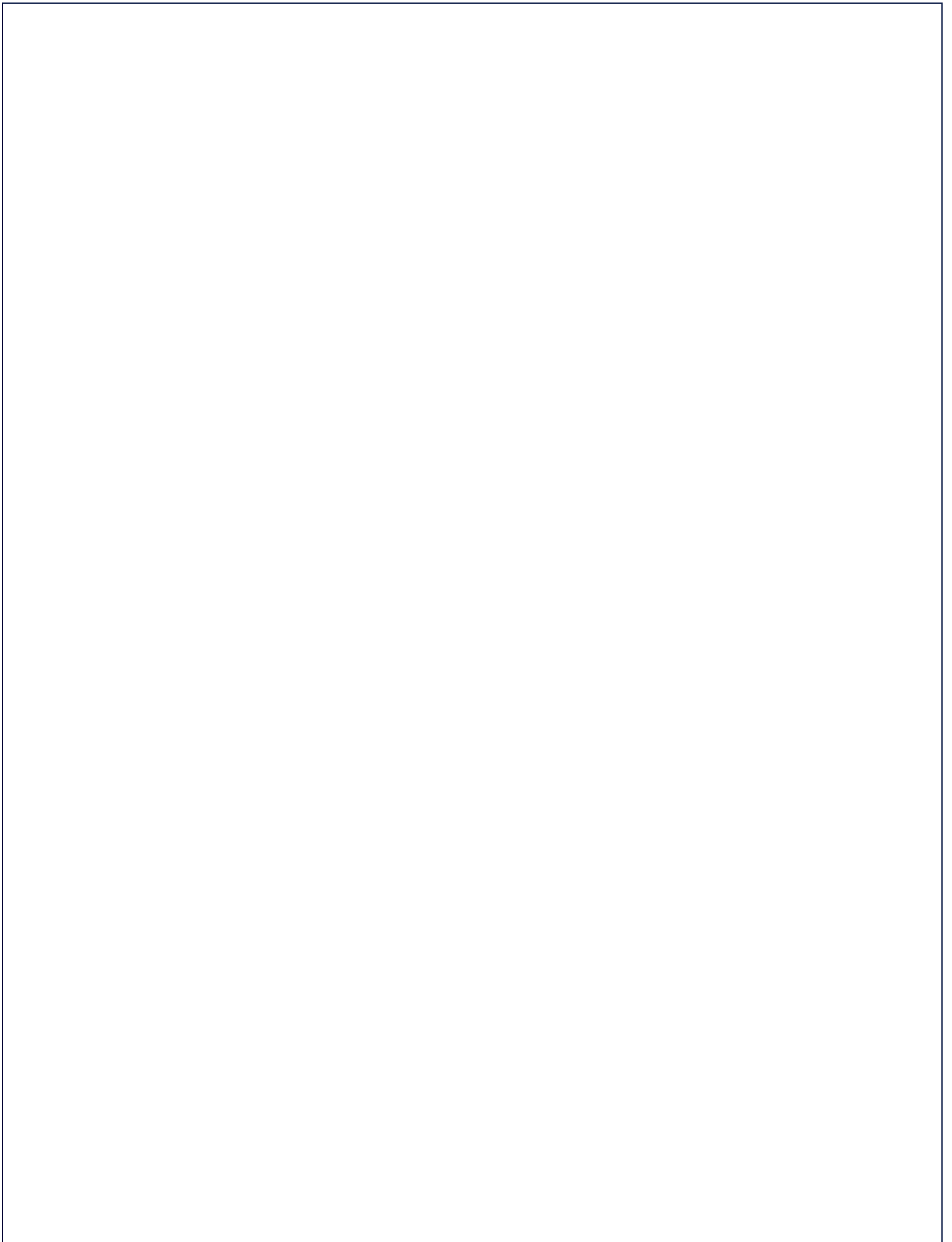


# THE AIRLINE GUIDE TO PMA



By  
David Doll





## Welcome to the Profitable New World of PMA

Airlines by their very nature combine huge, perpetual fixed costs with fickle demand. This makes them extremely vulnerable to any kind of disturbance. The years have seen a multitude of economic downturns, wars, acts of terrorism, diseases, aircraft crashes, and strikes suddenly shrink demand for air travel. Meanwhile, the costs of jet fuel and aircraft maintenance go up, up, and up. Survival demands that cost control must be a major ongoing effort for every airline in good times as well as bad. Over half the global profit in 2015 is expected to be generated by airlines based in North America (\$15.7 billion). For North American airlines, the margin on earnings before interest and taxation (EBIT) is expected to exceed 12%, more than double that of the next best performing regions of Asia-Pacific and Europe.

Many airlines try to save money by short building engines. They remain legal and safe, but they do not build in longevity. I call this strategy, “saving oneself into bankruptcy”. Maintenance is an investment that returns flying hours. A significant portion of a shop visit cost is fixed and is not reduced by short building the engine. Thus, an engine that returns to the shop early has a very high maintenance cost per flying hour. Within the space of a very few years the airline that short builds its engines is churning shop visits, operations are adversely affected, and maintenance costs are out of control.

A far better way to control maintenance cost is to reduce the cost of maintenance materials. According to data from AeroStrategy, one of the leading consulting organizations in the aerospace industry, airlines spent more than \$16 billion on spare parts in 2006. Savings on spare parts can definitely help an airline’s bottom line. Over the past few years a major tool has become available to maintenance organizations to help reduce these material costs – PMA parts. PMA parts are new parts, fully approved by the FAA. They are now available from PMA suppliers at savings ranging from 25% to 45% of what you are currently paying the aircraft or engine manufacturers (OEMs).

One leading PMA supplier estimates that they can save a customer up to \$130,000 on a single engine overhaul, and there are many PMA suppliers. A single airline in the US has documented \$40 million in material cost savings per year due to an aggressive PMA approval program that covers airframes, engines, and components.

The savings from PMA may go far beyond the PMA discount itself. Historically, the OEMs have held a strong monopoly on the sale of replacement parts. This has allowed them to push through spare part price increases on the order of 5% per year. According to AeroStrategy, competition from PMA has had a tendency to moderate this rate of growth. PMA provides operators with a useful tool, along with surplus parts, extensive part repairs, and joint procurement to counter the OEM pricing power and reduce the rate of price escalation.

Lack of knowledge about PMA continues to be a major obstacle in the path to achieving PMA savings. Airline maintenance organizations must necessarily be conservative about what they install on their aircraft. If you can't be certain about the origin or quality of a material (i.e. you don't have enough information), you won't let it near your aircraft. My goal here is to improve the level of knowledge about PMA and to show that the certification process for these products is both real and robust.

All of the information about the process that governs the approval of PMA is currently available. It's just arranged in a tangle of regulations that is difficult to sort out and understand. I was at a conference recently where a gentleman from an Asian carrier asked if somebody could please translate these regulations into Japanese. I thought, "Japanese is fine, but I wish somebody would translate them into English!" I'm going to do just that. I'll untangle this information and describe the process in an easy to understand summary. This summary is intended for an airline wanting to know more about PMA. It does not try to include all of the information that a PMA supplier would need to obtain approval for a part. If you work for an airline, you don't need all that legal detail. You just need to understand the PMA approval process well enough to have confidence that it is every bit as rigorous and thorough as the process that originally certified the aircraft.

I'm also going to address some of the major concerns about using PMA parts. I spent nearly three decades working in the maintenance arm of a major airline, so you can count on me to take an airline point of view on the issues.

I shall also share what I have learned about the industry best practices for making PMA a part of your overall supply chain strategy. Airlines are not keeping any secrets when it comes to PMA. Everyone I have contacted has been willing to share their experiences.

I'll list some useful resources that you can use to help you implement PMA parts, and I'll provide the links to the FAA regulations and some contacts to organizations that can help.

Finally, I'll provide a list of PMA suppliers that belong to the Manufacturing and Replacement Parts Association (MARPA), the trade association that represents the PMA community.



## Is PMA Legal, Safe, and Reliable?

When I worked as an engineer in an airline maintenance organization, I clearly understood that one of the worst sins I could commit was to poison the fleet with bad material. This would be a career limiting mistake that could shut down a large part of the airline fleet while corrections were being made. The question at hand is will installing PMA parts increase your risk of ending up with bad material in your fleet? The answer is a very strong **NO, it will not increase risk**, and when you look at the approval process required for PMA parts, I'm confident that you will agree. A close examination of the PMA approval process and the performance of PMA parts in service for more than 15 years will show that a PMA part has no more technical risk than the equivalent part provided by the original equipment manufacturer.

### Approved Replacement Parts

The PMA (Parts Manufacturer Approval) is a combined design and production approval by the FAA for replacement parts for type-certificated aircraft, engines, and propellers. In fact the law states that all replacement and modification parts must either have a PMA or be approved via one of the following exceptions.

- ❖ A part produced under a “one-time only” supplemental type certificate or a field approval should not get a PMA. This part is produced to return only one aircraft to service. If you are going to make parts for more than one aircraft, you need a PMA.
- ❖ Existing Production Approval Holders (the OEMs) don't need a PMA. If a supplier to the approval holder wants to sell parts without direct ship authority from that approval holder, the supplier will need a PMA.
- ❖ Aircraft owners or operators may produce parts for installation on their own aircraft. They must be able to prove that these parts comply with existing airworthiness standards, and they can't sell the parts unless they get a PMA.

- ❖ Civil air transport air carriers may produce parts for installation on their own aircraft without a PMA. The carrier must have accepted instructions and procedures in their manual, and they must comply with the applicable regulations on maintenance. **This is good way to reduce material costs if you have internal manufacturing capability. I know of at least three major airlines that have saved a great deal of money using this provision to produce simple parts such as bushings.** If the carrier intends to sell the parts, however, they must obtain a PMA.
- ❖ FAA certificated repair stations may fabricate parts for installation on aircraft during course of repair. Landing gear repair stations commonly produce custom bushings for installation on the gear, and every aircraft heavy maintenance facility has a sheet metal shop and a machine shop to support the aircraft repair process. Again, however, if these parts are going to be sold rather than be installed during the course of repair, a PMA is required.
- ❖ Standard parts such as nuts and bolts that conform to established industry or U.S. standards do not require a PMA. **This is another opportunity to save money. OEMs typically buy this hardware and apply huge mark-ups. If you are willing to invest in the research to find the standard equivalent to the OEM part number, the savings, which can be substantial, are yours.**
- ❖ Parts produced under an FAA technical standard order (TSO) also do not need a PMA. TSOs include such product families as airspeed instruments, automatic pilots, aircraft tires, aircraft fabric, APUs, and many others.

The combination of PMA and all of the exceptions to PMA listed above constitute the entire universe of “approved parts”. Any other replacement part is unapproved and cannot be legally installed on a type-certificated product.

Note that the standard legal requirement for replacement and modification parts is the PMA, and OEM-produced parts are actually just an exception to the PMA requirement. In the view of the FAA there is no drop off in status from the OEM part to the PMA part. Both have equal standing. In fact you won't find the term “OEM” in any of the FAA regulations.

## WHAT IS AN OEM?

The common understanding of an OEM (Original Equipment Manufacturer) in our industry is they are the corporations that sell the new aircraft or engine. In practice the OEMs have never manufactured every part of the product they sell. They have always relied on a combination of internal manufacturing and external suppliers to provide the best value proposition. Over the last two decades the OEMs have emphasized outsourcing to the extent that they have become systems integrators rather than manufacturers. In fact many of today's PMA suppliers are, or were, the actual OEM for the parts that they supply. Thus there is no legal standing for the concept of an OEM in the regulations. The corporation that proves the design and manufacturing quality systems is the Type Certificate and Production Certificate holder (TC/PC-holder). For my convenience and your ease of reading, I shall continue to refer to these corporations as the OEMs.

### FAA Approval Offices

As I wrote earlier, the FAA must approve both the design and the manufacturing process for PMA parts. To do this they have two separate types of organizations, the Aircraft Certification Offices (ACOs) and the Manufacturing Inspection District Offices (MIDOs).

The ACOs are responsible for determining that a PMA applicant's part meets the airworthiness standards that apply to the type-certificated product (aircraft, engine, or propeller) on which the part is to be installed. ACOs come in a couple of different flavors. The routine, simple PMA applications are processed by the geographic ACOs. This is typically the closest office to the PMA applicant. If the PMA part is complex or potentially critical to airworthiness, the application must be coordinated by the local ACO with the Certification Management ACO (CMACO in government speak). This is the organization that managed the original certification process for the type-certificated product on which the PMA part will be installed. The CMACO has extensive airworthiness experience for the product and may establish special test requirements to ensure the PMA part meets airworthiness requirements. For example the New England CMACO with responsibility for engines required a PMA applicant to conduct costly whole engine endurance testing in order to receive approval for a turbine blade design.

In the near future, the FAA plans to delegate some of the design approval authority to non-FAA organizations for simple, non critical parts. The FAA will manage and supervise the process similarly to their current Delegated Engineering Representative

(DER) process for repairs. Delegated organizations will be approved based on their proven experience and integrity. Their performance will be continuously monitored, and the authority will be revoked if the organization does not act in accordance with FAA policy.

The MIDOs are the Manufacturing Inspection District Offices. It doesn't matter how good the design is if the part is not manufactured correctly. The MIDO closes this loop. It audits the manufacturing facility that will produce a PMA part to ensure that it has the production and quality systems necessary to reliably produce an aerospace quality part per the design. Only when both the design and production system are approved will the Parts Manufacturer Authorization be issued by the FAA.

### The PMA Certification Process

The PMA process is the primary legal basis for approved replacement parts. Just how good is this approval process? If you look at the standards for approval, you will find them not only to be every bit as good as the standards for the original design of the aircraft, they are identical. Let's dig in and justify this claim.

At the very beginning of the PMA approval process the applicant must identify the applicable airworthiness standards to the FAA. It is important to note that the certification standards for the PMA part are exactly the same as for the original OEM part. If you want to produce a PMA part for manned free balloons, for example, then you must meet all of the applicable requirements of 14 CFR, Part 31, AIRWORTHINESS STANDARDS: MANNED FREE BALLOONS, the standards for the original product certification.

Once the applicable airworthiness requirements are identified the applicant must identify the basis for design approval. The FAA has three standard paths that can be selected.

- ❖ Identity with a license agreement – Often an OEM will decide that a portion of their certificated product is not a core part of their business, and life would be simpler if they were no longer responsible for supplying it. This part or system may have always been provided by an external supplier, or it may be at the end of its product life cycle. The OEM can license another firm to produce the part and notify the FAA that they are doing so. Since the OEM is providing a design that has already been approved by the FAA to the PMA applicant, there is no need for the FAA to reinvent the wheel on design approval. These applications go straight to the appropriate MIDO for approval of the production and quality control processes.



- ❖ [Identity without license agreement](#) – A PMA applicant taking this path tells the FAA that he can prove that his PMA part is identical in all respects to the OEM part. If the applicant does not have OEM part drawings, Identity is very difficult to prove. If the applicant has OEM drawings and no license agreement, he can probably expect a lawsuit from the OEM. Many suppliers have obtained part drawings from the Air Force using the Freedom of Information Act, but the Air Force program to buy designs from the OEMs ended years ago. Each year fewer and fewer parts are being substantiated using this method.
  
- ❖ [Test and Computation](#) – The applicant uses analyses and tests to prove the PMA part is equal to or better than the approved original part. Only minor changes or improvements from the original OEM part are allowed in a PMA design. (Significant changes require a Supplemental Type Certificate.) Most PMA parts and virtually all complex parts now use test and computation for design substantiation.

At this point in the process we have a proposal for a PMA part, and the applicable airworthiness standards and basis for proving the part meets these standards have been determined. The PMA applicant is just getting started. The applicant now has to determine the criticality of the part. This is done by means of a failure modes and effects analysis for the part and for the next higher assembly as well. Every possible way the part could fail is examined and the consequences of the failure are assessed. Based on this analysis the part is classed as **critical** (possibly affecting airworthiness of the aircraft), **important** (possibly affecting the performance of the aircraft or engine), or **not critical or important** (all the rest). Most PMA parts are neither critical nor important.

The applicant must also identify all Airworthiness Directives and unresolved service difficulties pertaining to the original part from the type design. The FAA will not approve a PMA for a part with an existing AD. Also service difficulties will cause them to delay processing the application until the problem in the original part is cleared. Remember, only minor changes from the original design are permitted on a PMA. The FAA does not want a PMA part that duplicates and perpetuates a known problem.

If the part is critical, important, or complicated, the FAA will want to see a Project Specific Certification Plan. This plan is a tool used by the applicant and the FAA to manage the testing process. It provides information on the testing procedures and performance measures along with milestones that must be met. The applicant will generally work with the ACO to develop this plan before investing a great deal of time and money in the testing process. The FAA can modify the plan to require any additional testing that they consider necessary. The test plan will identify:

- ✓ Test purpose
- ✓ Physical and functional description of the test article and setup
- ✓ Number of test units
- ✓ Unit identification
- ✓ Test conditions and duration
- ✓ Test success and failure criteria
- ✓ Test instrumentation and data collection
- ✓ Test safety control
- ✓ Control of test procedures

The applicant now must execute the plan and carry out the testing to ensure the part performs its intended function. Often an applicant will obtain a representative sample of OEM parts and analyze them to establish a benchmark that must be equaled or bettered by the PMA part. Careful dimensional analyses of the OEM part samples establish the part dimensions and tolerances for manufacturing. Various chemical and metallurgical tests are conducted to establish the materials and processes used on the original part. Finally, physical testing is accomplished to determine OEM part's ultimate strength and response to the operating environment. The PMA part is then designed using the findings from the OEM part sample. Advances in materials, processes, and manufacturing since the original product certification combined with airline experience with OEM part durability may enable the PMA supplier to provide a design that is superior to the original part.

Another approach to Test & Computation is to study the higher level certificated product and determine the physical requirements for a part to fulfill the function of the OEM part and satisfy the airworthiness standards. The PMA part is then designed to meet these requirements. Results of the tests are supplied to the FAA. This approach works well for plug-in units such as filters.

The applicant must also establish a fabrication inspection system that ensures that each completed part conforms to its design data and is safe for installation. The requirements are identical to the OEM manufacturing requirements.

- ✓ Materials must conform to part design specifications.
- ✓ Processes affecting the quality and safety of the finished product must be accomplished in accordance with acceptable specifications.
- ✓ Parts must be inspected for conformity with the design.
- ✓ Current design drawings must be available to manufacturing and inspection personnel.
- ✓ Major changes in the design must be controlled and approved.
- ✓ Rejected materials must be segregated to preclude their use in the finished part.

- ✓ Inspection records must be maintained and identified with the completed part, where practicable, for at least 2 years after the part has been completed.

After the PMA design is approved by the ACO, the MIDO will be dispatched to audit the PMA manufacturing facility to ensure that the applicant has an effective fabrication inspection system.

We're not done yet! The PMA applicant must also demonstrate that they have inspection and repair instructions for their part (Instructions for Continued Airworthiness). They can often simply state that the PMA part can be maintained according to the OEM maintenance manual, but if their part is different from the OEM, or if the OEM does not provide instructions (increasingly common), the PMA supplier must provide current instructions to the airlines on how to inspect and repair their PMA parts.

The applicant must also develop a Continued Operational Safety (COS) plan for their parts that addresses problem prevention, part monitoring, and problem response. The COS program must include at least:

- ✓ Detailed records of all aspects of the manufacturing cycle
- ✓ A record keeping plan for the entire part life
- ✓ Methods to isolate possible discrepant part population, continually monitor the service use of parts, and review design assumptions based on service experience
- ✓ Means for identifying possible failure modes and effects that account for the part's operating environment and interfaces to the next higher assembly and product
- ✓ Methods and resources used to identify causes of failures and to develop corrective actions and means to carry out these actions quickly based on assessment of associated risks

The Modification and Replacement Parts Association (MARPA), the non-profit trade association that represents the PMA community, worked closely with the FAA to develop the COS requirements for PMA.

### **[The Real Test – PMA Performance in Airline Operations](#)**

As you can see from all of the above, the certification process for PMA parts is every bit as rigorous as the process required for the OEMs. (I haven't even included all of the details found in the regulations.) How well does this certification process actually work? The proof is in the results. PMA parts approvals began to grow rapidly in 1992. To see how PMA stacks up against the OEM parts for safety, I reviewed all of the Airworthiness Directives for transport aircraft engines from 1992 to the present. I chose engines

because they have the greatest percentage of critical and important parts of any of the certificated products.

I found 287 Airworthiness Directives for turbine engines generated during this period. 286 were generated by OEM problems. There were three ADs associated with PMA parts. Two of these PMAs were clones of OEM designs that exhibited the same design problem as the OEM and were included on the ADs issued for the OEM parts. Beyond the engine category, I also know of one other PMA part that was found to have been the cause of a fatality in a helicopter accident. This part also replicated a design problem from the original OEM part and was joined with the OEM part in the ensuing AD.

The numbers appear to be overwhelmingly in favor of PMA. Given that there is a far greater amount of OEM material than PMA material out there flying, it's fair to say that the failure rates are probably about comparable with the PMA parts performing somewhat better than the OEM parts. The bottom line is that you absolutely do not have to accept any reduction in safety margins in order to use PMA. The PMA track record to date is outstanding!

My own small investigation mirrors the results of a much larger FAA Repair, Alteration and Fabrication (RAF) Study completed in August, 2008. This study was prompted by persistent lobbying from some OEMs who claimed that PMA represented a threat to aviation safety. The study team completed a thorough review of all existing regulations, policies, and practices governing the approval of replacement parts. They also reviewed the operational performance of PMA replacement parts to date. The FAA reported, ***"..the team did not find substantive evidence of failures or unsafe conditions arising from non-TC/PC holder (non-OEM) developed data. 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 or compliance shortfalls have not increased proportionally."***



## Some More PMA Issues

The arrival of PMA parts in large numbers in competition with OEM replacement parts is a relatively new phenomenon in our industry. Although PMA was established by the FAA about 50 years ago to enable pilots to repair obsolete WWII military aircraft, it didn't take off commercially until the 1990's. PMA is a new way of doing business. Instead of acting as a passive customer and accepting replacement parts as a fixed cost of business, airlines can now proactively shop for the best value proposition.

Any new way of doing business tests the existing institutions that have been built around the status quo. Regulatory agencies must modify or strengthen rules, procedures and their own organizations; repair agencies must establish new supply chain management systems to cope with the new market; and leasing companies must address issues of transferability and asset valuation.

To existing replacement part suppliers (the OEMs) the emergence of capable and aggressive competitors in what had been a monopoly market was a shock. After all spare part sales provide most of the profit on engine programs. Predictably the OEMs reacted aggressively to defend their revenue streams, and the ensuing war of words has created still more issues that must be resolved in the minds of potential PMA customers. (Note: I have studied a number of alternative product markets such as drugs, printer cartridges, auto parts, etc. in order to estimate the potential of the PMA market. I found that while our OEMs know how to play hardball, they are gentlemen compared to some other industries.)

I'll start with those issues created by a new way of doing business.

### Regulation

All replacement parts for transport aircraft must be produced under a regulatory framework, and the rapid growth of the PMA market tested that framework. As we have already seen, the FAA regulations and procedures have grown proactively to provide a robust regulatory structure for certification that can provide a high level of confidence in the safety of complex and important parts.

The FAA has also worked with airworthiness authorities around the world to forge Bilateral Aviation Safety Agreements (BASAs). The FAA recognized that the globalization of aircraft production was a fact and set out to leverage their efforts by building a global regulatory network that could ensure the airworthiness of parts originating in any nation that had a BASA with the US. In June of 2008 a BASA was signed with the EASA, the EU airworthiness authority. When the treaty activates, the BASA with EASA provides seamless coverage of PMA between the US and the 30 nations covered by EASA. Prior to the EASA activation Finland, France, Germany, Italy Netherlands, Norway, Sweden, Switzerland, and the United Kingdom have signed BASAs with the US. BASAs also exist with several other nations as shown in the table below. The FAA has committed to finalizing additional BASA agreements with other nations at a rate of 2 per year. Other more limited Bilateral Airworthiness Agreements (BAAs) exist with Argentina, China, Indonesia, and South Africa. The management of replacement parts with these nations with a BAA is a matter of individual negotiations leading to the bilateral agreements. What does this mean if you are a non-US carrier? If your country has a BASA with the US, then the FAA approval of PMA carries over to your country with the exception of critical parts. If your country has a BAA, or the PMA is a critical part, you should check with the airworthiness authority in your country to determine the regulations applicable to you before you take any action on purchasing the PMA.

---

**Nations Having BASA Agreements With the U.S.**

Australia	France*	Lithuania*	Russia
Austria*	Germany*	Luxembourg*	Singapore
Belgium*	Greece*	Malaysia	Slovak Republic*
Brazil	Hungary*	Malta*	Slovenia*
Bulgaria*	Iceland*	Mexico	Spain*
Canada	Ireland*	Netherlands*	Sweden*
Cyprus*	Israel	New Zealand	Switzerland*
Czech Republic*	Italy*	Norway*	United Kingdom*
Denmark*	Japan	Poland*	
Estonia*	Korea	Portugal*	
Finland*	Latvia*	Romania*	

\*Nations included in the BASA agreement with EASA

In summary, there is a robust certification and approval process for PMA that has been developed in the US. This process is being spread around the world through Bilateral Aviation Safety Agreements between the US and other airworthiness authorities. Each year the presence of PMA in an aircraft or engine is becoming less and less of an issue when transferring an aircraft title between different regions of the world.

**[Availability of PMA With Outsourced Maintenance](#)**

The trend among airlines is to consider maintenance to be a non-core activity and outsource it. Once maintenance is outsourced, an airline gives up the detailed management of such things as material procurement. This may or may not be a bad deal.

If your maintenance provider is the engine OEM, you can pretty well forget about PMA savings unless you are a very large customer and they really need the business. The most effective tool that OEMs have to block the growth of PMA competition is their ownership or control of maintenance providers. If they control the store window, they also control the type of parts that are sold through that window. You may benefit by high level maintenance management skills with an OEM, but you will not receive PMA savings. You have to decide whether a maintenance contract with an OEM is still competitive without PMA.

If you have a per hour maintenance contract with performance guarantees, then the material costs are transparent to you. You care about the high level value proposition - your maintenance cost per flying hour or trip. If these costs are high relative to other airlines, you are not getting a good deal. Airlines that fly aircraft types that are operated in the US, can relatively quickly determine whether their costs are competitive using data that US airlines submit to the Department of Transportation. In the short term, your ability to select material sources in a per hour maintenance contract is limited by your existing contract. All is not lost. Negotiations for contract renewal provide the opportunity to force some savings. This is the time to set up a PMA program and motivate it by sharing some of the savings with your maintenance provider.

If you have a time and material contract with your maintenance provider, and your provider is not an OEM, you definitely want to get your nose into the material. PMA could save you more than \$100,000 in an engine shop visit. Your provider should already have a catalog of PMA that they use, and they should also have experience on how these items perform. Your provider can also provide guidance on how to change your manuals to authorize the use of the parts. In this case the normal material handling fee charged by a time and material supplier should cover their cost in procuring the PMA replacement parts for you.

### Leasing

Leasing is currently a problem for PMA. This is a classic example of how a new way of doing business can intrude on an existing business structure. Lessors have two major problems with PMA, but both of these problems will diminish over time.

Every lessor has a horror story about not being able to place an aircraft at the end of the lease. The lessor is stuck with the aircraft payments but has no supporting flow of revenue. PMA can block an aircraft transfer because not all regulatory agencies and not all airlines will accept an aircraft with PMA replacement parts, particularly if the parts are complex or “important”. This problem is getting smaller every year. Because of the operating success of PMA, more and more airlines are taking advantage of the savings they provide. The strong regulatory structure established by the FAA is also winning over other aviation authorities, and good progress is being made with the Bilateral Aviation Safety Agreements to enable seamless use of PMA throughout the world.

The other concern to lessors is asset valuation. Lessors are finance people who are concerned that if you change out high-priced OEM parts and install lower cost PMA parts, their aircraft will have lower residual value. I believe that this too will eventually become a non-issue. When you purchase an aircraft or an engine, you are buying a capability. The fact that a small portion of that aircraft or engine may have a different manufacturer’s name on it does not affect its capability. The purchase price for that capability will be set by the supply and demand conditions in the market at that time.

Lessors also fear PMA replacement parts may affect residual value if an aircraft or engine is parted out. This usually occurs at retirement after the airlines have wrung all possible usefulness out of the aircraft. The question then becomes, “What is the value of a surplus, used aircraft part?” How much more value will a used OEM turbine blade have than a used PMA turbine blade? I predict that at aircraft retirement these parts will become commodities, and the difference in residual value will be negligible.

At this time, however, lessors can perceive financial risk with no compensating financial benefit to using PMA. At some point in the indefinite future, the lessors may find a competitive advantage in allowing PMA. The world’s largest lessor is an engine OEM that will not allow PMA. Conceivably a smaller lessor could establish relationships with trusted maintenance providers that offer PMA and use this relationship to structure very competitive lease terms concerning maintenance reserves with prospective customers. We shall see.

Meanwhile, most lessors are not too concerned about small PMA items such as brackets and hardware, but you need to check your contract before you adopt any PMA on a leased aircraft or engine. Just as in outsourced maintenance, the time to bring up PMA is during contract negotiations with the lessor. Once restrictions are cast in stone, you have to live with them. A good life cycle financial model of the cost of leasing with and without PMA can help you estimate what a leasing restriction will cost you, and you can use this estimate to press for favorable terms on the maintenance reserve.

Now let’s look at the controversy created by the OEM opposition to PMA.



### OEMs claim that PMA parts are not as good as the original OEM parts

There is an advertisement by an engine OEM showing a tired, second rate Elvis impersonator along with the headline, “LET’S FACE IT, LOOKALIKES NEVER PERFORM QUITE LIKE THE ORIGINAL”. As we have seen earlier, the substantiation requirements for PMA are the same as for the original equipment, and the approval process is quite rigorous. In fact OEMs receive approval via a type certificate for the entire aircraft or engine and do not have to substantiate the design of every individual part the way that PMA part designers do. Typically a new engine design matures five years or more **after** the engine enters service. The engine is considered technically mature when the number of new part failure modes finally decreases. If the OEM part designs were perfect, we wouldn’t see so many service bulletins. The Airworthiness Directive database maintained by the FAA and the recent FAA comprehensive study also show that PMA parts perform every bit as safely as those supplied by the OEMs. In fact, as we have seen, in two out of the three ADs for PMA engine parts, the problem was that the PMA did perform quite like the original.

This OEM campaign has provoked a sharp response from the FAA in the form of a Special Airworthiness Information Bulletin. This bulletin made it clear that when the FAA approves a PMA part, they expect that ***“the industry will treat that approval with the respect that a decision of the FAA deserves, and that furthermore, such parts are entitled to the full recognition of the FAA’s approval, and it is not up to the engine manufacturer to say that installation of a PMA part is wrong or invalid.”*** Ouch!

### OEMs claim that PMA designers don’t understand system effects

This concern, raised by an engine OEM, is a subtle variation of the first issue. The logic used is that the OEM is the designer of the entire engine, and only they understand the relationships that exist between different parts of the product. Engines are sophisticated and complex. A small change anywhere can have dire consequences somewhere else on the engine. A PMA company that designs a single part has no concept of how they might be affecting the rest of the engine.

This sounds like a valid concern unless you understand how engines are really designed and manufactured. Today the OEMs often do not design the entire engine. If you own an IAE or CFM engine, different portions of the engine were designed and built by different companies on different continents. In spite of the potential communication difficulties, these are highly successful engines that perform very well. Secondly, any mass produced item uses dimensionally controlled parts that are interchangeable. It is not uncommon to have an original engine part manufactured by more than one external supplier according to prints supplied by the OEM. PMA suppliers act in the same manner as any OEM supplier. Instead of receiving a print from the OEM, however, they

develop their own print using samples of OEM parts and reverse engineering techniques. In many cases these reverse engineering techniques produce parts that have tighter tolerances than the OEM originals. Furthermore, my experience is that engines are not quite as mysterious and sensitive as the OEMs would have us believe. A possible slight change introduced by a PMA design is certainly smaller than the changes that are routinely introduced by maintenance organizations during the repair of the original engine parts.

### OEMs threaten not to honor their warranty if PMA parts are used

Potential customers are frequently deterred from purchasing PMA parts because they fear that the OEM will no longer honor their warranty. This is in fact a non-issue for a couple of reasons. Firstly, the value of your warranty changes with the age of your engines. The most important warranty that you get from the OEM is the new product warranty. These typically provide replacement of all parts that fail during the term of the warranty. Nobody is going to consider buying PMA instead of accepting free parts from the OEM. Conclusion: the most valuable warranty you have is never threatened because there is no motive to use PMA while the warranty is in effect. **(Caution, you need to prepare your cost accountants and senior management for the shocking increase in maintenance cost that will occur when these warranties run out!)**

The extended warranty following the new product warranty is defined by your contract with the OEM. Legally, a contract is a promise that is enforceable under law. This contract defines your rights and the OEMs obligations. The OEM cannot ignore your rights or change their obligations without a negotiation and a new contract that is accepted by both parties. If you are concerned about the OEM not honoring the warranty, read it to determine if they can legally carry out the threat, and analyze your warranty to determine its actual value to your airline.

I would recommend this approach if the OEM threatens not to honor their warranty.

- Thank them for bringing up the subject.
- Tell them that the warranty has not been at the top of your priority list, but that they have aroused your interest, and you will now review it to make sure you are collecting everything to which you are entitled.
- If the warranty is worth anything, establish and resource a system to ensure that you collect every dollar possible under the warranty. **This may actually pay off handsomely.** I've extracted a few millions from OEM warranties during my airline career.

- If the warranty is not worth a systematic effort to collect it, then why worry about it at all?

After this happens a few times, I bet that a letter appears from the front office telling local OEM representatives not to mention warranties any more.

Finally, PMA parts have warranties too. Check out the part warranty offered by a PMA supplier and see how it compares to the OEM part warranty. You might be favorably impressed.

### OEMs threaten not to support the engine if PMA parts are used

The regulatory obligation of the OEM after the sale of the aircraft is the same as that of the PMA supplier.

- ❖ Report malfunctions, failures or defects in their products.
- ❖ Distribute the initial Instructions for Continued Airworthiness for their products.
- ❖ Make any required design changes to preclude unsafe conditions and correct non-compliances when the FAA finds that an unsafe condition exists or is likely to develop which requires an airworthiness directive to correct.

There is no regulatory requirement for an OEM to provide support beyond these three items, and they could legally reduce support to this level. This could cause problems. Sometimes aircraft or engine problems are beyond the capability of an airline engineering staff to diagnose. OEMs have a wealth of engineering knowledge, and their support is a valuable tool in these instances. I have used it many times during my career. Refusal to support their products, however, is a sword that cuts two ways.

Any airline engineer responsible for maintenance understands how the loss of OEM technical support would hurt the airline, but what would the pullback of support cost the OEM? The OEM could lose the operational information that they need to ensure the airworthiness and competitiveness of their products. Severe airworthiness problems never appear out of thin air. There are always warning signs that develop ahead of time in field operations. That is why OEMs need to stay close to the fleets operated by their customers to find these problems early and to apply corrective actions.

Failures affecting airworthiness hurt the reputation of the OEM. The airlines are a small, interconnected, and unforgiving community. An OEM that hurts the airlines by failing to contain technical problems will have great difficulty selling its products in the future.

Even if you don't use PMA, you will find that engine OEMs are already reducing their industry support to some extent. Their manuals, that are legally required to provide instructions for continued airworthiness, are increasingly populated with part repairs that state something along the lines of, "Send your part requiring repair to one of my business partners. By the way we are not responsible for anything that they do." This tactic provides revenue to the OEM, eliminates information that could be used to develop PMA, and forces PMA suppliers to dedicate resources to develop instructions for continued airworthiness.



## Starting a PMA Program

I remember a conversation that I had long ago with a sales representative from a PMA supplier. He said, “I have the easiest job in the world. All I have to do is convince airline employees to take on extra work and extra risk.” We have thoroughly disposed of the extra risk part of that quote, but there is no doubt about PMA creating extra work. In order to reap the rewards of PMA, which can be substantial, an airline must do some extra work. In this section I’ll talk about what you must do to operate a profitable PMA program. This “what to do” will be based on best practices that I have seen in the industry and a few best practices (recommendations) that I developed to maximize savings.

### Senior Management Involvement

Senior management must drive your PMA program if it is going to be successful. Without senior management involvement, you may dabble in PMA, but you’ll never save millions of dollars. PMA incorporation requires resources from supply, engineering, purchasing and quality assurance. Management interest ensures that these resources are available to do the work required to operate the program. Management must also establish goals and measures for PMA implementation to drive the program and maximize the savings.

Senior management also protects the program against OEM pricing countermeasures. The OEMs often react to PMA with sudden and dramatic price reductions. Once the PMA has been forced out of the market, they are free to raise prices again. Senior management can take the strategic, long term viewpoint to achieve some level of control over replacement part prices to moderate the growth of material costs in the future. Senior management involvement sends a clear message to the OEMs. “Your market share will shrink just as fast as your prices increase.”

### Interdisciplinary Approach

No single existing organization in the airline is resourced to accomplish all the activities that must be carried out to operate a PMA program. The program will require the synchronized actions of supply, purchasing, engineering, and quality assurance. Supply needs to focus efforts on the applications with the greatest potential for savings and

manage the PMA supply chain. Purchasing takes care of the business aspects and evaluates the financial viability of vendors. Engineering determines the acceptable criticality of applications and reviews and approves the quality of the PMA design. Quality Assurance audits and approves the quality system of the supplier. The team established by senior management must provide dedicated resources from all of these organizations. If prospective PMA must bounce from organization to organization, each stop becomes another long queue, and savings will accrue very slowly.

### Supply

“Show me the money!” is a classic movie line that should apply to your PMA program. Supply spends the money to obtain replacement parts for your aircraft. A simple analysis that ranks the amount spent on replacement parts from greatest to least will separate the significant few from the trivial many. In some cases it may be beneficial to group very similar parts into families to obtain a true picture of their financial impact. This analysis will focus the organization on the parts with the greatest potential for savings. Sorting by amount spent also provides an efficient approach for purchasing by developing a high impact shopping list to focus efforts on the greatest potential PMA savings.

Once the program is up and running, supply must manage the PMA supply chain and manage the stocking and distribution of the new PMA parts.

### Purchasing

Use the information from supply to set up your PMA attack plan. Provide some quick wins with easy applications to gain management confidence. Follow on with some big wins on high impact parts that combine high unit cost with high volume to keep their interest.

One of the best ways to leverage your resources for the PMA program is to evaluate and approve suppliers before you approve parts. Why use resources to approve part designs if you don't want to do business with the supplier?

Airlines fly their aircraft for many years. You want your supplier to be in business as long as you own your aircraft. The purchasing organization can screen potential vendors on the basis such criteria as their financial resources, years in the business, track record, liability insurance, and part warranty.

It is easier to work with a relatively few suppliers with broad product offerings than a host of small suppliers. Once a prioritized list of parts is available from supply, find suppliers who can provide many of the products that you need. This reduces the

overhead in vendor management and quality assurance. An exception to this rule would be a supplier that specializes in a high value replacement part not offered elsewhere.

Alliances with a broad based supplier can be beneficial. Under these alliances the PMA supplier commits to developing the parts from your high priority list in return for a guarantee from you to purchase these parts from them for a specified period of time. This type of agreement provides you with relatively rapid development of the parts you need and protects the PMA provider from being undercut by new competition or the OEM. As part of a development program, you may share some parts or information about your experience with the part performance with a PMA supplier, but you should never share OEM data or proprietary information. Responsible airlines understand the need to protect the intellectual property rights of the OEMs. When I managed airline engineers, I made sure that they understood that it would cost them their jobs if they shared an OEM print with any outside organization.

There are things that you do want to share with PMA suppliers. A significant annoyance expressed by airlines is that the PMA part documents do not show the complete effectivity for the part so the airline is unable to fully deploy the PMA. Let the suppliers know the aircraft and engine types and subtypes that you operate so they can provide complete information. In addition, when you have landed a supplier, keep them informed on the volume of purchases that you will make in the future. This helps them to manage their production efficiently and minimizes the possibility of shortages.

In some instances you may find it beneficial to form alliances with other airline maintenance organizations to build up the demand for a specific PMA part. Accurate insight into a high level of unfilled demand can spur a PMA supplier to move quickly.

A few airlines have provided engine test time for PMA development in return for substantial compensation. This is not a common practice. In general airlines expect the PMA suppliers to come to them with complete designs.

A good way to waste program resources is to compete several PMA providers against each other. The significant savings you need to achieve is found in the difference in price between the OEM and PMA. The difference in cost between PMA providers is small in comparison to this. It is better to use your resources to move on to the next part approval where you can save dollars rather than to try to save pennies on an existing PMA application. Once the magnitude of program savings has achieved its goal, you can always return and fine tune the program.

Purchasing will play a key role in the PMA program if maintenance is outsourced. In this case purchasing must ensure that favorable PMA provisions are included in the maintenance contract. These provisions should be structured to drive the program to the level of savings desired by the airline. Sharing savings with the maintenance

provider should be considered to provide motivation to the provider in a by-the-hour contract. In a time and materials contract you should be able to select the PMA items that you want from the provider's inventory, and you should be able to specify new types of PMA parts that will benefit your own operations. The provider should be willing to work with your engineering department to develop a list of approved PMA for your operations. The bottom line is that you need to understand the financial potential of PMA savings and make them a part of the financial analysis when selecting a maintenance provider.

### Engineering/Technical Services

The FAA approves PMA, and no further technical approval by an airline is legally required. The only FAA requirement regarding replacement part installation is that the airline must ensure that it installs only FAA approved parts. All PMA parts are, by definition, FAA approved parts. Remember, these PMA parts have already gone through the same certification as the original product from the OEM.

Currently, airline internal approvals of PMA applications cover the entire range from simply ensuring that the part is FAA approved to a full recertification of the PMA product design. You are responsible for maintaining the airworthiness of your aircraft. Your engineering organization must do some soul searching concerning how you want to approach the PMA process before you review your first part or receive your first PMA salesman.

If you decide that you must have a technical review of PMA before you approve it for your airline, an approach that maximizes scarce engineering resources is basing the intensity of review on the criticality of the PMA application and your experience with the PMA supplier. Applications with higher levels of criticality merit more review than simple parts that are neither "important" nor "critical". New suppliers to your airline also merit more review than suppliers that have demonstrated their competence and integrity to you.

What level of criticality are you capable of evaluating for a PMA application? What level of criticality do you want to accept in a PMA part? You can build a simple hierarchy from easiest to most difficult such as:

1. Simple external hardware (Nuts, bolts, brackets, shims, hoses, etc.)
2. Simple internal hardware (Nuts, bolts, bushings, etc.)
3. Simple parts
4. Complex parts or assemblies
5. Important parts (Can affect the performance of an aircraft or engine)
6. Critical parts (Can affect the airworthiness of an aircraft)



Several airlines are flying important parts such as brakes, blades, and combustors. There are several life-limited critical parts now in test, but nobody is flying them yet.

Another technique to leverage engineering resources is to group parts into part families. A part family is simply a group of parts with similar characteristics and operating environment. Examples would be all compressor blades or all low pressure turbine blades. Think through the important characteristics related to safety and reliability associated with the family. These are the characteristics you will want to verify in the PMA design. Once you have done this analysis for one part in a family, the same pattern can be repetitively applied to all of the rest of the parts in the family using a family-oriented checklist. This can get even easier. Once you know that a certain PMA supplier is fully competent in designing and manufacturing one part in a family, you need to spend very little time reviewing other similar parts from that supplier. This is similar to the risk-based approach that the FAA takes.

If you lack the technical expertise to directly review the certification basis and supporting data, you can exploit the prior experience of other airlines to determine how a part will behave in service. Ask the PMA supplier for the operating history of the part, and also ask for airline references. Every airline that I have talked to is willing to freely share their technical experience with PMA. Actual operating experience is a better test than any external review, and there is no reason for every airline to accomplish the same design review over and over again. Don't forget that there is no legal requirement to duplicate the FAA approval process on PMA parts, and the performance of PMA to date has been outstanding.

Technical approval of a PMA part is just the beginning. Engineering still has a lot of work to do. The airline is legally responsible for keeping maintenance records, and the engineering organization is responsible for defining the content of the aircraft. Every part on the aircraft must be shown as approved for installation in an engineering document, and every part that is to be repaired must be approved for that repair.

- Typically the Illustrated Parts Catalog must be revised to show the PMA parts approved for the aircraft, and interchangeability with OEM part numbers must be documented.
- The stores catalog must be revised to show that the PMA parts are approved for purchase.
- Installation documents such as job cards and on logs must be revised to specify the use of the PMA part.
- Repair documents for the part such as inspection criteria, repair instructions, and shop routers must be revised to show them to be applicable to the PMA part.

- If the PMA repair is different than the OEM part repair, new repair documents specific to the PMA part must be issued. These must be blended with existing OEM documents so that both types of parts can continue to be repaired.

In other words, if use of a part has to be documented for an OEM part, it also has to be documented for a PMA part.

### Quality Assurance

Airlines are no strangers to quality assurance. Airlines continuously send inspectors to audit the quality systems of maintenance suppliers. In this respect PMA suppliers are no different than any other maintenance supplier. No special training of your quality assurance organization is required to verify the quality systems of a PMA supplier.

Like everyone else in maintenance, your quality assurance organization is already very busy. This is one good reason to work with a few very good suppliers with a broad range of products. One audit can cover the audit requirements for many products, and fewer quality assurance resources will be required to support the program.



## MARPA MEMBERS 2015-2016

*This list reflects members as of July 1, 2015 and may not reflect a complete membership list*

### **Able Aerospace Inc.**

Lee Benson  
President & CEO  
lee@ableaerospace.com  
(602) 304-1227

[www.ableengineering.com](http://www.ableengineering.com)

Able Aerospace for 25+ years has thrived as the world's premier independent supplier of FAA-approved fixed/rotor wing, engine, structural and flight control parts.

### **Able Engineering & Component Services Inc**

Lee Benson  
President & CEO  
lee@ableaerospace.com  
(602) 304-1227

[www.ableengineering.com](http://www.ableengineering.com)

Combining 29 years of Component Repair & Overhauls with over 30 Engineering professionals, a large Spares Inventory and PMA Parts.

### **Aereos**

William Montgomery  
President  
wmontgomery@aereos.com  
(817) 267-1371

[www.aerotechholdings.com](http://www.aerotechholdings.com)

Focused on aircraft parts support and repair services, Aereos is a family of five companies with a combined operating experience of over 100 years.

### **Aero Brake & Spares, Inc.**

Scott McNew  
President  
scott@aerobrake.com  
(512) 356-9621

[www.aerobrake.com](http://www.aerobrake.com)

Aero Brake & Spares, Inc. is a leading aftermarket wheel and brake hardware manufacturer. Specializing in products approved by the FAA, USAF, US Navy, and US Coast Guard.

### **Aero Kool Corporation - MFG Division**

Rodrigo Gonzalez  
Engineer Manager  
rgonzalez@aerokool.com  
(305) 887-6912

[www.aerokool.com](http://www.aerokool.com)

Aero Kool specializes in the repair, overhaul and sales of a continually expanding listing of aircraft airframe and engine accessories.

### **Aero Parts Mart, Inc.**

Noel VanHook  
Business Development Manager  
nvanhook@apmparts.com  
(817) 923-2894

[www.apmparts.com](http://www.apmparts.com)

Aero Parts Mart is a leader in providing high quality, low cost PMA solutions. Latest technology in engineering design and production. Bringing value to aviation

**Aerometals**

Rex Kamphefner  
President  
rex@aerometals.aero  
(916) 939-6888

[www.aerometals.aero](http://www.aerometals.aero)

Largest supplier of FAA approved PMA parts for MD500 helicopters.

**Aerosource, Inc.**

Kevin Pruett  
Director of Quality & Engineering  
KPruett@aerosourceinc.com  
(732) 469- 9300 ext 197

[www.aerosourceinc.com](http://www.aerosourceinc.com)

Aerosouce manufactures Air Driven Generators and Ram Air Turbines for commercial and military Airframes, and Target and Fuel Pod Systems.

**Aerovision International**

Rick Cramblet  
Executive Vice President  
rcramblet@aerovi.com  
(231) 799-9000

[www.aerovi.com](http://www.aerovi.com)

AeroVision specializes in providing aircraft, engine, and component services to Operators and MR&O facilities throughout the World.

**Air Canada**

Anne-Catherine De Tiège  
Engineer  
anne-catherine.detiege@aircanada.ca  
(514) 393-3333

[www.aircanada.com](http://www.aircanada.com)

Air Canada is Canada's largest full-service airline and the largest provider of scheduled passenger services for flights to every major international destination.

**Air France**

Philippe Boucabeille  
Aircraft Base Maintenance GM  
phboucabeille@airfrance.fr  
+33 (0) 1 4175 4963

[www.airfrance.us](http://www.airfrance.us)

Air France is the French Flag Carrier and serves 35 destinations in France and operates worldwide scheduled passenger and cargo services to 164 destinations in 93 countries.

**Air New Zealand**

Liz McGill  
Group Supply Chain Procurement Manager  
Technical  
elizabeth.mcgill@airnz.co.nz  
+64 (9) 256-3707

[www.airnewzealand.com](http://www.airnewzealand.com)

Air New Zealand Limited is the national airline and flag carrier of New Zealand. Based in Auckland, the airline operates flights to 15 countries across Asia, Europe, North America and Oceania.

**Air Wisconsin Airlines Corp**

Janet Huculak  
VP Strategic Sourcing and Procurement  
janet.huculak@airwis.com  
(920) 749-4228

[www.airwis.com](http://www.airwis.com)

Regional Airline Fleet of CRJ-200 for Additional  
Contact Dave Messeler Director of Technical  
services

**Aircraft Component Design, Inc.**

William J. Grimm  
President & CEO  
billg@aircraftcomponentdesign.com  
(413) 527-8644

[www.aircraftcomponentdesign.com](http://www.aircraftcomponentdesign.com)

ACDI is an engineering company specializing in  
PMA development and manufacturing for  
legacy/mature engines and accessories. Full  
engineering capabilities with on-staff DER.

**Airgroup America, Inc**

Steve Grieme  
President  
sales@airgroupamerica.com  
(724) 779-9500

[www.airgroupamerica.com](http://www.airgroupamerica.com)

AirGroup America, Inc specializes in high quality,  
high precision replacement parts for aerospace,  
marine, commercial and military applications.

**Airlines for America**

Billy Nolen  
Senior Vice president, Safety, Security and  
Operations  
bnolen@airlines.org  
(202) 626-4000

[www.airlines.org](http://www.airlines.org)

We vigorously advocate for the American airline  
industry as a model of safety, customer service  
and environmental responsibility; and as the  
indispensable network that drives our nation's  
economy and global competitiveness.

**Airtomic**

Michael Mislán  
General Manager  
mmislán@sargentaerospace.com  
(317) 738-0148

[www.sargentaerospace.com](http://www.sargentaerospace.com)

A leading provider of aftermarket and MRO  
services worldwide. Offering broad range of  
services and competencies to our customers  
increasing readiness, reducing total cost and  
maximizing reliability and performance

**Alaska Airlines**

Dorina Ghiran  
Configuration Control/PMA Specialist  
Dorina.Ghiran@alaskaair.com  
(206) 392-9765

[www.alaskaair.com](http://www.alaskaair.com)

Alaska Airlines is the seventh-largest U.S. airline  
based on passenger traffic, is the dominant U.S.  
West Coast air carrier, and recently expanded to  
serve more U.S. East coast, Mexican and  
Canadian destinations.

**All Nippon Airways Co Ltd**

Takashi Matsuda  
Senior Manager, Repair Technology Development  
ta.matsuda@ana.co.jp  
+81 (3) 5756-9542

[www.anaskyweb.com](http://www.anaskyweb.com)

ANA was established in 1952 and now one of the largest airline in Japan. ANA group operates various types of 220 airplanes.

**Allegiant Air**

Kevyn Hollowel  
Buyer  
kevyn.hollowell@allegiantair.com  
(702) 830-8221

[www.allegiantair.com](http://www.allegiantair.com)

A U.S. DOT Certified "Scheduled Air Carrier", Allegiant makes leisure travel affordable and convenient.

**Amateras Group**

Miho Norinaga  
International Business Dept.  
norinaga@murc.jp  
+81 (3) 6733-3892

[www.amateras-tyo.biz/eng/](http://www.amateras-tyo.biz/eng/)

Amateras Group, comprised of ten companies in Tokyo, manufactures detail parts and provides assembling services.

**American Airlines**

Deidre Vance  
Senior Engineer - PMA - Part Development Engineering  
Deidre.Vance@aa.com  
(918) 292-1502

[www.americanairlines.com](http://www.americanairlines.com)

American Airlines maintains 5 fleets coming in the future. Maintenance is based in Tulsa and Ft. Worth. Most maintenance is performed in-house.

**American Eagle Airlines**

JoAnne Devine  
PMA Manager  
joanne.devine@aa.com  
(817) 931-1874

[www.aa.com](http://www.aa.com)

American Eagle Airlines is the regional partner of American Airlines, operates a fleet of more than 270 aircraft, and is a member of the oneworld® Alliance.

**Asiana Airlines, Inc.**

Jasmine Lee  
Assistant Manager of Parts Purchasing and Contracts  
gyoony@flyasiana.com  
+011 82 1588-8000

[www.flyasiana.com](http://www.flyasiana.com)

Asiana Airlines Inc. is one of South Korea's two major airlines, along with Korean Air. Asiana has its headquarters in Asiana Town building in Seoul.

**Austrian Airlines AG**

Erwin Fleberger  
Head of Airworthiness Office  
erwin.fleberger@austrian.com  
+43 (51) 766-1000

[www.austrian.com](http://www.austrian.com)

Austrian Airlines, (AUA), operating from its hub in Vienna, serves more than 100 destinations in some 60 countries through its Austrian Air, Austrian Arrows, and Lauda Air units and their fleet of about 100 aircraft.

**Aviation Component Solutions, Inc.**

Jeanne Betley  
Sales & Marketing  
betley@acs-parts.com  
(440) 295-6590

[www.acs-parts.com](http://www.acs-parts.com)

Aviation Component Solutions is a leader in FAA approved second source replacement parts (PMA Parts) for commercial aircraft and engine components.

**Aviation Inflatables**

German Alvarez  
CEO  
german.alvarez@av-inflatables.com  
(954) 749-3500

[www.av-inflatables.com](http://www.av-inflatables.com)

Aviation Inflatables, Inc. is a FAA /EASA Repair Station, parts distributor, PMA manufacturer specializing in emergency evacuation equipment; strategically customizing exchange and maintenance programs for all Airlines and MRO facilities

**Aviation Repair Resources**

John Wessner  
General Manager  
john.wessner@goarr.com  
(817) 557-2250

[www.goarr.com](http://www.goarr.com)

ARR is a full service machine shop. From design to assembly and prototype to production. ARR also has composite design and fabrication capabilities.

**B & E Aircraft Component Repair, Inc.**

Fred Thomas  
VP of Quality / General Manager  
fthomas@betool.com  
(413) 569-5585 ext 3110

[www.bandeacr.us](http://www.bandeacr.us)

The repair station at B&E was established in 1993 as a means of supporting existing repair schemes and the development of new repairs (DER's) for complex aircraft components and assemblies.

**Brackett Aero Filters, Inc.**

Scott Brackett  
President  
baf@citlink.net  
(928) 757-4009

[www.brackettaerofilters.com](http://www.brackettaerofilters.com)

Manufacturer of aircraft induction filters.

**British Airways Engineering**

Mark Novell  
Design Assurance Manager  
mark.novell@ba.com  
+44 (0) 562-8833

[www.britishairways.com](http://www.britishairways.com)

An impressive range of aircraft is maintained in our extensive facilities. We are focused on safety, delivery, reliability and value.

**Canadian Aero Manufacturing**

Ron Newburg  
President, Niagra Air Parts, Inc.  
ron@canadianaeromanufacturing.com  
(705) 326-1368

[www.canadianaeromanufacturing.com](http://www.canadianaeromanufacturing.com)

Starter adapter specialists, we manufacture components to overhaul all continental starter adapters.

**Carol E. Giles & Associates, Inc.**

Carol Giles  
President  
carol@carolgiles.com  
(703) 622-0915

[www.carolgiles.com](http://www.carolgiles.com)

Carol Giles has over 30 years of aviation maintenance experience in government and industry. Carol E. Giles & Associates, Inc., has provided regulatory compliance services to major airlines, and has teamed with other associates to conduct successful renew

**CHC Helicopters (Heli-One)**

Jerrick Danganan  
Program Coordinator (Engineering/Logistics)  
robert.kolmel@heli-one.ca  
(604) 952-7970

[www.heli-one.ca](http://www.heli-one.ca)

Heli-One Canada, Inc. is the world's largest helicopter services company specializing in transportation to offshore oil and gas platforms; civilian search and rescue services; and helicopter maintenance repair and overhaul.

**Copa Airlines**

Joseph Souaid  
Director of Procurement, Technical Operations  
jsouaid@copaair.com  
+507 238-1865

[www.copaair.com](http://www.copaair.com)

Copa Airlines was founded in 1947 as the national airline of Panama. It is now a leading Latin American provider of passenger and cargo service.

**Delta Airlines, Inc.**

David Linebaugh  
Sr. Principal Engineer  
david.linebaugh@delta.com  
(404) 714-0294

[www.delta.com](http://www.delta.com)

Delta Airlines is a worldwide airline, serving more than 160 million customers each year, offering service to 350+ destinations in 70 countries on 6 continents.



**DHL Air Limited**

Nick Hill  
Maintenance Manager  
nick.hill@dhl.com  
+44 (133) 285-7810

[www.dhl.com](http://www.dhl.com)

DHL offers integrated services and tailored, customer-focused solutions for managing and transporting letters, goods and information. We're the global leader in air freight, carrying 12% of the total worldwide market.

**Envoy Air Inc.**

Franklin M Tribble  
Engineering Manager  
frank.tribble@aa.com  
(817) 963-6100

[www.aa.com](http://www.aa.com)

American Eagle Airlines is the regional partner of American Airlines, Operates a fleet of more than 270 Aircraft and is a member of the oneworld® Alliance.

**Express Jet**

James Azelton  
Auditor, Quality Assurance/CASS  
jim.azelton@expressjet.com  
(404) 856-1633

[www.expressjet.com](http://www.expressjet.com)

As the world's largest regional airline, ExpressJet's 9,000 aviation professionals work hard every day to connect more people, more often to the places they love.

**FedEx Express**

Phillip A Shidler  
Materiel Aircraft Engineer  
pashidler@fedex.com  
(901) 224-4963

[www.fedex.com](http://www.fedex.com)

The world's largest airline in terms of freight tons flown and the world's fourth largest in terms of fleet size. Delivering to more than 375 destinations in nearly every country each day

**Gemini Engineering**

Kathryn Garberich  
Operations Manager  
kathryn@aviosupport.com  
(425) 739-6800

[www.aviosupport.com](http://www.aviosupport.com)

OEM direct FAA/PMA approved licensee, currently manufacturing over 4,500 quality part numbers to support the airline industry worldwide through our exclusive distributor, Aviosupport.

**Global Aviation Technologies**

Jerome Cottner  
Production Manager  
jerome@GlobalAviationTechnologies.com  
(316) 425-0999

[www.globalaviationtechnologies.com](http://www.globalaviationtechnologies.com)

Global Aviation Technologies provides design certification, aircraft maintenance and electrical manufacturing services to the aerospace industry. We are AS9100c, FAA PMA and Repair Station Certified.

**HEICO**

John Hunter  
Executive Vice President, Operations  
jhunter@heico.com  
(954) 744-7770

[www.heico.com](http://www.heico.com)

HEICO is the world's largest independent supplier of FAA approved jet engine, aircraft component and airframe replacement parts, developing approximately 500 new PMAs per year

**Hemico, Inc.**

Kevin Eitapence  
Program Manager  
keitapence@hemicoinc.com  
(866)-443-6426

[www.hemicoinc.com](http://www.hemicoinc.com)

Hemico, Inc. is a Parts Manufacture Approval holder focused on the Regional Aircraft market supporting wheel, brake, landing gear and actuator components.

**Herber Aircraft Service, Inc.**

Randolph Herber  
Director of Sales & Marketing  
rherber@herberaircraft.com  
(310) 322-9575

[www.herberaircraft.com](http://www.herberaircraft.com)

Supplier of parts for aviation, military, and industrial applications.

**Horizon Air**

Tom Durkee  
Service Engineer  
tom.durkee@horizonair.com  
(503) 384-4405

[www.horizonair.com](http://www.horizonair.com)

A regional airline based in SeaTac, Washington, United States. It is the eighth largest regional airline in the USA, serving 42 cities in the United States, Canada and Mexico

**HRD Aero Systems, Inc**

Tom Salamone  
President  
tom.s@hrd-aerosystems.com  
(661) 295-0670

[www.hrd-aerosystems.com](http://www.hrd-aerosystems.com)

Since 1985, HRD, has prided itself on becoming the largest independently owned Safety Equipment Repair Station in the world.

**Japan Airlines Int'l (JALUX Americas Inc)**

Hitoshi Ando  
Director JAL Procurement and Traffic  
hitoshi.ando@jal.com  
(310) 524-1050

[www.jaluxam.com](http://www.jaluxam.com)

The business of Jalux Americas, Inc. consists of the procurement and sales of aircraft parts, materials and ground support equipment for various airline carriers in the Far East.

**Jazz Air LP**

Dave Buchner  
Engineering Specialist  
david.buchner@flyjazz.ca  
(519) 457-8030

*www.flyjazz.ca*

Jazz Air operates more flights and flies to more Canadian destinations than any other carrier.

**Jet Blue Airways Corp.**

Zuhair Tibi  
Senior Aircraft Engineer  
zuhair.tibi@jetblue.com  
(718) 286-7900

*www.jetblue.com*

JetBlue Airways exists to provide superior service in every aspect of our customer's air travel experience.

**Jet Parts Engineering, Inc.**

Lani Davis  
Marketing Associate  
ldavis@jetpartsengineering.com  
(206) 281-0963 ext 127

*www.jetpartsengineering.com*

Jet Parts Engineering is an engineering-intensive company that manufactures and sells FAA-approved PMA parts.

**JK Tech Consulting, Inc.**

Akira "Jay" Kato  
President  
jktechci@jcom.home.ne.ja  
+8 (42) 754-2692

JK Tech Consulting provides consulting services to the aviation community in the US and Japan.

**Keddeg Co.**

Aaron Kuehl  
Engineering Manager  
akuehl@keddeg.com  
(913) 492-1222 ext 118

*www.keddeg.com*

Keddeg, a CLARCOR company, is a manufacturer of high quality, cost-effective aviation filtration products located in Lenexa, Kansas. AS9100 Certified

**KLM**

Ton Dortmans  
Executive Vice President Engineering & Maintenance  
a.dortmans@klm.com  
+6 (23) 977556

*www.klm.com*

KLM is the flag carrier airline of the Netherlands headquartered in Amstelveen with its hub at nearby Amsterdam Airport Schiphol.

**LKD Aerospace Inc.**

Mark Chamberlain  
CEO  
markchamberlain@LKDaero.com  
(425) 396-0829

[www.LKDaerospace.com](http://www.LKDaerospace.com)

LKD Aerospace, in operation since 1983, is a Global Leader specializing in Aerospace Engineering, Manufacturing, MRO Services, OEM and Aftermarket Distribution.

**Nasco Aircraft Brake, Inc.**

Daniel Aron  
President  
dla@nascoaircraft.com  
(910) 532-4430

[www.nascoaircraft.com](http://www.nascoaircraft.com)

NASCO Aircraft Brake is a manufacturer of FAA-PMA approved commercial and USAF-approved military aircraft brake components providing efficient, trouble-free products for more than 30 years.

**Pacific Sky Supply, Inc.**

Emilio Perez  
President  
emilio@pacsky.com  
(818) 768-3700

[www.pacsky.com](http://www.pacsky.com)

Pacific Sky Supply stocks more than 40,000 part numbers. Since our inventory is regularly replenished and maintained, you're free from maintaining one of your own.

**Pegasus Airlines**

Serife Ozturk  
Supply and Logistics Management  
serife.ozturk@flypgs.com  
(855) 229-8999

[www.flypgs.com](http://www.flypgs.com)

A low-cost airline headquartered in the Kurtköy area of Pendik, Istanbul, Turkey. by Esas Holding

**PMA Aero Parts LLC**

Bob Allen  
Accountable Maager  
pmaaeroparts@hotmail.com  
(623) 580-8880

**PMA Design and Manufacturing, Inc. (JAS)**

Jonathon Sanders  
Director of Engineering and Manufacturing  
jonathon@teamjas.com  
(904) 292-2328 ext 223

[www.teamjas.com](http://www.teamjas.com)

Worldwide supplier and PMA Holder of Twin Otter Aircraft parts and components.

**PMA Products, Inc.**

Charlie Causey  
President  
cgcausey@gmail.com  
(800) 762-0844

[www.pmaproducts.com](http://www.pmaproducts.com)

Our FAA-PMA replacement parts are primarily for Piper and Raytheon Aircraft, with a few parts for PT6 engines. Parts include bolts, bushings, switches, fuel caps, etc.

**PMA Sales, LLC**

Rob Watts  
Executive Vice President  
robwatts@pma-sales.com  
(480) 619-4386 ext 301

[www.pma-sales.com](http://www.pma-sales.com)

PMA Sales is an engineering, manufacturing and distribution company - specializing in pneumatics, as well as PMA'd silicone RTVs and sealants and LED lights.

**Qantas Airways**

James Chalupa  
Procurement Specialist  
james.chalup@qantas.com  
+61-296916480

[www.qantas.com](http://www.qantas.com)

Qantas Airways Limited is the flag carrier airline of Australia and its largest airline by fleet size, international flights and international destinations.

**Qualiseal Technology**

Robert Stuebing  
Vice President  
stuebing@Qualiseal.com  
(708) 887-6338

[www.qualiseal.com](http://www.qualiseal.com)

Qualiseal Technology designs and manufactures seals for the aerospace industry. Our seals are found worldwide on hundreds of aircraft and other demanding sealing applications.

**Quest Aviation, Inc.**

Jeffrey Johnson  
President  
jjohnson@quest-aviation.com  
(386) 961-9300

[www.quest-aviation.com](http://www.quest-aviation.com)

A leading international supplier of aircraft parts and services for more than 20 years. Delivering parts of exceptional quality and value while striving to meet or exceed customer service requirements.

**R&D Dynamics Corp**

Alex Garrett  
Director of PMA Sales  
alexg@rddynamics.com  
(860) 726-1204

[www.rddynamics.com](http://www.rddynamics.com)

R&D Dynamics manufactures and supplies FAA approved high quality PMA parts for almost every air cycle machine (ACM).

**RAPCO, Inc.**

Pat White  
President  
pat.white@rapoinc.com  
(262) 367-2292

[www.rapcoinc.com](http://www.rapcoinc.com)

Manufacturer of quality FAA PMA approved parts such as brake discs, pneumatic pumps, pneumatic components, pneumatic filters and propeller de-ice products

**Republic Airways**

Noel VanHook  
PMA Commodity Manager  
noel.vanhook@rjet.com  
(317) 471-2853

[www.rjet.com](http://www.rjet.com)

Republic Airways Holdings, based in Indianapolis, Indiana, is an airline holding company that owns Chautauqua Airlines, Frontier Airlines, Republic Airlines and Shuttle America.

**RPS Holdings**

Jason Peters  
Executive assistant to the CEO  
jpeters@rps-holdings.com  
(805) 459-2001

[www.rps-holdings.com](http://www.rps-holdings.com)

Providing electronic products and services to Aerospace and Defense operators and contractors. Delivering engineered solutions for unique requirements that demand high quality, reliability, and performance.

**Ryanair Ltd**

Lisa McCaffrey  
Technical Training Manager  
mccaffrey@ryanair.com  
+35 (31) 812-1432

[www.ryanair.com/ie](http://www.ryanair.com/ie)

Ryanair operates more than 1,400 flights per day from 44 bases and 1100+ low fare routes across 27 countries, connecting 160 destinations

**Seaside Helicopters, Inc.**

Jane Pettric  
President  
jpettric@seasidehelicopters.com  
(760) 806-3780

<http://www.seasidehelicopters.com>

Seaside Helicopters maintains a large inventory of turbine helicopter parts and overhauled components. In addition to its large parts inventory, specialize in full support of MD 500, MD 600 series helicopters.

**Seginus Inc.**

Erik Hatch  
Owner  
info@seginusinc.com  
(630) 800-2795

[www.seginusinc.com](http://www.seginusinc.com)

Seginus Inc. is a manufacturer of FAA PMA replacement aircraft parts. We manufacture aircraft bearings and electrical carbon brushes for many types of aircraft parts and accessories, heaters, and assorted hardware and flashtube lamp.

**SJH Sheffield Aerospace, LLC**

Tom Howard  
VP Regulatory Compliance  
tom.howard@sheffieldspace.com  
(210) 872-8504

[www.sheffieldspace.com](http://www.sheffieldspace.com)

SJH Sheffield Aerospace specializes in providing consulting services to the aviation industry. Services include compliance auditing, cost modeling, and high level engineering staff augmentation.

**SkyWest Airlines**

Kelly Grimshaw  
Manager of Accessory Shops and PMA  
Development  
kelly.grimshaw@skywest.com  
(801) 258-4810

[www.skywest.com](http://www.skywest.com)

SkyWest operates over 1,700 flights per day for United Express, Delta Air Lines operated by SkyWest, and proudly flies the ERJ 175, the Bombardier CRJ200, CRJ700, and the CRJ900.

**SoundAir Design & Dev.**

Travis Dykstra  
Director of Sales  
travisd@soundair.com  
(360) 453-2300

[www.soundair.com](http://www.soundair.com)

SDDG is focused on creating high quality PMA parts for aircraft ovens, coffee makers, and lavatory products that not only saves airlines money, but increases reliability

**Southwest Airlines Co.**

Brandon Sbragia  
Senior Buyer  
brandon.sbragia@wnco.com  
(214) 904-4639

[www.southwest.com](http://www.southwest.com)

Southwest is the United States' most successful low fare, high frequency, point-to-point carrier and operates more than 3,400 flights a day coast-to-coast, making it the largest U.S. carrier based on domestic passengers carried as of December 31, 2010.

**Spirit Airlines**

Manuel Garay  
Senior Buyer / Technical Purchasing  
manuel.garay@spirit.com  
(954) 359-1910

[www.spirit.com](http://www.spirit.com)

Spirit Airlines empowers customers to save money on air travel by offering ultra low base fares with a range of optional services for a fee, allowing customers the freedom to choose only the extras they value.

**SunExpress**

Ali Akman  
Aircraft Systems Engineer – Cabin Interior  
ali.akman@sunexpress.com  
+90 (535) 553-3223

[www.sunexpress.com](http://www.sunexpress.com)

SunExpress, is a Turkish airline based in Antalya, Turkey. It operates scheduled and chartered passenger flights to various destinations in Europe, Asia and North Africa.

**Thai Airways**

Porrerk Komilvanij  
Contact  
pkomilvanji@thaairways.com  
+66 (0) 81-810-7929

[www.thaairwaysusa.com](http://www.thaairwaysusa.com)

Thai Airways is the national carrier of the Kingdom of Thailand. It operates domestic, regional and intercontinental flights radiating from its home base in Bangkok.

**Timken Alcor Aftermarket Solutions, Inc.**

Larry Shiembob  
Director - Aerospace MRO  
larry.shiembob@timken.com  
(480) 632-1039

[www.timken.com](http://www.timken.com)

Timken supports engines (PT6, Model 250, T53, APUs) and helicopters (212/204/205/H-1) with quality replacement parts, part repairs, bearing repair, and engine/component overhaul.

**Triumph Interiors, LLC**

Angél Roy  
Inside Sales Manager  
aroy@triumphgroup.com  
(412) 788-4200

[www.triumphgroup.com](http://www.triumphgroup.com)

Triumph Group, Inc. is a global leader in supplying and overhauling aerospace systems and components.

**Turkish Airlines**

Ali ihsan Donmez  
a.donmez@thy.com  
+90 (126) 585-9800

[www.turkishairlines.com](http://www.turkishairlines.com)

In 1933 starting with just 5 airplanes since then growing to over 200 aircraft, maintaining passion and enthusiasm for service and quality, now has the youngest fleet in Europe.

**United Airlines**

Ed Pozzi  
Engineer - PMA Development  
ed.pozzi@united.com  
(650) 634-5103

[www.united.com](http://www.united.com)

United Airlines operates under United Continental Holdings, Inc., which is committed to being the airline customers want to fly, and the airline employees want to work for.

**UPS**

Jim Roberts  
Manager of Power Plant Engineering and Major Maintenance  
jhroberts@ups.com  
(502) 329-6041

[www.ups.com](http://www.ups.com)

UPS is the world's largest package delivery company and a leading global provider of specialized transportation and logistics services.



**US Air Force**

Ryan Perry  
Program Manager  
ryan.perry@tinker.af.mil  
(405) 736-7373

[www.airforce.com](http://www.airforce.com)

Today's modern US Air Force delivers global reach, global power and global engagement to defend and protect American citizens and allies anywhere, at any time.

**US Airways**

Dale Turner  
Manager, Engineering Configuration Control  
dale.turner@usairways.com  
(480) 693-7219

[www.usairways.com](http://www.usairways.com)

US Airways, along with US Airways Shuttle and US Airways Express, operates more than 3,200 flights per day and serves more than 200 communities in the U.S., Canada, Mexico, Europe, the Middle East, the Caribbean, Central and South America.

**UTC Aerospace System**

Arnold Ong  
Market Support Manager  
arnold.ong@utas.utc.com  
(704) 282-2694

[www.utc.com](http://www.utc.com)

UTC Aerospace Systems designs, manufactures and services systems and components and provide integrated solutions for commercial, regional, business and military aircraft, helicopters and other platforms. As well as major supplier to international space pr

**Vision Air Services, LLC**

Scott S. Smith  
President  
scott@vas-llc.com  
(480) 970-5014

[www.vas-llc.com](http://www.vas-llc.com)

As a PAH, PQ2075NM granted in 1995, we are a manufacturer of hydraulic and damper parts for various helicopter models

**Vision Air Services, LLC**

Scott S. Smith  
President  
scott@vas-llc.com  
(480) 970-5014

[www.vas-llc.com](http://www.vas-llc.com)

As a PAH, PQ2075NM granted in 1995, we are a manufacturer of hydraulic and damper parts for various helicopter models

**VRG Linhas Aereas S/A**

Vitor Franco De Araujo  
International Purchasing Analyst  
vfaraujo@golnawgb.com  
+55 (31) 3689-9617

[www.voegol.com.br](http://www.voegol.com.br)

114 aircraft among Boeing 737-700 and Boeing 737-800 are responsible for serving all of the company's routes in Brazil, South America and the Caribbean.



## Meet the Author

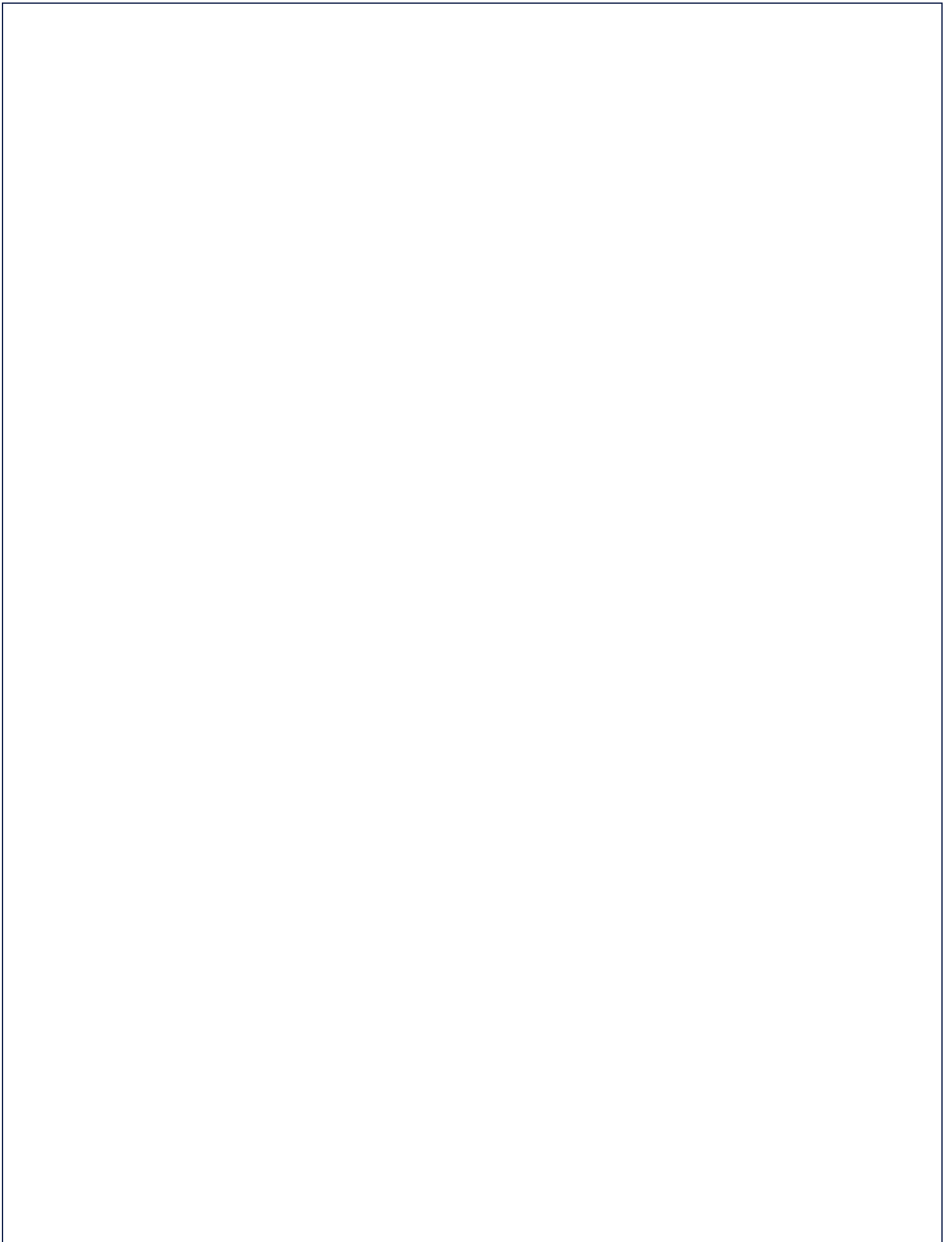
### David Doll

Mr. Doll is a 40-year veteran in the field of maintenance design and operations management. He has held key technical manager positions at United Airlines, including process engineering, fleet technical services, manufacturing engineering and component re-manufacturing. He currently provides consulting services in operations analyses, process re-engineering and market evaluation.



Mr. Doll has extensive experience in strategic planning, process improvement and project management. He pioneered the concept of high velocity production systems in repair environments and has helped numerous repair facilities improve maintenance programs and repair operations.

Mr. Doll holds a B.S. degree in mechanical engineering from Trinity College and an M.S. degree in mechanical engineering from the University of Santa Clara.





**Modification And Replacement Parts Association**  
**2233 Wisconsin Ave, NW Suite 503**  
**Washington, DC 20007**  
**202.628.6777**

***[www.PMAparts.org](http://www.PMAparts.org)***