Guidance Material and Best Practices for Alternate Parts (PMA) and Approved (non-OEM) Repairs (DER)

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2nd Edition

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1 Introduction

Airlines need to operate with utmost efficiency. They must continuously strive to reduce operating and maintenance costs while, at the same time, always be in full compliance with all regulatory requirements and reach ever-higher safety standards. One way to achieve these objectives is to implement a strategy that makes use of approved replacement parts and repairs available from sources other than the Original Equipment Manufacturer (OEM).

This manual provides guidance material and best practices for airlines who desire to achieve maintenance material cost savings by use of alternate replacement parts (e.g. under Parts Manufacturer Approval – PMA) and approved (non-OEM) repairs. These subjects will be covered primarily from the point of view of the airline operators.

In industry parlance, an alternate (i.e. non-OEM) replacement part that is approved by the Civil Aviation Authority (CAA) as replacement of the original (OEM) part is referred to as a “PMA part”. This accepted use of the PMA terminology is also applicable within the content of this manual.

The reader should be aware that, PMA is the result of a regulatory approach which was promoted by the Federal Aviation Administration (FAA). The applicable FAA regulatory provisions, in their evolved and refined form, continue to be in-force today. Although, at times, neither the PMA wording nor the respective regulatory processes are strictly applicable “as is” in other regulatory jurisdictions (e.g. in the case of European Aviation Safety Agency – EASA), for the purpose of this document, the alternate replacement parts produced and used within those regulatory jurisdictions are also generically referred to as PMA parts.

Additionally, the reader should be aware that, the “CAA approval” of repairs may not necessarily be a “direct” approval in the sense that the “case at hand” is looked into directly by the CAA. The same “CAA approval” wording could be used when the regulatory approval is issued “indirectly”, by a qualified agent/entity empowered by the respective CAA to act as and in the name of the CAA and issue the approval for the “case at hand”.

This manual is a 2nd Edition of the document published initially by IATA in 2012. While most of the content of the 1st Edition was preserved, since its subject relevance and applicability are fully valid today, some clarifications and updates were incorporated in the 2nd Edition.

The Appendix D of the 1st Edition was removed since it consisted of the comments provided by CFM International to the initial document and those comments were considered by IATA in the revision process. The review of the comments led, on a case by case basis, to their acceptance (in whole or in part) or their rejection and is appropriately reflected in this 2nd Edition of the manual. The reader should also be aware that, while all the web links integrated in the text were validated before publication of the document, their continued validity can not be guaranteed by IATA.

2 Background

Maintenance materials and parts account for approximately 4% of the aviation industry's total cost structure. Focusing only on maintenance costs, purchased parts account for about 30% of all costs (most of the remainder is labour). The engine and component overhaul and refurbishment sectors account for the largest portion of all material costs. For example, engine maintenance accounts for 36% of maintenance spending and engine materials represent 60 to 70% of total engine maintenance expenditures.

The industry has always depended on the OEMs, who design and sell aircraft, engines and components, to support their products in service during their lifetimes that may span 30 years or more. The International Civil Aviation Organization (ICAO) specified, and the national regulatory agencies have mandated, that the operating airlines and Maintenance, Repair and Overhaul organizations (MROs) follow instructions for continued airworthiness (ICAs) and other support documentation (including maintenance manuals and parts catalogues) provided by the OEMs. With appropriate consideration of this starting point, most airlines are allowed, nevertheless, by their local regulators, to make changes to maintenance schedules and procedures, to develop modifications and repairs and to introduce alternate parts. All such changes must be documented and shown to meet or exceed the original certification standards. The airline must follow internal processes and procedures approved by the local regulator. In some cases, changes must be individually approved by the local CAA who may rely on the guidance of the agency that approved the original aircraft or engine Type Certificate.

During the past 10 years, the OEMs have increasingly seen the "aftermarket" as a source of revenue and potential profit. Airlines have experienced annual price increases for spare parts exceeding 3% and in some cases exceeding 5%. At the same time, the airline industry is under pressure to reduce costs and improve efficiency. In the maintenance area, this results in a need to identify strategies that reduce labour, material, outsourcing and inventory costs. One such strategy that has been adopted by an increasing number of large airlines is the use of alternate approved replacement parts from third-party suppliers. A related strategy is to introduce use of approved repairs that restore worn or damaged parts to their original specifications. The availability of alternate parts and repairs provides choices for airlines and results in market competition that has a moderating effect on OEM prices.

The pressure on airlines to reduce costs has also resulted in changes to business models and a focus on "core" business functions. Particularly for new start-up "low-cost-carriers", maintenance is often viewed as activity that is best outsourced. Even traditional airlines have separated their maintenance/engineering departments and set them up as "Profit Centres" providing services to the airline at market prices while also seeking large volumes of 3rd party business from other airlines. This trend is particularly evident in the areas of heavy engine maintenance and component maintenance. In these sectors, the major players are MROs. These players may be totally independent of any airline or they may be airline group profit centres but, in all cases, there is a separation from the day-to-day airline operations.

One negative consequence of this trend is that airlines have less scope to innovate and improve maintenance efficiency using their in-house engineering departments with their delegated authority to develop in-house repairs and to approve modifications and alternate parts. Instead, the airlines with their remaining in-house engineering staff must become more proficient in working with the MROs and their sub-contractors to continue to drive down prices and costs. This requires leveraging of commercial marketplace solutions such as approved (non-OEM) repairs and alternate replacement parts (PMAs). The trend will also depend on support from the local regulators. In the past, the CAAs commonly authorized airlines, with large and capable in-house engineering departments, to operate under an "approved system" which frequently included delegated approval of major repair designs, fabrication of replacement parts, and approval of parts substitutions and modifications. The new airline maintenance business models require regulators to focus on the system and processes that airlines use to select highly capable and fully resourced MROs and exploit their capabilities and those of their sub-contractors. The global nature of the MRO business requires international acceptance of 3rd party design approvals for repairs and replacement parts. International barriers would result in a "sole-source" environment and a lack of competition in some jurisdictions, which will drive up costs without any inherent safety benefits.

Airline surveys have shown that the prices of PMA parts are typically 20-30% less than the equivalent OEM prices. In some cases, price reductions of more than 40% compared with OEM list prices have been reported.

In addition to cost savings, PMA parts provide other benefits such as:

- A new source of replacement parts in those cases where the OEM has stopped production of the original part. This may occur when the production standard has changed and the OEM has advised that replacement parts are not available after a specified date. Also, some manufacturers go out of business for various reasons, leaving the airline without support.
- Improved reliability where the PMA supplier introduces a better design and/or manufacturing procedure.
- Improved availability with shorter lead times. This supports faster turnaround and promotes inventory efficiency.

Parts Manufacturer Approval (PMA) is a rather unique design and manufacturing approval process developed by the US FAA (Federal Aviation Administration) in the 1950s and still widely used today. The term applies to several different situations:

1. A company independently designs a replacement for an OEM part and obtains FAA approval of the design and the associated manufacturing and quality control process using the PMA approval procedure.
2. A company develops a modification to an aircraft, engine or component and obtains approval by STC (Supplemental Type Certificate). The kits or parts produced for the modification have PMA approval and are identified as such.
3. A supplier is authorized by the OEM to manufacture and sell replacement parts under a license agreement. These parts are also identified as PMA parts.

Most of this document considers "PMA parts" in the first context above. Some replacement parts are approved under the STC process. The STC process is used when the replacement is not "form, fit and function" interchangeable or where the part is so complex or safety critical that the full STC design approval process is appropriate. The STC process is more or less standardized and accepted by all national regulatory agencies. The FAA uses the term "PMA" to identify the new parts or kits while under EASA regulations identification of parts with the letters "EPA" (European Part Approval) is required whenever the parts are produced in accordance with approved design data not belonging to the Type Certificate Holder (TCH).

The widespread adoption of PMA-approved replacement parts has been constrained by several factors.

1. The FAA PMA stand-alone approval does not always have a direct equivalent in other CAAs' jurisdictions. For example, in the EASA system the replacement or modification of parts is approved through design changes or STCs. Nevertheless, as mandated in the Technical Implementation Procedures (TIP) document that accompanies the US-EU Bilateral Aviation Safety Agreement (BASA), an acceptance procedure of FAA PMAs is agreed and only some of the critical components with PMA approval require an explicit EASA approval.
2. Combining the design approval and the manufacturing approval under one certificate, like in the FAA PMA system, is not the norm among regulators. Two independent approval processes and certificates are more common.
3. Regulators have been slow to address use of PMA-approved parts in their regulations and guidance documents. Some regulators have permitted use of PMA parts with significant restrictions and limitations. These restrictions are gradually being removed but the interpretation of the restrictions is a burden for the airlines and inhibits a global industry-wide approach.
4. Some OEMs have vigorously defended their de facto monopoly on supply of replacement parts and have emphasized potential shortcomings of PMA. In a few cases, the OEMs have suggested that safety could be affected, warranty could be voided and future product support jeopardized if PMA parts are installed.
5. Lessors have in some cases prohibited the use of PMA parts on their aircraft and engines. They have justified the policy by stating that some airlines and some regulators do not accept PMA parts, and therefore their asset value would be diminished. The lessors have been slow to recognize that this situation is changing rapidly.

All of these constraints will be discussed in more detail in the later chapters of this document. Best practices will be recommended to speed up removal of the constraints and encourage widespread industry acceptance of PMA parts.

Another strategy available to airlines to reduce expenses for materials is to repair rather than replace parts that are worn or damaged. This is particularly applicable to expensive engine parts. Traditionally, the engine OEMs have published "standard" repair schemes in the engine shop manuals. However, over the past 10-15 years, the Engine OEMs' strategy to profit from the aftermarket has resulted in fewer repairs being included in their manuals. Instead, repairs developed by OEMs have been provided to individual MROs only after license agreements have been completed and royalty payments agreed. The OEMs may also recommend replacing parts rather than repairing because their cost to manufacture a new part is a small fraction of the catalogue list price of the part. This situation has resulted in the development of repair schemes by third parties – the MROs and their suppliers of specialized repair services. These repairs can be approved under FAA regulations by airworthiness engineers (independent professionals or staff engineers in the repair centre) who are delegated to approve repair and repair process design data. These repairs are referred to as DER (Designated Engineering Representative) Repairs. This subject will also be discussed in more detail in later chapters of this document.

The FAA has recently strongly defended the airworthiness of parts they have approved under the PMA system and repairs approved under the DER system. At the same time, FAA approval processes have been clarified and extended to cover a wider variety of parts including some critical parts such as engine turbine blades. Moreover, FAA indicates in its recent provisions (see AC 21.303-4) that for PMAs of critical and life-limited parts the "PMA will require the same rigor of compliance showings as an STC process".

3 Alternate Parts (PMA)

3.1 FAA PMA Approval Methods

The PMA approval process is documented in FAA Order 8110.42D (Parts Manufacturer Approval Procedures). Please refer to this document for details of the approval procedures. Following is a summary of approval and documentation requirements that are relevant to acceptance and introduction of a PMA part for airline use. It must be noted that compliance with these requirements is solely the responsibility of the PMA part manufacturer. Airlines may review the compliance documentation and FAA approval letter and point out any omissions regarding their intended use of the part but they should not become involved in proving compliance (unless the airline wishes to manufacture and sell PMA parts that they have developed internally).

There are three primary methods specified by AC 21.303-4 to ensure compliance with (14 CFR) part 21, Subpart K (Parts Manufacturer Approvals) and obtain design approval. Each of these methods is covered in some detail below.

3.1.1 Identicality With Licensing Agreement

In some cases, the OEM may license a third party to manufacture and supply replacement parts based on the original FAA design approval (TC or STC or TSO). In this case, the PMA manufacturer uses the original design data package and demonstrates to the FAA that their part is identical. The license confirms that the PMA supplier has the OEM's authorization to use their design data.

When this approval method is used, only minimal review by the airline's engineering department should be required. The PMA part number and supplier may already be documented in the OEM's Illustrated Parts Catalog (IPC) as an alternate part. The PMA part number may or may not be the same as the OEM part number. In such cases where the PMA part number is included in the IPC the PMA part number is approved for installation under the TC or STC.

3.1.2 Identicality Without Licensing Agreement

Using this method, the PMA part manufacturer demonstrates to the FAA that their part design is identical to the design of the OEM's part. Although possible, this method is seldom used now because it usually requires the PMA applicant to possess the OEMs proprietary design data (engineering drawings, test procedures, etc.) The method may be used for simple non-critical parts or where the PMA manufacturer has legally obtained the right to use the original design data.

3.1.3 Test and Computation

This method is sometimes referred to as reverse engineering and there are two methods to accomplish this.

The first method is known as "comparative test and analysis" whereby the PMA manufacturer provides a design package to the FAA showing that the PMA part is at least equal to the OEM part in form, fit and function (without having to rely on the OEMs proprietary drawings). This method is suitable for simple parts, and it typically requires side-by-side testing and analysis of the OEM and PMA parts.

The second method is sometimes referred to as “general test, and analysis” and requires the PMA applicant to submit an extensive data package describing the design, including materials, processes, test specifications, compatibility and interchangeability analysis and maintenance instructions. The package also contains a test and substantiation document demonstrating compliance with each of the applicable airworthiness standards. A failure mode and effects analysis is also required to support classification of the part as critical or non-critical.

3.2 Alternate Parts (PMA) Marking and Identification

The FAA requires that all PMA parts must be identified and in most cases marked with specified information (see 14 CFR §45.15):

- The words “FAA-PMA”
- The PMA manufacturer’s name, trademark or symbol
- A part number (with licensing agreements, the OEM’s part number may be used with a prefix or suffix; the PMA part may have the same number as the TC part)
- Exceptions are allowed where it is impractical to mark the part but, in this case, the tag or its container must have the above information.

This information is required for traceability of the PMA part and to distinguish it from the OEM part. Airlines should add the PMA part number to their purchasing and inventory control system, and update the appropriate IPC showing maintenance personnel where use of the part has been authorized. This can be done via electronic IPC supplements or other internal systems.

The EASA requirements for alternate parts are also ensuring that any part produced in accordance with approved design data not belonging to the TCH of the related product is marked with “EPA” letters (see Part 21 Subpart Q – 21.A.804).

3.3 Installation Eligibility

PMA parts are approved only for installation on specific type-certificated products. Applicants for PMA approval must indicate the aircraft and model types on which the parts are to be installed and the FAA approval will reflect this limitation. A given OEM part may be approved for installation on several types and models of aircraft. The corresponding PMA replacement part is approved only for the models specifically listed in the FAA PMA approval or supplement. It is important for airlines to recognize this and implement procedures to control installation of PMA parts only in those specific applications or to negotiate with the PMA supplier to obtain additional installation approvals.

3.4 Instructions for Continued Airworthiness (ICA)

The application for PMA parts approval must include a review of the OEM’s maintenance instructions and any instructions for continued airworthiness (ICAs) and life limits. The applicant must state that the existing maintenance instructions, ICAs and life limits are still applicable with the PMA parts installed or the applicant must provide replacement instructions, ICAs and life limits.

It is of utmost importance for the airline to review this documentation and incorporate any changes required in the maintenance program and maintenance instructions. Moreover, the airline has an essential role in ensuring that all PMA parts and/or DER repairs incorporated in the product it operates, and which are in addition to or in lieu off the configuration defined by the product TCH, were appropriately considered in conjunction with one another at the product level. This should be adequately reflected, whenever applicable, in the product overall maintenance program.

3.5 Continued Operational Safety (COS)

PMA holders are responsible for the continued operational safety (COS) of their designs. Regardless of the part complexity, PMA applicants should develop a COS plan. The scope of the plan is determined by the complexity and criticality of the part and it may be part of the PMA applicant's quality system. The COS plan demonstrates how any in-service problems with the part will be identified, tracked, reported and corrected. Airlines that use the PMA part are an important part of this process and they must provide feedback to the PMA manufacturer. Any reliability problems with a PMA part should be detected by the operator's normal reliability monitoring process just as for OEM parts. The reliability system should distinguish between OEM parts and related PMA parts.

The PMA Holder role and responsibility, before and after FAA article approval through PMA, is clearly stipulated in AC 21.303-4 and is not strictly resumed to the approved article but will have to also consider its interfaces, impact on system and any associated life-limited parts. This is well captured in the MARPA's Guidance Material for a PMA Continued Operational Safety (COS) System and acknowledged by FAA (in AC 21.303-04) as an acceptable regulatory compliance guidance source. (The guidance document is available at http://pmamarpa.com/gvt/COSGuidance.pdf).

Airlines that use a PMA part must ensure that they receive continued airworthiness information from the PMA supplier for as long as the part is in service.

3.6 STC Design Approval as an Alternative to PMA

From the airline's point of view, STCs are usually treated as modifications and not just alternative parts. This also introduces additional overhead but the process is at least well defined and widely used.

Nevertheless, it should be noted that STC approvals are granted with the assumption that all parts installed in the product, other than those affected by the STC, are type design configuration. Should an operator wish to embody an STC in conjunction with other modifications or even other STCs, an assessment of their compatibility and the potential impact of these multiple changes must be performed by the installer.

From an international regulatory point of view, STCs are well understood and acceptable by most authorities. The procedures for local acceptance of STCs approved in foreign countries have variations in complexity but they may be automatically accepted under bilateral agreements. Most countries allow qualified local manufacturers to obtain approval for their new replacement parts using the STC process. This contrasts with the PMA process, which is used exclusively by the US FAA although other countries are slowly developing somewhat similar approval methods.

3.7 Production and Manufacturing Approval

To obtain FAA approval to produce (manufacture) PMA parts for sale, the PMA supplier must also prove that they have a production system with the necessary quality controls to reliably and repetitively produce parts that conform to the approved design. The PMA certificate includes a production authorization but the approval process is separate. The production approval is the responsibility of the FAA Manufacturing Inspection District Office MIDO. The requirements and procedures are described in FAA Order 8120.22 which covers all types of FAA approved manufacturing. Chapter 4 of Order 8120.22 provides special guidance for PMA parts.

It must be noted that the requirements for quality control including periodic auditing are the same for PMA parts manufacturers as for OEM (type certificate) manufacturers. In all cases however, the requirements are determined by the criticality or safety category of the parts being produced.

3.8 PMA Parts Applications and Availability

PMA parts have been developed for many different aircraft applications. In theory, a PMA part could be developed to replace any OEM part on any aircraft or engine type. In practice, however, PMA development is driven by sales opportunities and market demand. This means that frequently or routinely replaced (expendable/consumable) parts are the first target of PMA manufacturers. Higher value parts are obviously more attractive than low value parts but high-volume low value parts may also be good candidates for PMA.

PMA parts are most commonly installed as replacement parts during engine maintenance, component maintenance and heavy maintenance. Usage by line maintenance is also increasing – particularly in cabin interior applications.

It has been estimated by FAA that more than 1 Million PMA articles' approvals were issued prior to July 2014. Such approved alternative parts are available for components in all ATA chapters and for all airframe and engine OEMs. Following is a partial list of areas where PMA or STC alternatives have been developed.

Alternative parts for:

- hydraulic pumps
- fuel pumps
- hydraulic actuators
- landing gear replacement parts
- wheels and brakes
- dynamic and static seals and couplings
- bearings
- engine parts – shrouds, valves, heat shields, nozzles, insulation blankets
- engine JT8D combustion chamber
- engine gas path and life limited parts (Pratt and Whitney PMA parts for CFM56-3)
- air conditioning components
- electrical system – IDG, CSD
- flight controls
- ice and rain protection
- pneumatic components
- water and waste
- fire protection system
- oxygen distribution components
- Auxiliary Power Unit (APU)
- thrust reversers
- starters
- cabin interior parts – IFE, lavatories, seat parts, tray tables, galleys, bins
- avionics, battery packs
- nose cowls

3.9 Safety Classifications for PMA Parts

It is necessary to distinguish between "critical parts" and "non-critical parts" as a classification for each PMA part. The FAA PMA 8110.42D document has approval procedures for both classes but the requirements for approval of "critical or complex" parts are much more stringent than for "simple non-critical" parts. The criticality of the part is determined by a safety assessment that examines the consequences of PMA part failure on the next higher assembly and the associated aircraft, engine or component.

The FAA and EASA adopted a harmonized definition of a critical part. This definition is included in the Technical Implementation Procedures (TIP) of the Bilateral Aviation Safety Agreement (BASA) in force between US and EU.

The above mentioned definition designates a "critical part" as "a part identified as critical by the design approval holder during the product type validation process, or otherwise by the exporting authority. Typically, such components include parts for which a replacement time, inspection interval, or related procedure is specified in the Airworthiness Limitations section or Certification Maintenance Requirements of the manufacturer's maintenance manual or Instructions for Continued Airworthiness".

Some other Regulators may have slight differences from the above quote in their adopted definition of a critical part.

3.10 Databases for PMA Parts

The FAA maintains a database of all approved PMA parts and the corresponding OEM part number. The database can be accessed at:
http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgpma.nsf/MainFrame?OpenFrameSet

Also, various databases of available PMA parts with cross-references to OEM part numbers are available by subscription on the Internet.

Partsbase combines the FAA database with additional information provided by PMA parts suppliers.
http://www.partsbase.com/public/includes/Layout.asp?Page=HOME

Inventory Locator Service (ILS) has a large PMA cross reference database.
http://www.ilsmart.com/Aviation/Buy-Aviation-Parts

FlyPMA.com is a web-based database of FAA-PMA parts that allows for searching across multiple information fields. This is the most flexible searching available for FAA-PMA parts. Also, OEM part number lists (up to 5000 part numbers) can be matched with all available PMA parts. Results from either search can be downloaded and opened in MS Excel.
http://www.flypma.com/

Although there are many individual PMA suppliers, a small number of large, well-established suppliers dominate the industry. There is a current trend toward consolidation of PMA suppliers. Some airlines and large MROs are forming partnerships with large PMA suppliers. Also some airlines are urging smaller suppliers to join larger groups to reduce the burden on the airline required to set up and manage business relationships with many small individual suppliers.

A list of some of the major PMA suppliers and their websites is available in Appendix C.

Most of these have a database with a list of their PMAs and cross-references from OEM part numbers.

At least one PMA trade industry association has been formed: MARPA (Modification and Repair Parts Association). MARPA's mission is to promote uniform standards within the FAA PMA industry and to speak with a single voice to the entire worldwide aviation community to elevate awareness and acceptance. Several airlines are members. More details can be found on their website:
http://www.pmamarpa.com/

4 Operator Procedures for Acceptance and Use of Alternate Parts (PMA)

4.1 Regulatory Requirements and Background

International aircraft standards (e.g. provisions of ICAO Annex8 – "Airworthiness of Aircraft" and ICAO Doc 9760 – "Airworthiness Manual") and all countries' national regulations require measures to ensure that aircraft continue to comply with the appropriate airworthiness requirements after a modification, a repair or installation of a replacement part. Parts manufactured by the OEM or by the OEM supplier and listed in the Illustrated Parts Catalogue are, of course, considered to satisfy the airworthiness standards. Parts fabricated by the operator and parts from third parties are fully acceptable if they have been shown to comply with the airworthiness standards. Airline operators in all countries have a legal responsibility to implement processes and procedures that will ensure that airworthiness standards are maintained when replacement parts are installed. These processes and procedures must be documented in the Maintenance Control Manual and accepted by the local CAA. The operator must maintain adequate configuration control of each aircraft at all times, and this includes PMA parts. If the OEM part was serialized and tracked, the PMA part must similarly be serialized and tracked. The operator is also responsible to ensure that all parts used during maintenance have been proven to satisfy the design and manufacturing quality standards. PMA parts have a design and manufacturing approval from the US FAA but the airline (or the "installer") should implement additional processes to satisfy their responsibilities and to demonstrate the necessary controls to their regulator. The following paragraphs describe best practices that should be reviewed by airlines who intend to install PMA parts on their aircraft or engines.

4.2 Typical Airline PMA Procedures and Processes

Airline PMA procedures cover four separate but inter-related areas of activity:

The Purchasing or Finance or Supply Chain department identifies an opportunity to use a specific PMA part, performs the analysis necessary to show a "business case" and assembles a "Standard Data Package" using documentation from the prospective PMA part supplier.

The Engineering department reviews the standard data package for applicability to the airline's fleet and verifies that local regulatory standards and the airline's technical requirements have been satisfied. If the review shows that the PMA part is acceptable, the engineering department issues an engineering authorization to use the PMA part and initiates the necessary documentation changes for use by Maintenance. If the review identifies any issues, the candidate PMA part may be rejected or the PMA supplier may be requested to provide additional documentation.

The Purchasing department places orders for the part and updates the inventory control system.

The Maintenance department refers to the documentation that has been updated by Engineering (for example, Illustrated Parts Catalogue supplement) and installs the PMA part as a replacement during maintenance activities. Maintenance also completes any necessary record-keeping activities to document installation of the part on a specific airplane, engine or component.

The activities in each of these four areas include procedures outlined in more detail in this Chapter 4.

Note: These procedures are not required for acceptance of PMA parts made under a license agreement with the OEM (and when, usually, the PMA part number is listed in the IPC issued by the OEM), or for PMA parts manufactured under an STC design approval.

4.3 Identification of PMA Parts Opportunity and Business Case

The Purchasing department identifies a PMA part that provides a potential cost-saving opportunity. A commercial assessment spreadsheet is completed considering the following factors:

- PMA part number, manufacturer name and vendor code
- OEM part number
- Prices of OEM and PMA parts
- Frequency of usage of the part
- Calculate the estimated annual savings (based on annual usage forecast)
- Is the PMA manufacturer already accepted as a supplier to the airline?
- Does the airline have a business relationship with the PMA supplier?
- If significant commercial benefits are indicated, proceed to request data package from PMA supplier and forward it to the Engineering department
- Assess warranty, insurance and industry history of the PMA holder
- Determine PMA usage implications in aircraft or engine leasing agreements

4.4 Preparation of PMA Evaluation Package

The minimum evaluation data package should include:

- PMA manufacturer identification, part description and part number
- OEM part number
- Identification of Aircraft or Engine where part can be used
- OEMs IPC references
- Identification of Next Higher assemblies (components or engines)
- PMA Holder's name
- Copy of FAA Notification of Design Approval Letter (optional)
- FAA PMA Supplement
- Part Top Level drawing and revision history
- Design Compliance Substantiation (Test and Computation summary)
- Instructions for Continued Airworthiness if applicable (or a statement that specific ICA is not required)
- In service history and list of other users if available
- A sample part may be required by the engineer during the review
- Commercial assessment including prices of PMA and OEM parts and the warranty terms offered by the PMA supplier

The data package and the commercial assessment are submitted to the Engineering department for review. In some airlines, the role of the commercial assessment is undertaken by the supply chain function within the airline's technical operations. The commercial assessment should include monetary implications if PMA parts are used and need to be removed to meet aircraft lease return conditions.

4.5 Engineering Review and Authorization

The Engineering department receives the PMA data package and prioritizes the processing based on the cost savings information. The review should use the information in the data package and include the following considerations:

- Confirm that the part is equivalent to the OEM part in form, fit and function.
- Confirm that the PMA supplement shows that the part has FAA approval for use on the airline's specific aircraft fleet type (effectivity).

- Confirm that the part is suitably identified and the part number is marked appropriately.
- If a sample part was requested and provided, examine the sample part to confirm that it satisfies the specifications and airline requirements.
- Consider the function performed by the part.
- Consider the consequences of part failure. Some CAAs may not permit use of PMA parts as replacements in critical applications.
- Review the FAA PMA supplement and design substantiation documentation. If approval was accomplished only by "similarity", the PMA approval may not be fully acceptable in some countries, except for the simplest applications.
- Consider damage that could result from part failure. If the cost of possible damage exceeds a value determined by the airline, then request that the Purchasing department review warranty and insurance coverage. A blanket policy is that all PMA suppliers must have a minimum amount of insurance coverage in the area of $100M to $500M; amount results from risk management evaluation.
- If the part is an engine part additional analysis should focus on answering if: does it impact the LLP lifing (e.g. the part is a "life-limited part" or an "influencing part" as mentioned in AC 33.70-1)? does it affect the EGT margin? does it impact the fuel consumption? does it impact the stall and/or surge margin?
- Consider the reliability experienced with the OEM part and the expected reliability of the PMA part. If the OEM has a reliability improvement program underway, it may be advisable to wait for the results. However, if the PMA part has characteristics that would improve reliability this should be included in the evaluation.
- Critical parts are subjected to a more in-depth evaluation and some CAAs may have restrictions on use of PMA parts in critical areas that must be considered.
- Would use of the part require any changes to the maintenance manuals?
- Does the part require tracking by serial number?
- Is the OEM part subject to an Airworthiness Directive (AD)? If so, authorization to use the PMA part should be delayed until completion of actions to comply with the AD, and it will be important to confirm that the PMA satisfies the post-AD requirements.
- Are the instructions for continued airworthiness or Airworthiness Limitations different from the OEM's ICAs? If yes, local regulations may require that the PMA part is introduced as a major modification (STC).
- Consider the in-service history of the part. Consult with other airlines that appear on the customer list in order to assess their experience and satisfaction with this part.
- If the part is relatively new on the PMA market and is to be used in an important application, the Engineering department may decide on the need for an in-service evaluation before full acceptance of the PMA part.
- Consider whether to monitor PMA parts specifically in terms of the airline's reliability program.

If more documentation is required, the request should be directed to the PMA part manufacturer. Any additional testing and substantiation should be completed by the manufacturer. The airline Engineering department should not be responsible for any aspect of design or manufacturing approval – this remains the responsibility of the PMA part supplier. This includes satisfying the design and manufacturing quality requirements of the local CAA if they exceed the initial FAA PMA approval requirements.

If the review concludes that some requirements are not satisfied, airline use of the PMA part is rejected and the package is returned to the purchasing department.

4.6 Engineering PMA Acceptance Documentation

The Engineering department should record the conclusions reached during the review and retain a record of these conclusions along with a copy of the evaluation package. The airline should store all of its own in-house substantiation "paperwork" but may opt for not storing the PMA supplier's data that can be available from the PMA holder when necessary.

If the review demonstrates that all requirements are satisfied, the Engineering department authorizes use of the PMA part by issuing the appropriate engineering document. This document is usually a revision or supplement to the IPC showing the new part as an authorized substitute for the OEM part. Of course, this revision or supplement can be in digital/electronic format if the airline maintenance is accomplished in a paperless environment.

The results of the evaluation are returned to the Purchasing department.

4.7 Implementation Steps for PMA Parts

If the PMA part has been accepted by the Engineering department, the Purchasing department advises the PMA part supplier that the part was accepted and makes the appropriate commercial arrangements. If this is a new supplier, additional steps may be necessary to add the company to the approved supplier list. Arrangements are made to ensure that any continued airworthiness information (service bulletins, maintenance manual revisions, in-service alerts, etc.) is provided to the airline on a routine basis.

The Purchasing or Material Management department sets up the new part number in the inventory control system. The appropriate control parameters are also specified including preference for the PMA part, restrictions on fleet type use (if any) and restrictions on use when maintenance is accomplished on other airlines aircraft, engines or components (some airlines contracts may require exclusive use of OEM parts). If both the OEM and PMA parts will be maintained in inventory, the expected usage rates of each part number are recalculated.

4.8 Maintenance Routine Use of PMA Parts

When the Maintenance department orders the OEM part, they are alerted that a PMA replacement part is available and they are directed to the relevant engineering authorization. They are also alerted to any restrictions on use of the PMA parts, for example, when performing maintenance on other airlines' equipment.

4.9 Record Keeping

The installation of the PMA part is recorded in the same way as use of an OEM part would be recorded by maintenance. Reference is made to the applicable engineering authorization or IPC amendment. If the part is to be tracked, the PMA part number and/or serial number will be entered on the tracking document or in the tracking system.

5 Commercial and Business Considerations

5.1 Warranty

There are a number of issues regarding warranty and use of PMA parts. These apply to both the warranty provided by the PMA supplier and possible effects on the OEM's warranty for the Next Higher Assembly (the component, equipment and/or product on which the PMA part is installed).

The PMA supplier should be expected to provide a "normal warranty" covering failures due to design or manufacturing defects for an agreed period of time after installation. At a minimum, the warranty should provide a free-of-charge replacement for the failed part. In some cases, labour is also included.

The OEMs – airframe, engine and component, typically provide a standard warranty covering failures due to design or manufacturing defects for a fixed period after the aircraft or engine is delivered. This period is typically 3 or 4 years but, in some cases, it may be as short as 6 months or as long as 5 years (or even longer for some other part/structure). Airlines usually do not use PMA parts as replacements during the warranty period because the OEM replacement should be provided free of charge. Also, if the OEM part is subject to a reliability improvement program to correct a reliability deficiency, introduction of a PMA part is usually avoided.

5.2 Product Support

Some OEMs have publically indicated that installation of a PMA part could have an adverse effect on the product support that they provide for the next higher assembly. A few have even stated that their ICA are valid only if OEM replacement parts are used.

The FAA was concerned about these statements and issued a Special Airworthiness Information Bulletin (SAIB) in 2008: SAIB NE-08-40. Following text is reproducing the recommendations formulated in the FAA document:

> "1) FAA-approved TC/PC holder, PMA, and STC parts are interchangeable within the certificated product since they are approved only after a full demonstration of compliance to the applicable requirements of Title 14 of the Code of Federal Regulations (14 CFR). A PMA or STC part, when FAA-approved for installation on a certificated product, is a valid replacement part to the TC/PC holder part according to 14 CFR;
>
> 2) Unless stated otherwise as a limitation to an STC, the FAA has determined and the applicant has shown that FAA-approved life limits established for the TC/PC holder parts remain unchanged for those TC/PC holder parts when PMA or STC parts are installed elsewhere within the product. For example, the life limit for a TC/PC holder disk is unchanged and remains in effect when PMA blades are installed in that disk;
>
> 3) The FAA approves the content of an ALS and ICA based upon its review of the substantiating data provided by an applicant. Applicants for PMA or STC parts are required to assess the ICA requirements. A PMA or STC applicant either shows and states that the product's ICA are still valid with their part installed or provides a supplemental ICA for any differences; and
>
> 4) TC/PC holders, PMA holders, and STC holders are responsible for the COS support in accordance with the applicable standards for their parts and products which they have designed and produced.

> Owners and operators are ultimately responsible for the safety and airworthiness of the product, which includes being responsible for the configuration control of the product. Owners and operators must ensure that any replacement part installed in the product is approved for that installation and further, they must also ensure that they follow any supplemental ICA that may have been developed for that part."

Moreover, the FAA issued in March 2012 a policy statement PS-AIR-21.50-01 to address actions taken by some Type Certificate (TC) and Supplemental Type Certificate (STC) Design Approval Holders (DAHs) to inappropriately restrict the availability, distribution, and use of Instructions for Continued Airworthiness (ICA) through restrictive language in the ICA or through restrictive access or use agreements.

Of course, product support from OEMs and also from PMA suppliers is a very important factor for airlines. Selecting a PMA supplier who has the required business foundation, financial stability and commitment to support for the lifetime of the product is often more important than simple confirmation that the PMA part has been approved. This is particularly true where the PMA part is used in a critical application or the consequences of failure are significant. Airlines should also engage in frank discussions with major OEMs regarding possible use of PMA parts and other means to control maintenance costs during the lifetime of the aircraft. IATA recommends that airlines strongly resist any clauses in support agreements that prohibit use of non-OEM parts. This applies even if there is no current plan to use such parts.

5.3 Product Liability

Product liability is a significant issue particularly if the PMA part is used in a critical application. First, the probable and possible consequences of failure should be considered such as extent of damage to next higher assembly or to the aircraft or engine and possible contribution to incidents or accidents. If the risk is significant, contractual discussions should be held with the PMA supplier to determine what liability insurance coverage they hold and what protection will be provided to their customers. These discussions are normally initiated by the airline's strategic purchasing department with the involvement of the legal and insurance groups. The understanding must be formally documented in the contract or purchase agreement and it should cover scenarios where failure of the PMA part is clearly the cause of the damage as well as possible situations where the root cause is not obvious and the OEM alleges that the PMA part is responsible or partially responsible for the damage.

5.4 Leasing Company Requirements

Leasing company contractual requirements are seen by airlines as a major impediment to widespread use of PMA parts. Leasing companies state that some airlines and some national regulators do not accept aircraft or engines that have PMA parts installed. The lessors therefore maintain that their re-marketing opportunities are restricted when PMA parts have been used. Furthermore, they claim that the value of the asset (engine and/or airframe) is reduced if PMA parts are present. Lessors rely on appraisers who may ask if PMA parts have been installed and reduce their valuations accordingly but this will change as acceptance of PMA parts becomes more common.

IATA understands that the lessor and appraiser issues are related primarily to the historical lack of universal acceptance of PMA use by some regulators and some airlines. As the industry searches for maintenance material cost reductions and regulators strive for a "level playing field", this problem will diminish and eventually disappear. It is in the interest of all industry players to promote savings wherever possible. Significant progress has been made during the past seven years and this will continue. Of course, some OEMs will vigorously defend and attempt to increase their share of the aftermarket and they can be expected to resist competitive products. This commercial issue should not be permitted to reflect on the airworthiness of approved alternative replacement parts or to prevent their use.

Many lessors already permit use of PMA parts in non-critical areas such as expendables, general hardware and interior parts.

IATA recommends that airlines strongly object to clauses in lease contracts that restrict use of PMA parts. This recommendation is made on the basis that such restrictions will increase maintenance cost and that current trends indicate no loss of asset value at the end of the lease. Such clauses tend to reduce competition and increase revenue for OEMs while increasing costs for airline operators who traditionally have lower margins. Even where the operator does not foresee use of PMA parts, such clauses should be avoided if possible. The airline should propose instead a clause stating "only approved replacement parts and approved repairs will be installed".

5.5 Safety Record of PMA Parts

The FAA's objective when approving PMA parts is to ensure that they are at least equal to the original OEM part in terms of function, performance, reliability and safety.

The track record of PMA parts shows that they have achieved this objective.

In a study initiated by FAA and concluded in 2008 (see http://www.gpo.gov/fdsys/pkg/FR-2008-09-05/pdf/E8-20460.pdf), the Repair, Alteration and Fabrication Team authoring the report stated that:

> *"…*the team did not find any substantial evidence of failures or unsafe conditions arising from non-TC/PC holder developed data that would indicate a systemic lack of compliance or capability in either the non-TC/PC holders' designs or the FAA's oversight of compliance. The general population of PMA parts and non-TC/PC holder repairs, alterations has increased substantively in past years particularly in the commercial aviation sector yet the occurrence of service difficulties and airworthiness directives on such parts for design, production or compliance shortfalls have not increased proportionally."
>
> (Document available at http://www.pmamarpa.com/gvt/raftreport.pdf

Other industry studies have reached the same conclusion. However, airworthiness directives have been issued for PMA parts. In accordance with regulatory and industry practices, service issues with both TC Holder and PMA parts have been addressed by FAA ADs. In most cases, the PMA part had the same design defect as the OEM part and the AD covered both OEM and PMA parts. In all cases, the PMA manufacturer revised the design to eliminate the defect and supported the operators' retrofit of the defective parts to comply with the AD.

Many PMA parts have been in service with some airlines for many years and can demonstrate reliability "equal to or better than" the OEM part. Recent PMA approvals have been subject to the increased design scrutiny mandated by the latest FAA requirements – particularly for more complex or critical applications.

In addition, major players in the PMA industry are focusing on the subject of COS to ensure that any in-service problems are identified and fixed. The MARPA trade association has developed guidance material for their members addressing COS.

6 International Regulations Relating to Alternate Parts (PMA)

Each airline must satisfy the requirements of their local airworthiness authority (specifically, those of the "state of registration" of the aircraft) when performing maintenance. This includes the requirements relating to acceptance of replacement parts.

Although all countries generally follow ICAO standards, each country exercises its sovereignty by defining national standards. National airworthiness standards differ in some areas and the acceptability of replacement parts is one of these areas. Although there is an on-going "harmonization" process among regulators, each country has its own specific requirements and interpretations. Below is an overview of some of these.

6.1 USA

As explained above, PMA is a process for design and manufacturing approval of replacement parts defined by the US FAA. For this reason, PMA parts were first introduced in the USA and are now widely accepted and exploited by most major US airlines. Similarly, almost all manufacturers of PMA parts are American companies.

In response to the rapid growth of the PMA market and the drive toward use of more complex PMAs in more important applications, the FAA have made significant additions to the requirements that a prospective manufacturer must satisfy to obtain PMA approval. Particularly for critical or complex parts, the FAA now relies much less on "identicality" and much more on "test and computation" for design substantiation. A "Project Specific Certification Plan" is now required to demonstrate compliance with all the applicable Airworthiness standards. A "Failure Modes and Effects Analysis" (FMEA) is required and, if the part failure could have significant consequences, the certification plan will require analysis and testing equivalent to that required to obtain an STC approval. Also, there is now a requirement to formally review the existing ICAs and confirm that they can still be used or, if needed, to produce new ICAs for the PMA part.

Although the combination of design and manufacturing approval in one document (PMA) is unusual from an international regulatory point of view, the manufacturing quality and inspection system approval for PMA parts is actually handled by a separate division of the FAA (the MIDO) and it is almost identical to the process that any Production Approval Holder must undergo.

The FAA regulations continue to evolve. Acknowledging the need to expedite approval of non-safety significant articles by PMA, in 2012 the FAA issued the "Streamlined Process for Parts Manufacturer Approval" Order 8110.119. The implementation of PMA regulation recently received a significant revision when FAA issued "Parts Manufacturer Approval Procedures" Order 8110.42D in 2014.

In addition to covering more complex PMA parts, the changes are intended to improve the international acceptance of this type of approval for alternate replacement parts. In fact, international acceptance has been steadily increasing over the past 5-8 years and the trend continues. The FAA has signed BASA (Bilateral Aviation Safety Agreement) treaties with many countries whereby each party agrees to accept the other's findings of airworthiness and certifications. PMA parts are generally covered by these BASA agreements with some countries having exceptions for critical parts that may require a separate review or approval via an STC process.

Following are some examples of recent changes by various regulatory agencies. These changes address the acceptance of alternate replacement parts approved in other countries (e.g. PMA parts approved by US FAA) and in some cases, they also provide a regulatory framework whereby domestic manufacturers can obtain design approval for parts that they can offer as replacements for OEM parts.

6.2 Canada

Several years ago, Canada implemented a PDA (Parts Design Approval) process to allow Canadian manufacturers to obtain design approval for non-OEM replacement parts. Particularly for simple parts, the PDA approval procedure simplifies the requirements compared with the relatively complex STC process. A BASA with the USA has been signed which provides for acceptance of FAA design approvals including PMAs in Canada and acceptance of PDAs and Canadian STC parts in the USA. More than 200 parts have been approved and granted PDA certificates. A database of Canadian PDA approvals is available at:
http://wwwapps.tc.gc.ca/saf-sec-sur/2/nico-celn/c_s.aspx?lang=eng

In the past, Canada restricted installation of PMA parts and permitted installation only on aircraft types for which the US had jurisdiction for the initial type design. Canada now accepts FAA PMA parts without restriction.

6.3 Mexico

A BASA was signed in 2009. PMA parts are accepted without restriction.

6.4 Europe

The USA and the European Aviation Safety Agency (EASA) signed a BASA in 2008 that would permit acceptance of PMAs in all the 32 member states of EASA. On May 1st, 2011, the bilateral agreement between the European Union and the USA came into force (BASA 8312/09). In § 2.8 of the Technical Implementation Procedures (TIP) related to the BASA, the procedure for acceptance of PMA parts is described. This procedure is in line with the previously issued EASA decisions. Latest revision of the TIP (revision 4) is available at
http://easa.europa.eu/system/files/dfu/FAA-EASA%20TIP%20Revision%204.pdf

6.5 Australia

The BASA with the USA signed in 2005 provides Australian acceptance of FAA PMA parts. A 2009 revision to the BASA permits acceptance of Australian PMA parts in the USA although this is initially limited to parts to be installed on general aviation aircraft.

6.6 China

In November 2010, the Civil Aviation Administration of China (CAAC) announced support for PMA Parts and non-OEM approved repairs (CAAC AC 121-55R1). CAAC recognizes that this is one way to reduce the heavy cost burden of engine overhauls for Chinese Air Carriers. China also issues CAAC-PMA approvals to domestic manufacturers. Over the past 10 years, CAAC-PMA approvals have been granted for more than 400 parts from many suppliers. FAA PMA approval of the design data is accepted subject to the airlines accomplishing an administrative process and following guidelines to develop and establish a business relationship with the FAA-PMA manufacturer.

6.7 Japan

FAA PMA parts are accepted subject to a requirement that the PMA design approval documents are provided, reviewed and filed. The regulations also require that the airline receive continuing airworthiness data from the PMA supplier and make any required changes to the maintenance program.

6.8 Other Countries Having BASA Agreements with the USA

This list currently includes Argentina, Brazil, India, Indonesia, Israel, Japan, Korea, Malaysia, New Zealand, Russia, Singapore and South Africa. The details of the BASAs vary from nation to nation so it is necessary to consult the local airworthiness officials to determine what, if any, restrictions apply on a case-by-case basis.

Information regarding the FAA perspective and news on BASA could be accessed at https://www.faa.gov/aircraft/air_cert/international/bilateral_agreements/.

7 Approved (non-OEM) Repairs

7.1 The Repair or Replace Decision

Mechanical components are commonly subjected to wear or other types of physical deterioration during operation. The extent of wear eventually reaches the point where the strength and performance of the part no longer satisfy design requirements, and it is necessary to remove the worn part and install a replacement that meets the initial design specifications. The replacement may be a new part or it may be a “repaired” part – one that has undergone a process to fully restore the part so it satisfies its initial design requirements. For aeronautical parts, all applicable aspects must be considered – strength, hardness, surface finish, dimensions, etc. The repair process and specifications must be fully documented and approved – much like the original design approval.

When an approved repair exists, the decision to replace with a new part or repair the existing part is primarily an economic decision – cost of a new part versus cost of the repair. It may also be influenced by availability of new parts (the part may not be in stock and the lead time can be long) and the turn-around time for complex repair process can be significant. In the latter case, new parts may be used initially and repaired parts are re-stocked for later maintenance events.

7.2 Major and Minor Repairs

To decide what documentation is required for a repair, it is first necessary to determine if the repair is classified “Major” or “Minor” using the applicable airworthiness definitions of these terms.

The FAA definition of major repairs is:

> *Major repairs are those that if improperly done, might appreciably affect weight, balance, structural strength, performance, power-plant operation, flight characteristics, or other qualities affecting airworthiness or that are not done according to accepted practices or elementary operations.*

All repairs that are not major are defined by the FAA as minor.

On the other hand, EASA’s definition of minor repairs is:

> *A minor repair is one that has no appreciable effect on the mass, balance, structural strength, reliability, operational characteristics, noise, fuel venting, exhaust emissions, or other characteristics affecting the airworthiness of the airplane.*

All repairs that are not minor are defined by the EASA as major.

Criteria for classification of repairs are elaborated upon in GM 21.A.435(a).

Note: Some airlines, in their internal CAA classification worksheets may have other criteria that can make the repair “Major”.

7.3 Approval of Major Repairs

For FAA, major repairs must be accomplished using “approved data”. Minor repairs may be accomplished using “acceptable data” such as documented standard industry practices.

For EASA, both major and minor repairs must be accomplished using "approved data". EASA shall approve design data in support of repairs in accordance with EASA Part 21 Subpart M-Repairs and EASA’s procedure *Type Certificate Change and Repair Approval*. A design approval shall be issued for all repair design data.
Sources of “approved data” for repairs include:

- Repairs that are in the OEM’s Component Maintenance Manual (CMM) or repairs included in other OEM manuals such as engine manuals and structural repair manuals. All of these are sometimes referred to as “standard repairs”. It should be noted that in general OEM CMMs are not a source of “approved data”. Very few CMMs have FAA-approved data. Those that are “FAA-approved” are done so via tacit approval due to Airworthiness Directives. The only FAA-approved OEM manuals are the SRMs and life limit chapters.
- For the FAA, repairs may be approved by their engineering delegates: Designated Engineering Representative (DER) or Engineering Unit Member (UM) in case of an ODA. The approval is documented by using FAA form 8110-3 or 8100-9. The FAA delegation system is documented in 14 CFR 183.29. FAA Order 8110.37E is the DER handbook. Specific DER delegation is required for major repairs and for data approvals for “multiple use repairs”. The FAA has introduced a new type of delegation: “RS-DER – Repair Specification DER” which will further define this specialization. Major repairs approved by FAA DERs for multiple use are known as “DER Repairs”. These are most commonly used for repair of engines or components. The DER repairs may be protected by intellectual property rights and they may be licensed for use by an airline or an MRO. DERs may not approve minor repairs. A further means of obtaining repair data approved under the FAA is by means of an ODA (Organization Designation Authorization), see FAA Order 8100.15B.
- The FAA and many other national regulators also permit airlines who operate under an “approved system” to have in-house engineering departments with authority to develop and approve major repairs for use on their aircraft, components or engines. These repairs are usually restricted to use on the operator’s own aircraft.
- In Europe, repair design data is approved via an EASA repair design approval letter or a repair design approval issued under a Design Organization Approval (DOA).

Regardless of the source of approval, all repeatable major repair documentation must include design and process control elements. The repair steps must be documented and the repaired product must be shown to satisfy the original airworthiness standards. Also, all processes and special equipment required for the repair must be described in detail as well as any tests required on the repaired product. It is also necessary to identify the repaired part so it can be traced to the repair design documentation. Most repair developments include a “trial repair” or “prototype” whereby the repair process is evaluated at each stage by the repair designer and the final repaired part is evaluated by test or in-service trial before it is approved for unrestricted routine use. It should be noted that “prototype” repairs are not a standard industry practice.

7.4 Installation or Acceptance of Repairs

The “installation of the repair” or acceptance of the repaired part in an aircraft, engine or component is usually subject to a separate process. In some cases, the airline’s engineering department is delegated by the CAA to authorize installation and use of a repaired or new part based on a documented company process.

It is the responsibility of the installer (the airline operator) to ensure that parts installed during maintenance satisfy the airworthiness standards used in the original type design of the aircraft. This responsibility is usually covered by use of approved maintenance documentation such as IPC and repair/maintenance manuals. Repaired and new parts are accepted only from a list of approved suppliers and incoming parts are subjected to a system of receiving inspection that ensures that the necessary airworthiness certificates have been supplied.

7.5 Acceptance of Approved (non-OEM) Repairs outside of the USA

Some CAAs accept non-OEM repair design data (specifications). However, separate approval of the repair process and the facility (repair station) where the repair is performed is often required and this may be delegated to the operator; alternately, the CAA may require the operator to submit a data package for their approval.

Following the USA – EU BASA provisions entered into force in May 2011, and especially the related TIP agreed procedures, there is a clearly specified process for mutual approval or acceptance of repairs. Please refer to the TIP document Section III Chapter 3.3.

The complete documents are available on the EASA site at
http://easa.europa.eu/document-library/bilateral-agreements/eu-usa.

The FAA provides a very useful guidance material at
http://www.faa.gov/aircraft/air_cert/international/easa/media/EASA_FAQ.pdf.

The FAA DER handbook FAA Order 8110.37E became available on March 30th, 2011. Certain disclaimers under 4-12.k. (3) do not reflect the automatic EASA acceptance and the status of the order may need some clarification.

Except for critical components, repair designs approved by DERs or by EASA are fully acceptable to both bilateral partners without re-approval.

In cases where the 8110-3 approval has statements that prevent acceptance in other jurisdictions, the issue should be raised with the MRO and DER involved.

7.6 Sources of Approved Repairs

DER and EASA approved repairs are offered by some engine and component MROs as an integral part of their service and capability offerings. These MROs promote their non-OEM repairs as a method to reduce costs of replacement parts. Some private DER consulting firms offer a selection of DER repairs in their area of specialization. MROs can obtain the right to use these repair designs by paying a fee or royalty.

Please refer to Appendix C for some typical company databases that include listings of DER-approved repairs.

8 Conclusions and Recommendations

In the current challenging economic environment, airlines must continuously search for ways to reduce costs while maintaining high standards of safety and full compliance with regulations. IATA believes that PMA parts and non-OEM repairs are excellent methods to achieve significant maintenance material savings. To support widespread adoption, IATA offers the following viewpoints and recommendations:

- The use of PMA parts and non-OEM repairs is an efficient and recommended airline maintenance business strategy. This strategy offers significant direct savings and its widespread adoption will serve to counter the unreasonable high pricing and price increases by OEMs.
- PMA parts and non-OEM repairs are approved or accepted by the FAA and international regulatory acceptance is growing rapidly.
- National CAAs must be encouraged to adopt a more open/flexible approach towards non-OEM repairs as some CAAs still insist that all the individually approved non-OEM repairs have to be reviewed by the operators and/or approved by the CAAs.
- More emphasis should be placed on educating the industry with FAA's and EASA's implementation of their bilateral as a unified/aligned position/policy. Achieving this will encourage national CAAs to adopt a more flexible approach towards PMA/non-OEM sources based on the aligned position/policy. Without an aligned implementation of the bilateral policy from FAA/EASA, most CAAs will adopt a more conservative attitude towards PMA/non-OEM presence and this will give an excuse to the aircraft lessors to preclude the use of PMA parts and non-OEM repairs.
- Airlines should lobby their respective regulators to increase standardization (or harmonization) of requirements relating to acceptable and approved replacement parts.
- Airlines should take full advantage of bilateral agreements relating to reciprocal acceptance of PMA parts and approved (non-OEM) repair designs and avoid the burden of re-approving PMA parts and non-OEM repairs under local interpretations.
- Experience shows that PMA parts and approved (non-OEM) repairs are just as reliable as the original OEM parts and are fully equivalent in terms of quality, airworthiness and reliability. There is no justification for reduction in asset value where these strategies have been used during maintenance. There is no good reason for refusal to accept an aircraft, engine or component simply because of PMA/non-OEM element presence. Moreover, PMA parts and approved (non-OEM) repairs may provide additional maintenance options.
- TC Holders should not act as protecting the OEMs' well-being by issuing official statements to the operators to 'warn' them about the potential danger of fitting approved alternative/non-OEM parts.
- Acceptance of an OEM to supply parts to a TC Holder should include the TC Holder/OEM's product support agreement with a statement to allow the use of approved alternative parts in their system by the end users and clearly state that OEM cannot deny any warranty claims if the failure is proved unrelated to the quality of the approved alternative part(s). The OEM must not withdraw from honouring any product support commitments just due to the presence of PMA parts in their product, especially if PMA parts were not used to replace any critical parts.
- Airlines should object to clauses in lease agreements that prohibit use of alternate parts (PMA) and approved (non-OEM) repairs. Also, airlines who do not currently expect to use these options should object to such clauses on the basis that an element of competition for supply of frequently used replacement parts is essential to maintain the economic health of airlines and that a level playing field is increasingly important for the global industry. If the lessor proposes restrictions relating to replacement parts or repairs, airlines should propose the provision stating that they will "use only approved parts and repairs that conform to the applicable airworthiness standards".
- PMA parts may also be safely used even in critical applications. Here, good business practice and due diligence dictate that the airline's purchasing and engineering departments thoroughly review the supplier's experience, qualifications, reputation and capabilities in the specific industrial technology area(s). Also, they should confirm that the insurance and liability coverage provided by the PMA supplier is appropriate to cover direct and indirect consequences of any failures of critical parts. The

airline's engineering department should also review the methods that were used to demonstrate that the part design meets the airworthiness standards; the airline must be aware of any possibilities of difference in the overall "behaviour" based on differences in the design and/or material. For critical parts, the analysis, testing and documentation should be comparable to that required to obtain an STC certificate.

- Some airlines may adopt a business policy whereby only OEM parts and OEM-approved repairs will be used on their aircraft. These airlines should recognize that the availability of alternate sources of parts and repairs in the marketplace introduces an element of competition that allows them to negotiate more favourable prices with the OEM. These airlines should always emphasize that their pro-OEM policy is based on business and commercial decisions and does not result from any concern about the safety or airworthiness of non-OEM parts or repairs.

The development of non-OEM repairs and the use by the operator of PMA parts follows a structured process and adheres to FAA/EASA compliance requirements to assure a certified airworthy condition. Included in the FAA/EASA compliance requirements is the requirement to develop and provide Instructions for Continued Airworthiness (ICA) for the repair or PMA part as necessary. ICA provide a way to keep products airworthy. It is a requirement to assess existing Type Certificate Holder (TCH) ICA and state whether they remain adequate or to propose changes as supplementary instructions. The statement of adequacy or supplementary instructions encompasses the engine system to ensure that the Airworthiness Limitations published in Chapter 5 of the Service Manuals remain valid. Furthermore, to ensure the preserved validity of Airworthiness Limitations, the LLP influencing parts are maintained with FAA/EASA approved data or replaced with approved parts to be consistent with the configurations, repair, and inspection procedures provided in the ICA supplied by the TCH.

Confusion and misunderstanding have resulted for some operators upon the introduction of changes to the engine Service Manual Chapter 5 which included the introduction of a LLP influencing parts list. The changes raised doubt concerning the validity of the FAA approved Airworthiness Limitations when LLP influencing parts, including repairs, alterations, and operator approved PMA parts not sanctioned by the TCH, have been installed in the engine.

The FAA Engine Certification Office has advised, in response to CSI-12-20, that they support cautionary Service Manual statements regarding parts that may influence critical parts. However, the FAA clarified that influencing parts themselves are not critical and the statements introduced by the TCH in their Service Manuals are not regulatory or mandatory as they appear in the General Introduction Section of Chapter 5 which is not FAA approved and not included in the FAA approved Airworthiness Limitations Section. The FAA letter clarifies the status of influencing parts in accordance with existing FAA Guidance documents.

The FAA has issued two Advisory Circulars (AC) to provide guidance for developing substantiating data for PMA parts and major repairs. FAA AC 33-8 (see ref. in Appendix B) provides information for development of PMA parts and FAA AC 33-9 (see ref. in Appendix B) provides information for development of major repairs. Both ACs utilize a Failure Modes and Effects Assessment (FMEA) by which each possible failure mode of the part being considered for repair or replacement is analyzed for its direct and indirect effects on the part, next higher assembly, and on the entire engine system or its system interactions. The result of the FMEA is a categorization of whether the part is critical or complex and whether the part may affect a critical part (i.e. it is an LLP influencing part). Depending on the categorization, the technical elements and regulatory requirements to consider when developing test and substantiating data are provided within each AC. This process is conducted for each repair, alteration, or PMA part in order to ensure both the Type Certification basis of the part and of the engine remain valid with regard to the Airworthiness Limitations in Chapter 5 of the associated Service Manuals.

IATA supports the initiative to raise awareness of performance characteristics of parts that may affect the operating conditions and thus the performance of an LLP.

This initiative supported by IATA has the clear objective to ensure that the Airworthiness Limitations published in the ICA remain valid for all operators when products with approved (non-OEM) repairs or operator approved PMA parts are installed in the engine. To fully support that objective, any non-OEM developed and FAA/EASA approved repair or any operator and FAA-approved PMA part will continue to follow the guidance of FAA AC 33-9 or AC 33-8, respectively. Therefore, the appropriate assessments of each repair or PMA part would have been conducted on the engine system as a whole in order to establish any direct and/or indirect effect on LLP boundary conditions and to ensure the validity of the Airworthiness Limitations of LLPs published in the Service Manuals.

Appendix A – Abbreviations

Abbreviation	Meaning
AD	Airworthiness Directive
APU	Auxiliary Power Unit
ATA	Air Transport Association (USA)
BASA	Bilateral Aviation Safety Agreement
CAA	Civil Aviation Authority
CMM	Component Maintenance Manual
COS	Continued Operational Safety
CSD	Constant Speed Drive (generator)
CSI	Consistency and Standardization Initiative
DAH	Design Approval Holder
DER	Designated Engineering Representative
DOA	Design Organization Approval (EASA)
EASA	European Aviation Safety Agency
EGT	Exhaust Gas Temperature (engine)
ETOPS	Extended-Range Twin Engine Operations
FAA	Federal Aviation Administration (USA)
FMEA	Failure Modes and Effects Analysis
IATA	International Air Transport Association
ICA	Instructions for Continued Airworthiness
ICAO	International Civil Aviation Organization
IDG	Integrated Drive Generator
IFE	In-Flight Entertainment
ILS	Inventory Locator Service
IPA	Implementation Procedures for Airworthiness
IPC	Illustrated Parts Catalogue
MAG	Maintenance Access Guidance
MARPA	Modification and Repair Parts Association
MIDO	Manufacturing Inspection District Office (FAA)
MRO	Maintenance Repair and Overhaul
ODA	Organization Designation Authorization (FAA)
OEM	Original Equipment Manufacturer
PBH	Power by the Hour
PC	Production Certificate
PDA	Parts Design Authority (Canada)
PMA	Parts Manufacturer Approval
P/N	Part Number

RAFT	Repair, Alteration and Fabrication Team (FAA)
RS-DER	Repair Specification DER (FAA)
SAIB	Special Airworthiness Information Bulletin (FAA)
SARPS	Standards and Recommended Practices (ICAO)
SB	Service Bulletin
SRM	Structural Repair Manual
STC	Supplemental Type Certificate
TC	Type Certificate
TCH	Type Certificate Holder
TIP	Technical Implementation Procedures
TSO	Technical Standard Order
UM	(Engineering) Unit Member

Appendix B – Reference Material – Regulatory Sources

FAA Order 8110.42D, March 2014, Parts Manufacturer Approval Procedures
http://www.faa.gov/documentLibrary/media/Order/8110.42D.pdf

FAA Order 8110.37E, March 2011, Designated Engineering Representative (DER) Handbook
http://www.faa.gov/documentLibrary/media/Order/8110.37E.pdf

FAA Order 8120.22, February 2013, Production Approval Procedures
http://www.faa.gov/documentlibrary/media/order/8120.22.pdf

FAA Advisory Circular 43-18, June 2011, Fabrication of Aircraft Parts by Maintenance Personnel
http://www.faa.gov/documentLibrary/media/Advisory_Circular/Ac_43-18_Chg_1-2.pdf

FAA Advisory Circular 20-62E, December 2010, Eligibility, Quality, and Identification of Aeronautical Replacement Parts
http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC%2020-62E.pdf

FAA Advisory Circular 33-8, August 2009, Guidance for Parts Manufacturer Approval of Turbine Engine and Auxiliary Power Unit Parts under Test and Computation
http://www.faa.gov/documentLibrary/media/Advisory_Circular/33-8.pdf

FAA Advisory Circular 33.87-2, June 2009, Comparative Endurance Test Method to Show Durability for Parts Manufacturer Approval of Turbine Engine and Auxiliary Power Unit Parts
http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_33.87-2.pdf

FAA Advisory Circular 33-9, April 2010, Developing Data for Major Repairs of Turbine Engine Parts
http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC%2033-9.pdf

FAA Advisory Circular 43-210, February 2004, STANDARDIZED PROCEDURES FOR REQUESTING FIELD APPROVAL OF DATA, MAJOR ALTERATIONS, AND REPAIRS
http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC43-210.pdf

FAA Advisory Circular 145-9, March 2009, Guide for Developing and Evaluating Repair Station and Quality Control Manuals
http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgAdvisoryCircular.nsf/0/f1bf2d45c148209e8625758b00504191/$FILE/AC%20145-9%20CHG%201.pdf

FAA Special Airworthiness Information Bulletin NE-08-40
http://rgl.faa.gov/Regulatory_and_Guidance_Library%5CrgSAIB.nsf/(LookupSAIBs)/NE-08-40?OpenDocument

Agreement between the USA and the EU on cooperation in the regulation of civil aviation safety (BASA)
http://easa.europa.eu/document-library/bilateral-agreements/eu-usa

EASA-FAA Technical Implementation Procedures for airworthiness and environmental certification (TIP) – Revision 4
http://easa.europa.eu/system/files/dfu/FAA-EASA%20TIP%20Revision%204.pdf

EASA-FAA Maintenance Annex Guidance (MAG) – Change 4
http://easa.europa.eu/system/files/dfu/MAG%20Change%204.pdf

Transport Canada Exemption removing previous restrictions on PMA parts
http://www.tc.gc.ca/civilaviation/regserv/affairs/exemptions/docs/en/1885.htm

Transport Canada CAR 571.13 Installation of Parts
https://www.tc.gc.ca/eng/civilaviation/regserv/cars/part5-standards-571s-1827.htm

Australia-USA BASA Implementation Procedures
http://www.casa.gov.au/wcmswr/_assets/main/airworth/international/faaaustraliaipa.pdf

Japanese Civil Aviation Bureau (JCAB) PMA Circular No. TCL-159-93 (dated Feb. 26, 1993), and Revised PMA Circular No. 3-009 (dated Jan. 26, 2001)

Japanese Civil Aviation Bureau (JCAB) FAA DER Approved Repair acceptance Circular No. 4-016
This document specifies the process and documents for Japanese operators to use repair/alteration without OEM concurrence.

Appendix C – Reference Material – Industry Sources

The Airline Guide to PMA – David Doll:
http://www.pmaparts.org/pdf/AirlineGuideToPMA.pdf

MARPA Modification & Replacement Parts Association :
http://www.pmamarpa.com/

FlyPMA:
http://www.flypma.com/

HEICO:
http://www.heico.com/flight-support/

Wencor Group:
http://www.wencor.com/index.php

Aerosup:
http://www.aerosup.com

Chromalloy Catalogue:
http://www.chromalloy.com/CapabilityCatalog/index.aspx?cp=1&st=&ts=&em=Hamilton%20Sundstrand&et=&ob=&od=&xs=&in=ad

Pratt & Whitney GMS for CFM-56 Engine Maintenance:
http://www.pw.utc.com/content/services_for_cfm56_engine/pdf/c-1-7_cfm56_product_card.pdf

Aircraft Component Design:
http://aircraftcomponentdesign.com/index.php?option=com_content&view=article&id=57&Itemid=69

Aircraft Technology – Engineering & Maintenance
"Material benefits – a review of the PMA market", Issue 132, October-November 2014, Page 16-19

Aircraft Technology – Engineering & Maintenance
"The World is Opening to PMA Parts", Issue 108, October-November 2010, Page 52-58

Aircraft Technology – Engineering & Maintenance
"Specialist repairs – the market, the statistics and the strategies", Issue 98, February-March 2009, Page 46-53

Overhaul & Maintenance, March 2005, Page 37-40, "When is a Repair not a Repair?"

Overhaul & Maintenance, April 2009, Page 71-73, "The Cost of Repair"

Overhaul & Maintenance, May 2009, Page 31-33, "Designing Replacement Parts"

Overhaul & Maintenance, November 2009, Page 36-37, "PMA Planet"

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