

Failure to Follow Procedures - Installation

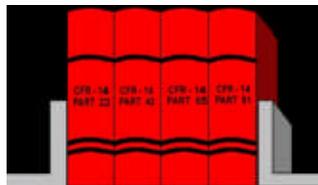
Introduction

The videos and photos of personnel and aircraft used in this training product are for illustration/education purposes only and have no connection to the accident scenario used in this product.

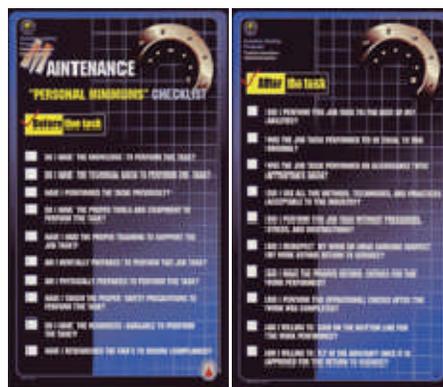
This training course is based on the scenario of an actual aircraft accident that resulted in fatal consequences. The fatal consequences were the result of maintenance performance failures. This course emphasizes how failing to follow procedures and human factor influences can lead to improper maintenance techniques. This course will provide preventative measures that, when used, will help you mitigate these risks. The training is applicable to any aviation maintenance technician. Whether you work on small aircraft or large air carriers, this training module will benefit every professional aviation maintenance technician.

The objective of this course is to provide the Aviation Maintenance Technician:

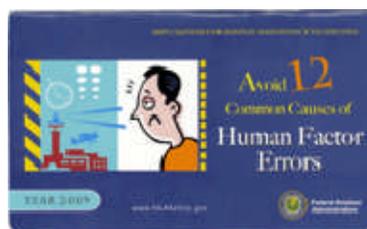
- A review of the applicable Title 14 Code of Federal Aviation Regulations regarding YOUR responsibilities and requirements when performing aircraft maintenance.



- Introduction, review, and familiarization of the “Maintenance Personal Minimums” Checklist.....
“The PMC”



- Explanation, recognition, understanding, and effects of the Dirty Dozen which are 12 common human errors in maintenance and how to minimize them when performing tasks.



- How to be better prepared and guard against the consequences from failure to follow procedures while performing maintenance.



Chapter 1

Ch.1 pg.1:

It's a typical morning in the maintenance shop. The maintenance crew has been working long hours the past week to make sure a customer's aircraft was ready for an upcoming important business trip. When they finish this job they will have some time to breathe.



Ch.1 pg.2:

While the rest of the technicians were completing their tasks, Pete was completing and AD inspection. The aircraft would finally be completed and given back to the customer. The paperwork was finished and the aircraft was approved for return to service. Later, the aircraft departs on its first flight after the maintenance. On board are two crewmembers and the owner of the aircraft.



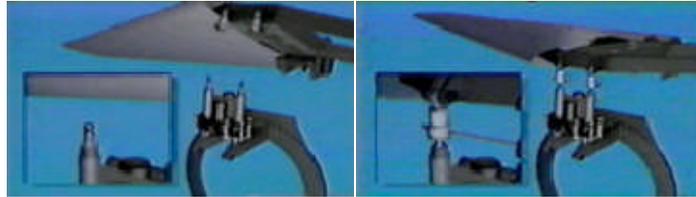
Ch1. pg.3:

Pause for a moment and consider what could be the worst possible outcome if the maintenance were done improperly.



Ch1. pg.4:

What you are seeing actually occurred in the flight control system during the first flight after maintenance. The aircraft stabilizer completely disengaged from the stabilizer trim actuator.



Ch1. pg.5:

The aircraft is in peril!! The nose pitches down into a rapidly increasing dive. As the pilots struggle to recover they find themselves with no pitch control. No matter how hard they pull back on the yoke, the aircraft continues accelerating toward the ground. What started as an uncontrolled descent has become an outside loop. With the aircraft now flying inverted, the crew continues pushing forward on the control yoke, allowing the aircraft to gain much needed altitude. As airspeed decreases, the crew rolls the aircraft upright. They struggle desperately to regain control of the aircraft and keep it in an upright attitude. However, the disconnected trim actuator has left the aircraft virtually uncontrollable and IT goes into an uncontrolled dive from which they can't recover.



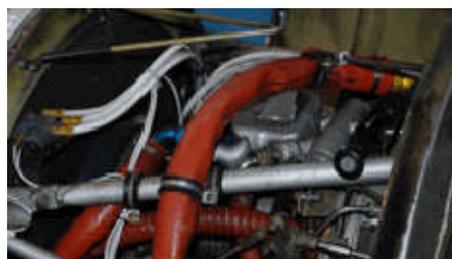
Ch1. pg.6:

Who do you think of think of when you hear the statement, “Most aircraft accidents are caused by human error.”? Pilot error? Most of us are probably guilty of making that assumption, but maybe we shouldn't. How often do you think about maintenance error?

“Human Error”

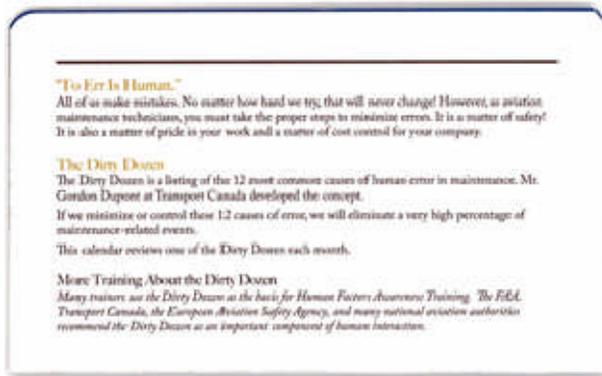
Ch1. pg.7:

These pliers were found left on the engine.



Ch1. pg.8:

Maintenance technicians work extremely hard and try to do the best job possible but we are subject to many external and internal factors that affect how we perform.



Ch1. pg.13:

Complacency.



Ch1. pg.14:

Complacency is defined as?

- Overconfidence from repeated experience on a specific activity.
- Failure to speak up or otherwise document concerns about instructions/orders.
- Failure to see a condition, understand what it is, and predict the possible results.
- Standard practices, usually documented, adopted by an organization or group.

(Answer provided at the end of the chapter).

Ch1. pg.15:

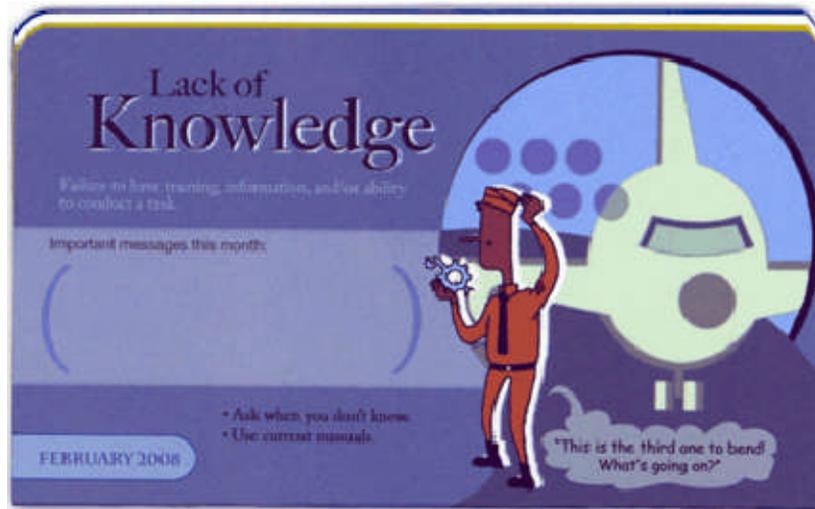
Which of the following would best illustrate Complacency?

- Jill checks off an inspection checklist item because it is not a critical component and she has never found any defects on all her previous inspections.
- Sam does not perform a required gear operational check because the owner of the aircraft insists it cost too much and states the gear has operated just fine since the last inspection.
- Bill is in the middle of his inspection, performing a complex adjustment measurement when he is pulled off the job to do another task.
- Sue is not sure she understands one step of the instructions in the maintenance manual but does not discuss this with her supervisor for fear it will make her look inexperienced.

(Answer provided at the end of the chapter).

Ch1. pg.16:

Lack of Knowledge.



Ch1. pg.17:

Lack of Knowledge is defined as?

- Failure to work together to complete a shared goal.
- Failure to speak up or otherwise document concerns about instructions/orders.
- Failure to have training, information, and/or ability to conduct a task.
- Failure to transmit, receive, or provide feedback in order to do the task.

(Answer provided at the end of the chapter).

Ch1. pg.18:

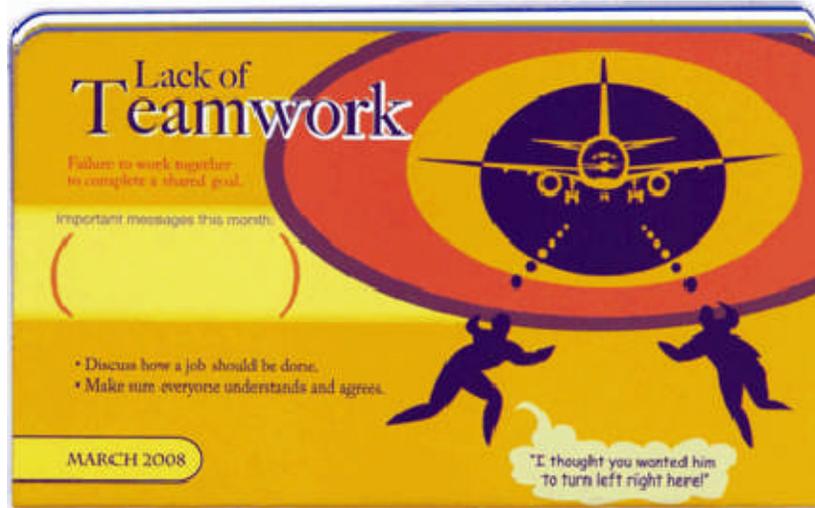
Which of the following would best illustrate Lack of Knowledge?

- John is attempting to finish a job left over by the night shift but there is no entry in the turnover log to indicate what has been done or needs to be completed.
- Jerry is directed to perform a task but doesn't have the special tools to complete the job.
- Sam performs a cable adjustment on the flight controls but doesn't know that the low temperature will affect his cable tension adjustment.
- None illustrate Lack of Knowledge.

(Answer provided at the end of the chapter).

Ch1. pg.19:

Lack of Teamwork.



Ch1. pg.20:

Lack of Teamwork is defined as?

- Failure to have the experience to complete a specific activity.
- Failure to speak up or otherwise document concerns about instructions/orders.
- Failure to see a condition, understand what it is, and predict the possible results.
- Failure to work together to complete a shared goal.

(Answer provided at the end of the chapter).

Ch1. pg.21:

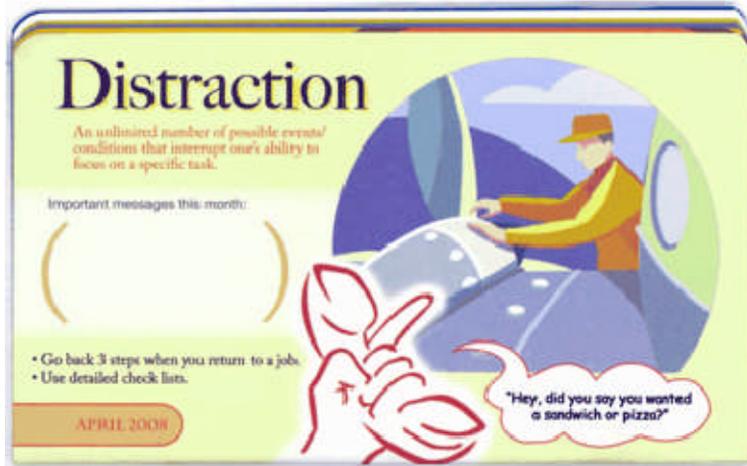
Choose the best answer that illustrates Lack of Teamwork?

- The wing of the aircraft hit a stand while being towed into the gate because a wing walker failed to perform the requirement to clear the area and brief the lead team member prior to the tow.
- During your final inspection of a completed task, you find the CSD drain plug safety wired backwards.
- You forgot to bring a torque wrench with you to the job site but completed the job anyway because you were pressed for time.
- You're new on the job and assisting the lead technician on a maintenance task. You do not speak up when you notice he is not using a torque wrench to secure the bolts as required by the maintenance instructions.

(Answer provided at the end of the chapter).

Ch1. pg.21:

Distraction.



Ch1. pg.23:

Distraction is defined as?

- Failure to see a condition, understand what it is, and predict the possible result.
- Standard practices usually undocumented, adopted by an organization or group.
- An unlimited number of events or conditions that interrupt one’s ability to focus on a specific task.
- Overconfidence from repeated experience on a specific activity.

(Answer provided at the end of the chapter).

Ch1. pg.24:

Select the answer that illustrates Distraction?

- While doing critical measurement, a coworker interrupts you to borrow a wrench.
- You’re an inspector on night shift and must do a required inspection of an installation done by one of the best day shift technicians. However, you find the panel is installed over the component. You have lots of work to do tonight so you sign off the inspection without removing the panel.
- The maintenance team is short of two people because of vacations.
- The boss informs you that the aircraft must be done two day earlier than originally planned.

(Answer provided at the end of the chapter).

Ch1. pg.25:

Fatigue.



Ch1. pg.26:

Fatigue is defined as?

- Physical exhaustion threatening work performance.
- Mental exhaustion threatening work performance.
- Physical and mental exhaustion threatening work performance.
- Psychological interferences distracting work.

(Answer provided at the end of the chapter).

Ch1. pg.27:

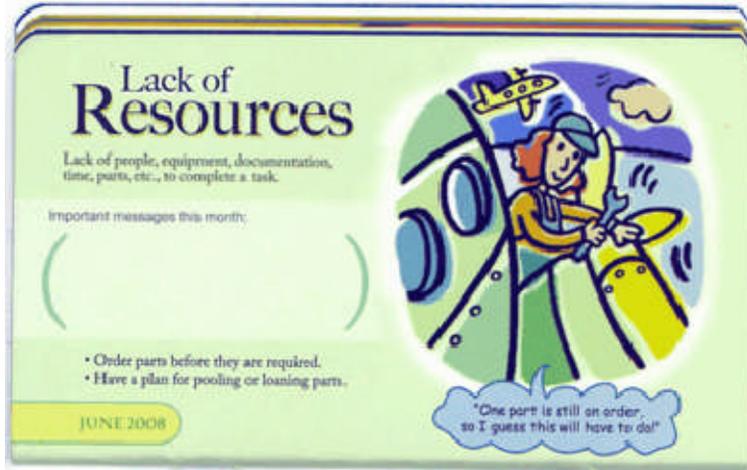
Choose the best answer that illustrates Fatigue.

- You have been up all night taking care of your sick child and your boss asks you to work overtime to complete the job.
- After reporting to work, you learn that an aircraft you worked on was involved in an accident.
- You get a call from the FAA requesting to interview you regarding an aircraft that you worked on that is involved in an accident.
- The boss informs you that the aircraft must be done two day earlier than originally planned.

(Answer provided at the end of the chapter).

Ch1. pg.28:

Lack of Resources.



Ch1. pg.29:

Lack of Resources is defined as?

- Lack of people and parts to complete a task.
- Lack of people, equipment, documentation, time, parts, etc. to do a task.
- Lack of people, equipment, documentation, parts, etc. to do a task.
- Lack of people, equipment, and parts to complete a task.

(Answer provided at the end of the chapter).

Ch1. pg.30:

Select the answer which best illustrates Lack of Resources.

- The maintenance team is short of two people because of vacations.
- The engine requires a muffler replacement but the part is still on order.
- The owner asks you to inspect his aircraft but informs you his maintenance records were recently destroyed in a fire.
- You turn down a customer who wants you to repair his composite wing because you have no equipment or training to do so.
- All answers are correct.

(Answer provided at the end of the chapter).

Ch1. pg.31:

Pressure



Ch1. pg.32:

Pressure is defined as?

- Physical or mental condition resulting from external forces. It may affect health and quality of work.
- External or internal forces demanding high-level job performance. It can be real or perceived.
- Overconfidence from repeated experience on a specific activity.
- Failure to see a condition, understand what it is, and predict the possible results.

(Answer provided at the end of the chapter).

Ch1. pg.33:

Select the answer which best illustrates Pressure.

- Three of the company's five aircraft are down for maintenance. The team lead calls in sick this morning and puts you in charge of the maintenance team.
- The boss informs you that the aircraft must be done two days earlier than originally planned.
- You been working on the problem for almost an hour and the pilot informs you that if the problem is not fixed in the next 30 minutes that flight will be canceled.
- The annual inspection your doing has already exceeded your initial estimate for cost and time by more than 30%. The customer is very disturbed. Now you have to inform the customer that the cylinder threads were stripped when his spark plugs were being replaced.
- All answers are correct.

(Answer provided at the end of the chapter).

Ch1. pg.34:

Lack of Assertiveness



Ch1. pg.35:

Lack of Assertiveness is defined as?

- Overconfidence from repeated experience on a specific activity.
- Failure to transmit, receive, or provide sufficient feedback in order to complete a task.
- Failure to speak up or otherwise document concerns about instructions/orders or action of orders.
- Physical or mental conditions resulting from external forces.

(Answer provided at the end of the chapter).

Ch1. pg.36:

Which of the following is an example of Lack of Assertiveness?

- After reporting to work, you learn that an aircraft you worked on was involved in an accident.
- You do not have the current maintenance manuals when performing removal and replacement of a component.
- You learn the scales needed to weigh the aircraft are out for calibration.
- You agree to do an inspection even after the owner of the aircraft pressures you not to do a required landing gear retraction on his aircraft.

(Answer provided at the end of the chapter).

Ch1. pg.37:

Lack of Communication



Ch1. pg.38:

Failure to transmit, receive, or provide sufficient feedback in order to complete a task is defined as?

- Lack of Assertiveness
- Lack of Communication
- Lack of Knowledge
- Lack of Teamwork

(Answer provided at the end of the chapter).

Ch1. pg.39:

Which scenario best illustrates Lack of Communication?

- You're an inspector on night shift and must do a required inspection of an installation done by one of the best day shift technicians. However, you find the panel is stalled over the component. You have lots of work to do tonight so you sign off the inspection without removing the panel.
- You're working on the horizontal stabilizer leading edge and instruct your new workmate to move the stabilizer up. Your work mate actuates trim switch to nose up and drives the leading edge into the maintenance stand.
- You've been working a double shift all week and your boss asks you to work the weekend because two technicians called in sick.
- A tire is just barely worn past the serviceable wear limits and really should be changed but you sign it off because no spare tire is available.

(Answer provided at the end of the chapter).

Ch1. pg.40:

Norms



Ch1. pg.41:

Standard practices, usually undocumented, adopted by an organization or group are defined as?

- Pressure
- Norms
- Complacency
- Distraction

(Answer provided at the end of the chapter).

Ch1. pg.42:

Which example best illustrates Norms?

- Personnel routinely work on top of the wings without using available safety harnesses.
- All the special tools are not available to complete the inspection on the aircraft.
- The maintenance team is one man short and the boss just informed you that the aircraft must be completed two days sooner than originally planned.
- Your wife calls and informs you that the IRS wants to audit your tax returns for the last three years.

(Answer provided at the end of the chapter).

Ch1. pg.43:

Stress



Ch1. pg.44:

Physical or mental conditions resulting from external forces which may affect health and quality of work are defined as?

- Stress
- Norms
- Fatigue
- Pressure

(Answer provided at the end of the chapter).

Ch1. pg.45:

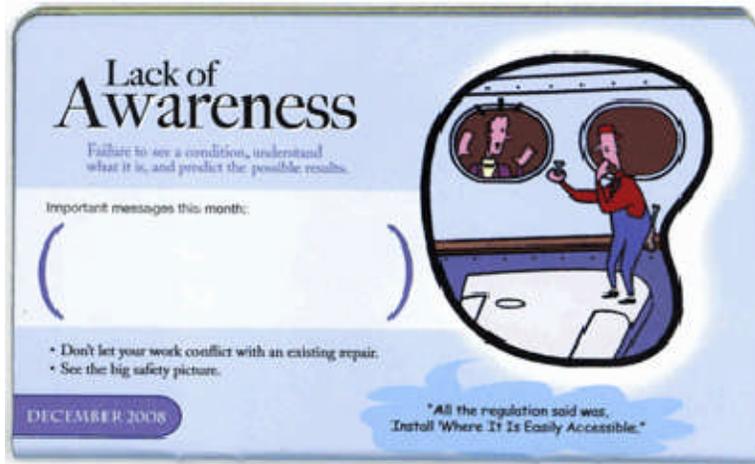
Select the answer which best illustrates Stress.

- An aircraft that you recently worked on is involved in a fatal accident.
- The IRS calls you at work and says they want to audit your tax returns for the last three years.
- The boss informs you that the company will lay off three mechanics next month due to financial problems.
- You finish up the last repair job on an aircraft. Work coming into your shop has been very slow for the past couple months. The shop's rent is past due and you're under the threat of eviction.
- All answers are correct.

(Answer provided at the end of the chapter).

Ch1. pg.46:

Lack of Awareness



Ch1. pg.47:

Lack of Awareness is defined as?

- Physical or mental conditions resulting from external forces. It may affect health and quality of work.
- External or internal forces demanding high-level job performance. It can be real or perceived.
- Overconfidence from repeated experience on a specific activity.
- Failure to see a condition, understand what it is, and predict the possible results.

(Answer provided at the end of the chapter).

Ch1. pg.48:

Which of the following illustrates Lack of Awareness?

- You replace a failed component but fail to realize the replacement part negates a termination action of a previously completed Airworthiness Directive.
- You're working on the horizontal stabilizer leading edge and instruct you new workmate to move the stabilizer up. Your work mate actuates trim switch to nose up and drives the leading edge into the maintenance stand.
- You're in the middle of a complex maintenance adjustment when your boss pulls you off to do another job.
- You receive a call from the FAA asking to interview you about an aircraft you recently worked on that is involved in a fatal accident.

(Answer provided at the end of the chapter).

Ch1. pg.49:

Recognizing these factors and their effects on human performance is an important step toward preventing errors **and** accidents. Any one of these factors, if left unchecked, can become a “link” in the chain that leads to an accident. In this training course we’ll take a closer look at how maintenance human error can lead to disaster, and how **you** can learn NOT to establish a “chain of events”.

Ch1. pg.50:

Let’s take a minute to look at something we use every day, but may not really understand the importance of.

Ch1. pg.51:

The word procedure is defined as “a particular way of accomplishing something” or “a series of steps followed in a regular definite order” What comes to mind when you hear someone say “procedures”?



Ch1. pg.52:

Pilots are expected to use their checklist before and during every flight, every day. They may know the procedures by heart but they are no less immune from the effects of human factors than the professional maintenance technician. The importance of following maintenance procedures cannot be overstated. It’s a matter of safety, a matter of pride in our work, and what maintenance professionals do.

Ch1. pg.53:

Our days are full of “procedures”, or “steps we follow”. This morning, didn’t you put your socks on before you put on your shoes?



Ch1. pg.54:

When you left for work this morning, didn’t you open the garage door first, put the vehicle in the correct gear then accelerate your vehicle outdoors. If you didn’t follow these procedures the results would be most undesirable.



Ch1. pg.55:

Most of us don’t think of these as procedures for these everyday tasks, but they are. Procedures are simply logical processes that result in a desirable outcome.

Ch1. pg.56:

As maintenance technicians, the word “procedures” usually makes us think of things like maintenance manuals, inspection checklists, or company procedures manuals. “Well... let’s think back to this morning.



Ch1. pg.57:

The results would not be desirable if you altered or **failed** to follow those simple, everyday procedures.



Ch1. pg.58:

Recall when leaving your garage this morning. If you didn’t follow simple procedures you could experience an undesirable as well as expensive outcome.



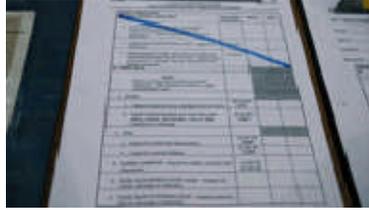
Ch1. pg.59:

We know our jobs as maintenance technicians are full of procedures. We use them every day to perform inspections and repairs. In this training course we’ll take a look at the importance of following procedures, and we’ll see the consequences when we don’t.



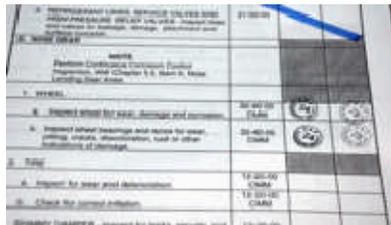
Ch1. pg.60:

“Failure to Follow Procedures” What does this phrase mean to you? There are several ways that we can fail to follow procedures.



Ch1. pg.61:

We are provided maintenance instructions in many forms such as maintenance manuals, checklists or organized work cards. It’s our job to follow them. However, we can and we do skip or miss steps either intentionally or by mistake.



Ch1. pg.62:

Or we can simply disregard the correct published procedures by not using a torque wrench because we decided that we have a better, quicker, or cheaper way to get the job done.

Ch1. pg.63:

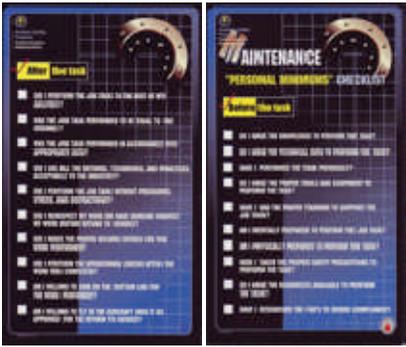
Whether we skip a step, or a procedure...or we decide to change the procedure we’ve failed to follow procedures, either through omission or commission

Ch1. pg.64:

If we omit a step, we’ve erred by omission. We failed to do a task or series of tasks. If we **change** the prescribed order of the steps, **or** decide to use our own procedures, we’ve erred through the act of commission (pronounced **co**-mission). Either way, a human error has occurred.

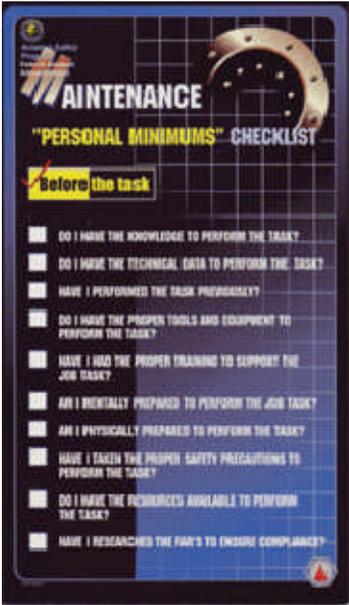
Ch1. pg.65:

You have now increased your knowledge and awareness of the 12 common causes of maintenance human error that will help you minimize these errors. There is also another job aid available. This aid will help you assess the work you do. It is called the Maintenance “PERSONAL MINIMUMS” Checklist. It’s a two part checklist you should add to your toolbox. You should use it to perform a self assessment of your daily work performance.



Ch1. pg.66:

The “Before the Task” checklist contains 10 questions you should ask yourself and honestly answer BEFORE you do a task.



Ch1. pg.67:

1. Do I have the knowledge to perform the task?

Knowledge is acquired through education, On the Job Training (OJT) or formal training, or prior experience. Is your knowledge sufficient to do this job? If not, is assistance available and are you willing to ask for it when needed?

Ch1. pg.68:

2. Do I have the technical data to perform the task?

Is the data current, is it applicable to the job to be performed, and most importantly do you understand the procedures?

Ch.1 pg.69:

3. Have I performed the task previously?

Do you have the experience? Do you understand the task well enough to recognize a potential situation or condition, understand what it is, and predict the possible results. This relates to Lack of Awareness which if your recall is one of 12 common causes of maintenance human error.

Ch1. pg.70:

4. Do I have the proper tools and equipment to perform the task?

This should not be an issue if you are employed by a certificated air carrier or repair station, YOU ensure that they are used. However, if you're an independent maintenance technician, this may challenge you. Assess your needs, acquire the proper tools and equipment, and do not be tempted to complete the task without it.

Ch1. pg.71:

5. Have I had the proper training to support the job task?

The important word here is "proper". Was your training related to the task you're about to do? Are you properly trained on the aircraft, the system, or the component you are about to inspect or work on? If not, ensure you have someone available to assist who has been properly trained as needed.

Ch1. pg.72:

6. Am I mentally prepared to perform the job task?

Are you mentally fit? Remember the Dirty Dozen, factors such as stress, distractions, and pressure. Are you angry, worried, or depressed? These will all have a negative impact on your performance.....if you let them.

Ch1. pg.73:

7. Am I physically prepared to perform the task?

Are you fatigued, ill, or recovering from an injury? If so, be aware that this can affect your performance and advise your fellow workers to keep an eye on your work.

Ch1. pg.74:

8. Have I taken the proper safety precautions to perform the task?

Did you open circuit breakers? Did you tag the circuit breakers, switches, control levers? Did you install system actuator locks, etc? Did you document the appropriate "warning" entries in the maintenance records or turn-over log? What about personal safety equipment such as safety glasses and ear protection.....if you have them, use them. If you don't have them, get them.

Ch1. pg.75:

9. Do I have the resources available to perform the task?

Are adequate finances available to complete the job, or to acquire necessary parts or tools? Will you need assistance.....and is assistance available?

Ch1. pg.76:

10. Have I researched the FAR's to ensure compliance?

Are you aware of the pertinent current regulations, do you have access to them, have you read them, do you understand them, are you and will you be in compliance?

Ch1. pg.77:

Now that you finished the job it's time to assess it. The "After the Task" checklist contains 10 questions you should ask yourself and honestly answer each time you complete a task.



Ch1. pg.78:

1. Did I perform the job task to the best of my ability?

Knowing your limitations is the key here. Your ability can vary due to mental and physical influences as well as job complexities. Remember the 12 common causes of human error. Recognize them, deal with them and you should be able to answer yes to this question every time.

Ch1. pg.79:

2. Was the job or task performed equal to the original?

It should not be difficult to answer yes if you use appropriate repair data. You should also be aware it is delineated in Title 14 CFR Part 43, Section 43.13(b). We will discuss this later in the lesson, helping to refresh your familiarity with this requirement.

Ch1. pg.80:

3. Was the job task performed in accordance with appropriate data?

This is a question every professional should always answer with a yes. Furthermore, the data should not only be appropriate, it should be current and understood. This is the most basic work ethic of every professional maintenance technician. Additionally, you should also know that it is required by Title 14 CFR Part 43, Section 43.13(b).

Ch1. pg.81:

4. Did I use all the methods, techniques, and practices acceptable to the industry?

The manufacturers determine and publish acceptable methods, techniques and practices to be used in maintaining their products to airworthiness standards. We must always perform to those standards when we work on their products. Acceptable methods, techniques, and practices are also published in Advisory Circular 43.13-1B and 2B, however, this may not be the appropriate data for the job at hand. Know what data to use and when to use it.

Ch1. pg.82:

5. Did I perform the job or task without pressure, stress, and distractions?

Recall the Dirty Dozen we discussed earlier? This checklist question specifically refers to three of the 12 most common causes of maintenance human error. They are subtle and are always present in our daily lives. Be aware how they can impact your performance.

Ch1. pg.83:

6. Did I re-inspect my work or have someone inspect my work before return to service?

This practice is something you should adopt as routine. It's cheap insurance. Whether we are qualified or not, as humans we all make mistakes. But as qualified professional aircraft maintenance technicians our mistakes can have serious consequences and it's best to find them before the aircraft takes off rather than during an accident(or)incident investigation.

Ch1. pg.84:

7. Did I make the proper record entries for the work performed?

This is another basic work ethic of every mechanic. Your work descriptions should be permanent, legible and thorough. Again, you should also understand that record entries are required by the CFR.

Ch1. pg.85:

8. Did I perform the operational checks after the work was completed?

After you fix it, make sure it works properly. Always operational check whenever you can. It's the right thing to do and it will give you peace of mind.

Ch1. pg.86:

9. Am I willing to sign on the bottom line for the work performed?

If you hesitate to sign off on the work, then don't. Recheck your work until you are absolutely confident you can do this without a second thought. Your signature carries with it tremendous responsibility as well as liability. All professional maintenance technicians should take this responsibility very seriously and be proud of what their signature represents.

Ch1. pg.87:

10. Am I willing to fly in the aircraft once it is approved for return to service?

It goes without saying this must always be a resounding yes when you approve equipment or aircraft for return to service.

Ch1. pg.88:

We are subject to many Federal Aviation Regulations when performing our jobs. There is a regulation that addresses the use of procedures. It's Title 14 of the Code of Federal Regulations (CFR), Part 43 "Maintenance, Preventive Maintenance, Rebuilding, and Alteration". Section 43.13, Performance Rules, Paragraph (a) states: "Each person performing maintenance, alteration, or preventive maintenance on an aircraft, engine, propeller, or appliance shall use the methods, techniques, and practices prescribed in the current manufacturer's maintenance manual or Instructions for Continued Airworthiness prepared by its manufacturer, or other methods, techniques, and practices acceptable to the Administrator".



Ch1. pg.89:

Choose the best answer from the following question. Section 43.13(a) states requirements for each person performing:

- Maintenance, inspections, or preventive maintenance
- Maintenance, major repairs, or preventive maintenance
- Maintenance, alterations, or major repairs
- Maintenance, alterations, or preventive maintenance

(Answer provided at the end of the chapter).

Ch1. pg.90:

Choose the best answer from the following question. Section 43.13(a) covers maintenance on:

- aircraft, engines, propellers, and appliances
- airframes, engines, and appliances
- airframes, engines, propellers, and appliances
- aircraft, turbines, rotors, and appliances

(Answer provided at the end of the chapter).

Ch1. pg.91:

Recall Title 14 CFR Part 43.13 (a) requires you to use methods, techniques, and practices prescribed in the current manufacturer's maintenance manual. More simply put this means "procedures". The important point to remember is that we are expected, no.....**required**, to follow procedures when we perform maintenance."



Ch1. pg.92:

14 CFR Part 43.13, paragraph (b) states other important requirements. It states: "Each person maintaining or altering, or performing preventive maintenance, shall do that work in such a manner and use materials of such quality, that the condition of the aircraft, airframe, aircraft engine, propeller or appliance worked on will be at least equal to its original or properly altered condition (with regard to aerodynamic function, structural strength, resistance to vibration and deterioration, and other qualities affecting airworthiness).

Ch1. pg.93:

Choose the best answer from the following question: 14 CFR, Part 43, Section 43.13(b) applies to:

- Airframe & Power plant mechanics performing maintenance, inspections, or preventive maintenance.
- Repairmen performing alterations, preventive maintenance and inspections.
- Each person performing maintenance, alterations, or preventive maintenance.
- Certificated Mechanics holding Inspector Authorization performing maintenance and inspections.

(Answer provided at the end of the chapter).

Ch1. pg.94:

Aviation is a diverse industry. Whether you work on general aviation aircraft, business aircraft, helicopters, or for an airline, your core “standards” are the same. Whether you are responsible for the entire aircraft, or one specific component of that aircraft, you are expected to live by those same core “standards”.



The principles discussed in this training course are relevant whether you work by yourself or work for a large maintenance organization. Now, we’ll take a closer look at the accident scenario and examine the human factors involved when maintenance technicians fail to follow procedures.”

Correct Answers for Chapter One Quizzes:

- Chapter 1 page 14 – A**
- Chapter 1 page 15 – A**
- Chapter 1 page 17 – C**
- Chapter 1 page 18 – C**
- Chapter 1 page 20 – D**
- Chapter 1 page 21 – A**
- Chapter 1 page 23 - C**
- Chapter 1 page 24 – A**
- Chapter 1 page 26 - C**
- Chapter 1 page 27 - A**
- Chapter 1 page 29 - B**
- Chapter 1 page 30 - E**
- Chapter 1 page 32 - B**
- Chapter 1 page 33 – E**

Chapter 1 page 35 - C
Chapter 1 page 36 - D
Chapter 1 page 38 - B
Chapter 1 page 39 - B
Chapter 1 page 41 - B
Chapter 1 page 42 - A
Chapter 1 page 44 - A
Chapter 1 page 45 - E
Chapter 1 page 47 - D
Chapter 1 page 48 - A
Chapter 1 page 89 - D
Chapter 1 page 90 - A
Chapter 1 page 93 - C

Chapter 2

Ch2. pg.1:

As you recall, the crew suffered from a pitch trim failure. Unfortunately, all three occupants perished during this flight. We work in the safest transportation system in the world, so, how could this happen? Let's take a look back to review these events.



Ch2. pg.2:

Pete works as an aircraft maintenance technician in an FAA certificated repair station. He enjoys an exciting career that provides the opportunity to work on a large variety of private and corporate aircraft. Today one of his company's valued customers has an inspection scheduled on their aircraft. Pete's supervisor has done all of the research in preparation for the inspection so that his mechanics can get started first thing in the morning. The Airworthiness Directives have been researched and those that are due have been listed on the work order. Inspection checklists have also been printed so the mechanics and inspectors have them available. Pete's supervisor asks him to start the inspection by complying with an AD on the pitch trim actuator. The AD is a recurring repetitive inspection requirement that needs to be completed.



Ch2. pg.3:

As he's done so many times before, Pete takes time to review the AD. He may not be thinking about it right now, but by reading the AD he is taking the first step in fulfilling the regulatory requirement we discussed earlier. That is Title 14 CFR Part 43.13 (subpart)(a) which states "use methods, techniques, and practices prescribed in the current manufacturer's maintenance manual." Remember, however, before we can use the methods, techniques, and practices prescribed by the manufacturer, we need to take the time to read and understand them.

Ch2. pg.4:

Pete reviews the AD and finds it refers to a Service Bulletin to use to accomplish the inspection. Pete prints a copy for easy reference at the aircraft. The AD requires inspection of the elevator pitch trim actuator jackscrews for cracks, and the tie rod for wear and the Service Bulletin states how this should be done.



Ch2. pg.5:

To get a better understanding of what Pete is looking for, let's take a look at how this actuator is designed. The trim actuator is a dual jackscrew assembly. Each jackscrew has a threaded rod end adapter that is screwed on to the upper end of each jackscrew shaft. The jackscrews and rod end adapters have drilled holes which are aligned when properly assembled. The rod end adapters are threaded onto the jackscrews until the holes through each component line up. Then a tie rod is inserted through the holes in the rod end adapters and jackscrews.

Ch2. pg.6:

The tie rod also interconnects the two jackscrews to ensure that they move evenly when the trim system is used.

Ch2. pg.7:

The AD requires Pete to inspect the tie rod for wear and to inspect the jackscrews for cracks. The Airworthiness Directive references a manufacturer's Service Bulletin that is to be used to perform the work. Pete uses the Service Bulletin as his step by step instructions for completing the inspection. The area of concern on the jackscrews is the upper end, where the tie rod hole is located. In order to inspect the tie rod, Pete will have to remove it from the actuator. Pete does this by removing the nut from one end of the tie rod and then pulling the tie rod out from the opposite end as instructed by the Service Bulletin.

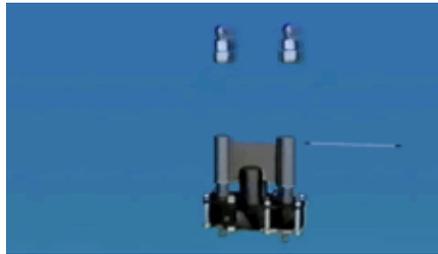


Ch2. pg.8:

Remember our discussion of Title 14 CFR, Part 43, Section 43.13 (subpart)(a) which is the requirement to use the manufacturer's "methods, techniques, and practices" when performing maintenance? In this situation, Pete has specific instructions given by the manufacturer which, in this case, is the Service Bulletin.

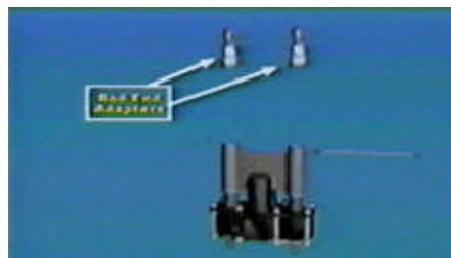
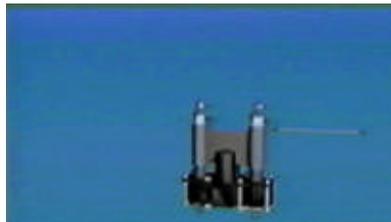
Ch2. pg.9:

The Service Bulletin instructions do not mention disassembly of the rod end adapters from the jackscrews. It only requires that the tie rod be removed and inspected. Furthermore, the instructions only require a slight push-pull force be applied to the jackscrew and rod end adapters to determine if the jackscrew is sheared. But Pete decides that a more thorough inspection can be achieved if he separates the rod end adapters from the jackscrews. Pete's decision is contrary to the Service Bulletin's **CAUTION** which states: "DO NOT LOOSEN JAM NUT ON ROD END OR ALLOW ROD END BEARING TO ROTATE AS THIS WILL CHANGE THE ADJUSTMENT OF ACTUATOR TRAVEL".



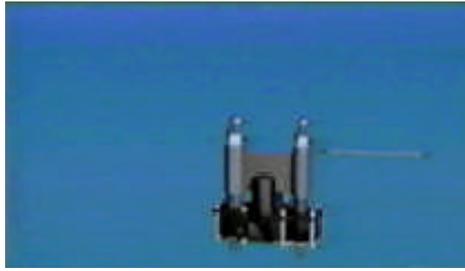
Ch2. pg.10:

If the actuator wasn't installed in the aircraft, the two rod end adapters could simply be unscrewed from the jackscrews, but with the actuator still installed, Pete decides to improvise. If he can hold the leading edge of the horizontal stabilizer down enough to relieve the load on the jackscrews, maybe he can rotate the two jackscrews enough to separate them from the rod end adapters. This would allow him to more thoroughly inspect the ends of the jackscrews for cracks.



Ch2. pg.11:

As stated earlier, Pete removed the tie rod from the actuator, inspected it in accordance with the Service Bulletin instructions. He affirmed it was serviceable per specifications and determined it would not need to be replaced.



Ch2. pg.12:

When Pete removed the tie rod, this also released the jackscrew dust cover allowing it to drop down exposing the jackscrew threads. Pete could now have access to the rod end adapters for inspection.

Ch2. pg.13:

Now he tries to get the jackscrews backed out of the rod end adapters so he can inspect them. But this proves more difficult than he had hoped. As he's struggling to get the jackscrews backed out, Pete decides he better have the Parts Department check on availability of a replacement actuator in case they end up needing one. He knows that the aircraft is needed for a trip at the end of the week and he doesn't want to miss their deadline waiting for an actuator. He fills out a "Price and availability request", and then heads back to the aircraft.

Ch2. pg.14:

Pete almost has the jackscrews backed out far enough to inspect when his supervisor comes over and asks him to help out on another airplane for a few hours so they can get it out the door this afternoon. Pete makes sure that everything is okay to leave the way it is for now and heads across the hangar. This is a critical interruption of the work on the actuator. It is important to note that Pete did not make any record of his work in progress, most critically, the number of turns he performed when attempting to unscrew the jackscrew out of the rod end adapters.



Ch2. pg.15:

As often happens, what was supposed to be a quick job, on the other aircraft, ended up taking the whole afternoon. Pete will have to finish inspecting the actuator in the morning.

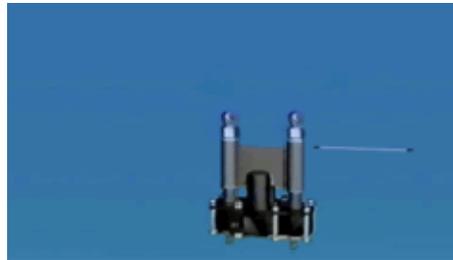
Ch2. pg.16:

The next morning Pete stops by the Parts Department to see if they were able to locate another actuator, but what they'd found was an invoice showing that a replacement actuator had already been installed on this aircraft last year. After a little more research Pete determines that the actuator they installed last year is actually one that doesn't require inspection after all. The AD he had been trying to comply with was in fact no longer applicable to this aircraft.



Ch2. pg.17:

Frustrated with the time wasted, Pete started putting things back together so he could help with the rest of the inspection. If he just reverses the steps he used to disassemble the actuator for inspection, he should be able to button it back up quickly, right? Pete tries to remember how many turns he made yesterday on the jackscrews when he was backing them out of the rod end adapters. If he turns them back the same amount of turns, the holes should be lined up so the tie rod can be installed.



Ch2. pg.18:

Pete tries to see if the holes are lined up, but it is difficult to get a good look even using his flashlight and mirror. Instead, he decides to use a small punch to help line up the holes in the jackscrews with the holes in the rod end adapters. At first it appears that the holes are not quite lined up because the punch won't go through. Thinking that he has inserted the jackscrews too far into the rod end adapters, he slowly begins to turn the jackscrews back out until the line-up punch slips easily through the holes. Looks like the holes are lined up now and the tie rod can be installed.

Ch2. pg.19:

Pete feels better knowing that it won't take long to finish up on this job so he can help with the rest of the inspection and he takes a needed break.



Ch2. pg.20:

After his break, Pete finishes putting the actuator back together by installing the tie rod. Remember, one function of the tie rod is to prevent separation of the jackscrews from the rod end adapters, similar to the way a cotter pin prevents a nut from rotating on a bolt.

Ch2. pg.21:

Pete fails to install the jackscrew dust cover. Remember the tie rod bolt also secures the dust cover in place.

Ch2. pg.22:

Now for a quick ops check. Pete runs the electric pitch trim full up, then full down. Each time he watches the trim indicator to verify correct trim movement. He even steps outside the aircraft to glance at the horizontal stabilizer when it is in the full up and full down positions to make sure everything looks right. Satisfied that the system is working correctly, he signs off the mechanic block on the work order. Since the work will need to be inspected, Pete leaves the inspection panels open and moves on to another task.



Ch2. pg.23:

It is always a good idea to ask another mechanic to inspect your work. A second set of eyes may see something you've missed. During an operational check, it is often advisable to ask someone else to operate the system while you observe the system movement.



Ch2. pg.24:

As work on the aircraft is being wrapped up, one of the company's designated inspectors takes the work order list and begins to inspect the work that has been signed off by the mechanics. The inspector takes a quick look at the pitch trim actuator, and even actuates the system from the cockpit to ensure it is functioning properly.



CHAPTER 3

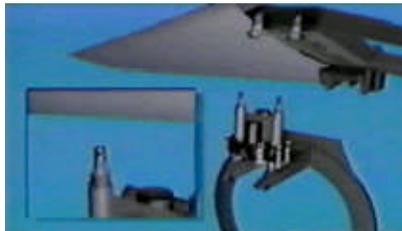
Ch3. pg.1:

What went wrong? Did human error contribute to the tragic climax? Could this happen to an aircraft you worked on?



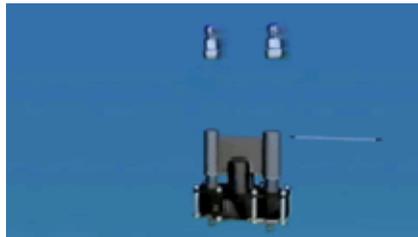
Ch3. pg.2:

This aircraft accident resulted when the horizontal stabilizer trim actuator became disconnected from the stabilizer rendering the aircraft uncontrollable in flight. Remember earlier we said there are normally a chain of events (human errors) which lead up to all accidents. Let's analyze and determine the links (Human Errors) in the chain. There are a number to consider.



Ch3. pg.3:

It is natural to focus on the pitch trim actuator since it was the last failure before the aircraft became uncontrollable in flight. Note we said LAST failure because, as we continue we will find that there were many failures in this scenario. Yes, Pete worked on the actuator and we know Pete did not properly assemble the actuator. However, why was Pete performing maintenance on the actuator?



Ch3. pg.4:

The aircraft was in the maintenance facility for scheduled maintenance. The owner of the aircraft was a regular customer so the aircraft was familiar to the maintenance shop personnel. Pete's supervisor performed Airworthiness Directive research and prepared maintenance work orders.



Ch3. pg.5:

Because the aircraft was a regular visitor, Pete's supervisor performed the AD research using only the shop's AD management/(and)tracking program. The system revealed the AD was applicable and required a recurring inspection. So he directed Pete to comply with the AD on the actuator.



Ch3. pg.6:

Human Error: The supervisor relied solely on the shop data to determine AD status on this aircraft. He did not perform a review of the aircraft maintenance records. Could this be NORMS? Do you remember the definition of NORMS?



Ch3. pg.7:

Norms are "standard practices", usually undocumented, adopted by an organization or group".

Ch3. pg.8:

If Pete's supervisor had also reviewed the aircraft records, he would have found a record entry stating that the pitch trim actuator was replaced a year earlier with one that terminated the AD inspection requirement. Pete would not have been directed to work on the actuator possibly eliminating a link in the chain of events that ultimately resulted in the accident.

Ch3. pg.9:

This leads to another Human Error. Someone in the maintenance shop failed to properly record in the shops AD tracking system that the AD recurring inspection was no longer required on this aircraft when the actuator was replaced a year earlier.



Ch3. pg.10:

Could this be LACK OF AWARENESS? Do you remember the definition of LACK OF AWARENESS?



Ch3. pg.11:

Lack of awareness is a “failure to see a condition, understand what it is, and predict the possible results”.

Ch3. pg.12:

Maybe it was Lack of Communication. Which if you recall is a “Failure to transmit, receive, or provide sufficient feedback in order to complete a task”. Someone failed to effectively communicate to the records department that replacement of the actuator terminated the AD inspection on this aircraft.



Ch3. pg.13:

What other common causes of human error in maintenance could have attributed to this error?

- Complacency: Overconfidence from repeated experience on a specific task.
- Distraction: An unlimited number of possible events/ conditions that interrupt one’s ability to focus on a specific task.
- Lack of Teamwork: Failure to work together to complete a shared goal.
- All could have attributed to human error.

(Answer provided at the end of the chapter).

Ch3. pg.14:

Pete was directed to perform the AD inspection on the actuator that did not require an inspection. Before Pete began to work on the actuator, he researched and reviewed the AD. The AD directed that compliance inspection must be done per instructions of a Service Bulletin. Pete had the Service Bulletin. The AD compliance instructions clearly state part number/(and)serial number of the applicable pitch trim actuators to inspect. A question one could ask at this point is why Pete didn't check the data plate to positively identify if the installed actuator was included in the applicability statement. Unfortunately, the data plate could not be clearly accessed and read with the actuator installed in the aircraft.....even with a flashlight and mirror. Pete decided to do the inspection anyway without further assessment.



Ch3. pg.15:

Human Error: Lack of Assertiveness on Pete's part. He failed to speak up about instruction/(and)orders.



Ch3. pg.16:

The Service Bulletin procedures did not require the unscrewing of the rod end adaptors from the jackscrew. As a matter of fact, it contained a CAUTION not to disturb this adjustment.

CAUTION: DO NOT LOOSEN JAM NUT ON ROD END OR ALLOW ROD END BEARING TO ROTATE AS THIS WILL CHANGE THE ADJUSTMENT OF THE ACTUATOR TRAVEL.

Ch3. pg.17:

HUMAN ERROR: Contrary to the "Caution", Pete attempted to unscrew the jackscrew out of the rod end adaptors.

Ch3. pg.18:

What should Pete have done before pressing on with his decision to unscrew the rod end adaptors from the jackscrew?

Ch3. pg.19:

He should have discussed and communicated his decision with his supervisor. They should have reviewed the AD, Service Bulletin, and maintenance manual together to reassess the applicability. They both should have discussed how the job was to be done and made sure each understood the proceduresand that they were followed.



Ch3. pg.20:

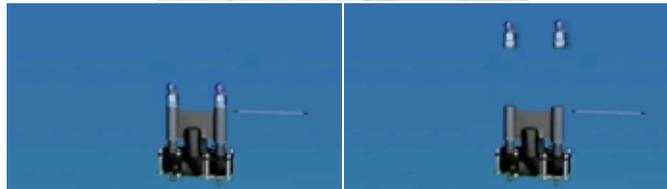
Pete and his supervisor's failure to discuss the task and work together to ensure the job got done properly can be attributed to which of the following causes of human error?

- Lack of Teamwork
- Lack of Knowledge
- Pressure
- Complacency

(Answer provided at the end of the chapter).

Ch3. pg.21:

Unfortunately, Pete did not discuss his decision to deviate from maintenance procedures with his Supervisor. He removed and inspected the tie bolt as instructed by the service bulletin. However, contrary to the service bulletin, he struggled to unscrew the jackscrews from the rod end adaptors. Even after experiencing difficulty he still didn't engage his Supervisor for assistance.



Ch3. pg.22:

HUMAN ERROR: Pete also sensed some pressure with the deadline to get the plane completed for a rapidly approaching flight.

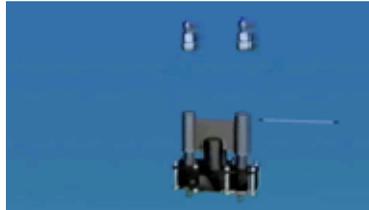


Ch3. pg.23:

He, in fact, submitted an order for a replacement actuator in case they needed one. This is when it was discovered from parts records that a new actuator was installed on this aircraft a year earlier and that the AD was not applicable to this new pitch trim actuator. This changed the course of the event. All Pete had to do was to reassemble the actuator and it would have been good to go.

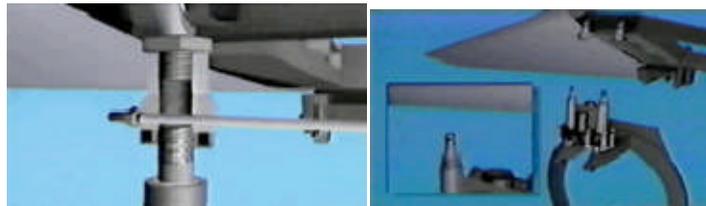
Ch3. pg.24:

HUMAN ERROR: But Pete had disturbed the original assembly adjustment and he also didn't record what he had undone. To complicate matters, visual affirmation of proper engagement was hampered due to extremely confined quarters.



Ch3. pg.25:

HUMAN ERROR: Pete assumed that when the punch, he was using, went into the tie rod holes in the rod end adaptors, the proper engagement was achieved. But he was terribly wrong. What had actually occurred was the jackscrew was not fully engaged into the rod end adaptors and the tie rod holes were above the end of the jackscrews. So when the tie rod was inserted, it did not engage in the jackscrew. This allowed the jack screw to rotate inside the rod end adaptors when pitch trim was engaged.



Ch3. pg.26:

Recall Pete's operational check of the system. The system performed satisfactorily when he operated the trim switch. Pete signed off the work. But what Pete didn't know was that when he operated the pitch trim, the jackscrews were turning inside the rod end adaptors and at the same time it was moving the stabilizer up and down. This would prove disastrous while the aircraft was in flight.



Ch3. pg.27:

This job required an inspection by an inspector. So Pete did not install the inspection panels. However, the inspector did not do a thorough job.



Ch3. pg.28:

HUMAN ERROR: The inspector failed to detect that the jackscrew dust covers were not properly installed. If he had, then the tie rod would have to be removed to reinstall the dust shield. This may have been an opportunity to find the jackscrews not properly engaged in the rod end adaptors.



Ch3. pg.29:

The inspector signed off the work and the inspection panels were installed. The aircraft was returned to service.



Correct Answers for Chapter Three Quizzes:

Chapter 3 Page 13: D

Chapter 3 Page 20: A