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Final Report

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16. Abstract

The Federal Aviation Administration (FAA) has significantly changed Title 14 Code of Federal Regulations (CFR) Part 145, which governs foreign and domestic air agencies that perform maintenance and alterations on U.S.-registered aircraft, engines, propellers, and appliances. In particular, there is a new provision—14 CFR 145.163—that requires each repair station to submit a training program to the FAA for approval no later than April 6, 2005. To assist industry and FAA inspectors in complying with this requirement, the FAA Flight Standards Aircraft Maintenance Division (AFS-300) requested the Risk Analysis Branch (ATO-P) to research the current state of training and to provide guidance and recommendations for establishing training programs at repair stations.

The research team reviewed the FAA's and other aviation authorities' requirements on repair station training and conducted interviews with FAA and industry personnel. The general consensus among those interviewed was that the FAA should specify hourly requirements as well as acceptable content and format for the training programs. Due to the diversity of the maintenance segment of the aviation industry, the challenge for the FAA is to create a reasonable compromise between an acceptable minimum of formalized training at smaller, less complex repair stations without reducing the training offered by the larger repair stations.

Based on the 14 CFR 145.163 regulatory requirement, the current state of training at repair stations, and the interview results with FAA and industry personnel, this report offers guidance and recommendations on establishing training programs at repair stations. The report discusses the elements and functions that constitute an effective training program and the recommended number of hours and topics for training repair station mechanics, managers, supervisors, and inspectors.

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LIST OF ACRONYMS

Throughout this document, there is occasionally a confusing variety of terms for aviation maintenance personnel. Generally, the preferred generic term for these professionals is mechanics, which are also referred to as aviation maintenance technicians or AMTs. A distinction should be drawn between personnel who hold Federal Aviation Administration (FAA) certificates and those who do not. The only personnel who perform maintenance on aircraft and hold FAA certificates are airframe and power plant mechanics and repairmen. However, these terms are not always used properly, and the research team has been careful to avoid changing the intended meaning of organizations that published reports or individuals who were interviewed for this research. Nevertheless, every attempt has been made to keep terms clear and consistent.

AC	Advisory Circular
AMO	Approved maintenance organization
AMT	Aviation maintenance technician
A&P	Airframe and power plant mechanic
ASI	Aviation safety inspector
ATA	Air Transport Association of America
BASA	Bilateral Aviation Safety Agreement
CAA	Civil Aviation Authority
CAR	Canadian Aviation Regulations
CBT	Computer-based training
CFR	Code of Federal Regulations
CRM	Crew resource management
DAS	Designated Alteration Station
EASA	European Aviation Safety Agency
EPA	Environmental Protection Agency
ETOPS	Extended-Range Twin-Engine Operations
FAA	Federal Aviation Administration
FSDO	Flight Standards District Office
FY	Fiscal year
GAO	General Accounting Office
HAZMAT	Hazardous material
IA	Inspection authorization
ICAO	International Civil Aviation Organization
IFO	International Field Office
JAA	Joint Aviation Authorities
JAR	Joint Aviation Requirement
LRU	Line replaceable unit
MIP	Maintenance Implementation Plan
MRM	Maintenance resource management
NAS	National Aviation Standard
NDI	Nondestructive inspection
NDT	Nondestructive testing
NPRM	Notice of Proposed Rulemaking
NTSB	National Transportation Safety Board

OEM	Original equipment manufacturer
OIG	Office of the Inspector General
OJT	On-the-job training
OSHA	Occupational Safety and Health Administration
PAMA	Professional Aviation Maintenance Association
PMI	Principal maintenance inspector
QA	Quality assurance
RII	Required inspection item
RSPA	Research and Special Programs Administration
SFAR	Special Federal Aviation Regulation
TCA	Transport Canada Aviation
TSA	Transportation Security Administration

EXECUTIVE SUMMARY

The Federal Aviation Administration (FAA) has significantly changed Title 14 Code of Federal Regulations (CFR) Part 145, which governs aircraft repair stations. In particular, there is a new requirement that requires each repair station to submit a training program to the FAA for approval no later than April 6, 2005. To provide industry with guidance, the FAA Risk Analysis Branch, with support from the F.J. Leonelli Group, Inc., conducted research to determine the types of training programs currently used by repair stations, and recommend requirements for repair station training programs.

The research team reviewed the FAA's and other aviation authorities' requirements on training and conducted interviews with FAA and industry personnel. The general consensus among those interviewed is that the FAA should specify hourly requirements as well as acceptable content and format for the training programs. The challenge for the FAA will be to create a reasonable compromise between an acceptable minimum of formalized training at smaller, less complex repair stations without reducing the training offered by the larger facilities.

The research team recommends that the FAA build on existing tools to create an effective template for repair stations to design their training programs. This will allow repair stations to develop realistic training programs that are acceptable to the FAA Aviation Safety Inspectors (ASI). The format, structure, and hourly requirement for the training of personnel should be specific and consist of a minimum that individual repair stations can expand on to suit their needs. The research team also suggests minimum basic hour requirements in repair station training programs with initial and recurrent training phases for each category of mechanics, managers, and inspectors. Repair stations should be allowed to conduct the recommended training in-house or to contract with an outside vendor or a 14 CFR Part 147 school.

The FAA may want to establish a standard mechanism for tracking training in general and on-the-job training in particular. Furthermore, although foreign repair station personnel are not required to hold certificates issued by the FAA, the FAA can encourage the adoption of its training standards by creating a program that issues certificates of recognition after completion of formal training. The FAA ASIs should also be properly trained to ensure that they can adequately evaluate repair station curriculum development, methods of training, and the training effectiveness. The research team also recommends that the FAA develop computer-based training materials on various regulatory and safety-related subjects and make them available at cost to the industry. The FAA can also institute free accident prevention seminars in conjunction with the Aviation Maintenance Technician Awards program, as well as industry conference workshops, and credit participants as attending valid training.

1. INTRODUCTION.

In August 2001, the Federal Aviation Administration (FAA) issued a final rule that significantly changed Title 14 Code of Federal Regulations (CFR) Part 145. That rule governs foreign and domestic air agencies that perform maintenance and alterations on U.S.-registered aircraft, engines, propellers and appliances. A new provision in 14 CFR 145.163 requires each repair station to submit a training program to the FAA and have it approved and in place no later than April 6, 2005.

The FAA has decided to develop guidance material on 14 CFR 145.163 and F.J. Leonelli Group, Inc., was commissioned to identify the current state of training and the types of training programs currently used by repair stations, as well as to develop recommended requirements for new repair station training programs. Due to the diversity of this segment of the aviation industry, the challenge for the FAA is to create a reasonable compromise between an acceptable minimum of formalized training at smaller, less complex repair stations without a reduction in the training offered by the larger repair stations.

The methodology used to collect data for the study was to start with a review of existing FAA, academic, other government and aviation industry guidance and policy documents; areas of concerns identified in governmental reports on repair stations; and program material related to the training of certificated repair station personnel and other maintenance personnel; and through interviews of industry trade associations, repair station personnel, FAA personnel to obtain data pertinent to the training of repair station personnel.

It should be noted that several attempts were made by the FAA headquarters staff to coordinate the research team's interviews of field Aviation Safety Inspectors (ASI) through their bargaining unit, the Professional Airways Systems Specialists; however, this effort was unsuccessful within the time constraints of this project. Therefore, all interviews of FAA ASIs described in this report refer to nonbargaining unit supervisory personnel.

Individuals at the following organizations were interviewed for this study:

- Aircraft Electronics Association Independence, MO
- Aeronautical Repair Station Association, Alexandria, VA
- Aviation Technician Education Council, Harrisburg, PA
- Federal Aviation Administration, Seattle, Portland, Miami Flight Standards District Offices, San Francisco and Singapore International Field Offices
- IASCO, Napa, CA
- Infinity Aviation, Inc., Lincoln, CA
- Joint Aviation Authorities (JAA), Hoofdorp, The Netherlands
- National Air Transportation Association, Alexandria, VA
- National Transportation Safety Board (NTSB), Washington, DC
- Singapore International Airlines Engineering Company
- Solano College Aeronautics Department
- The Professional Aviation Maintenance Association (PAMA), Alexandria, VA

- Transportation Security Administration, International Operations, Arlington, VA
- WECO Aerospace Systems, Lincoln, CA

1.1 REGULATORY RESEARCH.

Many of the certificated FAA 14 CFR Part 145 repair stations hold ratings issued by other civil aviation authorities throughout the world. In an effort to identify alternative training requirements and eliminate duplicity, the current training requirements of the International Civil Aviation Organization (ICAO), JAA of Europe, and Transport Canada Aviation (TCA) were reviewed. Although none of the above organizations had specific training requirements for repair station personnel there were certain basic commonalities within their regulations. This review yielded the following findings:

- ICAO—ICAO Annex 6 specifies that an operator shall ensure that all maintenance personnel are instructed regarding the maintenance methods to be employed, particularly when new or unfamiliar equipment is introduced into service. In addition, the ICAO Continuing Airworthiness Manual strongly recommends that policies for initial and refresher training be considered in an assessment for approval by each airworthiness authority. The ICAO manual also specifies that the size and scope of the applicant's proposed operation have no bearing on the need for an effective training program, but a small operator may contract with training facilities or devise other means that provide a satisfactory level of training.

- JAA—Joint Aviation Requirement (JAR) 145 does not specifically state that an Approved Maintenance Organization (AMO) must have a formal training program. However, JAR 145 is very specific in two areas: nondestructive testing (NDT) and maintenance human factors. For example, persons who carry out and/or control the performance of NDT must be trained and qualified under European standards. Also, effective in 2006, all JAR 145 facilities must have a formal training program in place that addresses human factors.

- Transport Canada—Part V, Subpart 573 of the Canadian Aviation Regulations (CAR) specifies that AMOs must implement a training program and that this required program "shall include initial training, updating and other training necessary… to ensure continued qualification that is appropriate to the function to be performed or supervised." The CARs also mandate training in human factors for mechanics.

1.2 ACADEMIC RESEARCH.

Currently, most mechanics acquire their required skills through a combination of formal training and hands-on experience. Many mechanics obtain their formal training through maintenance training schools certificated under 14 CFR Part 147, which establishes minimum curriculum requirements and certain hour and level of instruction requirements.

There are many methods available to deliver training. Certain training methods are more appropriate than others for teaching specific types of skill and knowledge. These can be classified into the following categories:

- Classroom (formal)
- On-the-job training (OJT)
- Computer-based training (CBT)
- Distance learning
- Internet/intranet training
- Just-in-time/embedded training

The most critical step in planning a training program is to determine exactly what training is required. It is important to build on the knowledge and skill foundation that already exists, and a comprehensive training plan is required to ensure that the training activity focuses on each organization's performance objectives.

The Air Transport Association of America (ATA) has issued Specification 113, which includes a methodology for the proper development of training programs and divides the process into several phases:

- Needs assessment/analysis
- Design phase
- Basic curriculum
- Prototype
- Validation
- Adoption
- Implementation
- Trainee evaluation
- Program measurement
- Feedback

In addition to using this process, it is also essential for repair stations to develop a training budget to ensure all training requirements are adequately funded.

1.3 INTERVIEW SUMMARIES.

The research team interviewed personnel at repair stations such as facility managers, quality assurance (QA) personnel, and maintenance educators to gain insight into the aviation industry's reaction to the new training program requirements and to obtain ideas on how to implement them. Some personnel were concerned about the economic effects the new requirements would have on their businesses, but the majority supported enhanced training of repair station personnel and provided constructive information.

Within the FAA, several of the ASIs interviewed had questions about the new requirements and seemed very concerned regarding the effect these new requirements would have on the repair

stations they oversee. The ASIs also expressed concern about the nature of the guidance the FAA would provide, emphasizing it must include adequate guidelines in the area of review and approval of repair station training programs.

The industry trade associations appeared to be in agreement with the requirement for formalized training programs. The representatives highlighted that there should be specific hourly requirements identified, acceptable contents and formats given and that the FAA should be very specific with respect to uniformity of acceptance of training programs by ASIs under 14 CFR 145.163. These representatives recommended that the FAA issue clear guidance that specifies the types of training repair stations should provide, as well as the minimum acceptable hourly requirements for such training programs.

2. BACKGROUND.

Domestic and foreign air agencies are certificated by the FAA under 14 CFR Part 145 to perform maintenance and alterations on United States-registered aircraft, engines, propellers and appliances. These air agencies are commonly referred to as repair stations.

According to the Department of Transportation Office of the Inspector General (OIG), major air carriers outsource 47% of their maintenance work to repair stations, in terms of dollars. This amounted to $2.5 billion in 2002. The OIG also found that major air carriers can save 40% to 50% by outsourcing their maintenance work to the 4600 domestic and 650 foreign repair stations currently certificated by the FAA.

In spite of this growing role and the emergence of the Joint Aviation Authority (JAA), which published training requirements for maintenance facilities, the training requirements in 14 CFR Part 145 were not extensive until June 1999 when the FAA issued Notice No. 99-09. This was a Notice of Proposed Rulemaking (NPRM) titled "Part 145 Review: Repair Stations."

Commenters to the NPRM voiced several concerns about the proposal, especially concerning new training requirements. Many complained that the proposal did not contain specific requirements and recommended that the FAA issue advisory material in tandem with the proposal to permit a better understanding of what the FAA had in mind. Commenters wanted to know what specific training the FAA would require, what the frequency of training would be, and how to qualify and quantify OJT. Some commenters stated that a program could not be developed that would encompass all types of repair stations, both big and small. One commenter stated that some repair stations do the same type of work year after year and, thus, their personnel would not require continuous training. Other commenters questioned the FAA's rationale for approving maintenance training programs rather than accepting them. The NTSB also submitted comments regarding the importance of job-specific skills and recurrent training for mechanics. Another commenter stated that FAA programs should not require training programs for foreign repair stations that are significantly different from JAA requirements, while labor unions strongly favored the proposals.

There was general agreement among commenters to the proposed recordkeeping requirements. They stated that the FAA should be specific regarding items that would have to be included in training records, instead of stating that the training record format should be "acceptable to the Administrator." The commenters also stated that the FAA should only require the maintenance of training records for 2 years.

After the comment period, the FAA issued a final rule with amended language that addressed the comments on the NPRM. This final rule was published in August 2001 as Notice No. 145-27 titled "Repair Stations." The rule included several significant changes, including a new 14 CFR 145.163 titled "Training Requirements." This section specifies a requirement for each repair station to have a training program in place, which must be submitted to the FAA and approved no later than April 6, 2005.

Even after the revision to the rule, the requirements of 14 CFR 145.163 are still in a general form and do not stipulate exactly what the training programs should include; instead, the rule states

that "a certificated repair station must have a training program approved by the FAA that includes initial and recurrent training." The rule further states that through this approved training program, repair stations must ensure that "each employee assigned to perform maintenance, preventive maintenance, or alterations, and inspection functions is capable of performing the assigned task." Repair stations are also required to document their training in an acceptable format and to retain these records for at least 2 years.

To address the general requirements in 14 CFR 145.163, the FAA has decided to conduct research on the training requirements for repair stations to ensure that the highest standards of safety are maintained. The research results were intended to be used in the development of advisory and guidance material for the aviation industry and FAA personnel.

The research team reviewed existing FAA, academic, other government and aviation industry documents, and program material related to the training of certificated repair station personnel. The group also reviewed published studies, advisory and guidance material, regulatory history, policy memoranda, and exemption activity. In addition, the group reviewed documents and programs under development by the FAA, FAA expert panel members, other government agencies, and the aviation industry.

This report characterizes the current state of training at 14 CFR Part 145 repair stations, based on industry and FAA input, to develop initial conclusions and recommendations for the evolution of the necessary training requirements. This effort was managed by the staff of the FAA William J. Hughes Technical Center Risk Analysis Branch.

2.1 REGULATORY HISTORY.

Prior to the August 2001 final rule change, 14 CFR Part 145 requirements did not specify training requirements for personnel involved in the repair of aircraft, accessories, or components that are returned to service by repair stations. 14 CFR 145.139 titled "Personnel Requirements" stated that applicants for domestic repair station certificates must "provide adequate personnel" to perform maintenance and that it is the responsibility of the repair station's management to "consider the justifications and abilities of their employees." These employees must be "properly qualified" and have "detailed knowledge of the particular maintenance function or technique for which" the repair station "is rated, based on attending a factory school or long experience with the product or technique involved."

For 14 CFR Part 121 air carriers, which are allowed to perform their own maintenance, the regulations regarding the training of maintenance personnel, are more specific. 14 CFR 121.375 specifies that 14 CFR Part 121 certificate holders must have "a training program to ensure that each person (including inspection personnel) who determines the adequacy of work done is fully informed about procedures and techniques and new equipment in use and is competent to perform his duties." 14 CFR Part 135 also includes a similarly worded requirement in 14 CFR 135.433 for those certificate holders. In addition, 14 CFR 121.371 addresses required inspection personnel and who can accomplish a required inspection item (RII) for an air carrier. Under this rule, "each certificate holder shall maintain… a current listing of persons who have been trained, qualified, and authorized to conduct required inspections."

The requirements in 14 CFR Parts 121 and 135 for a maintenance personnel training program also extend to 14 CFR Part 145 repair stations when they are performing work for 14 CFR Parts 121 and 135 air carriers. However, usually only a portion of a repair station's personnel are performing work for 14 CFR Parts 121 or 135 operators at any one time. Therefore, not all repair station personnel are covered by these training program requirements. With the old 14 CFR Part 145 rule in place, guidelines for the type and amount of training of repair station personnel were vague or nonexistent. The only currently recognized training standards and requirements are found in specialized areas, which include plating, shot peening, nondestructive inspection and testing (NDI/NDT), and welding.

2.2 OFFICE OF THE INSPECTOR GENERAL REPORT.

In July 2003, the OIG issued a report titled "Review of Air Carrier's Use of Aircraft Repair Stations" that addressed various issues related to repair stations, including training. One finding in the report was that 38% of repair stations visited by the OIG during the course of their study did not have "information on file to show that mechanics approving completed repairs possessed the necessary training and qualifications." The OIG also found that repair stations generally did not maintain training files for supervisory personnel, especially on what specific training was provided to these individuals who supervise or inspect repairs and maintenance work.

The OIG report specifically mentioned the 14 CFR Part 145 rule change and stated that the FAA ASIs should already start to look at how repair stations document the training and qualifications of personnel responsible for returning aircraft, engines, and appliances to service. The OIG report also stated that the transition will be easier when the new training requirement becomes effective in 2005, if repair stations work towards complying with them sooner.

2.3 GENERAL ACCOUNTING OFFICE REPORT.

In March 2003, the General Accounting Office (GAO) issued a report on the state of aviation maintenance technician (AMT)* training in the U.S. titled "FAA Needs to Update the Curriculum and Certification Requirements for Aircraft Mechanics," GAO-03-317, March 2003. Although the study did not specifically address repair station training, the report raised several areas of concern in the general level of training within the industry, which affects repair station personnel. The GAO study examined how AMTs were being trained and found that 58% of the 47,500 airframe and power plant (A&P) mechanics certificated by the FAA between 1996 and 2001 were trained on the job or by the military, while 42% attended one of the 175, 14 CFR Part 147 schools.

One of the principal areas of concern in this GAO report was whether there would be an adequate supply of AMTs through 2010, which is not particularly relevant to the issue of repair station training. However, the study also examined whether the curriculum for A&P mechanics at 14 CFR Part 147 schools was adequate, and changes were recommended in this area based on industry interviews.

* See note in the acronym list.

Because the A&P curriculum has not changed in recent years, industry officials indicated that the curriculum is geared towards systems and materials on smaller, less complex aircraft that rarely are used in air transportation (e.g., wood and dope fabric structures, soldering, and welding). It was recommended that the FAA de-emphasize or replace courses that do not apply to the materials and technology used on modern aircraft that transport the majority of the flying public. The GAO found that major commercial operators have had to provide their new-hire A&P mechanics with additional training because of these curriculum deficiencies. In fact, a representative of one major commercial air carrier interviewed by the GAO stated that 75% of their newly hired A&P mechanics that graduated from AMT schools failed the air carrier's mechanic basic skills assessment test. However, air carrier representatives have stated that this always was the case, and in a 1991 study, the GAO found that air carrier mechanics needed 2 to 3 years of OJT under close supervision, in addition to their schooling, to be fully productive.

While the FAA proposed changes to the A&P curriculum and certification processes in 1994 and 1998, these changes met with unfavorable comments, specifically in the area of recurrent training requirements. Therefore, the FAA withdrew the proposals in 1999. In interviews with FAA officials, the GAO found that one of the reasons the FAA withdrew its proposals was that "the cost of acquiring modern technologies for hands-on instruction would be cost prohibitive for some schools and they might close."

The GAO study specifically mentioned two programs instituted by the FAA to improve the qualifications of mechanics. One program is the Aviation Safety Program, which consists of 160 program managers that publish safety-related materials and conduct safety seminars for pilots and mechanics. According to an FAA survey quoted in the GAO study, 30% of respondents attended at least one seminar and 10% attended two or more seminars.

Another FAA program described by the GAO is the Aviation Maintenance Technician Awards Program, which consists of various awards for recurrent training sponsored by the companies that employ AMTs. The companies themselves can also earn certificates of recognition under the program. The popularity of these programs is reflected in surveys described in the study. For example, in fiscal year (FY) 2000, 19,963 mechanic lapel pins and 104 awards were given to mechanics and employers. In FY 2001, this increased to 24,047 pins and 146 employer awards. According to GAO, the FAA estimates that participation in the program has increased 5 to 7 percent over the last 3 years.

The GAO interviewed a stakeholder panel and AMT employers and asked them for recommendations on topics that they recommended to enhance the curriculum for A&Ps. Among the topics they recommended were:

- Computer-related subjects
- Composites
- Repair of turbine engines
- Basic and technical writing
- Reading comprehension

Delta Air Lines for example, requires new hires to participate in the following classes:

- Introduction to commercial jets
- Instruction in basic maintenance
- Safety rules

Some new-hire mechanics at Delta Air Lines also receive specialized training in:

- Hangar environments
- Aircraft systems
- Troubleshooting on specific aircraft types

The GAO study also found that most commercial airlines provide their mechanics with some form of recurrent training regardless of their level of experience. Alaska Airlines, for example, reported that each of its mechanics receives at least 100 hours of formal company training per year.

2.4 OTHER REGULATORY REQUIREMENTS.

2.4.1 International Civil Aviation Organization.

Training for AMO staff is addressed briefly in the following ICAO documents:

- Continuing Airworthiness Manual (Doc 9642)
- Manual of Procedures for an Airworthiness Organization (Doc 9389)
- Operation of Aircraft (Annex 6)

While ICAO Annex 8, titled "Airworthiness of Aircraft," details the standards and recommended practices for the certification and continuing airworthiness of aircraft, it does not address, per se, the training of staff performing those functions.

The standard established in Annex 6 is that an operator shall not operate an airplane unless it is maintained and released to service by an AMO, "or under an equivalent system." The annex further requires that an operator shall ensure that all maintenance personnel are instructed regarding the maintenance methods to be employed, particularly when new or unfamiliar equipment is introduced into service.

In addressing the subject of training for maintenance personnel, the ICAO Continuing Airworthiness Manual strongly recommends that policies for initial and refresher training be considered in an assessment for approval by the airworthiness authority. The manual also states that consideration should be given to the needs of mechanics, quality-control and/or quality-assurance personnel, as well as those persons certifying aircraft as fit for release into service. Furthermore, according to the manual, it is important to note that training should not simply consist of providing knowledge regarding the products maintained by the organization. It is also important to ensure that all organization personnel are given training on the company's procedures associated with its approval. In cases where an organization uses specialized

techniques, such as NDI or novel methods of repair, appropriate training should be provided to relevant personnel.

The ICAO Manual of Procedures for an Airworthiness Organization contains guidance for Civil Aviation Authority (CAA) inspectors to judge the adequacy of the maintenance training program of an AMO to be used by an applicant for an Air Operator Certificate. According to the manual, CAA inspectors should determine that the scope of maintenance and inspection personnel training is sufficient to ensure that aircraft operated by the applicant are maintained to a high degree of airworthiness. The manual also notes that the level of training required for each individual is a function of his experience and the complexity of the work he is expected and authorized to perform. In many cases, the work may be complex and require the use of specialized equipment.

In such cases, as specified in the manual, required training may range from OJT to formal classroom training and appropriate examinations. In any case, the training program should provide sufficient training for each individual to competently perform the work authorized.

A final point addressed by the ICAO manual is that the size and scope of the applicant's proposed operation have no bearing on the need for an effective training program. All operators need such a program, although a small operator should not be expected to duplicate all of the training facilities provided by a large operator. In fact, a small operator may contract with training facilities or devise other means that provide a satisfactory level of training in order to meet the ICAO requirements.

2.4.2 Joint Aviation Authority.

JAR 145 was first issued by the European JAA on July 30, 1991, with an effective date of January 1, 1992. In that regulation, the JAR prescribes the requirements for issuing approvals to organizations performing maintenance of aircraft and components and prescribes the general operating rules for AMOs.

Currently, the licensing and training requirements of JAR 145 only address AMOs that perform maintenance on aircraft with an operating weight of 5700 kg or higher. Smaller aircraft (with an operating weight less than 5700 kg) are not addressed at this time, but requirements will be developed for future revisions to JAR 145 or for the new European Aviation Safety Agency (EASA) Part 145 regulation that will be replacing the JARs.

JAA requirements for training affects U.S. repair stations with JAR 145 approvals. In order to reduce the impact of redundant training requirements of 14 CFR Part 145 repair stations that are also JAR-approved facilities, the research team conducted a comparative review of JAR 145 as well as an interview of the JAA staff member responsible for the JAR AMO requirements.

Although 14 CFR Part 145 and JAR 145 were developed with the idea of harmonizing their requirements, JAR 145 does not specifically state that an AMO must have a formal training program. There are also distinct differences in implementation between the two regulatory schemes.

However, JAR 145 is very specific in two areas—NDT and human factors. JAR requires that persons who carry out or control the performance of NDT be trained and qualified under European standard EN 4179. Effective September 2006, all JAR 145 facilities (under Amendment 5) must have a formal training program in place that addresses maintenance human factors. However, while the JAA system is designed to authorize only properly trained and licensed individuals to certify maintenance and release for return to service on aircraft and engines, it does not require certificated persons to release components.

The JAA imposes strict criteria on those persons certified to return products to service by connecting the JAR 145 authorization to JAR 66 licensing requirements. Operating JAR 145 facilities management personnel of the AMO are required under JAR 145.30(e) to ensure the competency of personnel involved in the performance of maintenance within the facility. Also, JAR 145.35(e) specifies that the AMO must establish the competence and qualification of the potential certifying staff on the particular aircraft before granting the JAR 145 certifying staff authorization. The assessment on competence and qualification may result in requiring additional training when needed.

JAR 145 specifically links the authority granted to personnel with the training and certification requirements of JAR 145.35, as well as the type of license held by those personnel under JAR 66. For example, one such requirement for base maintenance is that "the individual who certifies the maintenance accomplished must hold a type rated qualification based on JAR 145.35 plus JAR 66 category C licensing."

2.4.3 Canada.

Part V, Subpart 573 of the Canadian Aviation Regulations, titled "Approved Maintenance Organizations," specifies in section 573.06 that AMO certificate holders must implement a training program to "ensure that persons authorized to perform or supervise the performance of any (maintenance) function are trained in respect of the regulations, the standards and the AMO procedures applicable to that function."

Section 573.06 also specifies that this required program "shall include initial training, updating and other training necessary… to ensure continued qualification that is appropriate to the function to be performed or supervised." CAR section 573.07 titled "Personnel Records" further specifies that each AMO shall retain the records of employee training for 2 years and shall provide a copy of the written record of training to the individual employee on the completion of each training activity. Furthermore, the CARs also specifically mandate training in human factors for mechanics.

3. FINDINGS.

3.1 ACADEMIC RESEARCH.

3.1.1 Current State of Maintenance Training.

A review of current maintenance training practices and innovative approaches to training in the aviation industry was accomplished to effectively determine what type of training programs will be most appropriate for accomplishing the goals established in 14 CFR 145.163. Currently, most mechanics acquire their required skills through a combination of formal training and hands-on experience.

Maintenance training schools are certificated under 14 CFR Part 147, which establishes minimum curriculum requirements and certain hour and level of instruction requirements. All 14 CFR Part 147 schools must follow the requirements listed in 14 CFR 147.38 to develop curricula for the training of new A&P mechanics. That section states, in part, that "the curriculum must cover the subjects and items prescribed in Appendices A, B, C, and D as applicable. Each item must be taught to at least the indicated level of proficiency as defined in Appendix A." Also, Advisory Circular (AC) 65-2 titled "Airframe & Powerplant Mechanics Certification Guide," as amended, provides the same information listed in these appendices to explain more fully what knowledge and skill requirements are expected during the certification process.* 14 CFR Part 147 schools use these recommendations to better define major subject areas, subject subsets, and levels of learning.

An applicant for testing as an A&P mechanic can qualify by graduating from a 14 CFR Part 147 school after months of theoretical and practical instruction or, alternatively, through experience by performing maintenance under the supervision of an A&P. As a result, once applicants obtain their certificates, their experience is not standardized, and they do not possess the same type or levels of training. This presents a problem for their employers because the A&P certificate does not guarantee the same level of knowledge, skill, or work habits among employee applicants.

Recent industry surveys revealed that approximately two-thirds of graduates from 14 CFR Part 147 schools that find employment in aviation end up working on sophisticated transport category aircraft. Therefore, the employers of these new mechanics, which range from original equipment manufacturers (OEM), repair stations, and air carriers, have to ensure that incoming employees are then working at the same level. Without proper initial and recurrent training, maintenance and public safety could be degraded.

The types and quality of training available to the employers of maintenance personnel vary widely. Arguably, the best training is accomplished by the OEMs themselves and by the air carriers with large maintenance organizations. The level and quality of training at repair stations can vary, depending on numerous factors, not the least of which is the great variability that exists between 14 CFR Part 145 certificate holders. This can range from a single person working out

* The FAA needs to clarify the status of AC 65-2D, which is shown as canceled in AC 00-2.14, "Advisory Circular Checklist," but AC 65-2D has not been superceded. This has led to limited availability of this important guidance and left no clear alternatives.

of a shop in their home to a large facility with multiple aircraft bays and commensurate resources.

Based on industry surveys, training and qualifications (an area where return on investment justification is difficult to quantify) are not always viewed as an activity that adds value. Operators and aircraft maintainers alike will conduct any training that is mandated by the government because it is a legal requirement. They will perform relatively low-cost "right-to-know", hazardous materials (HAZMAT) and Occupational Safety and Health Administration (OSHA) training, but since neither aircraft mechanics nor repair stations have any annual recurrent training requirements beyond what is specified for a few with special task responsibilities, much of the training is considered optional, depending upon the position of maintenance management regarding its value.

Over the past several years, the state of aircraft maintenance has undergone a great deal of change. Many lower-cost air carriers have emerged and many of these carriers do not have the size or resources to justify accomplishing their own heavy maintenance work. As a result, several large 14 CFR Part 145 repair stations have emerged or existing repair stations have grown to accommodate increased major maintenance work for these carriers. There is also a trend developing for the larger air carriers to contract out work to 14 CFR Part 145 repair stations. This is often done for heavy maintenance that is either in excess of the air carrier's capacity, for a specific aircraft type of which few are in operation, or for a number of specific major repairs and alterations.

Operating under the limited requirements of 14 CFR Part 145, these repair stations do not have the same level of specific and detailed requirements for certification, training, and qualification of maintenance personnel as do the air carriers. The maintenance staff also significantly differs from the air carriers' in that the majority of those working in repair stations are specialists with slightly more than half being A&P-certificated mechanics. Another element of repair station staffing, due to the fluctuating nature of workloads, is the emergence of a large pool of maintenance personnel who work for temporary placement organizations (known as fourth-party maintenance providers). These organizations supply mechanics to the repair stations, allowing them to meet peak workload demands. The demand for these employees is high and is continuing to grow.

Hiring practices vary widely among repair stations as well. Most of them rely on interviews, background statements, military records, previous training documents, and resumes as indicators of training experience and qualifications. While a majority of the employees have legitimate experience, certification, and training qualifications, others do not. Obtaining previous training documents and organizing them into a verifiable and meaningful training record is difficult for smaller organizations operating with limited resources. There is open discussion within the aviation maintenance industry over the growing shortage of qualified certificated and noncertificated workers. The airlines, due to historically better salaries, benefits, and job security, hire those certificated A&P mechanics that are the best trained and qualified. Those that have less training and qualifications, and who are often newly certificated A&P mechanics or noncertificated specialists, often obtain employment at certificated repair stations.

In the workplace, mechanics must become productive on new equipment as quickly as possible. New aircraft technology is introduced frequently, aircraft are constantly modified and aircraft mission needs change often (e.g., extended-range twin-engine operations (ETOPs)) to meet market demands. It is becoming more and more difficult for repair stations to ensure that appropriately trained mechanics are available in the numbers required. Selecting and developing the proper training materials, method(s), and techniques in a manner that would be suitable to the many different types of repair stations and their various limited authorizations, has proven to be extremely difficult.

3.1.2 Maintenance Resource Management.

Maintenance resource management (MRM), or human factors, is part of the soft skills that have come to the forefront in the aviation maintenance business. MRM allows employees to better understand their role in the company's operation and its efforts to achieve a safe and error-free maintenance product.

Human factors training has proven invaluable for flight crews under the umbrella of crew resource management (CRM) and has been accepted at most airlines as a means to reduce errors in the cockpit. Over the past few years, research has proven the value of MRM in reducing maintenance errors. As a result, such training has become commonplace in many airline and corporate training programs to reduce errors and increase safety. One factor that increased attention on MRM was the Valujet accident in 1997 that resulted in increased surveillance and sharpened focus on maintenance program requirements, as well as airworthiness responsibilities between operators and the repair stations with which they outsource maintenance. There is now a heightened awareness within the airlines concerning their responsibilities for airworthiness in cases where their aircraft are maintained by third parties.

While the JAA, EASA, and TCA require MRM training and the consensus within the U.S. aviation industry is that human factors are an effective means of raising standards for maintenance training, selling the idea to mechanics can be a daunting task. There is a common perception among mechanics that human factors are merely one in a series of tried and failed improvement programs over the years. The support of mechanics is essential to any successful human factors error-reduction program. This support is anything but automatic and depends on more than just training. It involves the implementation of a total program in which certain conditions must exist, such as:

- A practical, team-based approach to the issue of reducing errors
- Support from management
- A clear and fair discipline policy that is applied consistently

Making the program practical so that mechanics can readily understand and actively participate in it is essential. This allows the program to be implemented as an error-reduction process. When an incident occurs, mechanics can be brought in to identify any human factors that might have contributed to the incident as well as to recommend strategies to reduce possible further occurrences. This group approach removes the individual mechanics from the focus of who made the error and, instead, encourages them to work as a team to discover the underlying causes

of the error. By participating in this process, mechanics can come face to face with the practical reality of human factors and how they can avoid contributing to errors in order to prevent future incidents.

3.1.3 Training Selection.

In the dynamic environment of repair stations, there are many occasions that may lead company managers to anticipate training needs. For example

- The repair station's principal customer is acquiring a new type of aircraft or is adding a new system to its existing aircraft. The repair station will need to provide qualified personnel to troubleshoot and service the new aircraft systems.

- Existing employees' skills require upgrading to ensure they can use new types of test equipment.

- Novice mechanics have been hired, and they need training to support an increased maintenance workload.

In each case, the repair station managers have to select the best method to train their employees. All maintenance training should be viewed in the context of an overall training system that accounts for the knowledge and skills that need to be imparted to employees, the existing proficiency of the employee, and the work environment in which the training occurs. Certain training methods are more appropriate for specific job tasks, which are outlined below.

3.1.4 Methods of Training.

There are many methods available to formulate good training programs or modules as well as actually delivering training. Certain training methods are more appropriate than others for teaching specific types of skill and knowledge. Training methods can be classified broadly into one of the following categories:

- Classroom (formal)
- OJT
- CBT
- Distance learning
- Internet/intranet training
- Just-in-time/embedded training

Sometimes the distinctions between these training categories can become blurred. CBT may be used in a classroom setting for example. However, these categories are a useful framework for the discussion of training alternatives.

3.1.4.1 Classroom Training.

Classroom instruction is the most traditional method of teaching and requires an instructor to deliver information on particular topics or tasks in a classroom environment. Students are able to interact with the instructor and to obtain other information that will enable them to better understand the material that is being presented. In the classroom setting, there may be a variety of media presentations or other types of teaching aids to assist the teacher and student in reaching their common educational goals.

There are disadvantages to the classroom method, one being its time-consuming nature. It is also relatively expensive and is not always adaptable to the individual needs of the training provider or student. Furthermore, the quality of the training relies quite heavily on the instructor's ability as well as the adequacy of the classroom environment.

Classroom training is most appropriate when face-to-face interaction is required to convey concepts and skills. For example, hands-on demonstration and practice with a piece of equipment, role playing, and small group problem solving are best done in a classroom setting. This allows instructors to provide a high-level, conceptual overview of a topic. It is also the method of choice for teaching soft skills where interaction among students is essential, such as communication.

3.1.4.2 On-The-Job Training.

The basic principle of OJT is to learn while actually doing the work. It is similar to an apprenticeship in which a new employee follows a more senior staff member throughout the day. This permits the new employee to learn while doing the work under the guidance of a more seasoned employee who serves as a mentor. Normally, OJT consists of demonstrations and supervised practice with equipment and procedures in the actual environment that the employee will be working in.

OJT can be a very effective method of imparting skills to employees. However, OJT can be used improperly, thus making it inefficient from a learning and a cost perspective. In most aviation maintenance situations, the trainer is a mechanic whose primary skills lie in performing maintenance rather than the fine points of training. Furthermore, OJT can lead to the perpetuation of improper procedures or norms. These deficiencies can result in OJT becoming haphazard, incomplete, and time-consuming.

Structured OJT is an appropriate training choice for a wide variety of maintenance tasks and may be most appropriate in the following situations:

- Trainees already have prerequisite knowledge and skills and do not need long explanations and discussions.
- The target skills can only be taught, or are best learned, in an actual work setting.
- The job environment cannot be reasonably simulated or replicated in the classroom or with CBT.

- The training task closely matches tasks found in the workplace, such as completing steps in a procedure.

- Line and staff organizations have a high level of financial and human resource commitments toward training employees while on the job.

3.1.4.3 Computer-Based Training.

CBT has become a generic term that refers to any electronically based technology that is used to create and deliver training. Computer-assisted instruction and technology-based instruction have become synonyms for CBT and all share the same characteristics for the purposes of this discussion.

Most CBT products include built-in testing, student management, administration, and recordkeeping functions. The products run on a variety of systems ranging from desktop computers to networked systems. The cost of hardware varies, and existing hardware can often be used. Overall, the equipment costs are usually a small fraction of the cost to develop software for the individual needs of a customer. While these costs can be greater than for either classroom training or OJT, the cost of the CBT can be spread out over several years.

CBT is primarily an interactive method of training, which means that it responds to an individual's actions. Older computer-based systems (sometimes disparagingly called page turners) can be monotonous and noninteractive. More sophisticated CBT systems (sometimes called intelligent tutoring systems) are adaptive and can model student input to change the course presentation and testing to conform to the student's level of knowledge, skill, and pace with respect to the material being presented.

An advantage of CBT is that it permits the material presentation and testing to be standardized. It is also efficient because it can provide independent, self-paced practice for the trainee and reduce the pressures of performing in front of others or appearing not to acquire the knowledge as rapidly as others.

CBT is fine for enhancing skills that require practice, such as troubleshooting and computational skills, or rote memorization of facts such as specifications. So-called drill and practice types of CBT are best for the latter and are usually designed to be used in small doses (approximately 20 minutes per module) to allow individuals to practice on their own during periods of lessened activity in the workplace.

The more sophisticated type of CBT (sometimes called electronic book) is an excellent tool in the introduction of basic concepts. Learners are usually given a pretest and then taken through conceptual material that is appropriate to their level. Each unit is usually enhanced with graphics, audio commentary, and video to supplement the on-screen text. The units typically also have practice exercises interspersed throughout, and learners can take a final test of their knowledge when they are ready.

Electronic book CBTs can be used as stand-alone, self-paced courses, but they are best used in combination with face-to-face classes. Instructing students to go through the material in such a

CBT prior to attending a class can help ensure that all students have mastered the basic prerequisite knowledge needed for the class. In this manner, instructors can be assured that the entire class is operating at a similar level.

3.1.4.4 Distance Learning.

Distance learning is part of a new trend and refers to any training in which the instructor and the students are not in the same geographical location. Traditionally, this has consisted of mail-based correspondence courses using either written or videotaped materials. Normally, the student watches the video, completes the corresponding work assignment, and mails the materials back to the granting institution.

A recent update in the technology of distance learning is the use of satellites and video conferencing. This permits a human instructor to be located at some distance from the students, who themselves may be in various locations. There usually is a mechanism in place for students to view slides or notes presented by the instructor, and they can also ask questions and hear other students' questions even though they are in different locations. This type of setup is sometimes called a virtual classroom, and the FAA itself has taken advantage of the technology by installing a one-way video classroom at the Mike Monroney Aeronautical Center in Oklahoma City to train FAA ASIs.

Distance learning has many of the characteristics of classroom instruction and usually is appropriate for the same types of training. The primary advantage of distance learning is that it provides a mechanism for people to pursue their professional development without expending the time and money to physically travel to another location. The choice between normal classroom instruction (in which the instructor and student are co-located) and distance learning is typically based on logistical and cost considerations.

3.1.4.5 Internet/Intranet.

Among the many changes the world has seen in recent years is the explosion of Internet usage. It was only a matter of time before the advantages of the Internet (such as public availability, low barriers to access, and common usage) were adapted to the distribution of training through online courses. These courses basically take the form of conventional CBT programs that have been ported into a format that can be used over the Internet or on an internal network (intranet), for example, a demonstration program for training pilots sponsored by FlightSafety International Inc. and Interactive Learning International Corp. Another example is the Safe Maintenance in Aviation Resource and Training Center, which was developed for the FAA Flight Standards Service Human Factors in Aviation in Maintenance Program and serves as an Internet-based forum for sharing information and discussing issues relating to MRM. An emerging provider of Internet training is www.aerolearn.com, which provides customized Internet-based courses for its clients. Some of its materials are available free of charge.

The advantages of using Internet training are consistency, wider access, ease of maintaining a single master version of the training software, and new mechanisms for the interaction between instructors and students. It has the potential to accommodate both live instruction and interactive

courseware in the same manner as CBT. The biggest advantage of Internet/intranet training is its accessibility because anyone can obtain the proper computer and communications setup required.

At the same time, the disadvantages of Internet training are technological. Without dedicated communication lines and servers, the response time of Internet training can vary from unnoticeable delays to frustrating waits. As information transmission becomes faster and more reliable, Internet-based training is expected to become increasingly available and popular.

3.1.4.6 Just-in-Time/Embedded Training.

Just-in-time training permits users to learn about a particular job task just before they need to do it or during the performance of the task itself. This type of training is also called embedded training because it can be incorporated into the equipment or software that is used to perform the job in question.

The easiest form of just-in-time training is to make relevant reference material easily accessible. This reference material can be implemented using several document management systems for aviation maintenance and inspections. One such system is the On-Line Aviation Safety Inspection System that has been distributed to FAA ASIs.

Some of the most popular software applications and operating systems in current use rely on embedded training in the form of sophisticated contextual "help" programs and tutorials. There is no need to run a separate application to provide instruction to the user, and it is available the entire time the program is in use at the touch of a button.

Just-in-time training has become very popular among managers because the training time is included within the total time to perform a task. No time needs to be set aside specifically for training. Embedded training is most appropriate under the following conditions:

- Learners are not complete novices but have some knowledge of the topic area.
- The task to be learned is bounded and conceptually simple.
- The media in which training is embedded are part of the task or equipment to be learned.

3.1.5 Training Program Development.

The most critical step in planning a training program is to determine exactly what training is required. Training should focus on the critical knowledge and skills that employees need to meet an organization's performance goals. It is important to build on the knowledge and skill foundation that already exists to ensure that resources are not spent on unnecessary training activities. A comprehensive training plan is required to ensure that every training activity focuses on the organization's performance objectives and no critical requirements are overlooked.

It is common for industry to divide training programs into initial and recurrent training phases. However, in academia, the term recurrent training does not appear. Education is a continuing developmental process in which a basic educational concept becomes a prerequisite in the understanding of more complex subject matter. For this reason, educators favor an approach

whereby most subjects are taught using a "from simple to complex" developmental process, which dictates that every lesson should build upon previous ones.

The term recurrent means something that is occurring or appearing again or repeatedly, returning regularly. The word itself implies that recurrent training subject matter should be something that has previously been taught or learned. In the case of aircraft mechanics, this refers to knowledge or training obtained through their training to become repairmen or A&Ps. An educational term with similar meaning to recurrent is reinforcement. Reinforcement in educational terms is used to introduce previously taught material into a lesson and is used to show the relationship between previously learned concepts and new material that is going to be taught. It is also used in the summation of a lesson or a series of lessons. Students are, thus, taken back to the beginning of the subject content and revisit each of its components until the complete unit or lesson has been reviewed and understood.

This checklist can be used to pinpoint required knowledge skills and information necessary in the development of an effective training program:

- Identify knowledge, skills, and equipment requirements
- Determine skills that already exist to build on that foundation
- Develop job skill checklists to evaluate training
- Perform job task and training analyses
- Develop skills from simple to complex
- Develop standards of performance
- Develop training syllabus and curriculum outline

Using these suggestions can help in the development of a comprehensive training plan that will identify all work force training and developmental needs. This method of developing a training program has proven very effective in the development of most aviation maintenance vocational education programs.

Repair stations should ensure that their training programs include adequate provisions to document training for the sake of employees and to enable monitoring of performance through audits from either internal or external sources. They should also ensure that adequate controls are in place to guarantee the quality of the training provided to employees. The ATA has issued Specification 113, which specifically addresses the development of maintenance human factors programs. Specification 113 includes a methodology that could be used as the foundation for the proper developmental process of any training program. This process is broken down into the following phases:

- Needs assessment and analysis
- Design phase
- Basic curriculum
- Prototype
- Validation
- Adoption
- Implementation

- Trainee evaluation
- Program measurement
- Feedback

Once developed, it is critical to properly implement and maintain a training program. To accomplish this, it is essential for repair stations to develop a training budget that ensures all training requirements are adequately funded. A cost-effective training philosophy always seeks to achieve a reasonable return on the investment in training. While this may be difficult to measure, providing the highest level of training is also good business.

3.1.6 Standards of Training.

The standards of performance, detailed here, would establish the minimum threshold criteria for all repair station training programs. They also provide a minimum acceptable level of performance that is achievable by this segment of the industry.

It is also important that all repair station training remains current with technology and industry advancements. Hopefully, repair station training exceeds the minimum that is required. For example, the following areas of employee training should be addressed to provide an acceptable standard of performance for repair station training programs:

- Curriculum
- Instructional techniques
- Employee evaluation
- Equipment

3.1.6.1 Curriculum.

The curriculum should be developed to be performance outcome-based, and there should be no requirement to mandate specific time on a task. If employees can demonstrate an acceptable level of performance, they may be credited with completing the task. All training programs should be written with a clear performance objective as well as a level of learning for each required task. Each task must include a level of learning to help evaluate student performance.

Student performance levels can be divided into three levels, knowledge, application, and manipulative skills.

- Knowledge: This is the measure of an employee's understanding of the principles, practices, and operational concepts of the subject task.

- Application: This is the measurement of the employee's ability to identify and apply rules or principles to solve a problem or complete a task with an element of difficulty.

- Manipulative skill: This is the measurement of the employee's ability to perform a task or process with speed, accuracy, and to accepted industry standards.

Employee performance levels provide the minimum standards of acceptable achievement that must be demonstrated by the employee for each performance objective. Some examples of employee performance objectives are:

- Demonstrate the ability to use aircraft drawings, symbols, and system schematics to perform aircraft maintenance activities.

- Demonstrate the ability to fabricate, proof test, and install rigid and flexible fluid lines and fittings.

- Demonstrate the ability to identify aircraft corrosion and its proper corrective and preventive treatment.

Employees' skill level should be graded on their knowledge, application, and manipulative skills in the performance of the objectives assigned.

3.1.6.2 Instructional Techniques.

A successful repair station curriculum requires the use of modern educational methods and technologies. Repair station training programs should use the accepted educational methods and technologies described above to provide for effective and efficient learning.

One guiding principle of a successful training curriculum is that most subject areas should introduce the material that is most directly related to the repair station's capability. The curriculum should also start from what is simple and build toward the more complex procedures, operations, and systems. However, the primary purpose of the curriculum is to prepare mechanics for work in a real-world environment. For this reason, the curriculum should emphasize basic maintenance principles and practices throughout so that it relates to the approved capabilities of the individual repair station. General concepts such as safety, team building, human factors, and error analysis should also be integrated into the training program.

No single method of instruction will work for all subject material. For example, training managers can choose among a variety of instructional methods for classroom training, such as lecture, discussion, computer-based instruction, and demonstration. Practical skills can be taught using individual projects, group projects, shared projects, structured internships, and OJT.

A qualified staff is the most important component of any training program and must possess the experience, qualifications, and capabilities essential for the successful conduct of the training program. Their qualities should include an appropriate aviation background, experience, professional certification, and demonstrated teaching ability. While many smaller repair stations may lack the ability to hire a dedicated training staff, it is important that training duties be assigned to individuals who possess the above-mentioned qualities.

3.1.6.3 Employee Evaluation.

Aviation maintenance is subject to rapid evolution and sees the frequent introduction of new technology and equipment. As a result, training has to keep up with new developments in

aviation maintenance. A comprehensive system that monitors and assesses employee progress and performance is required. Such a system should include practical examinations of mental and manual abilities, diagnostic techniques, and written and oral testing. However, a comprehensive practical examination of skill development in training is time-consuming and generally difficult to administer. As a result, a training program may dispense with formal practical examinations and assess the employee's practical work through a combined structured OJT program. An employee training program that can present convincing evidence that it has developed and implemented a comprehensive trainee evaluation system should find little trouble in obtaining FAA approval.

3.1.6.4 Equipment.

A repair station's training program must have suitable learning resources in the form of equipment and training devices to perform the instruction as detailed in the program's curriculum. This equipment can include aircraft, training aids, test equipment, special tools and technical software packages. Obviously, tools and test equipment must be in proper operating order and in a condition for use in training. Technical data and reference material (including CFRs, FAA ACs, manufacturer's maintenance manuals, and other technical publications) should be suitable for their intended training purpose.

Many training programs are increasingly computer-dependent for certain types of training. The computer facilities available to employees should reflect these requirements and encourage the use of computers by making them accessible and available and incorporate them into the curriculum. Distance learning techniques should also be considered for certain subject areas to allow for additional teacher-observed time in areas where certain skill development is critical.

3.2 INTERVIEW SUMMARIES.

3.2.1 Affected Personnel.

A variety of repair station personnel were interviewed, including facility managers, QA personnel, and individuals involved in aircraft maintenance training. There was overall support for the new training requirements among those interviewed, albeit with some trepidation.

Note: For the sake of brevity, and to avoid duplication, the following excerpts of interviews were paraphrased in an attempt to capture only the major concerns, suggestions, and recommendations of the participating industry and regulatory representatives.

3.2.1.1 Facility Managers.

The facility managers were concerned about the costs associated with the new requirements, specifically the increased documentation and records for maintenance training. The greatest cost would come from the new personnel that would be needed to handle the increased requirements. Further costs would come from having to send employees to factory schools when company personnel currently attend industry seminars. The equipment that mechanics work on has not changed, they have been working on the same equipment for many years, and additional training would not be helpful.

According to these managers, a large number of smaller repair stations that are not funded through larger companies could be turning in their repair station certificates. As it is, a lot of work can be performed under 14 CFR Part 91 instead of 14 CFR Part 145.

The new regulations will require a complete reconstruction of company manuals and training programs. Training costs could eventually exceed operating budgets. In this competitive environment with small profit margins, any increase in costs could be prohibitive. At the same time, there will be no demonstrable increase in quality resulting from the rule change.

3.2.1.2 Quality Assurance Personnel.

QA managers that were interviewed were much more positive about the new training program requirements. The majority of them already claim to have training programs in place that use a variety of training sources.

According to the QA managers, OJT is a very common way to provide training at their facilities. Usually training is conducted by employees with adequate experience and knowledge of the specific components involved. Some repair stations require that OJT instructors be certified repairmen, at the very least. The general trend is for recurrent training to be performed in-house as OJT. Some QA managers described a more formalized OJT system, which includes specific forms for each phase of both initial and recurrent training that are completed by both the trainer and the trainee. Some managers plan to include these OJT forms as part of their internal audit program.

A principal means of training repair station employees is through OEM/factory schools. According to the QA managers, airframe and system training are very expensive. This type of training represents the greatest challenge to justify in terms of budgeting. According to one interviewee, due to a virtual monopoly on airframe training by one provider, airframe and system training is not accessible from an economic standpoint. Conversely, power plant training is usually less expensive. There was general agreement among QA managers over the value of human factors training, especially in the identification of factors that resulted in reducing ground accidents. However, human factors training is an expense that is difficult to justify.

Another source of training is through seminars such as FAA Inspection Authorization (IA) renewals and FAA Safety seminars. Some QA managers are actually involved in developing such seminars.

In some cases, the training requirements have been made to align with existing training requirements for specialized personnel. This is the case for areas such as plating, welding, shot peening, and NDI/NDT. For example, one repair station arranged for the company that provides plating chemicals to also provide training to the repair station's personnel. The initial training is provided at the chemical manufacturer, and recurrent training is performed at the repair station on an annual basis. Generally, NDI/NDT personnel are trained in accordance with the requirements of the National Aerospace Standard 410 specifications.

The QA managers interviewed did not foresee any major increase in costs associated with the new requirements because the new regulations are not much different from the current

requirements and are largely in line with JAA rules (for those managers at facilities with JAA authorizations). Many were even thankful for the new rule and claim it will give them some leverage to justify to upper management some additional training for mechanics and inspectors. Overall, the QA managers expressed a desire to continually improve the quantity and quality of training provided to employees at their repair stations.

Some managers did express concern regarding the possibility of different interpretations by individual FAA inspectors and their Flight Standards District Offices (FSDO) regarding their training programs. They recommended that the FAA create an appeal process where differences between a FAA inspector and a FAA office could be elevated to a higher level and eventually result in a standard for training programs, at least at the FSDO level.

3.2.1.3 Maintenance Educators.

The maintenance educators interviewed for this study agreed that there have been many changes in the industry. However, maintenance training has not changed in the last 10 to 15 years; only some of the equipment has changed or improved. At the moment, training is not tailored to repair station requirements, and students are taught the standards as per 14 CFR Part 65 and AC 147-3.

According to educators, the quality and background of students entering 14 CFR Part 147 schools has not changed, it is the expertise required to do the work that has evolved, for example, the introduction of avionics and newer inspection techniques. All new aircraft and related products are moving toward a newer work process that concentrates on line replaceable units (LRU). With LRUs, all mechanics do is troubleshoot and replace them. The problem has become that the mechanic does not know why the unit failed, nor why the unit needed to be replaced. This type of training should be provided by 14 CFR Part 147 schools, but problems in funding are a major obstacle. This has made it difficult for schools to keep up with these changes. According to educators, there should be an avenue for the schools to purchase or otherwise obtain funding to acquire government-rejected parts and aircraft for training purposes. Apparently, accredited 14 CFR Part 147 schools are last on the list when it comes to making such purchases from the government.

Another issue raised by educators is that airlines have been dropping their apprenticeship programs. These programs provided the larger air carriers with the opportunity to align school curricula with their needs and requirements. Smaller repair stations could still arrange to do the same thing because a complete aero course only costs an average of $1,500 per student. Repair stations could stipulate areas to be added to individual courses that could meet their needs. This type of arrangement could become a “win/win” situation for all interested parties.

3.2.1.4 FAA Inspectors.

FAA inspectors have a similar perspective towards maintenance training as their industry counterparts. Many have participated in the development of training programs over the course of their aviation careers and are aware of the difficulties and costs involved. Generally, FAA inspectors that have reviewed existing training programs look for compliance with 14 CFR Part 65 requirements and proper tracking of the training performed by repair stations, including

OJT. FAA inspectors stated that most repair stations actually do have training programs in place; they just are not in a consistent format that the FAA readily can evaluate.

One example of an industry best practice in this regard is the use of an OJT log that trainees are required to sign. The OJT requirements are aligned with the training requirements set by the repair station in their training manual. In addition, the OJT is tied to the trainee's wages to ensure that all OJT items are completed. What is often lacking at repair stations is a way for the people who manage training programs to assess the effectiveness of the training.

The inspectors emphasized that OJT, as well as standard training, should be aligned with the training program and OEM requirements. Training programs should provide for checks and balances in the system and ensure that the standard of training is uniform for all personnel.

3.2.1.5 The New Requirements.

The FAA supervisory ASIs interviewed for this study understand that the new requirements of 14 CFR 145.163 will require repair stations to have training programs approved (not accepted) by the FAA by 2005. For many of the ASIs, the training program requirement is a secondary issue at the moment because they are working with repair stations on their new manuals that are due by January 31, 2004.

Most of the ASIs that have looked into the new requirements have several questions. Some examples of the ASIs' questions that should be addressed in any guidance material included

- What is an assigned task? Since this could be anything, what will be the level of specificity required for each task? What are the tasks of a supervisor, for example?
- What are task levels? Does the program need to address each possible part? If so, there will be literally thousands of tasks for each employee.
- Will the training program include all employees or only certificated employees?
- How does the training program relate to 14 CFR 121.375? Do the requirements of 14 CFR Part 121 supercede those for 14 CFR Part 145?
- What are the definitions of initial and recurrent training? Is recurrent training a repetition of the initial one?
- When and how does the training program have to be submitted and approved? At the initial certification or when the repair stations requests a new rating? How about when a repair station adds capabilities to its list? Do courses have to be approved again or is an approval good forever?
- What will the criteria be? What will trigger a re-evaluation of the programs? Will this take place every year?

- What does the FAA approval mean? Will this approval be for each task? How can FAA inspectors approve training when in some cases they do not know enough about a particular technique or specialty to evaluate that training? Will FAA ASIs be liable if they approve a training course and an accident occurs that is related to training?

- Will the FAA create an approved format for the programs? Will electronic versions be accepted for approval?

Based on the extent of these questions, a significant education effort will be required for FAA personnel.

3.2.1.6 Potential Costs and Benefits.

FAA ASIs had varying opinions on whether the new requirements would add a detrimental cost for repair stations. Many repair stations already have training programs in place and may only require revisions to their programs to comply with the new requirements. Many ASIs agreed that the greatest impact would be on the smaller repair stations with lesser resources. It all depends on what is required. One ASI stated that six repair stations in her local area have already given up their certificates due to the cost of revising their manuals to comply with the new 14 CFR Part 145 requirements. It will be important to accept previous experience in lieu of training to lessen the impact on these repair stations. For example, some repair stations perform repairs on very old equipment. How will these repair stations' employees get training on aircraft whose manuals may have been out of print for over 50 years?

3.2.1.7 Product Quality Improvements.

Most ASIs agreed that any training will improve the quality of repair station products. Some ASIs stated that repair stations that have good training programs tend to have good regulatory compliance. However, the quality of the training may vary, which will have an effect on how effective the training program is at improving the quality of repair station products.

3.2.1.8 One-Size-Fits-All Programs.

Some ASIs stated that it would be difficult, if not impossible, to create a generic training program that would apply to repair stations of all sizes and complexities. However, if the same building blocks are used for all programs and repair stations are given sufficient flexibility, it might work. One example of an organization that may cause a difficulty is a manufacturer that also has a repair station facility. This manufacturer has several thousand manufacturing workers that it can bring into the repair station when it needs the labor. How can the repair station ensure that all such personnel have been trained? One possibility would be to allow the repair station to train personnel on the spot as needed.

3.2.1.9 Meeting Current Training Programs.

The ASIs interviewed often see problems with regulatory compliance at repair stations that do not have training programs in place. Those companies may have made the extra effort to invest

in additional tooling and equipment beyond what is required. However, that does not mean that repair stations with such programs are necessarily and automatically compliant.

Even when a repair station's technical training is good, a problem that ASIs often find is that repair station personnel do not know what is in their existing manuals. Key people like inspectors and NDI personnel do better in this regard. Many have prior experience and are good at reading manuals. It is the quality systems at the repair stations that ensure proper work is being accomplished. Sometimes surveillance procedures such as quality assurance within the repair station are able to find issues with training and recommend appropriate remedies.

One ASI stated that a lot of training at repair stations is not technical and does not relate specifically to FAA requirements. Examples of such training are personnel sensitivity training and OSHA requirements. A lot of the OJT that is currently being provided is of little use and mechanics would be better off without it. For one thing, the OJT is only as good as the person who provides it. More quality needs to be built into such training and the choice of instructors.

Another ASI stated that there are existing problems in the field of NDI training. Requirements for NDI are extensive, they are found in numerous places and they are often difficult to understand. It would be useful for the FAA to provide some plain language guidance on NDI.*

3.2.1.10 Changes in Industry Training.

Some ASIs have found that repair stations provide less and less factory training to their employees due to its increased cost and the fact that there are fewer new products. Often, training is not readily available when they do need it. Sometimes lead mechanics provide the training.

3.2.1.11 Changes in Quality and Background of Mechanics.

Some FAA inspectors stated that there has been a decline in the quality and background of mechanics at repair stations over the years. For example, sheet metal work is becoming a dying art. In the past, there were several high schools and technical schools that provided this kind of training, but that is no longer the case. Local schools should institute programs to work with their local repair stations, but funding for such schools is in short supply, and it is difficult for trainees to get the latest training.

3.2.1.12 Training for New Products and Components.

According to FAA inspectors, training practices have not realigned with changes in the industry. New products have become more and more complex, especially with the introduction of avionics in the manufacturing process. This makes it very difficult for smaller repair stations to keep up with the changes in the industry. In addition, FAA inspectors also lack the training to recognize problem areas as they develop.

* Note: See http://www.faa.gov/certification/aircraft/NDTQUALSTDMEMO.htm for an FAA memorandum titled "Qualification Standards for Nondestructive Testing (NDT) Inspection/Evaluation Personnel," which provides such guidance.

When repair stations add ratings, the FAA often requires additional training for repair station personnel. Sometimes OEMs require that personnel have training for warranty work on certain products. Repair stations may occasionally hire new employees with the necessary training if they start working on new products.

Training should be based on the standard maintenance program for the specific product that each mechanic works on; otherwise, the product cannot be made to conform to its originally manufactured standard. In addition, the minimum training requirements for specialized service work should be established based on industry standards and specifications, such as NAS 410 for NDI/NDT and AMS-STD-1595 for welding.

3.2.1.13 JAA Requirements.

An ASI interviewed by the research team could find no specific reference to training requirements in the JAA checklist used to evaluate JAA requirements (JAA Audit Form 9). Training is implied in certain areas, but the JAA requirements merely supplement the FAA requirements. Another ASI stated that the JAA has no way to enforce its rules because it is a conglomeration of inspectors from many countries. The inspectors' interpretation and of the JAA requirements and how strict they are about the JAA requirements varies.

3.2.1.14 Meeting the New Recurrent Training Requirements and Additional Comments.

The ASIs interviewed for this study seemed pleased that the FAA is looking ahead to prepare for the upcoming changes in repair station training program requirements. However, it will be of great value to the field work force to see the AC and provide comments on it prior to it being issued in final form. Often, the impact of new requirements on the FAA FSDOs is not considered in the initial drafting. This is especially true in the area of conducting surveillance that ensures the programs are adequate. It may be useful to create a website to share ASI concerns regarding the new AC.

Some ASIs indicated the interface with 14 CFR Part 121 operators training definitely needs to be included during guidance development and evaluation. For example, 14 CFR Part 145 defines line maintenance but it is not defined in 14 CFR Part 121. Some repair stations try to make up for deficiencies in 14 CFR Part 121 programs. This has resulted in 14 CFR Part 121 programs not being improved.

FAA inspectors who are responsible for foreign repair stations are based in International Field Offices (IFO). They report that most foreign repair stations already have training programs in place. The average amount of training provided to the critical position of return-to-service inspectors is 4 to 6 hours for initial training on the repair station's manual system and other FAA-mandated requirements. Recurrent training is usually at least 1 to 2 hours per year, except for specialized technicians such as NDT, which normally conforms to industry standards in this regard.

FAA inspectors who worked in IFOs also expressed a desire for the FAA to implement a training program for all IFO ASIs concerning foreign certificate holders and the differences that exist between the requirements for foreign repair stations and domestic ones. This training could take

the form of OJT, CBT, or formal classroom training. In addition, there is a real need for training on specialized services such as shot peening, plating, and standards that appear in industry standards but are currently not covered in any FAA curriculum.

3.2.2 Industry Organizations.

Several interviews with industry representative organizations were conducted to determine the status of training programs currently in place at 14 CFR Part 145 repair stations and to learn what these organizations recommend for the new 14 CFR Part 145 training program requirements. The questions that were asked also related to the difficulties in creating training programs that could be implemented by repair stations of all sizes and whether size or complexity of the organizations would alter the character of the training programs that could be put into place.

3.2.2.1 The New Requirements.

The representatives from aviation industry associations had different interpretations of the new training program requirements in 14 CFR 145.163. One was concerned that the FAA's reliance on the term training excludes testing. For example, if a sheet metal worker does the same job every day; would the FAA really require that the worker receive initial and recurrent training on that function? Alternatively, would it be acceptable to simply test employees to ensure they still have the required skills for their assigned function? Welders currently use such testing to retain their proficiency and certification (under AMS-STD 1595), and testing could be used to take the place of recurrent training for technical areas. Another representative felt that repair stations should be able to use employee knowledge and training upon being hired and then test them rather than train them.

Training at repair stations is driven by air carrier requirements, and existing regulations require that repair stations follow the air carrier's training program. Under the new rule, will repair stations have to train employees on several air carrier programs? The standard for FAA approval of training programs should be that people can perform their assigned functions. What would be defensible, and what industry can live with, is a training program that accepts OEM, IA, and OJT training.

One industry representative felt that the new requirements represented a positive recognition on the part of the FAA that training is an essential part of airworthiness, as well as an ongoing process. It also validates the investment that manufacturers, mechanics, and employees make and recognizes the competitive edge of training. It further serves to quantify the minimum investment an organization can make for preserving its maintenance capability.

The FAA guidance on training programs should be absolute and not left up to interpretation. It should be descriptive without being prescriptive, and it has to create an even playing field. The requirements should not be argued by inspectors and should be something similar to what A&P mechanics have to do to accomplish the same work. The program should be descriptive and specify a suggested number of hours, allowing the repair station to fully understand what basic requirements an ASI would be looking for. There are differing opinions on what is appropriate.

The content of training should be broad, but the quantity should be fixed, and the training program should describe how the minimum standard is met.

According to one representative, approximately 8 to 16 hours of training should be required per year. That, in the industry's opinion, would be acceptable. Currently, the new requirements do not have enough specifics, and the FAA ASIs do not know what the new requirements will mean. Another association representative recommended that repair station employees receive 4 hours of initial training, including a minimum of 2 hours on the regulations. Another explained that on the issue of hours, the purpose is to establish competency. Initial training should have higher requirements and could be around 40 hours.

3.2.2.2 Potential Costs and Benefits.

According to some industry representatives, the new training requirement would not increase costs for repair stations. It may even save some repair stations money because it could potentially eliminate maintenance errors tenfold. If this new requirement is properly administered, quality and productivity should increase. Additionally, it should help to prevent accidents, maintenance delays, decrease warranty returns, decrease employee turnover, and decrease customer dissatisfaction. It will also increase personal responsibility and foster improvements in the industry. A mandatory training program makes it less expensive to do business and shows that training is not just a cost center. The training requirement will make operations more efficient and reduce costs.

Other representatives are not as convinced that a training program would not necessarily be detrimental. Vagueness may create the opportunity for costs to skyrocket. One representative was very concerned that if adequate guidance is not provided, each ASI will have their own ideas of training programs that they are willing to approve. The requirements have to be responsible, appropriate, mission-oriented, and should be applied consistently.

Another problem the representatives pointed out is that there are no boundaries to the requirement. There is a potential for extremes to be reached because inspectors have wish lists for repair stations they oversee. One association calculated that it costs approximately $5000 for a small business to send a single mechanic for a 1-week course. This figure includes transportation and lost productivity and revenue, in addition to the cost of the course itself. Representatives stated that many repair stations make only 2% to 3% profit and if the new requirements are not implemented properly the effects could have a significant economic impact.

3.2.2.3 Product Quality Improvements.

One industry representative stated that the new training requirement would improve the quality of repair station work for some, but insignificantly for others. The industry has always required a quality product and, as a result, repair stations have to do more than meet a minimum standard. The new requirements could improve the quality for those repair stations that only do the minimum that is required; however, these are in a minority. It was expressed that aviation is already safe, but the addition of the new requirements should enhance safety in an increasingly complex environment because safety issues have arisen that could have been remedied with increased training.

Still another representative expressed surprise that anything was broken in the system. According to this individual, there is a misconception that training will tell people what they have to do when it actually provides them with knowledge of proper techniques. As a rule, mechanics follow maintenance manuals rather than accomplishing tasks by rote. The training has to be appropriate to the mechanic and should not be how to perform a task. It should merely provide the mechanic with the basic tools that are reinforced at regular intervals.

One opinion is that the FAA has failed to identify a problem, but because ICAO requires training and everyone else has training requirements, the FAA is joining in. The FAA has not defended itself properly to the international community. The industry has had training for return-to-service individuals for many years. This has been considered adequate until now; "all we need to do is look at the IA renewal criteria in part 65."

One representative stated that the training requirements are a reflexive reaction to a belief that maintenance errors cause accidents. In fact, accidents are not due to a lack of training but to a lack of quality control over the work. Often mechanics do not lack training, but in fact it is the maintenance instructions that are inadequate. If the maintenance manuals are correct, but the problem persists or gets worse, then a maintenance error is likely. There is a tendency to band aid problems with more training. However, training can impart advanced skills but it does not make the process safer. Instead it makes the process more efficient. Safety is assured by maintenance instructions and quality systems. Efficiency is assured through training. For example, OJT could theoretically be used to completely replace formal training. However, the training would take much more time.

Another representative explained that much of the training accomplished today is OJT, but it can be burdensome. A good model is Canada's program, where a repair station has to defend that the training of its mechanics is appropriate (both to the mechanic and to the repair station). Repair stations in the U.S. want guidance but are concerned about ASI personal preferences filtering into the new training requirements. Repair stations need guidance on what a training program should be.

3.2.2.4 One-Size-Fits-All Programs.

One industry representative explained that it would be difficult to develop a generic training program that could apply equally across repair stations of any size. It would even be difficult for two similarly sized operations that perform different types of work to develop the same program. According to one representative, the particular repair station's specialties are more of a consideration than their size. Some of them do not use A&P mechanics (such as interior shops or avionics shops), and these organizations would require more training for their employees. Also, repair stations that work on many models would need more diverse training for their employees.

However, there was general agreement that there should be no special dispensation from the new training requirements just because a repair station is small. The requirements should involve taking definable tasks and "writing them backwards to meet those tasks." Technical training should be skill-based. It should also include remedial training and training on subjects such as

regulatory requirements, company manuals, and procedures. These subjects could be based on an hourly requirement.

One representative felt that small businesses should be treated differently, and that the goal of a training program has to do with the mechanic, not the size of the facility. There is a difference in the equipment mechanics work on because there have been some advances in technology. Therefore, training should relate primarily to the skills of the personnel and their ability to safely perform maintenance and return products to service.

A representative emphasized that the philosophy of training is that it is the product of a formal education. Skill is based on experience. Speed is the ability to do the work. You need a formal curriculum rather than just having OJT. Errors get introduced and expanded as knowledge gets passed on. Recurrent training reminds you of the basics, like the right way to do things that are fundamental to maintenance. Training is an investment, not a cost. There is a cost of doing business, and repair stations cannot survive if they do not invest in their maintenance training.

3.2.2.5 Meeting Current Training Requirements.

Some industry representatives explained that many of their members currently meet existing training requirements through voluntary training that is driven by customer's expectations. Many mechanics at these repair stations are A&Ps who have 30 months of OJT or who have attended an FAA-approved school. Some receive regulatory training, article-specific maintenance training (formal or OJT), and 14 CFR Part 121 customer-specific training for major components. Many lead mechanics get factory training. There are also official training programs that are customer- and requirement-specific, and an appropriate number of people with training oversee lesser-trained employees. An exception to this scheme is in areas such as NDI.

Another representative said that the members of his organization send mechanics to attend training sessions. Some of these courses are approved for AMT and IA renewals. Approximately 60 to 70 percent of member personnel receive regular training under the current system. For avionics, this is primarily FAA and association training. Much of it is OJT and some is informal through the simple asking of questions (one-on-one training). Some members provide factory training to their technical personnel.

One representative stated that training is not homogeneous throughout the industry. At repair stations that maintain high-end corporate aircraft, mechanics go to OEM-approved schools and receive formal training through seminars. In hard times, this is often the first place that employers start to cut. The new rule will take some flexibility out of spending money on training. Sometimes, the training expense can be turned into a marketing opportunity when companies educate their customers and explain the virtues of training, which is why they train their employees to the highest standard.

Regarding CRM and human factors, one representative stated that this type of training is based on the aggressive and overconfident fighter pilot mentality and environment. Human factors were applied to mechanics later, but they generally do not have these same personality traits. Therefore, the mechanics should not be admonished when their natural instincts are wrong. The quality process should be examined instead. One representative stated that the industry has

increasingly greater minority populations. Some do not have English as a first language and need "soft skills" such as communication, which is a part of human factors.

3.2.2.6 Changes in Industry Training.

According to the interviewed representatives, the industry has seen many changes. For example, at one time there was more component work. Now there is more emphasis on alterations and installations.

In the last 5 years, repair stations have also been providing more training because air carriers are demanding this. There are also changes in the technical environment, with new integrated systems increasing the complexity of the work. There is also a loss of expertise, with mechanics and old equipment being retired. This has resulted in OJT no longer being as effective.

According to one representative, it is the recording of training and training quantity that has changed the most. OJT was not recorded in the past, but now it is done in order to show repair station customers that employees are qualified.

3.2.2.7 Changes in Quality and Background of Mechanics.

There is significant disagreement among those interviewed regarding changes in the quality of new mechanics. For some, new employees do not have the same background as before—some have not even worked on cars. At 14 CFR Part 147 schools, few get heavy iron experience. There are also less mechanics than there were before.

One industry representative stated that many aircraft mechanics come out of the military. However, the majority go through A&P schools. Those that do come out of the military have a lot of catching up to do because of the great differences between the military and the civilian worlds. For example, military aviation mechanics are often very specialized and their job is compartmentalized to a small part of an overall aircraft or system.

Some representatives were disappointed at the quality of people coming out of schools. This is not due to the quality of the schooling but mostly due to low industry salaries that do not draw the same people as before. Aircraft maintenance is simply not attracting the same quality of people as before, and there are other opportunities for better salaries and better hours in other industries.

Other representatives felt that, historically, nobody has ever had a high comfort level with the quality of personnel entering the industry. But the industry has not lost skills; this is a myth. While there are fewer people applying for jobs with technical skills, these changes are incidental to aviation. Aviation is not considered magical like it was in the past, and the industry is relying on old methods of recruiting that depend on that magic.

One representative stated that trends do show a decrease in the quality of new mechanics, and the industry is trying to recruit people at the high school level who have talent. A good example is the Aviation High School in New York, NY, that on a yearly basis is producing a large portion of today's A&Ps. Almost all the graduates are minorities and are in great demand by employers.

The school has a Pegasus Society, consisting of the top 10% in each class, whose members wear special lab coats and create a very good impression on prospective employers. This should be a model for how aircraft mechanics are trained.

In spite of these differences of opinion, many representatives agree that maintenance training has been realigned to ensure that the quality of training keeps up with changes in industry personnel. Not only do new personnel need more training, but they especially need more oversight. However, schools are not adapting as much as they should. Some are still emphasizing doping and fabric. There is a difference between skills and knowledge training. The development of technical acumen is essential, but it is also important to understand modern systems. This is generally not taught well.

The most important areas in maintenance that need to be taught are inspection and troubleshooting, especially for avionics and test equipment, which is where most of maintenance lies. A&P schools teach students how to fix instead. They need to understand how to use the equipment. Inspection is vital for composites and structural materials: Quality inspection is where maintenance begins.

Many schools have realigned themselves over the years but are still providing the same 1900 hours of training. This meets the intent of the rule, but they cannot add more hours to the curriculum. Many schools discriminate based on costs and their inability to obtain the right training equipment.

Another representative stated that 14 CFR Part 147 organizations use OJT and still have to show demonstrated preparedness. These 14 CFR Part 147 schools want the government to set the standard because they will train to the minimum. There is no "brain trust" academia for A&P schools, unlike colleges. These prescriptive programs stifle the emergence of "out of the box" thinkers. The schools will not do more than what is required, which impedes innovation and advancement in the schools. We need to set the floor, not the ceiling on academic standards. The resistance is from managers who cannot justify doing more than what the FAA requires.

There is a burgeoning industry for blended training that is provided via the Internet. Future A&Ps will have no problem learning online, but it is a challenge for current A&Ps. This type of training can be interactive, using forums or discussions, and some even permit video interactivity. The infrastructure is there, which decreases the need for OEM courses that can take up to 2 weeks. According to one representative, the future of maintenance training can be found at CAE Simuflite in Dallas. They have a state-of-the-art facility that allows trainees to use a glass cockpit mockup, interrogate the maintenance computers of the simulated aircraft, and then see on screen how their actions relate to the aircraft's systems. There is also the Kansas Technical Training Initiative, which is an A&P school owned by OEMs to provide them with a source of trained mechanics. The OEMs allow some trainees to go to school at night and work for them during the day. This teaches trainees the value of a continuing education.

The PAMA is in the process of creating an aircraft maintenance society that will offer type ratings to mechanics based on certain levels of experience. The idea is to create advanced standards above the basic A&P, similar to underwater diving certifications, which they used as a

model. Under this system, skills are split up into specialties. PAMA predicts that the industry will move more towards such specializations.

Another representative agreed with this assessment and explained that mechanics need training on specific equipment, not just generic topics. Some training should be compartmentalized. However, another representative explained that the industry's biggest fear is that there will be a type rating for mechanics rather than the current general certifications.

3.2.2.8 Training for New Products and Components.

Industry representatives explained that repair stations provide training to their employees on new products and components through OEM factory schools or through their air carrier customers. Also, someone who has the required training or experience can provide OJT to others. This OJT should be given or approved by the Chief Inspector because he/she sets the highest criteria within the organization. Another option is to hire someone who has the necessary training.

Some repair stations develop their own maintenance training based on older equipment with modifications for the new ones. Usually, new products require some additional knowledge, but there are very few fundamental changes in technology. The equipment is basically the same, but it is used in newer applications.

Usually a technical representative shows mechanics how to work with new equipment. Some facilities may send select employees to factory training; in other instances, mechanics only need recurrent training on new equipment, which is provided locally.

3.2.2.9 Joint Aviation Authorities Requirements.

One industry representative admired the fact that Europeans have more respect for trades such as aircraft mechanics than in the U.S. The JAA requirements address maintenance training more specifically. Most U.S. repair stations with JAA approvals have been performing work for foreign air carriers that have been requiring them to train their maintenance personnel for years. Also, JAA rules only apply to transport aircraft, and now there is a move towards the EASA 145 regulations, which puts the JAA requirements in doubt.

One representative stated that the JAA training requirements do not affect U.S. repair stations very much. For example, human factors' training is not required of U.S. repair stations that are JAA-approved, unlike their European counterparts. JAA allows for some flexibility in this regard.

3.2.2.10 Meeting the New Recurrent Training Requirements.

According to one representative, the way the recurrent training requirement is written, it applies only to inspectors. As such, the requirements could be met through OJT, OEM training, association training, or any other FAA-endorsed or FAA-accepted training. Mandatory recurrent training could also include new methods, techniques, or practices.

One association representative recommended that repair station employees should receive a minimum of 2 hours of recurrent training per year on manuals, with a minimum of 0.5 hour on any changes to manuals. Another associate representative recommended that recurrent training range from 8 to 16 hours.

For technical training, one representative recommended testing employees at known intervals determined by the criticality of the nature of the work being performed. Any new methods, techniques, practices, equipment, or tools needed to perform work should be a part of the technical training. There should also be training on new air carrier customer requirements such as recordkeeping, procedures, and RII. Each repair station must assess its employees' current knowledge, expertise, and skills. This can be accomplished through technical and regulatory training or testing to verify the employees are at the right level and ensure that regular and basic skills are still there. There should be yearly testing of technical areas in lieu of training and hourly regulatory and Inspection Procedures Manual training requirements. HAZMAT awareness training requirements and training on new equipment and technology should also be mandated.

There is an infrastructure in place now through the IA renewal system that includes a specific curriculum and a requirement for IAs to have 8 hours of recurrent training. A representative recommended using a set hourly requirement based on the 14 CFR Part 65 standard for inspectors and half that for mechanics. Still another stated that the 8-hour recurrent requirement for IAs should be sufficient for the recurrent training of other mechanics. Mechanics should be held to a lesser standard than IAs. Chief inspectors should meet the same requirements as IAs (8 hours). The FAA should not waffle on this issue and should be specific in its advisory language. Another option could be to use standardized testing instead of a set number of hours.

One representative stated that the new training programs could be made to align with specification requirements that are called out in air carrier Operations Specifications for Specialized Services. For example, NDI training is set at 5 years by the ASTM standard, with an eye test every year. The critical nature of the work being performed should be taken into account and limited to individual job duties. The training intervals must align with job duties.

Another representative stated that any approved training requirement would reflect the operations specifications. However, this should be done under 14 CFR Part 43 and not 14 CFR Part 145. Mechanics should also be taught the regulations so that they know why they are doing things. They need to research the regulations and understand them.

The training programs should be general (e.g., how to read a wiring diagram) and use detailed job descriptions for each assigned job that must be definable. Skill elements of jobs should also be definable. One issue of concern was if industry sets up minimum standards to satisfy the FAA, organizations that have established higher standards for themselves would not be held to them.

One representative explained that the bottom line is that training should be based on the employees' assigned task; this should drive the training program. There should be set parameters that the FAA will look at to make sure each part of a system takes into account its

intended function. The FAA should use the employee's capability to perform their assigned task as its criteria. The FAA can determine what constitutes the initial versus the recurring phases of training. The proof should be in the pudding—if a repair station can get through an inspection, it indicates the training program is working.

3.2.2.11 Additional Comments.

One industry representative felt strongly that anybody who works on an aircraft should hold an A&P certificate, or at least a percentage of the work force should hold such a certificate. In smaller shops, mechanics are less likely to do the same things day after day. "Maintenance is the opposite of medicine." They become doctors first and then specialize. At repair stations, technicians start with a specialty and then become A&Ps. The industry is not geared to getting people rated on particular aircraft. Personnel should start with the A&P as an entry point, thus raising the bar.

Repair stations are at a disadvantage because they compete with A&Ps for work. Now you have to protect the big guy from the little guy because A&Ps work on almost anything. Repair stations were originally set up to remedy a shortage of A&Ps, and now, repair stations are struggling to compete.

OEM programs are excellent and high-quality training is created and provided by OEMs. OEMs provide these schools with students and new airplane owners get OEM courses as part of a package. This is not true for the second and third owners of these aircraft.

There should be some infrastructure to rate people based on their training. Maybe they can be allowed to apply their experience towards certificates so that they are working towards something. This legitimizes the training they are getting so that maybe they can get at least an airframe rating. This gives people an incentive. It makes people happy. There is a perception that people will take the training and leave, but it actually establishes a career path and can inspire loyalty—like an apprenticeship. It is important to encourage people to receive training and recognize companies that promote training through legitimization such as the FAA Aviation Maintenance Technician Award Program. The FAA AMT Award Program is a voluntary program which recognizes individuals and employers with five levels of awards—Bronze, Silver, Gold, Ruby, and Diamond—based on the level of training completed by an individual and percentage of employees completed training, respectively.

Mechanics want training, and they are often spending up to $2000 on their own to advance. If you make training available and set up incentives for training, you can create a positive training culture. Training resources should also be made available through a training library that would permit mechanics to study during down times and at their own pace. This encourages professionalism and is part of a lifelong commitment that will eventually result in saving lives.

Another representative proposed looking at hiring practices to see if employers are requiring practical tests of new employees to see what their skills are and if they need additional training. The hiring program should be a part of the initial training. OJT can fit the bill for subsequent recurrent training. A repair station can also hire people who are qualified and may not need as

much or any initial training. However, training needs to be more transportable for the mechanics from one company to another.

One representative stated that the FAA needs to include a requirement for a training record to bolster the ability of repair stations to hire people with 20 years of experience and take that into consideration. 14 CFR Part 65 does not allow such a person to work on products that he does not have prior or current experience working with. Every A&P should also keep records to show their experience. Recordkeeping should be standardized and documented to show how people are trained. They need to show proof. There is very little accountability, with quantification and validation of training being all important. Industry or OEMs can set the standards to allow for a universal industry-accepted training record method.

4. CONCLUSIONS AND RECOMMENDATIONS.

In order to provide standardization and consistency, all advisory or guidance material published on the 14 CFR Part 145 approved training program should clearly identify the Federal Aviation Administration's (FAA) intended goals and objectives and provide a process to measure the training programs' effectiveness in a manner that can be used as a standard guide by both industry and regulators.

Most FAA-certificated repair stations, whether domestic or foreign, have some form of training currently in place, although training may not be formally documented or conducted on a regularly scheduled basis. The FAA should build on existing tools to create an effective template for repair stations to design their training programs. This will allow repair stations to develop realistic training programs that FAA Aviation Safety Inspectors (ASI) will approve. Therefore, the format, structure, and hourly requirement for the training of personnel should be specific and consist of a minimum that individual repair stations can build on to suit their needs.

During the development of training programs certain subject areas should serve as a core of basic instruction subjects for the initial training of repair station personnel, with other training added based on the individual repair station's specific technical capabilities. These include

- Code of Federal Regulations (CFR) and other regulatory requirements
- Company indoctrination on manuals, policies, procedures, and practices
- Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), and right-to-know training
- Hazardous materials training
- Basic shop safety training
- Maintenance resource management (MRM) or human factors training

Based on this research and interviews, the following sample of minimum ranges for basic hour requirements in repair station training programs are recommended:

	Initial Hours	Recurrent Hours
Mechanics	8-16	8-16
Managers and Supervisors	10-20	8-16
Inspectors	10-20	8-16

Of course, some repair stations already have detailed and extensive training programs that will meet or exceed these minimums, which should continue to be acceptable under the new requirements.

Repair stations should be allowed to conduct their own training in-house or to contract their training needs with an outside vendor or institution such as a 14 CFR Part 147 school. Encouraging 14 CFR Part 147 schools to develop specialized curricula for repair station personnel would standardize the core training requirements, provide an economical means to obtain instruction for smaller companies, and at the same time provide additional resources for 14 CFR Part 147 providers.

Airframe and power plant (A&P) mechanics that hold an inspection authorization (IA) must renew it with a minimum of 8 hours of training per year. Because an IA performs many of the same functions as an inspector or chief inspector at a repair station, a similar or modified IA course specific to repair station functions that consists of at least 8 hours should be developed and deemed acceptable for repair station recurrent training.

The FAA may wish to establish a standard format for tracking training, in general, and on-the-job (OJT) training, in particular. There seems to be an acute need in the industry to provide portability and consistency for mechanic training records. Repair station training programs should also use a standard format and the FAA should provide the elements that must be included in a training program for it to be approved.

Although foreign repair station personnel are not required to hold certificates issued by the FAA, the FAA can encourage the adoption of FAA standards by creating a program that issues certificates of recognition after completion of formal training. This training could be provided through 14 CFR Part 147-approved courses (or through some other means of FAA approval) that are specifically designed for personnel who return U.S.-registered products to service. Repair stations using contracted personnel (fourth-party providers) during peak workload periods should include in their training program a formal provision to integrate such personnel into the repair station's quality and production systems and monitor their performance.

FAA ASIs should be properly trained so that they can adequately evaluate repair station curriculum development, methods of training, and the effectiveness of various types of training. They should also be given training on how to offer guidance in training program development.

While FAA oversight of repair station training programs could represent a significant increase in workload, the FAA can look for efficiency gains in this process. For example, various ASIs are responsible for the oversight of 14 CFR Part 145 repair stations, 14 CFR Part 147 schools, and 14 CFR Part 121 air carriers. There should be an efficient means for these ASIs to share information and surveillance results, which may require enhancements to FAA databases. In addition, FAA ASIs responsible for air carrier oversight can ensure that their air carriers' Continuing Analysis and Surveillance System (CASS) is also monitoring their contracted repair stations' training programs.

The FAA should also develop computer-based training (CBT) materials on various regulatory and safety-related subjects and make them available at cost to the industry. The FAA can also institute free accident prevention seminars (or in conjunction with the Aviation Maintenance Technician Awards program) acceptable industry conference workshops that would be credited as valid training for repair station employees.

Industry associations should be encouraged to develop enhancements to aviation maintenance technician (AMT) training. Various recognition programs are currently in place that issue specialized type ratings for mechanics based on certain levels of experience and additional training above the basic A&P.

Although limited in number, it is recommended that training programs for organizations performing very specialized functions under their authorities granted by SFAR-36 or those certificated as Designated Alteration Stations (DAS) specifically address the issue of training for their engineering staff. Requirements in these areas should be closely coordinated with the Aircraft Certification Service, since approvals of the above authorizations are a joint function of both FAA services.

Due to the changes in the industry that have taken place since September 11, 2001, the Transportation Security Administration is likely to require security measures for repair stations. These requirements should be closely coordinated, and it is suggested that, at a minimum, the training should include an employee awareness program and recurrent training in this area as the need arises.

4.1 CONCLUSIONS.

The FAA should build on existing tools (such as 14 CFR Part 147 appendices and Advisory Circular (AC) 65-2 as amended) to maintain standardization and create an effective template for repair stations to build their training programs. Keeping these requirements at a useable and justifiable level will allow repair stations of all sizes, whether they consist of a single mechanic or several thousand, to develop realistic training programs that the FAA ASIs will feel confident in approving. Therefore, the format, structure, and hourly requirement for the training of various categories of company personnel should be specific and consist of a minimum that individual repair stations can build on to suit their needs. It has been well established that many repair stations already conduct training; some of this training is quite extensive. It is unlikely that repair stations with such programs in place would pare them down because the FAA has issued guidance that establishes minimum standards for training periods. At the same time, the recommended hours of training will not overly burden the smallest repair stations.

A justifiable duration for mechanic recurrent training hours appears to be the 8-hour minimum that is already established for IA renewal. It is reasonable to require at least that number of hours for all employees that are authorized to approve for return to service products at a repair station. A minimum value for initial training has less obvious parallels among existing requirements, but it would be reasonable for it to exceed recurrent training periods or even double them based on the complexities of the maintenance performed by the repair station. This initial training period could be adjusted based on the level of experience a new employee brings. However, there will always be areas such as company procedures and documentation that will be unique to the repair station and essential to the new employee's integration into the repair station work force.

The structure of repair station programs should be based on existing requirements for 14 CFR Part 147 school curriculums, which are found in the appendices to 14 CFR Part 147, as well as the A&P certification requirements outlined in AC 65-2. These are well-established and have

proved adequate for the formation of thousands of A&P mechanics. And, although the guidance material of the relevant International Civil Aviation Organization (ICAO) documents is general in nature, training program requirements should meet the intent of the ICAO standards and recommended practices.

The FAA should also take the opportunity of issuing concise guidance on repair station training programs to address some areas of concern in the industry, such as the standardization and portability of training records—especially OJT records. The FAA should encourage this and provide avenues for mechanics to translate their increased training and skill sets into FAA awards or certificates.

4.2 RECOMMENDATIONS.

4.2.1 Recommended Repair Station Core Training.

It is recommended that the following subject areas serve as the core for the initial training of repair station personnel. Other training can be added based on the individual repair station's capabilities. Research has shown that these subjects should be a basic part of any repair station's training program, regardless of its size or capabilities:

- CFRs and other regulatory requirements
- Company indoctrination on manuals, policies, procedures, and practices
- OSHA, EPA, and right-to-know training
- Hazardous materials training
- Basic shop safety training
- MRM or human factors

In addition, each repair station should develop initial and recurrent training requirements in the practical skills relevant to the approved limitations of their respective 14 CFR Part 145 capability list. Any new methods, techniques, practices, equipment, or tools needed to perform work should also be a part of that technical training.

Many mechanics have obtained their training either by attending 14 CFR Part 147-certified schools or through work experience while working for a repair station, the military, or an original equipment manufacturer (OEM). In a majority of cases, mechanics received their basic knowledge and skills training while attending a 14 CFR Part 147 school. Many smaller shops may not have the resources to develop and deliver their own training. Therefore, repair stations should have the latitude to conduct their own training in-house or contract their training needs with an outside vendor or institution such as a 14 CFR Part 147-certified school. 14 CFR Part 147 schools already have approved curricula in all aircraft maintenance subject areas, and the associated skill levels are developed based on FAA requirements. This places 14 CFR Part 147 schools in the perfect position to revise their existing curricula (including hours of instruction) to meet the needs of individual shops and to develop other approved courses that would meet or exceed the demands of the new 14 CFR Part 145. Many 14 CFR Part 147 schools already have specialized training that could also meet the needs of specialized repair station training in areas such as nondestructive testing, welding, and composites, with approval by the local Flight

Standards District Office. This approach would also reduce the burden on the FAA because these 14 CFR Part 147 curricula have already been approved.

It would be beneficial for industry associations to work together to develop a series of 1- and 2-day workshops in specific maintenance skill areas that would meet the requirements for initial and recurrent training for repair station personnel worldwide. A reality of the market is that many 14 CFR Part 147 schools have lost prospective foreign students due to security concerns stemming from the recent terrorist attacks. Enrollments are down and some schools have been forced to close. As a result, with FAA and industry guidance, the new 14 CFR Part 145 training requirements can breathe new life into aerospace education and provide an alternative for small repair stations that are not financially able to meet the demands of the new requirements by themselves. Such arrangements will also allow for industry and schools to form partnerships that will serve to enhance aviation safety.

4.2.2 Selection of Instructors.

As described by the individuals interviewed during the course of this study and confirmed by research, proper training depends largely on the quality of instructors. Several general characteristics of good instructors have been identified and are listed below:

- Appropriate aviation background
- Aviation experience
- Professional certification
- Demonstrated teaching ability

Repair stations should have careful screening procedures for instructors, with written position descriptions that can be specified in company manuals.

4.2.3 Structure and Depth of Training Programs.

4.2.3.1 General.

There seems to be a general agreement within the industry that the FAA should be very specific with respect to what the Administrator will approve in a training program under 14 CFR 145.163. This specificity relates not only to the type of training certificate holders should provide, but also to the minimum hourly requirements for repair station training programs. The challenge for the FAA is to create a reasonable compromise between an acceptable minimum to raise the bar for repair stations (some consisting of a single person working out of a home) that currently offer no training without precipitating a reduction in the training offered by certificate holders of greater size or whose work is more complex. In other words, what minimums will increase safety on the lower-end of the repair station spectrum without negatively affecting safety at the high-end.

It is possible for repair stations with extensive training programs in place to be tempted to reduce their training budgets and still meet the new standard. However, the FAA should clearly state that the new standard is a minimum and represents the lowest common denominator based on the size and complexity of the repair station's operation. Repair station managers should be

encouraged to maintain at least the same level of training they currently accomplish, if only because they are not currently compelled to do so by the regulations. Obviously there are competitive advantages for these repair stations to devote the necessary resources to the training of their employees. As shown through research and interviews, it simply makes good business sense to have properly trained employees who can do the work efficiently and produce a safe product.

4.2.3.2 Initial Training.

Repair stations should be able to establish the skill level of a new employee and adjust initial training based on that assessment. Repair stations can write procedures into their training program to determine the quality of skills of the new employee. For example, new employees might fit in one of the following categories:

- A&P certificate from a 14 CFR Part 147 school
- Prior experience at another repair station
- Military aviation maintenance experience
- No prior experience

Individual repair stations could accept graduation certificates from a 14 CFR Part 147 school or an A&P certification as acceptable evidence of basic knowledge and skill level in particular areas. Levels of learning 1, 2, and 3, have already been established in the appendices of 14 CFR Part 147 and AC 65-2 for all subject areas. Based on these criteria, a requirement for initial employment could include a demonstration of a level 3 project in a particular skill area. The demonstration of skills could be accomplished by using the level 2 and 3 projects that already exist in the A&P practical study guides. Employees who take these courses or repair stations that sponsor them at a 14 CFR Part 147 school could be entitled to FAA achievement awards under the FAA awards program.

Regardless of the level of experience incoming personnel may have, there should be a basic indoctrination on procedures that are unique to the particular repair station. This should ensure the smooth integration of new employees into the repair station production and inspection systems. Initial training should be delivered to employees within the first 60 days of employment, and it is recommended that the initial training for all job functions be similar in order to establish a common core of knowledge among company employees.

Basic areas that should be covered during a repair station's initial training program include

- Company policy and procedures
- CFRs
- OSHA/EPA/Research and Special Programs Administration (RSPA) and right-to-know training (other governmental agency requirements)
- Shop safety

- MRM

- Policies, procedures, and record keeping requirements of certificate-holding customers

The number of hours of initial training can vary depending on the level of experience of incoming employees. A basic minimum developed by repair station management should be specified for the initial repair station training. However, there can be increased training time and content for the initial training of inspectors, managers, and supervisors, especially on CFRs and company policies and procedures.

4.2.3.3 Recurrent Training.

The FAA develops and conducts a variety of workshops and seminars both domestically and internationally. They cover subject matter that is relevant to all designee inspectors, and the tasks they are required to perform as designees of the Administrator. These seminars are used by designees and certificated airmen for the renewal of their certificates and designations. Each year, FAA-authorized inspectors must renew their designations by meeting certain work criteria. They must have performed specific numbers of major repairs, alterations, and inspections. They may also meet the requirements for renewal by attending and successfully completing a refresher course. This course consists of no less than 8 hours of instruction during the 12 months preceding the application for renewal and must be acceptable to the Administrator.

Currently, many representatives from OEMs and maintenance repair facilities voluntarily attend these seminars as a form of recurrent training. They strive to remain current on various subjects that are relevant to their managerial and/or inspection positions. These individuals recognize the value of refreshing and enhancing their level of expertise in areas such as:

- Regulatory changes
- Inspection procedures
- New techniques
- Sharing of maintenance problems
- Knowledge of forms, procedures, and records
- New air carrier customer recordkeeping and procedure requirements
- RII

Because the holder of an IA performs many of the same functions as an inspector or chief inspector at a repair station, an IA renewal seminar should be acceptable as one of the many alternate means of meeting the new 14 CFR Part 145 training requirements. It also follows that a similar course that consists of at least the minimum 8 hours can be acceptable for such recurrent training.

Recurrent training for all repair station job functions should include a review of all soft-skill, initial training subject matter, with an emphasis on revisions and changes made in the previous year to federal and state regulations and to repair station policies and procedures. Changes in subject content vary with each job function.

Repairman and mechanic practical skills development should also form a major part of the overall recurrent training curriculum. Repair stations have the option of developing their own training curriculum using AC 65-2 (as amended or superceded) or accepting training delivered by approved vendors, manufacturers, air carriers, and 14 CFR Part 147 schools. However, each repair station would still be responsible for developing its own curriculum, which would match their capabilities, work scope, and employee job descriptions.

4.2.3.4 Recommended Structure.

The FAA should recommend that repair stations use AC 65-2 (or its successor), along with Air Transport Association of America Specification 113, Chapter 5 in the development of certain recurrent training program outlines. These documents establish guidelines for curriculum development in all subject areas and levels of learning required for A&P certification under existing 14 CFR Part 65. Using this existing guidance would obviate the need for repair stations to develop their own curriculum outlines.

All repair station mechanics are required to have knowledge and perform maintenance, preventative maintenance, and overhauls to at least the same skill levels as a certificated A&P mechanic. Since the curriculum guidelines in each of these areas have already been developed, repair stations should take advantage of these existing tools. AC 65-2 is sufficiently generic, yet specific enough in content to allow repair stations interested in developing their own training to simply match their shop's capabilities, work scopes, and employee job descriptions with the current AC and develop their own training based on that document.

If a repair station wanted to develop its own training program, the curriculum outline has already been completed and only the lessons would have to be developed and delivered by a qualified trainer. Alternatively, 14 CFR Part 147 schools could be used as a source of training. In addition, employees without A&Ps who continue in a 14 CFR Part 147 program may, after completing all areas of instruction in either power plant or airframe subjects, qualify for FAA certification based on training and experience (if employed for more than 18 months in airframe or power plant maintenance.)

Classroom training in specific areas is also covered by AC 65-2. However, certain practical skills are better delivered using OJT or by a combination of the other existing methods of training. Knowledge skills (level 1) may be better suited for the classroom, while practical skills (levels 2 and 3) are best conveyed through OJT on the shop floor, on an aircraft, or through embedded training. All training would include not only the understanding of subject areas, but also a required demonstration of skill upon completion of each section.

4.2.3.5 Training Program Hours.

Based on the research and industry input, it is recommended that the following ranges of basic hour requirements be the minimum for repair station training programs.

	Initial Hours	Recurrent Hours
Mechanics	8-16	8-16
Managers and supervisors	10-20	8-16
Inspectors	10-20	8-16

Of course, some repair stations already have detailed and extensive training programs that will meet or exceed these minimums. For repair stations that are implementing training programs based on 14 CFR 145.163, the structure of their training programs can be made relatively consistent based on AC 65-2. The amount of time specified for each phase of training of each employee category can vary, but these basic minimums should provide a starting point.

4.2.4 Documenting Training.

The training program itself should use a standard format. The FAA may wish to provide a form that includes elements that must be included for a training program to be approved. Repair stations would be free to include attachments that would expand in greater detail how the repair station's training program would work. For example, they could include a copy of a training manual and use the FAA form as a cover for their submission. Many repair stations already have training manuals, and these should continue to be acceptable as written.

Having all required elements in a standard format would permit the FAA to collect data on levels of training for inclusion in its automated systems. This may enhance the FAA's computerized analysis of certificate holders and permit trends to be studied.

The training program form should include basic information about the repair station, as well as the following:

- Programmed hours of initial and recurrent training
- Training curricula
- Training providers
- Qualifications for instructors
- Training methods, including use of OJT
- Training schedule
- Location of training

Once a training program is approved, any amendments could be accomplished by resubmitting the appropriate form. For its part, the FAA should impose a window during which the amendment would have to be approved or significant disruptions to training cycles could occur. A sample training program is included in appendix A.

4.2.5 Subcontracted Maintenance Resources (Fourth-Party Providers).

For the work described in this report, the term fourth-party providers is generally defined as noncertificated companies that provide A&P mechanics through contracts with repair stations and 14 CFR Part 121 air carriers during periods of heavy workload. Because such an entity is

not certificated, the FAA has little oversight over the company's operations. However, repair station training programs should include provisions to formally integrate such personnel into each repair station's quality and production systems. This process should include a means to validate the prior training of such personnel and provide initial training with appropriate syllabi specific to that repair station's operation. The repair station should have documented methods for bringing such personnel into the repair station's processes as well as a description of how personnel are evaluated during their performance and are removed once their work period is complete. An important aspect of these procedures should be that the repair station cannot use fourth-party providers until that specific training program is approved by the FAA and these personnel have undergone their required training.

A related issue is that of OEMs that also have repair station certificates that can have up to several thousand manufacturing workers to bring into the repair station when it needs the labor. There should be a similar means for such repair stations to ensure that all such personnel have been trained before they perform work within the repair station system.

4.2.6 Improvements to OJT.

Interviews and research have demonstrated the need for repair stations to have proper OJT programs. These should be formalized in some way, such as through a training manual. Such a manual should describe who is responsible for the program, what the qualifications are for OJT instructors (e.g., at least a journeyman level). It should also describe where OJT is appropriate, such as for apprentices and new hires.

An effective OJT program should include a means for the repair station to track and adjust the training that takes place. There are often problems where personnel are trained on specific functions and the original training record is discarded. However, the original record has all the actual information pertaining to exactly what information was provided during the training function. The only information that is transferred to the computerized record regarding OJT is the general training indicators. In such cases, the dates and the trainer information are lost.

The FAA may wish to establish a standard format for OJT tracking, or training in general for that matter. There seems to be an acute need in the industry to provide portability and consistency for mechanic training records. Remedying this problem will make hiring practices easier, and may result in an increase in the professionalism and consistency of aircraft maintenance.

4.2.7 Foreign Repair Stations.

Historically, repair stations based outside the U.S. have been treated somewhat differently than domestic repair stations. In some ways, the requirements are more stringent. One example is the new 14 CFR 145.51(c) that requires foreign repair station applicants to show the necessity to obtain an FAA certificate based on customers with U.S.-registered aircraft and/or articles for use on U.S.-registered aircraft. Although the regulations allow for a 24-month renewal cycle, in practice, foreign repair station certificates are usually limited to 12 months, after which the certificates have to be renewed through an FAA inspection.

One area of significant difference between domestic and foreign repair stations (table 4-1) is the new 14 CFR 145.157, which specifies that persons authorized to approve articles for return to service must hold certificates issued under 14 CFR Part 65. However, this requirement is different for foreign repair stations in that such certificates are not required for personnel returning articles to service. Other requirements in 14 CFR 145.157 ensure an equivalent level of safety for foreign repair stations.

TABLE 4-1. DOMESTIC VS. FOREIGN REPAIR STATION CHARACTERISTICS

Domestic	Foreign
Do not pay for certification	Pay fee for certification
FAA certification lasts indefinitely	Typically certification is renewed every 1 to 2 years
FAA requires drug and alcohol testing	No alcohol or drug testing
Some personnel have to be FAA certificated	Personnel do not have to be certificated by the FAA (may have licenses issued by the local authority)

To ensure this level of safety is maintained, it is recommended that inspectors and other personnel at foreign repair stations who return articles to service have the same level of training specified for such personnel at domestic repair stations. This training should include, at a minimum:

- CFRs
- The repair station's FAA-accepted Repair Station Manual
- Quality manual
- Customer-specific work, such as RII, engine ground run/taxi
- Receiving inspection requirements
- Auditor training for those facilities with established auditor programs
- English language (communication) training appropriate to the level of personnel (the amount of training should be set forth in terms of hours)

Although foreign repair station personnel are not required to hold certificates issued by the FAA, the FAA can encourage the adoption of FAA standards and enhance the quality of released products by creating a program to issue certificates of recognition. These certificates could be issued based on 14 CFR Part 147 approved satellite courses (or through some other means of FAA approval) that are specifically designed for personnel at foreign repair stations who return U.S.-registered products to service. In this manner, foreign repair station personnel would have another source of training that would be acceptable to the FAA, and which could create enhance opportunities for U.S. businesses such as 14 CFR Part 147 schools or other organizations whose expertise are recognized and monitored by the FAA.

One training requirement that should be seriously considered is communication skills, specifically for those employees involved in the approval of return to service of U.S. products. It is recommended that a process to ascertain the initial skill levels of these personnel along with recurrent testing, training, or both be incorporated within the training program for foreign repair stations.

In a related area, FAA inspectors who have worked in International Field Offices (IFO) have stated there is a need for the FAA to implement a training program for all IFO ASIs concerning foreign certificate holders and the differences that exist between the requirements for foreign repair stations and domestic repair stations. This training could take the form of OJT, CBT, or formal classroom training.

4.2.8 Joint Aviation Authorities-Approved Facilities.

Under the current regulatory reorganization that is taking place in Europe, Joint Aviation Requirement (JAR) 145 was terminated on September 28, 2003, in order to allow for European Aviation Safety Agency (EASA) Part 145 to become the dominant regulation. Currently EASA Part 145 includes, for the most part, all requirements set forth by its predecessor, but the requirements are written in a more permissive manner.

Until such time as the new EASA Part 145 takes effect, it may be prudent to allow repair stations, which are also approved maintenance organizations, credit for training conducted in response to a JAR 145 listing on a case-by-case basis and monitor, but not react to, any new European requirements in the development of the FAA's new approved training programs. Acceptance of formal EASA Part 145 training as an alternative means of compliance with the new 14 CFR 145.163 training program requirement may be developed best under a Bilateral Aviation Safety Agreement's Maintenance Implementation Plan.

4.2.9 Additional or Alternative Training.

Repair stations should be extremely discerning when selecting individuals who will attend specialized training. Often the choice on who is sent to such courses is based on seniority rather than more important factors. Because the investment in such a course can be substantial, the person who is sent for advanced training should possess a professional attitude as well as the ability to convey the new information to other employees. Not everyone is suited for teaching such material, and repair station managers should seek out talented individuals to teach specialized courses.

Air carriers should include remedial training in their training programs as well. If a problem emerges through auditing, or through investigation of an accident or incident, provisions within the air carriers program should require remedial training be given at that repair station.

Many repair stations possess additional certifications from numerous Civil Aviation Authorities, most predominately, JAR 145 listing. The FAA should make every effort to evaluate and accept as alternative training those requirements being implemented by their repair stations that satisfy these additional ratings. This will reduce redundant training and lessen the economic burden imposed on the repair station.

4.2.10 Future Requirements.

Due to the changes in the operational environment that have taken place since September 11, 2001, the Transportation Security Administration (TSA) is likely to require increased security measures for repair stations. Although TSA is still in the process of evaluating this issue, it is recommended that the following list of basic areas of security awareness be included in a repair station's training program:

- Accessibility to the repair station premises, physical security.
- Use of subcontracted employees, such as cleaners, and awareness that such personnel are unlikely to have had proper background checks.
- Receiving and shipping of materials creates the possibly to allow chemically or biologically contaminated parts or sabotaged parts to find their way onto aircraft.
- Ensuring that shipped parts and materials are packaged in such a way that it would indicate if they have been tampered with.
- Security and validation of the Automated Test Equipment program content.

The RSPA solicited final comments in September 2003 for proposed changes to their regulations, specifically 49 CFR Parts 171, 173, and 175. This revision will require all repair stations to provide hazardous material recognition training to all employees. Once finalized, this requirement should also be placed within the repair station's training program.

It is important to specify that although repair station training programs that will be submitted for approval will include additional training that is required by other governmental agencies, the FAA ASIs will not be responsible for evaluating the adequacy or completeness of this training. It makes sense for repair stations to produce a single all-encompassing training program that includes these other requirements, but they are not obligated to demonstrate they are providing such training to their FAA ASIs.

4.2.11 Regulatory Responsibilities.

To provide standardization and consistency, all advisory or guidance material published on the 14 CFR Part 145 approved training program should clearly identify the FAA's intended goals and objectives and provide a process to measure the programs effectiveness that can be used as a standard guide by both industry and regulators.

The FAA ASIs should be properly trained in the evaluation of repair station curriculum development, methods of training, and the appropriateness of various types of training. They should also have the ability to offer guidance in the development of repair station training programs specified by 14 CFR 145.163.

Interviews of FAA personnel revealed that there are a great number of questions and concerns regarding the new requirements. For example

- What is an "assigned task" as described in the rule?
- What will be the level of specificity required for each task?
- What are the tasks of a supervisor, for example?
- What are task levels?
- Does the program need to address each possible part? If so, there will be literally thousands of tasks for each employee.
- Will the training program include all employees or only certificated employees?
- How does the training program relate to 14 CFR 121.375?
- Do the requirements of 14 CFR Part 121 supercede those for 14 CFR Part 145?
- What are the definitions of "initial" and "recurrent" training? Is recurrent training a repetition of the initial one?
- When and how does the training program have to be submitted and approved? At the initial certification or when the repair stations requests a new rating?
- How about when a repair station adds capabilities to its list?
- Do courses have to be approved again or is an approval good forever?
- What will the criteria be? What will trigger a re-evaluation of the programs?
- Will this take place every year?
- What does the FAA approval mean? Will this approval be for each task?
- How can FAA inspectors approve training when in some cases they don't know enough about a particular technique or specialty to evaluate that training?
- Will FAA ASIs be liable if they approve a training course and an accident occurs that is related to training?
- Will the FAA create an approved format for the programs?
- Will electronic versions be accepted for approval?

- Some repair stations perform repairs on very old equipment. How will these repair stations' employees get training on aircraft whose manuals may have been out of print for over 50 years (for example)?

- The interface with 14 CFR Part 121 operators training definitely needs to be included during guidance development and evaluation.

- Who monitors the quality of training conducted by external providers?

The FAA needs to make a concerted effort to gain ASI input into the development of guidance and ensure that the guidance clarifies important questions such as these. Some of the ASIs interviewed for this research stated that it would be of great value to the ASIs in the field to see the draft guidance and provide comments on it prior to it being issued in final form. They even recommended that it might be useful to create a website to share ASI concerns regarding the new AC.

One advantage may lie in the use existing FAA guidance such as AC 65-2 and AC 147-3 (which would provide consistency in all maintenance training) to develop their curricula. However, the FAA needs to clarify the status of AC 65-2, which is shown as withdrawn on AC listings but has not been superceded. This has led to limited availability of this important guidance with no clear alternatives in place. In addition, the FAA's auditing of their training programs would only differ slightly from existing procedures already in use for auditing 14 CFR Part 147 schools.

FAA oversight of repair station training programs could represent a significant increase in workload for FAA personnel if not properly coordinated during implementation. However, the FAA can look for efficiency gains in this process if it is approached in a systemic manner. Different aspects of repair station training will be evaluated by several ASIs with differing oversight responsibilities, such as oversight of 14 CFR Part 145 repair stations, 14 CFR Part 147 schools, and 14 CFR Part 121 air carriers. If the data collected during surveillance of these various types of operations is conducted in a cohesive manner, it should provide an efficient means for the ASIs to share information and surveillance results and should not increase ASI workloads. This will require enhancements to FAA data collection systems such as Program Tracking and Reporting Subsystem, which will need additional work codes to capture 14 CFR Part 145 repair station training program information. The FAA ASIs responsible for air carrier oversight can also ensure that the CASS of their air carriers is also monitoring the training programs of repair stations their air carrier's contract with. In addition, the FAA must also ensure that the Consolidated Aviation Suppliers Evaluation audits are modified to incorporate assessment of repair station training.

The FAA should develop CBT materials on various regulatory and safety-related subjects and make them available at cost to the industry. In addition, the FAA can also provide free accident prevention seminars, programs, and industry workshops that could be credited as valid training for repair station employees. At the same time, mechanics could also be issued maintenance awards for attending these sessions. This could become an important step in keeping mechanics aware of both regulatory (CFRs) and nonregulatory information, such as avionics or composites. Special workshops could be developed specifically for repair stations within the different FAA regions. In addition, the FAA could also give training credit for some industry conferences and

workshops, which many repair station personnel attend on a regular basis. For example, attendance at three approved workshops could be equivalent to 1 hour of training. The FAA should develop criteria on how to accept these seminars, such as through the review of curricula.

Associations such as the Professional Aviation Maintenance Association and the Aviation Technician Education Council should be encouraged in their efforts to develop enhancements to AMT training, such as the idea of recognized type ratings for mechanics based on certain levels of experience above the basic A&P. Under this system, skills are split into specialties and will raise the level of recognition for such training.

Although limited in number, it is recommended that training programs for organizations performing very specialized functions under their authorities granted by Special Federal Aviation Regulation 36 or those certificated as DASs specifically address the issue of training for their engineering staff. Requirements in these areas should be closely coordinated with the Aircraft Certification Service since approvals of the above authorizations are a joint function of both FAA services.

Also, some of the interviewed ASIs have stated that there is a real need for the FAA to provide training to its ASIs in specialized services such as shot peening and plating, which are standard in the industry but are currently not covered in any FAA curriculum.

5. RESEARCH MATERIALS.

- "Maintenance Human Factors Program Guidelines," ATA Specification 113, Revision 2002.1, Air Transport Association of America.

- "Comparative Study of Personnel Qualifications and Training at Aviation Maintenance Facilities," Raymond P. Goldsly, Senior Aviation Specialist," Galaxy Scientific Corp. Technology Information Division and Jean Watson, Program Manager, Aviation Maintenance Human Factors Research, Office of Aviation Medicine, FAA.

- "Standards for the Certification of Aviation Maintenance Technicians using a Structured Experience Program," (Final Report), Charles W. White, Aviation technical Training & Consulting and Michael J. Kroes, Purdue University for The Aircraft Maintenance Division of FSS.

- "Maintenance Human Factors Technician Training: Get it Right the First Time," David Hanson M.S., Program Manager Maintenance Human Factors Training, Flight Safety Boeing Training International, 16th Human Factors in Aviation Maintenance Symposium, April 2-4, 2002.

- Aviation Maintenance Technical Training: "Training Requirements for the 21st Century," Charles W. White and Michael Kroes.

- "FAA Needs to Update the Curriculum and Certification Requirements for Aircraft Mechanics," GAO-03-317GAO, Report on Aviation Safety, March 2003.

- "FAA Oversight of Repair Stations Needs Improvement," GAO Report on Aviation Safety, October 1997.

- "Review of Air Carrier's Use of Aircraft Repair Stations," FAA IG Report AV-2003-047, July 8, 2003.

- AC 65-2D, "Airframe and Powerplant Mechanics Certification Guide."

- AC 65-31A, "Training, Qualification, and Certification of Nondestructive Inspection (NDI) Personnel."

- AC 145-5, "Repair Station Internal Evaluation Programs."

- AC 145-7A, "Issuance of Repair Station Certificates to Foreign Approved Maintenance Organizations Under the Maintenance Implementation Procedures of a Bilateral Aviation Safety Agreement."

- AC 145-8A, "Acceptance of Repair Station by the JAA and JAA Member NAA Under the Maintenance Implementation Procedures of a Bilateral Aviation Safety Agreement."

- AC 145-9, “Guide for Developing & Evaluating Repair Stations & Quality Control Manuals.”
- AC 147-3, “Certification and Operation of Aviation Maintenance Technician Schools.”
- AC 147-4, “Guidelines for Evaluation of Military Aviation Training Courses.”
- Canadian Aviation Regulations Part V, Subpart 573, “Approved Maintenance Organizations.”
- FAA Memo, “Qualification Standards for Nondestructive Testing (NDT) Inspection/Evaluation Personnel.”
- ICAO Document 9642—Continuing Airworthiness Manual.
- ICAO Document 9389—Manual of Procedures for an Airworthiness Organization.
- ICAO Annex 6—Operation of Aircraft.
- JAA Administrative & Guidance Material, Leaflet No. 40 “JAR 66.45 Certifying Staff Type Certifying Courses.”
- JAR 66, “Certifying Staff Maintenance,”
- JAR 145, “Approved Maintenance Organizations.”
- JAR 147, “Approved Maintenance Training Organizations/Examinations.”
- NBAA Guidelines for Business Aviation Maintenance Training, National Business Aviation Association Inc. (NBAA) Booklet (undated).
- US Navy Training System Plan for AMTCS CBTSI, “Technology Infusion,” Initiative, June 2001.

APPENDIX A—SAMPLE TRAINING PROGRAM FORMAT

The most important features of a training program is that it is tailored to meet the needs of the repair station and it answers the essential "who, what, when, why, and how" questions of the repair station's program. The structure of the program (initial and recurrent phases) should be specified, as well as the syllabi for the various courses. However, if some or all of the training is conducted by an external organization, course descriptions from those training providers should be sufficient to meet the specific requirements of the repair station. The FAA may wish to set up a standardized format for the training program as a way to incorporate existing training programs into compliance with this new regulatory requirement. Organizations with existing training manuals could use this format as a template to present their training programs to the FAA for approval. In such cases, the repair stations should include its existing training manual as an attachment to avoid duplication of effort. Creating a standard format would also provide guidance to repair stations that are creating programs from scratch.

A.1 AIR TRANSPORT ASSOCIATION OF AMERICA SPECIFICATION 113.

Air Transport Association of America (ATA) has developed an excellent plan for the development of maintenance human factors training programs in Specification 113. That document divides training program development into the following phases (see figure A-1) that are useful in a more general sense for the development of overall training programs, as well as individual courses.

- Needs assessment/analysis—The purpose of this phase is to determine the goals and objectives of the training. This can be a self-assessment for the organization to figure out what it needs.

- Design phase—This phase serves to refine training goals and objectives and instructional and evaluation strategies.

- Basic curriculum—The basic curricula can be organized into subject matter areas and modules.

- Prototype—This phase includes the delivery of training materials, the training of instructors, and a dry run of the sections in the program to verify proper flow of the material.

- Validation—At this stage, the training can be delivered in a typical training environment. Meetings should be held to discuss and evaluate the prototype to fine tune the program.

- Adoption—The training program is scheduled and formally announced.

- Implementation—The training is provided at this stage.

- Trainee evaluation—It is important to evaluate the trainee's comprehension of all course material.

- Program measurement—Program developers should identify valid and reliable processes to measure training program effectiveness.

- Feedback—This phase allows the end product to influence the training program in a constant cycle of evaluation and improvement, such as though class and instructor evaluations.

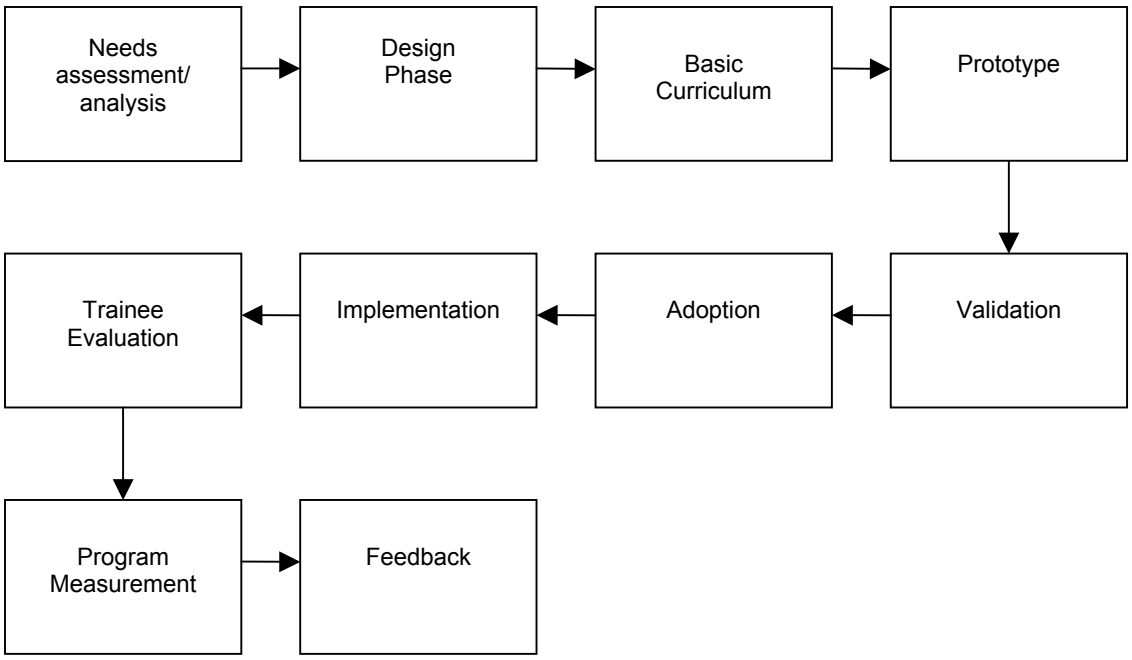

FIGURE A-1. THE ATA SPECIFICATION 113 TRAINING PROGRAM DEVELOPMENT PROCESS

A.2 PURPOSE.

The purpose of the training program is

- to comply with the regulatory requirements of Title 14 Code of Federal Regulations (CFR) 145.163 and others.

- to provide a thorough background and continuing education for employees to perform their job functions efficiently, safely, and correctly.

- to familiarize employees with the repair station's quality systems and procedures.

A.3 AUTHORITY AND RESPONSIBILITY.

The person who is responsible for the training program, as well as the person who has the authority to make changes to the program, should be identified. These may be the same person,

or at larger organizations, the responsibilities for the training program can be spread among several people. The various responsibilities for the training program include:

- Acting as liaison with the FAA on training issues
- Developing training requirements
- Identifying training needs
- Scheduling training courses
- Planning on-the-job training and selecting instructors
- Ensuring company training records are accurate and complete
- Evaluating the training program to verify that it continues to achieve its goals

A.4 PERSONNEL CATEGORIES.

Repair stations should divide their training requirements into personnel categories with similar training needs—in this example the categories are mechanics, managers and supervisors, and inspectors. The training program should include minimum training times for each phase of training. See figures A-2, A-3, and A-4 for examples.

The sample training programs shown in figures A-2, A-3, and A-4 depict training areas that have been differentiated by the use of solid boxes (see example below) where the training in question is mandated by the Federal Aviation Administration (FAA) or the repair station itself, which comes under the review of FAA Aviation Safety Inspectors (ASI). Other governmental requirements by agencies such as Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency are shown in dotted boxes (see example below) to show that while these training areas may be included in an overall training program approved by the FAA, the FAA ASIs who will be approving these programs will not review the content or make any determinations on the adequacy of such training.

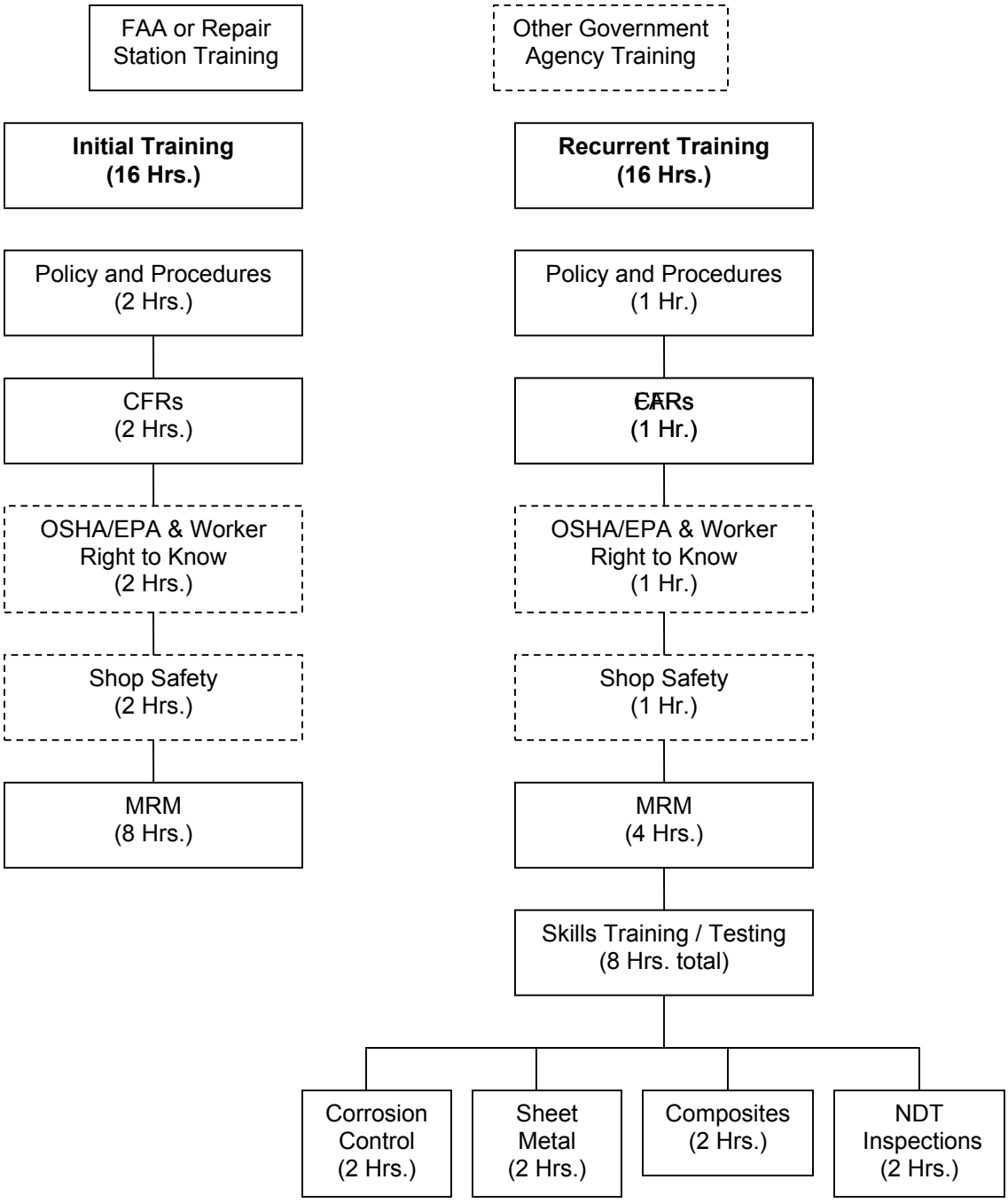

FIGURE A-2. MECHANICS TRAINING

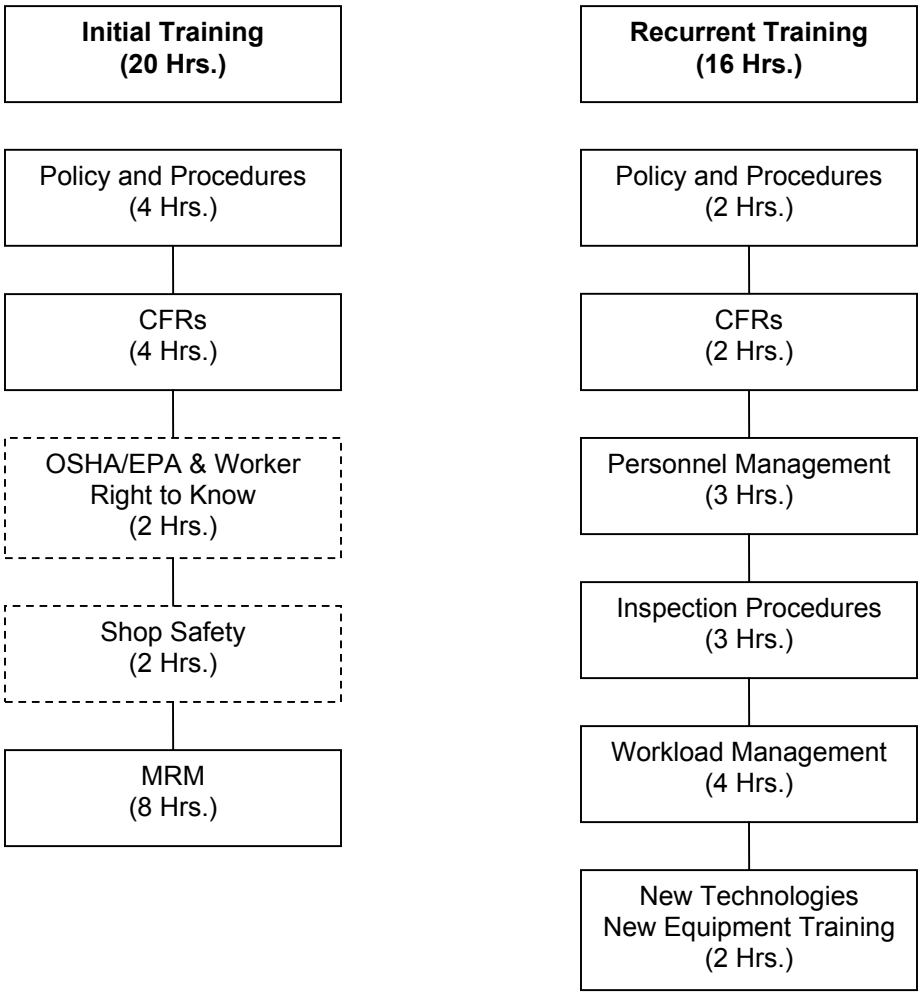

FIGURE A-3. MANAGERS AND SUPERVISORS

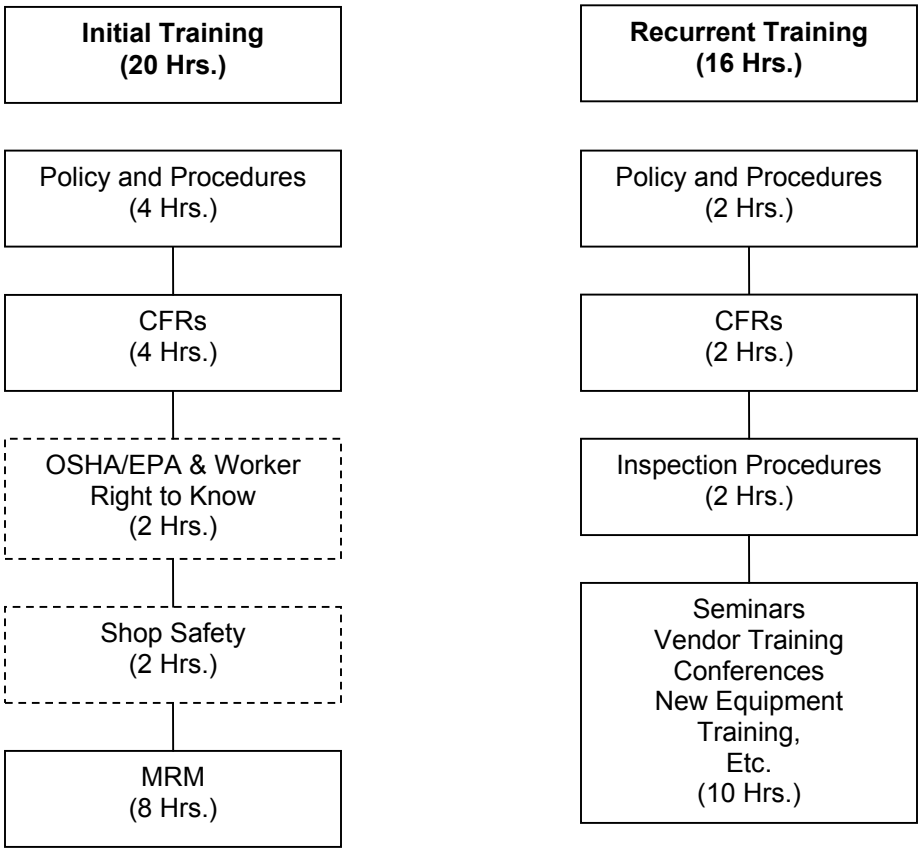

FIGURE A-4. INSPECTORS

A.5 INITIAL TRAINING.

All new employees should have a detailed training file initiated once they are hired to include all existing education, certificates, and qualifications. The responsible person or department should conduct an initial assessment based on this file to determine what the initial training should be for each employee. Some new-hire employees will have no aviation experience, while others will have extensive experience. The initial training program should be tailored appropriately.

The repair station's initial training can be provided all at once or in several phases, as long as it is accomplished within the first 60 days of employment.

Examples of phases for initial training are:

- Phase 1: Company policies and procedures
- Phase 2: Shop safety, maintenance resource management, CFRs, and other governmental requirements, such as OSHA and Department of Transportation hazardous materials training.
- Phase 3: Training on customer requirements and or specialized personnel requirements.

Once employees have completed the initial training, they should undergo testing to ensure retention of the required material.

A.6 RECURRENT TRAINING.

Recurrent training will vary by employee, but in all cases, it should be mandatory. The repair station's training program should specify what types of recurrent training will be offered to company employees. Subjects will range from basic skill training to advanced qualifications and should be listed in the program.

A.7 TRAINING COURSE SYLLABI.

These can be determined by the repair station as appropriate. Each syllabus should include the following information:

- Course prerequisites—What employees must have completed before they are eligible for the course.

- Training subject—What knowledge is supposed to be imparted by the course and what material the course is supposed to contain.

- Course duration—This should be specified in hours.

- Course methodology—The method for the training course should be specified. There are a variety of methods to choose from based on what is most appropriate for the course in question. They range anywhere from OJT to formal classroom courses.

- Completion standards—This is a clear specification of what has to be accomplished for the employee to complete the course. Examples of this could be a written or practical test with a passing grade, a submitted project or demonstration of skill, or a certificate of completion.

A.8 QUALIFICATIONS AND AUTHORIZATIONS.

The repair station should describe the training requirements for various qualification levels of its employees depending on their job function as well as individual authorizations. For example:

- Required inspection item
- Inspector levels
- Mechanic skill levels
- Specialized services

A.9 INSTRUCTOR SELECTION.

The repair station's training program should include criteria for course instructors and a description of how instructors are selected. In cases where the sources of training are external to the repair station, it may not be possible to select instructors, but the quality of instruction should be monitored to ensure the quality of training the employees receive is adequate.

A.10 PLANNING AND SCHEDULING.

Most training should be scheduled in advance to ensure adequate preparation time and to maintain a continuity of training for all employees. Management should plan training based on current requirements, but the plan may need to be adapted to changing needs, such as those of a new customer or with the acquisition of new equipment.

Occasionally, remedial training will be required for employees stemming from the results of an audit or from an accident or incident investigation. This type of training cannot be scheduled in advance and may have to be accomplished relatively quickly. Therefore, the training schedule should be sufficiently flexible to accommodate such circumstances.

A.11 TRAINING RECORDS.

The repair station's training program should specify where employee training records are maintained and for how long (at least 2 years). Many repair stations will elect to keep employee training record summaries in a computer system. If records are maintained electronically, the repair station should also maintain a physical file to keep important documents such as FAA certificates, diplomas, and proofs of course completions. The training program should also specify the procedure by which records are maintained as well as what quality control will be conducted over those records. At a minimum, the training record should include:

- Employee's name and signature
- Dates and duration of training
- Type of training
- Location of training
- Name and signature of instructor
- Test results (if applicable)

A.12 TRAINING FACILITIES.

A description of training facilities can be included in the repair station's training program. If the facility has a dedicated classroom it should be adequately lighted, ventilated, and equipped. Alternatively, an off-site facility could be used.

A.13 QUALITY CONTROL.

Each repair station should discuss in their training program how they intend to monitor the quality of the training they provide to their employees. There should be a formalized effort to review the effectiveness of the training program, although this may be through an external means (such as by an audit by a department other than personnel or training). At the very least, trainees should be asked to fill out course evaluation forms. These should be compiled and analyzed to identify either best practices or deficiencies in instructors or training materials.

Supervisors may also elect to attend certain classes to enhance the quality control process, although this may not be easy for classes provided by external organizations. Audits of external training providers may be scheduled as an alternative. If this is not possible or desirable, an interview of returning course attendees can be done to obtain more detailed information than would be possible through a written questionnaire.

A.14 DEFINITIONS AND ABBREVIATIONS.

The repair station training manual should define all terms and acronyms for the sake of clarity and to avoid confusion in cases where acronyms are company-specific and may have different meanings among different facilities.