BEE-Plane Project

Certification Part

TRL2

Project Manager :

Xavier Dutertre

Marie Andreeff

David Langlois

Marion Leroy

Guillaume Maillot

ESTACA 2013-2014

5A Levallois-Perret

Thanks

We would like to express our sincere thanks to our project manager, M. Xavier Dutertre, for guiding us right from the inception till the completion of the project. We sincerely acknowledge him for extending his valuable guidance, support for literature, critical reviews of project and the report and above all the moral support he had provided to us with all stages of this project.

We would like to thanks our certification teacher and our maintenance teacher, M. Benjamin Astruc and M. Yves Leberre , for giving us the bases in the certification process and maintenance planning.

We also want to thanks M. Loïc Lemattre for his help with the Project Management course.

We would like to thanks M. Marc Weber, our promotion director, for his help and cooperation throughout our project.

Table of Contents

Introduction

This project of a new kind of airplane - which could carry anykind of cargothanks to its detachable fuselage – has been proposed to our team at the end of October 2013. First thing to know is that the Bee-Plane is a collaborative project, we are now 50 students working on this study from several universities around Europe like ESTACA, INSA, Trinity College Dublin and others. All of these actors are working on different aspects of the plan.

In October, the current step of the project was the TRL2, which is a Technology Readiness Level relative to the technology concept and/or the application formulated. We were asked to work on the maintenance side of the Bee-Plane, and the prerequisites required for this task was the introductory course intheaircraft certification, which wewere givenat the beginning ofourschool year. Our project manager, Xavier Dutertre, allowed us tochoose which part ofthecertificationwewanted to study, andwe have choseneverything aboutmaintenance organizations, the Part 145, the PartMandtheAMM.

Our mains objectives was to get involved in the TRL2 development, to collect the documentation about the certification of a new aircraft, to explain the certification processes and the actors involved, to prepare the certification of the Bee-plane and to focus on part 145 & M, to identify the critical points, and to propose a maintenance program.

Issue

How to write an AMM? Are there other relevant documents to write before and what are they?

Abbreviation List

EASA : European Aviation Safety Agency

APRS : Approval for Release to Service

MOE : Specifications Manual of theMaintenance Organization

CS : Certification Specifications

CAMO : Continuing Airworthiness Management Organization

MRO : Maintenance Repair Overhaul

CAME : Continuing Airworthiness Management Exposition

AMM : Aircraft Maintenance Manual

TRL :Technology Readiness Level

IPC : Illustrated Parts Catalog

ISC : Industry Steering Committee

MPP :The Maintenance Program Proposal

MRB : Maintenance Review Board

MRBR : Maintenance Review Board Report

MSI : Maintenance Significant Items

MWG : Maintenance Working Groups

PPH : Policy and Procedures Handbook

SSI : Structural Significant Items

ZIP : Zonal Inspection Program

AISS :Aircraft Information System Security

ASM :Ageing Systems Limitations

CDCCL : Critical Design Configuration Control Limitations

CMR :Certification Maintenance Requirements

DFLP :Demonstrated fatigue Life Parts

EIS :Entry Into Service

FAL :Fuel Airworthiness Limitations

FC :Flight cycles

FH :Flight hours

LLP :Life Limited Parts

SSA :System Safety Assessment

TC :Type Certificate

I. Project Management

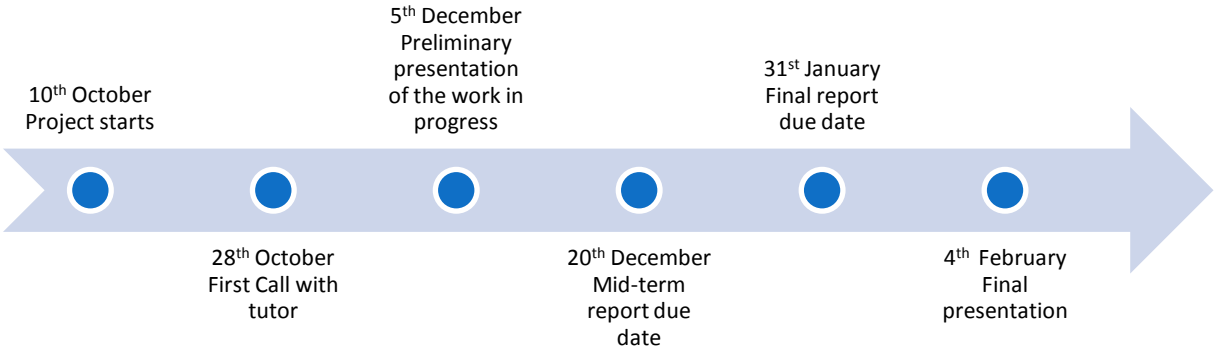
The team

Marie Andreeff, David Langlois, Marion Leroy, Guillaume Maillot

1) Our Objectives

- Get involved in the TRL2 development
- Collect the documentation about the certification of a new aircraft
- Explain the certification processes and the actors involved
- Prepare the certification of the Bee-plane
- Focus on part 145 & M
- Identify the critical points
- Propose a maintenance program

2) Planning

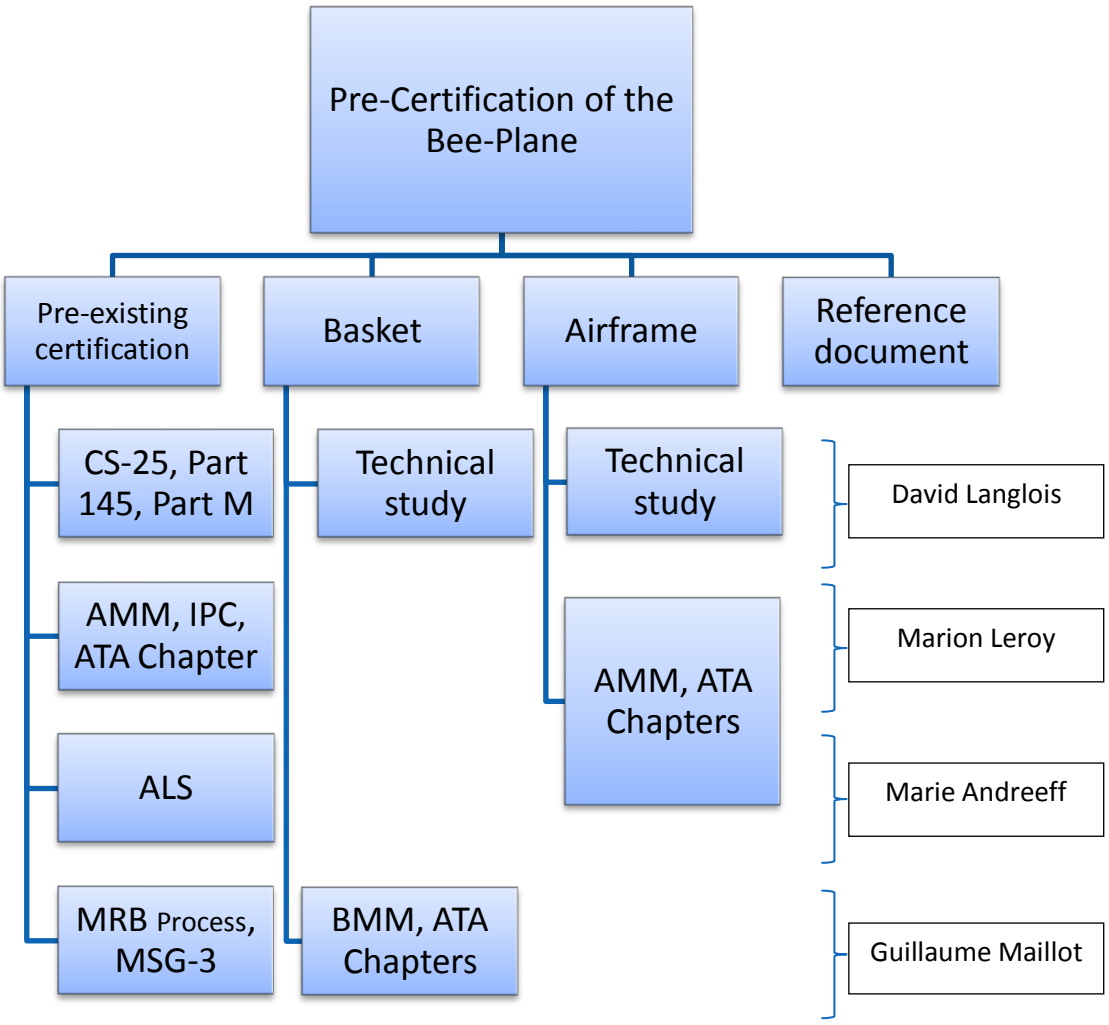


Week	Type	Action
Week 1	Meeting	First meeting with the team
22/10/2013	Meeting	Set the first meeting with the manager
to	Search	Technical literature research on the A321
17/10/2013	Search	Search of technical documents: AMM, A/C manual
Week 2	Meeting	**Conference call with the manager**
18/10/2013	Meeting	Debriefing with the team
to	Search	Research on the EASA website: part M and part 145
02/11/2013	Search	Search of some specific documentation regarding detachable elements

Week 3 *04/11/2013* *to* *09/11/2013*	Meeting ATA Lesson	Debriefing with the team Research of the ATA chapter list and choice of the relevant chapters Project Management
Week 4 *11/11/2013* *to* *16/11/2013*	Meeting Admin Search Analysis	Debriefing with the team Create of a file with all the official documentation Research of CS-25 Focus on the certification of the basket
Week 5 *18/11/2013* *to* *23/11/2013*	Meeting Meeting Search Search Writing	**Conference call with the manager** Debriefing with the team Research on MRO market Research on the ALS process Report on the ALS process
Week 6 *25/11/2013* *to* *30/11/2013*	Meeting Writing Writing Admin Writing	Debriefing with the team Awareness to Part 145 (Word document) Presentation of the AMM and IPC documents Open Bee License, Registration of the group on TechnoPlane database (server) Report on the MRO market
Week 7 *02/12/2013* *to* *07/12/2013*	Meeting Writing Meeting	Debriefing with the team Summarize of the certification process (scheme) **Conference call with the manager**
Week 8 *09/12/2013* *to* *14/12/2013*	Meeting Writing Analysis Analysis Analysis	Debriefing with the team Excel table about the documentation we have Structure of the AMM with new ATA Chapters Study on the MSG-3 and the MRB process Study of the case where manufacturer diff. Designer
Week 9 *16/12/2013* *to* *20/12/2013*	Meeting Writing Meeting Writing	Debriefing with the team Preparation of the PPT presentation and Project Management **Conference call with the manager** Intermediate report
Week 10 **Week 11**	X-mas holidays	
Week 12 *06/01/2014* *to* *11/01/2014*	Meeting Analysis	Debriefing with the team Study of the BMM (Basket Maintenance Manual)
Week 13 *13/01/2014* *to* *18/01/2014*	Meeting Writing	**Conference call with the manager** Final report
Week 14 *20/01/2014* *to* *25/01/2014*	Meeting Writing	Debriefing with the team Final report
Week 15	Meeting	Debriefing with the team

27/01/2014 to 01/02/2014	Writing Writing	Final report PPT presentation of the key points
Week 16 *03/02/2014 to 08/02/2014*	Meeting Presentation	Debriefing with the team **Conference call with the manager**

3) Breakdown Structure and Task Sharing



4) Risk Analysis

Risk	Probability	Impact	Consequences on the project	Solutions
Time Management	4	Critical	• Light report • Not original • Out of time • Stress	• Application of the PM Methodology • Good Communication
Lack of Experience	3	Major	• Impact on Time management • Lack of initiative • Bad interpretation of documentation	• Request information from teachers and tutor • Study of lessons given in class • Study of documentation
Team Organization	2	Major	• Difficulties related to an open project	• Creation of a Facebook group • Registration on the technoplane database
Lack of Reference	2	Major	• Writing mistakes	• Request information from teachers or tutor

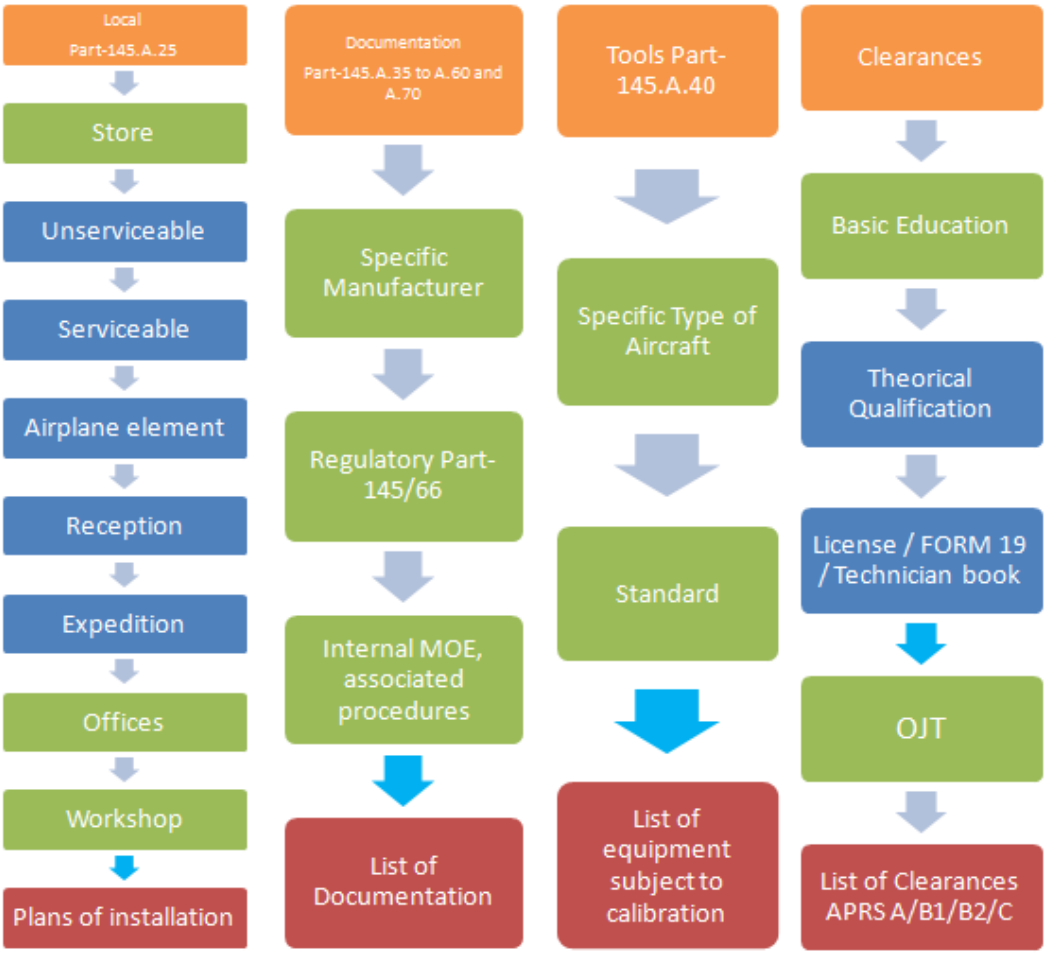
II. Maintenance Certification Documents

1) Part 145 : Maintenance Organization Approval

First, we should say that if an organization wants to make the maintenance and to deliver the APRS (Approval for Release to Service) of a plane, then she must be approved Part 145 (if she is in a country member of the EASA). In fact, the Part 145 specifies the requirements of the maintenance workshops of aircrafts and elements of aircrafts intended to be put back in service in public air transport.

So according to EASA and Jar, Part 145 relates to maintenance, as well as Part M, and is about regulations for the approval of maintenance organizations. Be approved by EASA means that the body is recognized able by its supervisory authority (DGAC in France) to carry out work in a defined scope.

Summary of key regulatory requirements



Hereafter are few examples of the main chapters of Part 145 :

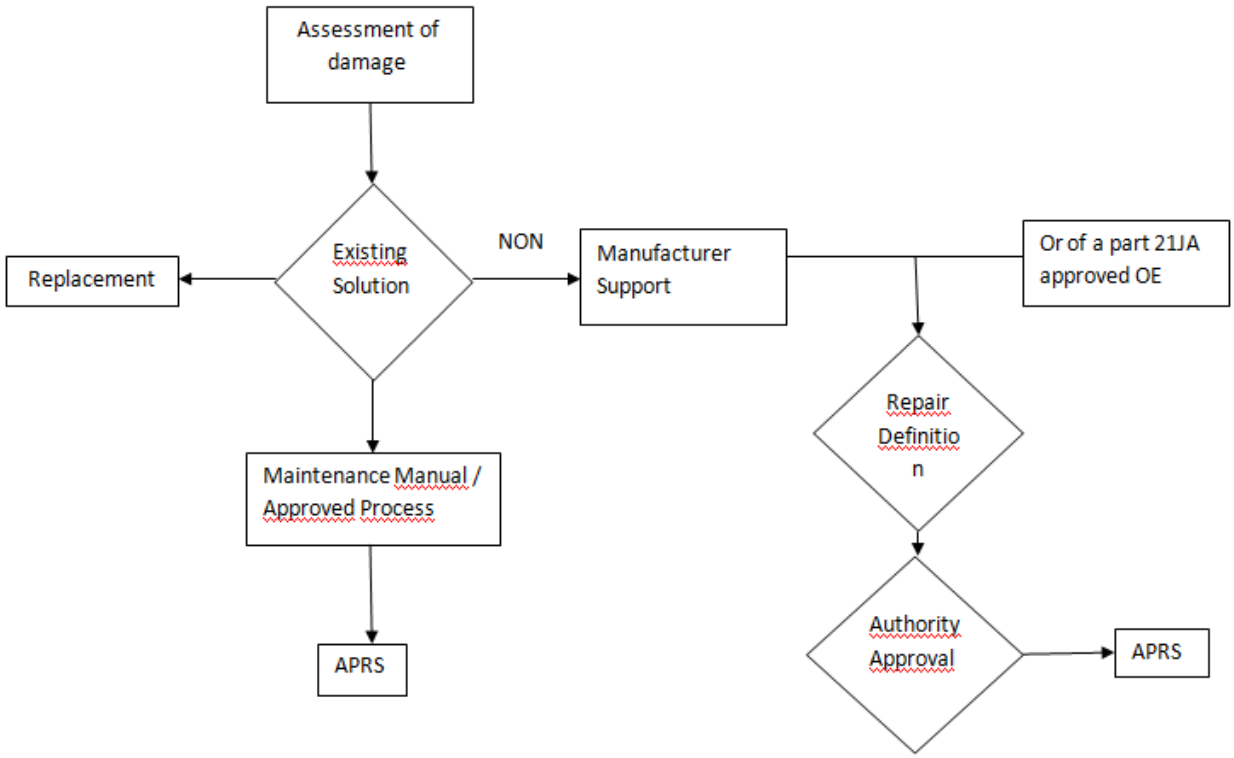
145.A.40 :Instruments-Tools –Hardware

- *Arrangement :*according conservation rules or customers requests
- *Segregation :* when non-compliant (in area type "Unserviceable")
- *Identification :*with next inspection / verification / calibration (measuring instruments) / eventually expiration date / with EASA Form one ...
- *Control :*by a recognized organization or according to internal procedures required to use
- *Documentation :*facility management lists / preservation of Evidence

145.A.45 : Maintenance Data

- Airworthiness Directives, Service Bulletin, Contract for outsourced maintenance, Maintenance Manual, Maintenance Program,…
- Instructionsof a maintenance datamayonly be amendedfollowinga procedure of the MOE(except incase of modification orrepair).
- For datapublished by theDesign Organisation, it must be informed ofany deviation froman approved data.
- Establishmentof a procedurefor the organization topostponethe authorof a documentany abnormalitiesthat can lead toinaccuracy,vagueness, ambiguity in themaintenanceinstructionsprovided by him.

Repair Solution



- *Work Cards :* transcribed from manufacturer data
- *Registration :*maintenanceoperations fromjob cards / Retained for2 years, protected from fire, flood ...(PART145.55)
- *Updating :* data confirmed by the customer

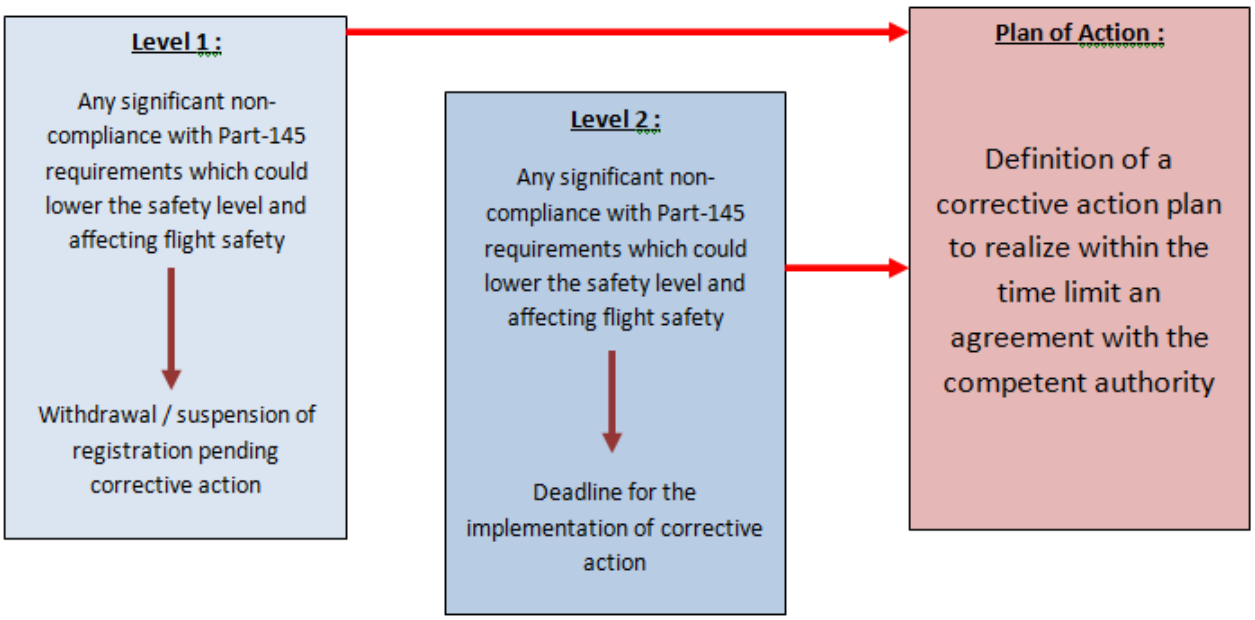
145.A.55 : Recording of the Maintenance Work

- *Register :*alldetails of the workand at leastkeep therecorddemonstrating compliance with therequirements.
- *Supply :*tothe operator,a copy of thecertificate of release toservice anda copy of anyrepair/modificationapproved data.
- *Keep :* for 2 years,a copy ofall recordsand anyassociatedmaintenance data / protect these documentsfromfire, theft, floods / backups shouldbe storedin a different placeofwork supports.

145.A.70 : MOE, Specifications Manual of the maintenance organization

- Description of the management, the organization chart, the commitment quality-safety of the direction, the description of premises, field of intervention and activity sector of the OE (list planes).
- Audit program,fault management, training and monitoring ofqualified personnel.
- Documents, forms, labels to be usedduring the work: theyare described andincludedin the proceedings.

145.A.95 : Findings (by the GSAC, Safety Group for Civil Aviation)



Regarding the Bee-Plane, some things will pose problems, or bring to investigate this case more closely in the implementation of Part 145. Indeed, the operation of this aircraft is certainly not

"common", it will define, for example if the same company will be responsible for maintenance of the basket and fuselage, or whether if a staff must be trained for each specificity of the aircraft (such as clips, ...).

For example, thePart 145.A.25 concerning the premiseswillsurely changegiven theuse of the aircraftand the factthat it has adetachablefuselage.

Requirements for maintenance organizations will therefore be changed somewhat; clauses will surely be added to the expectations for the maintenance of the aircraft.

2) Part M : Continuing Airworthiness

When the Part 145sets out theterms ofthe approvalof maintenance organizationsundermaintenance, the Part Mexplainsthemanagement of the continuingairworthiness of an aircraft. EASA Part-M consists of several subparts. The noteworthy subparts are F (Maintenance for aircraft below 5700 kg in non commercial environment), G (Continuing Airworthiness Management Organization = CAMO, coordinating the compliance of aircraft with maintenance program, airworthiness directives and service bulletins).

The Part 145 is usually used by the MRO Center (Maintenance, Repair, Overhaul), whereas the Part M is used by CAMO. A CAMO care, as their name suggests, airworthiness of aircraft. They can be part of the organization of an air carrier or so conduct their business independently. In addition to their basic approval, these organizations can also get the privilege to conduct the mandatory annual technical review of aircraft covered by Regulation (EC) No 216/2008 and, under certain conditions, to issue permits to fly. The CAMO has duties include establishing an aircraft maintenance programs and control or coordinate the alteration, repair or maintenance required, and that's here that Part M helps and tell how to do things in the right way, according to the regulation. They also conduct periodic technical review of aircraft (if they have privileges for this purpose) and manage technical aircraft records. They are also free to offer other benefits of private law to aircraft operators.

On theBee-Plane, the application ofPart M will evolvetothe same scale asthePart 145, that is to say according tothespecificitiesof the plane which will influence the continuing airworthiness management.

Application for approval according to the Part M, subpart G of the regulation (CE) n°2042/2003

"The request is deposited by means of forms 2 and 4 of the EASA, to which we shall join the CV of the manager responsible for the CAMO. The applicant is then invited in a first interview to agree on formalities to be carried out and of their calendar. He receives besides a copy of a standard CAME (Continuing Airworthiness Management exposition or manual worker of the management institution of the preservation of the airworthiness), to facilitate him the writing of his own manual worker."

3) Airworthiness details

The owner of the aircraft is responsible of the continued airworthiness. All requirements have to be established by the Type Certificate owner.

This is an example of agreement fields which could be suggested by a maintenance organism, it could be an aircraft manufacturer on an independent operator.

Example of agreement fields

Aircraft : category A1, turbopropeller aircraft

Engines :

- B1 : Turbine
- C1 : APU

Components other than complete engines or APUs

- C1 : Air conditioning & pressurization
- C3 : Communication & navigation
- C4 : Doors & Hatches
- C5 : Electrical power & lights
- C6 : Equipment
- C8 : Flight controls
- C9 : Fuel
- C12 : Hydraulic power
- C13 : Indicating-recording system
- C14 : Landing gear
- C15 : Oxygen
- C16 : Blades
- C17 : Pneumatic & vacuum
- C18 : Protection ice/rain/fire
- C19 : Windows
- C20 : Structural

Specialised services

- D1 : Non-destructive testing

Within "Non-destructive testing" we can find the Eddy current, Ultrasonic, Radiography, Penetrant inspection, Magnetic particle and Thermographic inspection.

This type of agreement is based on this one from the Airbus aircraft, therefore some parts will be adjust in accordance with the Bee Plane features.

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

dgac
DSAC

MINISTÈRE DE L'ÉCOLOGIE, DU DÉVELOPPEMENT DURABLE ET DE L'ÉNERGIE

Direction Générale de l'Aviation Civile

DIRECTION DE LA SECURITE DE L'AVIATION CIVILE
Membre de l'Union Européenne
(A Member of the European Union)

CERTIFICAT D'AGREMENT D'ORGANISME DE MAINTENANCE

(MAINTENANCE ORGANISATION APPROVAL CERTIFICATE)

FR.145.100

Conformément au règlement (CE) n° 216/2008 du Parlement Européen et du Conseil et au règlement (CE) n°2042/2003 de la Commission actuellement en vigueur, et dans le respect des conditions énoncées ci-dessous, la Direction Générale de l'Aviation Civile certifie :
(Pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council and to Commission Regulation (EC) No 2042/2003 for the time being in force and subject to the conditions specified below, the Direction Générale de l'Aviation Civile hereby certifies:)

AIRBUS
1 Rond Point Maurice Bellonte
31707 BLAGNAC CEDEX
FRANCE
Sites d'entretien en base / *Base Maintenance locations*:
Colomiers - Toulouse - Nantes (France)
Finkenwerder - Bremen - Stade (Allemagne)
Getafe - Puerto Real (Espagne)

comme organisme de maintenance conformément à l'annexe II (Partie 145), section A, du règlement (CE) n° 2042/2003, agréé pour entretenir les produits, pièces et équipements énumérés dans le domaine d'agrément joint et délivrer les certificats correspondants de remise en service en utilisant la référence ci-dessus.
(as a maintenance organisation in compliance with section A of Annex II (Part-145) of Regulation (EC) No 2042/2003 approved to maintain the products, parts and appliances listed in the attached approval schedule and issue related certificates of release to service using the above reference.)

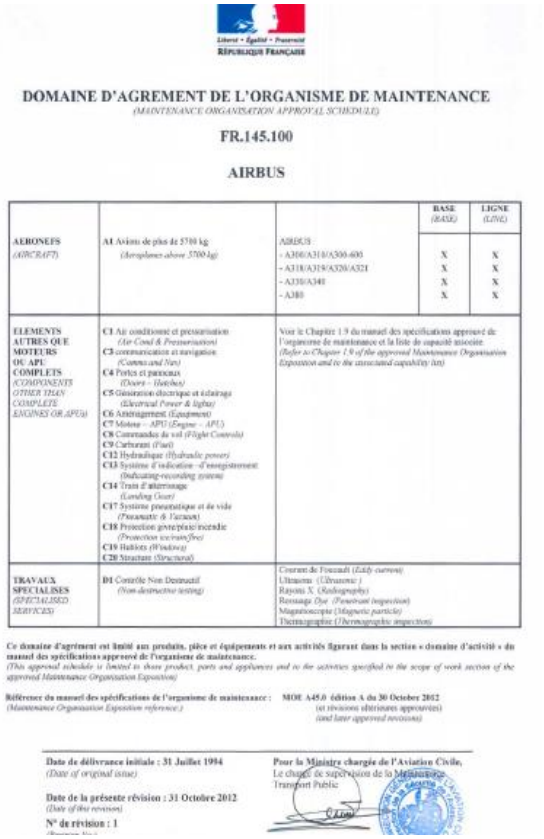
CONDITIONS :

1. **Le présent agrément est limité au domaine spécifié dans la section « domaine d'activité » du manuel des spécifications approuvé de l'organisme de maintenance visé à l'annexe II (Partie 145), section A du règlement (CE) n° 2042/2003.**
(This approval is limited to that specified in the scope of work section of the approved maintenance organisation exposition as referred to in Annex II (Part-145), section A of Regulation (EC) No 2042/2003)
2. **Le présent agrément exige de respecter les procédures définies dans le manuel des spécifications approuvé de l'organisme de maintenance.**
(This approval requires compliance with the procedures specified in the approved maintenance organisation exposition)
3. **Le présent agrément est valable tant que l'organisme de maintenance agréé respecte les dispositions de l'annexe II (Partie 145) du règlement (CE) n° 2042/2003.**
(This approval is valid whilst the approved maintenance organisation remains in compliance with Annex II (Part-145) of Regulation (EC) No 2042/2003.)
4. **Sous réserve du respect des conditions énoncées ci-dessus, la durée de validité du présent agrément est illimitée, sauf si l'agrément a auparavant été rendu, remplacé, suspendu ou retiré.**
(Subject to compliance with the foregoing conditions, this approval shall remain valid for an unlimited duration unless the approval has previously been surrendered, superseded, suspended or revoked)

Date de délivrance initiale : 31 Juillet 1994
(Date of original issue)

Pour la Ministre chargée de l'Aviation Civile,
Le chargé de supervision de la Sécurité
Transport Public

Date de la présente révision : 31 Octobre 2012



Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

DOMAINE D'AGREMENT DE L'ORGANISME DE MAINTENANCE

(MAINTENANCE ORGANISATION APPROVAL SCHEDULE)

FR.145.100

AIRBUS

			BASE *(BASE)*	LIGNE *(LINE)*
AERONEFS *(AIRCRAFT)*	**A1** Avions de plus de 5700 kg *(Aeroplanes above 5700 kg)*	AIRBUS - A300/A310/A300-600 - A318/A319/A320/A321 - A330/A340 - A380	X X X X	X X X X
ELEMENTS AUTRES QUE MOTEURS OU APU. COMPLETS *(COMPONENTS OTHER THAN COMPLETE ENGINES OR APUs)*	**C1** Air conditionné et pressurisation *(Air Cond & Pressurisation)* **C3** communication et navigation *(Comms and Nav)* **C4** Portes et panneaux *(Doors – Hatches)* **C5** Génération électrique et éclairage *(Electrical Power & lights)* **C6** Aménagement *(Equipment)* **C7** Moteur – APU *(Engine – APU)* **C8** Commandes de vol *(Flight Controls)* **C9** Carburant *(Fuel)* **C12** Hydraulique *(Hydraulic power)* **C13** Système d'indication –d'enregistrement *(Indicating-recording system)* **C14** Train d' atterrissage *(Landing Gear)* **C17** Système pneumatique et de vide *(Pneumatic & Vacuum)* **C18** Protection générale/ incendie *(Protection ice/rain/fire)* **C19** Hublots *(Windows)* **C20** Structure *(Structural)*	Voir le Chapitre 1.9 du manuel des spécifications approuvé de l'organisme de maintenance et la liste de capacité associée. *(Refer to Chapter 1.9 of the approved Maintenance Organisation Exposition and to the associated capability list)*		
TRAVAUX SPECIALISES *(SPECIALISED SERVICES)*	**D1** Contrôle Non Destructif *(Non destructive testing)*	Courant de Foucault *(Eddy current)* Ultasons *(Ultrasonic)* Rayons X *(Radiography)* Ressuage *Dye Penetrant inspection)* Magnétoscopie *(Magnetic particle)* Thermographie *(Thermographic inspection)*		

Ce domaine d'agrément est limité aux produits, pièce et équipements et aux activités figurant dans la section « domaine d'activité » du manuel des spécifications approuvé de l'organisme de maintenance.
(This approval schedule is limited to those product, parts and appliances and to the activities specified in the scope of work section of the approved Maintenance Organisation Exposition)

Référence du manuel des spécifications de l'organisme de maintenance : **MOE A45.0 édition A du 30 Octobre 2012**
(Maintenance Organisation Exposition reference:) (et révisions ultérieures approuvées)
(and later approved revisions)

Date de délivrance initiale : 31 Juillet 1994
(Date of original issue)

Date de la présente révision : 31 Octobre 2012
(Date of this revision)

N° de révision : 1

Pour la Ministre chargée de l'Aviation Civile,
Le chargé de supervision de la Sécurité
Transport Public

III. Maintenance Certification Process

1) Actors

The design of a new aircraft, engine and all the components that constitute, must be approved.
In this chapter we are going to define and describe the role of each actor for the certification and maintenance processes of a new innovative aircraft; the bee-plane.

2.1 The Authorities

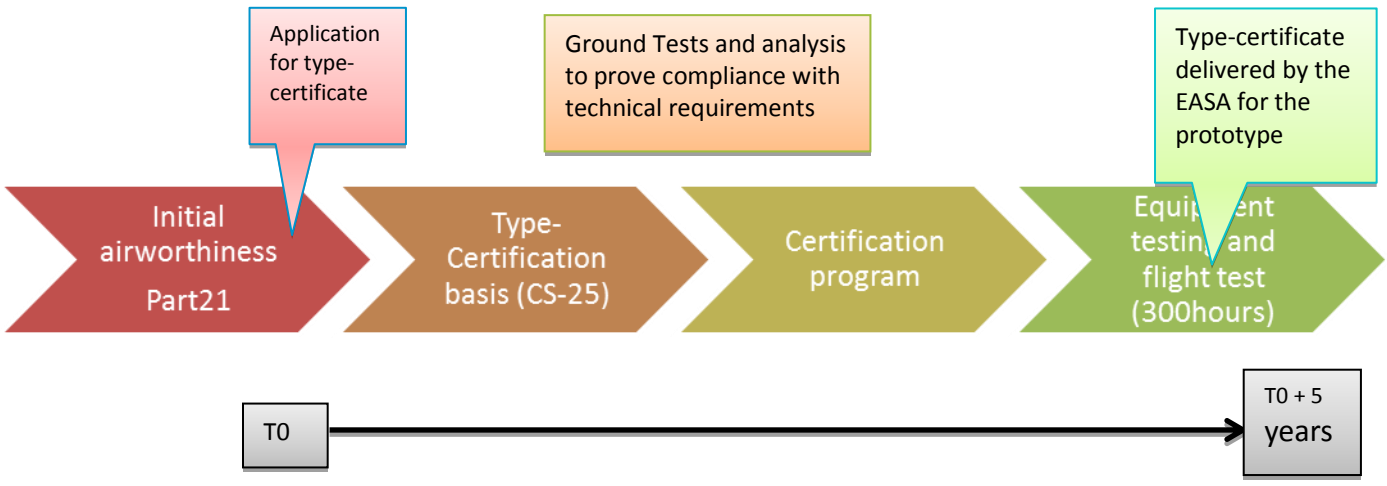
In terms of rules and regulation, the supreme authority is the International Civil Aviation Organization. The ICAO council (36 state-members) adopts standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference and facilitation of border-crossing procedures international civil aviation. ICAO defines the protocols for air accident investigation followed by transport safety authorities in countries signatory to the Convention on International Civil aviation (Chicago Convention).

In Europe the main authority is **the European Aviation Safety Agency (EASA)**, the EASA promotes the highest standards of safety and environmental protection in civil aviation in Europe and **issues certifications for aircraft and aeronautical products.** In France the **Direction générale de l'aviationcivile (DGAC) delivers most the approvals**.

In this report we will call "authority" the specified organization that delivers the approvals along all the development steps.

2.2 The TC Holder

In order to certify a new aircraft design, you have to apply for a Type certificate (or TC). The applicant has to register to the authority presenting a 3-view drawing. Then you have 5 years to certify that your aircraft comply with all the specified requirements through a certification program. The TC normally includes type design, operating limitations, a Type Certificate Data Sheet (TCDS), relative regulations and other DGAC conditions or limitations, and is basis for other approvals, including production and airworthiness approvals.
The TC holder is named on the authority's Type certificate data sheet. (EASA for 30).



An airworthiness certificate is only issued to an aircraft properly registered and found to conform to its TCDS and ensure safe operations. The certificate is valid and the aircraft may be operated as long as it is maintained in accordance with DGAC rules and regulations.

2.3 The Original Equipment Manufacturer (OEM)

Usually the TC holder is the manufacturer (OEM) of the aircraft or part. But it is very common for an organization that holds a type certificate to enter into an agreement with another organization that wants to take over the manufacturing and sale of the aircraft or parts.
It's often the time when a TC holder has moved onto new designs and no longer wants to make and sell parts for an ageing aircraft.

The TC holder licenses the right to make and sell the product but still owns the right of all the TC data.
The TC holder is responsible for the design and the continued airworthiness. The TC holder delivers the Maintenance manuals, part manuals, wiring diagram and deals with service bulletin (SB) and Airworthiness Directive (AD).

The production of Aircraft components requires approval 21G.

2.4 Operators

The operators are the airlines that operate the aircraft. Each operator is responsible for maintaining airworthiness throughout the chain of operations:

- Stop-over operations
- Flight
- Maintenance

The requirements for maintaining airworthiness are specified in Part M
Operations requires approval (OPS1 / Part M/G)

2.5 Maintenance Repair and Overhaul (MRO)

Any MRO organization requires approval (part 145) and must demonstrate that it meets the following requirements:

- Organization
- Safety and qualitypolicy
- Maintenance Procedures and quality system
- Release to service after maintenance (or Approval for return into Service, APRS)
- Use of approved data
- Facilities / Premises
- Staff Competence (mechanics who release an aircraft to service must have a part 66 license)
- Supplier control
- Equipment, tools and material
- Registration of maintenance task

The maintenance organization must appoint an officer responsible to the authority, also called: "accountable manager" and appoint key officials for:

- Aircraft maintenance
- Engine maintenance
- Equipment maintenance
- Quality …

And here is a recapitulation table of which authority monitors what approval for which organization:

Authority	Approval	Actor concerned
EASA	Part 21 J (Design)	TC holder / OEM
DGAC	OPS1	Operator (airline)
OSAC (Organisme pour la Sécurité de l'Aviation Civile) by delegation of the DGAC	Part 21 G (Production)	Manufacturer (OEM)
	Part 145 (Maintenance)	Repair shop (MRO)
	Part M/G (Continuing Airworthiness)	Airworthiness organization (CAMO)
	Part 147 (Training)	Training organization

2.6 Study of the MRO Market

Today, airlines monitor their total operating costs and look for levers of cost decreasing because advantage of turbo propellers aircraft is the benefits on the fuel cost but if someday this gap between jet engines and propeller, it shall have to find an other aspect to reduce operating cost that is why maintenance cost are real issues for future.

There are :

- Total maintenance cost
- Inventory parts cost
- Maintenance outsourcing cost

About RAMS : Reliability Availability Maintainability Safety

This is during design phase :

- SSA : System Safety Analysis
- FTA : Fault Tree Analysis
- FMEA : Failure Mode and Effect Analysis
- FMECA : Failure Mode and Effect Critically Analysis

During in-service phase : RAMS requirements are evaluated to verify compliance with initial objectives

In fonction of the components there are many reliability indicator, for example :

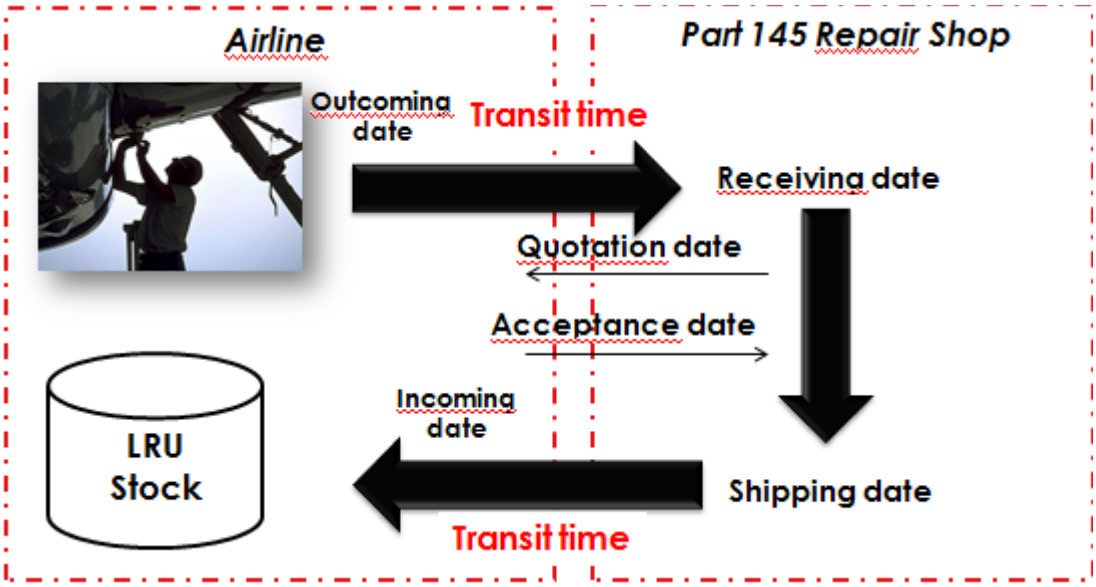
- Fuel pumps/avionic computer/radio.... : calculate on average time (MTBUR/MTBF)
- Landing gear : calculate on average on cycles (MCBR/MCBUR...)

- Actuation systems on Business PAX seat : calculate on average on use during flight (counter of activation)
- Pilot Mask : safety equipment used only in emergency situation : calculate with MTBUR/MTBF, these indicators do not reflect the use on aircraft

Moreover, most maintenance cost thinks in terms of repair time and maintenance directly improves maintainability by shortening restore time.

Few indicator :

- TAT : Turn Around Time
- SPT : Shop Processing Time
- MTTR : Mean Time To Repair



Availibility is also a major aspect , this is function of reliability and maintainability

$$Availibility = \frac{MTBF}{MTBF+MTTR}$$

All this factors have to be improved by keeping in mind the matter of the cost and the goal to reduce it. Maintenance cost for an aircraft and its engines vary with age. Indeed when aircraft is new, costs are relatively low, most of the maintenance tasks are under manufacturer's warranty.

Maturity of aircraft is considered as reached at the end of warranty period, a mature aircraft has predictable maintenance costs, which begins to rise again after around years, as airframe and components age.

Older aircraft require more non-routine maintenance due to :

- Airworthiness directives or service bulletin application, corrosion prevention tasks
- Expensive costs during "D-checks"

2) Documents

2.1 The MRBR and the MRB Process

The certification regulation (CS/FAR 25-1529) mandates the TC Holder to define an initial maintenance program for every product in order to control the airworthiness during operations.

MRB means Maintenance Review Board. The MRB Process is a sequence of steps, which generates and defines the minimum schedules maintenance tasks, which are necessary to deliver the Type Certificate of a product.

2.1.1 Actors

The MRB Process involves:

- **The TC Holder**: MWG chairman
- **The Operators:** chairman of the ISC
- **The Certifications Authorities**: observers in charge of the final approval

2.1.1.1 Industry Steering Committee (ISC):

ISC means Industry Steering Committee. The ISCs define the Working Principles in the **PolicyandProceduresHandbook(PPH),** validate the maintenance tasks proposed to the MRB and drive the MWG work. The ISCs direct the maintenance review board program.

2.1.1.2 Maintenance Working Groups (MWG):

MWG means Maintenance Working Groups. The MWGs perform the maintenance technical analysis, carry out and validate the MSG-3 analysis and propose minimal maintenance tasks to the ISC. There are actually 6 MWG for the following fields:

- Hydro-mechanical
- Environment/interior/fuel
- Power plant/APU
- Electric/avionic
- Structures
- Zonal

About the MSG-3 methodology:

The MSG-3 is a methodology, which allows defining maintenance tasks, which are adapted to the systems and associated failures types. (EASA/FAR 25-1529)

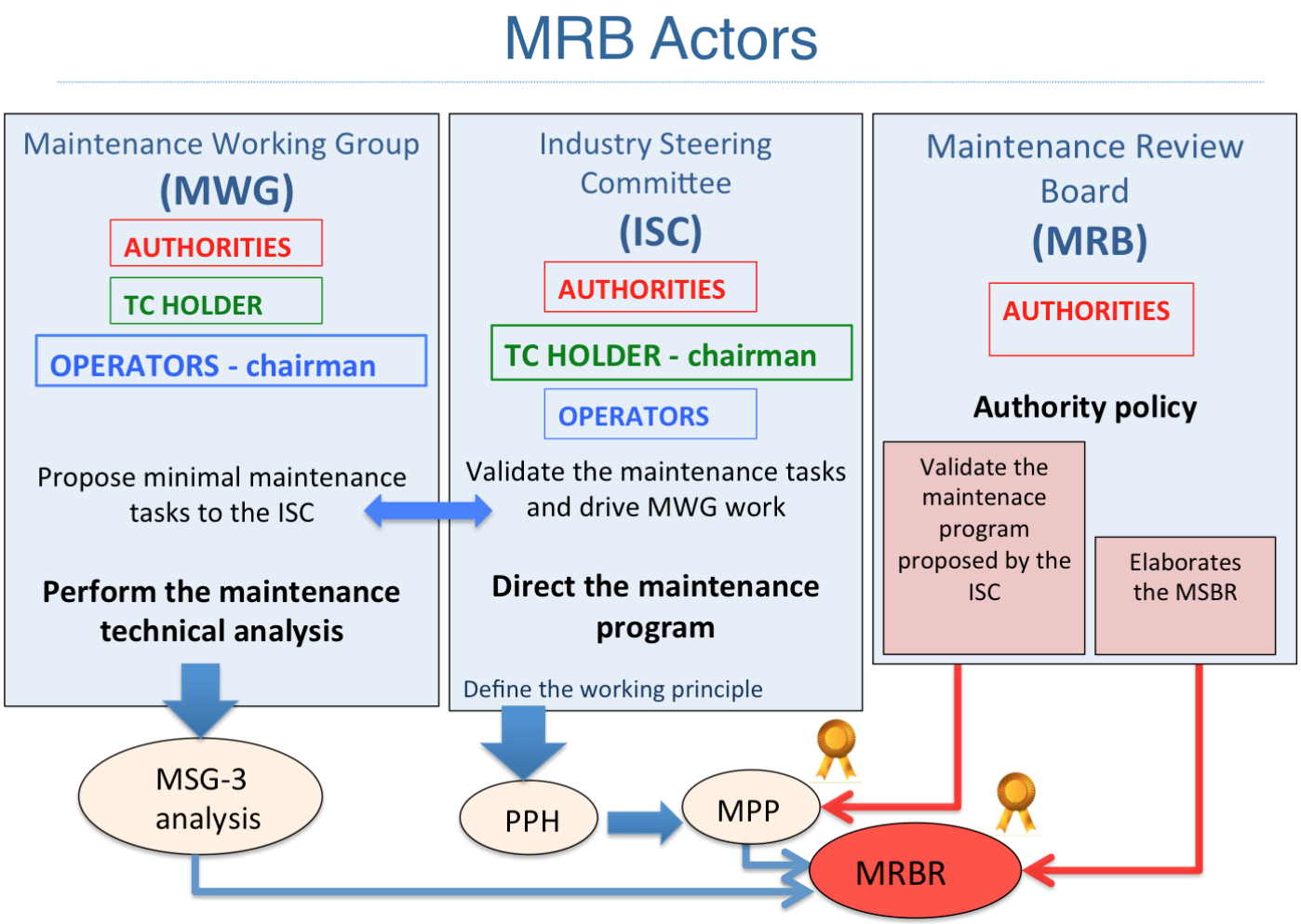
This methodology calls for several criteria to determine these tasks and the related parameters. The main criteria are safety, reliability and economy.

There are actually 3 types of analysis:

- **MSI-Analysis** (Maintenance Significant Items): all about **SystemsandPowerplant**
- **SSI-Analysis** (Structural Significant Items): all about **Structure**
- **Zonal-Analysis**: all about **ZonalInspectionProgram** (**ZIP**)

2.1.1.3 Maintenance Review Board (MRB):

The MRB is composed of the Authorities who validate the maintenance program proposed by the ISC and elaborates the final Maintenance Review Board Report.



2.1.2 Documents

The following documents are issued consequently to the MRB process:

- The Policy and Procedures Handbook (PPH)
- The Maintenance Program Proposal (MPP)
- The Maintenance Review Board Report (MRBR)

The Policy and Procedures Handbook (**PPH**) is written during ISC sessions and define the Working Principles.

The TC Holder and the operators elaborate the **MPP** during the ISC sessions.

The MPP is then submitted to the Authority, in the frame of the MRB process, for review and approval.

The **MRBR** is a Maintenance Document validated by the Authority and based on the MPP. In this document, the minimal inspection and maintenance tasks are defined.

You may find an example of MRBR in the Annex (Airbus A318/A319/A320/A321 – December 2007)

2.2 Airworthiness Limitation Section (ALS)

The manufacturer of the aircraft is the Type Certificate (TC) holder. He is in charge of designing and manufacturing of the system, in accordance with the **certificationrequirements**.

The A/C certification, regarding maintenance, is based on the following rules applicable to the Scheduled Maintenance Programs:

- FAR/EASA CS 25.1529, Appendix H: Instructions for continued airworthiness
- FAR/EASA CS 25.571: Damage tolerance and fatigue evaluation of structure
- FAR/EASA CS 25.603: Materials
- FAR/EASA CS 25.1309: Equipment, Systems and Installations

The TC holder is responsible for **maintainingAirworthiness** during the operational life of the aircraft, and must therefore develop **scheduledmaintenancerequirements**.

Airworthiness Limitation Section (ALS):

Definition: It's a report published by the Type Certificate Holder approved by the relevant authority (EASA) showing compliance with certification requirements in terms of maintenance.

The ALS document is made of 6 parts:

- Part 1: SL ALI - Safe Life Limitation Items or **LLP** Life Limited Parts (in French: PVL Pièces à vie limité)
- Part 2: DT ALI - Damage Tolerant Airworthiness Limitation Items (**StructureALI**)
- Part 3:**CMR** – Certification Maintenance Requirements
- Part 4:**ASM** – Ageing Systems Limitations (vieillissement)
- Part 5:**FAL** – Fuel Airworthiness Limitations (Fuel ALI)
- Part 6:**AISS** Aircraft Information System Security (systèmesinformatiques)

The structure of this document can be different from one aircraft manufacturer to another (Airbus/Boeing).

2.2.1 Life Limited Parts (LLP)

LLPs are issued from certification requirements due to fatigue (FAR/EASA CS 25.571). These parts have a limited life limit and most of them are designed through the safe-concept, that is to say "high" fatigue life demonstration by analysis and test. The failure of parts in this category could have a catastrophic impact on safety.

There are actually two categories:

- Life limited parts (LLP) for which the operational life limit is below the one of the aircraft. This involves a replacement threshold.

- Demonstrated fatigue Life Parts (DFLP) for which the calculated life limit is higher than the one of the aircraft. Should the physical tests not confirm the calculations, those parts will fall back into the LLP category.

2.2.2 Structure ALI

The ALI document contains the fatigue critical items and FC-related accidental arising from the fatigue and damage tolerance evaluation. The requirements developed and published in this document allow operation up to DSG figures. The aircraft should not be operated beyond theses values unless the manufacturer has updated this document to include a clearly defined life extension. Moreover, parts designed under the **damage tolerance concept** fall into this category. The key points of the design process for damage tolerance structure are:

- Identification of structure critical elements
- Type of damages to be encountered
- Damage initiation time, propagation rate, critical size
- Minimum detectable size
- Inspection threshold, interval, access etc
- Inspection methods

The list of parts under this category is usually issued several years after Entry Into Service (EIS). Initial design is based on the theoretical models and fatigue testing is carried out over several years. In some cases, the actual usage of the aircraft (FH/FC) ratio can have a significant impact on the data.

2.2.3 CMR : Certification Maintenance Report

2.2.3.1 Safety Requirements

The objective is to ensure an acceptable safety level for equipment and systems as installed on the aircraft. TheEASA (EASA/FAR 25-1309)has classified the Failure Conditions according to the severity oftheir effects(see below). Indeed, a logical inverse relationship exist between the Average Probability per Flight Hour and the severity of Failure Condition effects (see figure below).

Effect on Aeroplane	No effect on operational capabilities or safety	Slight reduction in functional capabilities or safety margins	Significant reduction in functional capabilities or safety margins	Large reduction in functional capabilities or safety margins	Normally with hull loss
Effect on Occupants excluding Flight Crew	Inconvenience	Physical discomfort	Physical distress, possibly including injuries	Serious or fatal injury to a small number of passengers or cabin crew	Multiple fatalities
Effect on Flight Crew	No effect on flight crew	Slight increase in workload	Physical discomfort or a significant increase in workload	Physical distress or excessive workload impairs ability to perform tasks	Fatalities or incapacitation
Allowable Qualitative Probability	No Probability Requirement	<---Probable---->	<----Remote---->	Extremely <----------> Remote	Extremely Improbable
Allowable Quantitative Probability: Average Probability per Flight Hour on the Order of:	No Probability Requirement	<----------> $<10^{-3}$ Note 1	<----------> $<10^{-5}$	<----------> $<10^{-7}$	$<10^{-9}$
Classification of Failure Conditions	No Safety Effect	<-----Minor----->	<---Major----->	<--Hazardous-->	Catastrophic
Note 1: A numerical probability range is provided here as a reference. The applicant is not required to perform a quantitative analysis, nor substantiate by such an analysis, that this numerical criteria has been met for Minor Failure Conditions. Current transport category aeroplane products are regarded as meeting this standard simply by using current commonly-accepted industry practice.					

2.1.1.4 CMR identification

Certification Maintenance Requirements are tasks arising from Systems Safety Assessment (SSA), which are associated with the most significant failure conditions. These requirements are allocated to the failure condition consequences and the sensitivity of the safety objective to interval increase.

Tasks associated with the following criteria are not identified as CMRs:

- Tasks associated with qualitative assessment
- Tasks for which the maximum acceptable interval is in excess of aircraft life
- Tasks associated with the conventional equipment not requiring detailed understanding of their operating philosophy to appreciate consequences of failure (for example the oxygen system and fire bottles may fall into this category)
- Tasks normally accomplished by the Flight Crew

2.1.1.5 CMR classification

- One Star CMRs (*)

The tasks and intervals specified in the CMR document are mandatory and cannot be changed, escalated or deleted without the concurrence of the Primary Certification Authority (EASA)

- Two Stars CMR (**)

Tasks intervals may be adjusted in accordance with an operator's approved escalation practices or an approved reliability program, but the task content may not be changed or deleted without prior Primary Certification Authority (EASA) approval.

2.1.1.6 Interval extension

Since CMR intervals are based on statistical averages and reliability rates, an exceptional short-term extension for a specific CMR interval may be made on one aircraft for a limited period of time without jeopardizing safety. Anyway, any request for temporary extension must be submitted to the authorities.

2.2.4 Ageing Systems Maintenance

The fourth part of the ALS document (ASM) is directly arising from the Ageing Analysis

2.2.5 Fuel Airworthiness Limitations

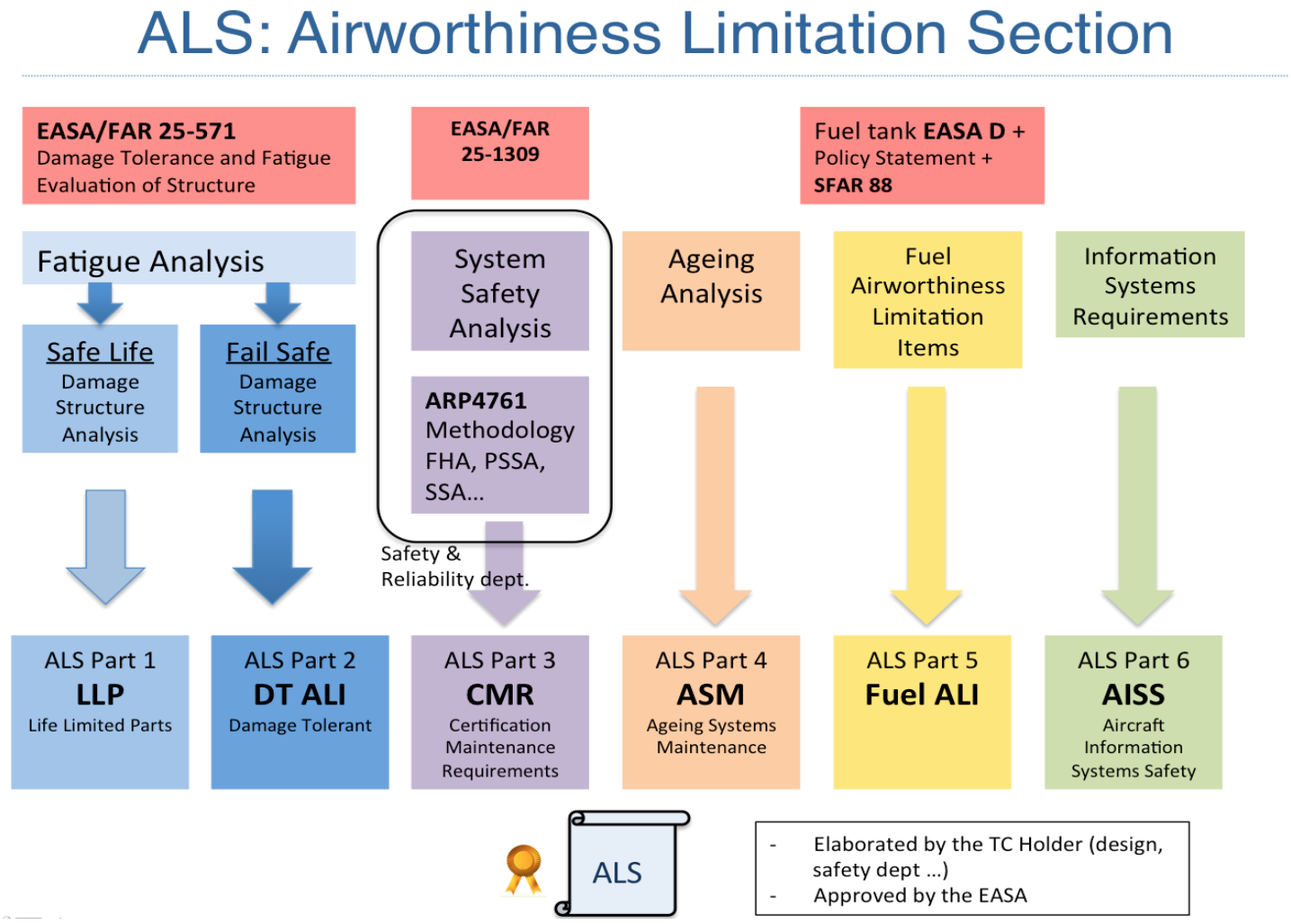
Fuel Airworthiness Limitations are items arising from a SSA that have been shown to have failure mode(s) associated with an "unsafe condition". These failures would lead to dangerous or catastrophic consequences. These are identified in Failure Conditions for which an unacceptable probability of ignition risk or an unacceptable increase in fuel tank flammability exposure could exist if specific tasks and/or practices are not performed. These tasks are classified in two categories:

- **Fuel ALI**: Maintenance tasks

- **CDCCL** (Critical Design Configuration Control Limitations): Maintenance instructions applicable to critical components of fuel systems.

2.2.6 Aircraft Information System Safety

The sixth part of the ALS document (AISS) is directly arising from the Information Systems Analysis.



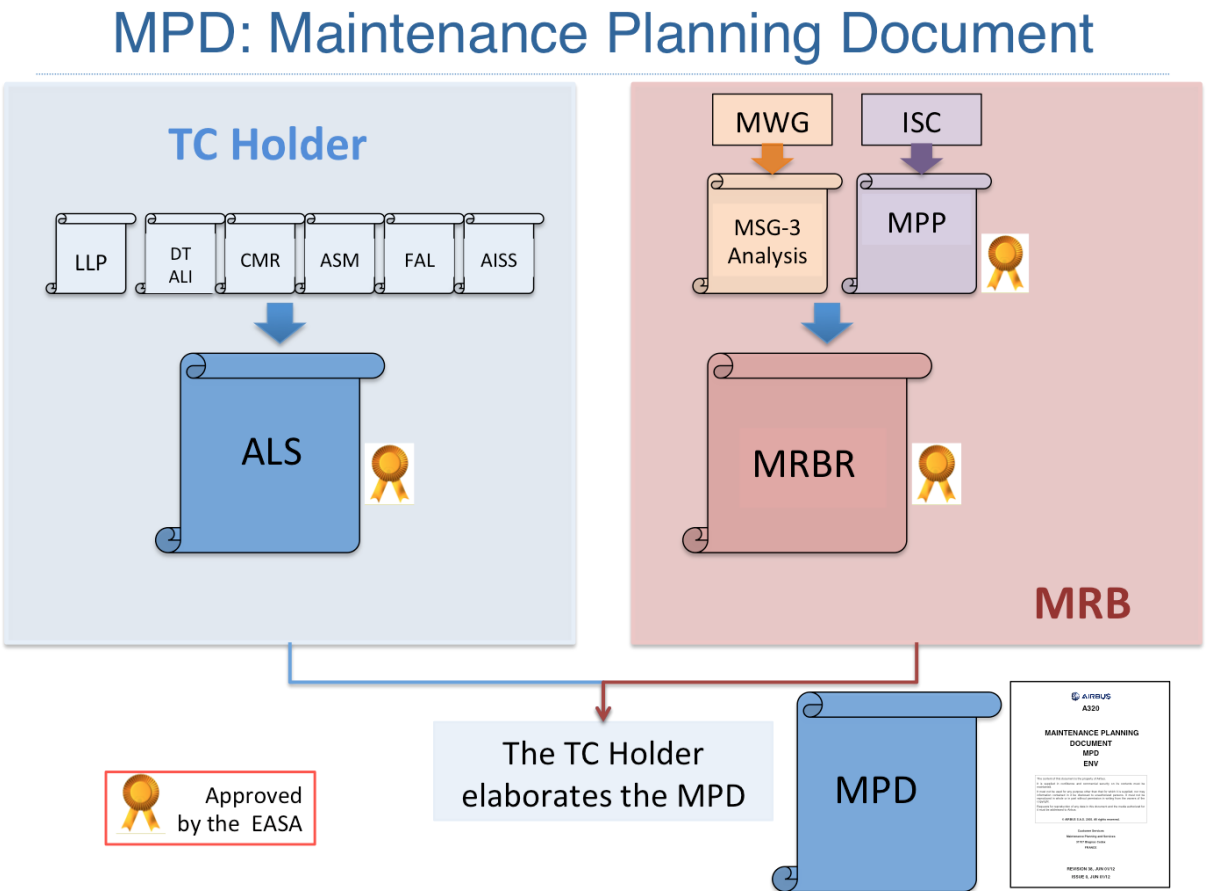
2.3 The Maintenance Planning Document (MPD)

The **MPD** is a standard maintenance program elaborated and recommended by the manufacturer, based on the MRBR and on the ALS (see figure below).

The authority does not validate this document. Additional tasks can be added to the MRBR basis in order to increase the reliability and to reduce the cost of operations.

The MPD shows the link between MRBR tasks and AMM references.

You may find an MPD in the Anne (Airbus – A320 – revision 38 – JUN 01/12).



IV. Applications to the Bee-Plane

Regarding the Certification Process, there are 3 main issues for the Bee-Plane:

- Status of the TC Holder
- Time Management
- Complexity of some innovative systems

- **Status of the TC Holder**

The TC Holder owns the right on all the Type Certificate data, is responsible for the design, is also responsible for the continued airworthiness (Maintenance Manuals, Part manuals, wiring diagram, Service bulletin). Moreover, the TC Holder engages discussion with the EASA in case of an AD regarding the design.

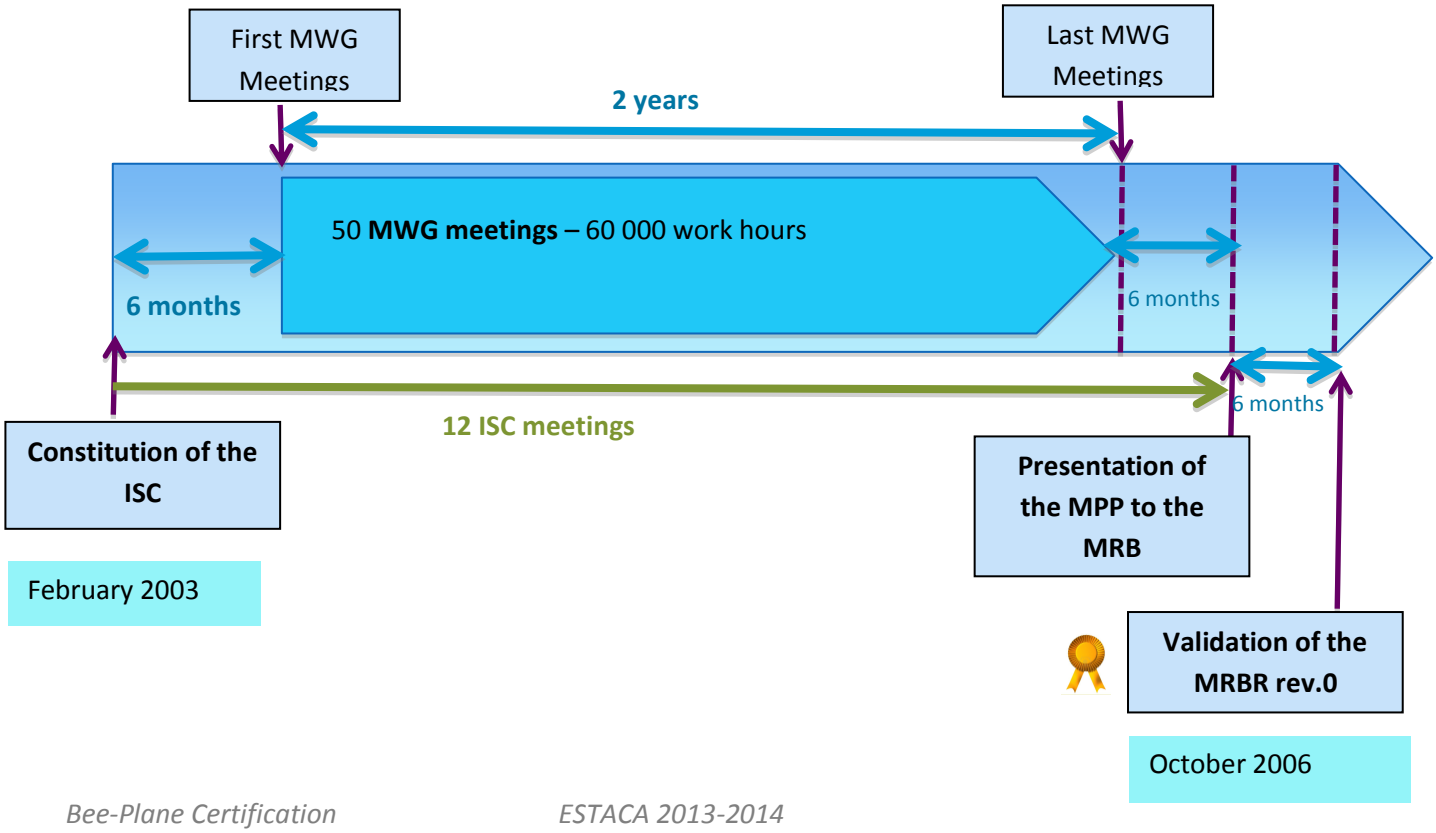
Most of the time, the designer is also the manufacturer (Airbus, Boeing) even if some part of the manufacturing work can be subcontracted.

Regarding the Bee-Plane, it is quite complex. Indeed, the current company that is designing the Bee-Plane (TRL 2) is looking for a future partnership with a big manufacturer like Airbus. Depending on the degree of partnership, the status of TC Holder is not certain (Airbus or Bee-Plane). For the next steps of development (TRL 3 & 4) it is crucial to raise the question "Who will be the TC Holder? " in order to lead the Certification Process.

- **Time Management**

The question of Time Management is crucial for the Certification Process, because this process is mandatory, quite long, and involves several actors, which work together.

This the example of the MRB Process of the A380:



- Complexity of some innovative systems

For some systems (APU, engines, wings etc.), we can rely on the experience of some big companies like Airbus.

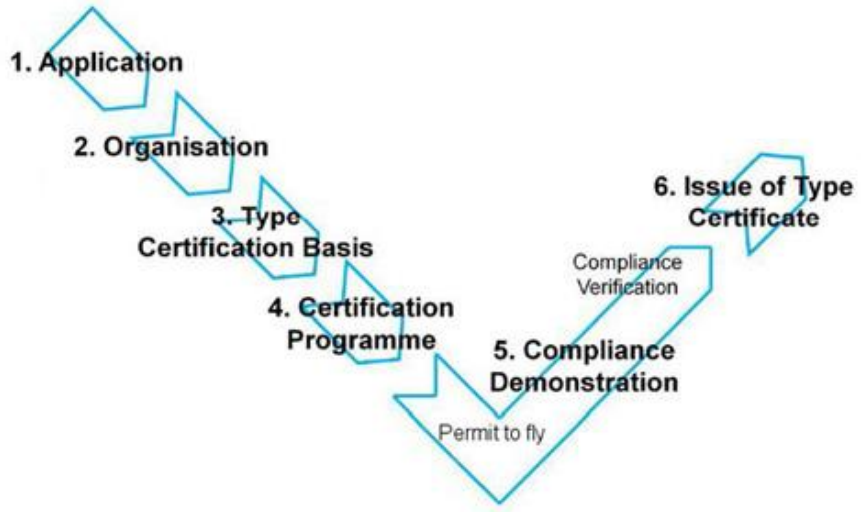
However, some innovations of the Bee Plane are complex. As they have never been experienced before, those innovations will be a critical point in the Certification Process (detachable fuselage, presence of a pilot, landing gears etc.)

The engineers in charge of the certification process will have to be innovative and will have to think of problems, which have occurred before. For example, the fatigue analysis of the connection between the baskets and the fuselage is crucial (ALS part 1 and 2). Moreover, the System Safety Analysis (Certification Maintenance Requirement) is quite important for innovating systems.

2.4 Certification Planning

The Certification process for an innovative aircraft is something very long which has to be manage meanwhile the other development of the project. Every department has to be in contact to insure the certification agreement. Moreover, one of the most difficult aspect for an innovative project is to be sure that all new components project will comply with the regulation.

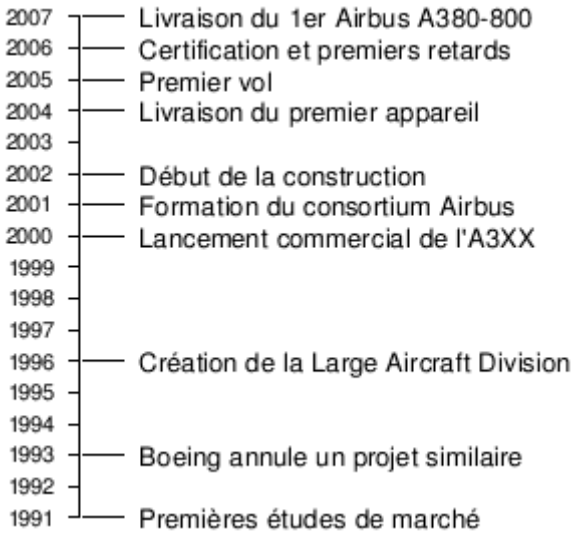
This is a mock-up of the Certification process



About the Bee Plane, the full economy version is planned for 2035-2040 with 2 pilots included without a communicative airlock with the cabin. About 2050 is planned a version fully automated. The certification of plane begins soon the design of this one, which means these steps are very major in the building process. Each major steps for a new aircraft has to comply with the regulation, without, the project could be compromise. As we can see below, for a commercial aircraft as the A380, the time about the launch and the first delivery is about 16 years. The Bee Plane is planned for 2035, which means that begins to think about the

certification process will be an upset for the Bee Plane, we also have to take in count the innovative structure of the Bee Plane so the project could be take further time than the A380 project.
As we can also see on the chart, the certification process could be the reason of major delays, that is why each steps has to followed by the certification planning.

Example : planning of the A380



V. Bee-Plane AMM Writing Issue

1) The AMM/BMM Issue

A manual that describes the methods, techniques and practices to be used by persons performing maintenance, alterations or preventive maintenance on an aircraft.

A manual approved by the manufacturer of the aircraft, engine, or components, giving detailed procedures of the method of maintenance. A manual should lay down the procedure for servicing and maintenance; the frequency of each check, overhaul, and inspection; the responsibilities of various classes of skilled maintenance personnel; the servicing and maintenance methods prescribed by, or which require the prior approval of, the State of Registry; and the procedure for preparing the maintenance release, the circumstances under which this release is to be issued, and the personnel required to sign it.

ELECTRICAL BONDING - REMOVAL/INSTALLATION

TASK 20-10-37-904-010

1. Electrical Bonding - Removal/Installation

A. References

Reference	Title
SWPM 20-20-00	Electrical Bonding Processes
SWPM 20-20-10	REPLACEMENT OF GROUND STUDS AND BONDING JUMPER INSTALLATION

B. Procecure

SUBTASK 20-10-37-900-001

(1) Refer to Electrical Bonding Processes, SWPM 20-20-00 in the Standard Wiring Practice Manual D6-54446.

SUBTASK 20-10-37-900-002

(2) Refer to REPLACEMENT OF GROUND STUDS AND BONDING JUMPER INSTALLATION, SWPM 20-20-10 in the Standard Wiring Practice Manual D6-54446.

END OF TASK

AMM extract from the B737, installation and uninstallation of electrical links

The AMM is subdivised into ATA Chapter. There is 100 ATA Chapter numbers. That is a common referencing standard for all the actors in commercial aircraft documentation. This system permits greater ease of learning and understanding for pilots, aircraft maintenance technicians and engineers. The standard was published y the Air Transport Association. ATA Chapters are divided into 4 major different parts of an aircraft.

- From 00 to 18 : Aircraft General
- From 19 to 50 : Airframe Systems
- From 51 to 57 : Structure
- From 58 to 92 : Power Plant

The remains ATA Chapters until 100 are not "use", there are blank in case or a new chapter will have to create in the future.

For the Bee Plane, there is the particular aspect that the plane is divided into two different parts, the Carrier and the Basket, which means an AMM and a BMM ought to be created.

The majority of the Bee Plane System are include in the existing ATA Chapter otherwise some new should be added in accordance with the innovative system provide by the Bee Plane. To give an example, no one ATA Chapter is concerning by the attach of the Basket with the Carrier. Within the airframe part, the chapter 50 has to be created to contain the specify check link to the connection between the Carrier and the Basket

Example of the ATA Chapter:

- 50 : Connectivty between the Basket and the Carrier
  - 00 : General

- 10 : Electric Power
- 20 : Air Conditioning
- 30 : Emergency System
- 40 : Crew Communication
- 50 : Oxygen
- 60 : Attaching System

Indeed, all the ATA Chapter are conditioned by the technical features of the plane, for the Bee Plane, which got an innovative structure the major things to in count for the AMM will be about the connectivity between the two different of the plane.

In the same way, some precise have to be indicated within sub-chapter in the AMM, as in the chapter 53 (Fuselage)

- 40 : Attach fittings with the Basket

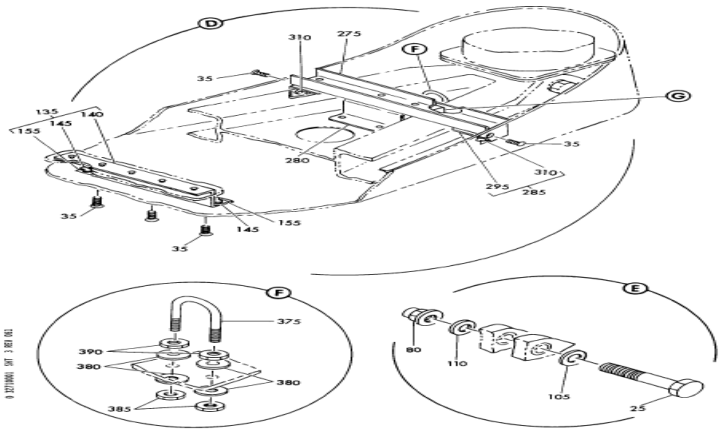
As we only talk of the Carrier without the Basket, we can remove all the parts about the cabin and in-flight entertainment. If we decided to establish an AMM and a BMM into two different documents is to save the idea to get two part self-governing which could be fixed independently of the other part.(The entire of the possible AMM and BMM in annex.)

2) Illustrated Parts Catalogue

The Illustrated Parts Catalogue is a key ancillary reference document which describes in comprehensive detail every component. It is essential supplement of the Aircraft Maintenance Manual but does not have the equivalent approved status and must be used only as supporting reference with the AMM.

So this is a book published by the manufacturer which contains the illustrations, references, parts number and other relevant data for their products or parts. This is describes in comprehensive details every component. It is essential supplement for users of the AMM.

Example of the IPC



32-71-00 FIGURE: 01

EFFECT	FIG-ITEM	PART NUMBER	MFR	US-AGE	QTY	NOMENCLATURE
404500 775999	005	65C32970-1	81205	RF	RF	FOR NHA SEE: 53-10-00-04D
404500 775999	010	BACB30LH4-8	81205	4	4	
404500 775999	015	HL1012AZ8-7	0PTK6	2	2	HI-LOK OPTIONAL PART: HL12VAZ8-7 V73197 HL12VAZ8-7 V92215 HL12VAZ8-7 V97928 L802-8K7 V06725 HL12VAZ8-7 V56878 HL1012AZ8-7 V06725 HL1012AZ8-7 V06950 HL1012AZ8-7 V17446 HL1012AZ8-7 V56878 HL1012AZ8-7 V60516 HL1012AZ8-7 V73197 HL1012AZ8-7 V97928
404500 775999	020	BACB30PU10-31	81205	1	1	
404500 775999	025	BACB30PU12-39	81205	1	1	
404500 775999	030J	BACB30PU8-33	81205	2	2	
404500 775999	035	BACB30VF4K3	81205	7	7	
404500 775999	040	HST10AG6-6	0PTK6	26	26	OPTIONAL PART: HST10AG6-6 V06725 HST10AG6-6 V56878 HST10AG6-6 V73197
404500 775999	045	HST10AG6-8	0PTK6	2	2	OPTIONAL PART: HST10AG6-8 V06725 HST10AG6-8 V56878 HST10AG6-8 V73197

Extract IPC B737 Part Drawings and Part References

Lessons Learnt

We learnt several things working on this project, both at the point of the theory of certification and that this implies that the management of such project.

First, we have been involved in the TRL2, which is an open project and it evolves during our project. To manage difficulties, we choose to organize many calls with our tutor. What we learnt from that is that our inputs may change during the project and that a good communication between every partner shall prevent any misleading information.

We had to collect all the documents regarding the certification of a new plane, and that implies to have large documents (more than 900 pages sometimes) and to focus on what matters to our tutor. For this, we used examples usable for the Bee-Plane and we learnt that a certification manager is a full time job, and we must know the boundaries.

We explained the certification processes and we had to not make a general certification lecture. So we had to focus on the key points for the Bee-Plane and we learnt to keep in mind the output, the deliverables should be useful for the customer and we had to insist on the added value.

Then we proposed a maintenance program for the Bee-Plane and we identified the critical points but we had no experience in a specialized and complicated field and it is a creative work. The solution for us was to go back to basics and to try to reproduce what already exist in the industry.

We had to provide something useful to our tutor but we had a lack of experience, of boundaries to the mission. We installed as much communication as possible with our tutor and we made a lot of research and took initiatives. We learnt that it is major to understand the customer needs and to put boundaries on the project since the beginning. We also learnt to take initiatives and to propose a solution by ourselves.

Finally we had to deliver the work on time, the difficulties could be to get behind the schedule, to be off topic and to have a poor resource management. We decided to have a group briefing each week, to create a Facebook group and to organize conferences call with our tutor every two weeks to facilitate the communication. We understood that communication is the key within the team and with the customer.

Conclusion

To conclude on what we brought to this Bee-Plane project, we can say that the certification process is a very complicated phase which occur at each steps of the development.

Indeed, there is a lot of documents to provide in order to comply with all the regulation. Especially for the maintenance process which concerned the manufacturer, the owner, the operator and also a maintenance organization.

For the Bee Plane we made an overview of all the process in order to comply with the maintenance certification in accordance with the part 145-M from the EASA. It is an innovative plane which supposed innovative certification process. For example, about the Aircraft Maintenance Manual, as the plane is divided into two different part, the carrier and the Basket, there is a maintenance manual for each parts. This kind of specificity is very rare cause for the most of the plane, this is one entity end not two for this project.

This project gave us the opportunity to explore the details of the plane certification and to apply them to the Bee Plane to give some remedy with the innovative structure of the plane and we can say that this goal is pretty reached.

We believe in this project of Bee Plane, to design a new period of the commercial aviation in changing our way to fly in order to improve the cost and the operation capacity of the aircraft.

Annexes

- **A- Literature review**
- **B- Maintenance Certification document**
  1. **CS-25**
  2. **Part 145 (Example of EASA/DGAC agreement for Airbus)**
- **C. Maintenance documents**
- **D. Maintenance Manual for the Bee Plane**
  1. **Aircraft Maintenance Manual (AMM)**
  2. **Basket Maintenance Manual (BMM)**

A.Litterature review

Technical documentation
A-C Characteristics A321
Données techniques atterrissage
FireFighting Chart_1
FireFighting Chart_2
ICAO- données techniques aéroports_1
ICAO- données techniques aéroports_2
A320 characterisitics maintenance planning
Aircraft Recovery Manual A318-A319
Extrait AMM B737_2
Extrait AMM B737_3
Extrait AMM B737
PC-12 Chapter 00
PC-12 47E Aircraft Maintenance ManualChapter 00
Extrait IPC B737

Certification documentation
Airbus-Certificat-agreement-FR-145
EASA-Certifi-Agreement_FR_145
MOA Consolidated Part 145
Part 145
FOR. MAI.01 (Formation Part 145 VF)
EASA TCDS E,033Europrop
EASA TCDS E,033Powerjet

relevant document
moderately relevant document
less relevant document

B. Maintenance certification documents

2. Part 145 (Example of EASA/DGAC agreement for Airbus)

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

dgac
DSAC

MINISTERE DE L'ÉCOLOGIE, DE L'ÉNERGIE,
DU DEVELOPPEMENT DURABLE ET DE LA MER
en charge des Technologies vertes et des Négociations sur le climat

Direction générale de l'aviation civile

DIRECTION DE LA SECURITE DE L'AVIATION CIVILE

Membre de l'Agence européenne de la sécurité aérienne

CERTIFICAT D'AGREMENT

(APPROVAL CERTIFICATE)

FR.145.115

Vu le règlement (CE) n°2042/2003 de la Commission en vigueur, et conformément aux conditions indiquées ci-après, la Direction Générale de l'Aviation Civile certifie que *(Pursuant to Commission Regulation (EC) n° 2042/2003 for the time being in force and subject to the conditions specified below, the Direction Générale de l'Aviation Civile hereby certifies)*

AIRBUS AVIONICS AND SIMULATION PRODUCTS
316 Route de Bayonne
31060 TOULOUSE CEDEX 9
France
Site(s) d'entretien en base / *Base Maintenance location(s):*
31060 TOULOUSE

est un organisme de maintenance Partie-145 autorisé à entretenir les produits répertoriés dans le tableau d'agrément joint en annexe et à délivrer des certificats d'autorisation de remise en service en utilisant la référence ci-dessus. *(as a Part-145 maintenance organisation approved to maintain the products listed in the attached approval schedule and issue related certificates of release to service using the above reference.)*

CONDITIONS :

1. **Le présent agrément est limité au domaine d'application spécifié dans la section correspondante du MOE agréé Partie-145, et** *(This approval is limited to that specified in the scope of approval section of the Part-145 approved maintenance organisation exposition.)*
2. **Le présent agrément exige le respect des procédures décrites dans le MOE agréé Partie-145, et** *(This approval requires compliance with the procedures specified in the Part-145 approved maintenance organisation exposition.)*
3. **Le présent agrément est valable tant que l'organisme de maintenance agréé Partie 145 reste conforme à la Partie 145.** *(This approval is valid whilst the approved maintenance organisation remains in compliance with Part-145.)*
4. **Sous réserve du respect des conditions ci-dessus, le présent agrément reste valable tant qu'il n'est pas rendu, remplacé, suspendu ou retiré.** *(Subject to compliance with the foregoing conditions, this approval shall remain valid for an unlimited duration until the approval is surrendered, superseded, suspended or revoked.)*

- **Date de délivrance initiale : 17 décembre 1993**
  (Date of initial issue)

Pour le Ministre chargé de l'aviation civile
Le 21 décembre 2009

Chargé de supervision de la Maintenance
Transport Public

F. SAINTON

Formulaire 3 de l'AESA

Page 1/2

C. Maintenance documents

AIRBUS

A320

AIRCRAFT CHARACTERISTICS
AIRPORT AND MAINTENANCE PLANNING

AC

AIRBUS S.A.S.
Customer Services
Technical Data Support and Services
31707 Blagnac Cedex
FRANCE

Issue: Sep 30/85 Rev: Jun 01/12

D. Maintenance Manual for the Bee Plane

1. Aircraft Maintenance Manual (AMM)

General

05 : Periodic Inspections

- 00 : General
- 10 : Time Limits
- 20 : Scheduled Maintenance Checks
- 50 : Unscheduled Maintenance Checks

06 : Dimensions and areas

Those charts, diagrams, and text which show the area, dimensions, stations, access doors / zoning and physical locations, of the major structural members of the aircraft. Includes an explanation of the system of zoning and measurement used.

07 : Lifting and Shoring

- 00 : General
- 10 : Jacking
- 20 : Shoring

08 : Leveling and weighing

- 00 : General
- 10 : Weighing and balancing
- 20 : Leveling

09 : Towing and taxiing

- 00 : General
- 10 : Towing
- 20 : Taxiing

10 : Parking, mooring, storage and return to service

- 00 : General
- 10 : Parking/storage
- 20 : Mooring
- 30 : Return to service

12 : Servicing Routine Maintenance

- 00 : General
- 10 : Replenishing

- 20 : Scheduled Servicing
- 30 : Unscheduled Servicing

Airframe Systems

20 : Standard Practices-Airframe

- 20 : Locking and retaining devices
- 30 : Consumable material list
- 40 : Corrosion
- 50 : Standard Practices

21 : Air Conditioning

- 00 : General
- 10 : Compression
- 20 : Distribution
- 30 : Pressurization Control
- 40 : Heating
- 50 : Cooling
- 60 : Temperature Control
- 70 : Moisture, air contaminant Control

22 : Auto flight

- 00 : General
- 10 : Autopilot
- 20 : Attitude Correction
- 30 : Auto Throttle
- 40 : System Monitor
- 50 : Aerodynamic Load Alleviating

23 : Communications

- 00 : General
- 10 : Speech Communication
- 15 : SATCOM
- 20 : Data Transmission and automatic Calling
- 30 : Passenger address, entertainment and comfort (control connecting to the Basket)
- 40 : Interphone
- 50 : Audio Integrating
- 60 : Static Discharging
- 70 : Audio and video Monitoring
- 80 : Integrated Automatic Tuning

24 : Electric Power

- 00 : General
- 10 : Generator drive

- 20 : AC Generation
- 30 : DC Generation
- 40 : External Power
- 50 : AC Electrical Load Distribution
- 60 : DC Electrical Load Distribution
- 70 : Primary and Secondary Power

25 : Equipment and Furnishing

- 00 : General
- 10 : Flight Compartment
- 30 : Buffet, Galley
- 40 : Lavatories
- 60 : Emergency
- 70 : Accessory Compartments
- 80 : Insulation

26 : Fire Protection

- 00 : General
- 10 : detection
- 20 : Extinguishing
- 30 : Explosion Suppression

27 : Flight Controls

- 00 : General
- 10 : Aileron
- 20 : Rudder
- 30 : Elevator
- 40 : Horizontal stabilizer
- 50 : Flaps
- 60 : Spoiler, drag devices and variable Aerodynamics fairins
- 70 : Gust Lock and damper
- 80 : Lift Augmenting

28 : Fuel

- 00 : General
- 10 : Storage
- 20 : Distribution-Drain Valves
- 30 : Dump
- 40 : Indicating

29 : Hydraulic Power

- 00 : General
- 10 : Main

- 20 : Auxiliary
- 30 : Indicating

30 : Ice and rain protection

- 00 : General
- 10 : Airfoil
- 20 : Air intakes
- 30 : Pitot and static
- 40 : Windows, Windshields and doors
- 50 : Antennas and radomes
- 60 : Propellers, rotors
- 70 : Water lines
- 80 : Detection

31 : Indicating/Recording systems

- 00 : General
- 10 : Instrument and control panels
- 20 : Independent Instruments
- 30 : Recorders
- 40 : Central Computers
- 50 : Central Warning Systems
- 60 : Central Display systems
- 70 : Automatic data reporting systems

32 : Landing gear

- 00 : General
- 10 : Main gear and doors
- 20 : Tail gear and doors
- 30 : Extension and retraction
- 40 : Wheels and brakes
- 50 : Steering
- 60 : Position and warning, and ground safety switch

33 : Lights

- 00 : General
- 10 : Flight compartment and annunciator panel
- 20 : Passenger compartment (control connecting to the Basket)
- 30 : Cargo and service compartment (control connecting to the Basket)
- 40 : exterior lighting
- 50 : emergency lighting

34 : Navigation

- 00 : General

- 10 : Flight environment data
- 20 : Attitude and direction
- 30 : Landing and taxiing aids
- 40 : Independent position determining
- 50 : Dependent position determining
- 60 : flight management computing

35 : Oxygen

- 00 : General
- 10 : Crew
- 20 : Passenger
- 30 : Portable

36 : Pneumatic

- 00 : General
- 10 : Distribution
- 20 : Indicating

37 : Vacuum

- 00 : General
- 10 : Distribution
- 20 : Indicating

38 : Water / Waste

- 00 : General
- 10 : Potable
- 20 : Wash
- 30 : Waste Disposal
- 40 : Air Supply

39 : Electrical Electronic Panel

- 00 : General
- 10 : Instrument & Control Panels
- 20 : Electrical & Electronic Equipment Racks
- 30 : Electrical & Electronic Junction Boxes
- 40 : Multipurpose Electronic Components
- 20 : Integrated Circuits
- 60 : Printed Circuit Card Assemblies

41 : Water Ballast

- 00 : General
- 10 : Storage
- 20 : Dump

- 30 : Indication

42 : Integrated Modular Avionics

- 00 : General
- 20 : Core System
- 30 : Network Components

45 : Central Maintenance System (CMS)

- 00 : General
- 05/19 CMS / Aircraft General
- 20/44 CMS / Airframe Systems
- 45 Central Maintenance System
- 46/49 CMS / Airframe Systems
- 50/59 CMS / Structures
- 60/69 CMS / Propellers
- 70/89 CMS / Power Plant

46 : Information Systems

- 00 : General
- 10 : Airplane General Information Systems
- 20 : Flight Deck Information Systems
- 30 : Maintenance Information Systems
- 40 : Passenger Cabin Information Systems
- 50 : Miscellaneous Information Systems

49 : Airborne Auxiliary Power

- 00 : General
- 10 : Power Plant
- 20 : Engine
- 30 : Engine Fuel & Control
- 40 : Ignition / Starting
- 50 : Air
- 60 : Engine Control
- 70 : Indicating
- 80 : Exhaust
- 90 : Oil

50 : Connectivity between the Basket and the Carrier

- 00 : General
- 10 : Electric Power
- 20 : Air Conditioning
- 30 : Emergency System
- 40 : Crew Communication

- 50 : Oxygen
- 60 : Attaching System

Structure

51 :Standard Practices & Structures General

- 00 : General
- 10 : Investigation, Cleanup & Aerodynamic Smoothness
- 20 : Processes
- 30 : Materials
- 40 : Fasteners
- 50 : Support of Airplane for Repair & Alignment Check Procedures
- 60 : Control-Surface Balancing
- 70 : Repairs
- 80 : Electrical Bonding

52 : Doors

- 00 : General
- 10 : Crew
- 20 : Emergency Exit
- 60 : Entrance Stairs
- 70 : Monitoring & Operations & Warning
- 80 : Landing gear

53 : Fuselage

- 00 : General
- 10 : Main Frame
- 20 : Auxiliary Structure
- 30 : Plates-skin
- 40 : Attach fittings with the Basket
- 50 : Aerodynamics Fairings

54 : Nacelles / Pylons

- 00 : General

55 : Stabilizers

- 00 : General
- 10 : Horizontal Stabilizer / Stabilator or Canard
- 20 : Elevator
- 30 : Vertical Stabilizer
- 40 : Rudder

56 : Windows

- 00 : General
- 10 : Flight Compartment
- 30 : Door
- 40 : Inspection & Observation

57 : Wings

- 00 : General
- 10 : Center Wing
- 20 : Outer Wing
- 30 : Wing Tip
- 40 : Leading edge & leading edge devices
- 50 : Trailing edge & trailing edge devices
- 60 : Ailerons &elevons
- 70 : Spoilers

Propeller / Rotor

61 : Propellers / Propulsion

- 00 : General
- 10 : Propeller assembly
- 20 : Controlling
- 30 : Braking
- 40 : Indicating
- 50 : Propulsor duct

62 : Rotors

- 00 : General
- 10 : Rotor blades
- 20 : Rotor head
- 30 : Rotor shaft
- 40 : Indicating

63 : Rotor Drive

- 00 : General
- 10 : Engine / Gearbox coupling
- 20 : Gearbox
- 30 : Mounts, attachments
- 40 : Indicating

67 : Rotors flight control

- 00 : General
- 10 : Rotor Control
- 20 : Anti-torque rotor control (Yaw control)
- 30 : Servo-control System

PowerPlant

71 : Power plant general

- 00 : General
- 10 : Cowling
- 20 : Mounts
- 30 : Fire seals & shrouds
- 40 : Attach fittings
- 50 : Electrical harness
- 60 : Engine air intakes
- 70 : Engine Drains

72 : Engine

- 00 : General
- 10 : Reduction gear & shaft
- 20 : Air inlet section
- 30 : Compressor section
- 40 : Combustion section
- 50 : Turbine section
- 60 : Accessory drives
- 80 : Propulsor section

73 : Engine fuel & control

- 00 : General
- 10 : Distribution
- 20 : Controlling
- 30 : Indicating

74 : Ignition

- 00 : General
- 10 : Electrical power supply
- 20 : Distribution
- 30 : Switching

75 : Air

- 00 : General
- 10 : Engine anti-icing
- 20 : Engine cooling
- 30 : Compressor control
- 40 : Indicating

76 : Engine controls

- 00 : General

- 10 : Power control
- 20 : Emergency shutdown

77 : Engine indicating

- 00 : General
- 10 : Power
- 20 : Temperature
- 30 : Analyzers
- 40 : Integrated engine instrument systems

78 : Exhaust

- 00 : General
- 10 : Collector-Nozzle
- 20 : Noise Suppressor
- 30 : Thrust Reverser
- 40 : Supplemental Air

79 : Oil

- 00 : General
- 10 : Storage
- 20 : Distribution
- 30 : Indicating

80 : Starting

- 00 : General
- 10 : Cranking

82 : Water injection

- 00 : General
- 10 : Storage
- 20 : Distribution
- 30 : Dumping &purging
- 40 : Indicating

83 : AccessoryGear Boxes

- 00 : General
- 10 : Drive Shaft Section
- 20 : Gear Box Section

2. Basket Maintenance Manual (BMM)

General

05 : Periodic Inspections

- 00 : General
- 10 : Time Limits
- 20 : Schedulet Maintenance Checks
- 50 : Unscheduled Maintenance Checks

06 : Dimensions and areas

Those charts, diagrams, and text which show the area, dimensions, stations, access doors / zoning and physical locations, of the major structural members of the aircraft. Includes an explanation of the system of zoning and measurement used.

07 : Lifting and Shoring

- 00 : General
- 10 : Jacking
- 20 : Shoring

08 : Leveling and weighing

- 00 : General
- 10 : Weighing and balancing
- 20 : Leveling

09 : Towing and taxiing

- 00 : General
- 10 : Towing
- 20 : Taxiing

10 : Parking, mooring, storage and return to service

- 00 : General
- 10 : Parking/storage
- 20 : Mooring
- 30 : Return to service

11 : Placards and markings

- 00 : General
- 10 : Exterior Colour Schemes and markings
- 20 : Exterior Placards and markings
- 30 : Interior Placards

12 : Servicing Routine Maintenance

- 00 : General
- 10 : Replenishing
- 20 : Scheduled Servicing
- 30 : Unscheduled Servicing

Airframe Systems

20 : Standard Practices-Airframe

- 20 : Locking and retaining devices
- 30 : Consumable material list
- 40 : Corrosion
- 50 : Standard Practices

21 : Air Conditioning

- 00 : General
- 10 : Compression
- 20 : Distribution
- 30 : Pressurization Control
- 40 : Heating
- 50 : Cooling
- 60 : Temperature Control
- 70 : Moisture, air contaminant Control

23 : Communications

- 00 : General
- 10 : Speech Communication
- 20 : Data Transmission and automatic Calling
- 30 : Passenger address, entertainment and comfort (control connecting to the Basket)
- 40 : Interphone
- 50 : Audio Integrating
- 60 : Static Discharging
- 70 : Audio and video Monitoring
- 80 : Integrated Automatic Tuning

24 : Electric Power

- 00 : General
- 10 : Generator drive
- 20 : AC Generation
- 30 : DC Generation
- 40 : External Power
- 50 : AC Electrical Load Distribution
- 60 : DC Electrical Load Distribution
- 70 : Primary and Secondary Power

25 : Equipment and Furnishing

- 00 : General
- 10 : Flight Compartment
- 20 : Passenger Compartment

- 30 : Buffet, Galley
- 40 : Lavatories
- 50 : Cargo Compartments
- 60 : Emergency
- 70 : Accessory Compartments
- 80 : Insulation

26 : Fire Protection

- 00 : General
- 10 : detection
- 20 : Extinguishing
- 30 : Explosion Suppression

30 : Ice and rain protection

- 00 : General
- 40 : Windows, Windshields and doors

31 : Indicating/Recording systems

- 00 : General
- 40 : Central Computers
- 50 : Central Warning Systems
- 60 : Central Display systems
- 70 : Automatic data reporting systems

32 : Landing gear

- 00 : General
- 10 : Main gear and doors
- 20 : nose gear, tail gear and doors
- 30 : Extension and retraction
- 40 : Wheels and brakes
- 50 : Steering
- 60 : Position and warning, and ground safety switch

33 : Lights

- 00 : General
- 10 : Flight compartment and annunciator panel
- 20 : Passenger compartment
- 30 : Cargo and service compartment
- 40 : exterior lighting
- 50 : emergency lighting

35 : Oxygen

- 00 : General

- 10 : Crew
- 20 : Passenger
- 30 : Portable

36 : Pneumatic

- 00 : General
- 10 : Distribution
- 20 : Indicating

44 : Cabin Systems

- 00 : General
- 10 : Cabin Core System
- 20 : Inflight Entertainment System
- 30 : External Communication System
- 40 : Cabin Mass Memory System
- 50 : Cabin Monitoring System
- 60 : Miscellaneous Cabin System

50 : Connectivity between the Basket and the Carrier

- 00 : General
- 10 : Electric Power
- 20 : Air Conditioning
- 30 : Emergency System
- 40 : Crew Communication
- 50 : Oxygen
- 60 : Attaching System

Structure

50 : Cargo and Accessory Compartments

- 00 : General
- 10 : Cargo Compartments
- 20 : Cargo Loading Systems
- 30 : Cargo Related Systems
- 40 : Unassigned
- 50 : Accessory Compartments
- 60 : Insulation

52 : Doors

- 00 : General
- 10 : Passenger / Crew
- 20 : Emergency Exit
- 30 : Cargo
- 40 : Service

- 50 : Fixed Interior
- 60 : Entrance Stairs
- 70 : Monitoring & Operations & Warning
- 80 : Landing gear

53 : Fuselage

- 00 : General
- 10 : Main Frame
- 20 : Auxiliary Structre
- 30 : Plates-skin
- 40 : Attach fittings
- 50 : Aerodynamics Fairings

56 : Windows

- 00 : General
- 10 : Flight Compartment
- 20 : Passenger Compartment
- 30 : Door
- 40 : Inspection & Observation