Overview of the Maintenance Technician

The Mechanic Certificate — Maintenance Technician Privileges and Limitations

Since part 65 was covered only briefly in Chapter 12, it was left for this chapter to develop it more completely. Therefore, this chapter discusses the Federal Aviation Administration (FAA) regulation governing the certification of airmen other than flight crew members. This chapter is based on the material contained in Title 14 of the Code of Federal Regulations (14 CFR) part 65, which has the following subparts:

- Subpart A — General
- Subpart B — Air Traffic Control Operators
- Subpart C — Aircraft Dispatchers
- Subpart D — Mechanics
- Subpart E — Repairmen
- Subpart F — Parachute Riggers

This chapter will only focus on the certification of maintenance technicians, and therefore subparts B, C, E, and F will not be addressed.

The FAA certifies two separate categories of maintenance technicians, mechanic and repairman.

The fundamental difference between these two is that the mechanic certificate is transportable, is issued to the technician based upon his or her training and knowledge, and is not dependent on the technician's location. Although the repairman certificate is also based upon the training and knowledge of the technician, it is specifically issued to that technician while he or she is employed at a distinct location of a specific company. This certificate carries a literal address where he or she is authorized to work using his or her repairman skills. When the technician is no longer employed there, the repairman certificate must be returned to the Flight Standards District Office (FSDO) that issued it.

Mechanic Certification — General (by 14 CFR Section)

65.3 Certification of Foreign Airmen Other Than Flight Crewmembers

Normally, the FAA issues these certificates only to U.S. citizens or resident aliens residing in the United States. However, on occasion if the FAA determines that the issuance of a certificate to a person located outside of the United States is necessary for the operation and continued airworthiness of a U.S.-registered civil aircraft, it will issue a certificate to that person, providing they meet the necessary requirements.

65.11 Application and Issue

Any person who meets the criteria for obtaining a mechanic certificate must apply by means of a form and in a manner prescribed by the Administrator. That form is FAA Form 8610-2, Airman Certificate and/or Rating Application. If a mechanic has had a certificate suspended, they may not apply for additional ratings during the time of suspension. A revocation of a mechanic certificate prevents that person from applying for a certificate within a period of 1 year after the revocation.

65.12 Offenses Involving Alcohol and Drugs

Any person, who has been convicted of violating federal or state statutes relating to drug offenses, can be denied their application for a certificate or rating up to 1 year after the date of conviction. The violation can be relating to any one or more of the following actions: growing, processing, manufacturing, selling, disposing, transporting, or importing narcotic drugs, marijuana, depressants, or stimulants. They may also face the suspension or revocation of any certificate that they currently hold.

65.13 Temporary Certificate

A qualified applicant who successfully passes all required tests (a minimum score of 70 percent is required) may be issued a temporary certificate, which is valid for not more than 120 days. During this time, the FAA will review the application and supplementary documentation, and will issue the official certificate and rating.

65.14 Security Disqualification

This section was added following the terrorist attacks of September 11, 2001. It basically states that anyone determined by the TSA to be a security threat will either have their application held if they are applying for a certificate, or have the certificate that they do hold revoked.

65.15 Duration of Certificate

Mechanics certificates are effective until they are surrendered, suspended, or revoked. The difference in these terms can be summarized briefly this way:

- Surrendered means given up voluntarily.
- Suspended means the FAA temporarily removed the certificate from the holder.
- Revoked means the FAA permanently removed the certificate from the holder.

65.16 Change of Name: Replacement of Lost or Destroyed Certificate

If the technician changes his or her name, or is seeking a replacement certificate, an application must be submitted to the FAA at:

Federal Aviation Administration
Airmen Certification Branch (AFS-760)
P.O. Box 25082
Oklahoma City, OK 73125

There is a charge for this service.

65.17 Test: General Procedure

The FAA has designated certain persons to administer the tests associated with obtaining a mechanic certificate. The minimum passing score for these tests is 70 percent.

65.18 Written Tests: Cheating or Other Unauthorized Content

If the mechanic or repairmen applicant is determined to be cheating, or otherwise involved in unauthorized conduct, they are not eligible for *any* certificate or rating under this chapter for a period of 1 year. Furthermore, current ratings the person already holds may also be suspended or revoked. Unacceptable conduct for written tests consists of:

- Copying or intentionally removing the test.
- Giving or receiving any part of a copy of the test.
- Giving or receiving help during the test taking period.
- Using any material or aid during the test taking period.
- Intentionally causing, assisting, or participating in any of the previous acts.

65.19 Retesting After Failure

Should the mechanic or repairman fail to achieve the required minimum passing grade, there are two options they may consider when desiring to apply for retesting:

- Wait a period of 30 days after the date of test failure.
- Seek additional instruction in the subject matter areas he or she failed, and provide a signed statement from the certificated technician providing the instruction.

65.20 Applications, Certificates, Logbooks, Reports, and Records: Falsification, Reproduction, or Alteration

In 14 CFR part 43, paragraphs 9 and 11, defines the requirements for a technician to make appropriate entries in the maintenance/inspection records for the work performed. This proper documentation is fundamental to safe and efficient operation of the U.S. civil aircraft fleet. Therefore, the FAA takes strong action against those who would participate in the falsification of those records. The following actions are the basis for suspending or revoking any certificate or rating held by the person invoked:

- Fraudulent or intentional false statement on an application.
- Fraudulent or intentional false statement in any logbook, record, or report required to show compliance with any certificate requirements.
- Any reproduction (for fraudulent purposes) of a certificate or rating.
- Any alteration of any certificate or rating under this part.

65.21 Change of Address

If the technician changes his or her address, the FAA (at the address shown below) must be notified in writing within 30 days after the change of permanent residence:

Federal Aviation Administration
Airmen Certification Branch (AFS-760)
P.O. Box 25082
Oklahoma City, OK 73125

65.23 Refusal to Submit to a Drug or Alcohol Test

Any technician who refuses to submit to a drug test, which is required by 14 CFR part 121, appendix I or J, is subject to denial by the FAA of any application for additional certification or ratings, and suspension or revocation of any existing certificate or rating he or she currently holds. Appendix I of part 121 is titled Drug Testing Program, and requires a urine sample from the employee. Appendix J is titled Alcohol Misuse Prevention Program and requires that the employee submit to a breath test. Each appendix contains a "Definitions" section and a section titled "Employees who must be tested." Persons involved with "Aircraft maintenance or preventative maintenance duties" are listed in both appendices. There are various types (or rather times) when testing is required.

- Pre-employment
- Periodic
- Random
- Post-accident
- Testing based upon reasonable cause
- Return to duty testing
- Follow-up testing

The numerous test methods and the harsh penalty imposed by the FAA on those who would involve themselves with these unauthorized substances, or abuse the allowable use of alcohol indicates the concern that the FAA has for the possible impairment of technicians. Aviation maintenance is a professional career choice that demands the highest caliber technical person to be capable of functioning at his or her maximum potential. There is no room in this profession for a person to be involved with substance abuse. By doing so, the technician not only endangers themselves, but their co-workers, and ultimately the customer who is expecting to have an airworthy aircraft delivered following a maintenance activity.

Mechanic Certification — Specific (by 14 CFR Section)

65.71 Eligibility Requirements: General

The requirements for obtaining a mechanic certificate are:

- Be at least 18 years of age.
- Be able to read, write, speak, and understand the English language. (Note: If the applicant does not meet this requirement and is employed outside the United States by a U.S. carrier, the certificate will be endorsed "valid only outside the United States.")
- Have passed all the required tests (written, oral, and practical) within the preceding 24 months from application.
- Possess and demonstrate the appropriate knowledge and skill for the certificate rating being sought.

If a technician has one of the ratings, and desires to add the other, he/she must meet the requirements set forth in section (§) 65.77, and take the written, oral, and practical tests within 24 months.

65.73 Ratings

The FAA recognizes two ratings, airframe and powerplant, which may be obtained by a person upon successful application and testing. These may be attained either individually, or as a combined certificate.

Any person holding an aircraft (A) or aircraft engine (E) certificate prior to June 15, 1952, and which was valid on that date, may exchange it for the corresponding current certificate. If both ratings were held, the A & E certificate may be exchanged for an A & P.

65.75 Knowledge Requirements

Any applicant meeting the experience requirements listed in 65.77 must pass a written test (minimum passing score of 70, reference §65.17) covering the construction and maintenance of aircraft. Applicable portions of 14 CFR 43 and 91 are also included in the testing. Basic principles for the installation and maintenance of propellers are included with the testing that is administered for the powerplant rating. Successful completion of the written test is required before the candidate may apply for the oral and practical tests identified in section 65.79.

65.77 Experience Requirements

Each mechanic applicant must have a certificate of completion from an FAA certified technician school (14 CFR part 147) or provide documented evidence of a minimum of 18 months practical experience related to either airframe or powerplant maintenance (30 months required if applying for certification for both airframe and powerplant).

65.79 Skill Requirements

Oral and practical tests to determine the applicant's basic knowledge and skills necessary for the certificate or rating sought are required to be completed after the applicant has successfully completed the written test. Minor repairs and minor alterations to propellers are required to be demonstrated as part of the powerplant rating.

65.80 Certificated Aviation Maintenance Technician School Students

Whenever satisfactory evidence is shown to the FAA that a student enrolled in an aviation maintenance training school certificated under part 147 is making satisfactory progress, that student may take the oral and practical tests required by paragraph 79, prior to completing the school (as required by paragraph 77) and prior to taking the written test required by paragraph 75.

65.81 General Privileges and Limitations

Once a technician becomes a certificated mechanic, he or she may perform or supervise the maintenance, preventive maintenance, or alterations of an aircraft or appliance (or part thereof) for which he or she is rated. However, he or she is *not* permitted to perform major repair or major alterations to propellers nor accomplish any repair to or alteration of instruments. These activities are reserved for certificated repairmen at an authorized repair station. Also, he or she may not supervise the maintenance, preventive maintenance, or alteration of any aircraft or appliance (or part thereof) for which he or she is rated, unless he or she has satisfactorily performed this work at an earlier date. This is where the benefit of keeping an on the job training (OJT) log cannot be overemphasized. Whether the technician attends a part 147 maintenance training school or receives the required number of months as practical experience, he or she has only scratched the surface of the tremendously complex world of aviation maintenance. The technician must either work with someone (like a shop mentor) or must perform the task satisfactorily for the FAA. The certified mechanic must have and be able to comprehend the maintenance manuals and/or instructions for continued airworthiness for the task he or she is accomplishing.

65.83 Recent Experience Requirements

In addition to having the proper documentation, the mechanic is required by this regulation to have recent and relevant work experience. Although, as it was stated earlier in this chapter, the A & P certificate is valid until it is surrendered, suspended, or revoked, it may not be exercised if the holder has not been actively working as a mechanic at least 6 of the preceding 24 months. This activity can be any one of the following, or any combination of them:

- Served as a mechanic under the certificate and rating
- Technically supervised other mechanics
- Supervised (in an executive capacity) the maintenance or alteration of an aircraft

65.85 Airframe Rating: Additional Privileges

A mechanic who holds an airframe rating may approve and return to service an airframe, an appliance, or any related part after he or she has performed, supervised, or inspected minor repairs or alterations. He or she may also perform the maintenance actions required for a major repair or alteration, and should initiate the appropriate form (FAA Form 337, Major Repair and Alteration) associated with that work. However, the return to service action must be accomplished by a certificated A & P technician holding an Inspection Authorization (IA). (Refer to 14 CFR §65.95.) The airframe mechanic is also authorized to perform the 100-hour inspection (if required per 14 CFR part 91 §91.409) on the airframe.

The FAA recently added a new category of aircraft called Light Sport. (Refer to 14 CFR part 21, §21.190.) A certificated Airframe technician can approve and return to service the airframe after performing and inspecting a major repair or major alteration. The work must have been done on products that are not produced under FAA approval (i.e., are not type certificated) and must have been performed in accordance with instructions developed by the manufacturer or person acceptable to the FAA.

65.87 Powerplant Rating: Additional Privileges

Similarly, a mechanic holding a powerplant rating has the same limitations imposed regarding the powerplant and propeller as the airframe technician has on the airframe rating. He or she may perform and return to service minor repairs or alterations. He or she may also accomplish the work activities required for a major repair or alteration, but the work must be signed off for return to service by an IA. The privilege of performing a 100-hour inspection (if required by part 91) on a powerplant or propeller is also authorized.

A certificated Powerplant technician can approve and return to service a Light Sport powerplant or propeller after performing and inspecting a major repair or major alteration. The work must have been done on products that are not produced under FAA approval (i.e., are not type certificated) and must have been performed in accordance with instructions developed by the manufacturer or person acceptable to the FAA.

65.89 Display of Certificate

Once a technician receives his or her mechanic certificate, the certificate must be kept in the immediate area where he or she normally conducts work and exercises the privileges of the certificate. When requested, the technician is required to present the certificate for inspection to the FAA, or any authorized representation from the National Transportation Safety Board (NTSB), or any federal, state, or local law enforcement officer.

Inspection Authorization (by 14 CFR Section)

65.91 Inspection Authorization

An A & P mechanic who has held his or her certificate for at least 3 years, and has been active for the last 2 years, may submit application using FAA Form 8610-1, Mechanic's Application for Inspection Authorization, to the FAA for consideration as an IA. In addition to the preceding time requirements, the IA candidate must have:

- A fixed base of operation where he or she can be located in person or by phone.
- Available equipment, facilities, and inspection data necessary to properly inspect the airframe, powerplants, propeller, or any related part or appliance he or she will be approving for return to service.

The applicant who meets all the above criteria must then pass a written (computerized) test to determine his or her ability to inspect the airworthiness of an aircraft following either a major repair or alteration action or the performance of an annual or progressive inspection. The minimum passing score for the computer test is 70 percent. If the applicant fails the test, retesting cannot be attempted until a minimum of 90 days have elapsed from the failure date. Unlike the A & P test, there is no reduction in this time if the applicant receives additional training.

65.92 Inspection Authorization: Duration

An IA certificate expires on March 31 of each odd numbered year, but may only be exercised during the time the technician holds a currently effective mechanic certificate. The IA ceases to be effective if:

- The technician surrenders it, or it is suspended or revoked.
- The technician no longer has a fixed base of operations.
- The technician no longer has the required facilities equipment or inspection data available.

Whenever the certificate is suspended or revoked, the technician must return it to the Administrator when requested by the FAA to do so.

65.93 Inspection Authorization: Renewal

An IA certificate may be renewed in one of the following ways each year the technician is seeking renewal:

- The performance of at least one annual inspection for each 90 days the technician has held the IA rating.
- The performance of the inspections of at least two major repairs or alterations for each 90 days the technician has held the IA rating. (Note: The inspections can be counted regardless of the approval or disapproval of the work.)
- The performance (or supervision) and approval of at least one progressive inspection.
- The attendance and successful completion of a refresher course (acceptable to the Administrator) that is at least 8 hours of instruction. This can be either a single day seminar or a combination of individual classes acceptable to the Administrator. Some seminars are sponsored by the FAA FSDOs and are free; others are low cost. Private industry also frequently conducts one-day sessions and usually charge for their efforts. Regardless of who is conducting the seminar, it is usually an excellent way to accomplish renewal, learn about new issues, and develop a network among peers.

No renewal is required for someone who received the IA during the first quarter of the calendar year, since the regulation states that anyone holding an IA for less than 90 days need not meet the preceding renewal requirements.

It should be noted that regulations clearly state the number of annual inspections and major repair or alteration inspections required for renewal are *for* each 90-day period and not *in* each 90-day period. Therefore, an IA could actually go 11 months without performing any inspection activity relative to renewal. Then, in March he or she could conduct all four necessary annual inspections, or all eight 337-related inspections. The regulations do not provide for the mixing of any of these renewal activities (i.e., two annual inspections and four Major Repair and Alteration forms).

Another method of renewal is to meet with the FAA-assigned FSDO inspector who will determine that the applicant possesses current knowledge of the applicable regulations and standards. Although this is often considered the renewal method of last resort, it should not be considered a negative experience. If the IA has been performing his or her activities in a professional manner throughout the year, this session can be considered a professional follow-up or consultation. Proper IA-to-FSDO inspector interaction can be enhanced with such a meeting.

65.95 Inspection Authorization: Privileges and Limitations

The IA may perform an annual inspection, or perform or supervise a progressive inspection. He or she may also approve for return to service any aircraft related part or appliance which has undergone a major repair or alteration (except aircraft maintained in accordance with a continuous airworthiness program operated under part 121).

The IA must keep his or her certificate available for inspection by any one of the following persons:

- Aircraft owner
- A & P technician
- FAA Administrator
- Authorized representative of the NTSB
- Any federal, state, local, or law enforcement officer

If the holder of an IA moves his or her fixed base of operation, he or she must notify in writing the FSDO responsible for the location he or she is moving to, before beginning to exercise the privileges of an IA. Although it is not required, good business etiquette and professional responsibility would suggest that a similar letter be written to the responsible FAA principal maintenance inspector (PMI) at the FSDO in the area he or she is leaving.

Ethics

This is a tremendously broad and diverse area of study. It is also an area that is coming under more scrutiny by consumers, individual watchdog groups, and government review committees. Ethics, or more appropriately the lack of ethics, has caused the loss of millions of dollars through fraudulent accounting practices, shoddy workmanship, etc. This chapter examines some definitions of ethics and some examples of poor business ethics in order to raise the awareness of the technician to the importance of ethics.

The word "ethics" is actually a philosophical term that comes from the Greek word "ethos," which means character or custom. So, it is logical that a current definition of ethics is "the study of standards of conduct and moral judgment." Although situations involving questionable ethics can exist wherever and whenever business decisions are made, the scope of this discussion is limited to areas with which the technician will probably be associated.

A Scenario

The following incident illustrates one way that both personal ethics and technician knowledge of regulations can work together to provide him or her with the ability to make the right decision. Unfortunately, others in that shop did not appear as concerned as the technician sharing the incident.

A technician working for an airline was involved in a situation that required a repair or replacement of a fuselage ice shield. The computer inventory indicated that a replacement part was in stock, so the technician removed the damaged component. It was then found that the replacement part was not actually in stock. At this point, a crucial decison was to be made: Can the damaged item be reinstalled? The steps in properly documenting a maintenance event are to record the removal of the damaged part, then document the installation of an airworthy part. Once the technician has committed to removing the damaged part, it becomes unairworthy and cannot be reinstalled regardless of its deferability in the minimum equipment list (MEL).

The actual sequence of events is as follows:

Significant impact damage to the ice shield was observed and recorded.

The inspector reviewed and instructed the technician to replace the ice shield.

Availability of the replacement part was confirmed by computer.

The damaged part was removed, and the technician prepared the surface for the replacement part.

The new part was ordered from inventory, but the part was not in stock. (Inventory Error)

The inspector instructed the technician to reinstall the old one.

The technician refused.

The inspector instructed the technician to repair it.

The technician researched the structural repair manual (SRM) and found that the facility did not have the proper facility authorization to repair the damaged part.

The inspector told the technician to apply 5-minute epoxy to the area, sand it down, and paint it.

The technician walked away.

The inspector found someone else to compromise standards. The aircraft departed on time—illegal and unairworthy.

This happens more often than one would like, is probably overlooked by many people, and, unfortunately, might be considered standard operating procedure (SOP) for some maintenance facilities. It is the responsibility of the mechanic to follow regulations and to question the actions of his or her supervisors if the policy is to circumvent rules to make an on-time departure.

This incident provides some valuable insights into how day-to-day events can lead to pressure to produce and ultimately compromise the decision-making.

1. The incident occurred while working for a commercial airline. The pressure for getting the aircraft in the air is tremendous in this environment.
2. Inventory error added to the pressure. The damaged part had been removed because the technician had queried and believed a replacement part was immediately available.
3. The inspector was either unaware of regulatory requirements or simply did not care.
4. The second technician was either unaware of regulatory requirements or simply did not care.

Final Observation

The underlying company culture was apparently lacking concern for ethical decisions and regulatory compliance. An effective organizational culture should always encourage ethical behavior and discourage unethical behavior. This means that not only does the upper management of an organization say that they conduct themselves ethically, they must do it consistently; employees, customers, vendors, and even competitors should know this company has "high ethical standards."

This latter issue may sometimes have painful consequences, if the businesses are competing for a customer's business. The ethical company may estimate the maintenance activities to take 8 weeks and quotes that time frame to the customer. The unethical company may also know the work will take 8 weeks, but tells the customer only 6 weeks, hoping to get the job. Once the plane is "captured" and maintenance has begun, explanations and excuses extend the original time estimate of 6 weeks to the actual 8 weeks or longer. Although the customer would be disappointed in this situation, few customers would be able to remove an aircraft undergoing maintenance. This "bait and switch" tactic is often used by unscrupulous companies to get an aircraft into their shop no matter what it takes. Although the shop's retention of clients is frequently very low, there always seem to be new ones willing to accept a shorter-than-normal turnaround time quote. Often these same shops will underbid the job, and then continually add extra costs as the work progresses. The technician is encouraged to avoid employment at maintenance facilities that do not think twice about trying to deceive the customer.

Since companies are usually in business to make money, the "bottom line" mentality frequently drives management, and ultimately technician decisions. But short-term, quick-fix solutions that focus only on immediate financial success promote the idea that everything boils down to monetary gain. Ethical behavior is not about monetary gain.

In addition to monetary gain, there are other common ways that unethical behavior is rationalized:

- Pretending that the behavior is not really unethical or illegal
- Excusing the behavior by saying it is really in the organization's (or the technician's) best interest
- Assuming the behavior is okay because no one else would even be expected to find out about it
- Expecting your superiors to support and protect you if anything should go wrong (Gellerman 1986)

This latter point often leads to a significant surprise for the individual technician if he or she compromised his or her standards at the encouragement of management to get the job done. Should there be a problem with maintenance and subsequent airworthiness of the aircraft, the very same managers or superiors who directed that technician to shortcut proper maintenance procedures would testify in court that they always encouraged their employees to work "by the book" and never encouraged unauthorized shortcuts.

Ultimately, every organization establishes a climate, or culture regarding honesty, integrity, and ethical behavior. This corporate climate sets the tone for decision making at all levels and in all circumstances. This leads to the second business example, the Aircraft Brake Scandal. It is a classic case of both personal ethics and "whistle blowing." A brief review of the pertinent facts in the incident is as follows.

A young engineering technician is in charge of conducting the required qualification testing for a newly designed brake and rotor system. An aggressive time schedule and an upper management mindset of not wanting to hear bad news (i.e., the brakes are failing tests), a senior engineer who is not willing to have his computations challenged, and a project manager who states the brake will be qualified "no matter what," ultimately lead to a congressional oversight hearing in 1969. Along the way, the brake system is tested (and fails 14 times), no one wants to write the required test report, low level employees seek legal advice, and the aircraft suffers serious damage during landing while conducting initial flight testing, due to unsatisfactory braking.

Some of the ethical conflicts that are evident in this situation are:

- Young engineer (newly hired) feels intimidated by senior level engineer.
- Early brake failure during development testing is excused away because "they are not representative of the final design."
- A company culture of intimidation and distrust.

Most of these conflicts could have easily occurred in the maintenance realm also, if the specifics are broadened, even a little.

- Change the word "engineer" to "maintenance technician."
- Instead of brake failure during development testing, think of component test failure (with the shop norm of "we don't follow the manual on this step; we have developed our own (unauthorized) procedure here.")
- The existence of a company culture of intimidation and distrust transcends all lines of business.

For a company to nurture a healthy ethical climate and long-term success, the element of trust is fundamental both inside and outside the organization. This trust will boost employee morale, and usually boosts productivity and, therefore, profitability. It will also aid and enhance long-term business relationship with customers and vendors.

When differences of opinion do exist, ethical organizations pay close attention to those who are dissenting. Those companies that are committed to promoting an ethical climate will encourage rather than punish dialogue and debate about policies and practices.

It is encouraging to note that more and more institutions of learning, whether business schools or technical colleges, are adding ethics courses into their required curriculum. More and more organizations are developing a corporate "code of ethics." Some are using the following seven-step checklist to help employees deal with an ethical decision:

1. Recognize and clarify the dilemma.
2. Get all the possible facts.
3. List options—*all* of them.

4. Test each option by asking such questions as:
   - —Is it legal?
   - —Is it right?
   - —Is it beneficial?
5. Make your decision.
6. Double check your decision by asking:
   - —How would I feel if my family found out about this?
   - —How would I feel if my decision is printed in the local newspaper?
7. Take action (Schermerhorn 1989).

Finally, the technician is encouraged to read the following code of ethics developed by Professional Aviation Maintenance Association (PAMA), Inc., and consider adopting it as their own.

"As a certified technician, my performance is a public service and, as such, I have a responsibility to the United States Government and its citizens. I must ensure that all citizens have confidence in my integrity, and that I will perform my work according to the highest principles of ethical conduct. Therefore, I swear that I shall hold in sacred trust the rights and privileges conferred upon me as a certified technician. The safety and lives of others are dependent on my skill and judgment; therefore, I shall never knowingly subject others to risks which I would not be willing to assume for myself, or those who are dear to me.

"As a certified technician, I am aware that it is not possible to have knowledge and skill in every aspect of aviation maintenance for every airplane, so I pledge that I will never undertake work or approve work which I believe to be beyond the limits of my knowledge. I shall not allow any superior to persuade me to approve aircraft or equipment as airworthy when there is doubt in my mind as to the validity of my action. Under no circumstances will I permit the offer of money or other personal favors to influence me to act contrary to my best judgment, nor to pass as airworthy aircraft or equipment about which I am in doubt.

"The responsibility that I have accepted as a certified technician demands that I exercise my judgment on the airworthiness of aircraft and equipment; therefore, I pledge unyielding adherence to these precepts for the advancement of aviation and for the dignity of my vocation."

Human Factors

FAA Involvement

The FAA has had a formal involvement in this issue since 1988. That was the year the first Human Factors Issues in Aviation Maintenance and Inspection National Conference was conducted, and that effort reflects a working relationship between government research and industry activity. This yearly event includes airlines, suppliers, manufacturers, schools, and government agencies. There is also an FAA website for human factors at http://hfskyway.faa.gov/ which is a tremendous resource.

Importance of Human Factors

The greatest impact in aircraft safety in the future will not come from improving the technology. Rather it will be from educating the employee to recognize and prevent human error. A review of accident related data indicates that approximately 75–80 percent of all aviation accidents are the result of human error. Of those accidents, *about 12 percent are maintenance related*. Although pilot/co-pilot errors tend to have immediate and highly visible effects, maintenance errors tend to be more latent and less obvious. However, they can be just as lethal.

Definitions of Human Factors

Human factors is concerned with optimizing performance … including reducing errors so that the highest level of safety is achieved and maintained.

—Ron LoFaro, PhD
FAA

Human factors is the study of how people interact with their environments.

—FAA-H-8083-25,
Pilot's Handbook of Aeronautical Knowledge,
dated 2003

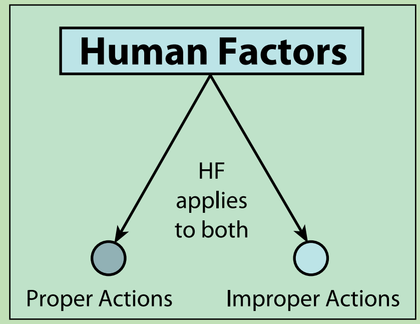
Human factors are those elements that affect our behavior and performance, especially those that may cause us to make errors.

—Canadian Department of Defense (video)

Our focus is on human factors as it relates to improper actions. Note, however, that human factors exist in both proper and improper actions. [Figure 13-1] Since improper actions usually result in human error, we should also define that term.

Human Factors

Active Failure
Assertiveness
Asynchronous Communication
Authoritarian Leader
Communication
Complacency
Crew Resource Management
Dirty Dozen*
Egalitarian
Ergonomics
Human Factors
Inter-team
Intra-team
Instructional Systems Design
Latent Failure
Leadership
Maintenance Resource Management
Mental Model
Norms
Participatory Leader
Safety Culture
Situational Awareness
Stressor
Synchronous Communication
Team
Team Situational Awareness
Teamwork



* 1. Lack of Communication 2. Complacency 3. Lack of Knowledge 4. Distraction 5. Lack of Teamwork 6. Fatigue 7. Lack of Resources 8. Pressure 9. Lack of Assertiveness 10. Stress 11. Lack of Awareness 12. Norms

Figure 13-1. Human factors exist in both proper and improper actions.

Human error is the unintentional act of performing a task incorrectly that can potentially degrade the system. There are three types of human error:

1. Omission: not performing an act or task.
2. Commission: accomplishing a task incorrectly.
3. Extraneous: performing a task not authorized.

There are also four consequences of human error:

1. Little or no effect.
2. Damage to equipment/hardware.
3. Personal injury.
4. Catastrophic.

Brief History

Although Human Factors Management is sometimes thought of as a relatively "new" science, it can actually be traced back to the early 1900s. (Refer to AC 120-51A, Crew Resource Management (CRM) Training, dated 1993.) During WWI, human factors was defined as individual skills and abilities. Most of that early focus in aviation was on the pilot and his or her functions. Specifically, things like technical proficiency, intelligence tests, and how "fearless" a volunteer was—were the important issues to consider. For the next 20 years, these core factors guided the pilot selection process. Although there was some learning that occurred in British munitions plants about the effects of fatigue on quality and productivity, it was not incorporated into aviation until many years later.

During WWII, "human factors" was more broadly defined, and encompassed crew coordination and machine design. Flight crew management was studied, and there was significant information gained about group dynamics and stress. The Army Air Corp. even redesigned cockpit controls. But, unfortunately there was no similar study conducted in maintenance operations, and mechanics were generally seen as individual contributors, and screened only for their technical competency.

Unfortunately, all the "lessons learned" in the WWII studies of group dynamics, and flight crew communication were seemingly forgotten after the war. Post WWII aircrew studies continued to focus primarily on flight crews, especially pilot selection, simulator training, and cockpit layout and design.

Subsequent studies of the technician focused on his or her individual competency, and included equipment design (ergonomics). The Vietnam Conflict brought the quest for greater safety, and with that, came a systematic approach for error reduction. This increased attention brought both good and bad changes. It led to the "Zero Defects" quality programs in maintenance and manufacturing. Generally, this had a positive effect. However, it also led to "crackdown programs" which were one-way communication from management (the infamous "my way or the highway" approach). This concept is more dictatorial than democratic, and typically had a long-term negative effect on the company. This "crackdown" approach for behavior control is based upon fear and punishment, which creates a problem. Errors are driven into hiding, and then become apparent later, usually at a more critical time ("Murphy's Law"). Additional attempts to develop "foolproof" equipment designs were added to the zero defect manufacturing goal and began to find recognition in the maintenance world as well. Subsequent efforts focused on effects of positive rather than negative motivators. The results of this effort were a reversal of the "crackdown" method, and motivation due to increased morale often improved maintenance safety performance. Studies have shown that motivation resulting from negative sources seldom achieved the same effect. This led to a "Participative Management" style recognized by some U.S. industry and a few airlines, but did *not* reach maintenance operations until much later.

The Airline Deregulation (1978–1988) effort had a profound effect upon the aviation community. Prior to 1978, the airline industry was regulated by the Civil Aeronautics Act of 1938. This resulted in peaceful markets, stable routes, and consistent air fares. However, there was a downside consisting of two major problems: wasteful management practices and excessively high wages compared to other comparable skilled-labor industries. The Airline Deregulation Act brought in competitive business practices, with routes and fares controlled by their profitability. This led to a new style of airline management in which a CEO was more of a business person and less knowledgeable of aviation. Existing airlines developed new routes and added new kinds of service and style. Start-up airlines brought other innovative ideas. The numerous mergers and acquisitions added an increasing pressure to focus on the financial bottom line. Doing more with less became the byline. In the 1980s, maintenance departments were not immune to the pressures of mergers and staff reductions. However, fleets were extremely reliable at that time, and significant savings were aided by a reduction in number of maintenance technicians. Other new ways of conducting business included leasing of aircraft and outsourcing of maintenance. A result of deregulation was change for the maintenance programs (both personnel and departmental) and the pressure to produce and adjust. The problem, however, was that human factors for aviation maintenance was still stuck in the 1960s model.

A detailed review of aviation literature published between 1976 and 1987 had very little to say about maintenance. Out of 50 published articles, only 15 even mention maintenance. Most of these articles deal with ergonomics, one article examines military engine design to "solider proof" the maintenance duties, and one U.S. Navy article advocated more management control.

As human factors awareness progressed, a "culture change" occurred in U.S. carriers in the 1990s. Management behavior began to change; there were practical applications of systems thinking; organization structure was revised; and new strategy, policy, and values emerged. Virtually all of these involved communication and collaboration. One example is from 1991, when Continental Airlines began "CRM type" training in maintenance. Airline executives saw the importance of improving communication, teamwork, and participative decision-making. A second example is the United Airlines establishment of a change in organization and the job of inspectors. They remained more accessible during heavy maintenance and overhaul and stayed in closer communication with mechanics during normal repairs. The results were fewer turnbacks and higher quality. A third example is the Southwest Airlines developement of a strong and clear organizational structure led by the CEO. This resulted in open and positive communication between maintenance and other departments. A final example is the TWA establishment of a new program to improve communication between the maintenance trade union and maintenance management, resulting in improved quality.

Current Approach

As mentioned earlier, the FAA itself has an increasing awareness and acceptance of "human factors" issues. In addition to the ACs already referenced, the FAA released in October 2005 an operator's manual titled *Human Factors in Aviation Maintenance*. This manual was generated in response to the industry's requests for a simple and manageable list of actions to implement a maintenance human factors program, and is an excellent reference document for it. A team of international industry experts chose the following six topics as necessary for a human factors program to be successful:

1. Event Investigation
2. Documentation
3. Human Factors Training
4. Shift/Task Turnover

5. Fatigue Management
6. Sustaining and Justifying a Human Factors Program

Probably the most well-known data associated with reducing the negative impact of human factors is the Dirty Dozen list of factors developed by Gordon DuPont from Transport Canada. [Figure 13-2] These 12 issues are:

1. **Lack of Communication:** lack of clear, direct statements *and* good, active listening skills.
2. **Complacency:** self-satisfaction accompanied by a loss of awareness of the dangers.
3. **Lack of Knowledge:** lack of experience or training for the task at hand.
4. **Distraction:** loss of focus, mental/emotional confusion or disturbance, draw one's attention away.
5. **Lack of Teamwork:** lack of working together to achieve a common goal.
6. **Fatigue:** weariness from labor or exertion, nervous exhaustion, temporary loss of power and ability to respond.
7. **Lack of Resources:** failure to use or acquire the appropriate tools, equipment, information, and procedures for the task.
8. **Pressure:** creating a sense of urgency or haste.
9. **Lack of Assertiveness:** lack of positive communication of one's ideas, wants, or needs.
10. **Stress:** mental, emotional, or physical tension, strain, or distress.
11. **Lack of Awareness:** failure to be alert or vigilant in observing.
12. **Norms:** informal work practices or unwritten rules that are ccepted by the group.

DuPont's Dirty Dozen	
1.	Lack of Communication
2.	Complacency
3.	Lack of Knowledge
4.	Distraction
5.	Lack of Teamwork
6.	Fatigue
7.	Lack of Resources
8.	Pressure
9.	Lack of Assertiveness
10.	Stress
11.	Lack of Awareness
12.	Norms

Figure 13-2. The human factors in aircraft maintenance most commonly leading to accidents.

Subsequent to the development of the Dirty Dozen, the "Magnificent Seven" list of human factors issues was developed by DuPont, and focused on positive aspects. These seven issues are:

1. We work to accentuate the positive and eliminate the negative.
2. Safety is not a game because the price of losing is too high.
3. Just for today—zero error.
4. We all do our part to prevent Murphy from hitting the jackpot.
5. Our signature is our word and more precious than gold.
6. We are all part of the team.
7. We always work with a safety net.

Posters of the Dirty Dozen and the Magnificent Seven are available for a fee from the Maintenance and Ramp Safety Society (M.A.R.S.S.) located in British Columbia, Canada.

Another major human factors tool for use in investigation of maintenance problems is the Boeing developed Maintenance Error Decision Aid (MEDA). This is based on the idea that errors result from a series of factors or incidents. The goal of using MEDA is to investigate errors, understand root causes, and prevent accidents, instead of simply placing blame on the maintenance personnel for the errors. Traditional efforts to investigate errors are often designed to identify the employee who made the error. In this situation, the actual factors that contributed to the errors or accident remain unchanged, and the mistake is likely to recur. In an effort to break this "blame and train" cycle, MEDA investigators learn to look for the factors that contributed to the error, instead of the employee who made the error. The MEDA concept is based on the following three principles:

- Positive employee intent (In other words, maintenance technicians want to do the best job possible and do not make intentional errors.)
- Contribution of multiple factors (There is often a series of factors that contribute to an error.)
- Manageability of errors (Most of the factors that contribute to an error can be managed.)

When a company is willing to adopt these principles, then the MEDA process can be implemented to help the maintenance organization achieve the dual goals of identifying those factors that contribute to existing errors, and avoiding future errors. In creating this five-step process, Boeing initially worked with British Airways, Continental Airlines, United Airlines, a maintenance worker labor union, and the FAA. The five steps are:

1. **Event:** the maintenance organization must select which error that caused events will be investigated.
2. **Decision:** was the event maintenance related? If the answer is yes, then the MEDA investigation continues.
3. **Investigation:** using the MEDA results form, the operator conducts an investigation to record general information about the airplane—when the maintenance and the event occurred, what event initiated the investigation, the error that caused the event, the factors contributing to the error, and a list of possible presentation strategies.
4. **Prevention strategies:** the operator reviews, prioritizes, implements, and then tracks the process improvements (prevention strategies) in order to avoid or reduce the likelihood of similar errors in the future.
5. **Feedback:** the operator provides feedback to the maintenance workplace so technicians know that changes have been made to the maintenance system as a result of this MEDA process.

The implantation and continuous use of MEDA is a long-term commitment and not a "quick fix." However, airline operators and maintenance facilities frequently decide to use the MEDA approach to investigate serious, high visibility events which have caused significant cost to the company. The desire to do this is based upon the potential "payback" of such an investigation. This may ultimately be counterproductive because a highly visible event may not really be the best opportunity to investigate errors. Those involved in the process may be intimidated by the attention coming from upper management and various regulatory authorities.

By using the MEDA process properly, the organization can investigate the factors that contributed to an error, discover exactly what led to that error, and fix those factors. Successful implementation of MEDA will allow the organization to avoid rework, lost revenue, and potentially dangerous situations related to events caused by maintenance errors.

The "SHEL" model is another concept for investigating and evaluating maintenance errors. [Figure 13-3] As with other human factors tools, its goal is to determine not only what the problem is, but where and why it exists. SHEL was initiated by Professor Elwyn Edwards (Professor Emeritus, Aston University, Birmingham, U.K.) in 1972. It was later modified slightly by the late Capt. Frank Hawkins, a Human Factors consultant to KLM (Royal Dutch Airlines), in 1975. The acronym SHEL represents:

- **S**oftware
- **H**ardware
- **E**nvironment
- **L**iveware

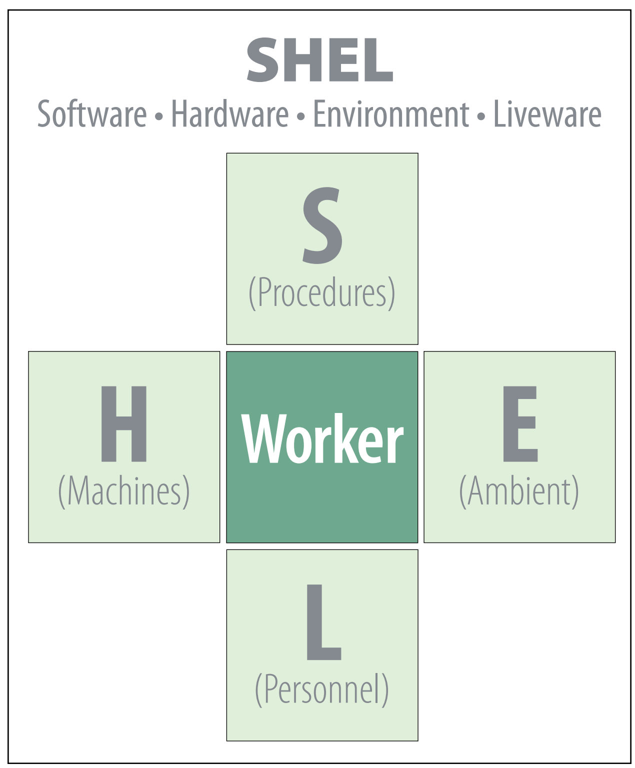


Figure 13-3. SHEL Model.

The model examines interaction with each of the four SHEL components, and does not consider interactions not involving human factors.

The term "software" is not referring to the common use of the term as applied to computer programs. Instead it includes a broader view of manual layout, checklist layout, symbology, language (both technical and non-technical), and computer programs.

Hardware includes such things as the location of components, the accessibility of components and tooling.

Environment takes temperature, humidity, sound, light, and time of day factors into account.

Liveware relates technician interaction with other people, both on the job and off. These include managers, peers, family, friends, and self.

No discussion of human factors is complete without reference to James Reasons' Model of Accident Causation. This diagram, which was introduced in 1990, and revised by Dr. Reason in 1993, is often referred to as the Swiss cheese model and shows how various "holes" in different systems must be aligned in order for an error to occur. Only when the holes are all aligned can the incident take place.

There are two types of failure which can occur—active and latent. An active failure is one in which the effects are immediate. An example of this type would be an aircraft slipping off one of the lifting jacks due to improper placement by the technician. In this example, the aircraft jack is the approved item of ground support equipment, and it has been properly maintained.

A latent failure occurs as a result of a decision or action made long before the incident or accident actually occurs. The consequences of such a decision may remain dormant for a long time. An example of a latent failure could also involve the aircraft slipping off a joint, but in this case it could be an unapproved jack being used because funding had not been approved to purchase the correct ground support equipment (GSE).

The field of human factors, especially in aviation maintenance, is a growing field of study. This section of this chapter has presented only a small segment of the numerous observations and presentations about the topic. If the technician desires to learn more, numerous books exist and a review of Internet data will provide an abundant supply of information.

A good place to start researching would be the FAA's own website at http://hfskyway.faa.gov/. This site, titled "Human Factors on Aviation Maintenance and Inspection (HFAMI)" provides access to products of the Federal Aviation Administration Flight Standards Service Human Factors in Aviation Maintenance and Inspection Program. Many aviation maintenance industry trade magazines include a section or at least a page devoted to human factors. "The Human Factors and Ergonomics Society" is a national organization composed of 22 technical groups, including one devoted to aerospace systems, which address both civilian and military issues of safety and performance.

Professionalism

The aviation technician is the central figure in aviation maintenance. From the day he or she sets out to become a certificated technician per 14 CFR part 65 to the day he or she retires or leaves the field, the technician must be fully qualified as an aviation professional. This means the technician successfully blends technical training with ethical thinking, and understands the ramifications of the various aspects of human factors. Although the word "professionalism" is widely used, it is rarely defined. In fact, no single definition can encompass all of the qualifications and considerations that must be present for true professionalism to exist. Though not all inclusive, the following list provides major considerations and qualifications that should be included in the definition of professionalism.

1. Professionalism exists only when a service is performed for someone or for the common good.
2. Professionalism is achieved only after extended training and preparation.
3. Professionalism is performance based on study and research.
4. Professionalism is reasoning logically and accurately.
5. Professionalism is making good judgment decisions.
6. Professionalism is not limiting actions and decisions to standard patterns and practices.
7. Professionalism demands a code of ethics.
8. Professionalism is being true to one's values and ethics and to those being served. Anything less than a sincere performance is quickly detected, and immediately destroys effectiveness.