NOTICE OF PROPOSED AMENDMENT (NPA) No 05/2005

DRAFT DECISIONS OF THE EXECUTIVE DIRECTOR,

AMENDING

DECISION NO. 2003/7/RM OF THE EXECUTIVE DIRECTOR,

of 24 October 2003 ON

Certification Specifications, including airworthiness codes and acceptable means of compliance, for propellers (« CS-P »)

And

AMENDING

DECISION NO 2003/11/RM OF THE EXECUTIVE DIRECTOR,

of 5 November 2003 ON

Definitions and abbreviations used in certification specifications for products, parts and appliances (« CS-Definitions »)

Major Revision to CS-P.

TABLE OF CONTENTS.

A. Explanatory Note

I. General

1. The purpose of this Notice of Proposed Amendment (NPA) is to envisage amending Decision 2003/7/RM of the Executive Director, of 24 October 2003 on Certification Specifications, including airworthiness codes and acceptable means of compliance, for propellers (« CS-P ») and Decision 2003/11/RM of the Executive Director, of 5 November 2003 on Definitions and abbreviations used in certification specifications for products, parts and appliances (« CS-Definitions »)
The scope of this rulemaking activity is outlined in TOR Nr: CS-P/001 and is described in more detail below.

2. The Agency is directly involved in the rule-shaping process. It assists the Commission in its executive tasks by preparing draft regulations, and amendments thereof, for the implementation of the Basic Regulation[1] which are adopted as "Opinions" (Article 14.1). It also adopts Certification Specifications, including Airworthiness Codes and Acceptable Means of Compliance and Guidance Material to be used in the certification process (Article 14.2).

3. This rulemaking activity is included in the Agency's rulemaking programme for 2005. It implements the rulemaking task P.001 Major Revision to CS-P.

4. The text of this NPA was developed by the JAA Engine Steering Group (ESG). It was adapted to the EASA regulatory context by the Agency. It is now submitted for consultation of all interested parties in accordance with Article 5(3) of the EASA rulemaking procedure[2].

[1] Regulation (EC) No 1592/2002. OJ L 240, 7.9.2002, p.1.

[2] Decision of the Management Board concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ("rulemaking procedure"), EASA MB/7/03, 27.6.2003.

II. Consultation

5. To achieve optimal consultation, the Agency is publishing the draft decision on its internet site in order to reach its widest audience and collect the related comments. Because the content of this NPA was already agreed for adoption in the Joint Aviation Authorities (JAA) system and was the subject of a full worldwide consultation, the transitional arrangements of article 15 of the EASA rulemaking procedure apply. They allow for a shorter consultation period of six weeks in stead off the standard three months and also exempt from the requirement to produce a full Regulatory Impact Assessment.
   Comments on this proposal may be forwarded *(preferably by e-mail)*, using the attached comment form, to:

   By e-mail: **NPA@easa.eu.int**

   By correspondence: Process Support Department
   Rulemaking Directorate
   EASA
   Ref: NPA 5-2005
   Postfach 10 12 53
   D-50452 Köln
   Germany
   Fax: +49(221) 89990 5508

   Comments should be received by the Agency **before 27-07-2005**. If received after this deadline they might not be treated. Comments may not be considered if the form provided for this purpose is not used.

III. Comment response document

6. All comments received will be responded to and incorporated in a Comment Response Document (CRD). This will contain a list of all persons and/or organisations that have provided comments. The CRD will be widely available ultimately before the Agency adopts its final decision.

IV. Detailed descripion of the Draft decision.

Certifications Specifications for propellers (CS-P)

In Book 1 „SUBPART A GENERAL“, for implementation reasons specific propeller definitions are added into CS-P to assure its correct interpretation in accordance with JAA NPA P-5. (implementation issue)

In Book 1 „SUBPART A GENERAL“, CS-P 40 is amended in accordance with JAA NPA P-9.

In Book 1 „SUBPART B-DESIGN AND CONSTRUCTION“, CS-P 150 and CS-P 160 are amended in accordance with JAA NPA-9.

In Book 1 „SUBPART B-DESIGN AND CONSTRUCTION“, CS-P 230 for safety reasons new fire resistance specifications for propeller control system components which are located in a designated fire zone are introduced in accordance with JAA NPA P-8.

In Book 2 „SUBPART A GENERAL“, completely new AMC texts for AMC P10 and AMC P 30(a) are created in accordance with JAA NPA P-4.

In Book 2 „SUBPART B-DESIGN AND CONSTRUCTION“ completely new AMC texts for AMC P 150, AMC P 160, AMC P 170, AMC P 210, AMC P 220, AMC P 230, AMC P 240 are created in accordance with JAA NPA P-4 and JAA NPA P-6. The acceptable means of compliance and guidance for certification of Propeller Control Systems are based on the same principle as currently applied to Engine Control Systems. (improvement of certification process)

In Book 2 „SUBPART C-TYPE SUBSTANTIATION“ complete new AMC texts for AMC P 330, AMC P 360, AMC P 370, AMC P 380, AMC P 390, AMC P 400 and AMC P 420 are created in accordance with JAA NPA P-4.

In Book 2 „SUBPART D-PROPELLER VIBRATION AND FATIGUE EVALUATION“ complete new AMC texts for AMC P 530 and AMC P 550 are created in accordance with JAA NPA P-4.

Definitions and Abbreviations used in Certifications Specifications for products, parts and appliances (CS-Definitions).

Definitions for “Variable Pitch Propeller” and “Reversible Pitch Propeller” are both used in CS-P and CS-E, and are therefore added to CS-Definitions. For clarity the definition of “Variable Pitch Propeller” is amended in accordance with JAA NPA-P-5.

V. Regulatory Impact Assessment.

Changes in Book 1 are made for correct interpretation of paragraphs and have therefore no economic impact.
The economic impact of the addition of new fire resistance specifications for propeller control system components is negligible as this would typically be standard practice for propeller design organisations.
Introduction of AMC paragraphs in Book 2 has no adverse economic impact.

B. DRAFT DECISIONS.

The draft decision for each paragraph is identified as follows: text to be deleted is crossed out and the text to be added is in bold and underlined print.
** * * Indicates that remaining text is unchanged.*

B.1 Certification Specification for Propellers (CS-P)

The following amendments should be included in Decision No. 2003/7/RM of the Executive Director of the Agency of 24 October 2003:

Book 1,

SUBPART A – General.

CS-P 15 Terminology

(a) This issue of CS-P must be used ~~in conjunction with the issue of CS-Definitions current at the date of issue of this CS-P~~ **with the CS- Definitions version existing at the date of issue. In addition to definitions of CS-Definitions, in this CS-P the following terminology is applied.** Where used in CS-P, the terms defined in this paragraph and in CS-Definitions are identified by initial capital letters.

(b) General definitions

Adjustable-Pitch Propeller	**means a Propeller, the Pitch setting of which can be changed in the course of ordinary field maintenance, but which cannot be changed when the Propeller is rotating.**
Beta Control	**means a system whereby the Propeller blade angles are directly selected by the air crew, or by other means.(normally used during approach and ground handling).**
Feather	**means moving the blade angle to Feathered Pitch.**
Feathered Pitch	**means the Pitch setting which in flight with the engine stopped gives the minimum drag, and corresponds with a minimum windmilling torque.**
Flight Idle	**Typically, the lowest power lever and associated minimum blade Pitch position permitted in flight. (In-Flight Low Pitch Position.)**
In-Flight Low Pitch Position	**means the minimum Pitch permitted in flight.**
Maximum Propeller Over-torque	**means the transient maximum propeller torque demonstrated in CS-P 410**

Pitch — **means the Propeller blade angle, measured in a manner and at a radius declared by the manufacturer and specified in the appropriate Propeller Manual.**

Pitch Control System — **means the components of the Propeller system that functions to control Pitch position, including but not limited to governors, Pitch change assemblies, Pitch locks, mechanical stops and Feathering system components.**

Propeller System — **means the Propeller plus all the components necessary for its functioning, but not necessarily included in the Propeller type design.**

Reverse Pitch — **means the Propeller blade angle used for producing reverse thrust with a Propeller. Typically this is any blade angle below ground idle blade angle.**

CS-P 40 Instructions for Continued Airworthiness

* * *

(b) The instructions for continued airworthiness must contain a section titled airworthiness limitations that is segregated and clearly distinguishable from the rest of the document(s). This section must set forth each mandatory replacement time, inspection interval and related procedure required for type certification. **For Propeller Critical Parts, this section must also include any mandatory action or limitation for in-service maintenance and repair identified in the Service Management Plan, as required under CS-P 160(c).**

* * *

SUBPART B - DESIGN AND CONSTRUCTION.

CS-P 150 Propeller Safety Analysis.

(a) (1) An analysis of the Propeller must be carried out to assess the ~~effects~~ **likely consequence** of each failure condition under stated aircraft operating and environmental conditions. This analysis will consider -

(2) A summary must be made of those failures which could result in Major Propeller Effects or Hazardous Propeller Effects **as** defined in CS-P 150 (g), together with an estimate of the probability of occurrence of those effects. **Any Propeller Critical Part shall be clearly identified in this summary.**

(3) It must be shown that Hazardous Propeller Effects will not occur at a rate in excess of that defined as **E**xtremely **R**emote (~~probability less than~~ **1x**10^{-7} **or less** per Propeller flight hour). The estimated probability for individual failures may be insufficiently precise to enable the total rate for Hazardous Propeller Effects to be assessed. For Propeller certification, it is acceptable to consider that the intent of this paragraph is achieved if the probability of a Hazardous Propeller Effect arising from an individual failure can be predicted to be not greater than $1x10^{-8}$ per Propeller flight hour. It will also be accepted that, in dealing with probabilities of this low order of magnitude, absolute proof is not possible and reliance must be placed on engineering judgement and previous experience combined with sound design and test philosophies.

(4) It must be shown that Major Propeller Effects will not occur at a rate in excess of that defined as remote (~~probability less than~~ **1x**10^{-5} **or less** per Propeller flight hour).

* * *

(c) It is recognised that the probability of primary failures of certain single elements (for example,**hubs and** blades) cannot be sensibly estimated in numerical terms. If the failure of such elements is likely to result in Hazardous Propeller Effects, they will be identified as Propeller Critical Parts and reliance must be placed on meeting the prescribed integrity requirements of CS-P 160 **in order to support the objective of an extremely remote probability of failure.** These instances shall be stated in the safety analysis.

* * *

(e) If the acceptability of the safety analysis is dependent on one or more of the following, it shall be identified in the analysis and appropriately substantiated.

- (1) ~~Mandatory~~ Maintenance actions ~~required for certification or other maintenance action performed~~ **being carried out** at stated intervals. This includes the verification of the serviceability of items which could fail in a ~~latent~~ **dormant** manner. **When necessary for preventing the occurrence of Hazardous Propeller Effects at a rate in excess of Extremely Remote,** ~~These~~ **the** maintenance intervals must be published in ~~the appropriate manual(s)~~ **the Airworthiness Limitations Section of the Instructions for Continued Airworthiness required under CS-P 40.** ~~Additional,~~ If errors in maintenance of the Propeller ~~system~~**, including the control system,** could lead to Hazardous Propeller Effects, appropriate procedures must be included in the relevant Propeller manual(s).

(f) If applicable, the safety analysis shall include assessment of indicating equipment, manual and automatic controls, governors and Propeller control systems, synchrophasers, synchronisers, ~~and Propeller thrust reversal systems~~ **as applicable.**

*** * ***

CS-P160 Propeller Critical Parts Integrity

~~The Propeller Critical Parts must be identified under CS-P 150 (c) and their integrity must be established by the following disciplines:~~

~~(a) An engineering plan, the execution of which demonstrates that the combination of loads, material properties, environmental influences and conditions are sufficiently well-known or predictable by analysis, or test experience to allow the parts to be withdrawn from service at a life before hazardous failure can occur.~~

~~(b) A manufacturing and inspection plan which defines the method of manufacture –~~

- ~~(1) For producing all parts with the attributes assumed by the engineering plan of CS-P 160 (a).~~
- ~~(2) To enable the relevant manufacturing history to be traceable.~~
- ~~(3) To ensure that manufacturing changes will be controlled to prevent the assumed attributes being degraded.~~

~~(c) The manufacturer must demonstrate that adequate procedures are adopted to ensure the necessary control of the engineering and manufacturing functions associated with the production of Propeller Critical Parts.~~

~~(d) The manufacturing processes, maintenance in service and overhaul of Propeller Critical Parts must be such as to ensure that they have characteristics essentially similar to those on which the certification of the design was based, and must be associated with specified acceptance standards and non-destructive inspection.~~

The integrity of the Propeller Critical Parts identified under CS-P 150 must be established by:

(a) An Engineering Plan, the execution of which establishes and maintains that the combinations of loads, material properties, environmental influences and operating conditions, including the effects of parts influencing these parameters, are sufficiently well known or predictable, byvalidated analysis, test or service experience, to allow Propeller Critical Parts to be withdrawn from service at an approved life limit before Hazardous Propeller Effects can occur. Any approved life limits must be published as required in CS-P 40(b)

(b) A Manufacturing Plan which identifies the specific manufacturing constraints necessary to consistently produce Propeller Critical Parts with the attributes required by the Engineering Plan.

(c) A Service Management Plan which defines in-service processes for maintenance and repair of Propeller Critical Parts which will maintain attributes consistent with those required by the Engineering Plan. These processes shall become part of the Instructions for Continued Airworthiness as required by CS-P 40.

CS-P230 Propeller Control System

*** * ***

(f) Propeller control system components which are located in a designated fire zone must be at least Fire Resistant.

Book 2

The following is a complete set of new AMCs to CS-P. For reasons of readability the text is ***not*** *highlighted in bold and underlined print.*

SUBPART A – General.

AMC P 10
Applicability

(1) If included as part of the Type Design then the structural integrity and functionality of the Propeller de-icing equipment is approved during Propeller certification to this CS-P.

The Propeller type certification does not approve de-icing equipment ice protection performance. Aircraft icing capability is demonstrated on the aircraft in accordance with applicable aircraft airworthiness requirements.

(2) If approval is granted after compliance has been shown with subparts A, B and C of CS-P, the Propeller Type Certificate Data Sheet will include the following statement;

"This propeller has been certificated in accordance with CS-P subparts A,B and C. Compliance with the requirements of Subpart D, which is specific to each aircraft installation, has not yet been demonstrated."

AMC P 30(a)
Instructions for Propeller Installation and Operation

(1) The installation manual should include control system characteristics, and define operation in primary and all alternate operational modes. If there is any change in operating characteristics in transition between modes or in backup modes, then these should also be described.

(2) Typical contents of an installation manual for a constant speed, Feathering, and reversing Propeller are as follows:

Drawings - List of top level Propeller drawing titles and numbers.

Propeller type data and description

Components and accessories

Propeller System description

Control system description.

Propeller properties and limitations

- Diameter
- Number of blades
- Power and rpm limits
- Torque limits
- Over-speed and over-torque limits
- Propeller shaft loads
- Propeller system mounting instructions and bolt torques
- Propeller balance
- Vibration environment.
- Altitude versus ambient temperature limitations
- Ground de-icing limitations

Propeller system component weights

- Moments of inertia
- Centre of gravity
- List weights

Pitch change

- Settings
- Pitch change rate
- Beta sensor position
- Limits on intended movement below the In-Flight Low-Pitch-Position
- Feathering limitations and minimum declared temperature

Recommended operating procedures including:

- Ground operation
  - Starting
  - Propeller brake operating
  - Over-speed governor check
  - Secondary low Pitch stop check
  - Limitations and restrictions.
- De-icing operation
- Flight operation
- Emergency operations
- Fault detection, isolation and accommodation
- Time limited dispatch requirements

Ice protection system - System description

Electrical - System description

- Power requirements
- Loss of aircraft electrical power effects
- EMI/Lightning protection
- System description
- Qualification results
- Limitations

Actuation and lubrication system

- Actuating fluids
- Propeller pump fluid requirements
- Fluid filtration
- Lubricating fluid
- Auxiliary motor and pump

Assumptions

- Safety Analysis
- Design
- Operation

SUBPART B – DESIGN AND CONSTRUCTION.

AMC P 150
Propeller Safety Analysis

(1) Description of terminology associated with Propeller Safety Analysis AMC P150:

(a) Dormant Failure.	A failure the effect of which is not detected for a given period of time.
(b) Failure Condition.	A condition with direct, consequential Propeller-level effect, caused or contributed to by one or more failures.
(c) Failure Mode.	The mechanism of the failure or the manner in which an item or function can fail.

(2) Introduction.

This AMC describes acceptable means, but not the only means, for demonstrating compliance with the requirements of CS-P 150.

Compliance with CS-P 150 requires a safety analysis, which should be substantiated when necessary, by appropriate testing and/or comparable service experience.

The depth and scope of an acceptable safety analysis depend on the complexity and criticality of the functions performed by the systems, components or assemblies under consideration, the severity of related failure conditions, the uniqueness of the design and extent of relevant service experience, the number and complexity of the identified failures, and the detectability of contributing failures.

Examples of methodologies are Fault Tree Analysis (FTA), Failure Mode and Effects Analysis (FMEA) and Markov Analysis.

(3) Objective.

The ultimate objective of a safety analysis is to ensure that the risk to the aircraft from all Propeller failure conditions is acceptably low. The basis is the concept that an acceptable overall Propeller design risk is achievable by managing the individual major and hazardous Propeller risks to acceptable levels. This concept emphasises reducing the likelihood or probability of an event proportionally with the severity of its effects. The safety analysis should support the Propeller design goals such that there would not be Major or Hazardous Propeller Effects that exceed the required probability of occurrence as a result of Propeller failure modes. The analysis should consider the full range of expected operations.

(4) Specific guidance.

(a) Classification of effects of Propeller failures.

Aircraft-level failure classifications are not directly applicable to the Propeller safety analysis since the aircraft may have features that could reduce or increase the consequences of a Propeller failure condition. Additionally, the same type-certificated Propeller may be used in a variety of installations, each with different aircraft-level failure classifications. Accordingly the classification of the consequences of Propeller failures should only be based on assumptions for a typical Propeller/Engine/aircraft combination in the absence of actual safety classifications from the Aircraft and Engine manufacturers.

CS-P 150 defines the Propeller-level failure conditions and presumed severity levels.

Since aircraft-level requirements for individual failure conditions may be more severe than the Propeller-level requirements, there should be early co-ordination between the Propeller manufacturer, engine manufacturer and the aircraft manufacturer to ensure Propeller, Engine and aircraft compatibility.

(b) Component Level Safety Analysis.

In showing compliance with CS-P 150 (a), a component level safety analysis may be an auditable part of the design process or may be conducted specifically for demonstration of compliance with this rule.

The specific requirements of CS-P 230 for the Propeller control system should be integrated into the overall Propeller safety analysis.

(c) Typical installation

The reference to "typical installation" in CS-P 150 (a)(1)(i) does not imply that the aircraft-level effects are known, but that assumptions of typical aircraft devices and procedures, such as governors, annunciation devices, etc., are clearly stated in the analysis.

CS-P 150 (f) requires the applicant to include in the Propeller safety analysis consideration of some aircraft components.

It is recognised that, when showing compliance with CS-P 150 (a)(3) and (4) for some Propeller effects, the applicant may not be in a position to determine the detailed failure sequence, the rate of occurrence or the dormancy period of such failures of the aircraft components.

In such cases, for Propeller certification, the applicant will assume a failure rate for these aircraft components. Compliance with CS-P 150 (d) requires the Propeller manufacturer to provide, in the installation instructions, the list of failures of aircraft components that may result in or contribute to Hazardous or Major Propeller Effects. The mode of propagation to this effect should be described and the assumed failure rates should be stated.
During the aircraft certification, the Propeller effect will be considered in the context of the whole aircraft. Account will be taken of the actual aircraft component failure rate.

Such assumptions should be addressed in compliance with CS-P 30.

(d) Hazardous Propeller Effects

(i) The acceptable occurrence rate of Hazardous Propeller Effects applies to each individual effect. It will be accepted that, in dealing with probabilities of this low order of magnitude, absolute proof is not possible and reliance should be placed on engineering judgement and previous experience combined with sound design and test philosophies.

The probability target of not greater than 10^{-7} per Propeller flight hour for each Hazardous Propeller Effect applies to the summation of the probabilities of this Hazardous Propeller Effect arising from individual failure modes or combinations of failure modes other than the failure of Critical Parts (for example; hubs, blades). For example, the total rate of occurrence of excessive drag, obtained by adding up the individual failure modes and combination of failure modes leading to an excessive drag, should not exceed 10^{-7} per Propeller flight hour. The possible dormant period of failures should be included in the calculations of failure rates.

If each individual failure is less than 10^{-8} per Propeller flight hour then summation is not required.

(ii) When considering primary failures of certain single elements such as Propeller Critical Parts, the numerical failure rate cannot be sensibly estimated. If the failure of such elements is likely to result in Hazardous Propeller Effects, reliance should be placed on their meeting the prescribed integrity requirements, of CS-P 160. These requirements are considered to support a design goal that failure of the component should be Extremely Remote throughout its operational life. There is no requirement to include the estimated primary failure rates of such single elements in the summation of failures for each Hazardous Propeller Effect due to the difficulty in producing and substantiating such an estimate.

Not all the effects listed in CS-P 150(g)(1) may be applicable to all Propellers or installations, owing to different design features, and the list is not intended to be exhaustive.

(e) Major Propeller Effects

Compliance with CS-P 150 (a)(4) can be shown if the individual failures or combinations of failures resulting in Major Propeller Effects have probabilities not greater than 10^{-5} per Propeller flight hour. No summation of probabilities of failure modes resulting in the same Major Propeller Effect is required to show compliance with this rule.

Major Propeller Effects are likely to significantly increase crew workload, or reduce the safety margins. Not all the effects listed in CS-P 150(g)(2) may be applicable to all Propellers or installations, owing to different design features, and the list is not intended to be exhaustive.

(g) Determination of the effect of a failure.

Prediction of the likely progression of some Propeller failures may rely extensively upon engineering judgement and may not be proved absolutely. If there is some question over the validity of such engineering judgement, to the extent that the conclusions of the analysis could be invalid, additional substantiation may be required. Additional substantiation may consist of reference to Propeller test, rig test, component test, material test, engineering analysis, previous relevant service experience, or a combination thereof. If significant doubt exists over the validity of the substantiation so provided, additional testing or other validation may be required under CS-P 150 (b).

(h) Reliance on maintenance actions.

For compliance with CS-P 150 (e)(1) it is acceptable to have general statements in the analysis summary that refer to regular maintenance in a shop as well as on the line. If specific failure rates rely on special or unique maintenance checks, those should be explicitly stated in the analysis.

In showing compliance with the maintenance error element of CS-P 150 (e)(1), the Propeller maintenance manual, overhaul manual, or other relevant manuals may serve as the appropriate substantiation. A listing of all possible incorrect maintenance actions is not required in showing compliance with CS-P 150 (e)(1).

Maintenance errors have contributed to hazardous or catastrophic effects at the aircraft level. Events may arise due to similar incorrect maintenance actions being performed on multiple Propellers during the same maintenance availability by one maintenance crew, and are thus primarily an aircraft-level concern. Nevertheless, precautions should be taken in the Propeller design to minimise the likelihood of maintenance errors. However, completely eliminating sources of maintenance error during design is not possible; therefore, consideration should also be given to mitigating the effects in the Propeller design.

If appropriate, consideration should be given to communicating strategies against performing concurrent maintenance of Propellers on multi-engine aircraft.

Components undergoing frequent maintenance should be designed to facilitate the maintenance and correct re-assembly.

In showing compliance with CS-P 150 (e)(2), it is expected that, wherever specific failure rates rely on special or unique maintenance checks for protective devices, those should be explicitly stated in the analysis.

(5) Analytical techniques.

This paragraph describes various techniques for performing a safety analysis. Other comparable techniques exist and may be used. Variations and/or combinations of these techniques are also acceptable. For derivative Propellers, it is acceptable to limit the scope of the analysis to modified components or operating conditions and their effects on the rest of the Propeller.

Various methods for assessing the causes, severity levels, and likelihood of potential failure conditions are available to support experienced engineering judgement. The various types of analyses are based on either inductive or deductive approaches. Brief descriptions of typical methods are provided below. More detailed descriptions of analytical techniques may be found in the documents referenced in paragraph (5) of this AMC.

- Failure Modes and Effects Analysis. This is a structured, inductive, bottom-up analysis which is used to evaluate the effects on the Propeller of each possible element or component failure. When properly formatted, it will aid in identifying latent failures and the possible causes of each failure mode.

- Fault tree or Dependence Diagram (Reliability Block Diagram) Analyses. These are structured, deductive, top-down analyses which are used to identify the conditions, failures, and events that would cause each defined failure condition. They are graphical methods for identifying the logical relationship between each particular failure condition and the primary element or component failures, other events, or their combinations that can cause the failure condition. A Fault Tree Analysis is failure oriented, and is conducted from the perspective of which failures should occur to cause a defined failure condition. A Dependence Diagram Analysis is success-oriented, and is conducted from the, perspective of which failures should not occur to preclude a defined failure condition.

AMC P 160
Propeller Critical Parts

(1) The following terminology descriptions apply to CS-P 160 and this AMC P 160:

Approved Life Limit means the mandatory replacement life of a part which is approved by the Agency.
Attributes means inherent characteristics of a finished part that determine its capability.
Propeller Critical Part means a part that relies upon meeting prescribed integrity requirements to avoid primary failure, which is likely to result in a Hazardous Propeller Effect.
Propeller Flight Cycle means the flight profile or combination of profiles, upon which the approved life limit is based.
Engineering Plan As defined in CS-P 160.
Manufacturing Plan As defined in CS-P 160.
Primary failure means a failure of a part which is not the result of the prior failure of another part or system.
Service Management Plan As defined in CS-P 160.

(2) Introduction

Because the failure of a Propeller Critical Part is likely to result in a Hazardous Propeller Effect, it is necessary to take precautions to avoid the occurrence of failures of such parts. Under CS-P 150 (c), they are required to meet prescribed integrity requirements.

For that purpose, an Engineering Plan, a Manufacturing Plan and a Service Management Plan are required under CS-P 160. These three plans define a closed-loop system which link the assumptions made in the Engineering Plan to how the part is manufactured and maintained in service; the latter two aspects are controlled by the Manufacturing and Service Management Plans respectively. These plans may generate limitations which are published in the Airworthiness Limitation Section of the Instruction for Continued Airworthiness. This AMC provides guidance for the establishment of such plans.

(3) General

(a) Identification of Propeller Critical Parts

The safety analysis required under CS-P 150 identifies Propeller Critical Parts that are required to comply with CS-P 160. A Propeller Critical Part is a Critical Part, by definition, with regard to compliance with Part-21.

If a part is made of various sub-parts, which are finally integrated in an inseparable manner into a unique part, and any one of the sub-parts is identified as a Propeller Critical Part, the entire part is then treated as a Propeller Critical Part.

(b) Attributes of a part

'Attributes' include, but are not limited to, material mechanical properties, material microstructure, material anomalies, residual stress, surface condition, and geometric tolerances. Processes such as forging, casting, machining, welding, coating, shot peening, finishing, assembly, inspection, storage, repair, maintenance and handling may influence the attributes of the finished part. Environmental conditions experienced in service may also affect the attributes.

(c) Content of a plan

The Engineering Plan, Manufacturing Plan and Service Management Plan should provide clear and unambiguous information for the management of the Propeller Critical Parts.

'Plan', in the context of this rule, does not necessarily mean having all technical information contained in a single document. If the relevant information exists elsewhere, the plan may make reference to drawings, material specifications, process specifications, manuals, etc., as appropriate. It should be noted that these references should be clear enough to uniquely identify the referenced document. The plan should allow the history of the individual part number to be traced.

(4) Guidance for defining an Engineering Plan

(a) Elements of an Engineering Plan

An Engineering Plan should address the following subjects:

- Analytical and empirical engineering processes applied to determine the approved life limit.
- Structured component and Propeller testing conducted to confirm Propeller operating conditions and to enhance confidence in the approved life limit.
- Establishment of the attributes to be provided and maintained for the manufacture and service management of Propeller Critical Parts.
- Development and certification testing, and service experience required to validate the adequacy of the design and approved life limits. Any in-service inspections identified as critical elements to the overall part integrity, should be incorporated into the Service Management Plan.

(b) Establishment of the Approved Life

It is possible that the final life calculated may be in excess of that considered likely for the associated airframe application. However, the life, in terms of cycles or hours as appropriate, should still be recorded in the Airworthiness Limitations Section in order that the usage of the part may be properly tracked.

The major elements of the analysis are:
(i) Operating conditions.

For the purposes of certification, an appropriate flight profile or combination of profiles and the expected range of ambient conditions and operational variations will determine the predicted service environment.

The appropriateness of the Propeller Flight Cycle should be validated and maintained over the lifetime of the design. The extent of the validation is dependant upon the approach taken in the development of the Propeller Flight Cycle.

(ii) Stress analysis.

The stress determination is used to identify the limiting locations such as bores, holes, changes in section, welds or attachment slots, and the limiting loading conditions. Analytical and empirical Engineering processes are applied to determine the stress distribution for each part. All methods of stress analysis should be validated by experimental measurements.

(iii) Life analysis

The fatigue life prediction method is based upon test data obtained from cyclic testing of representative laboratory, sub-component, or specific component specimens and should account for the manufacturing processes that affect fatigue capability, including fabrication from production grade material. The fatigue life prediction method should also account for environmental effects, such as vibration and corrosion, and cumulative damage.

When the fatigue life is based on cyclic testing of specific parts, the test results should be corrected for inherent fatigue scatter. The factors used to account for scatter should be justified.

(5) Guidance for Defining a Manufacturing Plan

(a) Introduction

The Manufacturing Plan is a portion of the overall integrity process intended to ensure the life capability of the part. The Engineering Plan includes assumptions about how Propeller Critical Parts are designed, manufactured, operated and maintained: each can have an impact on the part life capability. Therefore, it is essential to ensure that the attributes required by the Engineering Plan are maintained.

(b) Elements of a Manufacturing Plan

The part specific Manufacturing Plan should consider the attributes of the part delivered by the manufacturing process from raw material to finished part and should highlight all sensitive parameters identified as being significant with regard to part life which should not be changed without proper verification.

(c) Development and Verification of the Manufacturing Plan

The Manufacturing Plan should be reviewed and verified by the appropriate key Engineering and Manufacturing skills, which may include:

- Engineering
- Material Engineering
- Non-Destructive Inspection
- Quality Assurance
- Manufacturing Engineering

Hence, this same skill mix should evaluate and approve process validation and the procedures for manufacturing change control and non-conformance disposition to ensure that the product of manufacturing is consistent with the design assumptions of the Engineering Plan.

The level of detail in the Plan may vary depending on the specific process step being considered, the sensitivity of the particular process step, and the level of control required to achieve the required life capability.

(6) Guidance for defining a Service Management Plan.

(a) Introduction

The Service Management Plan forms part of the overall process intended to maintain the integrity of Propeller Critical Parts throughout their service life. The Engineering Plan includes assumptions about the way in which the Propeller Critical Parts are manufactured, operated and maintained: each can have an impact on the life capability of the part. Therefore, it is essential to ensure that these assumptions remain valid. The Service Management Plan conveys the processes for in-service repair and maintenance to remain consistent with the assumptions made in the Engineering Plan.

(b) Determining the acceptability of repair and maintenance processes

Repair and maintenance processes should be reviewed by the appropriate key Engineering and Product Support skills, which may include:

- Engineering
- Material Engineering
- Non-Destructive Inspection
- Quality Assurance
- Product Support Engineering
- Repair Development Engineering

The role of this cross-functional review is consistent with that laid out for the Manufacturing Plan.

(7) Airworthiness Limitations Section

To ensure a closed-loop between the in-service parts and the Engineering Plan, the importance of the limits to the repair and maintenance of Propeller Critical Parts should be highlighted in the Propeller manuals required by CS-P 40. Further, since inappropriate repair or maintenance could impact the integrity of the part in a hazardous manner, visibility should be provided through the Airworthiness Limitations Section (ALS) of Instructions for Continued Airworthiness. Wording as, or similar to, that shown below should be placed in the appropriate section of the ALS.

"The following airworthiness limitations have been substantiated based on Engineering analysis that assumes this product will be operated and maintained using the procedures and inspections provided in the Instructions for Continued Airworthiness supplied with this product by the Type Certificate holder, or its licensees. For Propeller Critical Parts and parts that influence Propeller Critical Parts, any repair, modification or maintenance procedures not approved by the Type Certificate holder, or its licensees, or any substitution of such parts not supplied by the Type Certificate holder, or its licensees, may materially affect these limits."

AMC P 170
Materials and Manufacturing Methods

(1) Metallic Materials and Processes for Propellers. The metallic materials used in Propeller production and the fabrication processes employed should be established on the basis of experience and/or tests. Related procedures should adhere to the following guidelines.

(a) Material selection. Selected materials should be suitable for their intended mechanical and/or physical function and be resistant to degradation by corrosion and by the environment to be encountered in the specific application. When the use of inherently resistant materials is not practical, the use of adequate coating systems should be considered. Alloy-temper combinations that are susceptible to stress corrosion cracking (SCC) should be avoided. Coatings may delay, but not prevent, the onset of SCC. Designs that involve active galvanic coupling of dissimilar metals/alloys should be avoided as much as possible. When such coupling becomes the logical design choice, the use of coatings, films or sealants should be considered.

(b) Specifications. Materials should be procured to adequately detailed specifications. Such specifications should be acceptable to the Agency, either specifically, or by having been prepared by an organisation which the Agency accepts as having the necessary credentials to do so. The detail of the specification should be related to the criticality of the application.

(c) Design values. The assumed design values of properties of materials should be suitably related to the most adverse properties stated in the material specification.

(d) Process Specifications. Manufacturing processes should be performed according to detailed process specifications. Such specifications should be acceptable to the Agency.

(e) Special Manufacturing Methods. Casting, forging, welding and brazing require additional precautions not ordinarily applicable to manufacture from mill products (bar, sheet, plate and the like). The following should be observed:

(i) Classification: Materials requiring special manufacturing methods should be classified according to their functional criticality. This classification becomes the basis for establishing the non-destructive inspection and testing requirements to be listed on the drawing.

(ii) Testing: Materials requiring special manufacturing methods should have provisions for testing the material. A reasonable plan for testing should be developed for these materials. The purpose of the test material would be to verify mechanical properties, microstructure and the like.

(iii) Inspection. Materials requiring special manufacturing methods should be subjected to a suitable non-destructive and destructive inspection process at an appropriate stage and with an appropriate sampling rate.

(2) Castings. The practices contained in this AMC are acceptable to the Agency as one means of complying with the Requirements of CS-P 170 with respect to castings.

(a) The means of maintaining the required quality of all castings should be established by such methods as analysis for correct chemical composition, tests of mechanical properties, microscopic examination, break-up examination, strength tests, radiographic examination, etc. While other forms of examination may be adequate for most parts of castings, radiographic examination, where practicable, should be carried out on the more highly stressed portions in order to establish that the foundry technique is satisfactory.

(b) When radiographic examination is called for, this should be continued until a satisfactory standard of quality has been established.

(c) All castings should be subjected to a suitable flaw-detection process. Such processes should be completed subsequent to any heat treatment.

(d) The drawings of each casting should contain information sufficient to identify the relevant means of manufacture and quality control, either by detailing the necessary information, or quoting the relevant documents. Where necessary, areas of high stress should be identified, but this may be done by a separate drawing.

(3) Forgings. The practices contained in this AMC are acceptable to the Agency as one means of complying with the requirements of CS-P 170 with respect to forgings.

(a) Forgings should be classified as Class 1, Class 2 or Class 3 parts in accordance with the following:

- Class 1. Those parts, the failure of which could cause a Hazardous Propeller Effect;
- Class 2. Stressed parts not covered by the terms of Class 1; or

- Class 3. Unstressed or only lightly stressed parts, not covered by the terms of Class 1.

(b) The means of maintaining the required quality of all forgings should be established by such methods as analysis for correct chemical composition, tests of mechanical properties, microscopic examination, fracture examination, strength tests, radiographic examination, etc.

(c) On the drawings of Class 1 parts, the direction of grain required should be indicated clearly in a manner which will ensure that it is brought to the notice of the person responsible for deciding the forging technique to be adopted. The agreed material properties required should also be identified.

(d) All forgings should be subjected to a suitable crack-detection process at an appropriate stage. Additional crack-detection tests should be made after any subsequent heat treatment has been completed. Where the level and location of residual stresses in forged Critical Parts could be significant in relation to the intended loads, and cannot be assessed by experience on similar designs using similar materials and forging methods, sufficient physical tests should be carried out to give adequate assurance of the level of residual stress likely to be present and of freedom from unacceptable variability.

(e) When radiographic or ultrasonic examination is called for, this should be continued until a satisfactory standard of quality has been established.

(f) The drawings of each forging should contain information sufficient to identify the relevant means of manufacture (e.g. the optimum fabrication method and sequence to obtain the desired level of residual stress and the correct grain flow in the finished forgings) and quality control either by detailing the necessary information or quoting the relevant process control documents.

(g) The strength of forgings classified as Class 1 or Class 2 parts should be proved to be satisfactory by calculation, by test, or comparison with a forging of similar design already proved to be satisfactory.

(h) Tests

- Each Class 1 and Class 2 forging should normally incorporate one or more projections which, after heat treatment of the forging, can be used as test piece(s) to establish that the material qualities of the forging are satisfactory.
- The location(s) and dimensions of the test piece(s) should be decided in consultation with the forging manufacturer
- In cases where the incorporation of test pieces is impractical, or would adversely affect the design, the drawing should indicate that such test pieces are not required. In such cases a suitable technique of sample testing should be agreed.

(4) Welded Structures and Welded Components. The practices contained in this AMC are acceptable to the Agency as one means of complying with the requirements of CS-P 170 with respect to welded structures.

(a) Fusion and resistance welds should be classified in accordance with the following:

- Group 1. Those welds the failure or leakage of which could cause a Hazardous Propeller Effect;
- Group 2. Highly stressed welds the failure or leakage of which would not cause a Hazardous Propeller Effect; or
- Group 3. All other welds.

(b) The necessary means of maintaining the required quality of all welded structures and components should be established. This may involve the verification of correct application of the approved preparatory and welding techniques, by destructive and non-destructive inspection of representative test specimens, at prescribed intervals during weld production, visual inspection of each weld produced, and pressure testing of welds, where applicable, etc.

(c) All welds should be subjected to a suitable crack-detection process at an appropriate stage. Additional crack-detection tests should be made after any subsequent heat treatment has been completed.

(d) When radiographic examination is called for this should be continued until a satisfactory standard of quality has been established.

(e) The drawings of each welded structure or component should contain information sufficient to identify the relevant means of welding to be used and the quality control method either by detailing the necessary information or quoting the relevant documents.

AMC P 210
Variable and Reversible Pitch Propellers.

Intended travel accounts for backlash, tolerances, secondary stop, etc. For example, a hydraulic failure of a dual acting Propeller system with Pitch lock operating at the In-Flight Low-Pitch Positions could permit a small decrease in blade angle due to system backlash. The Pitch lock may require a small blade angle change before it engages. This value is documented in the Instructions for Propeller Installation and Operation.

AMC P 220
Feathering Propellers.

(1) Emergency conditions in flight are those flight conditions outside of normal operation but not beyond the operational envelope of the aeroplane. Flights speeds above Vne and below the stall warning speed are outside of the range of emergency conditions.

(2) The Feathering and unfeathering characteristics and limitations may include parameters such as the Feather angle, rate of Pitch change, and airspeed limits above which the Propeller may not Feather completely or Feather at a slower rate. These should be listed in the Instructions for Propeller Installation and Operation.

(3) Evaluation at the minimum declared outside temperature may be verified in a cold chamber or by flight test. If a maximum diversion time has been established for the aeroplane installation this would be appropriate to use as the time for stabilisation to a steady state temperature.

AMC P 230
Propeller Control System

(1) Applicability

CS-P 230 is applicable to all types of Propeller Control Systems. For instance, these might be hydro-mechanical or hydro-mechanical with a limited authority electronic supervisor or single channel full authority Propeller control with hydro-mechanical back-up or dual channel full authority Electronic Propeller Control System with no back-up or any other combination. The electronic technology may be analogue or digital.

The Propeller Control System includes any system or device that controls, limits or monitors Propeller operation and is necessary for continued airworthiness of the Propeller. This includes all equipment that is necessary for controlling the Propeller and ensuring safe operation of the Propeller within its limits as specified in CS-P 50 . This implies consideration of all Propeller Control System components including the electronic control unit(s), pitch control unit(s), overspeed governor(s), feather pump, cables, wires, sensors, etc.

These requirements cover the main Propeller Control System as well as protection systems against, for example, over-speed or over-torque.

Propeller monitoring systems are covered by this requirement when they are physically or functionally integrated with the Propeller Control System or they perform functions that affect Propeller safety or are used to effect continued-operation or return-to-service decisions.

(2) Objective

The purpose of CS-P 230 is to set objectives for the general design and functioning of the Propeller Control System and these requirements are not intended to replace or supersede other requirements.

For electronic propeller control systems, AMC 20-1 provides additional and detailed interpretation of CS-P 230 with special consideration to interfaces with the aircraft, and the Engine when applicable.

(3) Integrity

The intent of CS-P 230 (c) is to establish propeller control system integrity requirements consistent with operational requirements of the various applications. In particular, the introduction of electronic propeller control systems should provide at least an equivalent level of safety and reliability for the Propeller as achieved by Propellers equipped with hydro-mechanical control and protection systems.

(4) Aircraft Supplied Power

Propeller Control Systems implemented in hydro-mechanical technology or technology other than electrical and electronic technology should inherently be compliant with CS-P 230 (e). However, if the system has functions implemented electrically or electronically that depend on aircraft-supplied electrical power, the system should be evaluated for compliance with this rule (see paragraph 13 of AMC 20-1 for relevant interpretation).

AMC P 240
Strength

Steady Loads – Acceptable Levels

(1) The acceptable levels for steady loads are expressed in terms of minimum factors for the resultant stresses when related to the proof stress of the material. Proof stress is based on 0.2% yield stress definition for metal components.

(2) The following factors apply to metal components.

(a) The hubs of Propellers with detachable blades should have proof factors of not less than 2.0 for tension and compression and an ultimate factor of not less than 3.0 in shear.

(b) Detachable Propeller blades should have a proof factor in tension and compression of not less than 2.0 for the root of the blade and of not less than 1.75 for the remainder of the blade. The shear stress ultimate factor should not be less than 3.0.

(c) Fixed Pitch Propellers should have a proof factor in tension and compression of not less than 2.0 except that the blade outboard of the innermost aerofoil section should have a factor of not less than 1.75. The shear stress ultimate factor should not be less than 3.0.

SUBPART C – TYPE SUBSTANTIATION.

AMC P 330
General.

Some tests may be run without automatic controls or safety systems. For example, a primary system may have to be disabled to test a backup system or a governing function may need to be disabled to test an overspeed condition.

AMC P 350
Centrifugal Load Tests

(1) The pass/fail criteria for these tests is that the Propeller completes the tests without evidence of:

(a) Failure. A failure would consist of the release of any component or debris. The fracture of a component without release would be a failure. Specifically, the separation of a composite blade bonded to a metallic retention would be a failure, even when the design has a backup system to prevent release of the blade.

(b) Malfunction. Elastic deformation of a hub that would prevent the blades from changing Pitch would be a malfunction.

(c) Permanent deformation is not acceptable.

(2) Hub, retention system and counter weight. (Guidance for CS-P 350(a))

(a) The maximum centrifugal load is based on the maximum rated rpm declared in the Type Certificate Data Sheet (TCDS). Transient overspeed events are not considered normal and do not constitute the maximum rpm to be used for establishing test conditions.

(b) The test may be conducted on an assembly, either by whirl testing or static testing, by applying the load to the assembled components to simulate the centrifugal load, as appropriate.

(c) This test does not have to include the complete blade. Stub blades, with weights to establish the correct centrifugal load during whirl tests, can be used. The stub blades should have the same blade retention as the full blade, to maintain similarity to the full blade retention.

(3) Blade Features. (Guidance for CS-P 350(b)) Blade features such as those associated with transitions from composite blade to the metallic retention can be tested during the hub and retention system test required by CS-P 350(a) or with a separate component test. There may be other applicable configurations, such as the transition associated with a configuration in which the blade of any material construction is bonded or otherwise attached to the portion of the blade that is retained in the hub.

(4) Propeller Components. Propeller components not requiring twice centrifugal load tests should be subjected to test or analysis equivalent to the centrifugal load resulting from 126% rotational speed (equivalent to 159% load at 100% speed) for a period of 30 minutes. These components may also be shown to be acceptable by similarity to existing components with applicable service history. Testing can involve whirl testing, static testing with the assembly or on a component or sub-component level. Analysis methods used to demonstrate compliance for these components should be accepted by the Agency.

(5) Additional Substantiation of Composite Blades, Spinners and Components attached to composite Blade features, such as those associated with transitions from composite blade to the metallic retention, can be tested during the hub and retention test required by CS-P 350 or with a separate component test. There may be other applicable configurations, such as the transition associated with a configuration in which the blade of any material construction is bonded or otherwise attached to the portion of the blade that is retained to the hub.

AMC P 360
Bird Impact

Compliance may be based on similarity and service history to existing Propeller installations, bird impact testing, or analysis combined with similarity and testing. Both static and rotating tests are acceptable. Both natural and artificial birds are acceptable for use in testing.

(1) Selection of critical operating conditions. The selection of critical operating conditions is based on an evaluation of the intended use of the Propeller, the operating conditions when the Propeller will most likely encounter bird populations, and the impact geometry of the Propeller. Typically, this condition occurs at takeoff and landing.

(2) Selection of impact site.

(a) Blade. The impact site should be chosen to produce maximum blade loads.

(b) Spinner. An impact site should be chosen that produces maximum loads. The site selected should show that the entire spinner would not separate.

(3) Selection of the bird. Natural birds or artificial birds may be used for testing. Artificial birds may be used if they conform to an international standard or are acceptable to the Agency.

(4) Static or rotating testing. Either static or rotating testing is acceptable. The objective is to simulate a bird strike in controlled manner to assess the resulting blade response and damage. When appropriate, blade hub, retention, and Pitch change hardware should be included as part of the static test set up for assessment of the effect of bird strike on these components.

(5) Damage evaluation. The evaluation for blades, including composite blades, typically includes a combination of:

- Visual examination
- Frequency response tests.
- Blade tap tests for delamination evaluation of composite components.
- Ultrasonic inspection for delamination and internal damage of composite components.
- X-ray inspection for internal damage
- Fluorescent penetrant inspection or magnetic particle inspection of metallic components.

AMC P 370
Fatigue Characteristics

(1) Vibratory Loads – Acceptable Levels
The acceptable levels for vibratory loads are expressed in terms of minimum factors for the resultant vibratory stress levels when related to the working fatigue limit for the component.

(a) The mean fatigue limit should be established from an S/N Curve constructed from representative tests and other data on the material concerned. Normally a fatigue limit established at 10^8 cycles would be acceptable.

(b) The working fatigue limit should be derived from the mean fatigue limit suitably factored to ensure, with a high degree of confidence, that all components produced to the same drawings and specifications as those tested to produce the S/N Curve of (a) will sustain no unacceptable fatigue damage.

(c) The factor on vibratory stress (including concentration effects) should be not less than 1.5 except for the blades outboard of the root where it should be not less than 1.8.

(2) Combined steady and vibratory loads – Acceptable Levels
The relationship of the acceptable levels of steady and vibratory loads of paragraphs (1)(a) and (1)(b) is illustrated in figure 1 for conventional Propellers with solid aluminium alloy blades. For other materials, such as composites, this relationship may vary.

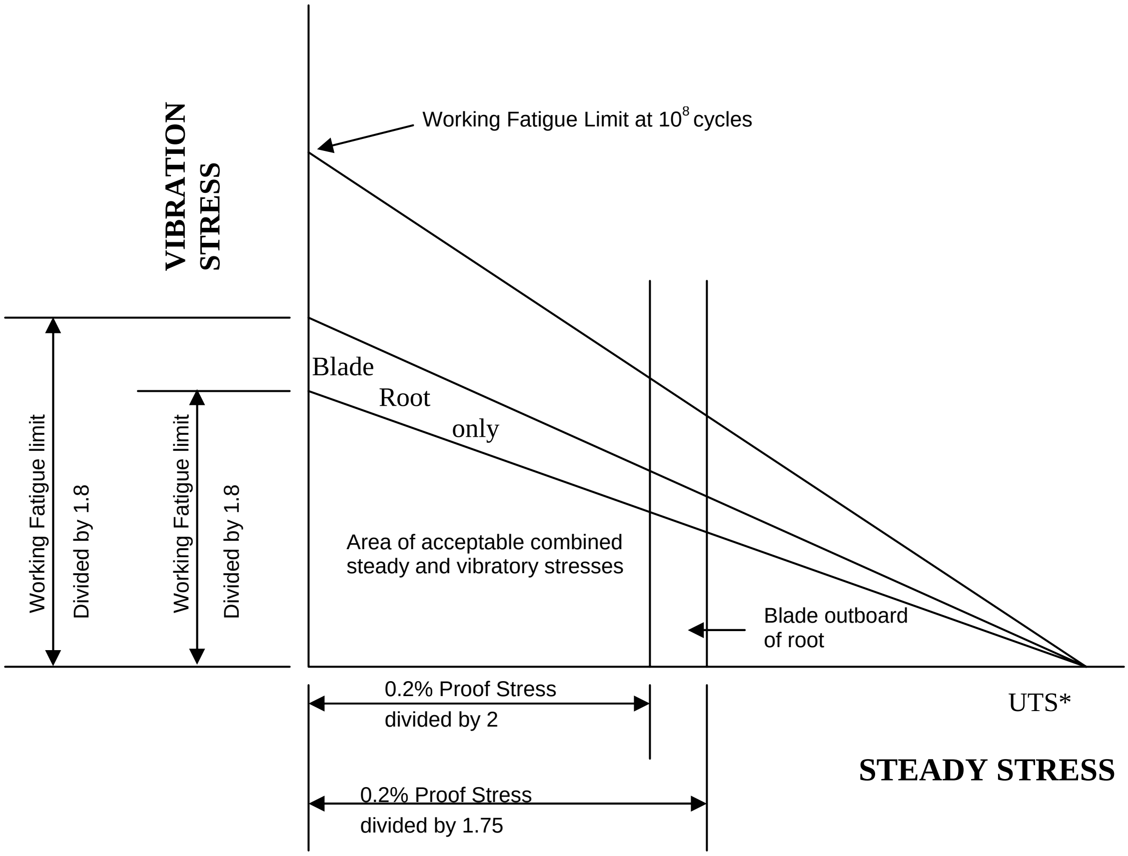

FIGURE 1 ACCEPTABLE STRESS LEVELS FOR CONVENTIONAL PROPELLERS WITH SOLID ALUMINIUM ALLOY BLADES

(3) Verification of Fatigue Limits
The procedures and factors presented by this AMC are intended to produce components with unlimited fatigue lives but the variables introduced by operation of the Propeller may require special procedures to ensure that the fatigue properties of the components are adequately maintained throughout the life of the Propeller. It will therefore be necessary to declare and institute methods to achieve this purpose. Such methods will usually take the form of:

(a) Adequate maintenance procedures (inspections, surface refurbishment, overhaul, etc); and

(b) Specimen fatigue testing of components withdrawn from service at periodic intervals.

(4) Previous experience will normally be accepted as a demonstration of compliance for fixed pitch wooden propellers of conventional design.

AMC P 380
Lightning Strike.

This guidance provides a description of test methodology used to determine the effect of a lightning strike on a Propeller. Detailed methods, test set-up information on voltage waveforms, current waveforms, or data collection are provided in the reference documents.

(1) Consideration should be given to all components of the propeller assembly that could be in the lightning path these include but are not limited to the spinner, blade, hub, blade bearings, and possibly the Pitch change mechanism. Additional consideration should be given to electrical/electronic components that could be influenced by the indirect effects, these include Propeller blade and spinner de-icing system components as well as any other Propeller mounted electrical or electronic components.

(2) The damage caused by lightning is characterised into two categories, direct and indirect. The direct effects associated with lightning depend on the structural component involved, the attachment point and current path through the structure. The indirect effects are classified as damage to electrical equipment by the current or voltages either by the associated electromagnetic field, surges, or by current directly injected into the electrical wires. Indirect effects testing determines the conducted currents, surge voltages, and induced voltages entering the aircraft electrical system through systems such as the Propeller deicing system. Testing involves measurement of voltages at the terminals of the de-icing system or other electrical/electronic systems where they connect to the aircraft electrical system.

(3) The references below provide information regarding test set-up, simulated lightning wave forms, other general procedures to conduct a lightning strike test.

(a) EUROCAE ED-81, "Protection of Aircraft Electrical and Electronic Systems Against the Indirect Effects of Lightning".

(b) EUROCAE ED-14D, "Environmental Conditions and Test Procedures for Airborne Equipment".

(c) EUROCAE ED-91, "Aircraft Lightning Zoning Standard,"

(d) EUROCAE ED-84, "Aircraft Lightning Environment and Related Test Waveforms Standard,"

AMC P 390
Endurance Tests.

(1) Test Configuration. Testing should be conducted with the Propeller and all other components required to operate the Propeller on an aircraft. Some components may not be included in the Propeller type design. The Propeller power output should be at least equal to the Propeller take-off and maximum continuous power ratings. Spinner and de-ice components should be installed during the endurance test. Controls should be operated in accordance with the applicant's instructions. The applicant's instructions should be those which are proposed to be incorporated in the propeller manuals.

(2) Propeller diameter. When the Propeller being certified includes more than one acceptable blade design, the Propeller tested need not include the blades that give maximum Propeller diameter. It should be shown that the blades tested will represent all other similar blades to be included in the type design. Testing with blades of different construction than blades for which certification is sought may not be acceptable. For example if both composite and aluminium blade options are to be included in the type design both the composite and aluminium blades should be tested.

(3) Representative engine. The engine used to drive the propeller during the test should be capable of developing the power and speed for which certification of the Propeller is sought. The engine

vibration should be similar to the intended application for the Propeller. For example testing conducted on a turbine engine may not be applicable to show that the Propeller is acceptable on a piston engine.

(4) Continuity of test. The endurance test may be continuous or in increments agreed upon by the Agency.

(5) Stops (Ground Tests). Each period should be run non-stop. In the event of a stop occurring during any period, the period should be repeared unless the Agency considers this to be unnecessary. The Agency reserves the right to require the complete test to be repeated if an excessive number of stops occurs.

AMC P 400
Functional Test.

The functional tests are intended to substantiate the control function in the Propeller system. This test may be performed in conjunction with the CS-P 390, Endurance test.

AMC P 420
Components of the Propeller Control System

This requirement is intended to identify functionality and wear of the Propeller Pitch Control Systems components for the purpose of establishing appropriate instructions for continued airworthiness.

SUBPART D – PROPELLER VIBRATION AND FATIGUE.

AMC P 530
Vibration and Aeroelastic Effects

(1) Propellers with Detachable Metal or Composite Blades

(a) The disposition and number of measuring points should be such as to give adequate indication of vibratory stresses in all significant flapping, edgewise and torsional modes of the blade.

(b) The survey should provide for at least the following:

(i) Ground Engine/Propeller tests using the Engine for which approval is sought, or one sufficiently representative to be an acceptable alternative. The survey should cover all the operating combinations of speed and torque from Ground Idle to Maximum Governed Rotational Speed.

(ii) Aircraft/Engine/Propeller ground and flight tests in the combination for which approval is sought (or one sufficiently representative as to be an acceptable alternative).

The results of (1)(b)(i) should show that the stresses likely to be present in conducting the flight tests of (1)(b)(ii) are not excessive.

The results of (1)(b)(ii) should be used in conjunction with the fatigue data generated in CS–P 370 to carry out the Fatigue Evaluation of CS-P 550.

(iii) In conducting the tests of (1)(b)(ii) the complete range of aircraft and operating conditions should be covered over the range of aircraft weights. The testing should also cover all ground operations, including Reverse Pitch if applicable, over the range of wind speed and directions for which approval is sought.

(2) Propellers with Detachable Wooden Blades

A test should be conducted on prototype Propellers to determine that the vibration characteristics are not such as to cause resonance detrimental to airworthiness throughout the whole range of engine speeds.

AMC P 550
Fatigue Evaluation

(1) From the fatigue data generated in CS-P 370 (S/N curve) a mean line is established together with a low probability of failure line. The low probability of failure line should take account of statistical variation due to scatter of results and due to the number of test specimens.

(2) The fatigue evaluation on the Propeller, using data generated to show compliance with CS-P 370 and CS-P 530, should use suitable factors to allow for manufacturing and material variations, deterioration during service and the permitted range of aircraft loading. In the absence of any other data the combined effect of these factors should be taken as 1.5. The low probability of failure line should be reduced by this combined factor to produce a working line to be used in the fatigue evaluation.

(3) If the fatigue data on full size components is for full reversal tests with no steady load then the effect of the steady loads should be taken into account in the evaluation. Coupon tests maybe used to establish the effect of steady loads.

(4) The fatigue evaluation can be carried out using safe life methods where the damage sustained during each vibratory cycle in the Propeller's life can be summed using methods such as Miner's rule using a working line on the S/N curve as established in (1) above.

(5) It is recognized that operation of the Propeller may result in changes to the fatigue properties of the Propeller. Therefore, in addition to adequate maintenance procedures (inspections, surface refurbishment, overhaul, etc),, Specimen fatigue testing of components withdrawn from service at periodic intervals may be required.

B.2 Definitions and Abbreviations used in Certification Specifications for products, parts and appliances (CS-Definitions).

The following amendments should be included in Decision No. 2003/11/RM of the Executive Director of the Agency of 5 November 2003:

Reversible Pitch Propeller	**A Propeller in which blades can be rotated to a Reverse Pitch blade angle.**
Variable Pitch Propeller~~s~~	means a Propeller, the Pitch setting of which changes or can be changed, when the Propeller is rotating or stationary. This includes:- a. A **non-governing** Propeller, the Pitch ~~setting~~ of which is directly under the control of the flight crew (controllable Pitch propeller). b. A **governing** Propeller, the Pitch ~~setting~~ of which is controlled by a governor or other automatic means which may be either integral with the Propeller or a separately mounted equipment and which may or may not be controlled by the flight crew (constant speed Propeller). c. A **governing** Propeller, the Pitch ~~setting~~ of which may be controlled by a combination of the methods of a. and b.

C. ORIGINAL JAA NPA PROPOSALS JUSTIFICATIONS

The proposals were already circulated for comments as a JAA NPA. This part contains the justification for the JAA NPA.

C1 Justification for JAA NPA P-4 "JAR-P Section 2 ACJ "

This advisory material is necessary to support the revised propeller rule proposed by NPA-P-3, which contains the justification for the changes to JAR-P Sections 1 and 2.

Economic impact analysis

For the same reasons as detailed in NPA-P-3 it is anticipated that NPA-P-4 will also have no adverse economic impact.

C2 Justification for JAA NPA P-5 (Rev. 3) "JAR-P Definitions"

This additional requirement to JAR-P is necessary to provide definitions for the revised propeller rule proposed by NPA-P-3.

Economic impact analysis

For the same reasons as detailed in NPA-P-3 it is anticipated that NPA-P-5 will also have noadverse economic impact.

Status of harmonisation with FAA

Not harmonized

C3 Justification for JAA NPA P-6 (Rev. 3)"Propeller Control Systems"

This NPA provides necessary advisory material to support JAR-P 230. This ACJ 230 is aligned with NPA E33 and the AMC to CS-E 50.

Economic impact analysis

For the same reasons as detailed in NPA-P-3 it is anticipated that NPA-P-4 will also have no adverse economic impact.

Status of harmonisation with FAA

This has not been harmonized with the FAA.

C4 Justification for JAA NPA P-7 (Rev. 3) "Propeller Safety Analysis"

This advisory material is necessary to revise the rule for propeller safety analysis in line with the current JAR-E and CS-E requirements for engine safety analysis. Accordingly, the ACJ material is also proposed in this NPA in support of the new JAR-P safety analysis requirement.

Economic impact analysis

For the same reasons as detailed in NPA-P-3 it is anticipated that NPA-P-4 will also have no adverse economic impact.

Status of harmonisation with FAA

This text was based on the harmonized NPA text for incorporation into JAR-E but modified as appropriate to be applicable to propellers. However, the specific text contained within this NPA-P-7 has not been harmonized with FAR 35.

C5 Justification for JAA NPA P-8 (Rev. 3) "Fire Precaution"

This is consistent with the intentions of NPA-E-24 as applied to JAR-E and CS-E

Economic impact analysis

he economic impact of this requirement is negligible as this would typically be standard practice for propeller design organisations.

Status of harmonisation with FAA

This has not been harmonized with FAR 35.

C6 Justification for JAA NPA P-9 (Rev. 3) "Critical Parts"

Critical Parts requirements have been in both JAR-E and JAR-P for many years. The Engine Study Group have debated this subject and proposed a revision to the existing engine Critical Part requirement in NPA-E-44. The objective of the revised rule is to be more specific in defining the attributes of Critical Parts that should be controlled and the processes by which integrity can be ensured. This NPA-P-9 utilizes the harmonized text of NPA-E-44 and applies the same principles to JAR-P. However, this specific text has not been harmonized with FAR 35.

Economic impact analysis

As stated above this NPA does not introduce any significant increase in regulatory burden from the existing JAR-P 70 failure analysis requirement with the associated ACJ-P 70(e)(2)advisory material covering Critical Parts.

Status of harmonisation with FAA

This is not harmonized with FAR 35.

D. JAA NPA COMMENT-RESPONSE DOCUMENT

This part summarizes the comments made on the JAA NPA and the responses to those comments.

D1 NPA P-4 Rev. 2 Comment Response Document:

Comment No.	ACJ-P Ref	Comm-entor	Comment (***Proposed Text* Change** followed by Reason)	Dispo-sition	Agreed Change
1a	Para 1.1	DGAC	Remove text and leave to editor	Agreed	Text deleted
1b	**ACJ P 10(2)**	CAA	It is recommended that the final paragraph be replaced as follows: ***“This propeller has been certificated in accordance with JAR P Sections A,B and C. (Compliance with the type certification requirements of Sub-Section D, which is specific to each aircraft installation, has not yet been demonstrated)”*** Provides a more generic statement.	Agreed (see 038)	Text amended (Note : Brackets removed.)
1c	**ACJ P 10**	DGAC	**3. PROPOSED TEXT/COMMENT** 3.1 The wording of paragraph (1) is not clear enough. An alternate wording is proposed as follows **(1) If the propeller de-icing equipment is included in the Propeller Type Design, then its structural integrity and functionality is established during propeller certification to this JAR P.** **The performance of propeller de-icing equipment in relation to ice protection is demonstrated as part of the aircraft certification.**	Agree Agree	Current text reflects this comment Current text reflects this comment

			3.2 In paragraph (2), the text of the proposed note in the TCDS is not appropriate. Propeller documentation is not supposed to address compliance with the aircraft codes. An alternate wording, to be consistent with JAR-P 10, is proposed as follows		
			(2) If the propeller type certificate is granted after compliance has been shown with only Sub-Sections A, B and C of JAR-P, the Propeller Type Certificate Data Sheet will include the following statement:	Agree	Text embodied then further modified
			"This propeller has been type certificated in accordance with JAR-P, Sub-Sections A, B and C. Compliance with Sub-Section D has not been demonstrated."	Agree	Text embodied then further modified
1d	**ACJ P 30**	DGAC	The first sentence of paragraph (1) does not bring any useful information and should be deleted.	Agreed (Sub Group Disagreed, Overruled by ESG)	Text deleted.
1e	**ACJ P 30**	DGAC	The second sentence of paragraph (1) is not very clear ("authority in both etc." has no link with the first part of the sentence) and should be modified taking account of words which can be found in NPA-E-33, for consistency in wording.	Agreed	Text amended
2	**ACJ P 30(a)**	Dowty	**The following requirements are repeated:-** • **Loss of electrical power** • **Lubricating fluids** Duplication of requirements	Agreed	Text amended

3	**ACJ P 30(a)(1)**	CAA	It is recommended that the second sentence be replaced with the following: **" The installation manual should include control system characteristics, and define operation in normal and any backup modes. If there is any change in operating characteristics in transition between modes or in backup modes, then these should also be described."** Clarifies intent and addresses transition between normal and backup modes.	Agreed	Text embodied then further modified
4	**ACJ P 30(a)(2)**	CAA	1) **It is recommended that "Propeller system component weights" and the associated three bullet points are removed and a new bullet point is added under "*Propeller properties and limitations*" stating "*component weight and moment of inertia*"** - Weights and inertia are considered to be part of the basic Propeller properties.	Disagree	It was considered necessary to keep Propeller and Propeller system items separate.
5	**""**	CAA	2) **under "Recommended operating procedures", "- loss of hydraulic pressure – loss of electrical power" and the bullet "fault detection, isolation and accommodation" should be removed.** - Emergency operations is made more objective and not limited to specific examples.	Partially Agree	**loss of hydraulic pressure – loss of electrical power has been deleted. However, the Sub-Group considered that the text "fault detection, isolation and accommodation" was of value.**

6	“”	CAA	**3) It is also recommended that an additional bullet point is added under “Recommended operating procedures” stating “*Time limited dispatch requirements*”** - Provides a placement for Time Limited Dispatch items, if appropriate	Agreed	Text embodied
7	“”	**FAA**	**Add text “Safety analysis assumptions** • **Assumed component reliability** • **Required safety checks** • **Maintenance actions”**	Partially Agree	The following text was embodied “Assumptions • Safety Analysis • Design • Operation” This was considered an improvement. Also Safety analysis assumptions are addressed under ACJ P150
8	“”	Dowty	**Omit the following from paragraph 2.** • **Propeller shaft loads** • **Vibration environment** • **Moments of inertia** • **Centre of gravity** • **List of weights** • **EMI/lightning protection qualification results** None of the above is of any value to the aircrew or operator who would not know what to do with it!	Disagree	Text remains. It is part of the instructions for installation which are being used by the aircraft manufacturer, not the aircrew or operator.

9a	**ACJ P 50**	DGAC	In summary - delete all ACJ P 50 Actual comment "First sentence :"requirements of this part". What is this ? Why is there such a second sentence ? This is an obvious statement. And there is no need for an agreement of the authority which will always accept more severe testing. Sentence to be deleted. The third sentence should be deleted. What does it bring to interpretation of JAR-P 50 ? Why is there a sentence on propeller maximum continuous power and nothing on other conditions ? Furthermore, this sentence conflicts with JAR-P 50 (a)(3). This sentence should be deleted. JAR-P 50 deals with ratings. Why are over-speed and over-torque addressed in this ACJ P 50 ? The sub-paragraph should be deleted." In conclusion the whole ACJ P 50 should be deleted.	Agreed	Text deleted
9b	**ACJ P 50**	FAA	• **Requests for increases in power or rpm ratings up to a maximum of 10 percent above the values substantiated by the tests required by this part, provided there are no structural changes in the propeller, should be accompanied by substantiating test data or stress analysis in a manner satisfactory to the Authority.** Historically substantiated increases power and rpm of up to 10% have been granted without requiring a new test. Stating this in the advisory material would validate standard practice.	Not accepted	All of ACJ P 50 text has now been removed for the reasons stated by DGAC in comment 9a

9c	**ACJ P 170**	CAA	**ACJ P 170 addresses materials and manufacturing concerns shared with engines and transmission systems. Should there be a suitable document to treat this as generic text across all products (possibly within GAI-20).** Development of comment ACJ material.	Comment noted	This comment should be made to the ESG for their consideration.
10	**ACJ P 170(3)(a)**	FAA	Forgings. The practices contained in this ACJ are acceptable to the Authority as one means of complying with the requirements of JAR P 170 with respect to forgings. (a) Forgings should be classified as Class 1, Class 2 or Class 3 parts in accordance with the following: - Class 1. Those parts, the failure of which could **cause a Hazardous Propeller Effecthazard the aircraft;** The use of Hazardous Propeller Effects should be consistent throughout the advisory material and requirements. Also, the requirements are at the propeller level not the airplane level.	Agreed	Text amended
11	**ACJ P 170(4)(a)**		Welded Structures and Welded Components. The practices contained in this ACJ are acceptable to the Authority as one means of complying with the requirements of JAR P 170 with respect welded structures. (a) Fusion and resistance welds should be classified in accordance with the following: - Group 1. Those welds the failure or leakage of which could **cause a Hazardous Propeller Effect**~~hazard the aircraft~~; - Group 2. Highly stressed welds the failure or leakage of which	Agreed	Text amended

			would not **cause a Hazardous Propeller Effect**~~hazard the aircraft~~; or The use of Hazardous Propeller Effects should be consistent throughout the advisory material and requirements. Also, the requirements are at the propeller level not the airplane level.		
12a	**ACJ P 170**	DGAC	3.1 Editorial. There are two paragraphs (1), two paragraphs (2) etc. This should be corrected.	Agreed	Text amended
			3.2 Semantic. “Materials should adhere” is not possible.	Agreed	Text changed
			3.3 There are references to “the Administrator”. This is obviously not appropriate for JAR-P. This should be corrected. Note that the first paragraph (2) is wrong because it is not consistent with a DOA concept. The applicant to TC, holding a DOA, is supposed to be capable of showing compliance with JAR-P without input from the authority. This should then be deleted.	Agreed Agreed for future adoption	References to “Administrator” have been removed. Text not amended at this revision
			3.4 In the first paragraph (2), how is defined “criticality” ? An ACJ should clarify application of a rule and should not introduce new, undefined, concepts.	Not Agreed	Use of “criticality” is with a small “c” as the word is used in the English context, not as a JAR-P definition. Thus the sub-group consider that this text is correct.
			3.5 Note that the text is not in UK-English (z instead of s for example). This should be corrected.	Agreed	Text amended
			3.6 It seems that the first paragraph (4) and paragraph (5) addresses “critical parts”, without taking account of NPA-P-9. This should be checked and ACJ P 170 modified in consequence.	Comment noted	The group agreed that where manufacturing control of critical parts is

					necessary this is addressed by JAR-P 170. and is not inconsistent with JAR-P 160
			3.7 In the second paragraph (2), the first sentence should be deleted. It is an unnecessary statement.	Not addressed	Unsure which text is referred to.
			3.8 In (2)(b), the second sentence is not relevant to certification of a propeller. Furthermore, it introduces undefined terms such "quantity production" or "constructor". This should be eliminated.	Agreed	Text removed
			3.9 In (2)(e), the text is not relevant to ACJ to JAR-P. This is dealt with in JAR-21.	Agreed	Text Removed
			3.10 In second paragraph (3), the first sentence should be deleted. It is an unnecessary statement. The practices contained in this ACJ are acceptable to the Authority as one means of complying with the requirements of JAR- P 170 with respect to forgings.	Not Agreed	To a regulator this sentence may appear obvious but to industry it still offers useful information.
			3.11 In (3)(a), Class 1 : "the failure of which could hazard the aircraft". Is this another definition of critical parts ? Consistency with NPA-P-9 should be ensured and this ACJ P 170 entirely re-written.	Agreed	Text modified to be consistent with the definition of critical parts
			3.12 Class 3 refers to class 1. This is not logical. Should this be class 2 ? Or class 1 and class 2 ?	Disagree	The proposal for Class 1,2 and 3 is Class 1 = Hazardous Class 2 = Non-Hazardous but stressed Class 3 Non-Hazardous and low stress The Sub-Group agree with the original text.

			3.13 In (3)(d), there is reference to critical parts. It is assumed that the intent is to address propeller critical parts.	Noted	The Sub Group consider this to be clear. Await advice of ESG.
			3.14 Comment 3.8 above also applies to (3)(e).	Agreed	Text deleted
			3.15 In (3)(h), the sentence "the forging manufacturer should certify …" should not be part of an ACJ to JAR-P must should be in JAR-21. An ACJ is not allowed to create new JAR-21 rules.	Agreed	Text modified
			3.16 In (3)(i), again we find JAR-21 rules (see comment 3.9 above).	Agreed	Text removed
			3.16 In second paragraph (4), the first sentence should be deleted (se comment 3.10). "The practices contained in this ACJ are acceptable to the Authority as one means of complying with the requirements of JAR-P 170 with respect welded structures.	Not Agreed	To a regulator this sentence may appear obvious but to industry it still offers useful information.
			3.18 In (4)(a), again, group 1 is a new definition of critical parts. See comment 3.11.	Agreed	Text modified
			3.19 (4)(d) see comment 3.8.	Agreed	Text modified
			3.20 (4)(f) see comment 3.9.	Agreed	Text removed
			3.21 Conclusion : a complete revision of this ACJ is necessary.	Agreed	All comments have been dispositioned and appropriate changes have been made.

12	**ACJ P 210**	FAA	**ACJ P 210** **Variable and Reversible Pitch Propellers.** **Intended travel accounts for backlash, tolerances, secondary stop, and etc. For example a hydraulic failure of a dual acting propeller system with pitch lock operating at the in-flight low-pitch positions could permit a small decrease in blade angle due to system backlash. The pitch lock may require a degree or two of blade angle change before it engages. This value is documented in the Instructions for Propeller Installation and Operation.** No advisory has been presented for JAR P 210. The above paragraph is proposed for advisory material for ACJ 210.	Agreed	text embodied
13	**ACJ P 220**	Dowty	**The text in paragraph (2) requires a noun between the words “include” and “such” in the first sentence. Suggest the noun is “parameters”** Sentence is grammatically incorrect	Agreed	Text amended
	ACJ P 220	DGAC	3.1 Editorial. (3) is not in UK-English. To be corrected. 3.2 Grammar. “may include such as” in (2) is not correct. 3.3 In (3), what is this “this” in “this would be appropriate” ? To be explained.	Agreed Agreed Not Agreed	Airplane replaced with aeroplane. Inserted “parameters” This refers to diversion time. The intent is considered to be clear.
14	**ACJ P 240**	DGAC	~~**(a)**~~ Steady Loads – Acceptable Levels **(1**~~**a**~~) The acceptable levels for steady loads are expressed in terms of minimum factors for the resultant stresses when related to the proof stress of the material. **Proof stress is based on 0.2% yield stress definition for metal components.**	Agree	Text amended

			A definition of proof stress will clarify the advisory material. A format change has also been proposed because there is no other main paragraph.		
15	**ACJP 240(2)**	FAA	**(2) The following factors apply to metal components.** **(a~~b~~)** The hubs of Propellers with detachable blades should have proof factors of not less than 2.0 for tension and compression and an ultimate factor of not less than 3.0 in shear. These factors are only applicable to metals. There are no equivalent proof factors for composites. A format change has also been proposed because there is no other main paragraph.	Agree	Text amended
	ACJ P 240	DGAC	**3.1 This ACJ is in fact a rule. The current JAR-P 240 (of NPA-P-3) addresses only maximum stresses ("The maximum stresses developed in the Propeller shall not exceed acceptable values"). There is no requirement to add factors and there is no reference to "proof stress of the material".** **The rule must be changed or the ACJ be limited to interpretation of the current rule.**	Not agreed	ACJ adequately explains"acceptable values". This is unchanged from current ACJ.
	ACJ P 240		**3.2 Editorial. Why is there a paragraph (a) (by the way wrong numbering of an ACJ) when there is no paragraph (b) ?**	Agreed	Text amended accordingly
	ACJ P 240		**3.3 The rule is not limited to steady loads. Why is this ACJ so limited ?**	Noted	JAR-P 240 addresses maximum loads. Vibratory loads are addressed by JAR-P 530 in Amendment 8.

16	**ACJ P 340**	CAA / DGAC	**This paragraph should be deleted as it is only concerned with inspections, adjustments and repairs necessary during certification testing.**	Agreed	Paragraph deleted
17	**ACJ P 350**	Dowty	**The last paragraph (f) is a heading only and does not have any text. The paragraph should also be numbered (5)** **Suggest following wording from previous draft of NPA P-4 be used** **"(5) Additional Substantiation of Composite Blades, Spinners and Components attached to composite** **Blade features such as those associated with transitions from composite blade to the metallic retention can be tested during the hub and retention testrequired by JAR P 350 or with a separate component test. There may be other applicable configurations, such as the transition associated with a configuration in which the blade of any material construction is bonded or otherwise attached to the portion of the blade that is retained to the hub"**	Agreed	Text amended
18	**ACJ P 350(f)**	FAA	~~**(f) Additional Substantiation of Composite Blades, Spinners and Components Attached to Composite**~~ This section is incomplete, does not appear to be needed and therefore can be deleted.	Agreed	See Comment 17
	ACJ P 350	DGAC	3.1 The paragraph (1) attempts to repeat the rule. Instead of helping the interpretation, it confuses it with "definitions" which cannot understood. For example, in (1)(a) we find the following "the fracture of a component without release would be a release of any component or debris" if we believe the first sentence which defines a failure. In (1)(b), we find a totally new vocabulary : a malfunction is defined as a deformation. Paragraph (1) should be entirely deleted.	Partially Agreed	The text has been amended to clarify its intent to pass fail criteria.

			3.2 The usefulness of (2)(a) is not obvious. The maximum rated rpm is well understood. Why is this paragraph trying to confuse the reader by referencing things which are not to be considered ? It should be entirely deleted.	Partially Agree	Text amended for clarity.
			3.3 In (4), it should be noted that a component is not in position to require anything, unless they benefit from artificial intelligence. What is meant here ? Is this an obscure means to refer to component addressed under JAR-P 350 (c) ? Why is there reference to load at 126% of speed when the rule refers to 159% of load ? Consistency in wording should be ensured, even if the end result is the same. The reference to the administrator is not acceptable : the last sentence should be deleted.	Noted	Equivalent load added in parenthesis
			3.4 There is a paragraph (f) which seems to be totally out of place.	Agree	Text deleted
19	**ACJ P 360**	Dowty	**The ACJ is verbose and contains superfluous text. The attached amended text is proposed.**	Partially Agreed	Agreed that some of propose text is unnecessary.Some of the proposed text has been added..
20	**ACJ P 360(1)**	FAA	**(1) The bird impact capability of fixed pitch wood propellers of conventional design has been established by their service history. A fixed pitch wood propeller of conventional design is a propeller that has the following physical properties:** **- One piece laminated wood construction;** **- Two or four blades;** **- Surface coatings that do not contribute significantly to the propeller strength; and** - Surface coatings that only provide environmental protection.	Disagree	The provision to allow service experience to address this issue in both the rule and ACJ is continued.

			A fixed pitch propeller that has a composite shell over a wood core does not qualify as conventional design if the composite shell contributes significantly to the strength and frequency response of the propeller. A fixed pitch wood propeller with a fabric or composite covering for environmental protection that does not significantly alter the structure qualifies as conventional design. Add a section to validate that fixed pitch propellers of conventional design are exempt from this requirement because of good service history.		
21	**ACJ P 360(4)**	CAA	A sentence should be added to the end of the existing paragraph as follows; ***"Where the applicant carries out a static impact test, the hub and/or blade must also be subjected to centrifugal loads for one hour representative of cruise conditions followed by a further 2 minutes representative of landing and reverse thrust if applicable.*** **Clarification of static test procedure.**	Not accepted	This proposed text would be rule making by ACJ and would present a significant cost burden. Thus this has not been embodied. However, the commenter is invited to submit a proposal to the ESG.
22a	**ACJ P 360(6)**	CAA	Remove this paragraph completely. This is unnecessary as the rule is adequately specific.	Agreed	Paragraph removed.
22b	**ACJ P 360**	DGAC	3.1 The words of NPA-E-45 should be used : "Artificial birds may be used in the tests if they are internationally standardised and are acceptable to the Authority".	Agreed	Text embodied
			3.2 In (2), under "blade", does the first sentence mean that the rule is not necessary because the experience shows that all blades can withstand the impact of birds ? This should be clarified or the sentence should be deleted. The "therefore" in second sentence is	Agreed	Text amended

				not understood : there is no logical link between the contents of the two sentences. What is meant by "blade retention" ? There is no retention ring around the propeller blades. The rule refers to "highest blade loads" when this ACJ refers to "maximum blade retention loads" : the ACJ is not allowed to change the rule. The rule refers to major or hazardous propeller effects. The ACJ seems to ask for different criteria : this is not appropriate. This paragraph should be entirely re-written to be clear and consistent with the rule.		
			3.3	Similarly, the paragraph on "spinner" seems to deviate from the rule. It should be reviewed for consistency with the rule.	Agreed	Text amended
			3.4	In (3), what is "to weigh be" ? Simulated birds : see comment 3.1.In fact, (3) should entirely deleted. To define how to perform a test is not the purpose of an ACJ.	Partially agreed	Text amended
			3.5	In (4), how is defined the "when appropriate" ? What are the relevant criteria to make such decision ?		The intent of this comment is agreed and the text has been clarified.
			3.6	(5) is not relevant and should be entirely deleted.	Agreed (by ESG)	Text deleted
			3.6	In (6), what is the meaning of the first sentence ? Is not this the purpose of any certification test ? The second sentence needs correction ("have no more than 10% of the bird is sliced and passing"). Interesting geometric criteria in "the bird should be orientated within 10 degrees off axis in any direction" : this is complex means to say that the bird must be exactly on axis. This paragraph should be clarified.	Agreed	Paragraph deleted

			3.7 In (8), should not the limitations placed in the airworthiness limitation section ?	Noted	The comment has prompted review of the paragraph and has been deemed incorrect.
23	**ACJ P 370**	Dowty	**Before Figure 1 the sentence should be modified to end "….is illustrated in figure 1 for conventional propellers with solid aluminium alloy blades. For other materials, such as composites the shape of this figure may vary.** The shape of the Goodman diagram for composites is different to aluminium alloy.	Partially agreed	Text improved
24	**ACJ P 370**	Dowty	**Figure 1 is not legible**	Agree	Redrawn. Also "0.1% proof" should be changed to "0.2% proof."
25	**ACJ P 370**	FAA	**An acceptable method of compliance for aluminum components may be based on the methodology presented in (1) through (4). In addition advisory circular AC 35.37 provides a method to show compliance with JAR P 370. The fatigue characteristics of fixed pitch wood propeller of conventional design has been established by their service history.** Add a section to: 1) Clarify that the methodology in (1) through (4) is applicable to aluminum components. 2) Validate the use of FAA advisory circular AC 35.37 as agreed by the Propeller Harmonization Working Group in 1999. 3) Validate that fixed pitch propellers of conventional design are exempt from this requirement because of good service history.	Partially Agree	The ACJ as proposed does state that it is applicableto aluminium. However, text has been amended to clarify that fixed pitch wooden propellers of conventional design may show compliance by other means..
25b	**ACJ P 370**	DGAC	3.1 We find terms with capital letters (noting defined terms) which are not defined (Working Fatigue Limit, etc.). This should be avoided. These terms should not have capital letters and should be defined in this ACJ.	Agree	Text amended

			3.2 More importantly, the reference to acceptable levels of vibratory loads is rulemaking by advisory material. This ACJ is in no manner related to the rule of JAR-P 370. The ACJ should be entirely deleted or totally re-written to be made consistent with the rule.	Not Agreed	There is no technical change introduced by this NPA.
			3.3 It must be noted that the figure 1, referenced by the text as being applicable to all propellers, has a title limiting its validity to some particular propellers. This should be clarified.	Agreed	Text amended
			3.4 Editorial. In (1)(b) what is “the S/N curve of a.” ? In (2) there are references to paragraphs (a) and (b) : there are no such paragraphs in this ACJ. It should be noted that there is no paragraph (3).	Agreed	Text amended
26	**ACJ P 380**	FAA	This guidance provides a brief overview of test methodology used to determine the effect of a lightning on a propeller. Detailed methods, test set-up information on voltage waveforms, current waveforms, or data collection are provided in the reference documents. ACJ JAR P 230, Propeller Control Systems, addresses the effects of lightning on electronic controls. **The lightning strike capability of fixed pitch wood propellers of conventional design has been established by their service history.** Add a section to validate that fixed pitch propellers of conventional design are exempt from this requirement because of good service history.	Disagree	The use of service history as a means of compliance is stated in the rule and ACJ.
27	**ACJ P 380(3)**	CAA	**This Section lists a number of US documents containing information relevant to lightning strike testing. In cases where equivalent European documents exist it would be more appropriate to list these instead of the US documents, as follows:**	Partially Agreed	Agree with this proposal apart from (b) which does not apply to propellers. Embodied.

			(a) EUROCAE ED-81, "Protection of Aircraft Electrical and Electronic Systems Against the Indirect Effects of Lightning". **(b) AC 20-53A, "Protection of Airplane Fuel Systems Against Fuel Vapour Ignition Due to Lightning", April 12, 1985.** **(c) EUROCAE ED-14D, "Environmental Conditions and Test Procedures for Airborne Equipment".** **(d) EUROCAE ED-91, "Aircraft Lightning Zoning Standard,"** **(e) EUROCAE ED-84, "Aircraft Lightning Environment and Related Test Waveforms Standard,"** **[Note: the final two documents listed as (f) and (g) in the NPA are proposed to be deleted since these are now obsolescent.**		
27b		DGAC	3.1 In opening paragraph, there is a reference to ACJ P 230 which does not exist. What is the definition of "electronic controls" ?	Agreed	Text amended
			3.2 In opening paragraph, the words "a brief overview" are not usual wording for an ACJ. This should be changed to more conventional wording.	Agreed	Editorial. "description" added.
			3.3 In (2)(a), what is the definition of "the terminals of the de-icing system" ?	Not agreed	Text is clear that the terminals are connections to the a/c electrical system.
			3.4 In (2)(b), the construction of the blade has no influence ? This should be clarified.	Agreed	Text deleted.

			3.5 (3) reads "information provide information". Interesting style.	Agreed	Text amended
28	ACJ P 390	Dowty	**Paragraph 2, third sentence, starting "The blades shall be representitive…" does not make sense. It is not obvious what this is trying say.** **The whole of this ACJ adds very little and it is proposed that this is deleted.** P 390 is quite specific in the requirements and this ACJ is not considered to add anything significant.	Agreed Disagree	Text revised Amendments made to improve text.
29	**ACJ P 390(5)**	CAA	**"Stops." Is misleading and should be replaced with an alternative title such as "Test Plan".** **The remaining sentence should read "The test should run in accordance with the approved test plan unless otherwise agreed by the authority."**	Agreed Partially agreed	Text revised Text clarified.
	ACJ P 390	DGAC	**3.1 The last sentence of paragraph (1) allows deviation from the rule. This is not acceptable. Either the rule is changed or the ACJ is made consistent with the existing rule.**	Agreed	Last sentence removed
			3.2 Paragraph (2) reads "the diameter need not be the blade". Interesting grammar. Other examples are "the propeller for use with the blade", "the blades will result in the same test conclusions if the blade" or "if the blade design differs from the design that the endurance test results will be applicable". The paragraph should be entirely re-written. At same time it should be simplified to be clearer.	Agreed	Text improved
			3.3 In (3), what is this engine ? There is no reference to engine in previous paragraphs of this ACJ.	Agree	Text improved

			3.4 The last sentence of (3) should be deleted as not bringing any useful additional information.	Agree	Last 2 sentences removed
			3.5 In (4) reference to the administrator is not correct. And such reference to the authority is not consistent with the concept of DOA. It is suggested deleting entirely the first sentence. In second sentence what these "controls" ? The text in brackets should be deleted.	Partially Agreed	The text has been improved and relocated to a more suitablelocation.
			3.6 (5) should be entirely deleted. Not relevant to interpretation of the rule.	Disagree	Text has been amended as the result of other comments.
	ACJ 400	Group	**ACJ changed to JAR**		Text amended
	ACJ 400	DGAC	**This ACJ should be entirely deleted. It does not bring more information than the rule itself and in fact it differs from the rule. In particular, it should be noted that the test must be performed in accordance with the rule, not with some ACJ.**	Partially agree	Text amended
	ACJ P 410	DGAC	**This ACJ should be entirely deleted. It does not bring more information than the definitions of over-speed and over-torque.**	Agree (ESG)	Text deleted
	ACJ P 420	Group	**ACJ changed to JAR**		Text amended
		DGAC	**3.1 This ACJ significantly changes the rule ("test should be conducted…" in first sentence; "this test is to identify …" in third sentence). This is not acceptable. The ACJ should be entirely re-written to be consistent with the rule.**	Agreed	Text amended
			3.2 It should be noted that the test must be performed in accordance with the rule, not with some ACJ.	Agreed	Text amended

			3.3 Is a "declared overhaul period" applicable to all propellers ? This should be checked and text changed accordingly if necessary.	Agreed	Text deleted
			3.4 In last sentence, is the word "rational" really necessary ? Is there any applicant thinking of proposing an irrational analysis ? What is "this section" ?	Agreed	Text deleted
			3.5 Basic question : is there a real need for such ACJ ?	Noted	Text has been improved.
	ACJ P 430	DGAC	**3.1 This ACJ should be deleted or totally re-written to be clearer and consistent with the rule. See comments below.**	Agree	ACJ P 430 has been deleted.
			3.2 The purpose of the rule is not to check the "adequacy" of the component. This is the duty of the propeller designer. First sentence should be deleted.	Agree	Text deleted
			3.3 Second sentence reads "test testing". The third sentence reads "verification may be shown". This is not correct.	Agree	Text deleted
			3.4 The rule does not refer to "no significant fracture". What is "significant" ? The ACJ is not supposed to introduce more uncertainty in the interpretation of the rule. The rule does not refer to fracture.	Agree	Text deleted
			3.5 The rule does not refer to "unacceptable permanent deformation".	Agree	Text deleted
30	**ACJ P 530**	CAA / Dowty / FAA	**Vibration Tests (Acceptable Means of Compliance)** **See JAR-P530**	Agreed	Amended text with some modifications.
			(1) Propellers with Detachable Metal or Composite Blades		

			(a) **The disposition and number of measuring points shall be such as to give adequate indication of vibratory stresses in all significant flapping, edgewise and torsional modes of the blade.**		
			(b) The survey shall provide for at least the following: (i) Ground Engine/Propeller tests using the Engine for which approval is sought, or one sufficiently representative to be an acceptable alternative. The survey shall cover all the operating combinations of speed and torque from Ground Idle to Maximum Governed Rotational Speed.		
			(ii) Aircraft/Engine/Propeller ground and flight tests in the combination for which approval is sought (or one sufficiently representative as to be an acceptable alternative).		
			The results of (1)(b)(i) shall show that the stresses likely to be present in conducting the flight tests of (1)(b)(ii) are not excessive. **The results of (1)(b)(ii) shall be used in conjunction with the fatigue data generated in JAR–P370 to carry out the Fatigue Evaluation of JAR-P550.**		
			(iii) In conducting the tests of (1)(b)(ii) the complete range of aircraft and operating conditions shall be covered over the range of aircraft weights. The testing shall also cover all ground operations, including reverse pitch if applicable, over the range of wind speed and directions for which approval is sought.		

			(iv) In the case of piston engine installations an exploration shall also cover the effects of running with the cylinder inoperative which is most likely to produce the most adverse results. Consideration shall also be given to the need to explore the effects of crankshaft damper wear and of engine mount wear.		
			(2) Propellers with Detachable Wooden Blades A test shall be conducted on prototype propellers to determine that the vibration characteristics are not such as to cause resonance detrimental to airworthiness throughout the whole range of engine speeds.		
			(3) Propellers Fitted with Spinners and Fans **In all cases where the Propeller is fitted with a spinner and/or fan assembly of mass more than 4.5 kg (10lb.) evidence shall be provided that throughout the whole range of engine speeds no marked resonance occurs.**		
			In the text of the NPA: • Sub-paragraphs (iii) & (iv) replicate paragraphs (i) & (ii). • "JAP-P550" should read "JAR-P550". Reference is made to "weight" and not "mass"		
31	**ACJ P 530(2)**	FAA	**(2) Additional methods of compliance may be found in AC 20-66.** Add a section to validate the use of FAA advisory circular AC 20-66 as agreed by the Propeller Harmonization Working Group in 1999.	Not Agreed	Other methods of compliance will be considered when requested by applicant.

32	**ACJ P 530(3)**	FAA	**(3) The vibration capability of fixed pitch wood propellers of conventional design has been established by their service history.** Add a section to validate that fixed pitch propellers of conventional design are exempt from this requirement because of good service history.	Disagree	The use of service history as a means of compliance is stated in the rule and ACJ.
		DGAC	**3.1 This ACJ does not fit with the rules of JAR-P 530 (starting with a different title : ACJ refers to vibration tests when JAR-P 530 title is Vibration and Aero-elastic Effects). It should be entirely re-written to be clear and consistent with the rule. See comments below.**	Agreed	Title changed and text amended in accordance with other comments
			3.2 Paragraphs (1)(b)(iii) and (iv) duplicate (i) and (ii).	Agreed	Text amended
			3.3 In between (1)(b)(ii) and (iii), the text refers to unknown paragraphs. And it uses the word "shall" which is prohibited in an ACJ.	Agreed	Addressed. Text amended
			3.4 (1)(b), using shall, seems to set rules which are not exactly those of JAR-P 530. JAR-P is supposed to address propeller certification : why is there reference to "the engine for which approval is sought" ? Is this intended to be an ACJ to JAR-E ? What is an "acceptable alternative" ?	Agreed	Text amended
			3.5 (1)(c) exempts from flight test. How does this fit with JAR-P 530 (b)(1) ? Note that this paragraph refers to an unknown paragraph.	Agreed	Text deleted.
			3.6 (1)(d) refers to an unknown paragraph and seems to be creating a new rule.	Agree	Text modified
			3.7 In (1)(d)(i), "wind speed and directions for which approval is sought". Is this really the intent ?	Noted	This is the intent.

			3.8 In (1)(d)(ii), what is a "probable emergency condition" ?	Noted	Text deleted.
			3.9 In (1)(e), is the word "fan" appropriate ? Is this paragraph setting new rules ? Link with text of JAR-P 530 should be explained.	Agree	Text deleted
33	**ACJ P 550(4)(b)**	CAA	**This paragraph should be removed. Damage tolerance is not appropriate for propellers unless used as a secondary method of risk reduction alongside a safe life methodology.**	Agree	Embodied but ref to "damage tolerance removed" in (4)
34	**ACJ P 550(6)**	FAA	**(6) Additional methods of compliance may be found in AC 20-66.** Add a section to validate the use of FAA advisory circular AC 20-66 as agreed by the Propeller Harmonization Working Group in 1999.	Not agreed	Other methods of compliance will be considered when requested by applicant.
35	**ACJ P 550(6)**	FAA	**(7) The fatigue capability of fixed pitch wood propellers of conventional design has been established by their service history.** Add a section to validate that fixed pitch propellers of conventional design are exempt from this requirement because of good service history.	Not agreed	The use of service history as a means of compliance is permitted in the rule and ACJ.
	ACJ P 550	DGAC	**3.1 In (1), what is a "failure line" ? What is "scatter of the number of test specimens" ?**	Partially agreed	Text amended for clarity
			3.2 In (2), "must use suitable factors" is a new rule. Rulemaking by advisory material is not acceptable. This text should be changed to fit with the rules of JAR-P 550.	Agreed	"must" changed to "should"
			3.3 In (2), "variations between aircraft" : is really the intent to check every individual aircraft of the same type design ? What is meant here ?	Agreed (ESG)	Text improved
			3.4 In (2), what are these "failure line values" ?	Agree	Text revised

			3.5 Paragraph (4) seems to interfere with NPA-P-9 on critical parts. Consistency of the various text must be ensured.	Noted	No change considered necessary.
			3.6 Paragraph (5) is clearly a new rule and this is not hidden ("procedures and factors presented by this ACJ are intended …"). This is not acceptable. Either the rule is changed or the ACJ is made consistent with the rule. Note that the paragraph ends with "take the form of "…. and nothing follows.	Agreed	Text improved
			3.7 Paragraph (6) has no opening sentence and therefore cannot be understood.	Agreed	These sentences are bullets for paragraph (5) . The text has been amended accordingly
36	ACJ P 560	FAA	**ACJ P 560** **Flight Functional Tests** **Compliance with JAR P 560 may be shown by completing the requirements of JAR 23 or JAR 25 or FAR part 23 or part 25 which is documented by the approval of the propeller on the airplane Type Certificate Data Sheet.** Add a section to validate that approval for use of a propeller as documented on an airplane type certificate data sheet is sufficient to show compliance with JAR P 560. For a propeller to be listed on an airplane type certificate data sheet the airplane with that propeller must have been shown to meet the airplane requirement of JAR 23 or 25 or FAR parts 23 or 25.	Not accepted	This does not comply with JAR P philosophy for approval of installation.
		CAA	**EDITORIAL**		

			General - The numbering of sub-paragraphs throughout the document should be reviewed and amended to conform to the JAA convention.	Agreed	
			General – Throughout the document, references to "Administrator" should read "Authority". (e.g. ACJ P170(1), ACJ P 350(4), ACJ P 390)	Agreed	
			ACJ P10(1) - Replace "under the airworthiness requirements of JAR-23 and 25" with "in accordance with applicable aircraft airworthiness requirements"	Agreed	
			ACJ P30(a)(2) - under "Propeller properties and limitations" replace "torque's" with "torques"	Agreed	
			ACJ P50 – Replace "by the requirements of this part" with "in accordance with JAR-P".	N/A	
			ACJ P170(1) - under "(1) Material selection" remove the words "atmospheric" and "chemical". These are considered to be superfluous.	Agreed	
			ACJ P170(1) - (3) Design values. Remove the words "conservative" and "or some other recognized document".	Agreed	
			ACJ P170(1) - (5) Special manufacturing methods. The first sentence should be replaced with "Casting, forging, welding and brazing, require additional precautions not ordinarily applicable to manufacture from mill products (such as bar, sheet, plate, e.t.c.)." This is to avoid the use of the term "custom manufacturing methods" which can be misleading.	Agreed	
			ACJ P170(3)(a) - Forgings. This should read "Class 1. Those parts, the failure of which could result in hazardous Propeller effects."	Agreed	

			ACJ P170(4) - Welded Structures and Welded Components. The end of the first sentence should read "with respect **to** welded structures."	Agreed	
			ACJ P 220 - The reference to "airplane" should read "aeroplane" (in two places).	Agreed	
			ACJ P 360 (1) - "Typical" should read "Typically".	Agreed	
			ACJ P 360 (2) – Replace "is capable to receive bird strikes" with "can be struck."	Agreed	
			ACJ P360(3) - Remove the second sentence "The bird is defined to weigh be four pounds." This is poor English, does not conform to the SI convention and is a repeat of the rule.	Agreed	
			ACJ P 360 (7) – Replace "is typically include" with " typically includes"	Agreed	
			ACJ P 390 – Spelling mistake – "spinner" in last sentence	Agreed	
		Dowty CAA	**ACJ P 390 (2) –** Replace " the diameter of the propeller tested need not be the blades that give maximum propeller diameter." with " the propeller tested need not include the blades that give maximum propeller diameter." Also amend the last sentence to read: "included **in** the type design**"**	Agreed	
			ACJ P420 - The title "Components of the Propeller Control System" should be in bold format.	Agreed	

			ACJ P 420 - The references to "the Endurance tests, ACJ P 390, and Functional tests, ACJ P 400." should, more properly, refer to "the Endurance tests required by P 390, and the Functional tests required by P 400."	Agreed	
		Dowty	**ACJ P430** - The second sentence should commence “For the burst pressure test, testing should………”	Not found	
			ACJ P 550 – The text contains the following numbering errors; in 4(a) it should read “…as established in (1) above”, “paragraph (6) “ should be “paragraph (9)” and the last sentence should be “(B)”.	Agreed	

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Comment No.	ACJ-P Ref	Comm-entor	Comment	Dispo-sition	Agreed Change
1	ACJ P 15	FAA	FAA proposed "means a **control** system whereby the propeller ~~**can be operated at**~~ blade angles **are** directly selected by the air crew, or by other means. means a **control** system whereby the propeller ~~**can be operated at**~~ blade angles **are** directly selected by the air crew, or by other means~~,~~ ~~**in-flight low pitch and normally used during the approach and ground handling**~~." JAR-P Sub Group agreed definition of Beta Control – "means a system whereby the propeller blade angles are directly selected by the air crew, or by other means. (normally used during approach and ground handling)."	Agreed	Text amended
2			Feathered pitch – Remove definition	Disagree	The term" feathered pitch" helps to define the term "feather", as used in the requirements of JAR-P 220 and JAR-P 400.
3			Flight Idle – add "Typically, the lowest power lever and associated minimum blade pitch position permitted in flight. (In-flight low pitch position.)	Agreed	Text amended
4			Take off power – "means the Takeoff Power declared on the Type Certificate Data Sheet and demonstrated in the JAR-P 390."	Disagree	Definition is already contained in JAR-1.

5			Takeoff rotational speed – "means the Takeoff Rotational Speed declared on the Type Certificate Data Sheet and demonstrated in the JAR-P 390."	Disagree	This is adequately covered by JAR-P 50.
6			Maximum Continuous Power –" means the Maximum Continuous Power declared on the Type Certificate Data Sheet and demonstrated in the JAR-P 390."	Disagree	Already contained in JAR 1
7			Maximum Continuous Rotational Speed – "means the Maximum Continuous Rotational Speed declared on the Type Certificate Data Sheet and demonstrated in the JAR-P 390"	Disagree	This Is adequately addressed by JAR-P 50.
8			Maximum Permissible Rotational Speed – delete.	Agreed	Text deleted
9			FAA proposed text "Maximum Propeller Over-speed - means the **transient** maximum propeller rotational speed **demonstrated in JAR-P 410**~~**. , inadvertent occurrence of which for periods of up to 20 seconds, has been agreed not to require rejection of the propeller from service or maintenance action (other than to correct the cause)."**~~	Disagree	Text deleted, This definition is contained in JAR 1 / CS-D
10			Maximum Propeller Over-torque – "means the transient maximum propeller torque demonstrated in JAR-P 410."	Agreed	New text added
11			Minimum Governed Rotational Speed – delete.	Agreed	Definition deleted
12			Propeller Equipment – remove definition.	Agreed	Definition deleted
13			Reverse pitch – change to "Reverse pitch is any blade angle below ground idle blade angle."	Partially Agreed	Text amended

14			Reversible Pitch Propeller – change text to "A propeller in which blades can be rotated to a reverse pitch blade angle."	Agreed	Text changed
15			Rotational Speed – remove "engine crankshaft or its equivalent."	Agreed	Complete definition removed
16		DGAC	It is suggested changing the text to read as follows : (a) This issue of JAR-P must be used with the JAR-1 version existing at the date of issue. In addition to definitions of JAR-1, in this JAR-P the following terminology is applied. Where used in JAR-P, the terms defined in this paragraph and in JAR-1 are identified by initial capital letters.	Agreed	Text amended
17			It is noted the policy on capital letters is not applied uniformly in this proposed JAR-P 15. This should be corrected.	Agreed	Text corrected
18			"Adjustable pitch propeller" and "fixed pitch propeller" definitions are not consistent in vocabulary. One refers to "pitch setting of which", the other one to "pitch of which". What is the appropriate terminology ?	Agreed	Text corrected
19			It seems that "beta control" is used only once in section 1 (in JAR-P 560) and may be in ACJ P 420 as proposed by another NPA. Apparently there is no need for such a definition. In addition, the currently proposed definition uses suspect grammar and is confusing with the wording "in-flight low pitch" when you read it in relation to the definition of pitch. It is suggested deleting this definition. It does not bring any useful information for applying or interpreting JAR-P. Or in the opposite way : its deletion does not influence application or interpretation of JAR-P.	Disagreed Agreed Disagreed	Definition is worthwhile as "beta control" is a commonly used term and is used in the rule. The text has been changed to improve grammar. The need for the definition should not be influenced by the number of times it appears in the rule.
20			In definition of "feathered pitch", the words "specified in the appropriate propeller manual" are not relevant to the definition. They should be deleted.	Agreed	Text deleted
21			In definition of "in-flight low pitch position", should the reference be to "blade pitch setting" or is "blade pitch position" something different ?	Agreed	Text corrected

22			According to definition of "pitch", this definition of "in-flight low pitch position" means "blade propeller blade angle position". There is some confusion in use of "pitch", "pitch setting", "pitch position", "blade angle", "blade pitch position". For example, "in-flight low pitch position" is defined but we find "in-flight low pitch" in definition of beta control. Could this vocabulary be clarified and harmonised as necessary ?	Agreed Comment noted	Definition of In Flight Low Pitch Position has been changed. "pitch", "pitch setting", "pitch position", "blade angle", are all different things. "Blade pitch" has, however, been replaced with "pitch".
23			There is apparent inconsistency in wording among these definitions. We find "variable pitch (governing) propellers" and "variable (non-governing) pitch propellers. "Variable pitch propellers" is defined, without any reference to governing or non-governing but with reference to "controllable pitch propeller". This should be clarified.	Agreed	The definition of Variable Pitch Propellers has been amended.
24			There is no need to define "normal operation". Definition to be deleted.	Agreed	Definition deleted.
25			Is it sure that laws of physics in our universe will allow thrust to become "negative"?	Agreed	Changed to "reverse"
26			It is interesting to note that "pitch" means propeller blade angle, when "reverse pitch" is only blade angle. Consistency should be ensured among definitions.	Agreed	Text amended
27			In "reversible propeller", there is reference to negative blade angle. See comment 3.1 above. In addition, why is there no reference to reverse pitch in this definition ?	Agreed	Text amended
28			There is no need to define rotational speed. This is common vocabulary. In addition, the proposed definition is not really a definition because of the "unless otherwise specified". The definition of "variable pitch propellers" (note : this should be singular) contains a comment ("this includes (1)…(2)… (3)). The relevance of this part is not obvious. It is suggested deleting this part of the definition. The text of the "justification "paragraph should be up-dated because the paragraph "it has been considered that it would be even better etc." is no longer valid. Some definitions of JAR-1 are still relevant.	Agreed Partially Agreed Agreed	Definition deleted. Definition changed to "Propeller" Text updated

D3 NPA-P-6 Rev. 2 Comment Response Document.

Note : It has been agreed that ACP-P 230 will be completely rewritten. Accordingly the majority of the comments made are not applicable to the latest proposed text. The new text of ACJ-P 230 is based on that agreed for NPA E-33.

Comment No.	ACJ-P Ref	Comm-entor	Comment (***Proposed Text* Change** followed by Reason)	Dispo-sition	Agreed Change
1	ACJ P 230	CAA / DGAC	As a general comment, this NPA should be reviewed for technical consistency with the NPA E-33 that has been agreed by the ESG following worldwide consultation.	Agreed	This NPA has been completely re-written in line with NPA E-33.
2 to 7		CAA	All other CAA comments inapplicable to new text.	Not Applicable	See note above.
8 to 113	ACJ P15	FAA	FAA request to move the Propeller Control System definitions to ACJ 230 is agreed	Agreed	ACJ Text amended such that these definitions no longer apply.
14 to 23	ACJ P230	FAA	All FAA comments relating to ACJ P 230 text in previous NPA are inapplicable to new text.	Not Applicable	See note above.

D4 Comment Response Document for JAA NPA P-7.

Comment No.	ACJ-P Ref	Comm-entor	Comment (***Proposed Text* Change** followed by Reason)	Dispo-sition	Agreed Change
1&4	JAR P15	CAA	In a number of the Definitions proposed for addition to JAR-P 15, examples are quoted to illustrate the definition of the terms described. It is proposed that, if required at all, these illustrative examples be included as relevant ACJ material rather than included in the Definitions themselves. It would be preferable however to have definitions that were clear and required no further explanation.	Agreed	All definitions are moved to ACJ P 150 and amended where necessary since all relate to text used in the ACJ.
		DGAC	Some definitions are not useful. They do not bring any useful information for applying or interpreting JAR-P. Or in the opposite way : their deletion does not influence application or interpretation of JAR-P. Furthermore, they are not used widely enough to warrant a specific definition in JAR-P 15. For example, the word "redundancy" only appears in section 1 of JAR-P … in its definition ! These definitions are the following Assessment Check Error Failure cause Redundancy System They should be deleted. The need for definitions of "failure condition" and "failure mode" in JAR-P 15 is not obvious. "Failure condition" appears only 3 times in section 1: in its definition added by this NPA, in JAR-P 150 as proposed by this same NPA or in JAR-E 130 as proposed by NPA-P-8. "Failure mode" appears only 3 times in section 1: in its definition added by this NPA, in definition of "failure cause" added by this same NPA or in JAR-E 370. Note that "dormant failure" appears only twice: in its definition and in JAR-P 150, both added to JAR-P by this NPA. These 3 definitions could be transferred to ACJ.	Noted and partially agreed	Addressed by action taken in response to comment above.

			Conclusion : it is suggested cancelling proposal A1 of this NPA.		
15	JAR P 15	FAA	It is proposed that the definitions be advisory in ACJ P 150 not regulatory in JAR 15. Also, the following words and phrases are not in the requirements and therefore do not need to be defined in a regulatory manner: Dormant failure Error. Failure cause In addition System is used through out JAR P with various definitions. Examples include, safety systems, retention systems, control systems. A single definition could result in confusion.	Agreed	All definitions are moved to ACJ P 150 and some examples have been removed.
3	JAR P 15	DGAC	The paragraph number in JAR-P 15 should be identified.	Noted	Text deleted in response to other comments.
	JAR P 15	FAA	Move all definition to ACJ P 150	Agreed	Text moved to ACJ
5	JAR P 150(a)	DGAC	In (a)(1)(ii), “dormant failure” should have capital letters if it is a defined term (however, see comment on proposed JAR-P 15). In (a)(1)(iii) and (a)(2), the word “JAR-P 150” should be added before references to (d), (g)(1) and (g). In (a)(3), “extremely remote” should have capital letters, if it is a defined term in JAR-P or JAR-1. Same for “remote” in (a)(4).	Noted Agreed Agreed	This definition has now been moved to ACJ P 150 Text amended Text amended
16	**JAR-P 150(a)(1)**	FAA	**a) (1) An analysis of the Propeller shall be carried out to assess the likely consequence effects of each failure condition under stated aircraft operating and environmental conditions. This analysis will consider -**	Agreed	Text amended
3	**JAR-P 150 (a) (3)**	CAA	**JAR-P 150 (a) (3)** "judgment" should read "judgement"	Agreed	Text corrected

6	JAR P 150(c)	DGAC	Editorial. “primary failure” should have capital letters if it is a defined term (see NPA-P-9). This raises the question of integration of NPA-P-7 and NPA-P-9 into JAR-P. Depending on the order of integration, the end result for JAR-P 150 (c) would be different ! In these two NPAs, there should a note for the publishing office giving the order for the integration.	Noted Noted	NPA P 9 Definitions have been moved to ACJ P 160. This should be highlighted in the covering letter from ESG to CJAA
17			(c) It is recognized that the probability of primary failures of certain single elements (for example, blades) cannot be sensibly estimated in numerical terms. If the failure of such elements is likely to result in Hazardous Propeller Effects, they will be identified as **Propeller** Critical Parts and reliance must be placed on meeting the prescribed integrity requirements of JAR-P 160. These instances shall be stated in the safety analysis.	Agreed	Text amended
7	JAR P 150(e)(2)	DGAC	What is the definition of “functioning of safety” ? This wording must be clarified.	Agreed	The text is consistent with NPA-E-38
18	JAR P 150(g)(1)	FAA	(1) The following are regarded as Hazardous Propeller Effects - **(i) A significant overspeed of the propeller.** (**i**i) The development of excessive drag. (i**i**i) A significant thrust in the opposite direction to that commanded by the pilot.	Disagree	Significant overspeed is not hazardous as long as drag, thrust remain acceptable and there is no release of the propeller or major proportion of the propeller.
			(~~ii~~**iv**) A release of the Propeller or any major portion of the Propeller. (~~i~~v) A failure that results in excessive unbalance. (**vi) Unintended movement of the propeller blades below the established minimum in-flight low-pitch position.**		Movement to a pitch below minimum in flight low pitch position is not hazardous as long as drag, thrust remain acceptable and there is no release of the propeller or major proportion of the propeller.

8	JAR P 150(g)(2)	DGAC	3.1 Editorial. Depending on decision on NPA-P-5, some words, if defined in JAR-P 15, should have capital letters. 3.2 Contrary to JAR-E 510, there is no definition of a “Minor Propeller Effect”. Does this means that there are only major and hazardous propeller effects ?	Agreed Disagreed	Text amended as necessary JAR P 150 is consistent with JAR-E / CSE 510 In that a target failure rate is not specified for Minor effects. Consequently it is not considered necessary to define Minor propeller effects in JAR P.
19	JAR P 150(g)(2)	FAA	(2) The following are regarded as Major Propeller Effects - (i) An inability to feather the Propeller (for feathering propellers). (ii) An inability to change Propeller pitch when commanded. (iii) **Significant** ~~An~~ uncommanded change in pitch. (iv) **Significant** ~~An~~ uncontrollable torque or speed fluctuation.	Disagreed	JAA consider any uncommanded change in pitch, or uncontrollable torque or speed fluctuation to be to be a major effect.
20	ACJ P 150	FAA	Move definitions into ACJ P 150.	Agreed	Text amended
9	ACJ P 150, para 1	DGAC	First sub-paragraph should be deleted : obvious statement valid for all ACJs. Second sub-paragraph refers to “safety analysis” when third sub-paragraph refers to “safety assessment”. Note that in paragraph (3)(a), we find “propeller assessments” : is this intended to be “propeller safety assessments” ? Consistency of vocabulary should be ensured.	Disagreed Agreed	Similar text is used in JAR E. This proposal was kept as close to JAR-E as possible. Text amended as necessary to ensure consistent terminology.
10	ACJ P 150, para (2)	DGAC	It is assumed that the “Major, Hazardous Propeller Effects” does not designate another category of effects and that the intent is to read “Major or Hazardous Propeller Effects” ?	Agreed	Text corrected
11	ACJ P 150, para (3)	DGAC	3.1 It is assumed that the reference to JAR-E 515 is an error and that this should be JAR-P 160.	Agreed	Text corrected

			3.2 “Prescribed integrity requirements such as JAR-E 515, **<u>among others</u>**” : this is not what is required in JAR-P 150 (c). This is then rulemaking by advisory material.	Agreed	Text corrected
			3.3 The grammar is sometimes curious. It reads as : “Those failures .. that could be classified as hazardous events include not all the effects listed in JAR-P 150 (g)(1) may be applicable”. Below that sentence, there is a list of effects without any introductory paragraph. This should be clarified.	Agreed	Text corrected
			3.4 The purpose of the “list” referred to in comment 3.3 is not clear. Items 1 and 3 in that list are already covered by JAR-P 150 (g)(1)(ii). What would be the effect of the event noted in item 2 ? Is it covered by JAR-P 150 (g)(1)(i) or (ii) ? If it is hazardous and not already covered in JAR-P 150, why is it not added to JAR-P 150 (g)(1) ?	Agreed	Text corrected
21	ACJ P 150, para (3)(c)	FAA	(c) Typical installation The reference to "typical installation" in JAR-P 150 (a)(1)(i) does not imply that the aircraft-level effects are known, but that assumptions of typical aircraft devices and procedures, such as **governors** ~~**fire-extinguishing equipment**~~, annunciation devices, etc., are clearly stated in the analysis.	Agreed	Text amended
22	ACJ P 150, para (3)(d)(ii)	FAA	(ii) When considering primary failures of certain single elements such as **Propeller** Critical Parts, the numerical failure rate cannot be sensibly estimated. If the failure of such elements is likely to result in Hazardous Propeller Effects, reliance must be placed on their meeting the prescribed integrity requirements, such as ~~**JAR-E 515**~~ **JAR-P 350 and 370**, among others. These requirements are considered to support a design goal that~~,~~ ~~**among other goals, primary LCF (Low Cycle Fatigue)**~~ failure of the component should be Extremely Remote throughout its operational life.	Partially Agreed	Removed ref to LCF and reference to JAR P 160 added regarding integrity. (The proposed references to JAR-P 350 and 370 are incorrect).
23	ACJ P 150, para (3)(d)(ii)	FAA	Not all the effects listed in JAR-P 150(g)(1) may be applicable to all propellers or installations, owing to different design features**.**~~**, and the list is not intended to be exhaustive.**~~ ~~**- Uncommanded reverse thrust selection on ground**~~ ~~**- Unintended in-flight movement of the propeller blades below the established minimum inflight low-pitch position;**~~ ~~**- High forward thrust when reverse thrust is commanded on the ground.**~~	Partially Agreed	List has been removed but reference to “exhaustive” has been kept.

12	ACJ P 150, paragraph (3)(e)	DGAC	The word “engine” appears three times. Is this really the intent or should this be “propeller” ?	Agreed	Text corrected
13	ACJ P 150, paragraph (3)(h)	DGAC	Is the statement in third sub-paragraph, copied on ACJ E 510, really true for propellers ?	Partially Agreed	Text revised
14	Justification		This justification should be reviewed for accuracy (for example, incorporation of NPA-P-3 into FAR 35 is unlikely to happen).	Agreed	Text corrected.
4	ACJ P 150	CAA	It is suggested that paragraphs 5 and 6 of proposal B be deleted entirely.	Agreed	Paragraph 5 is deleted however, there is no paragraph 6 in NPA-P-7
24	ACJ P 150, paragraph (5)	FAA	Hazardous and Major definitions /descriptions should be added in para 5.	Disagree	These failure effects are adequately defined in the rule.

D5 Comment Response Document for JAA NPA P-8.

Comment No.	JAR-P Ref	Comm-entor	Comment (***Proposed Text* Change** followed by Reason)	Dispo-sition	Agreed Change
1	JAR P 130	CAA	The justification for this NPA rests solely on the subject of "Fire" being identified as a difference between JAR-E and JAR-P. This difference alone is not considered to justify the introduction of a new requirement with regard to Propellers. A more robust justification, based upon a demonstrated need to address a safety of flight issue, or a need to harmonise between FAR 35 and JAR-P, is considered necessary before this NPA could be adopted. In the absence of any service experience that shows that there is a safety of flight issue that needs to be addressed by new rulemaking activity, the CAA-UK believe that there is no need for the introduction of Fire requirements for Propellers as proposed in this NPA. The CAA-UK, in taking this view, has therefore not developed any detailed comments on the content of this NPA.	Partially Agreed	The JAR-P Sub Group agree with the opinion that fire does not present a safety of flight issue for propellers in general. However, for parts of a Propeller System located inside a fire zone, a requirement is considered justified. The Group agreed that these parts should be required to be fire resistant and that this should be stated in JAR-P 230.
2	JAR-P 130	FAA	**JAR P-130 Fire Precaution** **Propeller components that are located in the vicinity of an ignition source or are located within the engine fire zone must meet CS-E 130.** **Reason(s) for proposed text/comment:** The rule should be completely re-written or deleted to meet the intent as written in the Justification section of NPA P-8. NPA P-8 states that "There are requirements for "fire" in JAR-E for the engine on which a propeller is attached and in the aircraft codes for the aircraft in which the engine / propeller combination is installed. It has been found adequate to harmonise these various certification codes for consistency, especially if some parts can be part of the propeller, or part of the engine, or part of the aircraft, depending on the design and on the business agreement between the type	Partially Agreed	Position as above.

			certificate holders for the propeller, the engine and the aircraft." If this is a known loop hole that has been identified than the requirement should be written to specifically address the loop hole and not be extended to the entire propeller. If the intent of the rule is to cover those propeller components that are mounted to the engine or located in the engine fire zone or may catch fire than the rule should be modified to state that. As written the rule could potentially prevent wood or composite blades and oil filled hubs. The change meets the intent as written in NPA-P 8. The rule should not be intended to cover rotating propeller parts. It should be added that there has never been a known accidents cause by a propeller fire. Unlike an engine the propeller does not have "hot" sections for combustion. There may be some propeller components such as a control system that would be mounted on the engine. If appropriate these components should meet the same requirements as the engine mounted components.		
3	JAR-P 130	DGAC	3.1 "propellers" should be changed into "the propeller".	Not Applicable	Text now deleted in response to earlier comment
4			3.2 "Internal fire" : this wording comes from JAR-E. Is this concept also valid for propellers ?	Not Applicable	Text now deleted in response to earlier comment
5			This wording comes from JAR-E. Is this concept also valid for propellers ?	Agree	See above comment

D6 Comment Response Document for JAA NPA P-9.

Comment No.	JAR-P Ref	Comm-entor	Comment (***Proposed Text* Change** followed by Reason)	Dispo-sition	Agreed Change
1	JAR-P 150 JAR-P 160 ACJ P 160	CAA	The CAA-UK supports this NPA. However, the CAA would recommend that the JAA ESG task the relevant sub-group to review this NPA-P-9 with the final version of NPA-E-44 as amended following world-wide consultation.	Agreed	New text of original NPA-P-9 has been revised in line with revision 2 of NPA-E-44
2		FAA	The Federal Aviation Administration (FAA) has provided comments on previous versions of the Certification Requirements for Propellers. These include NPA-P 3, and draft versions of JAR-P and CS-P. Some of the comments have been adopted and some have not. At this point in time it is assumed that the requirements previously recommended for deletion will be adopted in some form into JAR-P. This includes: JAR-P 160 Propeller Critical Parts - It is recommended that this requirement not be adopted until Authority and Industry consensus be reached. This requirement has not received adequate review by the Propeller Harmonization Working Group. Therefore, comments will be provided regarding JAR-P 160 even though the overall recommendation is that it not be adopted at this time.	Noted	
3			**~~(xxx) Terms associated with Propeller Critical Parts~~** **~~Approved Life~~** **~~means the mandatory replacement life of a part which is approved by the Authority.~~**	Agreed	