spreadsheet-based methodologies to ensure the resulting comparison is thorough, current, user-friendly, dynamic (easily updateable) and inclusive of interpretive guidance.

The data and the treatment of the data:

The data requirements for this study consist of extensive access to published literature. Both external and internal (DSTO report series) documentation will be accessed during exploration of the standardised approach to standards comparisons. The most recent copies of certification regulations and standards will also be required.

The data needed and the means for obtaining the data:

The data shall be obtained via web based search engines and DSTO research library tools.

The research methodology:

The work will be conducted as an individual research project under the guidance of DSTO supervision chain. The work will be completed in three stages:

1. The determination, based on a literature review, of a standardised approach for the comparison of airworthiness regulations and standards. Based on the preliminary literature review, such a standardised approach will incorporate benefits of both the text-based and spreadsheet-based methodologies;

2. The conduct of the standards comparison using the standardised approach formulated in stage one; and finally

3. The documentation and presentation of results. This will include publication in a formal DSTO report; however, presentation of the comparison as an artefact within Kahuna will be required to retain user-friendly and dynamic features.

The specific treatment of the data for each sub-problem:

N/A

The qualifications of the researchers:

This research program will be conducted under the guidance of the Air Vehicles Division - Structures Branch, Helicopter and Transport Group Functional Head (S&T 7). All work will be conducted by S&T 5 level staff. General guidance and input will be provided by staff from S&T level 6.

Proposed study outline:

The proposed study has a nominal duration of six months and 0.5 Staff Years of effort. An outline of the study is provided at Table A1.

Table A1: Proposed study outline

Week	Sub Prob	Activity Description	Staff Involved	Comment
1	1	Finalise literature review and determine standardised approach for the comparison of airworthiness regulations and standards.	S&T5 x 0.5	
2			S&T5 x 0.5	
3			S&T5 x 0.5	
4	2	Conduct standards comparison using methodology formulated from stage one.	S&T5 x 0.5	
5			S&T5 x 0.5	
6			S&T5 x 0.5	
7			S&T5 x 0.5	
8			S&T5 x 0.5	
9			S&T5 x 0.5	
10			S&T5 x 0.5	
11	3	Documentation and presentation of the results.	S&T5 x 0.5	To 'First draft' standard for formal report.
12			S&T5 x 0.5	

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4. *Design and Airworthiness Requirements for Service Aircraft*. (2010) DEFSTAN 00-970, Part No: 7, Section No: 2, Issue 3 (29/01/2010). In *Defence Standards*. UK MoD.
5. *Airworthiness Standards: Normal Category Rotorcraft*. FAR 27, Amendment No. 27-44 (as of 31/03/2008). In *Federal Avation Regulations*.
6. *Airworthiness Standards*: Transport Category Rotorcraft. FAR 29, Amendment No. 29-35 (as of 02/11/1994). In *Federal Avation Regulations*.
7. *Certification of Normal Category Rotorcraft*. (2008) AC 27-1B, Change 3 (30/09/2008). In *Advisory Circular*. FAA.
8. *Certification of Transport Category Rotorcraft*. (2008) AC 29-2C, Change 3 (30/09/2008). In *Advisory Circular*. FAA.
9. *Certification Specifications for Small Rotorcraft*. (2008) CS-27, Amendment No. 2 (17/11/2008). In *Certification Specifications*. EASA.
10. *Certification Specifications for Large Rotorcraft*. (2008) CS-29, Amendment No. 2 (17/11/2008). In *Certification Specifications*. EASA.
11. Maxfield, K. (2009) *A Comparison Study between the European Aviation Safety Agency (EASA) and Federal Aviation Authority (FAA) Certification Specifications of Large Aeroplanes, paragraph 25.571 - Damage Tolerance and Fatigue Evaluation*. [Unpublished Report] Melbourne, Vic., DSTO
12. Jackson, P., Amaratunga, R. and Walker, K. (2005) *Comparison of the Aircraft Design Guides and Airworthiness Standards - FAR 25, DEFSTAN 00-970, and JSSG 2006, Particularly Relating to Fatigue and Damage Tolerance Requirements.* [Unpublished Report] Melbourne, Vic., DSTO
13. Morrish, J. (2009) USAF Structures Bulletin Review.
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Appendix B: Literature Review

Literature Review:

DSTO and External Publications involving a comparison of structural certification standards

Airworthiness Standards Group

Air Vehicles Division

December 2011

Literature Review: DSTO and External Publications involving a comparison of structural certification standards

This literature review was required to inform the development of a standardised approach for the comparison of airworthiness regulations and standards as outlined in the research proposal "A comparison of civil and military, European and US regulations and structural certification standards".

The review builds on the preliminary review included in the research proposal and incorporates additional DSTO references and a number of external publications.

As in the preliminary review, the focus was to identify the scope of previous comparisons, the comparison methodologies applied and to assess the benefits and limitations of these methodologies.

Review

Maxfield, K. [1]

This report focussed on a comparison of the European Aviation Safety Agency (EASA) and Federal Aviation Authority (FAA) Certification Specifications of Large Aeroplanes with a focus on paragraph 25.571 - Damage Tolerance and Fatigue Evaluation.

After introducing the content of each of the regulations, the report compared each of the main categories, using a text-based comparison approach, and provided some interpretive comment on the effect of the differences identified.

The benefit of this approach was that it was simplistic and thorough; however, considering the limited scope of the review the result was text heavy and with the sole output a formal DSTO report, the results were not dynamic or user-friendly. Also, the long lead time for publication meant that the results were potentially out of date before the report was distributed.

Jackson, P. et al [2]

This report compared the FAR 25, DEFSTAN 00-970 and JSSG 2006 Aircraft Design Guides and Airworthiness Standards with a focus on fatigue and damage tolerance requirements.

In a similar manner to Ref. [1], the report used a text-based approach. The report also included extensive background chapters on the history of standards development and the use of standards within the RAAF, including examples.

The end result of the additional content from a standards comparison perspective was to further exacerbate the issues of publication timeliness mentioned in regard to Ref. [1].

Morrish, J. [3]

This work reviewed the FAR 25, DEFSTAN 00-970 and JSSG 2006 Aircraft Design Guides and Airworthiness Standards as well as the Draft USAF structures bulletins. The focus was again on fatigue and damage tolerance requirements.

This work, utilising Excel Spreadsheets, differed from the previous references in that it enabled a more timely presentation of the comparison across the focus documents. However, the work did not include any interpretation of the differences between the documents.

The approach was more user-friendly and accessible than the text-based comparison with the potential to be updated if required.

The intent of this work was to generate a 'living' comparison tool; one that was easily updateable and would assist users to identify areas of relevance to their work for further exploration as required.

Callus, P. [4]

This report focussed solely on the requirements for the Design and Airworthiness of Composite Aircraft Structure contained in DEF STAN 00-970.

While this report did not contain a comparative focus, it was interesting in the way it identified and rearranged applicable text within DEF STAN 00-970 into an order that made sense for composite structures. In effect the work tackled the issue of interpreting standards content into a more user-friendly format which is of interest to the work under the research proposal.

As for Refs [1, 2], the text-based approach limited the output in regard to being timely and current.

Knight, C. G. [5]

The focus of this report was different again as it addressed structural certification issues in the context of an actual platform, the Eurocopter Tiger. The Tiger certification basis incorporates FAR 29 Amdt 22, as well as a number of MIL-STDS.

The report reviewed the certification basis in terms of the likely operation of the Tiger in ADF service. Therefore, in affect, the assessment reviewed the certification basis against the ADF comparative standard.

The comparison methodology again appeared to be text-based and substantial interpretive comment was provided in areas where the certification structural design standard was deficient against the comparative standard.

The point of difference in this work was that the standards comparison was done in the context of a platform in ADF service. This context provided a more tangible way to identify differences between the certification and comparative standards.

King, C. [6]

Similarly to Ref. [5], this work focused on deficiencies in the certification basis for a single aircraft type, when compared to the ADF comparative standard. The platform in this case was the Eurocopter Squirrel, which was certified against FAR 27.

The author intended to assess the applicability of FAR 27 in the military context utilising a more analytical approach than Ref. [5]. Instead of identifying deficiencies between the certification and comparative standard the intent was to assess the OEMs justifications for achieving certification to FAR 27 against the requirements in the comparative standard; effectively the same comparison, only at a more fundamental, quantitative level.

However, due to a lack of availability of the required information the focus was restricted to a review of ADF usage and a comparison of this to the requirements in FAR 27.

The approach taken here was more quantitative in nature than the previous references. The method is fundamentally more thorough; however, it has the potential to be very time consuming.

Kappas, J. [7]

The main focus of this report was a review of the 'state of the art' of probabilistic methods for the risk and reliability assessment of gas turbine engines. A part of this work looked at the relevant standards and whether they quantified acceptable risk levels. Within the report there was a small amount of comparison between DEFSTAN and some MIL-STDS.

The comparisons conducted followed the text-based methodology seen in many of the previous references; accordingly, the benefits and limitation presented for these previous references are equally applicable here.

Tuck, A., et al. [8]

The main focus of this report was the transition from built up to unitised structures. Of relevance to the current research was a chapter that considered "the various certification and verification methods available during each phase of an aircraft's life". In this section, the move towards unitised structures was looked at from the perspective of how certification should be managed; given the 'major change' requirements of the TAMM.

The majority of the relevant content was generic; however, some detail was provided regarding specific certification criteria within DEFSTAN 970 with relevance to certification testing. Some generic comments were also made on the contents of the FARs, Defence Standards (DEF STAN) and Joint Services Specification Guides (JSSG) relevant to verification by analysis.

There was minimal comparative content in this report.

Eastin, R. G. [9]

In this paper the author compared the damage tolerance requirements of the FAA[1] and the USAF[2].

The paper first addressed the USAF requirements, detailing what they prescribed, and then it contrasted the FAA requirements against the USAF requirements.

The paper did not introduce anything new in a methodology sense; it repeated the compare/contrast methodology of [1] and [2]. The comparison made use of a table to cross reference each element of the requirements reviewed.

Emmerling, S. [10]

The scope of the comparison within this paper included both FAR and EASA documents (specifically paragraph 571); however, the key point of difference to previous comparisons was that it was looking at the differences between the existing rules for fatigue evaluation and the rules proposed in a NPRM for a separation of the fatigue evaluation aspects for metallic and composite structure.

The first step of the comparison was to look at the new rules and old rules separately to address how similar the FAR and EASA documents were. The assessment was essentially a text-based process which found the FAR and EASA documents to be practically identical in all cases.

A text-based comparison was then conducted between the old and new FAR rules, broken down into sub-sections (Residual strength, fatigue tolerance/damage tolerance etc).

Again, the comparison methodology boiled down to a text-based comparison of one document to another. While this paper showed it could be done in a more succinct fashion, it was still the same old methodology.

Fox, F. W. [11]

This paper focused on a comparison of the FAR operational requirements to FAR technical requirements to determine what might be relevant for ADF technical airworthiness. FAR 25 was used as the technical regulation basis for the comparison.

As in some of the other references reviewed, the comparison was preceded by a cross reference of relevant sections in the documents to be compared. Again it was a text-based

[1] FAR Final Rule, Federal Register: October 5, 1978 (Volume 43, Number 194), 14 CFR Part 25 (Docket No. 16280; Amendment No. 25-45).
[2] MIL-A-83444 (USAF), Airplane Damage Tolerance Requirements, July 1974.

comparison. The documents for consideration were reviewed, interpreted and then compared. Differences were highlighted and discussed; incorporating an interpretive element.

Again, the comparison methodology was essentially a text-based approach with no new lessons to be learnt.

Summary

A text-based approach, while thorough, was not very user-friendly and was less likely to be current due to the long lead times required for publication in the DSTO report series. The work was also not dynamic, and represented only a single snapshot in time; however, it did allow for interpretation of the impact of differences between the documents.

The spreadsheet-based approach was far superior regarding its currency and user-friendliness. The approach meant that the comparison could be updated if required. The drawback of the approach was that it would be more difficult to incorporate an interpretation of the differences between the documents reviewed.

The development of a standardised approach for use within the standards comparison detailed in this research proposal should combine the benefits of the text-based and spreadsheet-based methodologies to ensure the resulting comparison is thorough, current, accessible, updateable and inclusive of interpretive guidance.

References

1. Maxfield, K. (2009) *A Comparison Study between the European Aviation Safety Agency (EASA) and Federal Aviation Authority (FAA) Certification Specifications of Large Aeroplanes, paragraph 25.571 - Damage Tolerance and Fatigue Evaluation*. [Unpublished Report] Melbourne, Vic., DSTO
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Appendix C: Updating a Standards Comparison Product

An assessment of the updateability of a standards comparison product generated from the standardised methodology detailed in DSTO-TN-1136

The standardised comparison methodology was developed with the intention that once created a comparison product could be updated, reflecting the content of amended standards, without having to conduct the comparison from scratch.

The recommended update process, utilising paragraph references attached to each content map requirement, was briefly presented in the Technical Note [1] for the Helicopter Standards Comparison activity [2]. More detailed guidance was incorporated into the content and comparison maps themselves.

An assessment of the recommended update process is presented. The assessment was conducted in the context of an update to the Helicopter Standards Comparison product [2] following an amendment to FAR 29 [3] released during the conduct of the original standards comparison.

Application of the update process

Amendment 29-55 to FAR 29 made significant alterations to not only the content, but also the paragraph structure of the standard. Unfortunately, the process developed for updating a comparison product relied on the structure remaining fixed.

When the structure of a standard is altered, the requirements within amended paragraphs cannot be aligned with the appropriate requirements within the existing content map. This results in a breakdown of internal validity[1].

Therefore, where an amendment changes the structure of the standard, the content map must be developed from scratch following the three stage process in [1][2]. While this is not ideal, redeveloping a single content map is far quicker than modifying an existing text-based comparison to account for an amended standard.

The redevelopment of a content map can also be used when changes to the content of a standard are so significant that it would be easier to start again than to modify the existing

[1] In this case, the numbered paragraphs of the original and amended standard would not align.

[2] An exception to this exists for standards published by the Federal Aviation Administration, where the published 'Final Regulatory Evaluation' may include a table that cross-references the paragraph numbers for the existing and final (amended) rule. In this case, the cross-referencing provided enables the text search update method to be conducted. The only additional step is to ensure that the new paragraph numbers replace the existing paragraph numbers in both the content and comparison maps. If available, paragraph cross-references would be included within the 'Final Regulatory Evaluation' document available under the appropriate docket number from http://www.regulations.gov/#!home.

content map, even though the structure of the standard may have remained unchanged. This decision is left to the person updating the comparison product.

With an entirely new content map developed, the regulation comparison map was updated by revisiting the comparison at each level and category combination relevant to the new content map. Care was required to ensure removal of any comparison text relating to superseded FAR 29 content.

Detailed guidance for the update process

Step by step guidance outlining the update process, including procedures to account for structural changes in amended standards, is detailed below (Annex A includes modified instructions for inclusion in content and comparison maps):

Content map update

If the amendment has modified the structure of the standard, the content map must be redeveloped[3] following the three stage process outlined in [1].

If the structure of the standard has not been altered, the following process should be applied[4]:

1. Update the text, amendment status and hyperlink in the 'Headings, general comments and discussions' boxes at the top of the content map.
2. Identify all amended paragraphs within the standard.
3. For each amended paragraph:
    a. Conduct a text search of the content map to identify all occurrences of the changed paragraph (Nb: The content map will need to be fully expanded for the search function to work properly).
    b. Mark all requirement boxes matching the text search with the 'scissors' teacher tool (Accessed from the left menu panel).
    c. Review the updated paragraph against each marked requirement box.
        i. Update requirement box as required. When updated, mark the 'scissors' tool with the 'tick' tool. If no updating was required for a particular requirement, mark it with an 'exclamation point' tool.
        ii. Add new requirement boxes as required within the appropriate level and category (and under a suitable acceptable method if appropriate). Mark these boxes with the 'tick' tool.
        iii. For any existing boxes no longer represented in the standard, mark with the 'cross' tool.

[3] Unless a cross-referencing of paragraph numbers is provided for standards released by the Federal Aviation Administration.
[4] As already mentioned, where there are extensive changes to a standard, it may be easier to redevelop the content map, even if no changes to the structure have been made.

iv. Where a combined requirement existed (i.e. more than one paragraph reference for a single requirement box) and only a single paragraph is required to be deleted or modified, the combined requirement should be split into separate requirements. If this is done, note that an alteration to the text in the separated requirement boxes may be required to ensure they represent the content from the remaining referenced paragraphs.

4. Once all modified paragraphs have been updated, the content map should be reviewed as a whole against the updated standard to ensure the map accurately represents the standard.
5. Once the content map is considered acceptable, any requirement boxes marked with an 'exclamation point' can have these markings removed as they have not been altered and require no changes in the comparison map. The remaining markings should be kept until the comparison map has been updated so that the affected requirements, and their parent paragraphs, can be easily identified.

Comparison map update

If the content map has been redeveloped due to structural changes in the amended standard, the comparison map must be updated by revisiting the comparison at each level and category relevant to the newly developed content map. Care must also be taken to ensure that all old paragraph references within the paragraph cross-reference boxes are replaced with updated ones and that any comparison text relating to superseded FAR 29 content is removed.

If the structure of the standard has not been altered, the comparison map can be updated by revisiting the comparison for each level and category combination affected by the amendment (i.e. those requirements within the content map tagged with 'tick' and 'cross' markings). In this instance, the following process should be applied:

1. As per the content map, update the text, amendment status and hyperlink in the 'Headings, general comments and discussions' boxes at the top of the comparison map.
2. For each of the affected requirements in each amended content map (indicated by the 'tick' and 'cross' marks).
    a. Review the comparison box for the appropriate level and category, and update as required.
    b. Update the paragraph cross-reference boxes, as required.
3. Review the comparison map to ensure the intent of the amendment has been captured.
4. Remove the markings in the content map and delete any requirement boxes marked with a 'cross'.

Conclusions

The process developed for updating a comparison product [1] relied on the paragraph structure of amended standards remaining fixed. Where changes to a standard resulted in a restructuring of the document, a new content map must be constructed from scratch.

While this increases the effort required to update a comparison product, the additional effort remains substantially less than that necessary to update a text-based comparison following an amendment to a subject standard.

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Annex A: Updating guidance for inclusion on comparison and content maps

The following text should be included on each content and comparison map to assist users in updating a comparison product.

Updating the comparison map:

Prior to updating this comparison map, following amendments to the subject standards, the relevant content maps should be updated (Directions are included within each content map).

When this is complete, the comparison map can be updated by revisiting the comparison for each level and category combination of the content map affected by the amendment.

If the content map was redeveloped due to structural changes in the amended standard, the comparison map must be updated by revisiting the comparison at each level and category relevant to the newly developed content map. Care must also be taken to ensure that all old paragraph references within the paragraph cross-reference boxes are replaced with updated ones and that any comparison text relating to superseded standard content is removed.

Step by step guidance for the update process is provided in the 'Assessment of Updatability' document accessible at the following link:
http://erebus.dsto.defence.gov.au/kahuna/index.php/A_Standardised_Methodology_for_the_Comparison_of_Standards

Updating the content map:

Following an amendment to the subject standard, this content map can be updated by conducting a text search for the paragraph number of each updated paragraph. The text within the boxes identified by the search can then be updated as required to reflect the new content in the standard.

If, however, the paragraph structure of the standard has been altered, the content map will need to be redeveloped using the three stage process in the Technical Note, DSTO-TN-1136. (Except where paragraph cross-references have been provided by the Federal Aviation Administration. If available, these would be included within the 'Final Regulatory Evaluation' document available under the appropriate docket number from http://www.regulations.gov/#!home).

Where extensive changes have been made to the content, regardless of whether the paragraph structure has been altered, it may be easier to develop a new content map from scratch.

Step by step guidance for the update process is provided in the 'Assessment of Updatability' document accessible at the following link:
http://erebus.dsto.defence.gov.au/kahuna/index.php/A_Standardised_Methodology_for_the_Comparison_of_Standards

Appendix D: Helicopter Standards Comparison Product Examples

Example comparison and content maps from the Helicopter Standards Comparison activity

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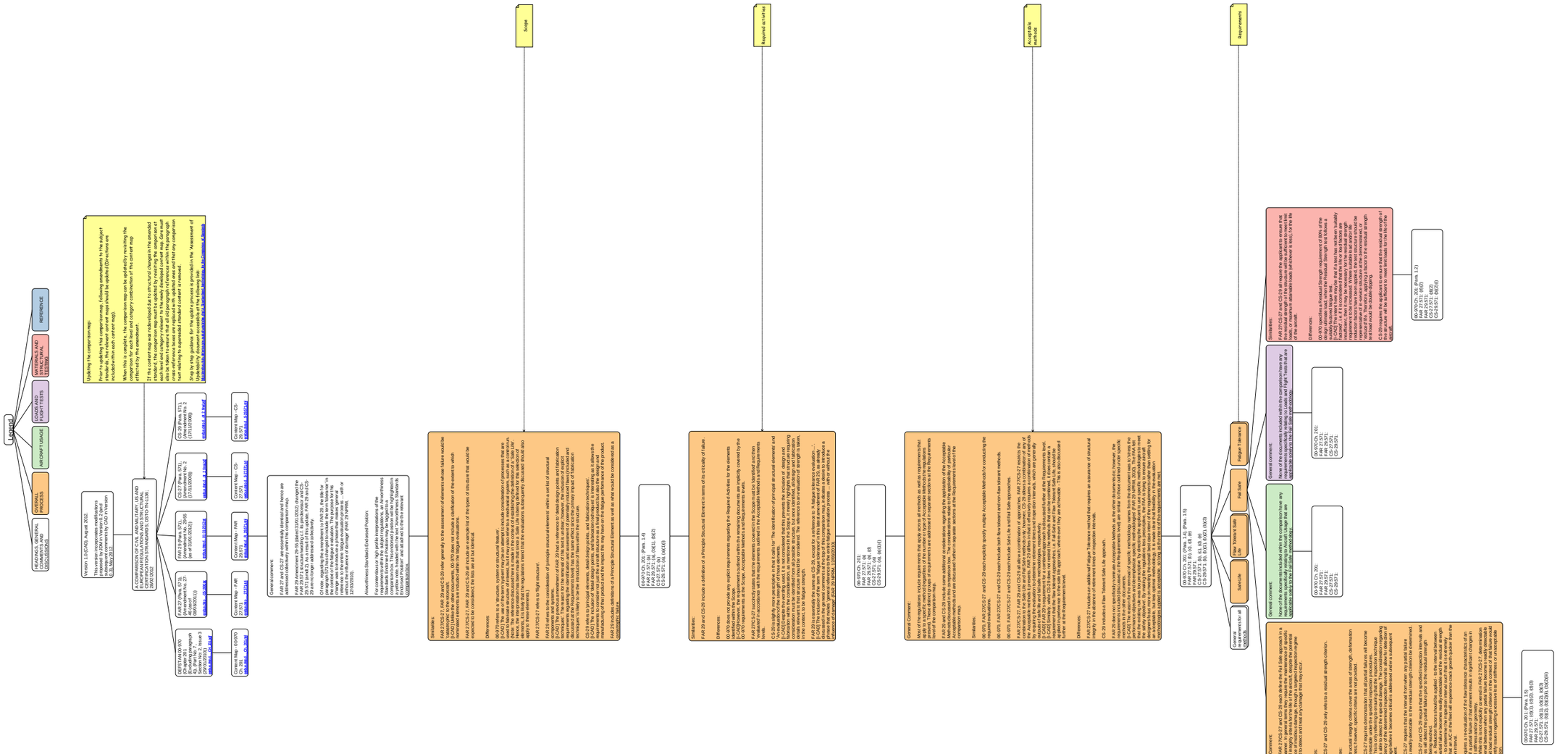

Figure D1: Helicopter Standards Comparison - Regulations comparison map

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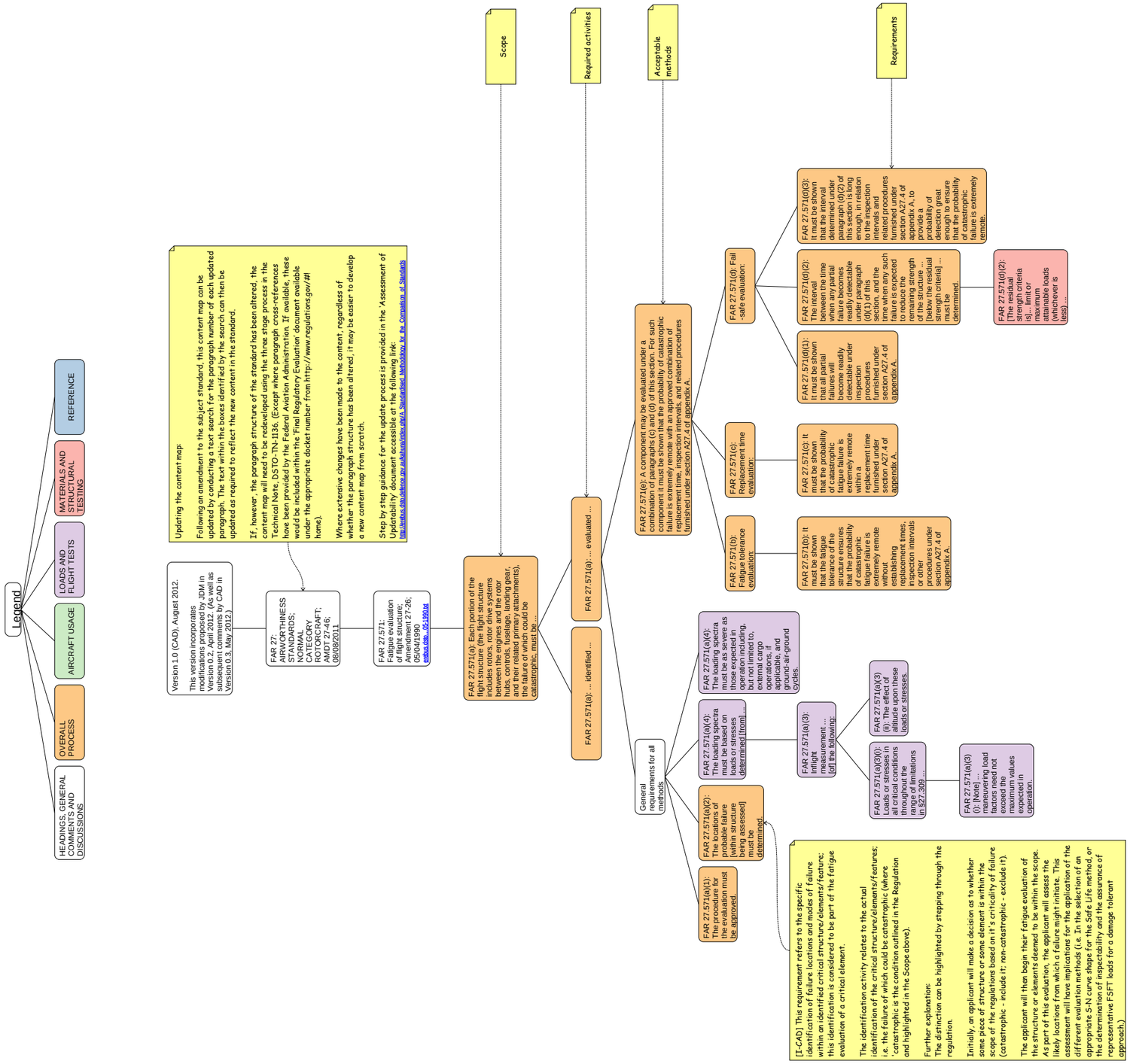

Figure D2: Helicopter Standards Comparison - [FAR 27 content map]

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19. ABSTRACT

A comparison of a range of civil and military, United States and European regulations and structural certification standards for the fatigue substantiation of rotary wing aircraft structure was conducted. The comparison utilised a graphical hierarchy-based methodology developed as an improvement on text-based and spreadsheet-based methodologies identified in a review of relevant literature. The result of the comparison activity was a thorough, updateable, user-friendly, interpretive and current comparison product that will be used to guide the Technical Airworthiness Authority and Defence Science and Technology Organisation researchers on the intent of the subject documents and the similarities and differences between them.