

AIR CARRIERS' OUTSOURCING OF AIRCRAFT MAINTENANCE

Federal Aviation Administration

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Transportation
Office of the Secretary
of Transportation
Office of Inspector General

Memorandum

Subject: **ACTION:** Review of Air Carriers' Outsourcing
of Aircraft Maintenance
Federal Aviation Administration
Report Number AV-2008-090

Date: September 30, 2008

From: David A. Dobbs 
Principal Assistant Inspector General
for Auditing and Evaluation

Reply to
Attn. of: JA-1

To: Acting FAA Administrator

At the request of the House Committee on Transportation and Infrastructure, we reviewed the Federal Aviation Administration's (FAA) oversight of air carriers' outsourced aircraft maintenance. As of July 14, 2008, there were 4,159 domestic and 709 foreign repair stations certificated by FAA to perform maintenance on U.S. aircraft. When an air carrier uses an FAA-certificated repair station to repair its aircraft or parts, the repair station's organization becomes an extension of the air carrier's maintenance organization.

Our audit objectives were to (1) identify the type and quantity of maintenance performed by external repair stations and (2) determine whether FAA is effectively monitoring air carriers' oversight of external repair stations' work and verifying that safety requirements are met. Exhibit A details our audit scope and methodology, and exhibit B lists the entities we visited or contacted.

BACKGROUND

Our work on outsourced maintenance has continually found that the issue is not where maintenance is performed but that maintenance requires effective oversight. Outsourced maintenance requires a multifaceted, risk-based oversight approach, and it is important that each of these elements work together successfully (see table 1 below).

<i>Title</i>	<i>Oversight Role</i>
FAA Certificate Management Inspector (CMO)	Assesses whether air carriers' maintenance oversight programs ensure domestic and foreign repair stations use carrier procedures when repairing aircraft and parts.
FAA Flight Standards District Office Inspector (FSDO)	Ensures that FAA-certificated domestic repair stations meet FAA standards.
FAA International Field Office Inspector (IFO)	Ensures that FAA-certificated foreign repair stations meet FAA standards.
Foreign Aviation Authority Inspector	Through agreements with Germany, France, Ireland, and Canada, certifies and oversees FAA-certificated or U.S. carrier-used aircraft repair stations in these countries (FAA has reserved the right to do random spot inspections).
Air Carrier Auditor	Conducts pre-contract award and periodic follow-up audits of repair stations.
Air Carrier On-Site Technical Representative	Provides full-time quality control at repair stations performing heavy aircraft checks to ensure they comply with the contract, FAA standards, and air carrier requirements.
Repair Station Auditor	Conducts internal and external audits to ensure repair station and its subcontractors comply with FAA and air carriers' standards.

When we reported on air carriers' use of FAA-certificated repair stations in 2003,¹ we recommended that FAA place greater emphasis on repair station oversight rather than air carriers' in-house maintenance facilities by (1) determining trends in air carriers' use of repair stations; (2) identifying heavily used repair stations and performing frequent, detailed reviews; and (3) ensuring that foreign authorities follow FAA standards in conducting inspections and provide FAA with adequate documentation. In response, FAA began working closely with foreign authorities to improve the surveillance they perform on FAA's behalf and implemented two new systems—one for inspectors to collect better information on the quantity of repairs maintenance providers perform and one to provide risk-based oversight for repair stations.

Our 2007 testimony before the House Transportation and Infrastructure Committee stated that FAA needed to be vigilant in locating and monitoring the most critical maintenance and ensuring inspectors are well-positioned and properly trained to adequately oversee outsourced aircraft repairs.²

¹ OIG Report Number AV-2003-047, "Review of Air Carriers' Use of Aircraft Repair Stations," July 8, 2003. OIG reports are available on our website: www.oig.dot.gov.

² OIG Testimony Number CC-2007-035, "Aviation Safety: FAA's Oversight of Outsourced Maintenance Facilities," March 29, 2007.

RESULTS IN BRIEF

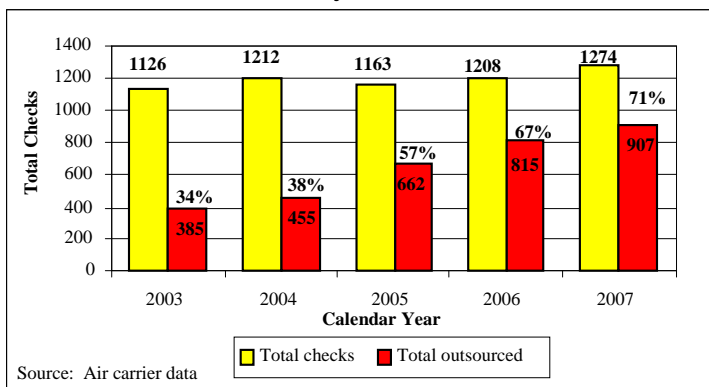
Air carriers are increasingly outsourcing maintenance to repair stations to reduce operating costs. The nine major air carriers we reviewed³ sent 71 percent of their heavy airframe maintenance checks to repair stations in 2007, up from only 34 percent in 2003 (see figure 1). This work includes performing complete teardowns of aircraft that can take up to 7 weeks to complete.

At these nine carriers, foreign repair stations performed 27 percent of outsourced heavy airframe maintenance checks in 2007, up from 21 percent in 2003. While air carriers are increasingly contracting with foreign companies for heavy airframe maintenance, foreign companies are also sending work to the United States.

With the growing outsourcing trend, FAA and air carriers must continually improve their oversight of repair stations to ensure that safety measures keep pace with the changing nature of the industry. Although FAA has taken important steps to move its safety oversight toward a risk-based system, the Agency still faces challenges in determining where the most critical maintenance occurs and ensuring sufficient oversight.

FAA needs to improve its system for determining how much and where outsourced maintenance is performed. FAA set up a system in fiscal year (FY) 2007 for air carriers and repair stations to report the volume of outsourced repairs; however, we found this system is inadequate as these reports are not mandatory. Further, when carriers do voluntarily report this information, FAA does not require that they list *all* repair stations performing repairs to critical components⁴ or that FAA inspectors validate the information. Air carriers are only requested to report their top 10 substantial maintenance⁵ providers. As a result, the system provides only limited data for FAA to use in targeting inspections. FAA plans to issue revised guidance by the end of calendar year 2008 that will *require* carriers

Figure 1. Percentage of Heavy Airframe Maintenance Checks Outsourced for Nine Major Air Carriers, 2003 to 2007



³ AirTran Airways, Alaska Airlines, America West Airlines, Continental Airlines, Delta Air Lines, JetBlue Airways, Northwest Airlines, Southwest Airlines, and United Airlines. American Airlines, the largest U.S. air carrier, has retained its heavy maintenance as opposed to making a significant shift to outsourcing; therefore, we did not include its outsourcing data in our review since it could skew the resulting data.

⁴ For the purposes of this report, we use the term “critical components” to identify those components that are significant to the overall airworthiness of the aircraft, such as landing gear, brakes, and hydraulics. FAA does not use this term or include these types of components in its definition of substantial maintenance.

⁵ FAA defines substantial maintenance as major airframe maintenance checks; significant engine work (e.g., complete teardown/overhaul); major alterations or major repairs performed on airframes, engines, or propellers; repairs made to emergency equipment; and/or aircraft painting.

to report the volume of repairs they outsource. However, the revisions, as currently drafted, still do not require air carriers to report volume data for all repairs of critical components and inspectors to validate the data.

Gathering adequate data to target inspections is important since FAA does not have a specific policy governing when CMO inspectors should initially visit repair stations performing substantial maintenance for air carriers. Instead, FAA allows inspectors to rely on the air carriers' initial audits as a basis for approval. FAA permits this practice even if inspectors have found problems with the carrier's audit processes.

As a result, we found significant delays between FAA's initial approval of repair stations and its first inspections at those locations. For example, over a 3-year period, CMO inspectors for an air carrier inspected only 4 of its 15 substantial maintenance providers. Among those uninspected was a major foreign engine repair facility. CMO inspectors did not visit this facility until 5 years after FAA approved this facility for carrier use—even though the repair station had worked on 39 of the 53 engines repaired for the air carrier.

At other repair stations that did not receive timely CMO inspections, problems existed, such as untrained mechanics, lack of required tools, and unsafe storage of aircraft parts. While these problems were not immediate safety-of-flight issues, they could affect aircraft safety over time if left uncorrected. Without on-site FAA inspections, there is no assurance that oversight of repair stations performing substantial maintenance will be sufficient. FAA either needs to conduct an on-site inspection before approving facilities for use or verify that the air carrier's audit process is effective.

FAA needs to ensure carriers and repair stations have strong oversight systems. In addition to their own inspections, FAA inspectors must ensure that air carriers and repair stations have strong audit systems to correct identified deficiencies, as FAA relies heavily on air carriers' oversight. While all the carriers we visited had audit programs, we found that these programs were not always effective. As a result, maintenance problems either went undetected or reoccurred.

FAA has no requirement for when carriers must conduct a follow-up audit and allows carriers to close findings based on written statements from repair stations that they will take corrective actions. Therefore, it is critical that FAA inspectors closely review air carrier audit findings; validate, while on site, that repair stations corrected deficiencies; and fully document their results.

For example, at one heavy airframe repair station, *all three types of oversight failed*—FAA, air carrier, and repair station. We found that two air carrier audits and two FAA inspections (CMO and FSDO) failed to detect significant

weaknesses at this facility. These were not discovered until another major air carrier's pre-contract award audit found problems in the repair stations' maintenance practices, such as not properly overseeing subcontractor maintenance. The problems identified were so serious that repair station management stopped operations for over a month so it could take corrective actions.

In addition to periodic audits, air carriers have on-site personnel to monitor repairs at heavy maintenance repair stations. However, FAA does not have any guidance on how these personnel should examine and document their inspections, which has resulted in an inconsistent level of oversight. For example, on-site personnel for two carriers we reviewed only performed *undocumented*, on-the-spot inspections of work at repair stations. As a result, the air carriers could not use the data for trend analysis or ensure the repair station took corrective actions.

FAA needs to improve processes for documenting inspection results. We also found that FAA inspectors did not consistently document or share inspection results. We reported similar problems in 2003. In response, FAA began requiring inspectors to include repair station names on inspection reports and document areas that were inspected, the results, and corrective actions taken in the national inspection database. However, we found the problem persists as FAA does not have controls to ensure that inspectors adhere to this requirement or initiate contact with other inspectors who may be reviewing the same repair station. As a result, inspectors had incomplete data to prepare risk assessments, and identified deficiencies went uncorrected.

For example, in one case we found that an inspector did not enter inspection results in the database despite finding serious errors at a repair station that affected 24 nose landing gears repaired over 2 years for 1 of 3 air carriers using the facility. This type of data is critical to FAA's ability to perform risk-based assessments. To illustrate, at the time of our review, this repair station had not received on-site monitoring by CMO inspectors for air carriers using this facility for at least 5 years.

FAA should expedite actions to ensure air carriers better define their maintenance procedures. We found that FAA does not require air carriers to have specific guidance for outsourced repairs. Although FAA requires repair stations to follow air carriers' manuals, these manuals have been traditionally geared toward in-house maintenance. Since repair stations may perform repairs for various air carriers, all with different in-house procedures, FAA should ensure that air carriers provide repair stations with well-defined maintenance procedures.

FAA recognizes the significance of this problem and is developing a rule to require specific language in air carriers' manuals for maintenance completed by

external repair facilities. While this is an important step, the rule has been indefinitely delayed. We are recommending that FAA take interim actions such as encouraging written agreements between air carriers and repair stations to clearly define maintenance responsibilities and processes.

SUMMARY OF RECOMMENDATIONS

We recommend that FAA enhance its oversight of air carriers' outsourced aircraft maintenance through several actions: (1) develop and implement an effective system to determine how much and where critical maintenance is performed and ensure CMO inspectors conduct initial and follow-up inspections to adequately assess risks at substantial maintenance providers, (2) require inspectors to perform detailed reviews of air carrier and repair station audits and corrective actions, (3) establish controls to ensure inspectors document inspection findings in the national database and review related findings by other inspectors, (4) ensure that air carriers have specific guidance for outsourced repairs, and (5) encourage air carriers and repair stations to develop agreements that clearly define maintenance processes and responsibilities. We are making a total of seven recommendations, which are listed on page 19.

SUMMARY OF AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

We provided FAA with our draft report on August 22, 2008, and received FAA's formal response on September 26, 2008. FAA concurred with all seven recommendations and agreed to take corrective actions.

For two recommendations, however, we are requesting that FAA provide additional information as FAA's response and planned actions did not fully address our intent. FAA's comments, our response, and actions required are fully discussed on pages 20 through 21. FAA's response is included in its entirety in the appendix to this report.

We appreciate the courtesies and cooperation of FAA representatives during this audit. If you have any questions concerning this report, please contact Lou Dixon, Assistant Inspector General for Aviation and Special Program Audits at (202) 366-0500 or Robin Koch, Program Director, at (404) 562-3770.

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cc: FAA Chief of Staff
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Air carriers are increasingly outsourcing maintenance to repair stations to reduce operating costs. While FAA has taken important steps to move its safety oversight toward a risk-based system, we found it still relies too heavily on air carriers' oversight procedures, which are not always sufficient. Specifically, we determined that FAA did not (1) have an adequate system for determining how much and where the most critical maintenance occurs; (2) have a specific policy governing when CMO inspectors should visit repair stations performing substantial maintenance; (3) require inspectors to validate that repair stations have corrected deficiencies identified in air carrier audits; and (4) have adequate controls to ensure that inspectors document inspection findings in the national database and review related findings by other inspectors. As a result, FAA could not effectively target its inspection resources to those repair stations providing the highest volume of repairs, which caused deficiencies at repair stations to go undetected or reoccur and prevented inspectors from obtaining sufficient data to perform comprehensive risk assessments.

In addition, since many air carriers do not differentiate between in-house and outsourced maintenance, FAA must ensure air carriers provide repair stations with clearer guidance on how to perform maintenance and inspections at repair stations. FAA is working to address this issue through a rulemaking change but needs to pursue actions in the interim to establish agreements between air carriers and repair stations on how maintenance is to be performed.

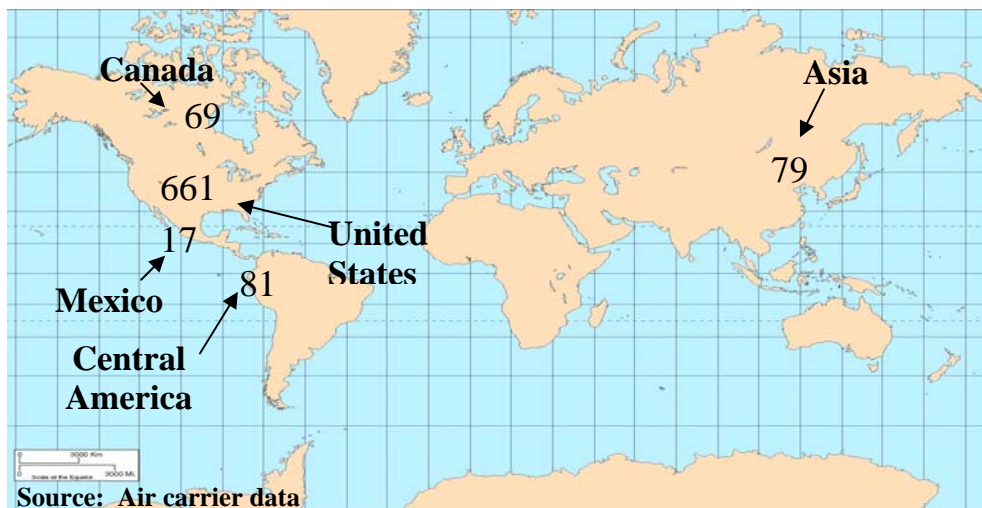
Air Carriers Are Increasingly Using Contract Maintenance Providers To Perform Substantial Maintenance

Overall, major air carriers⁶ outsourced an average of 64 percent of their maintenance expenses in 2007, compared to only 37 percent in 1996. This work includes everything from repairing critical components, such as landing gear and engine overhauls, to performing heavy airframe checks.

The nine air carriers we reviewed sent 71 percent of their heavy airframe maintenance checks to contract maintenance providers in calendar year 2007, up from 34 percent in 2003. Foreign repair stations completed 246 (27 percent) of these carriers' 907 heavy airframe maintenance checks outsourced in 2007, up from 21 percent in 2003. These maintenance checks were performed worldwide at 22 repair stations located in the United States, Canada, Mexico, Central America, and Asia (see figure 2 on page 2).

⁶ Alaska Airlines, America West Airlines, American Airlines, Continental Airlines, Delta Air Lines, Northwest Airlines, Southwest Airlines, United Airlines, and U.S. Airways. These are the major air carriers we have been monitoring since our last report in 2003. These carriers all outsource various levels of maintenance, including heavy airframe.

Figure 2. Locations of Repair Stations That Performed Heavy Airframe Maintenance for Nine Major Air Carriers in 2007



While air carriers are increasingly contracting with foreign companies for heavy airframe maintenance, foreign companies are also sending work to the United States. There are approximately 1,200 FAA-certificated repair stations in the United States that also have European Aviation Safety Agency certifications, which allow them to perform repairs for foreign companies. Nationwide data are not available for the amount of work that is coming into the United States; however, data we obtained from 1 air carrier disclosed that 11 (24 percent) of the 46 customers using the air carrier for maintenance were foreign companies. In addition, some airlines, such as American Airlines, perform all heavy airframe maintenance in-house.

FAA Needs To Improve Its System for Determining How Much and Where Outsourced Maintenance Is Performed and Ensure Sufficient Inspection Coverage

With the growing outsourcing trend, FAA has taken important steps to move its safety oversight toward a risk-based system. Further actions are needed, however, as we identified problems with the frequency of inspections at 5 of the 15 repair stations we reviewed, all of which performed a significant volume of substantial maintenance for their air carrier customers. We determined that FAA needs to improve its inspection coverage of outsourced maintenance by requiring comprehensive data on how much and where critical maintenance is performed and ensuring CMO inspectors perform initial and recurring on-site visits to repair stations so that potential problems are identified and properly addressed.

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FAA Still Does Not Have Comprehensive Data on How Much and Where Outsourced Maintenance Is Performed

In 2003, we recommended that FAA determine what type of repairs air carriers send to repair stations and which repair stations carriers use the most. In response, FAA implemented a system in FY 2007 for both air carriers and repair stations to submit quarterly utilization reports. These reports are supposed to show carriers' or repair stations' maintenance providers that have the highest volume of maintenance activity and perform the most critical maintenance. We are concerned, however, about the completeness and accuracy of the data submitted because FAA does not require air carriers to (1) report all high-volume repair stations or (2) consistently categorize all repair stations that provide maintenance of critical components as "substantial maintenance providers" (e.g., landing gear repair facilities).

FAA only directs air carriers to report their top 10 substantial maintenance providers. Air carriers formulate this list quarterly according to the number of requests for service that repair stations receive rather than the volume of repairs they perform. Therefore, the reports can omit high-volume, critical component maintenance providers that may have received fewer service requests. For example, if four emergency evacuation slides are sent to a repair station *individually* each slide is counted as a separate request. However, 30 emergency evacuation slides sent to a repair station *at once* are counted as 1 service request. The provider that only repaired 4 slides would then receive a higher reporting priority over the provider that repaired 30 slides. As a result, a high-volume substantial maintenance provider would be omitted from the quarterly report just on the basis of the shipping method the carrier uses to send its emergency evacuation slides to its vendor.

Our review of air carriers' reports submitted to FAA confirmed inconsistencies in data reporting. For example, some of the reports only included the top 10 substantial maintenance providers, as requested by FAA. Others contained a mix of both substantial maintenance providers and high-volume, critical component vendors, such as those providers that repair wheels and brakes. In our view, including high-volume critical components would benefit FAA's oversight efforts. If the reports are to be an effective means for FAA to track and accurately target those repair stations that carriers use the most, a more thorough process will be needed.

FAA has initiated the following two actions to improve the reporting of outsourced maintenance, but these actions still fall short of providing FAA with the data it needs:

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- On January 24, 2008, FAA issued a change to its Operations Specifications guidance that would require air carriers to list all certificated and non-certificated repair stations they use. FAA later cancelled this guidance and is now developing a new method to obtain this data because industry representatives expressed significant concerns with the undue burden of this reporting requirement.
- By the end of calendar year 2008, FAA plans to issue revised guidance that will *require* air carriers to submit data on the amount or volume of repairs they outsource. FAA has determined that it can legally require them to submit this data through changes to air carriers' Operations Specifications, rather than through the rulemaking process. FAA is also revising related inspector guidance to reflect this change.

We remain concerned because the revisions, as currently drafted, still do not require air carriers to report complete volume data for all repairs of critical components or FAA inspectors to validate the data. Without some form of data verification, FAA cannot be assured that air carriers have provided accurate and complete information.

FAA's definition of substantial maintenance does not include all repairs of critical components, resulting in inconsistent carrier reports of outsourced maintenance. FAA inspection guidance defines substantial maintenance as major airframe maintenance checks; significant engine work; major alterations or major repairs to airframes, engines, or propellers; emergency equipment repairs; and aircraft painting. *Yet, this definition does not include components such as landing gear even though the safe landing of an aircraft relies on properly maintained landing gear*—maintenance on such components is critical to the safe operation of the aircraft.

As a result, FAA offices applied inconsistent policies on whether air carriers should list landing gear repair facilities as substantial maintenance providers. Inspectors for five of the nine air carriers we reviewed considered landing gear to be substantial maintenance while the remaining four did not. FAA Flight Standards staff advised us that decisions on whether landing gear is considered substantial maintenance would depend on the type of work performed. We found this can lead to wide disparities in air carriers' reports of locations performing repairs of critical components, which can limit inspectors' ability to conduct adequate risk assessments.

To illustrate, one air carrier that used a landing gear repair station we visited did not consider it to be a substantial maintenance provider. Yet, that repair station performed the same work for another air carrier that *did* consider it to be a substantial maintenance provider. As a result, although the former air carrier was

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the repair station's biggest customer, with 59 landing gears sent for repair in 2005, we found that, at the time of our review, neither the CMO inspectors nor air carrier auditors had visited the facility in nearly 4 years.

Air carriers must correctly and consistently identify repair stations that conduct substantial maintenance since FAA inspectors and air carrier auditors target these facilities as higher oversight priorities. FAA should reassess its definition of substantial maintenance, identify critical components that should be included in the definition, and ensure that air carriers and FAA offices consistently apply this definition.

FAA Does Not Have a Policy Governing When Inspectors Should Visit Substantial Maintenance Providers

FAA requires air carriers to have a system in place, called the Continuing Analysis and Surveillance (CAS) System, that continually detects and identifies deficiencies found at repair stations and provides timely corrective action. Air carriers primarily use periodic quality assurance audits to assess whether repair stations are properly performing their inspection and maintenance programs. Since 1996, FAA has required air carriers to conduct on-site audits before contract repair facilities can be used to provide substantial maintenance.

FAA does not, however, require its CMO inspectors to conduct on-site inspections—they can just review air carriers' pre-contract award audits as a basis for approving air carriers' use of the repair stations. FAA allows inspectors to decide when the initial inspections for substantial maintenance providers should take place. In addition, FAA has not established a timeframe for when inspectors should visit facilities *after* they are approved as outsourced maintenance providers. On-site inspections conducted prior to approval for carrier use would provide assurance that the facility does in fact have the proper procedures, tooling, training, and equipment to conduct aircraft maintenance in accordance with air carriers' procedures. Without an established policy for inspection schedules, there is no standard for all FAA offices regarding initial inspector visits, which can cause safety issues to go unchecked at repair stations—some for as long as 5 years—and limit CMO inspectors' ability to effectively assess risks (see table 2 on page 6).

For example, CMO inspectors did not inspect one foreign heavy airframe repair station until *8 months* after FAA granted initial approval—even though IFO inspectors responsible for overseeing this facility had found 23 discrepancies 3 months after the initial approval (during their annual inspection). Some of these discrepancies were significant and could have affected the quality of repairs for all air carriers using the facility (e.g., there were not enough required tools, required

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inspections of completed work were not accomplished, and the safekeeping of parts in long-term storage could not be guaranteed). By the time CMO inspectors visited the facility, it had already performed heavy maintenance checks on five of the air carrier's aircraft. Since CMO inspectors are responsible for ensuring that repair stations meet carrier maintenance standards, the IFO inspection findings should have prompted more immediate attention from the CMO. The CMO inspectors had relied on the air carrier's audit as a basis for initial approval and identified outsourcing risks in their surveillance plan as "unknown" since they had not been on site.

Table 2. Repair Stations That Performed Substantial Maintenance for Long Periods Before First CMO Inspection

Repair Station	Number of Aircraft and/or Parts Repaired Before First FAA Visit ^a	Time Lapse Between Approval for Carrier Use and First FAA Inspection ^b
A	5 heavy airframe checks	8 months
B	7 heavy airframe checks	5 months
C	39 engines	5 years
D	30 landing gears a year	At least 5 years
E ^c	At least 81 landing gears At least 94 landing gears At least 21 landing gears	At least 5 years At least 5 years At least 5 years

^aRepair station and/or air carrier records

^bSource: FAA inspection database

^cThree air carriers use this repair station.

It is important to note the following regarding repair stations C and E:

- **FAA solely relied on a foreign authority to oversee repair station C.** Although FAA can conduct spot inspections at this repair station, the Agency's IFO inspectors had not conducted any inspections of this facility for over 5 years at the time of our review. Instead, FAA solely relied on inspectors from the foreign aviation authority to inspect this facility and provide FAA with a recommendation to renew the facility's FAA maintenance certificate. After we conducted our review at this IFO, FAA inspectors initiated a joint inspection with the foreign aviation authority.
- **None of the CMO inspectors for three air carriers that used repair station E had inspected the facility.** Despite the failure of landing gears that were repaired by repair station E, CMO inspectors for the carrier that experienced the failures did not inspect the repair station. An internal investigation performed by the repair station revealed it had performed an improper repair on 24 landing gears for this carrier over a 2-year period. Therefore, no one who had reviewed this facility during these 2 years—including FSDO

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inspectors, air carrier auditors, and repair station internal auditors—detected this repair error until the air carrier experienced landing gear problems.

We identified similar problems with the frequency of CMO inspectors' on-site inspections at repair stations performing work for cargo carriers. For example, FAA inspectors for 2 cargo air carriers had not visited a major foreign engine overhaul facility in at least 5 years even though the facility repaired 50 engines in 1 year for those carriers.

Inspector Staffing and Budget Issues Could Be Affecting FAA's Ability To Provide Sufficient Inspection Coverage for Substantial Maintenance Providers

Inspectors at five of the nine air carriers we reviewed told us that staffing and budget issues affected their ability to provide sufficient inspection coverage for substantial maintenance providers. Inspectors for one of these five were only able to inspect 16 percent of the air carrier's substantial maintenance providers in 2007.

For example, inspectors stated that they did not have enough on-site time at repair stations and that this time was split between aging aircraft inspections and outsourced inspections. Since aging aircraft inspections—those inspections requiring a visual check of the condition of an aircraft's structure—are mandated by Congress, money is made available to FAA to perform these essential inspections. FAA principal inspectors have instructed their inspectors to combine contract maintenance inspections with their aging aircraft inspections. Although this procedure seems prudent, inspectors told us that they do not have adequate time during a typical 2- to 3-day inspection visit to properly assess both programs.

In addition, FSDO principal maintenance inspectors for two heavy airframe repair stations told us that staffing and budget constraints limited their oversight capabilities. FAA is addressing these issues by developing a staffing model to better determine its staffing needs given the increasing shift to outsourced maintenance.

FAA Relies Heavily on Air Carrier and Repair Station Audits, Which Are Not Always Sufficient To Correct Identified Deficiencies

In addition to their own inspections, FAA inspectors must ensure that air carriers and repair stations have strong audit systems to correct identified deficiencies, as FAA relies heavily on their oversight. While all the carriers we visited had formal audit programs, we found that these audits were not always thorough and that FAA should have required its inspectors to perform on-site inspections in some instances. Specifically, at 5 of the 15 repair stations we visited we found that air carrier auditors did not identify all deficiencies and adequately follow up on

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findings. FAA and air carriers also rely on repair stations to perform audits of external vendors they contract with for parts and maintenance. We determined that repair station processes for conducting these audits, correcting identified deficiencies, and performing trend analyses could have been stronger at 10 of the 15 repair stations we visited. Without reliable oversight of audit findings and corrective actions, maintenance problems at repair stations can remain undetected or reoccur.

FAA Needs To Ensure Inspectors Visit Heavy Airframe Repair Stations Instead of Allowing Them To Solely Rely on Air Carrier Audits

Our review of FAA inspections of nine air carriers' CAS programs showed that FAA identified problems with three of the nine carriers' quality assurance audit programs—the very audit programs that FAA inspectors can opt to rely on when they decide to approve substantial maintenance providers for use. We question this oversight practice given the following problems FAA identified:

- Faulty CAS procedures that could not properly identify weaknesses in vendors' heavy maintenance processes.
- Inaccurate reporting of findings in audit reports.
- A lack of regularly scheduled and effective CAS meetings. These meetings are important because air carrier representatives discuss data analyses and identify high-risk areas that will be closely tracked.

In addition, FAA cited one of these three air carriers for having inadequate CAS program management. This included the following:

- An undersized quality assurance audit staff.
- No person designated with the responsibility for overall program management.
- Sixty corrective action responses from a major repair vendor that exceeded the required 10-day response time window.

These problems, however, did not stop FAA inspectors from relying on the air carrier's audits to approve substantial maintenance providers for use by that carrier—*without* first conducting on-site, pre-award inspections of those facilities.

For example, CMO inspectors for one air carrier relied on the air carrier's pre-contract award audit report to approve the repair station for use. However, when CMO inspectors performed an on-site inspection 3 months later—when the first aircraft was in for repair—they identified significant findings related to mechanics' training. FAA inspectors required the air carrier to make changes to

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its training program for contract vendor employees and took enforcement action to address the following deficiencies:

- Over 100 repair station employees did not receive specialized maintenance training by the required due date; yet, inspectors found that these employees were working on the air carrier's aircraft.
- Several repair station employees had not received a required 8-hour air carrier training class; instead, air carrier personnel provided a shortened 4.5-hour training class, contrary to company manual requirements.

In this instance, solely relying on the air carrier's audit to approve the facility for use was insufficient. FAA either needs to conduct an on-site inspection before approving facilities for use or verify that the air carrier's audit process is sufficient to ensure that repair stations' mechanics are properly trained and fully understand air carrier requirements before they begin working on air carriers' aircraft.

Currently, however, FAA relies on air carriers to ensure personnel at repair stations are fully trained. FAA guidance to the industry⁷ only states that *air carriers* should verify that personnel, including contract maintenance provider staff, are trained and qualified to accomplish their duties. At another air carrier we reviewed, an aircraft released into service after undergoing a heavy maintenance check at a repair station had to turn back following take-off because the nose landing gear would not retract.

In investigating the cause, air carrier officials determined that the repair station mechanics had been trained but did not fully understand the air carrier's requirements for landing gear repairs. The air carrier had to conduct an informal training session for repair station mechanics using photographs to more clearly show how each part is assembled. In this case, if the air carrier had conducted a more thorough audit of the repair station it would have found that the personnel were improperly trained and the incident may have been avoided.

FAA Must Ensure Air Carrier Audits Verify Repair Stations' Corrective Actions Before Closing Audit Findings

When air carrier auditors identify a deficiency, the air carrier must determine if a corrective action is warranted and, if so, require the repair station to provide a written response detailing the cause of the problem, the corrective action that should be taken, the action for preventing recurrence, and an estimated completion date. We found, however, that air carriers typically close the findings based on projected corrective actions from the repair facility management without ensuring

⁷ Advisory Circular 120-79, Developing and Implementing a Continuing Analysis and Surveillance System, April 21, 2003.

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that the corrective action actually resolves the problem. As a result, identified deficiencies reoccur. For example:

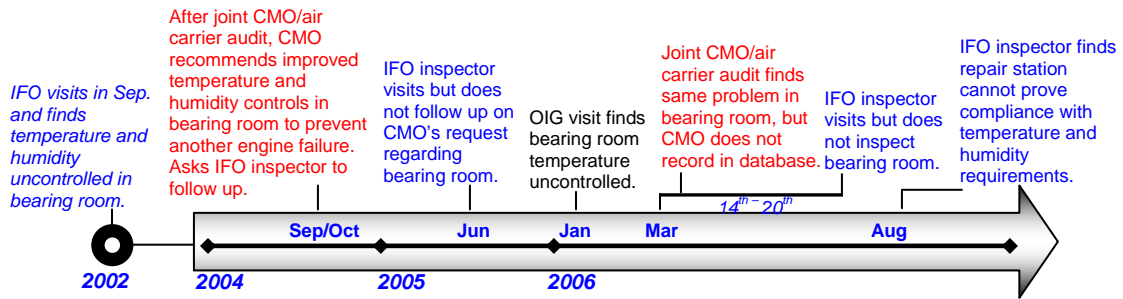
- At a heavy airframe maintenance provider, we identified work cards that air carrier mechanics and inspectors had not properly signed, including cards for significant maintenance tasks. Without proper sign-offs, there is no assurance that the work was actually performed. Air carrier auditors had reported a similar finding at this repair station 6 months before our on-site audit, but they had closed it without ensuring that the repair station resolved the problem.
- At a foreign repair station, we observed that temperature and humidity in the engine bearing inspection shop were consistently above the maximum allowed by the manufacturer. This is critical to safety as engine bearings are precision components that support heavy loads at high speed. Air carrier officials had identified similar concerns 2 years earlier while conducting an audit initiated after an engine shutdown caused by the premature wear of an engine bearing. However, air carrier auditors did not return to the facility until almost 2 years later.

We found that the problem was actually occurring as early as September 2002 (see figure 3 timeline on page 11). Yet, air carrier auditors and FAA inspectors did not ensure that the repair station actually corrected this deficiency. Even after we informed the IFO inspector of our finding, he did not verify that the problem had been corrected. The IFO inspector did not physically inspect the bearing room during his visit in March 2006; instead, he took the repair station staff's word that the bearing room was in compliance.

During an August 2006 follow-up inspection, the IFO inspector found the same problem and determined that shop personnel needed to improve compliance with temperature and humidity requirements during bearing inspection. According to the inspector, the repair station began recording the temperature on the router document associated with the bearing undergoing maintenance and inspection. Yet, we found no evidence in FAA's inspection records to show that FAA has verified whether this action resolved the problem.

Findings

Figure 3. Chronology of FAA Inspections at a Repair Station



Source: FAA Inspection Records, Air Carrier Audit Records, and OIG On-Site Visit Records

Effectiveness of Air Carriers' On-Site Personnel Unknown Due to Inconsistencies in the Level of Oversight

Because FAA cannot continually be on site to inspect repair stations, the Agency also relies on another layer of air carrier oversight at heavy airframe maintenance providers: on-site air carrier representatives. However, FAA does not have any guidance for how these personnel should examine repairs and document observations. As a result, this oversight is inconsistent, and the lack of air carrier data from these personnel makes it difficult to determine whether this process is effective. For example,

- On-site personnel for two of the nine air carriers we reviewed performed only *undocumented*, on-the-spot inspections of repairs. As a result, these carriers did not have methods for ensuring corrective actions or requiring data for trend analysis. When we asked to review one of these carrier's procedures, we were told that the procedures did not exist and that there were plans to add a section to the procedures manual that would deal strictly with outsourcing, but that had not yet occurred. In addition, on-site personnel at this repair station told us they only spent 35 percent of the time on the hangar floor. Yet, on-site personnel for another air carrier, which has a formal on-site monitoring process, at the same facility told us they spent about 70 percent of the time on the hangar floor. Both air carriers that used this repair station operate similar aircraft and had approximately the same number of aircraft serviced by the repair station.
- The number of on-site air carrier personnel ranged from 3 personnel for 1 carrier to 22 personnel for another carrier at a different repair station. We recognize that there are many variables in determining how many on-site personnel air carriers will place at repair stations; however, without any guidance, FAA inspectors face difficulties in applying consistent oversight of this process.

Findings

To improve the air carrier on-site representative process, FAA should develop guidance that instructs on-site personnel to record their observations of substantial maintenance so that the data are available to FAA inspectors and air carrier auditors.

Repair Stations Need To Improve Quality Assurance Processes

Repair stations' audit programs must ensure that facilities they use adequately correct deficiencies disclosed by their internal and external (vendor and supplier) audits. Subcontractors to repair stations are frequently responsible for repairing critical parts. We found, however, that repair stations need to improve their quality assurance processes.

For example, a parts receiving inspector at a domestic repair station—not a trained quality assurance auditor—performed desk audits of repair station vendors. Allowing a person not trained as an auditor to conduct audits raises concerns as to the type of in-depth review performed of all current vendors' documentation and the handling of any findings. In 2004, an air carrier also found problems at this repair station regarding limited involvement from the quality assurance department. Specifically, the carrier was concerned that the quality assurance department was not involved in the corrective action process, which resulted in recurring deficiencies.

We found the following instance where *all three types of oversight systems*—FAA, air carrier, and repair station—failed to detect weaknesses at a heavy maintenance provider:

Two air carrier audits and two FAA inspections (CMO and FSDO) failed to detect significant weaknesses in a heavy airframe repair station's internal audit program. These were not discovered until another major air carrier's pre-contract award audit found significant problems in maintenance practices. This brings the quality of air carrier and FAA oversight into question, along with the repair station's internal program. The problems identified were so serious that repair station management stopped operations for over a month so it could take corrective actions. Specifically, the repair station did not properly oversee the following:

Findings

- **Composite shop practices:** Numerous problems found, such as mechanics using improperly calibrated equipment, which indicated a complete lack of control over this critical maintenance process.
- **Subcontractor maintenance:** Numerous problems found, such as the use of an unqualified subcontracted employee to perform inspections, use of unapproved vendors, and assignment of an acceptable rating and approval for a vendor despite the vendor's self-assessment survey being *80 percent incomplete*.
- **Non-destructive testing processes:** Problems found included unqualified inspectors performing inspections and required tests not being performed.
- **Internal audit program:** Repair station personnel did not identify deficiencies during internal audits because their audit checklists were not detailed enough to detect these problems. In addition, we found that the person conducting the audits and the head of the quality assurance department did not have formal audit training or auditor certifications.

The air carrier that detected these deficiencies ultimately chose not to contract with this heavy airframe repair station. Therefore, the responsibility for ensuring that the repair station properly addressed these deficiencies, regardless of the carrier's decision, should have fallen to the FSDO inspectors responsible for overseeing this repair station. However, our review of FAA's inspection database disclosed that even though repair station officials notified FSDO inspectors of the air carrier's audit findings, FSDO inspectors *did not* record the audit findings or indicate any follow-up inspections. As a result, other CMO inspectors, whose assigned air carriers also use this repair station, would not have known about these problems, some of which could affect the airworthiness of the aircraft they oversee.

It is critical that inspectors closely review air carrier audit findings; validate, *while on site*, that repair stations corrected deficiencies; and fully document their results—especially since FAA has no requirement for when carriers must conduct a follow-up audit (a second audit may not occur until 1 to 2 years later). Documenting these reviews is important because many air carrier findings identify deficiencies within repair stations (including within facilities' internal audit programs) that should be brought to FSDO inspectors' attention.

Findings

FAA Needs To Improve Its Inspection Data Documentation

In 2003, we reported that FAA's FSDO and CMO inspectors were not sharing inspection information. In response, FAA implemented procedures to improve information sharing by requiring inspectors to include repair station names on inspection reports and document areas inspected, the results, and corrective actions taken in the national inspection database. While FAA has improved in this area, we found this problem persists among FAA offices. In addition, FAA still has not corrected problems with recording the identity of inspected repair stations, which we also reported in 2003.

Our interviews with inspectors and evaluation of inspection records disclosed poor communication among 12 of the 19 FAA offices we either contacted or visited. We identified the following types of communication problems:

- Poor interaction between FSDO/IFO and CMO inspectors.
- Undocumented inspection findings.
- Limited communication between FAA and foreign authorities.
- Untimely communication of significant inspection findings.

As a result, inspectors had incomplete data to prepare risk assessments, and there was no assurance that identified deficiencies were adequately corrected. For example:

- Deficiencies at a heavy maintenance repair station went uncorrected due to a breakdown in communication between FSDO and CMO inspectors and a FSDO's failure to review the inspection database. Specifically, a CMO inspector had identified poor conditions in the composite shop at this repair station that could cause contamination and affect the integrity of final repairs. The CMO inspector recorded his inspection results in the inspection database and stated in his report that he had left a voicemail to FSDO inspectors responsible for overseeing this facility to advise them of his findings.

When we showed FSDO inspectors a copy of the inspection record, they told us they never knew about these problems even though the problems were recorded in the database nearly 4 months earlier. In addition, they told us that they did not know the other inspector had tried to contact them. As a result, the problems in the composite shop still existed 2 months after the CMO inspector first found the problems.

- CMO inspectors for a major air carrier were unaware of a FSDO inspector's findings regarding a heavy airframe repair station that the carrier used. The FSDO inspector found that the repair station had started work on the air

Findings

carrier's aircraft before ensuring it had all tools, equipment, and manpower required to perform maintenance (i.e., only 30 maintenance personnel were available for work performed during shifts that would normally require approximately 110). When we questioned the CMO inspectors about this finding, they said they were unaware of the finding even though it was recorded in FAA's inspection database.

- In assessing risks at a domestic repair station, CMO inspectors may have been unaware of deficiencies because the FSDO inspector *did not document any findings in the inspection database*. Rather he simply told the repair station to fix the discrepancies and then visually checked for corrective actions during the next visit. For instance, the repair station made an error that affected 24 air carrier nose landing gears repaired over a 2-year period. The error was reported to FAA but not entered in the database. This prevented other FAA inspectors from accessing key safety data about this repair station. As a result, the repair station could receive fewer inspections. This repair station had received no on-site monitoring by CMO inspectors for air carriers using this facility for at least 5 years.
- At a foreign repair station, IFO inspectors did not consistently enter inspection findings in FAA's database. As a result, CMO inspectors were not able to view these findings and properly assess risk at this foreign repair station where their assigned air carrier has contracted maintenance.

Our review showed that between 2003 and 2005, the foreign aviation authority conducted three inspections of this foreign engine repair station on FAA's behalf through international aviation agreements with the United States. The inspectors identified 23 findings and reported them to the IFO. FAA recorded 8 of these 23 findings in the database, but the remaining 15 were only recorded on paper copies, which were maintained in the IFO's files. Although we found that most of the 15 findings were administrative in nature, 3 were not. For example, inspectors found the following:

- Weaknesses in the repair station's knowledge of Part 145 European Aviation Safety Agency regulations that govern repair station operations.
- No evidence to show that internal audit findings conducted by engine repair station quality auditors had been completed or closed (a similar finding we identified again during our January 2006 visit).
- No proof of required training.

Findings

In July 2006, IFO inspectors conducted their own inspection of this engine repair station, but they did not record closure actions in the database until we asked about the status of the inspection nearly 1 year later. We were told that “due to workload and time constraints, the corrective actions were not placed into [the database].”

FAA Needs Procedures To Ensure That Inspectors Properly Identify Inspected Repair Stations

We found that FAA still has not corrected problems with recording the identity of inspected repair stations, as we recommended in July 2003. In response, FAA issued guidance in April 2005 requiring CMO inspectors to document repair station designators on their inspection reports. However, we determined that 33 percent of the 897 repair station inspection records entered into the database after April 2005 and through June 2007 for the air carriers we reviewed *did not* contain the required designator information. Moreover, in June 2007, FAA reminded all CMO inspectors to include these designators in their reports. FAA indicated that failure to do so would hinder analysis capabilities and compromise repair station risk models that rely on accurately prepared inspection reports for risk assessment.

Even at this urging, however, inspectors *still* did not include repair station designators. As shown in figure 4, there was virtually no change in inspectors’ recordings of repair station designators from May 2005—after FAA issued initial guidance—to November 2007—well after FAA issued a reminder to inspectors. For the air carriers we reviewed, the percentage of records without designators remained approximately one-third of the total records in the database.

Figure 4. Number of Inspection Reports Without Required Repair Station Designator Code

Figure 4a. Reports Without Designator Codes After April 2005 Guidance (May 2005–June 2007)

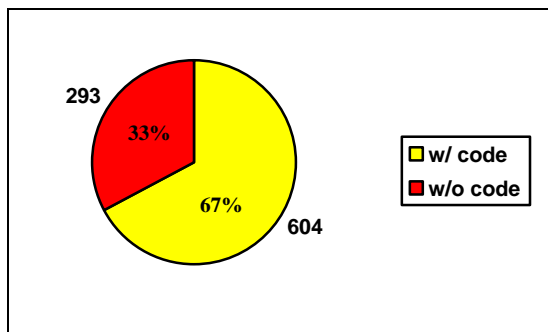
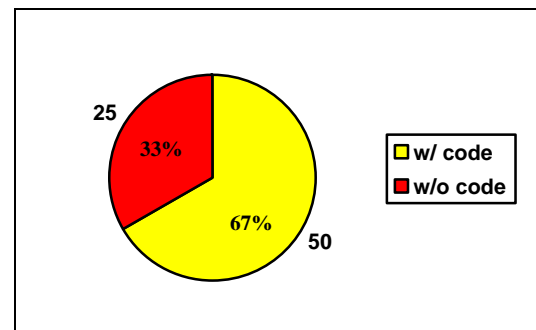


Figure 4b. Reports Without Designator Codes After June 2007 Reminder (July–November 2007)



Source: FAA inspection records

Findings

Of the 25 records shown in figure 4b, 1 office was responsible for 16 of these records (64 percent) that were entered into the inspection database without a repair station designator, a clear violation of inspection guidance and a potential detriment to FAA's ability to properly assess repair station risk. A principal CMO inspector in this office told us that inspectors are not required to enter the repair station designator unless they are performing surveillance on the repair station, not when they are performing oversight of the air carrier's procedures at the repair station. This is contrary to FAA's direction to include repair station certificate numbers on inspection reports.

Properly recording inspection results is now more important than ever since FAA's risk-based system is predicated on using comprehensive inspection data to target inspectors to risk areas. To guarantee the viability of this system, FAA will need to ensure that FSDO inspectors conduct an appropriate number of inspections and record their results in the inspection database. This will allow CMO inspectors to better assess risk at their assigned carriers' repair stations and adjust their surveillance as needed. FAA must also develop adequate procedures to ensure inspectors document their findings and review the inspection database for previous findings.

Current inspector guidance recommends that inspectors review all available inspection records to note any discrepancies found by other inspectors before they inspect a repair station. However, we found that inspectors did not always perform this review and if they did, they did not normally record it in FAA's inspection database; therefore, we could not verify whether inspectors actually completed this action or followed up on prior findings.

FAA Should Ensure That Air Carriers Have Well-Defined Processes and Responsibilities for Outsourced Maintenance

Current FAA regulations do not provide specific guidance to air carriers regarding outsourced maintenance procedures. The regulations only require each air carrier to have (1) a program covering maintenance of its aircraft that it or other persons (i.e., contract facilities) perform and (2) a system that monitors and analyzes the performance and effectiveness of inspection and maintenance programs.⁸

Although the regulations state that repair stations are to follow air carriers' procedures, air carrier manuals have been traditionally geared toward in-house maintenance. Since repair stations may perform repairs for various air carriers, all with different in-house procedures, FAA should ensure that air carriers provide

⁸ 14 C.F.R. § Part 121.369 currently requires each air carrier to have a program covering maintenance, preventive maintenance, and alterations performed by it or by other persons. This regulation also requires maintenance, preventive maintenance, and alterations to be performed in accordance with the air carrier's manual.

Findings

repair stations with well-defined maintenance procedures and properly document their oversight processes.

We found key oversight and maintenance processes that FAA should require air carriers to document in their manuals, such as vendor reliability programs and subcontracting and parts receiving processes.

FAA Should Encourage Air Carriers To Better Document Programs To Track Reliability of Outsourced Maintenance Vendors

Although not required by FAA, most of the air carriers we reviewed had established reliability programs to monitor the effectiveness of aircraft maintenance performed by outsourced maintenance vendors. However, we found inconsistencies in how air carriers accomplished this monitoring, and some air carriers had not fully documented the process in their FAA-approved manual.

For example, a major air carrier had a system to track maintenance difficulty items and aircraft out-of-service rates against every substantial maintenance provider; yet, the carrier did not document the system within its policies and procedures, and the vendor scoring system did not contain well-defined criteria. A lack of defined procedures for scoring vendor performance may not give an accurate view of airframe heavy maintenance vendor performance.

FAA Should Ensure That Air Carriers Clearly Document Processes for Approving Vendors and Receiving Parts

We determined that air carriers had varying degrees of controls for ensuring that new parts and parts sent out for repair were from approved vendors and met specifications when received. Air carriers often require repair stations to use air carrier-approved vendors for supplying new or repaired parts. In addition, repair stations have their own approved vendor lists they use if air carriers do not specify which vendors to use. This results in multiple approved vendor lists and multiple procedures that repair stations must follow to ensure they are using only air carrier approved vendors. Another potentially vulnerable area we identified is when air carriers have parts sent directly from a vendor without going through its receiving process. FAA must ensure air carriers document clearly how these parts should be processed.

FAA recognizes the discrepancies within air carriers' programs for in-house and outsourced maintenance. FAA is developing a rule to require specific language in air carriers' manuals for outsourced maintenance. The Agency originally expected to issue its proposed rulemaking in June 2008, but it has been delayed by higher priority rulemakings. In our view, FAA must initiate interim actions, such as

Findings

encouraging “Airworthiness Agreements” between air carriers and repair stations that clearly define outsourced maintenance responsibilities (e.g., how mechanics’ training will be accomplished).

RECOMMENDATIONS

We recommend that FAA:

1. Improve its maintenance data reporting system by: (a) revising its guidance to include all maintenance providers performing repairs of critical components, not just the top 10 substantial maintenance providers and (b) developing procedures for inspectors to validate the accuracy and consistency of reports.
2. Require CMO inspectors to conduct (a) initial baseline inspections of substantial maintenance providers to assess whether the maintenance providers are in compliance with air carriers’ procedures and (b) follow-up inspections to determine whether this baseline assessment has changed.
3. Reassess its definition of substantial maintenance to include critical components and ensure that air carriers and FAA offices consistently apply the definition.
4. Require inspectors to: (a) follow up to verify that deficiencies identified by air carriers have been corrected at repair stations and (b) ensure that repair stations have adequate processes for conducting audits, correcting identified deficiencies, and performing trend analyses of findings.
5. Develop controls to ensure inspectors are complying with inspector guidance to document their findings in FAA’s inspection database and review the inspection database for previous findings.
6. Ensure air carriers document inspections conducted by air carriers’ on-site technical representatives at heavy airframe maintenance providers.
7. Encourage the industry best practice of using airworthiness agreements between air carriers and repair stations that more clearly define maintenance procedures and responsibilities.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

We provided FAA with our draft report on August 22, 2008, and received FAA's comments on September 26, 2008. FAA concurred with all seven recommendations and provided appropriate milestones for implementing corrective actions. We consider recommendations 1, 2, 3, 6, and 7 resolved and open pending completion of the planned actions.

However, for recommendations 4 and 5, we are requesting that FAA provide additional information since FAA's response and planned actions do not fully address our intent, as discussed below.

Recommendation 4: While FAA's planned actions adequately address recommendation 4a, its response to 4b requires further clarification. Specifically, FAA's planned actions, if properly implemented, will verify that air carriers have adequate audit processes to oversee maintenance performed at repair stations. However, it is not clear whether the Agency intends for FAA inspectors and air carriers *to also verify that repair stations have adequate audit processes for their vendors*. Therefore, we request that FAA clarify its planned actions with regard to recommendation 4b to address oversight of repair stations' audit processes.

Recommendation 5: FAA plans to revise ATOS software to make repair station designators a required field—an action that complies with recommendations from this report and our prior reports. However, we are concerned that FAA's planned action to provide guidance to ATOS data reviewers to include documentation of repair station findings in their reviews will not address all the situations that we identified during our audit.

For example, we found inspection documentation problems at FSDOs and IFOs that do not have ATOS data reviewers. Therefore, revisions made to ATOS processes would not improve these situations. In addition, FAA did not address the portion of the recommendation related to establishing controls to ensure inspectors review the inspection database for previous findings. We therefore request that FAA provide additional information to fully address recommendation 5.

ACTIONS REQUIRED

FAA's planned actions satisfy the intent of our recommendations for recommendations 1, 2, 3, 6, and 7, and no further information is required. In accordance with Department of Transportation 8000.1C, we request that FAA provide us with additional information on actions it intends to take to fully address recommendations 4b and 5 along with estimated target completion dates. We would appreciate receiving your response within 30 calendar days.

EXHIBIT A. SCOPE, METHODOLOGY, AND PRIOR WORK

We conducted this performance audit between May 2005 and June 2008 in accordance with generally accepted Government Auditing Standards prescribed by the Comptroller General of the United States. We included such tests as necessary to provide reasonable assurance of detecting abuse or illegal acts. In March 2007, we testified on our preliminary analysis results before the House Transportation and Infrastructure Committee.

We performed work at FAA Headquarters, 16 FAA field offices, 9 major air carriers, and 15 repair stations. We also contacted three other FAA offices to obtain data. The nine major air carriers that we reviewed represented a cross-section of nine of the largest network and low-cost air carriers that had either always outsourced their maintenance or had recently begun shifting to outsourcing. In addition, we met with officials at one additional air carrier, American Airlines, and its associated FAA certificate management office to determine the carrier's reason for keeping the majority of its maintenance in-house.

To determine which repair stations to visit, we obtained and reviewed the lists of approved substantial maintenance providers for the nine air carriers selected for review to ascertain which repair stations they use. Our goal was to ensure that we established a balanced number of both foreign and domestic repair stations coupled with those stations that are used the most by U.S. air carriers. The 15 repair stations visited all conducted substantial maintenance for air carriers. Of the 15, 11 performed heavy airframe maintenance, 2 performed engine overhauls, and 2 performed overhauls of landing gear. Exhibit B lists the entities we visited or contacted during our audit.

To determine the type and quantity of maintenance that air carriers are outsourcing, we requested data from the nine air carriers visited. Our initial work disclosed that obtaining quantities for all types of maintenance would be extremely labor-intensive because air carriers did not have the data readily available, did not report the data consistently, and in some instances would not provide it because of the data's proprietary nature. Therefore, as agreed to with congressional staff, we focused our review and analysis of repair volume on heavy airframe maintenance checks because of the critical nature of this work and the fact that these data are more readily available at air carriers.

To assist us in assessing the effectiveness of FAA and air carrier oversight, we contracted with Simat, Helliessen and Eichner, Inc. (SH&E), an international air transport consulting firm. SH&E focused on determining whether repair station

internal quality assurance programs, air carrier quality oversight, and FAA surveillance plans were in place and functioning satisfactorily. SH&E also conducted random testing of repair station procedures to identify any weaknesses in FAA's oversight.

Prior OIG Work on Outsourced Maintenance

- Statement Before the House Transportation and Infrastructure Committee, "Aviation Safety: FAA's Oversight of Outsourced Maintenance Facilities," March 29, 2007 (CC-2007-035).
- Statement Before the Senate Subcommittee on Aviation Operations, Safety, and Security, "Aviation Safety: FAA Oversight of Foreign Repair Stations," June 20, 2007 (CC-2007-076).
- Review of Air Carriers' Use of Non-Certificated Repair Facilities, December 15, 2005 (AV-2006-031).
- Congressional Correspondence to Representative Oberstar Regarding FAA Actions on Air Carriers' Use of Aircraft Repair Stations, June 27, 2005 (CC-2005-035).
- Review of Air Carriers' Use of Aircraft Repair Stations, July 8, 2003 (AV-2003-047).

EXHIBIT B. ENTITIES VISITED OR CONTACTED

FEDERAL AVIATION ADMINISTRATION

Headquarters:

Aviation Safety (AVS)	Washington, DC
Flight Standards Service	Washington, DC

Certificate Management Offices (CMO) for:

AirTran Airways	Orlando, FL
Alaska Airlines	Seattle, WA
**American Airlines	Fort Worth, TX
America West Airlines	Phoenix, AZ
Continental Airlines	Houston, TX
Delta Air Lines	College Park, GA
JetBlue Airways	Garden City, NY
Northwest Airlines	Bloomington, MN
Southwest Airlines	Dallas, TX
United Airlines	Daly City, CA
*US Airways	Coraopolis, PA

Flight Standards District Offices (FSDO):

Albany FSDO	Latham, NY
Miami FSDO	Miami, FL
Orlando FSDO	Orlando, FL
Seattle FSDO	Renton, WA

* Contacted only to obtain clarifying data.

** Conducted on-site visit only to determine reasons for keeping the majority of its maintenance in-house.

*Indianapolis FSDO

Indianapolis, IN

*Van Nuys FSDO

Van Nuys, CA

International Field Offices (IFO):

Miami IFO

Miami, FL

Frankfurt IFO

Frankfurt, Germany

Singapore IFO

Singapore

AIR CARRIERS

AirTran Airways

Orlando, FL

Alaska Airlines

Seattle, WA

**American Airlines

Tulsa, OK

America West Airlines

Phoenix, AZ

Continental Airlines

Houston, TX

Delta Air Lines

Atlanta, GA

JetBlue Airways

Forest Hills, NY

Northwest Airlines

Minneapolis, MN

Southwest Airlines

Dallas, TX

United Airlines

San Francisco, CA

REPAIR STATIONS

AAR Landing Gear Services

Medley, FL

Aeroman

San Salvador, El Salvador

Air Canada Technical Services

Vancouver, Canada

AMECO Beijing

Beijing, China

Avborne Heavy Maintenance Inc.

Miami, FL

Empire Aero Center

Rome, NY

GE-Celma	Petropolis, Brazil
Goodrich Aviation Technical Services	Everett, WA
HAECO	Lantau, Hong Kong
Hawker-Pacific Aerospace	Sun Valley, CA
MTU Maintenance Hannover GMBH	Langenhagen, Germany
PEMCO World Air Services	Dothan, AL
SASCO	Singapore
TAECO	Xiamen, China
TIMCO	Lake City, FL

INDUSTRY & FAA INSPECTOR WORKFORCE REPRESENTATIVES

Aircraft Mechanics Fraternal Association	Washington, DC
Air Carrier Association of America	Washington, DC
Air Transport Association	Washington, DC
International Brotherhood of Teamsters	Phoenix, AZ
Professional Airways Systems Specialists	Washington, DC
Regional Airline Association	Washington, DC
Transportation Trades Department, AFL-CIO	Washington, DC

EXHIBIT C. MAJOR CONTRIBUTORS TO THIS REPORT

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Andrea Nossaman	Writer-Editor

APPENDIX. AGENCY COMMENTS



Federal Aviation Administration

Memorandum

Date: September 26, 2008

To: Lou E. Dixon, Assistant Inspector General for Aviation and Special Program Audits

From: *for Carl W. Burnett*
Ramesh K. Punwani, Assistant Administrator for Financial Services/CFO

Prepared by: Anthony Williams, x79000

Subject: OIG Draft Report: Air Carriers' Outsourcing of Aircraft Maintenance

Thank you for the opportunity to review your draft of the subject report. We concur with all recommendations contained in the report. The Federal Aviation Administration's (FAA) planned action for addressing each recommendation is stated below. These actions include a requirement for air carriers and repair stations to submit quarterly utilization reports of maintenance providers. FAA is also developing a rule to specifically address maintenance completed by external repair stations. FAA continues to take important steps to move its safety oversight towards a risk-based system.

OIG Recommendation 1: Improve its maintenance data reporting system by: (a) revising its guidance to include all maintenance providers performing repairs of critical components, not just the top 10 substantial maintenance providers and (b) developing procedures for inspectors to validate the accuracy and consistency of reports.

FAA Response: Concur. The FAA is revising the guidance and including more than just the top 10 maintenance providers. Principal airworthiness inspectors will be required to validate the accuracy of reports through periodic audits. We will complete our action on this recommendation by March 31, 2009, subsequent to completing our action on recommendation 3, below.

OIG Recommendation 2: Require CMO inspectors to conduct (a) initial baseline inspections of substantial maintenance providers to assess whether the maintenance providers are in compliance with air carriers' procedures and (b) follow-up inspections to determine whether this baseline assessment has changed.

FAA Response: Concur. The FAA does have current guidance which supports this recommendation in FAA Order 8900.1, Flight Standards Information Management Systems (FSIMS),” volume 6, “Surveillance,” chapter 2, section 41, “Evaluate/Inspect Part 121/129 (N-registered only)/135 (10 or more) and 125 Operator’s Outsource Maintenance Organization Facility. Section 41, paragraph 61123, states; “The FAA air carrier inspector will evaluate (emphasis added) the outsource maintenance

provider, facility (certificated or non-certificated and other air carrier) to ensure that it has adequate housing, equipment, spare parts, technical data, and qualified personnel available to satisfactorily complete all contracted maintenance in accordance with (IAW) parts 91K, 121, 125, 129 (N-registered only) and 135 (10 or more), and the air carrier or commercial operators program and applicable sections of the maintenance manual.” We agree that initial and follow-up on-site inspections of essential maintenance providers (see FAA response to recommendation 3, below) should be accomplished to the greatest extent practicable and will implement this recommendation after assessing its impact on resources based on the definition of “essential maintenance.” We will need to complete our definition as outlined in recommendation 3 to determine what the impact will be to require initial audits of all air carriers with operations specifications paragraph D091. Action to be completed by June 30, 2009, after determining its impact on resources.

OIG Recommendation 3: Reassess its definition of substantial maintenance to include critical components and ensure that air carriers and FAA offices consistently apply the definition.

FAA Response: Concur. The FAA has a project in-progress to define a single definition for the term “substantial maintenance,” “critical,” and “critical parts.” Our current review of Title 14 Code of Federal Regulations (14 CFR) has revealed another maintenance activity performance requirement. That activity is the Required Inspection Item (RII). The rules governing RII address maintenance, not parts, including at least those items of maintenance that could result in a failure, malfunction, or defect endangering the safe operation of the airplane, if not performed properly or if improper parts or materials are used.

We will address these previous terms and the RII maintenance by using the term “essential Maintenance” in our FAA guidance, as we conduct our review to determine the impact this will have on existing policy, guidance, operations specifications D091, and quarterly utilization reporting. At the completion of these two reviews, we will update all policy and guidance to reflect the new definition. We expect completion by January 31, 2009.

OIG Recommendation 4: Require inspectors to: (a) follow up to verify that deficiencies identified by air carriers have been corrected at repair stations and (b) ensure that repair stations have adequate processes for conducting audits, correcting identified deficiencies, and performing trend analyses of findings.

FAA Response: Concur. Regulations make air carriers responsible for parts (a) and (b) of this recommendation. Therefore, we will revise guidance to principal airworthiness inspectors to: (a) verify that deficiencies identified by air carriers have been corrected at repair stations when conducting the Air Transportation Oversight System (ATOS) element performance inspections at those repair stations; and (b) make a determination that the air carrier has adequate processes for conducting audits, correcting identified deficiencies, and performing trend analyses of findings when conducting ATOS design assessments of elements 1.3.7, Outsource Organization, and/or 1.3.11, Continuous Analysis and Surveillance. We will complete action on this recommendation by June 30, 2009.

OIG Recommendation 5: Develop controls to ensure inspectors are complying with inspector guidance to document their findings in FAA’s inspection database and review the inspection database for previous findings.

FAA Response: Concur. We will provide guidance to ATOS data reviewers to include in their reviews documentation of repair station findings and entry of repair station designators. We will complete this action by March 31, 2009. We will revise ATOS software to make repair station

Appendix. Agency Comments

designators a required field where practicable. We will provide a date for completing this action as soon as it can be determined based on other priorities for software revisions.

OIG Recommendation 6: Ensure air carriers document inspections conducted by air carriers' on-site technical representatives at heavy airframe maintenance providers.

FAA Response: Concur. The FAA believes that existing regulations and FAA guidance address this recommendation. Title 14 CFR, sections 121.373 and 135.431, require the air carrier to establish and maintain a Continuing Analysis and Surveillance System (CASS). CASS evaluates the performance and effectiveness of a carrier's inspection program, its program covering other maintenance, preventive maintenance, and alterations, its process for the correction of any deficiency in those programs. This is true regardless of whether those programs are carried out by the certificate holder or by another person. CASS is a quality management system for air carriers and commercial operators that monitors and analyzes the performance and effectiveness of inspection and maintenance programs.

The FAA views CASS as a continuous, system safety-based, closed-loop cycle of surveillance, investigation, data collection, analysis, corrective action, monitoring, and feedback for operators to use to continually monitor and correct any deficiencies. The deficiencies described in the OIG report should have been noted in the air carriers' CASS program through the audits conducted by the air carrier. CASS functions are built around principles of what is commonly referred to as risk management. In CASS, the FAA expects a formal risk management process (system safety) with safety and compliance as the top priorities.

The FAA will publish a notice placing special emphasis on ensuring that the on-site technical representative audit findings are documented during performance assessments of element 1.3.7, and element 1.3.11.

The FAA will evaluate the need for a possible "special emphasis" inspection on air carriers' CASS programs and their effectiveness. We expect our evaluation for "special emphasis" to be completed by November 2008 and a notice to be issued by March 31, 2009.

OIG Recommendation 7: Encourage the industry best practice of using airworthiness agreements between air carriers and repair stations that more clearly define maintenance procedures and responsibilities.

FAA Response: Concur. The FAA will review existing maintenance agreements and evaluate for best practices and determine what guidance needs to be incorporated in FAA Order 8900.1 and/or AC 120-16, "Air Carrier Maintenance Programs." We will complete this action by March 31, 2009.

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The following pages contain textual versions of the graphs and charts included in this document. These pages were not in the original document but have been added here to accommodate assistive technology.

Air Carriers' Outsourcing of Aircraft Maintenance

Section 508 Compliant Presentation

Figure 1. Percentage of Heavy Airframe Maintenance Checks Outsourced for Nine Major Air Carriers From 2003 to 2007

(Year) 2003	1,126 total checks; of this amount, 385 (or 34 percent) were outsourced.
(Year) 2004	1,212 total checks; of this amount, 455 (or 38 percent) were outsourced.
(Year) 2005	1,163 total checks; of this amount, 662 (or 57 percent) were outsourced.
(Year) 2006	1,208 total checks; of this amount, 815 (or 67 percent) were outsourced.
(Year) 2007	1,274 total checks; of this amount, 907 (or 71 percent) were outsourced.

Source: Air carrier data

Figure 2. Locations of Repair Stations That Performed Heavy Airframe Maintenance for Nine Major Air Carriers in 2007

Asia	79 repair stations
Canada	69 repair stations
Central America	81 repair stations
Mexico	17 repair stations
United States	661 repair stations

Source: Air carrier data

Table 2. Repair Stations That Performed Substantial Maintenance for Long Periods Before First Certificate Management Office Inspection

Note: In the table below, data on number of aircraft and/or parts repaired before first FAA visit were obtained from repair station and/or air carrier records.

Note: In the table below, data on time lapsed between approval for carrier use and first FAA inspection were obtained from FAA inspection database.

Repair Station A	5 heavy airframe checks performed before first FAA visit.	8 months lapsed between approval for carrier use and first FAA inspection.
Repair Station B	7 heavy airframe checks performed before first FAA visit.	5 months lapsed between approval for carrier use and first FAA inspection.
Repair Station C	39 engines repair before first FAA visit.	5 years lapsed between approval for carrier use and first FAA inspection.
Repair Station D	30 landing gears a year repaired before first FAA visit.	At least 5 years lapsed between approval for carrier use and first FAA inspection.
Repair Station E (Note: 3 air carriers use this repair station)	At least 81 landing gears for one carrier repaired before first FAA visit.	At least 5 years lapsed between approval for carrier use and first FAA inspection.
Repair Station E	At least 94 landing gears for one carrier repaired before first FAA visit.	At least 5 years lapsed between approval for carrier use and first FAA inspection.
Repair Station E	At least 21 landing gears for one carrier repaired before first FAA visit.	At least 5 years lapsed between approval for carrier use and first FAA inspection.

Figure 3. Chronology of FAA Inspections at a Repair Station

- 2002: International Field Office visits in September and finds temperature and humidity uncontrolled in bearing room.
- September to October of 2004: After joint Certificate Management Office and air carrier audit, Certificate Management Office recommends improved temperature and humidity controls in bearing room to prevent another engine failure. Asks International Field Office inspector to follow up.
- June 2005: International Field Office inspector visits but does not follow up on Certificate Management Office's request regarding bearing room.
- January 2006: Office of Inspector General visit finds bearing room temperature uncontrolled.
- March 14th through March 20th of 2006: Joint Certificate Management Office and air carrier audit finds same problem in bearing room, but Certificate Management Office does not record in database. International Field Office inspector visits but does not inspect bearing room.
- August 2006: International Field Office inspector finds repair station cannot prove compliance with temperature and humidity requirements.

Source: FAA Inspection Records, Air Carrier Audit Records, and Office of Inspector General On-Site Visit Records

Figure 4. Number of Inspection Reports Without Required Repair Station Designator Code

Figure 4a. Reports Without Designator Codes After April 2005 Guidance (May 2005 to June 2007)

Number of Inspection Reports With Designator Code	604, or 67 percent
Number of Inspection Reports Without Designator Code	293, or 33 percent

Figure 4b. Reports Without Designator Codes After June 2007 Reminder (July–November 2007)

Number of Inspection Reports With Designator Code	50, or 67 percent
Number of Inspection Reports Without Designator Code	25, or 33 percent

Source: FAA inspection records