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Maintenance Management Analysis Craftsman

Volume 1. Maintenance Management

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THIS CAREER DEVELOPMENT course, 2R071, *Maintenance Management Analysis Craftsman*, introduces us to the different aspects of maintenance management. This course is designed to increase the background knowledge of the maintenance management analyst with the maintenance management process that adapts to the new Air Force mission. It provides the general knowledge and background information to expand your ability to do an effective analysis of maintenance indicators and also perform effective supervision. Senior leaders in our career field selected certain maintenance management areas they feel are important to add to our knowledge base. With the senior maintenance management analyst assuming a greater role in the maintenance leadership and supervision, the time to increase and broaden your knowledge of the maintenance mission starts when you become a supervisor. However, you must not stop expanding your knowledge base after you finish this course; continue learning to become an effective leader and team player.

This one-volume course is mandatory for all personnel in upgrade training to the 7-skill level. It is a consolidation of several maintenance management objectives, programs, and processes governed by Air Force policies and instructions.

The subjects in this volume are as follows:

Unit 1 begins with the First Look and annual flying requirements. It gives a synopsis of the Flying Hour Program (FHP), maintenance capabilities assessment and the planning factors involve in their development. The unit concludes with discussing select portions of the Reliability and Maintainability Information System (REMIS).

Unit 2 covers the distinct roles and functions of the Plans, Scheduling & Documentation (PS&D) section with the maintenance management production career field.

Unit 3 explains the official medium of Air Force technical orders, the different topics they include, as well as how they are disseminated and managed.

Unit 4 presents advanced statistics and their applications. This unit takes predictive analysis a step further by demonstrating why and when to apply the 12-step analysis process.

A glossary is included for your use.

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This volume is valued at 24 hours and 8 points.

NOTE:

In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then complete the unit review exercises.

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Unit 1. Operations and Maintenance Planning

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BY THIS POINT in your career, you've been involved in spending literally millions of dollars of the taxpayers' money. How? A big portion went to buy all the parts and equipment that we, as analysts have investigated and studied to provide useful information to maintenance managers in making decisions. Based on the information you presented these expenses were necessary to improve maintenance performance. As a 7-level, you are even more involved in the effective management of resources. With recent budget constraints, it is even more imperative that we properly assess maintenance and provide our leadership with accurate data so they can make appropriate management decisions. In this unit we discuss First Look/Annual Requirements and the Reliability and Maintainability Information System (REMIS). These programs are not only high visibility, but effective and efficient management of these programs and information systems ensures your resources are properly managed and ultimately your mission is achieved.

1–1. First Look/Annual Requirements

As maintenance management analysis craftsmen, there is no doubt that your daily efforts contribute to unit objectives and mission accomplishment. However, due to aggressive operations tempos and increased flying demands, it becomes common for analyst to understand the operational mindset. As analyst, it is important to keep in mind that our overarching concern is maintenance and the ability to support the mission through effective maintenance management. It is vital to formulate the best plan and provide the best information to leadership for effective use of our thinning budget and resources. Remember, an over-stretched maintenance unit eventually becomes fatigued and less effective towards accomplishing the mission. With that in mind, it is essential that Flying Hour Program (FHP) planning be as thorough as possible. Effective management of resources is the key, and maintenance is a major resource essential to successful FHP execution. Proper planning sets the blueprint for the right mix of operations needs and maintenance capabilities which leads to mission success.

001. Flying Hour Program

The Air Force FHP is a structured program governed by a myriad of documents ensuring continuity, accountability, flexibility and capability across the force. Air Force Policy Directive (AFPD) 11–1, *Flying Hour Program*, states the critical importance of this program due to its direct relationship to levels of combat capability as it relates to the "Total Air Force." Although the mission of the FHP is generating combat capability, the planning factors used to build and support the program are based on peacetime home station training requirements and available resources.

The basis for each flying unit's local annual planning is the FHP, a levy of requirements and parameters that determine flying and maintenance requirements, capabilities, and funding. Before we delve into the annual requirements and First Look planning cycle, let's go over a few terms and concepts relevant to the formulation of the overall Flying Hour Program. During the annual planning phase, as maintainers, we tend to overemphasize maintenance information without trying to understand operations terms. To put together a good plan, it is just as important to understand and learn the big picture perspective; both maintenance and operations. As a maintenance analyst, you are involved in the assessing the FHP. You need to be familiar with the entire FHP cycle. In this learning objective, there are a few terms to consider when you are doing your part to evaluate the annual FHP or developing the First Look that is discussed later. This lesson helps you understand what you, as the maintainer, are signing up to support.

Flying Hour Program calculation and requirements

The annual FHP for each unit and mission design series (MDS) is formulated by the respective lead command and Air Staff offices that have oversight of aircraft, manpower, budget allocation, and execution. The key elements in determining the flying hour model and the annual FHP for a particular unit are crew ratio, Ready Aircrew Program (RAP), average sortie duration (ASD), capability-based aircraft availability and mission capability (MC) rates, and ratio of experienced/inexperienced aircrew.

Crew ratio

The planned crew ratio upon which the FHP for a particular unit is built may not account for all aircrew training requirements levied upon the unit. There may be additional or special requirements for sorties/events for attached aircrew (from higher headquarters [HHQ], major command [MAJCOM], numbered air force [NAF], or even wing).

Ready Aircrew Program

The RAP and its associated requirements, to include flying hour requirements and currency events and intervals, must be considered. RAP defines the number of training sorties required for aircrew proficiency and currency in certain mission events.

Average sortie duration

ASD is based on training range location, base, and local airspace traffic peculiarities. Each flying unit or mission has an assigned "fly-box" so to speak. The duration of each sortie depends on factors such as how long it takes to get to the fly-box, if they are meeting with tankers/air refueling, the type of mission, and so forth.

Capability-based aircraft availability and mission capable rates

Air Staff determines these rates annually and transmits them to MAJCOM lead commands as a result of the FHP. Aircraft availability pertains to aircraft that are available to perform the unit's mission (e.g., not at depot), while the MC rate pertains to the percentage of aircraft in mission capable status, also known as the fleet mission capability rate.

Ratio of experienced/inexperienced aircrew

Flying squadron manning is a mix of experienced and inexperienced aircrew based upon their individual qualifications and upgrade status. Aircrews have graduated flying hour/event requirements, prescribed by RAP guidance, depending upon their respective experience levels.

Standard utilization rate

The Air Force standard utilization (UTE) rate is determined by the lead command for the weapon systems or aircraft under their control. For example, Air Combat Command (ACC), as the Lead command for the Combat Air Forces (CAF), establishes standard UTE rates for weapons systems possessed by ACC and similar MDS in commands that operate the identical airframe. Unit-level maintenance leaders have no control over the standard UTE rate; therefore, it is important to understand the cost/benefit dynamics in planning to support the unit's directed UTE rate.

As analyst and maintenance leaders, our philosophy is to be responsive to mission needs and the needs of maintenance managers to produce aircraft. Your goal is to assess the organizational health of the unit and give feedback to assist in producing the maximum fleet availability with the highest achievable MC rate. This is effectively supported by proactively ensuring all scheduled and unscheduled maintenance events are accomplished at the opportune time.

It is common for flying units to fall behind in meeting their monthly FHP for one reason or another. Because operations and maintenance (O&M) days are traditionally limited to five per week, this may be seen as a modifiable limiter to meet the monthly UTE. In this instance, it is necessary for maintenance leaders to validate operations' requirements and then coordinate to develop an achievable schedule. Plans, scheduling, and documentation (PS&D) inputs to this process is very important, especially in regards to the aircraft maintenance unit (AMU) scheduler, because it is PS&D that is most familiar with the moving pieces of the plan.

Some techniques considered for meeting operations needs when aircraft availability and other known maintenance considerations are outpaced by operations sortie/hourly requirements include the following:

- Flying additional turns per day (i.e., some three-go days versus two-go days).
- Surges (i.e., flying all available MC aircraft at an increased turn rate for one or more days, while considering lead command policies).
- Flying aircraft on additional O&M days (e.g., on weekends and holidays or on scheduled UTE/goal days).

Annual Flying Hour Program requirements

The hourly requirements of the Annual FHP are derived, in simple terms, by determining all of the following:

- All of the required training events required of aircrew.
- The currency/recurring qualification interval required (number of times that events must be re-accomplished to retain currency during the training cycle).
- Attrition factors represent historical percentage of scheduled sorties lost to causes outside of unit control (e.g., maintenance, weather, etc.).
- The actual flying hours required to perform all of the sorties/events prescribed in the RAP requirements.

Financial cost

In this day and age, we are all experiencing the money squeeze where we are doing more with less. The Annual FHP has associated financial costs and requirements for accountability and management of allocated funds. The Annual FHP is accompanied by associated categories of funds that are managed at lead command and unit level. These associated funds are allocated proportionally to flying hours. We are not going to get to the granular level of the FHP associated funds; however, it is important to have an understanding about the funds you are involved with as a maintenance analyst. We may not have a visual over each and every dollar spent during the execution of the FHP, but understanding the schedules and plans that are formulated equals spending the allocated money.

Understanding the basics of the funding structure and variables that affect aircraft maintenance is useful for management of the maintenance and supply discipline.

O&M budget

O&M budgets fund items that are typically the day-to-day expenses for the United States Air Force (USAF). O&M funds are used to operate, sustain, and maintain aircraft, space and related weapons systems; train and develop Airmen; operate advanced communications, command and control systems; purchase critical supplies; equipment and fuel; and operate both stateside and overseas installations.

Furthermore, O&M resources directly support essential combat enablers such as intelligence; logistics; weather; air traffic control; search and rescue; reconstitution; airfield, runway and base facility maintenance; and improvements to the working and living environment for Air Force personnel. Other types of O&M funds you may have a stake in include, but not limited to the following:

- Depot-level reparable. The budget category used to fund components purchased to replace “not reparable this station” (NRTS) and line replaceable unit (LRU).
- Materiel Support Division (MSD). The working capital fund for high-dollar equipment items to support prime weapons systems.
- General Support Division (GSD). Used to fund bench stock purchases and replenishment.
- Transportation Working Capital Fund (TWCF).
- Joint air/airborne transportability training (JAATT).

O&M days

O&M days are the total amount of days the unit has to conduct their mission in a given month (see the following table). There are variations to the amount of days depending on location, especially when compared between continental United States (CONUS) and outside continental United States (OCONUS). Units located OCONUS typically observe both the United States and host nation holidays.

Month: MAY
Days in May: 31 days
Less weekends: 8 days
Less holidays: 1 day
Less lead command family day: 1
Total O&M days: 21 days

Other Flying Hour Program considerations

Other added requirements or “collateral” or “cost-of-business” sorties (e.g., air shows, flybys, and photo shoots) may consume O&M dollars, flying hours, sorties, and resources, but do not necessarily contribute to aircrew mission capability, or upgrade. These additions undeniably require the same amount of effort from our maintainers, both in preparations and postflight tasks. AMU analyst often have a front row seat to the fleet health and availability, and problem areas that need attention. When appropriate you must articulate why and how this may disrupt the balance between fleet health and maintenance production capability.

Maintenance leaders have a role in disciplined expenditure of budgets, and they trust all within their group to help identify areas where maintenance may need to “push-back.” We are all expected to be good stewards of the budget and in exercising supply discipline, which can both conserve funds and ensure that adequate resources are available for the maintenance mission. When the aircraft parts budget is depleted, parts may be purchased with administrative O&M funds, but maintenance leaders must understand that if they are using this method they will not be reimbursed. This situation is not ideal.

002. Operations and maintenance planning cycle

To optimize wing mission capability, O&M created an annual plan to execute the lead command-directed FHP. When properly managed, this plan allows for completion of all operations requirements while maintaining the health of the fleet. The wing uses the annual O&M planning cycle to develop mutually agreed upon quarterly, monthly, weekly, and daily maintenance and flying schedules that allow both operations and maintenance the ability to achieve their respective goals.

The wing plan

Lead commands develop procedures to ensure the intent of the operational planning cycle is met. The objective of the operational planning cycle is to execute the wing FHP consistent with operational requirements and maintenance capabilities. The operational planning cycle begins with the annual allocation of flying hours and UTE rates. O&M schedulers propose an annual flying plan, balancing both operational requirements and maintenance capabilities. The annual plan, detailed by month, evaluates the capability of maintenance to support the annual FHP. The plan is developed, coordinated, and consolidated jointly by the operations support squadron (OSS) and PS&D.

The printed wing plan requires the following:

1. Including an assessment of the wing's ability to execute the FHP.
2. Coordinating with the O&M group commander (GP/CC) before getting approval by the wing commander (WG/CC).
3. Committing the fewest number of aircraft possible to meet programmed UTE rate standards and goals.

If applicable, lead commands develop scheduling procedures for units involved in Operational Test and Evaluation, Developmental Test and Evaluation, or Initial Operational Test and Evaluation to ensure the intent of the flying and maintenance planning cycle is met.

What is First Look?

First Look is an internal wing document. It is a very important and useful tool; it helps determine budget allocation and sets the blueprint for flying for the upcoming fiscal year. The First Look report is intended to highlight potential limiting factors between the operational requirements and maintenance capability to support flying for the upcoming year. It is a foundational step in the many scheduling processes used to ensure the wing is conducting business within the confines of its maintenance capabilities.

The ultimate goal of this assessment is to gauge the wing's ability to execute the FHP while committing the fewest number of aircraft possible to meet its goals. If you are attached to a unit that operates fighter aircraft, more than likely you will be involved in the First Look process. In direct contrast, in the airlift community, you may not be involved in the First Look process at all. Here, most of the flying hour efforts are dictated by the Tanker and Airlift Control Center (TACC) providing real-world mission airlift support to the war efforts and beyond. Because of the nature of this dynamic environment, the flying hour allocation, if any, may not be as visible to you. In the fighter environment on the other hand, training is more static, making it predictable and full participation is expected from maintenance scheduling.

First Look requirements

Every year, the First Look report is initiated to plan for the upcoming fiscal year. On or about 15 March, the maintenance operations flight (MOF) PS&D requests from Maintenance Management Analysis (MMA) an airframe capability assessment. This assessment includes personnel capability and facility capability assessments and is accomplished for each individual aircraft maintenance unit based on their respective historical data.

The assessment is submitted to MOF PS&D no later than the last workday of March. This collection of data helps determine if a unit's available aircraft and resources are able to support its flying requirement. Performing this study early allows for a substantial lead time to make the necessary changes; this study helps set a structured blueprint for final flying hour allocation.

Now, we are breaking down each set of information that PS&D and MMA are responsible for and how they come together to complete the maintenance capability study. Keep in mind that processes differ from base to base; nonetheless, all units have to perform the same study.

Maintenance capabilities

The maintenance capabilities are an integral part of the applied metric to formulate the wing's Flying Hour Program. The purpose of conducting this study is to find or to create a balance to ensure maintenance resources can sustainably support flying requirements. The wing relies on MMA each year to produce the maintenance capabilities assessment. This assessment is composed of historical and present data in three areas: parts, airframe and personnel/facility capabilities in accordance with Air Force Instruction (AFI) 21–101, *Aircraft and Equipment Maintenance Management*. These factors are considered when determining a unit's capability to support flying requirements. After all, a good flying unit is only as good as the maintenance support that keeps it flying. You will obtain the data used in the calculations from various sources across the wing. Some of the more common sources are plans and scheduling, the aircraft maintenance squadron (AMXS) workcenter supervisors, maintenance squadron (MXS) workcenter supervisors, the Integrated Maintenance Data System (IMDS), and manning documents.

NOTE: Due to the enormous scope of past, present, and future information involved in producing the maintenance capability assessment, it is difficult for the following text to be all inclusive. The intent of the explanations and examples contained in this career development course (CDC) is to provide a snapshot of the different factors considered when computing these capabilities.

Airframe capability

Airframe capability is used when determining the unit's capability to support the operational flying requirement for a specified month, quarter, or fiscal year. It is an assessment of various maintenance and operations factors based on historical data and assumptions. Airframe capability computations are a compilation of factors that determine if a unit's available aircraft can support any type of requirement in peacetime and wartime. When all factors are considered, the assessment is developed in terms of airframe capability forecast. This is a tool commanders use to assess their peacetime or wartime capability.

Airframe capabilities vary with the airframe mission, base support, and unit mission requirements. For the purpose of this study, you use fighter base units with F–16s with a single operational mission. Look at the total F–16 sortie generation capability of all F–16 units.

The basic assumption starts with a scenario, whether the tasking is a peacetime or wartime capability. The assumption states its conditions and limitations, as directed by HHQ. For example, the peacetime scenario includes a two-shift operation of nine hours each shift, 40 work hours a week. A third shift could incorporate training with essential personnel only.

Maintenance factors

Maintenance factors are all maintenance-related activities that can affect the availability of aircraft for sortie generation. These maintenance factors reduce airframe availability. If one aircraft is provided as a maintenance trainer, then that is one aircraft less for flying. Aircraft wash and scheduled maintenance actions are included, as well. These factors are assigned a numerical value for each unit (e.g., the maintenance factors for units are Base A – 2, Base B – 4, Base C – 1, etc.). The maintenance factor is only one of the factors used for sortie generation.

Sortie generation factors

Listed are additional sortie generation factors.

- Number of operations and maintenance days per year.
- Total possessed aircraft.
- Historical MC rate.
- Turn factor (hours).
- Average sortie duration (hours).

- Flying envelope (hours).
- Crew preflight time (hours).
- Maintenance preparation time (hours).
- Attrition rate.

You have learned about some of these topics in our previous lessons or the journeyman course, so we will not cover them in any detail. Instead, we'll treat them as available data given to us.

Computations

In your computations, look for maximum capability. Given some factors that can reduce your F–16's capability; determine how much you can "deliver." Considering all of these factors, look for the following:

- Sortie capability (initial and maximum).
- Sortie losses (projected).
- Flying hour capability (maximum).
- Sortie UTE rate (maximum).

NOTE: In the following formula, notice you use primary aircraft inventory (PAI) and possessed aircraft. You are to use the lower of the two at the time you are making the computations. The number of O&M days per year is based on 4.5 workdays per week and does not include training, safety, or goal days. The formula used in computing airframe capability is as follows:

Initial Sortie Capability = (PAI or Possessed Aircraft-Maintenance Factors) × MC Rate × O&M Days per Year

First Turn Aircraft Available = (PAI or Possessed Aircraft) – Maintenance Factors

First Turn Sortie Capability = First Turn Aircraft Available × MC Rate × O&M Days per year

Sortie Capability = Initial Sortie Capability + First Turn Sortie Capability

Projected Sortie Losses = Sortie Capability × Attrition Rate

Maximum Sortie Capability = Sortie Capability – Projected Sortie Losses

Maximum Flying Hour Capability = Maximum Sortie Capability × Average Sortie Duration

$$\text{Maximum Sortie UTE Rate} = \frac{\text{Maximum Sortie Capability}}{(\text{PAI or Possessed Aircraft})}/12$$

During the airframe capabilities study, the maintenance operations flight (MOF) PS&D provides some or all of the following information. It is provided in a "by day" format for each of the months:

- Cannibalization aircraft.
- Alert requirements.
- Training (weapons load training [WLT], field training detachment [FTD], fire departments, etc.).
- Transfer/acceptance.
- Programmed depot maintenance (PDM) aircraft.
- Phase/isochronal (ISO) inspections.
- Scheduled maintenance.
- Deployments (if known).
- Other information if applicable (usually unique to your unit's aircraft type).

Personnel capability

Personnel capability projections help determine if a unit's workforce is capable of supporting the flying requirements. It helps identify potential shortfalls and recommend necessary changes to better position its personnel and resources to meet mission requirements. It also helps identify and mitigate the source of any internal or external manning problems and fix problems that are within the unit's control.

The computation for personnel capabilities is conducted on each maintenance activity, such as flightline and backshop aircraft maintenance (e.g., crew chiefs, specialists, electrical and environmental, engines, weapons, etc.). It also takes into account non-direct aircraft maintenance personnel (e.g., aerospace ground equipment (AGE), armament, munitions, etc.) using the same skill level factors. The factor applies weights to the three, five, and seven skill level mix for each of the specialties needed and is more than likely to come from personnel loaded in IMDS with a 100 labor code in the ranks of technical sergeant (TSgt) and below.

You also take into consideration manning imbalances and skill level imbalances when compared between what is assigned and what is authorized. Other information taken into account is the fluctuation of manpower due to leave, temporary duty (TDY), medical, special absences, education and training, and so forth in accordance with AFI 38–201, *Management of Manpower Requirements and Authorizations.* Personnel capability is measured in terms of maintenance personnel per operational unit (MP/U). MP/U measures the total number of direct maintenance personnel needed for each specified operational unit to perform direct on- and off-equipment work. You use this measurement in developing manpower projections to support specified operating and maintenance concepts. This is only an estimated manpower projection. You take into consideration basing, deployment, and operational scenarios.

MP/U calculations include direct on- and off-equipment maintenance personnel and specialties related to direct on- and off-equipment support (e.g., structural repair [including sheet metal and composites] and nondestructive inspection [NDI]). When analyzing manpower requirements, lead commands consider and use projected MC, partially mission capable (PMC), mean repair time (MRT), and mean time between maintenance (MTBM) rates, coupled with aircraft battle damage repair analyses to determine overall manpower needs.

MP/U calculations exclude maintenance staff agencies, logistics command section operations and support personnel, powered SE personnel, and munitions supply and missile maintenance personnel.

Personnel capability is expressed in several ways, depending on unit requirements. It is expressed as a ratio, with factors such as flying hours, sorties, work center, man-hours, crew, inspections (hourly post-flight [HPO]) and periodic (PE), number of personnel, and workday month (WDM). To meet operational requirements, it may be expressed as the number of sorties or flying hours a work center can support.

The following formulas are some that can be used:

Flying Hours Non-supported = Flying Hour Requirement-Workcenter Flying Hour Capability

Total Man-hours Required = Flying Hours Required × Man-hour per Flying Hour Factor

$$\text{Number of Personnel Required} = \frac{\text{Total Man-hours Required}}{\text{Number of available Man-hours for One person in WDM}}$$

$$\text{Number of HPOs per crew per month} = \frac{\text{WDM}}{\text{HPO days}}$$

Number of HPOs per month = (# of HPO per crew per month) × (# of HPO crews available)

$$\text{Number of HPOs per PE cycle} = \frac{\text{HPO inspection cycle}}{\text{PE inspection cycle}}$$

$$\text{Man-hours Per Flying Hour Factor} = \frac{\text{JDD (job data documentation) Direct Man-hours Expended}}{\text{Flying Hours Flown}}$$

$$\text{Aircraft Work Ration} = \frac{\text{Man-hours By standard reporting designator (SRD)}}{\text{Total Aircraft Man-hours}}$$

$$\text{Supportable Flying Hours} = \frac{\text{Available Man-hours}}{\text{Man-hours Per Flying Hour Factor}}$$

$$\text{Supportable Sorties} = \frac{\text{Supportable Flying Hours}}{\text{Average Sortie Duration}}$$

Facility capability

Facility capability computations determine if your unit has the facilities in place to support the next fiscal year's flying requirements. These facilities are, but are not limited to, the phase/ISO inspection dock, fuel barn, low observable (LO) barn, and so forth. For the sake of this CDC, we will address only the phase portion of a dock capability assessment. The dock capability computation method is illustrated below.

When the term *facility* is used, it refers to space requirements (e.g., for a dock to be considered a complete operational unit, it must include the facility and the necessary personnel). In this instance, facility capability is computed to determine how many flying hours or sorties the inspection docks can support. These are determined for each type of aircraft. You must be able to calculate how many docks are required to support the flying schedule.

Facility capability may be expressed in *docks* and *crews*. Even though only one dock may be required, it may consist of three crews or shifts. To determine the number of flying hours or sorties your facilities can support, you need the following information: inspection cycle, average sortie length, WDM, in-dock time, and number of docks available.

To determine the dock requirements, use the following formulas:

$$\text{Number of Inspections Required} = \frac{\text{Flying Hours Scheduled}}{\text{Inspection Cycle}}$$

Dock Days Required Number of Inspections Required Average Dock Days Per Inspection.

$$\text{Number of Docks Required} = \frac{\text{Dock Days Required}}{\text{Work Days Per Month}}$$

To determine flying hours and sortie capability, use these formulas:

$$\text{Number of Inspections Per Dock} = \frac{\text{WDM}}{\text{Average Dock Days}}$$

Number of Inspections Per Month = Number of Inspections per Month × Number of Docks Available.

Dock Flying Hour Capability = Number of Inspections per Month × Inspection Cycle

$$\text{Dock Sortie Capability} = \frac{\text{Dock Flying Hour Capability}}{\text{Average Sortie Length}}$$

There are different algorithms for maintenance capabilities (i.e., airframe, personnel, and facility) developed by the lead commands that meet their fleet and geographical requirements. You must follow the formulas prescribed by the lead command to which you are assigned to meet their requirements.

Data compilation

Once you have completed the initial assessment report, PS&D makes further refinements to the report by applying projected maintenance requirements. In accordance with lead command procedures, PS&D provides the operations support scheduling section and maintenance supervision a copy of the assessment in a monthly format for the entire fiscal year. PS&D compiles all projections to include operational requirements, an assessment of maintenance ability to support the monthly contract requirements, and an overall assessment of the unit's maintenance capability to meet the annual flying hour program.

Initial review

After the initial reviews are complete, AMXS and the operational squadron (OS) send their coordinated responses to MOF PS&D where it is gathered. All responses are then forwarded to OSS's current operations flight scheduling section for consolidation into a comprehensive package. Operations incorporate operational requirements while PS&D incorporates the inspection dock capability into the package. The package includes the following:

1. UTE rates. (N/A [not applicable] to Mobility Air Forces [MAF] units)

   Sortie UTE sortie utilization (SUTE) rates are the number of sorties an aircraft must fly per month to meet the annual requirement.

   $$\text{Sortie UTE Rate} = \frac{\text{Sorties per month}}{\text{Number of PAI aircraft}} \times 100$$

   Hourly UTE hourly utilization (HUTE) rates are the number of hours an aircraft must fly per month to meet the annual requirement.

   $$\text{Hourly UTE Rate} = \frac{\text{Hours per month}}{\text{Number of PAI aircraft}} \times 100$$

   NOTE: The SUTE rate is used for fighter aircraft whereas the HUTE rate is used for all other aircraft.

2. Sorties contracted/scheduled per day. (N/A to MAF units)

   $$\text{Programmed sorties} = \frac{\text{Number of sorties required}}{\text{Number of O \& M days}}$$

3. Monthly scheduled sorties. (N/A to MAF units)

   $$\text{Monthly scheduled sorties} = \frac{\text{Number of sorties or hours required}}{\text{(1 - attrition factor)}}$$

4. Phase/ISO inspection dock capability.

   $$\text{Dock capability} = \frac{\text{Number of O \& M days}}{\text{(Number of Phase/ISO days} \times \text{inspection cycle)}}$$

PS&D and MMA compute and provide the phase/ISO dock capability projection. The computation is accomplished for each maintenance unit by month for the entire fiscal year. It is important that these projections are reviewed with AMXS and MXS supervision.

Squadron level review

Collaboratively, PS&D and OS co-chair a meeting with all required agencies, to include but not limited to AMXS, MXS, munitions squadron, and OS. Capability studies and operational requirements are thoroughly reviewed and discussed. In the event that any maintenance, operational, or support limitations are identified, they are noted and presented to the maintenance and operation GP/CCs for further consideration.

Final review/approval

After all reviews are completed at the squadron level, PS&D and OS assemble the airframe, personnel, and facility capability studies, operational requirements and all notable limiting factors collected from previous reviews. All of the First Look data is organized into a comprehensive package for presentation to the operations group (OG) and maintenance group (MXG) commanders. When presenting the First Look package to the GP/CCs, it is important all gathered data and any documented shortfalls are discussed. It is at this venue where deadlocks can be decided by the appropriate level of management. After the group level review is complete, the compiled FHP proposed response is presented to the WG/CC for final approval. After WG/CC approval, the final assessment of maintenance capabilities to support the operational requirements and the proposed flying hour projections are sent to the lead command no later than the predetermined suspense date.

Final flying hours allocation

As previously stated, the unit's proposed flying hour projections or response is sent to the lead command. Here, the proposed FHP response is reviewed for final approval. Once approved by the lead command commander, the message is forwarded down to the unit 30 to 60 days prior to the applicable fiscal year. This allocation becomes the final contract for the unit's annual flying and maintenance planning process. This final contract is the set of numbers the wing uses as basis for annual, quarterly, and monthly utilization planning and execution.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

001. Flying Hour Program

1. What defines the number of training sorties required for aircrew proficiency and currency in mission events?

2. What are some elements on which ASD is based?

3. What rate is determined by the lead command for the weapons systems or aircraft under their control?

4. List techniques to consider for meeting operation needs when your unit gets behind on its monthly FHP goals.

5. Describe the O&M fund and how it is used.

6. Provide examples of activities that may consume O&M funds, but do not necessarily contribute to aircrew MC or upgrade.

002. Operations and maintenance planning cycle

1. During the O&M planning cycle what three things does the wing plan require?

2. When is the First Look report initiated?

3. What agency does the wing rely on and is responsible for producing the maintenance capabilities assessment?

4. What becomes the contract for the unit's annual flying and maintenance planning process?

1–2. Reliability and Maintainability Information System

Air Force planners in the 1980s saw the need for a centralized database that would provide accurate and timely maintenance and logistics information to increase the readiness of Air Force weapons systems. At the time, many maintenance data collection and tracking systems were operated independently, which sometimes duplicated one another; additionally, the process of obtaining this information was costly and unreliable. The Air Force capitalized on advances in computer technology to meet its need for a system that would provide instant information concerning its weapons resources. Knowing how many aircraft you can deploy in a war and sustain their operation is a dream becoming a reality for your combat logistics planners and field commanders.

003. System overview

REMIS was created at the same time as IMDS to provide decision support information to Air Force managers by providing access to accurate, combined reliability, and maintenance data (i.e., analysis of failure trends, excessive maintenance costs, quality problems, and cost), which is critical for increasing the readiness and sustainability of USAF weapons systems. It is the official source for weapons system data to support reports to the Department of Defense (DOD) and Congress. REMIS is also the primary Air Force database for collecting and processing equipment maintenance of operational information. REMIS is the answer to the objectives of the Reliability and Maintainability (R&M) 2000 program. These objectives are listed:

- Increase war-fighting capability.
- Increase survivability.

- Decrease deployment lift requirements.
- Decrease manpower/unit output.
- Decrease costs.

System management center
The system management center (SMC) is the single point of contact for REMIS hardware and software problem resolution, providing around-the-clock technical support to all users 365 days a year.

Major REMIS interfaces
The vast majority (approximately 90 to 95 percent) of the data in the REMIS comes from other computer systems. There are several different computer systems that interface with the REMIS. These include the IMDS, Depot Maintenance Management Information System (DMMIS), stock control and distribution (SC&D) system, and the Standard Base Supply System (SBSS). Other systems interfacing with the REMIS include Air Force contractor systems, the Air Staff computer system, and the Weapon System Management Information System (WSMIS) (fig. 1–1). IMDS provides the majority of the REMIS data. IMDS also provides base maintenance and equipment inventory, status, and utilization data to the REMIS, while the REMIS supplies edit tables, allocated flying hours, time compliance technical order (TCTO) data, and configuration tables to IMDS units. DMMIS provides detailed data about depot maintenance to the REMIS, while the REMIS supplies equipment history and edit tables to DMMIS. The REMIS provides WSMIS data about weapon system status and utilization. The Air Staff provides flying-hour allocations to the REMIS, while the REMIS supplies inventory and utilization data to the Air Staff. Air Force contractors supply repair action data to the REMIS, while the REMIS provides maintenance experience data to contractors.

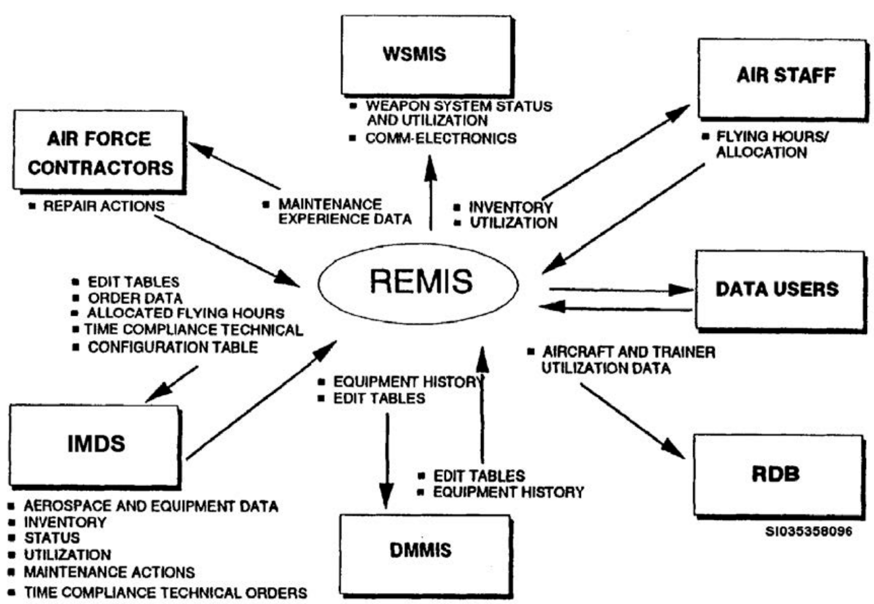

Figure 1–1. Major REMIS interfaces.

REMIS users and access
REMIS users consist of civil service, contractor, and Air Force personnel. They range from DOD planners to base-level schedulers. REMIS users access the database for many diverse reasons. DOD strategy planners use REMIS data to prepare annual materiel readiness reports to Congress and in preparing the DOD budget. Planners at Headquarters Air Force use REMIS data to plan and prepare

budgets for submission to DOD planners and in allocating and using resources. Planners at the base level can use REMIS data to schedule flying hours or maintenance, track work in progress, and in weapon system analysis and comparisons. Most REMIS users access the system using a desktop personal computer (PC). Since REMIS is graphical user interface (GUI) based, each PC workstation requires an Internet Web browser. A browser-based, terminal emulation software allows each PC to communicate with the REMIS system. The emulation software does not need to be installed on each PC. The software talks with your PC. A local area network (LAN) connection is still required for the network connectivity because REMIS data is transmitted through the military network globally and is accessed through the Air Force portal.

REMIS software subsystems and core

REMIS is functionally divided into four high-level functional areas. Three of them are software subsystems and the fourth includes the CORE programs. Figure 1–2 shows the three REMIS subsystems and their respective inputs. The REMIS subsystems are explained in the following table:

REMIS Software Subsystems and Core	
Subsystem	**Explanation**
Equipment Inventory, Multiple Status, Utilization Reporting Subsystem (EIMSURS)	Provides inventory, status, and utilization data on aerospace vehicles, automated test equipment, selected missiles and support equipment, and communication-electronic equipment.
Product Performance Subsystem (PPS)	Collects and provides on- and off-equipment maintenance data, TCTO maintenance actions, and equipment effectiveness information.
Generic Configuration Status Accounting Subsystem (GCSAS)	Monitors and tracks equipment approved and actual configuration as well as TCTO compliance.

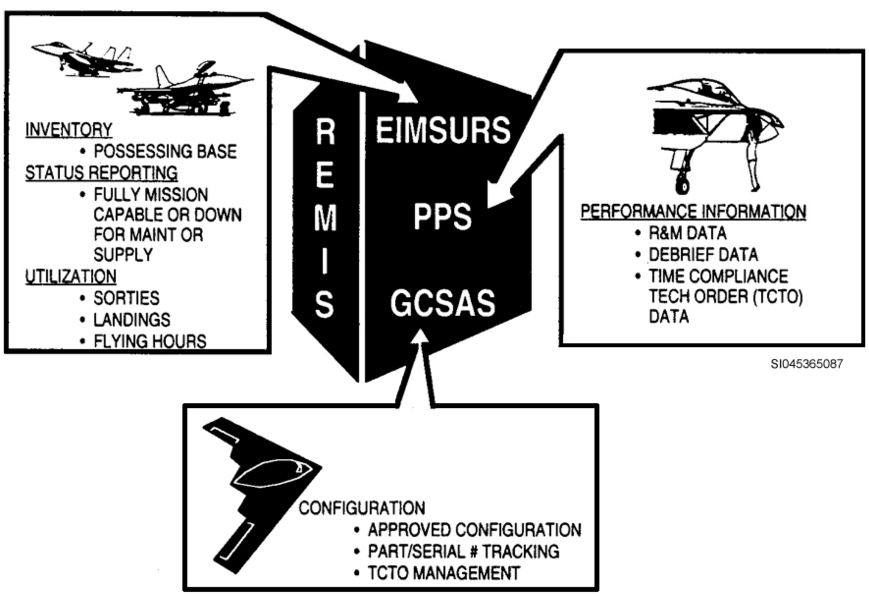

Figure 1–2. REMIS subsystems and their functions.

The CORE ties the subsystems together into one heterogeneous system and provides the interface between the three subsystems. While it provides the other subsystems the support they need to process R&M data, it also controls user access to the REMIS, its data, and all other application software (fig. 1–3).

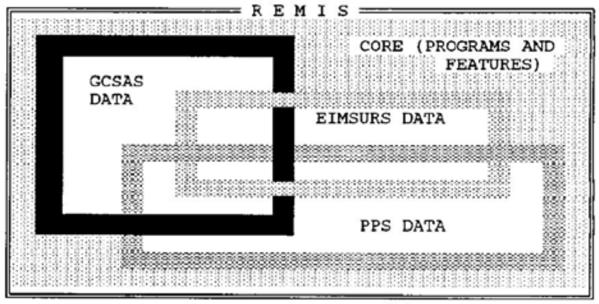

Figure 1–3. REMIS subsystem relationships.

004. Equipment Inventory, Multiple Status, Utilization Reporting Subsystem

EIMSURS is one of the subsystems of REMIS. EIMSURS's primary function is to provide both detailed and summary/historical data for all of the following equipment categories per AFI 21–103, *Equipment Inventory, Status and Utilization Reporting.*

- Aerospace vehicles.
- Automated test equipment.
- Selected missiles.
- Selected support equipment.
- Communications-electronics equipment.

It applies to all organizations that report inventory and maintenance data on assigned equipment. The EIMSURS subfunctional areas are discussed in this lesson.

EIMSURS process

How does this data actually get into the REMIS database (fig.1–4)? Equipment inventory, maintenance status, and utilization data comes in from the using organizations. Also, REMIS users enter similar data from terminals and workstations. This data is stored by the REMIS until it is needed. Managers can use this information to make decisions concerning operations and budget allocations.

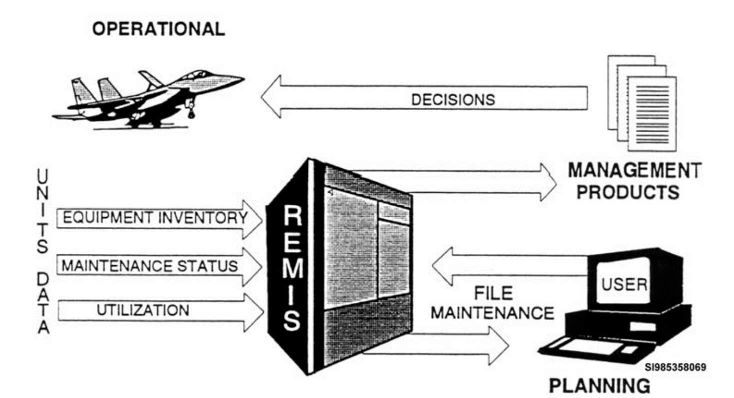

Figure 1–4. The EIMSURS process.

Inventory reporting

EIMSURS' subfunction provides worldwide inventory tracking for AFI 21–103 reportable equipment. It provides an automated correlation process by end-item serial number for all inventory gain, loss, and termination transactions. As a minimum, the data includes: assigned command and organization by program element code (PEC); possessing command and organization; inventory by tail number and MDS codes.

REMIS uses EIMSURS assignment/possession data to edit other incoming data; therefore, the inventory data must be kept current at all times or the REMIS will reject other data received through other EIMSURS functions or REMIS subsystems. Air Force aerospace vehicle distribution officers (AVDO), MAJCOM AVDOs, and other inventory control personnel are responsible for keeping assignment/possession data up to date.

Equipment status

The status subfunction provides statistics for MC rates, fully mission capable (FMC) rates, and so forth. The statistical data can be compared by equipment type and supporting organizations to assess equipment effectiveness. Additionally, it relates to the combat readiness of Air Force equipment assigned throughout the world.

Equipment utilization

The utilization subfunction provides statistics for flying hours, landings, sorties, and so forth, for aircraft. It also provides usage data for trainers and automated test equipment. Airframe hours and flying hours are reported for each aircraft by serial number and tail number, respectively. Utilization data is one thing the Air Staff uses to determine flying hour allocations and DOD budgets.

EIMSURS file maintenance, reports, and queries

EIMSURS has three functions that enable you to modify, update, manipulate, and/or view data from the REMIS database: file maintenance, reports, and queries. The file maintenance function allows the user to add, change, delete, and retrieve data. This is how EIMSURS data is entered into, removed from, or retrieved from the database. The report's function allows you to produce standardized inventory, status, or utilization reports. You can review reports on-line and download them to your personal computer and then print out the information at your leisure or use the data in an application software program such as Excel. EIMSURS query function allows you to retrieve and view data from the REMIS database on your monitor.

How EIMSURS data is used

Air Force AVDOs use REMIS data to monitor inventory, use inventory, and to configure assigned inventory. Planners use EIMSURS's data to track the official Air Force inventory, assign new equipment to the inventory, and allocate flying hours. This data is for use in developing Air Force programming documents and their related budget and manning requirements. This data provides the background for briefing general officers on worldwide status of the fleet and logistics support, or the latest status of equipment by serial number, work unit code, unit, and so forth, for inspection purposes. This data is a management tool that provides a real-time accurate measurement of equipment, allowing managers to respond to any type of emergency in a timely manner.

005. Product Performance Subsystem

The PPS collects and provides on-equipment and off-equipment maintenance data collection (MDC) type data and general support data (fig. 1–5). With this information, a user can find what the malfunction was (How Mal Code), when the discrepancy occurred (When Disc Code), what kind of maintenance was being performed when the discrepancy was discovered (Type Maintenance Code), and so forth. This type data is for use by analysts to spot negative trends on a particular equipment component. The general support data collected is helpful for analyzing manpower utilization per sortie or flying hour.

PPS process

On- and off-equipment maintenance data comes into the REMIS from base organizations, depots, and contractors (fig.1–5). Also, REMIS users enter similar data from terminals and workstations that can be stored by REMIS until needed and managers can use this information to make decisions concerning logistics support and equipment projections.

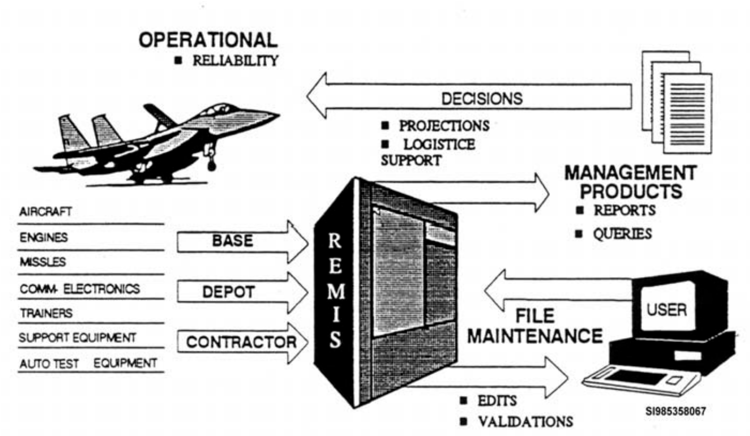

Figure 1–5. PPS process.

On-equipment maintenance and repair data

This subfunction provides on-equipment maintenance data on maintenance man-hours, cannibalization rates, maintenance repair actions, failure rates and component lifetime, and TCTO maintenance actions. In addition, the PPS provides statistical data as well as maintenance narrative data, such as descriptions of discrepancies and corrective actions.

Off-equipment maintenance and repair data

This subfunction provides off-equipment maintenance data on bit and piece replacement items, in-shop inspection and repair actions, items replaced during field and depot repair, and TCTO maintenance actions. This data tells you who, what, where, why, and how of these maintenance actions. PPS also collects and maintains information on materiel deficiency reports. In addition, the PPS provides statistical data as well as maintenance narrative data, such as descriptions of discrepancies and corrective actions.

Support general data

Support general codes (03- and 04-series work unit codes [WUC]) are codes that cover generalized work that supports other types of aircraft maintenance actions. These codes include such things as scheduled and special inspections like preflight and postflight inspections, major and minor isochronal inspections, and special inspections, like hard landing inspections, functional check flights, and analysis of oil sample inspections.

PPS file maintenance reports and queries

The PPS has three functions that enable you to modify, update, manipulate, and/or view data from the REMIS database: file maintenance, reports, and queries. The file maintenance function allows you to view and manipulate data in the REMIS database. The reports function allows you to produce standardized MDC-type reports for on-line viewing or downloading to your PC for later printing or use in application software programs. The PPS query function allows you to retrieve and view data directly from the REMIS database.

How PPS data is used

The main goal of the PPS is to keep systems and equipment ready to perform their missions at the least cost to the government. The data provides users with weapon system and equipment product performance data, allowing the user to identify and project weapon system R&M trends. These trends assist the Air Force with new weapon systems and equipment design, as well as, the modifications to existing systems and equipment. This data also improves logistic decisions, due in part to reliable, timely maintenance data. The Air Logistics Complex (ALC) planners use the PPS data to compute repair requirements and track the accomplishment of TCTOS.

006. Generic Configuration Status Accounting Subsystem

The GCSAS functions (fig.1–5) include weapon system and computer program identification number (CPIN) approved and actual configuration status and accounting and TCTO reporting.

GCSAS configuration function

This function enables the system program manager (SPM) to load and update the approved configuration of equipment, serialized controlled items, and CPINs. It also holds contractor-loaded configuration data until it has been validated by the appropriate authority (e.g., System Program Office (SPO), item managers (IM), SPMs, and so forth).

GCSAS gives base level and depot-level personnel “read-only” access to approved configuration. They, in turn, provide the actual equipment configuration data back to REMIS as they report maintenance and inspection data.

GCSAS TCTO function

The appropriate office of primary responsibility (OPR) loads TCTO data directly into GCSAS. Data to be loaded includes engineering change request (ECR) number, TCTO number, TCTO data code, and so forth, as well as data to establish links between related TCTOs.

The GCSAS provides OPRs the capability to track TCTOs. They are able to check the following TCTO information: rescission date, percent of completed and uncompleted TCTOS, expended and nonexpended man-hours, applicable equipment by serial number or lock numbers, and so forth. This does not include TCTO maintenance actions.

GCSAS process

Configuration, TCTO, and software data come into REMIS from base, depot, and contractor organizations (fig. 1–6). Also, REMIS users enter similar data from terminals and workstations. This data is stored by REMIS until it is needed. Managers can use this information in the form of queries and reports to make decisions concerning operations.

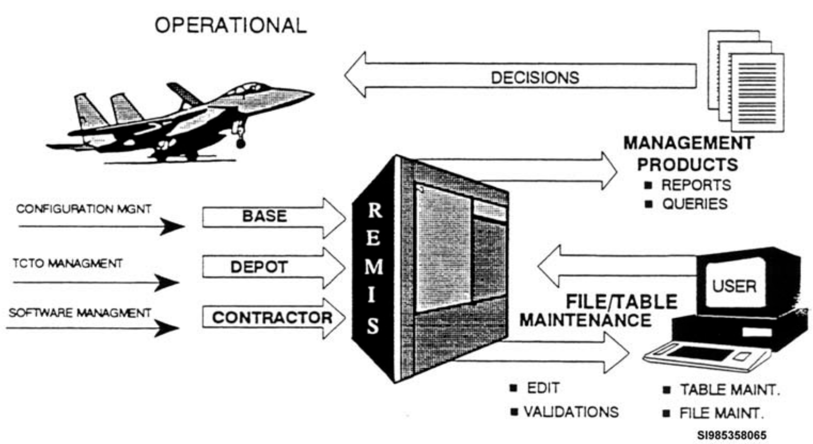

Figure 1–6. The GCSAS process.

GCSAS file maintenance, reports, and queries

GCSAS has three functions that enable you to modify, update, manipulate, and/or view data from the REMIS database: file maintenance, reports, and queries. The file maintenance function allows you to view and manipulate configuration and TCTO data in the REMIS database. The reports function allows you to produce standardized TCTO and/or configuration reports for on-line viewing on your PC. You can download these reports to your PC for use in Windows application software programs to make a printout of the data. The GCSAS query function allows you to retrieve and view data directly from the REMIS database.

Information provided to the MAJCOMs by the GCSAS is used to manage modifications, report TCTO status, perform calculations and analysis, justify new modifications, and investigate trends (forecasting). This information helps to project and/or schedule workload requirements against time change items and also assures spare items are procured and provided to the unit responsible for completing the removal and replacement actions. The ALCs use the data provided by the GCSAS to help ensure modifications are completed within the time frame specified in the TCTO.

007. Reports and queries

REMIS was designed with selected flexibility so you can obtain needed database information to perform your assigned duties. The on-line detailed and summarized data available through REMIS is predefined On-Demand Reports, predefined Queries, Table Pushdown Output, and standard File Maintenance input screens. Each screen and report is hard-coded to provide users with the data they need and in the format they require.

REMIS on-demand reports

REMIS has a pre-defined On-Demand Report function that provides the primary access method of generating reports from the REMIS database information. An authorized user can schedule one or more reports to be automatically generated on a specific date at a set interval. Every report screen has a fixed input format and limited output report format options. The report screen allows the user to enter the data selection criteria for the data to be retrieved.

REMIS queries

The Predefined Query function permits you to generate reports using archived historical data. There are no scheduled queries that are automatically generated and transferred to the user through REMIS. Each query screen has a fixed input and limited output format. Each query screen permits the user to enter the data selection criteria for the data to be retrieved and set the data output format options.

REMIS table pushdown output

Selected REMIS users have the authorization to pushdown or send tables and selected records to other interfacing computers systems such as IMDS. The tables are used at the input level to ensure proper construction of inputs from both *system-to-system input* (SSI) and *man-to-machine input* (MMI) processing. Examples of tables that would be pushed down and made available to one or more organizations would be action taken code (ATC) tables, how malfunction code (HMC) tables, and geographic location (GLC) tables. Most tables are pushed down in their entirety; however, the WUC tables are sent by specific equipment designator; therefore, an organization receives only the applicable WUC tables for the specific type of equipment that is maintained.

REMIS data

REMIS is the central database for Air Force equipment. It has been receiving EIMSURS-related data since 1987, PPS-related data since 1990 and GCSAS-related data since 1994. The data is received on an hourly, daily, weekly, or monthly cycle. The database currently contains inventory, status, utilization, maintenance, configuration, and TCTO associated with Air Force aircraft, missiles, communications-electronics (C-E), and selected support equipment. The data is primarily provided from IMDS and other data systems. However, the same type of data can be entered directly into REMIS through its own File Maintenance input screens.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

003. System overview

1. Which automated information system provides the majority of data to REMIS?

2. What are the three software subsystems in REMIS?

3. What does the CORE subsystem do?

004. Equipment Inventory Multiple Status Utilization Reporting Subsystem

1. What is the primary function of EIMSURS?

2. List the five equipment categories identified under AFI 21–103.

3. How does the Air Staff use REMIS utilization data?

005. Product Performance Subsystem

1. What is the primary function of PPS?

2. Who provides on- and off-equipment maintenance data to REMIS?

3. How do ALC planners use PPS data?

006. Generic Configuration Status Accounting System

1. What capability does the GCSAS configuration function provide to system program managers?

2. What capability does the GCSAS TCTO function provide to TCTO OPRs?

3. How do ALCs use GCSAS data?

007. Reports and queries

1. What is the on-line detailed and summarized data available through REMIS?

2. What are the two options in REMIS that allows a user to enter the data selection criteria for the data to be retrieved?

3. What is the purpose of Table Pushdown Output?

Answers to Self-Test Questions

001

1. RAP.
2. Training range location, base, and local airspace traffic peculiarities.
3. Air Force standard UTE rate.
4. (1) Flying additional turns per day (i.e., some three-go days versus two-go days).
   (2) Surges (i.e., flying all available MC aircraft at an increased turn rate for one or more days, while considering lead command policies).
   (3) Flying aircraft on additional O&M days (e.g., on weekends and holidays or on scheduled "UTE/goal days").
5. O&M budgets fund items that are typically the day-to-day expenses for the USAF. O&M funds are used to operate, sustain, and maintain aircraft, space and related weapons systems; train and develop Airmen; operate advanced communications, command and control systems; purchase critical supplies; equipment and fuel; and operate both stateside and overseas installations.
6. Air shows, flybys, and photo shoots.

002

1. (1) Including assessment of the wing's ability to execute the Flying Hour Program.
   (2) Coordinating with the O&M GP/CCs before being approved by the WG/CC.
   (3) Committing the fewest number of aircraft possible to meet programmed UTE rate standards and goals.
2. Every year on or about 15 March.
3. MMA.
4. Final flying hours allocation.

003

1. IMDS.
2. (1) EIMSURS.
   (2) PPS.
   (3) GCSAS.
3. Ties the subsystems together into one heterogeneous system and provides the interface between the three subsystems.

004

1. To provide both detailed and summary/historical data for all of the items identified per AFI 21–103.
2. (1) Aerospace vehicles.

(2) Automated test equipment.

(3) Selected missiles.

(4) Selected support equipment.

(5) Communications-electronics equipment.

3. To develop Air Force programming documents and their related budget and manning requirements.

005

1. To collect and provide on-equipment and off-equipment MDC type data and general support data.
2. Base organizations, depots, and contractors.
3. To compute repair requirements and to track the accomplishment of TCTOs.

006

1. Enables the SPM to load and update the approved configuration of equipment, serialized controlled items, and CPINs.
2. Provides OPRs the capability to track TCTOs.
3. To help assure modifications are completed within the time frame specified in the TCTO.

007

1. Predefined On-Demand Reports, predefined Queries, Table Pushdown Output, and standard File Maintenance input screens.
2. On-Demand reports and queries.
3. To pushdown or send tables and selected records to other interfacing computers systems such as IMDS.

Complete the unit review exercises before going to next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).

1. (001) What is the basis for each flying unit's local annual planning that is a levy of requirements and parameters determining flying and maintenance requirements, capabilities, and funding?
   a. Operations and Maintenance (O&M) budget.
   b. Higher headquarters (HHQ) taskings.
   c. Flying Hour Program (FHP).
   d. Deployments.

2. (001) When considering Flying Hour Program (FHP) calculations and requirements for a unit, the important elements to determine the flying hour model and annual FHP are crew ratio, Ready Aircrew Program, average sortie duration, aircraft availability and
   a. break rates.
   b. attrition rates.
   c. utilization rates.
   d. mission capability rates.

3. (001) Which funds are used to procure items typically considered day-to-day expenses for the United States Air Force (USAF)?
   a. Defense Reutilization and marketing Office (DRMO).
   b. Operations and Maintenance (O&M).
   c. Government purchase card (GPC) holders.
   d. War reserves.

4. (001) When considering Flying Hour Program (FHP) requirements, what is considered an additional collateral or cost of business sortie?
   a. Exercise.
   b. Calendar.
   c. Flight suit.
   d. Photo shoot.

5. (002) When will the maintenance operations flight (MOF) plans, scheduling, and documentation (PS&D) request from Maintenance Management Analysis (MMA) an airframe capability assessment?
   a. On 1 March.
   b. On or about 15 March.
   c. On 1 October.
   d. On or about 15 October.

6. (003) Which automated information system provides the majority of data to Reliability and Maintainability Information System (REMIS)?
   a. Standard Base Supply System (SBSS).
   b. Integrated Maintenance Data System (IMDS).
   c. Depot Maintenance Management Information System (DMMIS).
   d. Core Automated Maintenance System CAMS for mobility (G081).

7. (004) Who is responsible for keeping Air Force Instruction (AFI) 21–103 equipment assignment and possession data up to date?
   a. Air Force supply distribution officers.
   b. Air Force weapons systems managers.
   c. Air Force major command commanders.
   d. Air Force aerospace vehicle distribution officers.

8. (005) The Product Performance Subsystem (PPS) collects and provides maintenance data collection (MDC)
   a. flight data.
   b. contractor data.
   c. general support data.
   d. field test evaluation data.

9. (006) Which does the Generic Configuration Status Accounting System (GCSAS) allow the System Program Manager (SPM) to load and update?
   a. Work unit code (WUC) codes.
   b. Programmed depot schedules.
   c. Serialized controlled items.
   d. Time change items.

10. (006) The Air Logistics Complex uses Generic Configuration Status Accounting System (GCSAS) data to
    a. start a modification.
    b. schedule new modifications.
    c. ensure modifications are completed within the specified timeframe.
    d. request more time for the modification.

11. (007) When selected users have the authorization to send selected records to other interfacing computers systems such as Integrated Maintenance Data System (IMDS) is called
    a. system processing.
    b. table pushdown input.
    c. table pushdown output.
    d. the Reliability and Maintainability Information System (REMIS) report.

Please read the unit menu for unit 2 and continue ➔

Unit 2. Maintenance Management Production

2–1. Planning and Scheduling 2–1
008. The operational contract 2–2
009. Monthly utilization and maintenance plan 2–4
010. Weekly utilization and maintenance plan 2–7
011. Daily utilization and maintenance requirements 2–11
012. Generation flow plans 2–15
013. Time change requirements 2–18
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023. Configuration management 2–55

AS THE ROLE OF THE senior maintenance management analyst increases to include a thorough familiarization of the different maintenance staff functions and other maintenance support activities, it is logical to begin with its associated career field—maintenance management production (2R1X1), known in maintenance as the maintenance scheduler, or simply scheduler. This unit takes us to the key functions and responsibilities of that office, still known as plans, scheduling, and documentation or PS&D. The unit is designed to follow the order of that name. The PS&D may have distinct functions and activities; however, it nonetheless provides a seamless operation. Planning includes scheduling and scheduling involves documentation. We focus on some tasks that consolidate the majority of the maintenance schedulers' responsibilities. This is not all that they do; only what you see them do on a regular, if not daily, basis.

2–1. Planning and Scheduling

The planning and scheduling tasks are challenging and complicated and require a tremendous amount of planning—preparing for future events regarding the use of our resources. Planning ensures optimum use of aircraft, aircrew training devices, and related support equipment (SE). Knowledge of operational requirements is necessary to determine whether the maintenance capability exists to support all the operational requirements. If not, steps must be taken to provide support when mission requirements cannot be adjusted. This knowledge then becomes the basis to support the maintenance plans and operational schedules in the planning cycle. Much of the maintenance planning and scheduling is based on the maintenance and operational requirements.

The term *planning cycle* used in this text is defined as a series of prepared events repeating themselves. The planning cycle consists of the following five steps:

- Receiving annual and quarterly operational requirements, usage rate, and airframe availability requirements.
- Preparing and using quarterly (long-range) plans.
- Formalizing quarterly requirements through the monthly planning process.

- Refining each month's operational requirements and maintenance schedule weekly.
- Verifying each week's maintenance and operational requirements daily.

The planning cycle starts over with the next quarterly portion.

The lessons in this section explain the roles of the maintenance activities and the procedures you use in the first three steps of the planning cycle. The planning cycle outlines the operational and maintenance procedures with each objective. As a scheduler, you must follow set procedures to fulfill the mission, accomplish the maintenance, and publish and distribute maintenance plans and operational schedules on a timely basis.

008. The operational contract

To begin this process, you must be aware of how an annual operational contract is built, because this is where you receive the flying requirements for the quarterly plan.

The planning cycle has two facets:

1. The operational planning cycle enables the orderly execution of the wing flying-hour program consistent with operational requirements and maintenance capabilities.
2. The maintenance planning cycle ensures proper and effective use of maintenance resources.

Each fiscal year, wings are authorized a certain number of flying hours to accomplish their missions. This is known as the annual Flying-Hour Program. A maintenance scheduler's primary concern regarding the annual FHP is the capability of maintenance to support this contract.

Flying hour/sortie analysis

Once you receive the initial breakdown of flying hours/sorties from operations, check the maintenance and aircraft capability to support the annual plan. Although there are no step-by-step instructions for verifying capabilities, the following table describes four logical areas to check, including dock capability, major maintenance and operational events, utilization rates and attrition rates.

Capability	Description
Inspection dock	One of the first areas of concern is to see whether the inspection dock can support the flying hours. This is done because you cannot fly more hours than your inspection dock can produce (e.g., if operations wants to fly 600 hours in a month and phases are performed on your aircraft every 100 hours, then you must complete six phases this month to fly 600 hours [600 ÷ 100 = 6]. The number of docks, manpower, and days it takes to complete an inspection determine the number of inspections that can be completed this month.
Maintenance and operational events	Another area of concern should be major maintenance and operational events that occur throughout the year (e.g., if you perform an exercise in the second month of every quarter that uses a lot of flying hours, then you may need to decrease the number of hours flown in the previous month; this ensures you have enough fleet time to support the exercise or surge [to produce sorties at a higher than normal rate]). There are, of course, other major maintenance and operational events that can cause you to increase or decrease the amount of hours you fly in a given month.
Utilization (UTE) rate	For a CAF unit, the UTE rate (not applicable to Air Mobility Command [AMC]) is another area to which you must pay particular attention. When the MAJCOM initially sends your unit its annual allocation of flying hours, the command also provides you with a recommended annual UTE. The UTE rate simply means the number of times an aircraft must fly per month/year to meet the annual requirements. This UTE may be used in two ways. First, on a monthly basis, take your contracted sorties and divide them by your PAI. This gives you the monthly UTE. Second, on an annual basis, add up the monthly UTEs and divide by 12 months. This gives you the average annual UTE rate. This should not exceed the annual UTE given to you by your command. Generally, you don't exceed the annual number because your command does

Capability	Description
	not give your unit more sorties than it can support. Obviously, the monthly figure is of greater concern. Remember, the UTE is based on your PAI aircraft, and it may not reflect the actual number of aircraft you possess. Most units also possess backup aircraft inventory (BAI).
Attrition rates	The first step is to obtain unit historical data from the previous flying months from MMA. For illustration purposes, when computing attrition for Jan 15, use historical data for Jan 14, Jan 13, Jan 12, Jan 11, Jan 10, and so forth. Use as much historical data as required, ensuring seasonal variations are considered to determine a basis for attrition. Second, compare the monthly attrition rates with the amount of sorties or hours you intend to fly. During months when the attrition rates are high (e.g., heavy weather months), you may need to decrease the number of sorties or hours you contract. In turn, low attrition months may give you an opportunity to contract for more sorties or hours.

Quarterly planning

The planning cycle begins with the quarterly planning process, progresses to the monthly plan, then to the weekly, and finally to the daily. Let's take a closer look at quarterly planning.

Operational requirements

Quarterly planning begins with the quarterly allocation of flying hours. Each MAJCOM devises procedures to ensure the objectives of the quarterly scheduling cycle are met. The Operational Squadron (OS) operations officer provides these requirements to the AMU supervision and PS&D no later than (NLT) 25 days before the beginning of the quarter. These operational requirements represent the total hours to be flown for the affected quarter. AMU supervision and the OS operations officer discuss these requirements at the scheduling meeting before the quarter being scheduled. These plans include the following:

- Known special missions.
- PDM schedules.
- HHQ commitments.
- Lateral command support requirements.

PS&D refines and adjusts monthly and weekly schedules to meet the quarterly plan objectives within maintenance capabilities. Use the following priority to determine which objectives to support if a lack of resources prevents meeting requirements:

- Alert commitments.
- HHQ-directed missions.
- Training.

The OG/CC and MXG/CC chair a quarterly meeting NLT 14 days before the next quarter. The OSS's current operations flight scheduling compiles, coordinates, and briefs the unit's quarterly plan and includes operational requirements, support capability, and any difficulties expected. Once an approved quarterly plan is established, OSS's current operations flight scheduling forwards a copy to the OS, AMXS, OG, and MXG CCs, along with all scheduling agencies. The plan is posted so it may be viewed by maintenance and operations.

Maintenance requirements

Just as you have a plan for dealing with operational requirements, you also have a plan to incorporate the maintenance requirements into the quarterly plan (known as *long-range planning*). Long-range planning is a set of known maintenance requirements displayed chronologically to prepare the maintenance complex for at least the current month and the next two months. This ensures decisions regarding the use of personnel, equipment, and facilities help achieve the overall mission of the unit.

Adjustment to quarterly schedule

The purpose of quarterly planning is to ensure proper and effective use of resources; moreover, PS&D must be able to project aircraft availability to support the quarterly plan. As a minimum, the quarterly schedule shows the current month's and the next two months' known maintenance requirements (e.g., quarterly flying-hour programs, future PDM, TCTOs, inspections, and scheduled exercises. This includes a potential schedule for manpower and facilities to be used. These requirements, which are needed to construct the quarterly schedule, do not come to you all at once or in any set sequence. You may get the PDM requirements for your fleet of aircraft in July for the next fiscal year (October through the following September), and you may receive TCTOs at any time. Your MAJCOM sets up procedures to ensure the operational requirements for the quarterly flying-hour allocation that you are to provide to the maintenance activity. This quarterly allocation normally remains relatively constant. It often arrives long before the mandatory date if your organization is not experiencing any major changes.

Air Force Form 2401, Equipment Utilization and Maintenance Schedule

Scheduling forecasts and monitors the quarterly plan on an Air Force (AF) Form 2401. This form can be in paper copy, but it's usually automated and stored on a computer (automated system); however, long-range requirements may be posted on charts or scheduling boards. For our purposes, the AF Form 2401 is automated and stored in the automated system. As additional maintenance and operational requirements are received, they are added to the AF Form 2401.

009. Monthly utilization and maintenance plan

Monthly planning is essentially a transposition of a portion of the quarterly plan into a monthly format. Each level of command, from your MAJCOM down to the group, may have its scheduling requirements. You must follow these requirements for monthly planning; this includes procedures on what is to be added to the AF Form 2401. Your monthly schedule includes all known operational events (e.g., exercises, deployments, and surges). This information helps you determine maintenance's capability to meet operational needs. Additionally, you project aircraft availability to meet operational needs. You use the same AF Form 2401 used in the quarterly process.

Remember to keep the monthly plan as simple and direct as possible, but ensure all required information and mandatory contents are included. This monthly UTE and maintenance planning applies to aircraft and engines, where applicable.

Preventive versus corrective maintenance

To the greatest extent possible, maintenance should be accomplished on a preplanned scheduled basis. Maintenance planning provides the most effective and efficient use of people, facilities, and equipment. It reduces unscheduled maintenance and allows for progressive actions toward maintaining and returning aircraft to a safe operating condition. Bench checks of components and proper control of repair cycle assets throughout the maintenance cycle are also critical elements of an effective preventive maintenance program.

The purpose of the entire maintenance process is to sustain a capability to support the flying and training missions. To accomplish this objective, the primary focus of the maintenance effort should be on preventive—rather than corrective—maintenance. Preventive (or scheduled) maintenance ensures equipment is ready and available at the time of need. On the other hand, corrective (or unscheduled) maintenance is generated during the process of using equipment.

Preventive maintenance

AF aircraft require regular maintenance and repair to ensure their optimum availability for mission tasking. Each aircraft is designed with a maintenance concept tailored to its operational mission. Built into that concept are specific inspection and servicing requirements, which form the basis of a preventive maintenance program. All AF units must implement and manage the tasks specified in the scheduled program for their assigned aircraft and associated SE. By following that program, aircraft systems and components operate with greater reliability over time, ensuring aircraft availability. A conscientious and disciplined approach to preventive maintenance is the method used to meet that goal safely and effectively. Preventive maintenance concepts are described in Technical Order (TO) 00–20–1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*.

Monthly timeline

No later than the first weekly scheduling meeting of the month, the OS operations officer provides AMU supervision (maintenance) and PS&D with the estimated operational needs (e.g., sorties/hours, exercises, surges, and deployments/TDYs) for the following month in as much detail as possible. NLT the second weekly scheduling meeting of the month, AMU supervision notifies the OS operations officer whether requirements can be met or what limitations exist. When changes are made, you must make adjustments to the proposed monthly schedule to satisfy maintenance and operational requirements.

NLT the third weekly scheduling meeting with the OG and MXG CCs, next month's plan must be finished before presenting it to the WG/CC for final approval. During the monthly meeting, OS scheduling outlines past accomplishments, status of flying goals, problems encountered, and detailed needs for the next month. AMU/AMXS outlines projected maintenance capability, and aircraft/equipment availability. If conflicts arise between the operational requirements and maintenance capability, the GP and WG CCs decide what portion of the mission to support and to what degree.

Basic requirements

You must be aware of the basic requirements necessary to support the flying schedule before you can properly predict scheduled and unscheduled maintenance. These requirements are the actual number of flying hours, sorties, and alerts for each type of equipment operations intends to fly in a given period. You must consider many factors in computing the maintenance requirements to ensure adequate flying and maintenance are predicted to support the flying commitment. For example, let's say that 14 aircraft are assigned to the 123rd Fighter Wing (FW). The following table could then show the 123rd's commitment for the next month:

Type of Mission	Sorties	Flying Hours
Primary mission	118	295
Functional check flight (FCF) at home station	1	4
Flights to depot	1	5
Flights from depot	2	10
Total	122	314

Computation of attrition

A description of attrition says it is the reduction or loss of sorties because of weather, operation cancellations, or failure of maintenance to provide aircraft for scheduled sorties. When scheduling sorties to fulfill the mission commitment, consider certain attrition factors that influence the ability of maintenance to provide the sorties. Use attrition factors to compensate for non-unit controlled factors. To allow for attrition, the maintenance scheduler over-schedules the contracted sorties by the number of sorties indicated by the attrition factor.

NOTE: The MXG/CC approves the use of attrition factors different than the statistical attrition rates calculated by MMA.

The contract figure (118 sorties) plus the attrition (for this CDC, it will be 0.10) determines the number of sorties to schedule monthly. When you perform your calculations, always remember to round the final sortie count to the next whole number (i.e., 131.11 rounds up to 132).

Now, let's walk through the attrition process so you can understand how to compute the total monthly sortie requirements using this formula:

$$\text{Total sorties to schedule} = \frac{\text{Sorties required}}{(1 - \text{attrition factor})}$$

The following table shows how the calculations are done:

Sorties contracted (required = 118).
Subtract attrition factor from 1 (1 - 0.10) = 0.9.
Divide 118 by 0.9 = 131.11.
Required sorties to schedule is 131.11, but you round up to 132.

NOTE: There is no set AF attrition factor, so the 0.10 or 10 percent attrition factor is for *this CDC only*.

Monthly maintenance plan

Now that you understand the timeline for the monthly schedule, you need to know what details/contents make the monthly schedule complete. The consolidation of all pertinent maintenance requirements and activities make up the monthly maintenance plan prepared by the PS&D. As you review the following table, you probably recognize all the information could not possibly fit on an AF Form 2401. However, in addition to the AF Form 2401, there are other schedules compiled along with it to make a complete monthly schedule for your wing to view.

Monthly Maintenance Plan	
Type of Requirements	**Information**
General Requirements	Include the total aircraft flying hours, total sorties and missions, alert requirements, and scheduled sortie or mission requirements, daily turn plans for each MDS by squadron, group, or wing.
Monthly Maintenance Requirements (as required)	Transient work schedule, if applicable, includes the following: • Scheduled inspections, TCTOs, engine changes, time changes, delayed discrepancies awaiting parts, contract or depot maintenance, washes, corrosion control, training aircraft, and all other known maintenance requirements. • Test, measurement, and diagnostic equipment (TMDE) and SE scheduled inspections, contract or depot maintenance, TCTOs, time changes, delayed discrepancies, washes, and corrosion control. • Avionics and other off-equipment maintenance scheduled inspections, TCTOs, assembly, or repair operations. • Engine in-shop inspections. • Munitions, photo, electronic countermeasures (ECM), and other mission-loading or configuration requirements, including ammunition changes. • Total ordnance requirements for aircraft support. • Tanks, racks, adapters, and pylons (TRAP), and war readiness material (WRM) scheduled inspections, TCTOs, assembly, or repair operations.

Monthly Maintenance Plan	
Type of Requirements	**Information**
	• Special activities (e.g., commander's calls, group TDY, and unit formations). • Monthly training schedules, if not published separately.
Detailed Support Requirements (as necessary)	Petroleum, oil, and lubricants (POL) servicing includes the following: • Supply requirements. • Food service requirements. • Fire department requirements. • Security requirements. • Civil engineering (CE) requirements. • Airfield operations.

Miscellaneous items

Allow time for quality assurance (QA) inspections, which should be listed by type and quantity, special activities (e.g., unit commanders' calls), TDYs, down days, and unit formations. This section can vary greatly, but any information here can help supervisors plan their work. The following may hold true at your base. Based on the maintenance data on your aircraft, your unit may require you to schedule a down day before you place an aircraft on alert. Also, on the first day after the alert, schedule the aircraft for at least one sortie. This enables the aircraft to take off from the alert pad, which precludes towing it back to the ramp. Remember, these are only samples of the types of maintenance requirements you need to consider.

Training

Training schedules may include weapons load, individual, and contract training. The training activity coordinates the proposed training schedule with published by PS&D. As you can tell, the training list could fill many pages in the monthly maintenance plan.

Publishing

The monthly maintenance plan (monthly schedule) must be published/distributed NLT five duty days before the end of the month (or before the beginning of the effective month). Provided that local security requirements are met, you may publish monthly schedules electronically.

010. Weekly utilization and maintenance plan

The purpose of the weekly UTE and maintenance plan is to refine the monthly maintenance plan and provide additional details to it. The plan is adjusted to accommodate unforeseen operational and maintenance problems (e.g., missions added by HHQ, bad weather, and various attrition factors). Once published, the weekly schedule provides the final planning guide for maintenance and operations. Deviations from the schedule must be held to an absolute minimum. All aerospace vehicles and equipment are required to meet the schedule, and all planned maintenance must be done within the specified intervals. This is done by adequately projecting maintenance and aircraft availability. This weekly UTE and maintenance planning applies also to aircraft and engines, where applicable.

Functions

Although the various commands have vastly different missions, they have many functions in common. They are scaled down to meet each unit's operational needs when the mission does not warrant full-scale support. Likewise, in the aircraft maintenance activities, certain functions are always required, and they may be scaled down or consolidated when warranted by the unit's size.

Mission requirements dictate the feasibility of establishing specialized support functions in combat and combat-support units.

The depth and degree of maintenance coordination required varies among activities because of mission and organizational structure, and the types of aerospace vehicles and equipment assigned. Each maintenance function must fulfill its portion of the mission commitment. For that reason, the weekly plan should include all the details essential to fulfilling specific mission requirements levied by operations.

Constructing the weekly utilization and maintenance plan

The monthly maintenance plan is the basic source document used in developing the weekly UTE and maintenance plan. From the current monthly maintenance plan, extract all the known maintenance—dock inputs, arrival/departure of PDM aircraft, TCTOs, training requirements, corrosion control, wash schedules, and so forth. These items give you the basis for the weekly maintenance plan. All weekly schedules should be developed to conform as closely as possible to the current monthly maintenance plan.

Scheduling, within PS&D, is responsible for compiling all the data to be incorporated in the weekly maintenance plan. A major player within PS&D is documentation. Scheduling works, hand-in-hand with documentation to review changes to inspection schedules, newly received publications, TCTOs, instructions, FCFs, document reviews, and so forth. PS&D coordinates with the affected work centers and maintenance activities, as necessary, for building the weekly schedule. However, before maintenance support requirements can be computed, you must know the operational requirements.

Operational requirements

As early in the week as possible, but NLT two workdays before the weekly meeting, the OS operations officer gives AMU supervision the proposed schedule for the coming week. AMU supervision then forwards a copy of the schedule to PS&D. The proposed schedule lists the following (as required):

- Aircraft takeoff and landing times.
- Configuration requirements.
- Munitions requirements.
- Fuel loads.
- Special or peculiar mission support requirements.
- Alert requirements.
- Exercise vulnerability.
- Deployments.
- Off-base sorties.
- On-equipment training requirements.
- Other special requirements.

Maintenance requirements

Aircraft tail numbers, types of missions, and equipment configurations must be included in the weekly UTE and maintenance plan. The following maintenance requirements must also be included:

- Sortie sequence numbers, aircraft tail numbers (primary and spares), scheduled takeoff and landing times, aircraft or equipment scheduled use times, configurations, and special equipment requirements. Units tasked by TACC need not include aircraft tail numbers. Units that fly a published and constant average sortie duration need not include landing times.

- Scheduled maintenance actions, by aircraft and equipment serial number, to include inspections TCTOs, time changes, contract and depot inputs, engine changes, washes or corrosion control, documents review, and deferred discrepancies.
- Required pre-inspection and other maintenance/scheduling meeting schedules to include minimum attendees.
- Wash rack use.
- On-equipment training requirements.
- AGE inspections or maintenance schedule by type and ID number.
- A list of new or revised publications, TO indexes, inspection workcards, checklists and –6 codebooks. Include the date of change. Automated systems are used, if available.

MAJCOMs develop specific procedures to record and coordinate changes to the weekly schedule using an AF Form 2407, Weekly/Daily Flying Schedule Coordination. Include minimum approval levels for approving changes to the weekly schedule.

Serial number assignment

Serial number assignment is simply the process by which a particular aerospace vehicle is chosen to fulfill a given sortie or mission commitment. Selecting the proper aircraft to fly specific missions can make the difference between mission accomplishment and failure, so develop all your schedules carefully. The weekly schedule you prepare starts where the current monthly schedule ends. If your monthly schedule is properly prepared, all you must do is add the necessary details. The monthly schedule shows certain aircraft flying on certain days, but it does not give the types of mission, configuration, takeoff times, and so forth. Your job is to match the serial numbers from your monthly schedule with the mission requirements from operations.

There are no set rules for this process, but there are certain factors to consider in making your selection. For example, which of the aircraft scheduled to fly on the monthly plan are actually capable of performing this mission? This information can usually be obtained from the operations scheduler, crew chief, or certain flight chiefs. Some schedulers prepare decision logic tables of go/no-go charts for keeping this information current.

Which of the aircraft are in commission? If six sorties are required, and only five of the aircraft scheduled are in commission, check with the controlling agency for the latest expected time in commission (ETIC). If the ETIC indicates the aircraft will not be available, choose, as a replacement, the aircraft that will cause the least disruption of the monthly schedule.

Which of the aircraft is properly configured? Many maintenance work-hours can be wasted in indiscriminately rigging, derigging, loading, and unloading aircraft with primary and alternate mission equipment. If a continuing requirement exists for a certain number of aircraft in a particular configuration, choose the aircraft very carefully with a view to maximum utilization in their current loading. Change configurations only when necessary, and leave those aircraft in the new configuration as long as possible.

What is the impact on the long-range plan if this or that aircraft is chosen? Look as far ahead as possible, and use your aircraft as evenly as possible. Never allow an aircraft capable of flying a mission to sit on the ground for prolonged periods. The aircraft was designed to fly, and long periods of idleness can create maintenance problems—batteries may discharge, seals may dry out, tires may develop flat spots, and so forth.

Deviations

Selecting the right aircraft to fly a given flight or mission certainly is one of the most important decisions you will make as a scheduler. Proper scheduling of an aircraft or a fleet of aircraft is as important as flying the aircraft itself. This one decision can make or break your organization. For example, do not schedule an aircraft to fly a mission it is not capable of flying because it is misconfigured due to a lack of parts (not mission capable supply [NMCS]) or because the aircraft MDS is incorrect for this type of mission. To do so makes a chargeable deviation against your unit. The MAJCOM measures each organization on its flying and maintenance scheduling effectiveness. The standard of effectiveness is based on tail-number assignment. The standard may vary among organizations, but normally does not exceed a 10 percent allowable deviation rate. The MAJCOM's effectiveness guidelines should be published in a coordinated O&M instruction. Remember, a plan is no better than its planner.

Coordination process

Coordination is as important at this level of planning as it is for long-range or monthly planning. Before the weekly scheduling meeting, the O&M functions should discuss the weekly requirement and agree on a weekly schedule. The agreement may include scheduled flying times, sortie length, depot flights, TDY flights, dock requirements, preventive maintenance, and training requirements. You must make allowances for unpredictable maintenance (e.g., engine and equipment failures). Full consideration must be given to specialist support personnel and equipment requirements to prevent last minute changes. Procedures must be established to coordinate the support requirements with other base agencies (e.g., POL, supply, security forces (SF), and food service). This helps them plan their peak workload requirements, hours of operation, and degree to which flightline support is required (e.g., if night flying is required, the agencies must adjust their work schedule to ensure adequate coverage is maintained).

Weekly planning meeting

The OS operations officer and AMU supervision review and coordinate the proposed weekly flying and maintenance schedule with OS, AMXS, and MXS before presenting it to the OG and MXG CCs. The purpose of this meeting is to brief any (maintenance or airframe) limiting capabilities to support operational requirements. Since PS&D built the weekly plan, PS&D may need to explain why any portion of the schedule cannot be met. Do not go into this meeting empty-handed. Prepare yourself with as much documentation as needed to help state your case. This is also a good time to have an accurate quarterly/monthly plan available; furthermore, you are able to explain any shortfalls confidently if properly prepared. When trends and limitations exist and adjustments are required, every effort should be made to arrive at a solution before the WG/CC's weekly scheduling meeting.

Finally, after the GP/CCs approve the schedule, it is submitted to PS&D for compilation, and a complete paper copy is given to the WG/CC at the weekly scheduling meeting. At this meeting, last week's accomplishments are evaluated, to include flying and maintenance scheduling effectiveness. This is the final phase for the weekly meeting; now, the WG/CC approves/signs the schedule.

Assembling the weekly plan

The logical sequence used in the table of contents of the weekly plan is similar to that in most military publications. The following sequence is intended only as an example to show you a logical organization of a weekly plan. It may vary in your organization. The parts of a weekly plan may include the following elements:

- Cover sheet.
- Table of contents.
- Basic plan.
- Weekly aircraft UTE/maintenance schedule.

- Maintenance meeting schedule.
- SE.
- Inspection schedule.
- Transportation vehicle inspection schedule.
- POL requirements.
- Publications listing.

Weekly plan distribution

Once the weekly schedule is reviewed and signed by the OG, MXG, and WG CCs, it becomes the final planning guide for operations and maintenance, and the basis for deviation reporting. You must follow this schedule as printed or amended by coordinated changes. Coordinated changes do not cancel out reporting deviations according to MAJCOM guidance. PS&D distributes the schedule to each appropriate activity and maintenance work center NLT 1200 hours (1400 hours for the Air Education and Training Command [AETC]) on the Friday proceeding the effective week. Weekly flying and maintenance schedules may be transmitted electronically provided local security requirements are met.

Now that the schedule is finalized and distributed, follow your MAJCOM-developed procedures to record and coordinate changes to the printed weekly schedule. These changes are recorded on an AF Form 2407. Any changes to next week's schedule before 1600 hours local Friday are authorized. They are non-reportable and become part of the printed weekly flying schedule. An AF Form 2407 is required stating the changes are "pen-and-ink." This is not a tool to extend the process. PS&D inputs all "pen-and-ink" changes into IMDS.

011. Daily utilization and maintenance requirements

Of all the planning processes (annual, quarterly, monthly, weekly, and daily), daily planning takes most of the time in any given day. This involves maintaining schedules, preparing maintenance preplans, attending daily maintenance meetings, and coordinating daily flying requirements with operations and key maintenance personnel. As a scheduler, you plan—in detail—each daily portion of the weekly maintenance plan. You are concerned with future and daily maintenance and operational requirements.

Planning

PS&D is where information is gathered, decisions are made, and the daily plan is finalized. Daily maintenance planning is necessary to incorporate *unscheduled maintenance requirements* into the daily portion of the weekly maintenance plan. Most of the unscheduled maintenance requirements (e.g., the preplanning of documented [delay or deferred] discrepancies) are identified. The unscheduled and scheduled maintenance needs, once verified, are the actions requiring support. These maintenance requirements are then balanced against the specialist availability and shop workload requirement through the daily planning meeting and the scheduling actions on preplanned and debriefing identified requirements.

In dealing with maintenance requirements for daily planning and scheduling, there are two processes you must be familiar with—debriefing and preplanning options.

Debriefing

There are several options of debriefing. The method used in your organization is chosen by your MAJCOM. The purpose of debriefing is to inform the controlling agency and PS&D of discrepancies on your assigned aircraft. Some of the discrepancies may be acted on immediately; others may be forwarded to PS&D to be included in the maintenance plan for the next day. The latter case applies more frequently. These jobs originate in debriefing and are sent to you, the scheduler. For some reason, such as priority of the aircraft and type of work, it is sometimes not necessary to work these jobs immediately. You then schedule the jobs in the daily maintenance preplan for the next day.

Daily preplanning maintenance meeting

Representatives of each section meet in a daily maintenance meeting. This meeting is conducted by PS&D and is a vital part of successful planning. If you ever attend this meeting, be prepared! Practically everything that affects maintenance is discussed. This includes changes to the weekly UTE and maintenance schedule, TCTOs in progress or scheduled to start soon, status of SE, work priorities, and personnel availability for shop production or specialist dispatch, and so forth. Preplanning is a big factor in daily maintenance planning.

Process

Changes to the existing weekly UTE and maintenance plan, and deviations during the execution of today's plan make it difficult for you to select aircraft for tomorrow's schedule. The actual process of selecting aircraft is based on measurement and comparison of the following four areas:

1. Required launch time.
2. Mission length.
3. ETIC.
4. Date of a scheduled maintenance action or hours remaining to scheduled maintenance action.

The criteria for measurement and comparison of these four areas are different from MAJCOM to MAJCOM, and even from base to base. This section gives you information that will help you measure and compare various O&M elements. It explains operational deviations and some maintenance documents and processes.

Daily planning is used to verify the daily portion of the weekly maintenance and UTE schedule with operations. Be constantly aware of the aircraft and equipment assigned to your unit because schedule changes could occur at any time to the published weekly maintenance plan. These changes may occur because of the following factors:

- Added or deleted missions.
- Failure of the aircraft or equipment to perform its assignment.
- Component or system failures.
- Non-availability of flight crews.

These changes, whatever they may be, always result in deviations from the flying schedule. This is why past flying schedules are beneficial in identifying trends. Once the adverse trends are identified and eliminated, better scheduling effectiveness results.

Deviation categories

A deviation is defined as something other than what was planned. Your MAJCOM sets up criteria to measure and evaluate your unit's mission accomplishment in the weekly flying schedule. In other words, you are evaluated to determine if what was printed on the weekly flying schedule actually flew as scheduled. This is done to improve management efficiency and decrease deviations. Deviations from the weekly flying schedule are any factors that affect the mission accomplishment of the piece of equipment. Operations and maintenance share the responsibility for monitoring and controlling deviations from the published weekly flying schedule.

Flying scheduling effectiveness (recorded)

A ground deviation is an event that occurs before aircraft takeoff. All ground deviations are recorded in IMDS and used in flying schedule effectiveness (FSE) calculations, unless otherwise noted.

The following table shows specific ground deviations:

Recorded Ground Deviations	
Category	**Explanation**
Addition	An increase in sorties or aircraft added to the printed weekly flying schedule.
Cancellation	An aircraft or sortie removed from the printed schedule for any reason.
Early takeoff	Scheduled sorties launched more than 30 minutes before scheduled takeoff. Exception: do not record early takeoff deviations for hot pit turn sorties.
Ground abort	An event after crew show time that prevents a “crew ready” aircraft from becoming airborne. Ground aborts are categorized as maintenance, operations, HHQ, weather, sympathy, other, and so forth. The difference between a ground abort and cancellation is after crew show, it’s a ground abort; before crew show, it’s a cancel. A ground abort is not a deviation, but can cause a deviation (e.g., a canceled sortie or late take-off).
Late takeoff	A scheduled sortie launched more than 15 minutes after scheduled takeoff time.
Spare	An aircraft specifically designed on the flying schedule to replace an aircraft that cannot fly its sortie. Spares can include aircraft that have been canceled, aborted, flown on an earlier sortie, or released after an FCF/operational check flight (OCF). Do not count “printed spares” used as deviations when computing FSE.

Flying scheduling effectiveness (non-recorded)

Not all deviations are recorded in FSE. Air deviations are events occurring after takeoff. They are recorded in IMDS, but are not included in FSE calculations. Ground deviations take precedence over air deviations when only one deviation can be loaded in IMDS. The following table shows air deviation categories:

Nonrecorded Air Deviations	
Category	**Explanation**
Air abort	An airborne aircraft that cannot complete its primary or alternate mission.
Air abort, in-flight emergency (IFE)	An air-aborted aircraft/sortie with a situation resulting in an IFE declared by the aircrew.
Early landing	Any scheduled sorties landing more than 15 minutes before scheduled landing time. Do not record early landing deviations for hot pit turn sorties launched more than 15 minutes before the scheduled takeoff time.
IFE	An aircraft/sortie with a situation resulting in an IFE declared by the aircrew after the mission is accomplished.
Late landing	An aircraft/sortie landing more than 15 minutes after the scheduled landing time. If the sortie originated on time, record any subsequent late takeoff or cancellation against the agency that caused the late landing. If the extended sortie did not originate on time, record any subsequent sortie deviation against the agency that caused the original delay.

Deviation coordination

A situation could occur that necessitates adjustments and changes to the printed schedule. Your duty assignment is scheduling (PS&D), and you should be aware of adjustments and changes to the printed schedule.

As stated earlier, the weekly maintenance plan is the final planning guide for operations and maintenance. This does not mean if a specific aircraft is scheduled to fly tomorrow and it is incapable of making the mission, you should cancel the mission. It means if operations still have that requirement, you must give them an aircraft if you have one, and it must be properly configured to fulfill that requirement. Daily planning is only “hand massaging” the weekly maintenance plan into a viable and comprehensive maintenance and operations plan. PS&D notifies maintenance and operations of changes to the next day’s flying schedule and the details of preplanned maintenance.

This ensures maintenance and operational requirements are met; however, keep tail number changes to a minimum on the published schedule. If not, operational and maintenance scheduling effectiveness will be adversely affected. Your MAJCOM develops specific procedures to record and coordinate changes to the printed weekly schedule using an AF Form 2407 (fig. 2–1). Furthermore, the MAJCOM includes minimum approval levels for changes to the weekly schedule. Any change to the printed schedule requires an AF Form 2407 with the following changes:

- To the original printed takeoff or landing time of 15 minutes or less.
- Of aircrew names, ranges, or airspace.
- Occurring after the first crew ready time for the squadron’s current day’s scheduled flying window.

WEEKLY/DAILY FLYING SCHEDULE COORDINATION

DATE AND TIME INITIATED: 20091001 1200

INITIATED BY: 358 Aircraft Maintenance Unit / MXACPS TSgt Jeremy Doe

EQUIPMENT AFFECTED	SCHEDULE CHANGE	EFFECTIVE DATE
A0011 LINE: 102	CHANGE CONFIGURATION TO: V@12BD4F4G REASON: STUDENT CHANGE	20091002
A0008 LINE: 104	CHANGE CONFIGURATION TO: V@6BDST2F2GA REASON: STUDENT CHANGE	20091002
A0014 LINE: 108	CHANGE TAKE-OFF AND LAND TIME TO: 0800 / 0900 REASON:	20091002

DECISION

OPERATIONS SCHEDULING OFFICER: [signature] — ☒ APPROVED ☐ DISAPPROVED

MAINTENANCE CONTROL SUPERVISOR: [signature] — ☒ APPROVED ☐ DISAPPROVED

NOTIFICATIONS *(As necessary)*

AGENCY	NAME	TIME	AGENCY	NAME	TIME
OPS TOP 3	Capt Smith	0730	WEAPONS	1st T...	0705
AMU OIC	Maj Griffith	0711	CMS	MSgt Erickson	0732
AMXS / MXA	SMSgt Bailey	0710	EMS	[signature]	0735
PRO-SUPER	MSgt Ahl	0700	PS&D	TSgt Doe	0706
			MOS/MXOO	MSgt Pond	0800

AF FORM 2407, 19720601 *(IMT-V1)* SI045449056

Figure 2–1. Air Force Form 2407.

Changes made during the daily scheduling meeting also require an AF Form 2407. The agency requesting the change initiates the AF Form 2407 and coordinates it through the affected Pro Super, maintenance supervision, and required group staff agencies (i.e., maintenance operations center (MOC), PS&D, analysis, etc.) according to MAJCOM procedures. After coordination, a copy of the original AF Form 2407 is filed in the MOC. The MOC ensures MMA receives all AF Forms 2407 for deviation accounting.

Methods

Coordinating between operations and maintenance ensures complete dissemination and understanding of the following day's requirements. The methods used to expedite changes to the weekly or daily schedule include the daily maintenance meeting, the telephone, e-mail, or letters.

Daily maintenance meeting

The daily maintenance meeting is held with selected maintenance supervisors from the squadrons to verify their portions of the next day's aircraft and equipment UTE schedule. Work priorities are established and unscheduled maintenance requirements are incorporated into the daily plan. Serial number changes to the following day's flying schedule must be coordinated with operations. Again, these changes are coordinated on an AF Form 2407. PS&D and controlling activities compile data concerning changes or refinements to the plan, assign the maintenance priority, make the necessary entries on the daily plan, and, at the daily maintenance meeting, ensure complete dissemination and understanding of the final version of the plan.

Telephone

The telephone is the most convenient and fastest means of coordinating your maintenance requirements. Whenever practical, use it.

E-mail

To reach a broad audience and ensure timely coordination, use the base e-mail system.

Letter

The letter also provides an advantage: you can refer to letters when in doubt about a particular work center's requirements; however, sometimes you cannot use the letter because of the time factor involved. Try to focus the letter on a particular operation or program consisting of a series of sorties (e.g., munitions flight may use a series [letters or numbers] to identify certain load configurations). To minimize conflicts and misunderstanding, the letter should break down these codes to specific easily understood load configurations.

012. Generation flow plans

Up to this point, the lessons have discussed the operations and maintenance requirements needed to complete the mission of flying aircraft. These requirements are planned, scheduled in advance, and then flown under normal conditions. What happens when aircraft must be launched under conditions that are not normal—war, natural disaster, readiness/inspection, and so forth? You must have a plan to launch them properly configured, in the least amount of time, without having specialists tripping over themselves. This lesson discusses what is involved in combat support responsibilities, the forms used to develop generation flow plans, and the development of a generation flow plan. The word generation, as it applies to aircraft, is the launch and recovery of aircraft under other than normal conditions. Thus, a generation flow plan is a formal outline of scheduled maintenance actions required to prepare aircraft for generation.

Types

There are various unit taskings that cause aircraft to generate. As a scheduler, you must be familiar with the two explained in the following table:

Type	Explanation
Emergency war order (EWO)	An order issued by headquarters (HQ) USAF to launch combat-ready weapons systems maintained in readiness or generated for first-strike wartime operations.
Contingency	A plan for certain situations that may cause your equipment to operate or perform its assigned mission under other-than-normal conditions. These plans support your operational readiness for contingencies that can be reasonably anticipated (e.g., weather evacuation).

Preparation

When the mission at your base includes EWO or contingency plan requirements, the PS&D must ensure sufficient copies of individual maintenance plans are prepared outlining the scheduled actions required in preparation for launch. AF Forms 2408, Generation Maintenance Plan and 2409, Generation Sequence Action Schedule, are general planning forms used for this purpose. When multiple mission taskings preclude depicting all possible configurations, these forms, or locally developed forms, are used to provide a basic plan. This helps ensure an organized effort within the maintenance complex. The PS&D, in conjunction with the AMU, wing weapons manager, and MXS personnel, develop, coordinate, and prepare all aircraft maintenance flow plans.

NOTE: These forms are not prepared for AETC units that do not hold a mobility position.

Air Force Form 2408, Generation Maintenance Plan

This form (fig. 2–2) reflects the hour sequence of all actions necessary to launch aircraft when required by EWO or contingency. This form contains a locally established legend indicating the type aircraft and tasked mission.

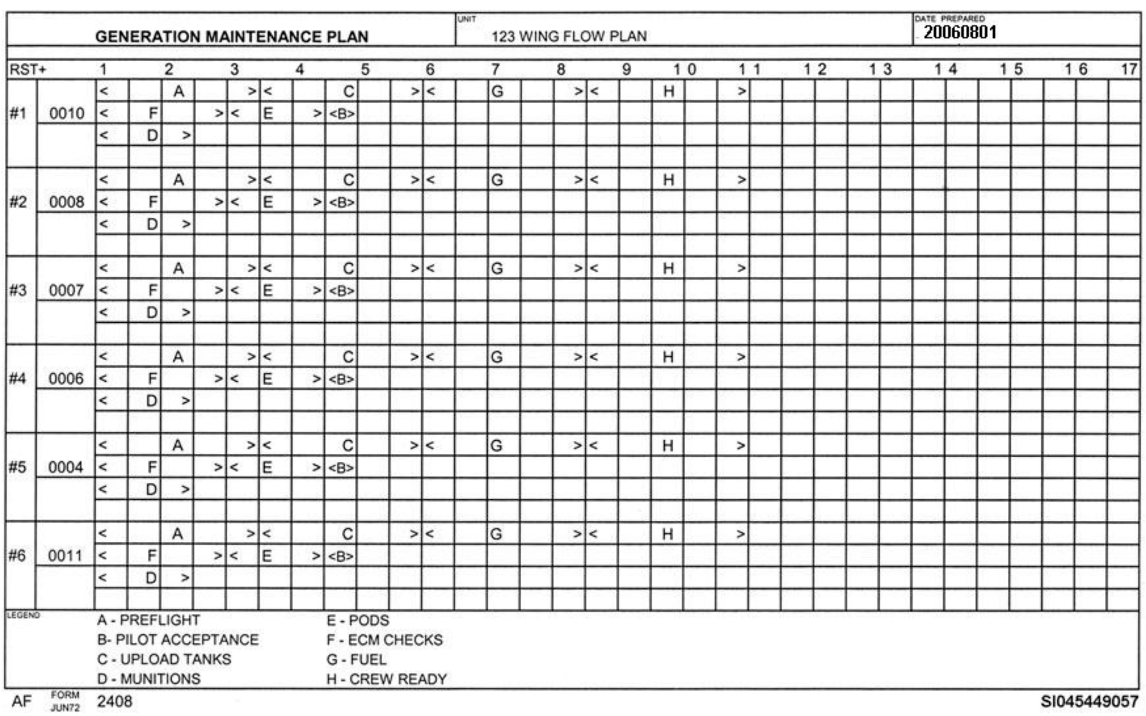

Figure 2–2. Air Force Form 2408.

Air Force Form 2409, Generation Sequence Action Schedule

This form (fig. 2–3) is used to sequence all maintenance actions required for sortie generation against a specific line number. This form uses locally established codes for maintenance shown in the action column blocks, and to report maintenance actions during generation.

GENERATION SEQUENCE ACTION SCHEDULE			DATE PREPARED 20060801			LINE NUMBER #1		
		REPORT	START TIMES			COMPLETION TIMES		
ACTION	REQUIREMENT	CODE	TIME	SCHEDULED	ACTUAL	TIME	SCHEDULED	ACTUAL
			RST +	0100		RST +	0330	
PREFLIGHT	AS REQUIRED	A	LOCAL			LOCAL		
			+	0100		+	0300	
ECM CHECKS	AS REQUIRED	F	LOCAL			LOCAL		
			+	0100		+	0230	
MUNITIONS	AS REQUIRED	D	LOCAL			LOCAL		
			+	0300		+	0430	
PODS	AS REQUIRED	E	LOCAL			LOCAL		
			+	0430		+	0500	
PILOT ACCEPTANCE	AS REQUIRED	B	LOCAL			LOCAL		
			+	0330		+	0600	
UPLOAD TANKS	AS REQUIRED	C	LOCAL			LOCAL		
			+	0600		+	0830	
FUEL	AS REQUIRED	G	LOCAL			LOCAL		
			+	0830		+	1100	
CREW READY	AS REQUIRED	H	LOCAL			LOCAL		
			+			+		
			LOCAL			LOCAL		
			+			+		
			LOCAL			LOCAL		
			+			+		
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AF FORM NOV93 2409 SI045449058

Figure 2–3. Air Force Form 2409.

Develop a maintenance flow plan

There is no reference material to guide you in building a maintenance flow plan, nor is there any one correct way to build one. There are, however, many incorrect ways that could cause your unit not to meet its EWO or contingency commitment. One of the most important rules to remember in building a plan is coordination! Without good, effective coordination with all squadrons involved, you cannot build a valid generation plan.

Once you've received the required time frame, try to schedule as many maintenance actions as possible to be completed simultaneously with other tasks. This enables the crew chief to monitor work being done on the airframe and help in other areas, if needed.

After you complete the AF Form 2408 initiate the AF Form 2409 using the information from the AF Form 2408. When the whistle blows and the generation begins, annotate line numbers (tail numbers) on AF Forms 2408 and 2409. Use the AF Form 2408 to execute the generation; use the AF Form 2409 to monitor each line number.

When the generation is finished, PS&D attends a post exercise/contingency "hot wash" meeting to evaluate flow plans for changes or improvements.

013. Time change requirements

The applicable aircraft –6 inspection manual lists all time-change items (TCI) and their frequencies; if the frequency is not listed, then the –6 refers you to the applicable reference that has the required information. You must ensure these TCIs are loaded into IMDS with their frequencies and replacement due dates, and then ensure these TCIs are available in supply. Now, let's see what time change requirements are and how they are forecasted and ordered.

Replace the items designated as TCIs at specified intervals. The primary objective of the time change replacement program is to achieve maximum usage of components consistent with the economic operation of aerospace equipment without jeopardizing flight or operational safety.

NOTE: Throughout this unit, you will frequently see the term *aerospace equipment*. The definition of aerospace equipment is any weapon systems and equipment including aerospace vehicles, missiles, nuclear weapons, TMDE, ground communications-electronics (C-E), trainers, and all related SE.

Time change replacement requirements are prescribed only for those items that have a measured service life expectancy and display an age-related failure pattern (e.g., a failure pattern that rises sharply at some given operating time or age of an item). Additionally, the item must fall into one or more of the following categories to be a valid candidate for time change replacement:

- Items whose failure due to location or function within a system would compromise safety of flight of airborne systems or the operational safety of ground equipment.
- Items whose failure due to location or function within a system would definitely cause a mission to abort, or ground equipment failures that would cause excessive downtime for mission critical items.
- Items for which a failure might cause damage beyond economical repair.
- Items whose physical characteristics allow an accurate prediction of deterioration from calendar time or hours in operational use.

Time change requirements using technical orders

The replacement schedule of the –6 scheduled inspection and maintenance requirements manual or inspection workcards are the only authority for the scheduled replacement interval of accessory and components, except for the following deviations:

- TO 2–1–18, *Aircraft Engine Operating Limits and Factors*, is used as the authority for scheduled replacement of reciprocating engines, gas turbine engines, and propeller reduction gearboxes.
- The 11P or 11A-series TOs are used for scheduled replacement of explosive devices. Service life requirements for life support items can be found in specific TO series (e.g., 14D, 14S, 15X, etc.).
- The –6 manuals or inspection workcards note each listed item and reference the applicable commodity series TOs that serve as authority if in conflict with the –6 manual or workcards.

Time change replacement

Replacement intervals for any specific item are based on the aerospace equipment installation and utilization, rather than being a general replacement interval for all applications. Based on this rule, the replacement interval for an identical item may vary considerably for different aerospace equipment applications. It can also vary greatly in the same aerospace vehicle operating in different climates (e.g., an F–117 operating in the New Mexico desert may have items that require replacement less often than an F–117 operating in northern England).

TCIs are considered due for replacement in conjunction with the hourly post-flight (HPO), home station check (HSC), phase (PH), pre-flight (PR), minor (MIN) or major (MAJ) isochronal (ISO), scheduled programmed depot maintenance (PDM), and so forth nearest to the replacement date. The determination of the nearest inspection for calendar TCIs is based on the average or projected utilization of the aerospace equipment for any given period. As an example, if an aerospace vehicle having a 25-hour inspection cycle accrues an average of 25 hours each month and is undergoing an inspection on the first day of the month, any calendar TCIs due for change between the 1st and 15th of that month are due for change at that inspection. Similarly, any calendar TCIs due for change between the 16th and the last day of that month are considered due for change at the next inspection.

Depot replacement

During depot processing, a TCI may be replaced only if due as indicated by the TCIs replacement documents. It may be more expedient and less expensive to accomplish replacement of some TCIs at the depot. The annual workload conference should review those TCIs that, because of accessibility or other factors, may be candidates for depot change. The TCI candidates would then be negotiated for change before PDM input when their accumulated time was high in relation to their specific replacement interval. The item must be approved for replacement on the applicable AFTO Form 103, Aircraft/Missile Condition Data, before depot will replace the TCI.

Replacement of "select" time-change items (exceptions)

TO 00–20–9, *Forecasting Replacement Requirements for Selected Calendar and Hour Time Change Items*, provides procedures for forecasting replacement requirements for selected calendar and hourly TCIs. The following "selected" items are found in TO 00–20–9:

- Select calendar and hourly TCIs.
- Select calendar time change life-sustaining items.
- Select cartridge-actuated devices (CAD)/propellant-actuated devices (PAD).

The expiration date for the service (date of installation [DOI]) and shelf life (date of manufacture [DOM]) on life sustaining or CAD/PAD items is the last day of the expiration month. Furthermore, service limits of life sustaining or CAD/PAD items cannot exceed the limits imposed in the following three tables. These items are scheduled for replacement at the nearest scheduled inspection before expiration of service life established by the applicable series TOs. This policy enhances effective maintenance scheduling, reduces equipment downtime, and eliminates the need for checking replacement documents on a daily basis.

Aerospace Equipment TCI Rules

Rule	If an aerospace equipment TCI:	And maintenance:	Then maintenance will:
1	is determined due replacement at the next scheduled inspection	fails to replace the item at the next scheduled inspection excluding PR, thru-flight (TH), and basic post-flight (BPO)	place a red dash in the applicable maintenance forms indicating the time change is due replacement.
2	was determined due replacement at the last scheduled inspection, or the replacement time has expired and the aerospace vehicle had no –6 HPO requirement	placed a red dash in the applicable maintenance forms	upgrade to a red X in the applicable maintenance forms at the start of the next scheduled inspection.

Life-sustaining Aerospace Equipment TCI Rules			
Rule	**If a life-sustaining TCI identified with an asterisk in the –6 or a CAD/PAD item:**	**And maintenance:**	**Then maintenance will:**
1	is determined to be due at the next applicable inspection, and that inspection will occur after the item's replacement time/date has expired	does not replace the item when the item replacement time/date expires	place a red X in the applicable maintenance forms indicating the item is due replacement before the next flight or operation.
2	is determined to be due at the next applicable inspection, and that inspection will occur before the item's replacement time/date has expired	does not replace the item during the inspection	place a red dash in the applicable maintenance forms indicating the item is due replacement at the expiration of replacement time/date.
3	was entered in the forms as a red dash indicating replacement due at the expiration of the replacement time/date	does not replace the item when the replacement time/date expires	place a red X in the applicable maintenance forms indicating the item is due replacement before the next flight or operational use.

Processing TCIS Where Previous Operating Time Is Unknown Or Known To Be Invalid			
Rule	**If aerospace equipment TCI (includes CAD/PAD) has a previous operating time**	**And the TCI is:**	**Then maintenance will:**
1	which is unknown or known to be invalid	life-sustaining installed in an aerospace vehicle	place a red X in the applicable maintenance forms indicating that item is due replacement before the next flight or operational use.
2	which is unknown or known to be invalid	life-sustaining not installed in an aerospace vehicle	process for overhaul in accordance with TO 00–20–3, *Maintenance Processing of Reparable Property and Repair Cycle Asset Control System.*
3	which is unknown or known to be invalid	not life-sustaining and is installed in an aerospace vehicle	estimate the previous operating time at 50 percent of the service life and continue to use.
4	which is unknown or known to be invalid	not life-sustaining and not installed in an aerospace vehicle	process in accordance with TO 00–20–3 for condition determination. If serviceable, or made serviceable by minor maintenance, estimate previous operating time at 50 percent of serviceable life. If made serviceable through an authorized overhaul, it may be considered as having zero operating time unless notification has been issued to the contrary by the overhaul facility.

Calculating time-change item due dates

TCI due dates are determined by the earlier of the expiration of the shelf or service life. The expiration will not exceed total shelf or service life of the item. For example, an item manufactured in June 2005 has a ten-year DOM and a ten-year DOI; the item would expire 30 June 2015, regardless of DOI. If the item was not installed until June 2010, it would still expire 30 June 2015. The following table is a graphical representation for computing the date due for DOM/DOI.

DOM (Shelf Life)	DOI (Service Life)
10-year DOM	7-year DOI
DOM is June 2005	DOI is June 2010
Due date = 30 June 2015	Due date = 30 June 2017
— Earliest due date —	
TCI will be due by DOM 30 June 2015	

In the preceding example, the service life (DOI) cannot exceed the shelf life as determined from the DOM. When an item's DOM is less than an item's DOI, the earlier expiration date dictates the time change due date.

Let's try one more: if an item was manufactured in August 2014 with a nine-year DOM and was not installed until October 2015 for a seven-year DOI, what is the TCI expiration\due date? Again, use the following table in computing the date due for DOM and DOI. Remember, the earliest date determines the expiration date.

DOM (Shelf Life)	DOI (Service Life)
9-year DOM	7-year DOI
DOM is August 2014	DOI is October 2015
Due date = 30 August 2023	Due Date = 31 October 2022
— Earliest due date —	
TCI will be due by DOI 31 October 2022	

However, if that part was installed in September of 2006, it must be changed out by 30 August 2023, based on DOM.

014. Forecasting time change items

Accurate forecasting is a critical element of the TCI budgeting and procurement process. Failure to submit an accurate forecast results in asset shortages and possible aircraft grounding. Use the forecast data to determine requirements for replenishment spares and development of budget submissions.

CAD/PAD items are forecasted annually. Forecasts must be completed and submitted to the IM by 1 August each year, and must include all aircraft assigned as of 15 June. Forecasts are by quarter, for the first four years starting with the first quarter of the upcoming fiscal year, and by year for the remaining years, covering a period of time corresponding to the total service life of the item or a minimum of nine years. The quarters cover periods beginning with October, January, April, and July.

Once a CAD/PAD item is installed the first time, its service life expiration cannot change. For example, a 5-year service life item installed in October 2014 reaches its service life in October 2019. If the part is taken out and later reinstalled in another aircraft, the service life expiration remains October 2019. IMDS must be adjusted manually to reflect this.

Forecasting methods

Now we can discuss how to properly forecast CAD/PAD items. The primary method for forecast submission is the automated or manual AFTO Form 223, Time Change Requirements Forecast, as outlined in TO 00–20–9.

Integrated maintenance data system/G081 non-automated units

PS&D forecasts CAD/PAD items listed in TO 00–20–9, Chapter 4, Table 4–1, and initiates the forecast by completing blocks 1 through 6 of the AFTO Form 223 (fig. 2–4). The PS&D superintendent ensures forecasts are reviewed for accuracy and coordinates the forecast with work centers responsible for maintaining CAD/PAD components (egress, life support, and survival) before submission to the munitions activity.

20060801

TIME CHANGE REQUIREMENTS FORECAST

LOCAL CONTROL NUMBER

REPORTS CONTROL SYMBOL
RCS:

1. LOCATION	2. ORGANIZATION	3. DATE (YYYYMMDD)	4. SUPPLY ACCOUNT NUMBER	5. MAJOR COMMAND
Sheppard AFB, TX 76311	123th FW	20060801	FV1234	AETC

6. MAINTENANCE INFORMATION — 7. SUPPLY INFORMATION

STOCK NUMBER A	NOUN B	c. REQUIREMENTS QUANTITY BY YEAR AND QUARTER																TOTAL D	ASSETS O/H A	OLDEST ITEM/QTY B	EXPIRATION DATE C
		5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	8				
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
1377-01-044-6367ES	SQUIB	4	0	2	1	8	0	2	5	6	4	3	2	8	4	2	1	52			
1377-01-052-8206ES	HARNESS RELEASE, CARTRIDGE	0	5	2	1	6	2	4	1	1	5	5	7	2	0	9	1	51			
1377-01-052-8207ES	MORTAR CARTRIDGE	8	5	6	2	4	8	7	2	5	6	7	4	2	0	0	1	67			
1377-01-052-8208ES	DROGUE GUN CARTRIDGE	1	8	6	4	7	5	0	0	4	5	11	2	3	5	2	5	68			
1377-01-053-0586ES	ROCKET MOTOR	0	0	0	22	2	5	9	7	4	12	0	0	22	1	2	5	91			
1377-01-053-8604ES	SEQUENCER	12	2	7	9	6	4	8	0	5	4	12	8	3	0	0	0	80			
1377-01-166-4261ES	INERTIAL REEL INITIATOR	1	1	1	0	0	0	0	1	1	0	3	0	2	0	1	0	11			
1377-01-169-7797ES	ROCKET CATAPAULT	8	6	4	9	7	2	4	5	0	0	0	0	12	5	2	1	65			
1377-01-332-2379ES	REEFING LINE CUTTER	2	4	8	6	7	5	3	2	4	9	7	5	0	0	4	19	85			
1377-01-333-9143ES	LOCKING CORD CUTTER	6	5	7	3	0	0	1	5	0	4	9	0	11	0	0	0	51			
1377-01-359-3194ES	CATAPAULT CKU-5/B/A	1	2	3	4	0	9	2	0	1	0	7	9	1	2	8	7	56			
1377-01-496-2522ES	DROGUE FLSC SEVERANCE ASSY	4	2	4	5	7	9	2	3	4	0	1	7	3	8	3	4	66			

AFTO FORM 223, 19940901 *(IMT-V1)* PREVIOUS EDITION WILL BE USED SI045449032

Figure 2–4. AFTO Form 223 for CAD/PAD items.

The munitions operations section or munitions accountable systems officer (MASO), and PS&D keep copies of the current forecast. The PS&D forwards one copy to Ogden ALC, Hill Air Force Base (AFB), Utah (OO-ALC/Hill AFB, UT) by 1 August of each year according to TO 00–20–9. A courtesy copy is sent to the applicable MAJCOM maintenance scheduling and egress functional managers.

Integrated maintenance data system/G081 automated units

All aircraft-installed CAD/PAD items must be loaded into IMDS database for time change tracking and requirements forecasting purposes. This process greatly eases administrative workloads at local and depot levels, and provides greater visibility of worldwide assets and requirements to depot-level managers.

The PS&D forecasts all WUC 97XXX items contained in the IMDS database using screen 490 transaction identification code (TRIC) TCF, Selected Calendar and Time Change Item Forecasting. On-hand balances are not included as part of the forecast. The forecast covers three years' worth of data at a time and must be pulled three times to obtain nine years of data. It is essential that part numbers be accurate to obtain an accurate forecast. If changes are required, update IMDS and the rerun the forecast. After the forecast is validated by the PS&D superintendent all units will e-mail their forecast to OO-ALC/Hill AFB by 1 August of each year according to TO 00–20–9.

Forecasting non-cartridge-activated device/propellant-actuated device time-change items

PS&D orders non-CAD/PAD or engine TCIs up to 60 days and not less than 10 days before the need date on an AF Form 2005, Issue/Turn-In Request. The ordering date should be based on availability of parts. Accurate and timely forecasting to supply is critical to ensure all required TCIs are available before the forecast due date. As you near the time when the TCI will actually be changed, a smooth operation can be maintained using this timeline.

Forecasting munitions time-change items

Order all munitions items requiring time change according to TO 00–20–9 and AFI 21–201, *Munitions Management.* Notify the munitions flight of the need to order munitions items according to AFI 21–201. Forward the AF Form 2005 (fig. 2–5) to munitions operations no earlier than 60 days, but not later than 45 days, before the beginning of the month in which the item is required as described in the following table. This rule is based on TCIs ordered stateside through munitions.

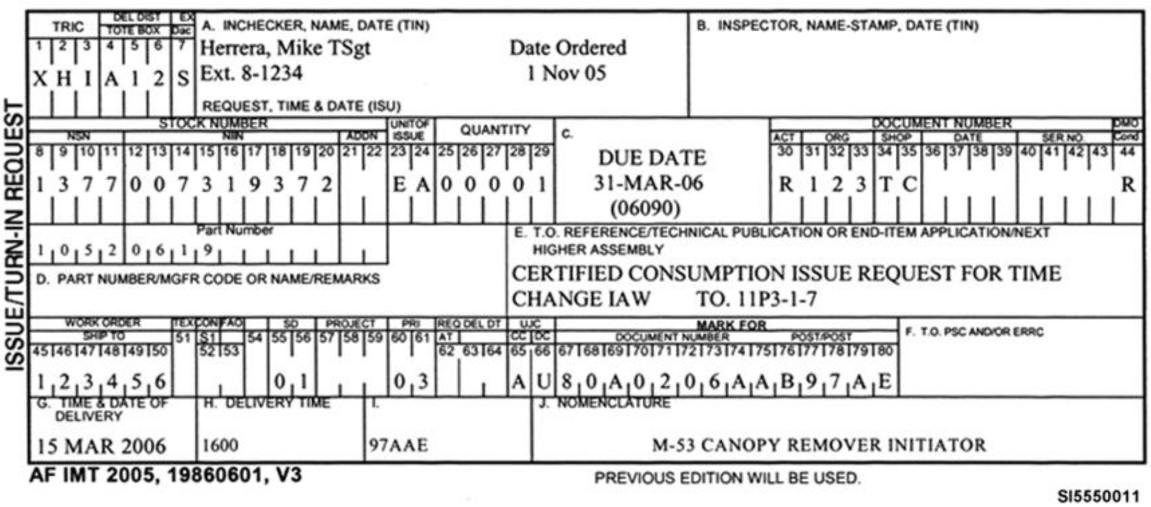
ISSUE/TURN-IN REQUEST
TRIC X H I
A. INCHECKER, NAME, DATE (TIN)
Herrera, Mike TSgt
Ext. 8-1234
Date Ordered
1 Nov 05
B. INSPECTOR, NAME-STAMP, DATE (TIN)
REQUEST, TIME & DATE (ISU)
STOCK NUMBER 1377 00731937 2
UNIT OF ISSUE E A
QUANTITY 0 0 0 0 1
C. DUE DATE 31-MAR-06 (06090)
DOCUMENT NUMBER R 1 2 3 T C R
Part Number 1 0 5 2 0 6 1 9
D. PART NUMBER/MFGR CODE OR NAME/REMARKS
E. T.O. REFERENCE/TECHNICAL PUBLICATION OR END-ITEM APPLICATION/NEXT HIGHER ASSEMBLY
CERTIFIED CONSUMPTION ISSUE REQUEST FOR TIME CHANGE IAW TO. 11P3-1-7
WORK ORDER 1 2 3 4 5 6
0 1
PRI 0 3
MARK FOR A U 8 0 A 0 2 0 6 A A B 9 7 A E
F. T.O. PSC AND/OR ERRC
G. TIME & DATE OF DELIVERY 15 MAR 2006
H. DELIVERY TIME 1600
I. 97AAE
J. NOMENCLATURE M-53 CANOPY REMOVER INITIATOR
AF IMT 2005, 19860601, V3
PREVIOUS EDITION WILL BE USED.
SI5550011

Figure 2–5. AF Form 2005.

CONUS Time Change Requisition Schedule		
Required Month	**Earliest Requisition Date**	**Latest Requisition Date**
Jan – Mar	1 Nov	15 Nov
Apr – Jun	1 Feb	15 Feb
Jul – Sep	1 May	15 May
Oct – Dec	1 Aug	15 Aug

Overseas bases order munitions items 90 to 120 days before the required quarter according to AFI 21–201 as described in the following table. Include the validated forecast time change date on the AF Form 2005.

OCONUS Time Change Requisition Schedule		
Required Month	**Earliest Requisition Date**	**Latest Requisition Date**
Jan – Mar	1 Sep	1 Oct
Apr – Jun	1 Dec	1 Jan
Jul – Sep	1 Mar	1 Apr
Oct – Dec	1 Jun	1 Jul

If any of the requisition dates are missed, then a late request letter is required with the reason why you are submitting a late request and the signature of the requestor's CC.

NOTE: CAD/PAD TCIs with nine months or less service life remaining are turned in to munitions operations and are not reissued. PS&D reflect replacement dates to coincide within the nine-month parameter. Do not order a CAD/PAD item, which has more than nine months service life still remaining, for change out. By exceeding the nine-month rule, you are abusing the system and munitions will return the old part back to you as serviceable.

Updating time-change items

Once the TCI has been changed, the technician removes the old part and installs the new one in IMDS. This is called taking time for the job. Upon completion, the scheduler uses TRIC QVR, Suspense Validation, to verify the old data is removed and the new data entered by the technician is correct.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

008. The operational contract

1. What should your primary concern be regarding the annual operational contract?

2. What should you do once the initial breakdown of flying hours is received from operations?

3. What is the simple definition for the UTE rate?

4. How much historical data should be used when using attrition rates for the annual contract?

5. Who devises procedures to ensure the objectives of the quarterly scheduling cycle are met?

6. When does operations provide the quarterly requirements to the AMU supervision and PS&D?

7. What four quarterly requirements do the AMU supervision and the OS operations officer discuss at the scheduling meeting before the quarter being scheduled?

8. When do the OG and MXG CCs chair a quarterly meeting?

9. What is the purpose of quarterly planning?

10. At a minimum, what months are to be included in the quarterly schedule?

11. Who establishes procedures to ensure the operational requirements for the quarterly flying-hour allocation are provided to the maintenance activity?

009. Monthly utilization and maintenance plan

1. What should be the primary focus of the maintenance effort in support of the flying and training missions?

2. When does AMU supervision notify the OS operations officer whether requirements can be met or limitations exist?

3. If conflicts arise between the operational requirements and the maintenance capability, who decides what portion of the mission to support and to what degree?

4. What is the purpose of the attrition factor?

5. What is the formula to calculate total number of sorties to schedule?

010. Weekly utilization and maintenance plan

1. What document contains the final planning guide for maintenance and operations?

2. When constructing the weekly schedule, what items give you the basis for planning?

3. List four of the 11 requirements that operations submits to AMU supervision NLT two workdays before the weekly meeting.

4. What action, in the act of planning schedules, can spell the difference between mission accomplishment and failure?

5. For what unpredictable maintenance should allowances be made to prevent last minute changes to the weekly schedule?

6. Who distributes the schedule to each appropriate activity and maintenance work center NLT 1200 (1400 for AETC) on Friday proceeding the effective week?

011. Daily utilization and maintenance requirements

1. What type of maintenance requirements being incorporated into the daily portion of the weekly maintenance plan makes daily maintenance planning necessary?

2. What is the purpose of the debriefing function in relation to daily scheduling?

3. The actual process of selecting aircraft for the next day's schedule is based on measurement and comparison in what four areas?

4. What are the four factors you must be constantly aware of that might cause changes to the published weekly maintenance plan?

5. What is a deviation in regards to the schedule?

6. Who sets up guidance to measure and evaluate your unit's accomplishments?

7. What type of deviation is an FSE used to record?

8. List the six recorded ground deviations.

9. What deviation is *not* recorded in FSE?

10. List the five nonrecorded air deviation categories.

11. What four methods are used to expedite changes to the weekly or daily schedule?

012. Generation flow plans

1. What generation flow plan is issued by HQ USAF?

2. If a hurricane is heading toward your base and is leaving a path of destruction, what plan do you execute?

3. Who prepares the generation flow plan?

4. What does the AF Form 2408 reflect?

013. Time change requirements

1. What is the primary objective of the time change replacement program?

2. The time change replacement requirements are prescribed only for those items that have a measured service life expectancy and display what type of failure pattern?

3. When are TCIs considered due for replacement?

4. List the three categories of select time changes found in TO 00–20–9.

5. Time change due dates are determined by the earlier of expiration of DOM (shelf life) or what?

6. If an item was manufactured in January 2014 with a ten-year DOM and ten-year DOI, when will the item expire?

014. Forecasting time change items

1. When CAD/PAD items are forecasted annually, the forecasts are to be completed and submitted to the IM by 1 August each year. What must this forecast include?

2. What are the beginning months for quarters covered when forecasting CAD/PAD items?

3. In what chapter and table of TO 00–20–9 does the PS&D forecast CAD/PAD items listed?

4. What blocks must be completed on AFTO Form 223 for the CAD/PAD forecast?

5. When the time change forecast is validated for automated units, it is emailed to OO-ALC-Hill AFB by what month?

6. Munitions TCIs that are ordered stateside must be ordered no earlier and NLT what time period before the beginning of the month in which the item is required?

7. According to AFI 21–201, within how many days before the required quarter will overseas bases order munitions items?

8. When a time change item has been replaced, the technician removes the old part and installs the new one in IMDS; what TRIC does the scheduler use to verify the old data is removed and the new data entered by the technician is correct?

2–2. Documentation

Maintenance documentation is an integral part of all PS&D functions. PS&D sections maintain historical maintenance data within the Maintenance Information System (MIS). The accuracy of maintenance document entries is a basic responsibility of the initiator and supervisors. PS&D sections develop wing maintenance plans using MIS aircraft historical data input by all maintenance personnel. The accuracy of entries in the MIS affects the development of plans and is a basic responsibility of all unit personnel. This section covers different areas that need timely and accurate documentation: proper aircraft inventory and reporting, inspection and TCTO requirements, equipment forms and historical records, and engine tracking. All these documentations are essential to proper maintenance accomplishments.

015. Time compliance technical order requirements

The management process discussed here involves identifying TCTO requirements. We will explain the process that begins when a TCTO is received at your base, and show all the maintenance agencies involved in the process and the procedures they follow. The PS&D administers and manages the overall TCTO program as outlined in AFI 21–101 and MAJCOM publications.

Munitions scheduling manages munitions-related TCTOs and engine management (EM) manages engine-related TCTOs. The owning scheduling agency (PS&D, EM, AGE, armament, munitions, and precision measurement equipment laboratory [PMEL]) completes all scheduling, tracking, and day-to-day monitoring of TCTOs. If schedulers are not designated or assigned to an owning agency, PS&D performs the listed owning agency responsibilities.

TCTOs are considered scheduled maintenance—except immediate and urgent action—and are integrated into the maintenance planning cycle. The concurrent completion of TCTO work with other scheduled or unscheduled maintenance is considered. When practical, all peacetime operating stock (POS) and readiness spares package (RSP) assets are modified before in-use or installed items.

Quality assurance

When a TCTO arrives at your base, QA performs an initial evaluation of the TCTO to determine its applicability against a unit’s equipment, including the aircraft serial numbers for aircraft TCTOs. Because not all TCTOs are for aircraft, QA reviews non-aircraft TCTOs against engine serial numbers for engine TCTOs, and by part numbers or other specific criteria for commodity TCTOs. When QA is finished reviewing the TCTO and finds it is applicable to your equipment, QA date stamps it to reflect the date the hard copy is received. Only date-stamped TCTOs from QA are authorized for use. It’s important to remember all TCTOs received from outside agencies must be routed through QA first for the review process.

Managing agency

The appropriate TCTO managing agency (PS&D, EM, or munitions) is the individual or individuals responsible for researching the total number of end items applicable to the TCTO. Depending on the MAJCOM, these responsibilities can be performed by a section or an individual at a wing or unit level.

TCTO meeting

After the managing agency determines the number of items to be modified, it chairs a TCTO meeting with representatives from the appropriate owning and performing work centers, QA, and supply (if kits, parts, or tools are required).

Minutes of this meeting are recorded on an AF Form 2410, Inspection/TCTO Planning Checklist, and provide an overall plan to implement the TCTO. Minutes include:

- TCTO applicability by ID number (or applicable part number or serial number for commodity TCTOs).
- Purpose of the inspection or modification.
- Performing work centers.
- Serial number or ID number of equipment on which QA performs initial verification.
- Training requirements.
- Scheduling parameters.
- Remove from service date.
- A review of the TCTO procedures.
- Forms entries and any supply requirements identified before the TCTO can be scheduled for accomplishment.

All attendees sign the AF Form 2410 at the conclusion of the planning meeting indicating agreement with the conditions.

The status of TCTO completion must be a primary concern of all maintenance managers. Bring significant problems or potential delays in TCTO accomplishment to the immediate attention of the managing scheduling agency and elevated to squadron and group CCs, as appropriate.

PS&D monitors all TCTO status and briefs unaccomplished TCTOs within 30 days of grounding at the MXG level each week. PS&D immediately notifies the AMXS and MXG CCs when TCTOs will not be completed before the grounding/rescission date.

Ordering kits, parts, and tools

The appropriate TCTO managing agency (PS&D, EM, or munitions) uses the MIS supply interface to order required TCTO kits/parts/tools according to MIS manuals. The managing agency controls and releases kits from supply for all TCTOs requiring kits. When a MIS supply interface is not available, the managing agency initiates three copies of the AF Form 2001, Notification of TCTO Kit Requirements, and forwards two copies of the form with a copy of the TCTO to the supply TCTO monitor. For locally obtained parts, prepare an AF Form 2001, listing each item by stock number, nomenclature, and quantity required. Assign identification (ID) numbers to kits as they are received. Use Part II of the AF Form 2001 to manage kit/part assignment and track individual end items, date issued, document numbers, and number of kits remaining. The supply TCTO monitor ensures kits and parts, if required, are complete (assembled) before release. The performing work center orders and maintains all hazardous material (HAZMAT) required to comply with TCTOs and provides document numbers to the TCTO managing agency and supply TCTO monitor.

Monthly TCTO reconciliation of kits, parts, and tools

The TCTO managing agency (PS&D, EM, or munitions) attends the monthly supply TCTO reconciliation meeting. This meeting is conducted using the TCTO reconciliation listing from supply.

The purpose of this meeting is to discuss:

- Number of kits on hand.
- Any “mark for” changes.
- Estimated delivery dates compared with the time to accomplish parameters, which is measured against TCTO remove from service dates.

After the monthly supply TCTO reconciliation meeting, PS&D chairs a monthly TCTO review meeting attended by all TCTO owning and managing agencies. Issues discussed include:

- Issues from the monthly supply TCTO reconciliation meeting.
- Supply status.
- Scheduling factors.
- Current TCTO status.
- Anticipated problems for all active TCTOs.

PS&D TCTO monitor produces minutes from the monthly review meeting and distributes them to all affected agencies.

TCTO folder

The appropriate TCTO managing agency (PS&D, EM, or munitions) establishes and maintains a TCTO folder for each active TCTO. TCTO folders mirror a master TCTO folder standard developed by PS&D. The folder includes, as a minimum, the following items (in the order they should be placed):

- The basic TCTO.
- All supplements.
- Completed AF Form 2410.
- AF Form 2001, (if required).
- Messages.
- The supply cover memorandum from QA.

Once the TCTO has reached its rescission date, print an MIS product showing the current status of the equipment and place it in the TCTO folder. Move the folder to an inactive TCTO file. The TCTO managing agency maintains the folder until the TCTO is rescinded in the applicable TO index, and then disposes of it according to the AF RDS. TCTOs loaded in the MIS are deleted at that time. TCTOs are not deleted from the MIS before the rescission date.

016. Inspection requirements

In addition to TCIs, schedulers are likewise responsible for inspections. We speak about inspections and time changes together because they have many similarities in the way you track, forecast, and process them. This lesson covers inspection packages and inspection preplanning. Some of the IMDS routines we cover here also cover time changes as a part of the inspection packages we are talking about.

Basic inspection references

Scheduled maintenance inspections required for AF equipment are prescribed in the scheduled inspection and maintenance requirements section of the applicable –6 TO and inspection workcards or checklists. The various types of inspections and policies are listed in TO 00–20–1, *Aerospace Equipment Maintenance Inspection, Documentation, Policy and Procedures*. PDM intervals are listed in TO 00–25–4, *Depot Maintenance of Aerospace Vehicles and Training Equipment*.

The scheduled maintenance inspection intervals for weapon systems, support systems, equipment end-items, and components are specified in the scheduled inspection and maintenance requirements section of the applicable –6 and inspection workcards. All requirements pertaining to inspections normally are completed concurrently to avoid complications in scheduling and controlling the required maintenance.

Inspection workcards

Inspection workcards outline the minimum inspection requirements, and provide each technician and specialist with a convenient inspection guide. They list the requirements performed and reflect the most logical sequence for accomplishment. Each workcard contains pertinent information to indicate when the work is scheduled, how much time is allotted, work area, type of technician or specialist required, and electrical power requirements. Cards are grouped by the types of specialist required to complete the inspection so all requirements listed on any particular card can normally be done by one individual. This arrangement of the workcards permits the supervisor to assign a technician to a certain work area to do a specific task or series of tasks. The use of the workcards permits each individual's work to be programmed without task interruption. This affords planned use of personnel, early detection of discrepancies, and more accurate planning for the accomplishment of the required repair work. When required, prepare and maintain inspection workcards, for all Air Force weapon systems, support systems, or equipment items. A detailed description is contained in TO 00–20–1.

Inspection packages

Before you can schedule an aircraft inspection, you must develop an inspection package for each aircraft. This package is a combination of Air Force forms and IMDS products. The actual procedures for the development of the inspection packages differ from MAJCOM to MAJCOM. The PS&D or PS&D section may develop the inspection package for inspections. The first step in developing this package involves IMDS.

IMDS requirements

Before an inspection package can be produced for your aircraft, a job flow package must be initiated in IMDS. The following routines will help you to load and maintain your requirements in IMDS. Keep in mind, this process is done just once for each inspection listed in the applicable –6 TO. Your IMDS reference for this area is Air Force Computer System Manual (AFCSM) 21–566V2, *Inspection and Time Change Software User Manual*.

Job flow package load/change/delete/inquiry

The job flow package (JFP) load/change/delete/inquiry TRIC is used to load, change, delete, and inquire all pertinent data required for establishing a job standard (JST) with the following options:

Job Flow Package Options

Option	Description
Job flow package *load*	Used to load all data required to establish a JST. When processed, you are passed to TRIC JFF to process the shop data load.
Job flow package *change*	Used to change data on a particular JST (e.g., you can make changes to the frequency of a specific JST that adjusts all associated inspections or time changes loaded to the JST).
Job flow package *delete*	Deletes the entire JST and associated inspections and time changes. An inquiry option must be processed before deletion. Once a deletion is processed, there is no recovery except to reload the entire JST.
Job flow package *inquiry*	Used to inquire by a JST number already loaded in IMDS.

Job flow package inquiry

The purpose of the job flow package inquiry (JFI) TRIC is to provide the capability to query the database to obtain information pertaining to JSTs. Using this screen, you may query a job flow package using the three formats described in the following table.

Job Flow Package Inquiries	
Format	**Description**
1	This format produces outputs that display data loaded to a particular JST. It can be restricted by entering a beginning and ending stop sequence number, or can be run for a complete JST by leaving the sequence number blank.
2	This format provides a list of up to 10 assigned JST numbers between the low and high numbers input.
3	This format produces output data pertaining to equipment loaded to the JST and displays the due time. It can be sorted by due time sequence of equipment ID/part number sequence and owning work center.

Job flow package shop data load/change/inquiry/delete

The job flow package shop data load/change/inquiry/delete (JFF) TRIC is used to load performing work centers to established JSTs. You can also change, inquire, and delete workcenter information with this TRIC.

Responsibilities

PS&D uses TRIC JFP to load and maintain the JST records. A JST must be established for each inspection or time change requirement. A JST is a five-character code assigned by IMDS to identify an inspection or time change requirement. PS&D uses TRIC JFF to load any assisting work centers to the JST. For example, we have an inspection requirement to inspect the fuel cell on an F–16C.

Inspection requirement

The inspection requirement includes the following shops responsible for the inspection (*shown in the order in which they must take the applicable steps*):

1. The aircraft crew chief must make the aircraft safe and remove panels LW216 and LW218. The shop designation for the crew chief is AFLT.
2. Weapons system personnel must remove the #2 and #3 pylons. The shop designation for the weapons system personnel is WEAP.
3. Fuel system personnel must then inspect the fuel foam in the fuel cell for deterioration.

The JFP would then be built using the following information:

- Inspection Narrative: Inspect left wing fuel cell, fuel foam for deterioration.
- Work centers:

  AFLT – R&R panels LW216/LW218.

  WEAP—R&R pylons #2 and #3.

  FUEL—Inspect fuel foam.

Once this is built, IMDS returns with a JST. When you have completed loading all requirements, run an IMDS background product that gives you a listing—the job standard master listing (JML)—of all your JSTs.

Job standard master listing

The JML TRIC provides a list of unit JSTs loaded to the database in four different output formats. Only those JSTs for the unit making the input are listed. The JML includes those standards no longer used, but not yet deleted from the database.

Inspection planning

The PS&D scheduler develops the long-range inspection dock forecast for all assigned aircraft and monitors it daily. This forecast, as a minimum, includes the current month, plus the next two months.

The inspection dock forecast is entered on the long-range plan and continually monitored to ensure the aircraft are scheduled to fly to meet the inspection input date.

Preparation for pre-inspection (pre-dock) meeting

After the PS&D scheduler reviews the planned aircraft inspection schedule, they initiate an AF Form 2410 before the pre-inspection meeting. This is done to arrange for scheduled inspections (e.g., PR, ISO, PH, and HPO). The PS&D scheduler prepares the AF Form 2410 in duplicate. The original is used as the basic inspection data for planning.

All requirements against the aircraft are incorporated into a work package. Also, deferred discrepancies (DD) that will be fixed during the inspection keep their original job control number (JCN). The AF Form 2410 is used as an aid in planning for and conducting the pre-inspection meeting (figs. 2–6 and 2–7). The form includes the following information:

- Blocks 1–13: Unit, aircraft, engine, and inspection data.
- Block 14: Agencies attending the meeting and any discussion items to be presented.
- Block 15: Specialist support tasks, in addition to normal inspection needs.
- Block 16. TCTOs and TCIs to be accomplished during the inspection.

Pre-dock meeting

At the pre-dock meeting, the PS&D scheduler informs representatives of the inspection schedule and scope, including TCTOs, TCIs, special inspections, DDs, and any special requirements that must be accomplished. Furthermore, aircraft configuration is discussed during the meeting. The PS&D scheduler provides a list of items identified as out-of-configuration to the dock chief in the pre-dock package for verification and correction during the major inspection. The responsible work center verifies and corrects erroneous data and out-of-configuration items in IMDS before the post-dock meeting.

The representatives at the meeting inform PS&D of any limiting factors that might affect the schedule. The AF Form 2410 also is used to record this information. When all requirements are annotated on the form, a copy is given to the dock chief. The original is maintained in the aircraft jacket file for later use as a guide when conducting the post-dock meeting.

Post-dock meeting

When the inspection is completed, the dock chief, PS&D, crew chief, and other attendees discuss open discrepancies, review any significant inspection events, and identify any problems that may adversely affect future scheduling. The dock chief gives the completed inspection work package to PS&D scheduler for filing until it is replaced by the next similar inspection work package. The PS&D scheduler files a computer-printed listing of completed on-line work orders in the aircraft jacket file along with the original AF Form 2410.

INSPECTION/TCTO PLANNING CHECKLIST	1. DATE PREPARED 20060801

2. UNIT	3. ACTIVITY	4. FLIGHT/SECTION
123rd AMXS	MXACPS	AMU PS&D

5. AIRCRAFT		6. INSPECTION NUMBER	7. DOCK NUMBER	8. START TIME/DATE	9. DATE PREPLAN MEETING SCHEDULED
MDS	SERIAL NUMBER	☐ CALENDAR ☒ TIME			
A-10	A1234		#1 PRE DOCK	0700 13 DEC 2004	20041210

10. ACFT TIME AT INSP	11. ACFT LAST INSP	12. ENGINE TIME	NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6	NO. 7	NO. 8	13. DATE DUEOUT OF INSP
A. ESTIMATED 7000	A. TIME 6600	A. ESTIMATED	E1234 3000	E5678 4000							20041223
B. ACTUAL 6999	B. DATE 20041213	B. ACTUAL	3010	4010							

14. PREPLAN MEETING PARTICIPANTS AND DISCUSSION ITEMS

ACTIVITY	NAME	DISCUSSION ITEMS
AMU PS&D TSgt Smith		-- Work package requirements. -- Out of configuration items for correction.
Pro-Super MSgt Runshow		-- Coordination and responsibilities.
Dock Chief MSgt Treble		
APG MSgt Edgy		
Specialist MSgt Pointy		
EMD TSgt Thrust		-- No engine inspections due this phase.
EGRESS SSgt Eject		--Seat must be removed first day of phase.
EMS SSgt Russ		
Supply SSgt Order		--All TCI parts received and ready for pick-up.
Weapons TSgt Bomber		--Bomb racks and gun must be removed during phase.

15. ADDITIONAL SPECIALIST TASKS

SHOP	TASKS
EMS	#1 Phase inspection JCN 04347A001
EGRESS	36 Month Seat Removal JCN 043470001 36 Month Chute Repack JCN 043470002
Weapons	Removal of Bomb Racks JCNs: 043470002, 043470003, 043470004, 043470005, 043470006, 043470007, 043470008, 043470009, 043470010, 043470011, 043470012.
Weapons	Gun Removal JCN 043470013

AF IMT 2410, 19720601, V1 SI045449034

Figure 2–6. AF Form 2410, Inspection/Time Compliance Technical Order Planning Checklist (front).

16.			TCTO AND TIME CHANGE			
ENG OR ITEM	ENGINE TMS OR NOMENCLATURE OF ACCESSORIES IF APPLICABLE	SERIAL NUMBER	TCTO OR TIME CHANGE	PARTS-KITS AVAILABLE		REMARKS
				YES	NO	
ACFT	Inertia Reel	0113226	Time Change	☒	☐	
ACFT	Spin-up Gyro	12845577	Time Change	☒	☐	
ACFT	Wiring Harness	4567954	TCTO 1455 Wire harness replacement	☒	☐	
ACFT	Nose landing gear Strut Seal	98798798	TCTO 1489 Seal replacement	☒	☐	
ACFT	Bulb replacement	54875	TCTO 1490 Replace bulb at station Z1432	☒	☐	
				☐	☐	
				☐	☐	
				☐	☐	
				☐	☐	
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				☐	☐	
				☐	☐	
				☐	☐	

17.	LIST OF SPECIAL INSPECTIONS, DISCREPANCIES, AND REMARKS

AF FORM 2410, 19720601 *(REVERSE) (IMT-V1)* SI045449035

Figure 2–7. AF Form 2410, Inspection/Time Compliance Technical Order Planning Checklist (reverse).

017. Automated time change records

The inspection and time change area uses many of the same routines; that is, the TRICs mentioned earlier. Therefore, once a TRIC has been explained, the explanation portion is not repeated in following sections. Let's first take a look at the automated process for inspections.

Automated inspections

As mentioned before, to schedule an inspection for completion, the inspection requirement must first be loaded into IMDS using TRIC JFP. Remember, this should have already been done when the aircraft was assigned to your unit or when a new requirement was identified by a –6 change. When you completed JFP, a JST was assigned for each requirement. At this point, you take each requirement, by JST number, and load it to each aircraft, by equipment ID, and assign a due date for that requirement. Use TRIC ISP to accomplish this task.

Inspection load/change/delete/inquiry all equipment except engines

The inspection load/change/delete/inquiry all equipment except engines (ISP) screen is used to load, change, delete, and inquire about inspections, time changes, and profiles for all equipment, except engine components, to the IMDS database. The frequency and WUC of the inspection requirements is obtained from the JST record identified in the input. The due time must agree with the maintenance type interval. Here's a brief description of the various transactions you can do with TRIC ISP:

- The load transaction establishes inspection or time change requirements for an item of equipment.
- The change transaction causes a limited number of elements in the inspection or time change record to be altered.
- The delete transaction removes a previously established requirement from the record of a given item of equipment.

The inputs to this TRIC are made from any IMDS terminal and are processed in an on-line mode of operation. Now IMDS is set to handle the day-to-day operations for managing the inspection program.

This part of the process begins with forecasting the inspections coming due on your aircraft. This should sound familiar and help you understand how inspection packages and preplanning inspections come into play. On a daily basis, PS&D monitors inspections to determine which inspections should be scheduled for completion.

Inspection/time change/time compliance technical order forecast

This inspection/time change/TCTO forecast (ITF) online inquiry lists all inspections, time changes, and TCTO requirements against a specific aircraft or part/serial number (PSN). The output provides you with the JST number, equipment ID, due date, and JST narrative for the inspection. Reference for this TRIC is in AFCSM 21–565V2, *Operation Event Subsystem Software User Manual*. In addition to the inquiry, there are several other products that may serve your purpose.

Planning requirements

Planning requirements (PRA) is a background TRIC that provides the capability to list maintenance requirements and forecasts of time changes and inspections for equipment specified in the input. It lists all inspection and time change requirements that become due during the period of the report, based on the UTE rate in the input.

Time distribution program

The time distribution program (TDI) is a background TRIC which produces a graphic display of the time remaining to inspection, profile, or time change for each item of equipment under the input equipment designator. The JST input option provides the capability to obtain a graph of the time remaining to a specific time change, profile, or inspection by JST number. It is formatted in time remaining sequence or in time remaining within an equipment ID. The “next” option provides a graph of the time remaining to the next major inspection formatted in time remaining sequence. The owning work center field provides a listing of only the equipment for that work center. The “next” option provides the option to specify an inspection of a specific WUC or WUC subsystem.

Current operating time report

This TRIC provides the capability to obtain a current operating time (COT) report for equipment and parts. There are several different formats available to you, which produce listings that provide operating time by:

- Equipment ID for a specific MDS, type make series modification (TMSM), or end-item WUC.
- All data serial numbered items for a specific part number.
- A single equipment ID and all engines installed on that equipment.
- A single equipment ID and all items installed on that equipment.
- Operating time and cycles for the J–79 series engines.

Once the PS&D scheduler determines which requirements are coming due, the scheduling process can begin. The PS&D scheduler must schedule inspections and complete them using TRIC ZSC.

Scheduled maintenance

The scheduled maintenance (ZSC) TRIC is used to create an automated work order for the inspection being scheduled. Once this screen has been completed, IMDS returns with a Yr/Event ID Number. Additionally, if you placed an “X” in the originating work center, you should receive a solicited message in the form of a work order notification. This is an automated work order.

On the scheduled date/time, the performing work center should go out to the location of the aircraft or of the inspection activity, and perform the specific task from the work order. Once you complete the physical task, the maintenance technician, using an IMDS terminal, documents the completion of the work order. Just as in TCTOs, the technician starts this process by using TRIC job data documentation menu, (JDM), and fills in the YR/Event ID and work center event (WCE). Upon processing, this takes the technician to TRIC JOS, On–equipment Maintenance (Support General). The technician then completes the screen with the required information. If all the fields are filled in correctly, IMDS returns to the JDM screen. This is IMDS’ way of telling the technician the work order is now complete and is ready for the next job that needs to be documented.

At this point, the PS&D scheduler must verify all the information input into IMDS regarding the inspection that was completed using TRIC QVR.

Suspense validation inquiry

The suspense validation inquiry (QVR) TRIC is used to validate the scheduled maintenance work order. As IMDS completes work orders for inspections, time changes, or TCTOs, it creates a suspense, which must be validated. Once it is validated, IMDS automatically updates the inspection due date. This update is based on the frequency that was input when the JST number was created by PS&D. The PS&D scheduler uses “option 1” to obtain a list of all suspense records that need to be validated.

Once you find the transaction sequence number, return to QVR and choose “option 3” to process a specific sequence number. You could also just move your cursor next to the straight line input from the initial inquiry and process. Either way, this accesses TRIC JDC (job data collection). This screen is prefilled and the PS&D scheduler only needs to review it for accuracy and transmit. As a final step, it is always a good idea to run an inquiry in IMDS to verify the data input. Once again, you could use TRIC ITF for this purpose.

Automated time changes

Again, many of the TRICs used to process inspections are also used to process time changes. So, if a TRIC has been discussed before, we will not repeat the entire description here. We will only cover the information pertinent to processing time changes in IMDS.

Just like inspections, a time change must be loaded into IMDS before anything else can be done. Like an inspection, you use TRIC JFP to load the time change requirement into the master job standard table, which then assigns a JST to the requirement to identify that requirement in the database. Unlike inspections, which are primarily loaded against the aircraft or end-item, TCIs are loaded into the system using the PSN of the component, which is then installed on the aircraft or end-item. So, when a TCI is initiated in IMDS, you must first load the PSN item before the component can be installed on the end item.

Part/serial number load/change/inquiry/delete

The PSN load/change/inquiry/delete (SEL) TRIC is used to load, change, inquire, and delete the basic equipment identification information for PSN items. Once the component is loaded into IMDS using SEL, you must identify the PSN item as a TCI by loading the time change requirement, by JST number, to the PSN. You also need to tell IMDS the due date for that TCI. To identify the PSN item as a TCI, use TRIC ISP.

Inspection load/change/delete/inquiry all equipment except engines

The inspection load/change/delete/inquiry all equipment except engines (ISP) TRIC is used to load, change, and delete TCIs for all equipment, except engine components, to the IMDS database. Once you have established the PSN item as a TCI with a due time/date, you need to tell IMDS where this component is located. This is done by installing the component on an end-item or part in IMDS. Use TRIC IAE for this purpose.

Equipment installation

Use the equipment installation (IAE) TRIC to establish the installed-on relationship between two items of equipment. Using this TRIC, you may install parts on aircraft, other parts, AGE, and end-item C-E equipment. Once all of the time change requirements and components have been loaded in IMDS, the next step is to forecast the time change requirement to ensure the time change is accomplished.

At this point, you should recall our discussion of forecasting TCIs and inspections from previous lessons. Keep in mind, forecasting time changes is an involved process. Our focus here is specifically related to IMDS. As far as IMDS is concerned, you can forecast time changes in much the same manner as you forecast inspections.

Remember, on-line you can use TRIC ITF; for background products, you can use TRICs PRA, TDI, or COT. Whichever method you use is strictly your choice. When PS&D determines a TCI is due, they must schedule the TCI to be replaced. Keep in mind, the item was forecast for replacement as a part of the AF Form 223 forecast; here, we are referring to the actual replacement of the time change.

Scheduled maintenance (job standard assigned)

Scheduling uses the ZSC TRIC to schedule and create an automated work order for the TCI. Once this TRIC has been processed, IMDS returns with a Yr/Event ID Number (job control number [JCN]). On the scheduled date/time, the performing work center (PWC) should go out to the location of the aircraft and perform the specific task from the work order.

Job data documentation

Once the physical task is completed, the maintenance technicians, using an IMDS terminal, document the completion of the work order, much in the same way they documented completed inspections. Once again, they start by using TRIC JDM menu and fill in the Yr/Event ID and WCE for the job they are processing. This takes them to JOM, where they input the time taken to complete the job, as well as, input information about the part they removed and the part they installed—to include part, serial, and lot numbers. If the item being installed has not been loaded into IMDS already, it prompts the user to load the PSN. Selecting the option to load the PSN takes you to SEL. After this information processes, IMDS continues with the documentation process and takes the technician to JDN to document, in narrative format, what happened during the maintenance process. When this processes, IMDS returns to the JDD menu. At this point, PS&D is back in the process to validate the information input by the technician.

Suspense validation inquiry

Just as in inspections, PS&D uses QVR to validate the scheduled maintenance work order. When dealing with TCIs, however, there are a couple of differences. When a TCI is replaced, it creates two maintenance actions in IMDS. One is the removal of the TCI being replaced and the other is the installation of the component taking its place. Therefore, when you validate the technicians' entries, you must first validate the removal action of equipment, and then validate the equipment installation. Using QVR in this process, you are automatically taken to the prefilled removal action RAE, Equipment Removal. This removes the installed-on relationship between the component and the end-item or part. This is done by simply verifying the information on the screen and processing it. Again using QVR, you follow the same procedure to install the new item on the end item or part. QVR automatically takes you to the prefilled IAE discussed earlier. Once again, all you need to do is verify the information on the screen and process it.

Establishing newly installed time compliance items

You now need to turn your attention to the newly installed component. Although you have installed this component, you have not told IMDS that this item is a TCI. Just as you did when you initially established time changes in your system, you must once again complete ISP for the new item and assign its due date in IMDS. When you complete this, run an inquiry to check your work. You could use the on-line inquiry ITF for this purpose. Verify the JST has a new PSN and due date, and the old PSN is absent. This tells you the item was removed from your aircraft. In this way, you can ensure you completed the task correctly.

Additional programs

In addition to all of the IMDS products mentioned in previous lessons, here are a few additional TRICs that will assist you in maintaining the time change and inspection subsystems.

Automated history entry

This automated history entry (AHE) TRIC establishes and maintains the automated significant history for any piece of equipment loaded that has a requirement to maintain an AFTO Form 95, Significant Historical Data.

Master identification/inspection schedule report

The master identification/inspection schedule report (GTM) TRIC is used to provide an output product that lists equipment inventory with inspection due dates and equipment schedules for AGE, SE trainers, and munitions.

Significant historical data

The significant historical data (SHD) TRIC provides the capability to retrieve historical data for a specified type of equipment, and a specific piece of equipment and its installed items.

018. Equipment historical records

PS&D keeps a file of all required forms. This lesson covers the establishment of the jacket file and gives examples of the forms to be kept.

Aircraft jacket files

The PS&D section establishes a file for aircraft and maintenance historical documents (jacket file). The jacket files are standardized according to the master aircraft jacket file. Any documents decentralized to sections maintaining installed-on equipment (e.g., fuel cell records at fuel systems section, landing gear strut records at hydraulics section, etc.) are filed by, and the responsibility of, the owning work center. PS&D lists all historical records, including those decentralized in the file plan (or office of record).

Documents and integrated maintenance data system listings

The IMDS listings (e.g., event history recorder and significant historical data) can also be a part of the complete historical file, but these are usually filed separately in a book or sliding drawer file for convenience. Documents for nonpowered AGE, training equipment, and common equipment items that require very little maintenance documentation may be grouped together in a single folder or area to eliminate keeping a record folder on each individual item. When this is done, documents for similar items should be grouped together and the recorded information should be identifiable to particular pieces of equipment.

Deployed records

When aircraft are temporarily moved to operating locations away from the unit of assignment, send only those documents necessary to ensure safety of flight and current aircraft status to the temporary location. Units develop written procedures for records taken to a deployed location based on duration of TDY and peculiar operating requirements. The accumulated airframe hours, TCTO status, TCI status data on installed engines, and critical components are sent from the operating location to the parent unit as specified by MAJCOM instructions when pertinent documents are not sent with the aircraft.

File contents

Each file may contain historical documents maintained for the life of the equipment, operational data and maintenance status documents that accommodate continuing entries, and reports that reflect a current status.

Here are some examples of the documents required in a jacket file:

- AFTO Forms 781–aircraft series forms.
- AFTO Forms 95 and other engine conditioning forms.
- AFTO Forms 349, Maintenance Data Collection Record, for TCTOs; TCIs; and PH, PR, or ISO inspection work packages.
- TCTO system history documents (e.g., history cards or history listings required).
- NDI documents or resume reports that are current, and X–ray films, if applicable.
- FCF checklist/worksheets.
- MIS products.

Jacket file review

Active AF and AF Reserve (AFR) units review aircraft jacket files and associated decentralized records semi-annually using the PS&D-developed quarterly review checklist. Keep the last completed checklist on file in each aircraft jacket file. If engine records are decentralized to the EM section, EM is responsible for quarterly reviews of engine records.

Maintaining pulled Air Force Technical Order 781-series forms

Maintain inactive (pulled) AFTO 781-series forms according to the AF RDS. AFTO 781-series forms are reviewed to ensure no forms are missing, page number blocks are correct, and the “from” date matches the “to” date from previous forms (AFTO Form 781A, Maintenance Discrepancy and Work Document) before filing. If forms are missing, send a missing forms letter to the appropriate section chief with a 5-duty-day suspense. If a response is not returned within five duty days, notify AMU supervision. If forms cannot be located, file the missing forms letter, endorsed by the section chief and AMU supervision, in the aircraft jacket file in place of the missing forms.

When equipment is received, and historical documents are missing or have incomplete information, the gaining organization must notify the losing organization. The losing organization must send the missing documents or initiate new ones.

Air Force Technical Order Form 95, Significant Historical Data

The AFTO Form 95 (fig. 2–8) is a document for maintaining a permanent history of significant historical maintenance actions on end items of equipment including, but not limited to, aerospace equipment. As a minimum, annotate the installation/removal dates and component accumulated hours, reason for removal, and a brief narrative as to the maintenance performed on the component (e.g., unit overhauled, unit cleaned, inspected and repaired; replaced minor parts, TCTOs completed, and scheduled maintenance complied with). This information portrays those conditions that could have a bearing on future maintenance or tracking of the aerospace equipment. This form also serves as a history to document accumulated cycles, operating time, and maintenance history, as well as, pertinent manufacturing data for jet engine turbine wheels.

SIGNIFICANT HISTORICAL DATA			PAGE 1 OF 1 PAGE
1. MISSION DESIGN SERIES/TYPE, MODEL AND SERIES 8852962-30	2. MANUFACTURER MENASCO	3. SERIAL NUMBER 13B15422	4. ACCEPTANCE DATE UNKNOWN
DATE A	REMARKS B		ORGANIZATION C
20060801			OGDEN ALC
	MRS ACTION C/W COMPONENT PARTS		
	CYLINDER, OUTER P/N 885962-10 S/N 13B15422 CYLINDER, INNER P/N 19042-1 S/N 13B40411 ASSEMBLY P/N 8852962-70 S/N 13B15422		
	ALL PREVIOUS T.O. C/W		4S-1-182
1 OCT 2004	INSTALLED ON ACFT A5922 (ACFT TIME 12,987 1hrs) RIGHT MAIN LANDING GEAR STRUT		SHEPPARD AFB, TX
2 OCT 2004	Automated History Started This Date		SHEPPARD AFB, TX

AFTO IMT 95, 20020617, V2 PREVIOUS EDITION IS OBSOLETE SI045449044

Figure 2–8. AFTO Form 95, Significant Historical Data.

Automated Air Force Technical Order Form 95

When an AFTO Form 95 is initially automated, an entry is made on the manual AFTO Form 95 indicating the date and location of the event. Additionally, the following statement is entered onto the original AFTO Form 95 in ink; "Automated history started this date." A printed MIS automated AFTO Form 95 is attached to the original AFTO Form 95 and filed in the jacket file record. Print a new automated AFTO Form 95 for aircraft-installed components requiring an AFTO Form 95 (according to the applicable –6 TO) and attach it to the original AFTO Form 95. Print and download a copy of an MIS automated history or equivalent to a compact disc (CD) annually and place it in the jacket file.

Additional uses of the Air Force Technical Order Form 95

Additional uses of AFTO Form 95 are prescribed by the MAJCOM or MXG/CC. Forms prepared for MAJCOM or MXG/CC requirements must accompany the equipment when it is transferred; but after review of the forms package, these forms may be disposed of if not required.

019. Document reviews

The aircraft AFTO 781-series forms, for aircraft in a unit's possession, are reviewed by flightline maintenance functions (dedicated crew chief or alternate), PS&D, EM, and supply to ensure the accuracy and validity of entries.

Purpose

The purpose of the aircraft document review (ADR) is to validate and correct any errors on the following six items:

- Airframe and engine operating times and cycles.
- TCTO documentation.
- TCI component operating times.
- Time remaining to the next inspection.
- Backordered supply document numbers.
- Open and deferred discrepancies.

Complete an ADR at least every 60 days for units using fully automated AFTO 781-series forms. Units without access to an MIS system and authorized to use manual AFTO 781-series forms must complete an ADR at least every 30 days. Complete an ADR also when any of the following occur:

- An aircraft is transferred.
- An aircraft is deployed for more than 30 days.
- Before and after scheduled inspections (PH or ISO).
- Before and after storage.
- After fatigue tests.

For cannibalized (CANN) aircraft, conduct ADRs at least every 30 days. It's important to note the MAJCOM and group CCs may shorten the ADR interval as needed. It's not uncommon to see an interval of at least every 14 days for an ADR.

Aircraft document review procedures

PS&D creates a JST for ADRs, and it is responsible to load and schedule this inspection against all assigned aircraft. An ADR is a scheduled maintenance action and counts in maintenance scheduling effectiveness (MSE) computations.

The PS&D and EM validate the following:

- Applicable inspections.
- TCIs.
- TCTO data for correct due dates or expiration dates.
- Airframe and engine operating times (or flight times, if applicable).
- Appropriate symbol entry required by TO 00–20–1.
- Correct configuration.

Supply runs a tail number inquiry to validate backorders and corrects any discrepancies discovered. The maintenance personnel, usually the DCC or assistant, correct all documentation discrepancies discovered during the ADR before updating the ADR JCN. The PS&D develops a checklist on what needs to be completed during the records check. See figure 2–9 for a sample ADR checklist.

ALL PURPOSE CHECKLIST		Page 1 of 1		
TITLE/SUBJECT/ACTIVITY/FUNCTIONAL AREA AIRCRAFT DOCUMENT REVIEW CHECKLIST		OPR MOF PS&D	DATE 1 Aug 2006	
NO.	ITEM (Assign a paragraph number to each item. Draw a horizontal line between each major paragraph.)		INT	
	AIRCRAFT: A0922 DATE: 25 OCT 2004 JCN 042991085			
	CREW CHIEF			
	ENSURE ALL DISCREPANCIES ON AFTO FORMS ARE LEGIBLE			
	ENSURE ALL DEFERRED DISCREPANCIES HAVE THE CORRECT DEFERRED CODES IN THE AFTO FORM 781s AND IMDS			
	ENSURE ALL DOCUMENT NUMBERS IN AFTO FORMS 781s MATCH IMDS DATA			
	ENSURE CURRENT ENGINE OPERATING AND OIL TIME, AS REFLECTED IN IMDS (SCREEN 713), ARE ANNOTATED ON AFTO FORM 781 J, IF NOT CORRECT USE (IMDS SCREEN 726) TO FIND THE FLIGHT TIME ERROR			
	OBTAIN A DOCUMENTED MAINTENANCE LIST FROM IMDS SCREEN 380 WITH SUPPLY DATA FOR DOCUMENTS REVIEW ALONG WITH IMDS SCREENS 701,713,726,538 & 525			
	ENSURE THE DOCUMENT REVIEW NUMBER INDICATES "STARTED" IN IMDS			
	ENSURE IMDS SCREEN 538 DOES NOT HAVE SUPPRESSED MAIN JOBS			
	SUPPORT SECTION			
	VERIFY ALL SUPPLY DATA IS ENTERED CORRECTLY IN AFTO FORM 781s, IMDS, AND SUPPLY SYSTEM			
	ANNOTATE (IN RED) ON DOCUMENTED MAINTENANCE LIST (380) ANY ADDITIONS, CHANGES, OR DELETIONS OF SUPPLY DATA			
	OPERATIONS SQUADRON P.S.&D.			
	VERIFY AIRFRAME TIME ON AFTO FORMS 781J / 781H ON SCREEN 700 IN IMDS			
	VERIFY INSPECTION AND TIME CHANGE DATA USING SCREEN 701			
	VERIFY TCTO DATA USING SCREEN 525 OPTION 4 AND ENSURE TCTOs ARE CORRECTLY ANNOTATED ON THE AFTO FORM 781K			
	VERIFY ACCURACY OF DUE TIMES FOR ITEMS LISTED ON AFTO FORM 781K			
	VERIFY IMDS SCREEN 538 FOR SURPRESSED JOBS			
	CALL OIL TIMES IN TO THE JOAP LAB FOR VERIFICATION			
	VERIFY ENGINE DATA IS DOCUMENTED CORRECTLY NOTE: REFER CREW CHIEF TO EMB TO RESOLVE ENGINE DATA PROBLEMS			
	NOTE: FILE IMDS PRODUCTS UNTIL NEXT DOCUMENT REVIEW IAW 21-101			
	CREW CHIEF MAKE REQUIRED CORRECTIONS AND UPDATES TO THE 781 SERIES FORMS AND IMDS COMPLETE DOCUMENTS REVIEW IN AFTO 781 SERIES FORMS AND IMDS			
	FLIGHT CC / FLIGHT CHIEF			
	REVIEW AFTO 781 SERIES FORMS FOR ACCURACY, APPEARANCE, AND COMPLY WITH ANY ADDITIONS ACTIONS REQUIRED BY YOUR UNIT			

SI045449048

Figure 2–9. Aircraft document review checklist.

020. Aerospace vehicle distribution

Every AF base is assigned a specific mission based on the type of aircraft it possesses. HQ USAF tasks the installations to perform special missions or participate in exercises based on their assigned mission. Can you imagine what would happen if HQ USAF did not know where, how many, or what type of aircraft was under its command? Without a positive system to control inventory, HQ USAF would not be able to have the correct aircraft at the proper location on time. This, of course, would leave our forces vulnerable. AFI 21–103 is designed to keep HQ USAF and other organizations informed as to the number, types, and location of aircraft in the AF's inventory. This information is vital to the success of any operations directed by HQ USAF. To understand equipment inventory, status, and UTE reporting, you must be familiar with the general reporting process. This lesson covers the reporting system, how reports are used, and the importance of reporting accuracy.

Reporting process

The reporting system begins at base or depot level. AFI 21–103 establishes procedures for reporting the inventory, status, and UTE of vehicles. It's very important you know and understand the equipment inventory reporting system because reports generated by the system are relied on to justify and defend the USAF plan, program, and budget. Therefore, accurate and timely reporting is critical. Errors in aerospace vehicle reporting can result in the loss of funding, manpower authorizations, and supplies. The reporting system is based on the basic concept that each aerospace vehicle is possessed by an AF unit. These units include the active Air Force, Air National Guard (ANG), and Air Force Reserve (AFR). The possessing organization reports the following:

- The hours it possesses the aerospace vehicle.
- Changes in aerospace vehicle possession.
- Status conditions that affect an aerospace vehicle's ability to perform assigned missions.
- Flying hours and sorties.

The information from reports generated by each reporting system is used mainly for accounting and analysis. Each reporting system also gives basic historical management information and data on equipment availability and use to all levels of command. Specifically, this information is used for:

- Maintaining the official AF inventory.
- Developing the AF programming documents and their related budget and manning requirements.
- Preparing statistical analysis for congressional committees, the Office of Management and Budget, and the DOD.
- Establishing MC goals as required by the MAJCOM and in coordination with the Air Staff. These goals enable HQ USAF to evaluate resource allocation funding on a quarterly basis. The MC rate goals and plans are also used for the annual DOD materiel readiness report to Congress.

As you see, knowing what to report and when to report it is vital. It's very important you understand the reporting process for aerospace vehicles.

Types of reporting

Under the inventory reporting concept, all aerospace vehicles in the Air Force must be accounted for as long as they are assigned and possessed by the Air Force, ANG, or AFR unit. Accountability begins when the aerospace vehicle is accepted according to AFI 21–103 and AFI 16–402, *Aerospace Vehicle Programming, Assignment, Distribution, Accounting, and Termination*. Inventory reporting is divided into two distinct types: assignment and possession.

Assignment reporting

Assignment reporting is the distribution or allocation of aerospace vehicles by HQ USAF and MAJCOMs to AF installations based on the mission of the command. For example, one of the missions of ACC is air-to-air combat; therefore, fighter-type aircraft are allocated or assigned to ACC bases. Since a mission of AMC is to transport passengers and cargo, cargo-type aircraft are assigned to AMC bases.

The MAJCOM AVDO is responsible for the distribution of aerospace vehicles within a command. The AVDO directs the transfer of aircraft from base to base and assigns new aircraft or aircraft received from other MAJCOMs.

PS&D is responsible for the aerospace vehicle distribution function at each base and unit level. PS&D reports all inventory changes involving aerospace vehicles at the base level. These changes are reported to the MAJCOM AVDO.

Assignment reporting, therefore, involves the distribution of aerospace vehicles. HQ USAF assigns and distributes aerospace vehicles throughout the Air Force. The MAJCOM AVDO handles the distribution of aerospace vehicles within a command. The unit AVDO at each base reports inventory changes and information at the base level.

Possession reporting

Possession reporting, in contrast to assignment reporting, is the actual acceptance or designation of responsibility for an aerospace vehicle. Each aerospace vehicle is possessed by an AF unit, which has sole responsibility for its maintenance, care, and use. The possessing unit’s PS&D is responsible for reporting certain information about the aerospace vehicles possessed by that unit. This information includes the status and UTE of the aerospace vehicles. Status and UTE are reported through the use of an automated maintenance system to the MAJCOM.

Status data

According to AFI 21–103, the term status refers to the condition of the aircraft (e.g., FMC). In a perfect world, the status of your aircraft would always be FMC. However, we know aircraft break and, when they do, the status must be reported. This status is based on the *concept of exception* reporting. Exception reporting simply means you report only the abnormal conditions. FMC is what is meant by “normal,” whereas partially mission capable (PMC) and nonmission capable (NMC) are not considered normal conditions (i.e., they are the exceptions).

Utilization data

UTE information includes how much and for what purpose the aerospace vehicles are being used, the number of sorties (flights)/hours flown, and what types of missions are being flown. In other words, UTE data is the record of hours the aircraft flew. The hours are taken from the AFTO 781–series forms, which are taken from the aircraft forms binder daily for each aircraft flown.

Condition status reporting

Once an aircraft has been assigned, the MOC reports the condition status on the aircraft according to AFI 21–103. The mission/condition status is the vehicle’s ability to fly the unit’s mission. For example, FMC vehicles fly all peacetime and wartime missions. PMC vehicles fly at least one, but not all, missions. NMC vehicles do not fly any assigned missions.

Inventory reporting procedures

At the unit level, two activities are responsible for different facets of AFI 21–103 reporting. These activities are the MOC and maintenance management production. This lesson focuses on the responsibilities of AVDOs and maintenance management production. MOCs were mentioned earlier in the unit.

Unit aerospace vehicle distribution officers

The unit AVDO at the base level generates the report data that ultimately ends up at Air Force Materiel Command (AFMC) and reporting unit's MAJCOM. They are the primary points of contact (POC) for collecting and initiating all inventory possession, condition status, and UTE reporting on the aerospace vehicles possessed by their unit.

Sortie and hour reconciliation responsibility

The responsibility for unit sortie and hour reconciliation belongs to the aerospace vehicle utilization monitor (AVUM) and AVDO. We already know the AVDO is a function within PS&D, but you might be wondering who is responsible for the AVUM function according to AFI 21–103. This function is assigned to the operations aviation resource manager.

Establishing reconciliation procedures

Now that you know who's responsible for reconciliation, you need to know how the AVUM and AVDO establish procedures to get the job done. The AVUM and AVDO first establish and publish procedures on how to verify hours and sorties on a daily, monthly, and yearly basis. These procedures are established according to AFI 21–103 and MAJCOM supplements. Furthermore, the procedures provide guidance for daily reconciliation of all sorties flown, ensure the MIS is reconciled with operations, and ensure all changes are completed NLT the fourth calendar day of the month.

Generating reports

To generate reconciliation reports, MMA provides reports to the AVUM and AVDO daily. The official reporting source is from the MIS flying hour data. The end of month and other reports are provided to operations, as requested. The AVUM checks the maintenance reports from the previous day's flying hours daily to ensure the data is correct. The AVUM then coordinates any necessary changes between squadron operations and debrief personnel. After the AVUM and AVDO are finished comparing reports and the data in the MIS represents hours flown, the AVUM submits a monthly flying hour report. This report is sent to the MAJCOM for the previous month's flying hours. The monthly flying hour report only includes those hours reported and reconciled in the MIS as of 2400 on the fourth calendar day of the following month. Any hours or changes reported after that are included as late time in the following month's report.

Plans, scheduling, and documentation

Whenever an aircraft is transferred from one unit to another, PS&D is responsible for the AVDO function or inventory. The scheduling function of the losing organization reports the loss. The appropriate scheduling function at the gaining organization reports the gain. This is done before the aircraft's condition status and UTE can be reported. In fact, an ID number and serial number is loaded into the MIS when an aircraft is gained to report work-hour accounting from the appropriate forms. Again, the aircraft must be assigned to report UTE data.

Possession reporting criteria

This is where you get into the picture. When the selected subordinate unit assumes possession of an aerospace vehicle, you begin reporting the vehicle in the inventory reporting system. Keep in mind that, depending on the organization; the inventory may be stable, change occasionally, or change frequently.

Possession reporting

You are most concerned with three major possession transactions: gain, loss, and termination. Each type of possession transaction requires a certain message format. AFI 21–103 provides guidance on message formats.

The following table describes the three transactions:

Possession Transactions	
Transaction	**Refers to**
Gain	The assumption of possession and responsibility for an item by a unit.
Loss	The release of possession and responsibility for an item by a unit.
Termination	The deletion of an aerospace vehicle from the AF inventory because it is transferred to a non-AF activity, is damaged beyond economical repair, or is destroyed.

Deployed aerospace vehicle reporting

When aerospace vehicles are deployed to another station, they are possessed by the organization and command that has the direct responsibility for their use and support. However, do not change possession accountability, unless directed in the operation plan (OPLAN) describing the deployment.

021. Comprehensive Engine Management System

Aircraft flown by today's Air Force are sophisticated and the most advanced aircraft in the world. A major difference in the technology of the forties and fifties, and today's aircraft is the engines that power them. Many of today's aircraft, especially fighters, are no longer propeller powered. Instead, they are powered by powerful jet engines. With the advent of the jet engine, the Air Force soon realized the way these engines were managed needed to change. This realization resulted in the development of the Comprehensive Engine Management System (CEMS).

Comprehensive data collection

Comprehensive means taking into account all of the factors or details concerning an issue, problem, or subject—that is, it is all-inclusive. So, just as its name implies, CEMS is a worldwide data collection system that collects and processes information on USAF turbine engines and modules. This EM system is comprehensive because it includes or is used to manage engines worldwide. In addition, CEMS serves as a single EM system at base and depot level, meaning the base and depot use the same EM system.

Information can be requested in the form of on-line inquiries or background reports. The output products can be used at base level to manage time changes, inspections, and TCTOs on the engines. You could think of CEMS as being a time change and inspection system for engines. The information is also used at depot for engine analysis. This depot analysis involves determining reliability of parts, reasons for part failure, and what is needed to improve the reliability of parts. For instance, if a part is found to be very reliable, then the time change frequency of the part might be raised from 500 to 750 hours. On the other hand, if a part is found to be unreliable, then a TCTO might be issued by depot to correct the problem or the time change frequency might be lowered from 500 to 300 hours.

Segments of CEMS

CEMS is divided into two distinct segments as described in the following table:

CEMS Segment	Description
Base level	The base-level segment of CEMS is a subsystem of IMDS. It serves as the initial collection point for the two major types of engine data: 1. Engine status data: consists of the location and condition of the engine—in other words, whether the engine is serviceable, installed, removed, and so forth. 2. Component operational data: consists of hours, cycles, and time above certain temperature levels the engine accumulates while in operation.

CEMS Segment	Description
	Along with being the initial collection point for engine data, CEMS is also used to provide EM personnel with background and on-line products. These products can be used to project engine changes, life-limited component changes (time changes on engine parts), or aid in scheduling engines or components. Additionally, every base-level segment of CEMS has an interface with the central database (CDB) segment of CEMS to report data on engines and modules to the CDB.
CDB	The CDB segment is the hub of CEMS—it is the computer storage site where all records for engines, modules, and tracked components are stored. All information concerning the engines is eventually sent to the CDB by the base-level segments of CEMS. Also, the CDB provides initialization data to the base-level segment of CEMS for the purpose of loading engine, module, and tracked component records to IMDS.

Direct line reporting

The primary method of transferring data between the two segments of CEMS is through direct line reporting (DLR). Through the use of DLR, data is input to a terminal linked directly to the CDB. Each transaction is transmitted to the CDB as it is input and processed. Any errors generated by these transactions are transmitted back to the user of the terminal immediately. With DLR, errors can be corrected immediately or suspended for correction later if research must be done to correct the error. Quite often, this research could involve the verification of a part and serial number before the error can be corrected. Inputs and requests for data involve two CEMS applications, including the Information Management System (IMS), as well as, the time sharing option (TSO).

Information Management System

The IMS is used to update status and configuration data. It uses job IDs to identify the various programs used to report CEMS data, much the same way IMDS uses TRICs to identify its transactions.

Time sharing option

The TSO application is used for requesting products from the database. It provides the ability to browse, submit, and view products out of CEMS. The TSO is a menu-driven application that provides users with processing options pertaining to CEMS news, scheduled pushdown products, report submission, viewing, and printing.

Collecting and processing accumulated hour and event data

The purpose of collecting accumulated hour and event data is to enable engine managers to know the condition of these critical engine parts at any given time. The data tells you how quickly your engines, modules, and their TCIs are wearing out. In addition, it enables you to manage your engines, modules, and their TCIs. The entire purpose of collecting data in any computer system is to be able to retrieve that data in whatever way you need. This is why in IMDS and CEMS you have inquiries and background reports.

Types

There are several basic types of accumulated hour and event data being collected. The first type is engine and component operating time/hours. The tracking method for this type of data is engine operating time (EOT) and is used mainly to keep track of due times on engine parts removed on an hourly basis. In other words, some parts are removed under the EOT concept when they exceed their life limits.

The second type of engine data is cycle data which has several components. Some of the tracking methods for cycle data are calculated cycle (CCY), manual cycles (MC) and low cycle fatigue (LCF).

The third type of data is time above certain temperatures, which documents how long the engine stays above certain temperatures (e.g., some of the tracking methods are hours above 790 degrees Celsius (°C) and hours above 810°C).

The last type of engine data is occurrence of events above certain temperatures. When something happens or the engine reaches a certain temperature, an event is recorded. Some of the tracking methods for this type of data are hot starts, events at 550°C, and hot section temperature level II.

These are just a few examples of the different types of data being collected on the engines. Perhaps you can begin to understand the reliability-centered maintenance concept better when you think of these different types of data as the conditions under which the engines are operated.

Collecting

Data is collected on a regular basis. To keep collecting data on the operation of engines, there must be some guidelines on when to collect the data. Usually, data is collected after the engine is operated for any period of time or when maintenance is performed on the engines. For example, accumulated hour and event data is collected at regular intervals—such as:

- For each flight or the last flight of the day.
- After an attempted flight (if engines were started).
- After each ground or test cell operation.
- When serially controlled items are removed or installed.
- Each time an engine is removed or installed.

Depending on the type of aircraft and engine, different methods of collecting accumulated hour and event data are used. Some aircraft have an older system that uses a meter box to collect data while the engine is operated. With the advancement of computer technology, newer aircraft have diagnostic systems that collect and download data to a computer. Still, another method used to collect data does not use a meter box or a diagnostic system. Instead, the data is collected from the flight crew. Let's examine each method a little closer.

Meter boxes

Meter boxes collect data in the form of meter readings or window readings. Meter readings are the values or readings shown in the windows on the meter boxes. The data must be read visually by maintenance personnel and annotated on the proper form. After the form is filled out with the engine data, the form is forwarded to the EM section where it is used to update IMDS and CEMS. This method is far from error free, because the forms must be completed by hand, read by the EM personnel, and input into IMDS and CEMS. This process leaves a lot of leeway for human error. Often the forms are scribbled on and soiled by grease and hydraulic fluid. The two meter boxes currently being used are the event history recorder (EHR), and engine time and temperature recorder (ETTR). Meter boxes are used on older aircraft and are slowly being replaced with diagnostic systems.

Diagnostic systems

Diagnostic systems collect data electronically. In addition, electronic transfer of data is the only way to obtain diagnostic system data. Diagnostic systems have no windows to read or forms to fill out. Instead, the accumulated hour and event data is downloaded using an electronic collection unit connected to the aircraft. After the data is collected from the aircraft, the data is transferred from the electronic collection unit to a ground station unit (GSU). Then, the GSU electronically transfers the data to IMDS and CEMS. When the data is processed, it can then be used by engine managers to print a report of engine operating abnormalities.

Flight crew

The last method of collecting accumulated hour and event data is obtaining it from the flight crew. This method is used on the older-model engines in the AF inventory. The Air Force is converting the older model engines to the multiple tracked system; however, because of the expense in redesigning older engines, they are not being fitted with meters or diagnostic units. Instead, critical parts never before tracked are being identified and tracked on these engines. The only accumulated hour and event data being collected are flying hours and cycles, which is collected from the flight crew. This data is input into IMDS when the aircraft is debriefed.

IMDS transactions for accumulation and event data

To process accumulated hour and event data in IMDS, there are a few TRICs with which you should be familiar.

Event history recorder

The EHR program updates, adds, subtracts, revises, and inquires modular engine and their components records for accumulated hours and events (raw totals); time at temperature; hot section time; CCYs; total cycles; starts; EOT; and engine history.

Multiple tracked equipment

The multiple tracked equipment (MTE) program provides the capability to obtain the current operating time, planning requirements, time distribution of time remaining to inspections or time changes, and a parameter ratio summary.

Type make series modification engine forecast

This program is used to request current operating time; JST type, number, and frequency; catalog number; time remaining; estimated date due to inspection/time change or K–factor; and projected hours remaining in flying time or EOT for tracked equipment. Reports also provide the next higher assembly equipment ID or installed-on PSN and position number. You can also get a list of permanently transferred items listed on the last page of the product if the suppress indicator is left blank.

Part number engine forecast

This forecast provides exactly the same information as the TMSM engine forecast (TEF), except it is provided by PSN.

On-line engine inquiry

This inquiry is used to request general engine data and EHR information on engines, which are tracked locally or by the CEMS CDB.

022. Processing Comprehensive Engine Management System status and inventory

As we've already learned, CEMS is a worldwide data collection system. Each base-level segment of CEMS keeps track of hundreds of engines and thousands of parts installed on these engines. In addition, the base-level segment of CEMS is collecting data on a daily basis concerning these engines and parts. As you already know, this data involves accumulated hour and event data, but it also includes the many removals and installations of parts and engines. All of this data is forwarded or sent every day to the CDB segment of CEMS through DLR. So, as you can imagine, there is a great potential for mistakes and errors to be made with the number of individuals involved in reporting the engine data. This last section covers how to correct these errors when they occur.

Quarterly physical inventory

Each quarter (December, March, June, and September) a physical inventory is required for all accountable assets at the base level. For deployed and prepositioned accountable items (assets not actually at your base), the accountable stock record account number (SRAN) is required to establish specific procedures for obtaining the required inventory and reporting information; this usually involves training and checklists.

In addition to the quarterly inventory, an inventory must be completed anytime there is a change of SRAN engine managers. The CDB provides automated products upon request whenever a SRAN engine manager's assignment ends and a new SRAN engine manger is assigned.

Conducting the inventory

The CDB quarterly inventory report is prepared and distributed on the 20th of December, March, June, and September. The inventory is completed by visually comparing the data plates of accountable assets with the CDB quarterly report. When the data plate is not accessible for installed assets or assets in containers, the records—aerospace vehicle engine documents to include the AFTO Forms 95—must be reviewed.

Do not rely on serial numbers stenciled on containers. Annotate the inventory report to reflect only changes up to the sequence number identified on the report; if any discrepancy reflects a lower sequence number than the one listed, the working copy must be annotated. For example, if an accountable item was previously shipped or transferred to another base, line through the transaction and annotate the working copy with the base SRAN and the date transferred or shipped. If the accountable item has been in transfer status 10 days or in shipped status 20 days before receipt of the quarterly report, notify the shipped-to SRAN to submit appropriate receipt of reports. If an engine has been removed, line through the serial number on the A10Q and add it to the A20Q. If an engine was installed, line through the serial number on A20Q and add it to the A10Q. If a spare engine changes status, it must be annotated on the report. All changes annotated on the report include the following:

- Type model series (TMS).
- Serial number.
- Transaction/condition code (TCC).
- Transaction date.
- Reporting sequence number.

After the physical inventory is conducted, the annotated working copy should be compared with all documentation records to determine if the discrepancies found during the physical inventory are valid. You must report any accountable asset added to the CDB product at the time of the physical inventory to CEMS.

Inventory status

When completing the quarterly inventory, the SRAN EM is responsible for ensuring IMDS and CEMS contain the same information. If an accountable asset cannot be located and no record exists of the asset currently being at that SRAN, or if the item was shipped/transferred more than 60 days before, a certificate of deletion must be submitted. When completing the certificate, include all known data that will help in an investigation. Submission of a certificate of deletion does not necessarily mean responsibility for the accountable asset by the SRAN EM ends. The FJ2031 accountable officer must be satisfied as to accountability before CEMS records are adjusted. If no response to a certificate of deletion is received before the next inventory, include a statement on A40Q, "Certificate of Deletion previously submitted." Transfer the latest annotated status for each possessed accountable asset from the updated working copy to the original copy of the CDB report as of the end of the quarter. The SRAN EM signs a copy of the inventory certifying the accuracy of the annotated products. Attach the certificate of deletion, include a statement on A40Q, "Negative Certificate of Deletion or Certificate of Deletion" previously submitted, and mail to OC-ALC/TILC.

Daily transaction listing

The engine manager's daily listing (EMDL) is prepared daily and contains five parts. The EMDL includes the prior 30 days transactions. The SRAN EM reviews the EMDL each day and corrects the EMDL immediately upon receipt. The product varies in output and contains only pertinent information.

TCTO reconciliation

All CEMS-reporting activities, except depots, are required to complete a TCTO quarterly reconciliation. Contractors serving in EM capacities that report to CEMS must also accomplish a quarterly TCTO reconciliation.

Once per quarter, CEMS produces a two-part TCTO reconciliation listing by base for engines, modules, and components that reflect the TCTOs for that base's assets.

IMDS procedures

When the TCTO reconciliation list is received, EM produces an IMDS TCTO status listing for engines, modules, and components that reflect the TCTOs for that base's assets using TRIC STL (Serial Number Detail Listing).

Using the previously discussed base-level product and the CDB report, you compare and manually annotate these listings. Compare any error between the two reports to the engine historical records to verify the status of the TCTO. Any changes made to IMDS are done at this time.

Use the CDB reconciliation report to report errors the base cannot correct. Send the listing to CEMS for correction. Correct these required changes by circling or marking through the incorrect data and annotating the correct data immediately to the right of the incorrect data. When you have made all corrections, send only the pages requiring changes to the CDB. Make changes to CEMS upon receipt of the listing from each base.

The annotated copy of the TCTO reconciliation report must be mailed to the CDB within 30 days from the date of the report. If no corrections are required for the complete listing, forward a negative report to the CDB, confirming the quarterly reconciliation report was received, reviewed, and no discrepancies were found.

CEMS procedures

DLR bases compare the TCTO status on the CDB TCTO reconciliation report with the manual records. If discrepancies are found, DLR bases make corrections to TCTO status using TCTO status update job A241 listed in TO 00–25–254–2, *System Manual–Comprehensive Engine Management System for DSD: D042*.

When you have reviewed the TCTO reconciliation report and the corrections input to CEMS, instead of returning a copy of the report, forward a message or letter to the CDB confirming the quarterly TCTO reconciliation report has been received, reviewed, and all identified discrepancies have been corrected. If no discrepancies are found, forward a negative report (message or letter) to the CDB. There are two CEMS job IDs that will assist you in TCTO reconciliation:

1. A241–TCTO update by serial number. This job is used to update the TCTO status code, status date, and man-hours from one to ten TCTO numbers at a time for a specified configured item identifier or serial number. Additionally, if the TCTO status code is in a closed status in error, the job may be used to reverse the status code.
2. F035–TCTO status report. This job selects the TCTO compliance data and computes a TCTO compliance summary on a specifically requested configured item identifier and data code number.

Status and inventory change data

Reporting status changes is the primary duty of the SRAN engine manager. The SRAN engine manager's knowledge of status reporting procedures must be complete in all respects. At the base level, a SRAN engine manager is assigned to control the collection of data affecting engine status and for the purpose of processing the data off-base to the CEMS CDB. The SRAN engine manager should be the person most knowledgeable about CEMS operations. Once you input engine data into IMDS and CEMS, it is available for off-base use.

The engine status reporting system provides the Air Force with one very important asset—it tells the Air Force the most efficient way to manage engines. The data received and processed at the CDB is analyzed, sorted, tabulated, and distributed to ALCs, engine inventory managers (EIM), and various planning groups constantly endeavoring to streamline EM techniques.

Transaction/condition code

The status of an accountable item is identified using a two-character code. This code is referred to as a transaction/condition code (TCC), sometimes called engine status codes. The first character of the code identifies the latest transaction that has occurred on the item (e.g., transaction code "S," which represents a shipped transaction). The second character of the code identifies the current condition of an item (e.g., condition code of "F," which tells us the item is in a reparable condition with a quick engine change [QEC] kit installed). Put together, the transaction and condition codes of "SF" show an item has been shipped in a reparable condition with a QEC kit installed.

Figure 2–10 is taken from the left side of an AF Form 1534, CEMS CDB Report. It displays all the available codes used for status reporting.

12. TRANSACTION (*Circle one*)				13. CONDITION (*Circle one*)	
GAIN		ENMCS	E	**SERVICEABLE**	
NEW PRODUCTION	A	WORK COMPLETED	F	BUILT-UP	B
REIMBURSABLE	B	TEST CELL REJECT	G	RAW	R
NON-REIMBURSABLE	C	WORK STOPPED	H		
EXCHANGE	D	WORK STARTED	J	**REPAIRABLE**	
		REMOVED TRANSIENT	K	CONDEMNED	C
LOSS		REMOVED OTHER	L	WITH QEC	F
ATTRITION	W	CHANGE IN MAINT	M	WITHOUT QEC	G
FOR PARTS	X	AWAIT DISPOSITION	N	MINOR OVHL	K
SALVAGE/DPRO	Y	ISSUE MAINTENANCE	P	MAJOR OVHL	L
OTHER	Z				
		CAB/ORG CHANGE	2		
NON-GAIN/LOSS		CONFIGURATION	6		
RECEIVED	R			**INSTALLED**	
SHIPPED	S	INSTALLED TRANSIENT	U	ACTIVE	A
TRANSFERRED	T	INSTALLED OTHER	V	INACTIVE	Z

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Figure 2–10. Air Force form 1534 extract.

Transaction codes

Transaction codes are divided into the following three types:

1. Gain transactions.
2. Loss transactions.
3. Non-gain/loss transactions.

Condition codes

Condition codes are also divided into the following three types:

1. Serviceable condition.
2. Reparable condition.
3. Installed condition.

A complete explanation of each transaction code and each condition code can be found in TO 00–25–254–1, *System Manual—Comprehensive Engine Management System (CEMS) (D042) Engine Status, Configuration and TCTO Reporting Procedures*.

Logical sequence

Status changes can't happen in random order; they must follow a logical sequence. An engine must be removed before it can be shipped. There usually are several codes that could follow an authorized code, so an engine must be installed before it can be removed because there are so many TCCs available. All authorized TCCs and available next logical TCCs can be found in TO 00–25–254–1.

CEMS/IMDS interface

During CEMS/IMDS interface, it is the SRAN engine manager's responsibility to ensure inputs to IMDS are made accurately and promptly. The SRAN engine manager is also held accountable for ensuring proper sequence actions are transmitted to the CDB.

023. Configuration management

Aircraft configuration management (ACM) provides unit managers with the capability to determine the actual versus approved configuration of an aircraft. The intent of the ACM subsystem is to ensure selected serially controlled TCIs are properly identified and loaded to the MIS database. The major concerns of ACM are accurate, approved part numbers, quantity per assembly, and next higher assembly items by WUC or logistics control number (LCN).

Principals of loading parts in the mission information system

When you load data, use only AF-approved part numbers, with an exact quantity per assembly (QPA) and next higher assembly (NHA) items by WUC. Maintenance management production personnel have overall responsibility for the MIS ACM subsystem. The following are a few steps that must be entered in the MIS:

- Assigning specific work centers, which perform remove and replace actions on controlled parts, with responsibility to update the system database. This includes checking and processing of the suspense validation records on a daily basis.
- Checking, during document reviews, the actual configuration data against the approved configuration.
- Annotating differences on the applicable AFTO Form 781, ARMS Aircrew/Mission Flight Data Document. Entering out-of-configuration life-sustaining TCIs (e.g., egress and life support) in the AFTO Form 781A, as a red X condition.
- Coordinate the daily resolution of configuration management notices.
- Provide GCSAS assistance to maintenance personnel.
- Identifying parts discovered as out-of-configuration during the PH or PE inspection at the post-dock meeting. Discrepancies must also be briefed at the daily production meeting and forwarded to the appropriate maintenance section for corrective action. Verified copies of the approved and actual configuration listing for an aircraft must be maintained in the maintenance management production section until the next scheduled PH inspection for that aircraft.

Identify approved configuration

Aircraft configuration information is organized into configuration tables for F–15s, F–16s, F–22As, CV22B, B–1s, and B–2s, which are pushed to each unit from REMIS to the IMDS-CDB as aircraft configuration changes occur. Maintenance personnel discovering a tracked part number that is not on the approved configuration table should send the part number for validation to the configuration specialist. Upon receipt of the part number, the configuration specialist approves or disapproves the new part number in REMIS. If approved, maintenance personnel load the part number in the IMDS. Because of a TCTO modification, the ALC or configuration specialist changes configuration tables in REMIS. The changed table is automatically pushed to the IMDS-CDB.

Once an updated or new configuration table is pushed to IMDS, the IMDS DBM processes screen 942, Actual Configuration Set-up, to update the MDS or particular aircraft. Once this is done, you can process screen 990, Configuration Tracked Item Inquiry.

Auditing of configuration records

The maintenance management production section is required to audit the weapon system configuration records. Its responsibilities for auditing and its minimum requirements are identified below.

Responsibilities

PS&D's responsibility is to assist maintenance personnel with the following:

- Validates installed items on aircraft that do not currently have an established configuration table using IMDS screen 810, Parts Tracked Inquiry.
- Coordinates the daily resolution of configuration management notices using IMDS screen 690, GCSAS Error Correction Main Menu.
- Provides GCSAS assistance to maintenance personnel.
- Verifies configuration items.
- Develops procedures for verifying configuration items during aircraft phases.

Minimum requirements

As a minimum, the following are required to be done:

- PS&D requests the IMDS DBM to process screen 942, Actual Configuration Set-up, using the ID number of the aircraft entering PH inspection.
- PS&D runs IMDS screen 990, giving a copy of this product to the phase dock chief at the pre-dock meeting for verification/correction in IMDS of all items out of configuration during the PH inspection. This document is turned in to PS&D during the post-dock meeting.
- The PS&D section requests the DBM to process screen 990 for the same tail number to verify corrections. Brief discrepancies at the daily production meeting and forward to the AMU for corrective action.

The PS&D section maintains the completed/verified copies of the output product until the next scheduled PH inspection for that aircraft.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

015. Time compliance technical order requirements

1. Who administers and manages the overall TCTO program as outlined in AFI 21–101 and MAJCOM publications?

2. Who determines all scheduling, tracking, and day-to-day monitoring of TCTOs?

3. Who date stamps the TCTO to reflect the date the hard copy is received?

4. Who is the individual or individuals responsible to research the total number of end items applicable to the TCTO?

5. Who must be primarily concerned with the status of TCTO completion?

6. Who ensures TCTO kits and parts are assembled before release?

7. After the monthly supply TCTO reconciliation meeting, who chairs a monthly TCTO review meeting attended by all TCTO owning and managing agencies?

8. The TCTO managing agency maintains the TCTO folder until it is rescinded in the applicable TO index, and then disposes of it according to which AF guidance?

016. Inspection requirements

1. Before an inspection package can be produced for your aircraft, what type of package must be initiated in IMDS?

2. Which TRIC and option is used to delete the entire JST, and associated inspections and time changes?

3. What is the format number used from TRIC JFI that produces outputs that display data loaded to a particular JST, and can be restricted by entering a beginning and ending stop sequence number, or can be run for a complete JST by leaving the sequence number blank?

4. Which TRIC provides a list of unit JSTs loaded to the database in four different output formats and only those JSTs for the unit making the input are listed?

5. Who reviews the planned aircraft inspection schedule and initiates an AF Form 2410 before the pre-inspection meeting?

6. Who prepares the AF Form 2410 in duplicate?

017. Automated time change records

1. What does the transaction of TRIC ISP allow you to do?

2. What TRIC lists all inspections, time changes, and TCTO requirements against a specific aircraft or PSN, and provides you with a JST number, equipment ID, due date, and JST narrative for an inspection?

3. List the five different formats available using TRIC COT (current operating time report).

4. What TRIC is used to create an automated work order for the inspection being scheduled?

5. Who must validate completed maintenance work orders for inspections using TRIC QVR, option 1?

6. What TRIC is used to load, change, and delete TCIs for all equipment, except engine components, to IMDS database?

7. Which TRIC establishes the installed-on relationship between two items of equipment?

8. What two maintenance actions are validated for time changes through suspense validation?

9. Which TRIC do you use to establish an item as a time change and assign the item a due date in IMDS?

10. Which TRIC provides the capability to retrieve historical data for a specific piece of equipment?

018. Equipment historical records

1. Who is responsible to file documents decentralized to sections maintaining installed-on equipment (e.g., fuel cell records, landing gear strut records, etc.)?

2. When aircraft are temporarily moved to operating locations away from the unit of assignment, what do you do with the aircraft records?

3. When do units in the AFR review the aircraft jacket files and associated decentralized records?

4. What guidance provides instructions to maintain inactive (pulled) AFTO 781-series forms?

5. If AFTO 781-series forms are missing, what type of suspense would you use when sending a missing forms letter to the appropriate section chief?

6. How often does a copy of an MIS automated history or equivalent get printed/downloaded (on a CD)?

019. Document reviews

1. The purpose of the ADR is to validate and correct any errors on what six items?

2. When do units that use the manual AFTO 781-series forms complete an ADR?

3. Who develops a checklist on what needs to be completed during a records check?

020. Aerospace vehicle distribution

1. What AFI establishes procedures for reporting the inventory, status, and utilization of vehicles?

2. Identify things can be lost as a result of errors in aerospace vehicle-associated reporting.

3. List the four items the aerospace vehicle-possessing organization reports.

4. Under the inventory reporting concept, you must account for all aerospace vehicles in the Air Force as long as they are assigned and possessed by what three agencies?

5. Who is responsible for the distribution of aerospace vehicles within a command?

6. Who is responsible for the aerospace vehicle distribution function at each base and unit level?

7. When an aircraft is broken and the status changes from FMC to PMC or NMC, what concept of reporting is this called?

8. Once an aircraft has been assigned, who reports condition status on the aircraft?

9. At the unit level, which two activities are responsible for different facets of AFI 21–103 reporting?

10. At the base level, who generates the report data that ultimately ends up at AFMC and the reporting unit's MAJCOM?

11. Who is responsible for the unit sortie and hour reconciliation?

12. What type of basis is used by the AVUM and AVDO to establish procedures on how to verify hours and sorties?

13. Who provides daily reports to the AVUM and AVDO for reconciliation?

14. What are the major possession reporting transactions?

021. Comprehensive Engine Management System

1. CEMS is a worldwide data collection system. What type of information does it collect and process?

2. How can CEMS information be requested?

3. At base level, what can CEMS products be used to manage?

4. What is the purpose behind the CDB providing initialization data to the base-level segment of CEMS?

5. List the types of tracking methods for cycle data used to accumulate hour and event data.

6. Give five examples for when accumulated hour and event data is collected at regular intervals.

7. What are the two meter boxes currently being used on engines?

8. What type of system is slowly replacing meter boxes used on older aircraft?

022. Processing Comprehensive Engine Management System status and inventory

1. In what quarterly months is a physical inventory required for all accountable assets at the base level?

2. What must you complete anytime there is a change of the SRAN engine manager?

3. What types of changes are to be annotated on the quarterly inventory report?

4. Who is required to complete the engine TCTO quarterly reconciliation?

5. When the TCTO reconciliation list is received, engine management produces an IMDS TCTO status listing for engines, modules, and components that reflect the TCTOs for that base's assets using what TRIC?

6. If no discrepancies are found during the TCTO reconciliation, what type of report do you send to the CDB?

7. At the base level, a SRAN engine manager is assigned to control the collection of data affecting engine status and for the purpose of processing the data off-base to where?

8. The current status of an accountable item is identified by using what type of code?

9. Transaction codes are divided into what types of transactions?

023. Configuration management

1. What is the intent of the ACM subsystem?

2. What is the responsibility of the maintenance management production personnel during a PH or PE inspection?

3. Explain how aircraft configuration information is organized for F–15, F–16, and F–22As fighter aircraft?

4. What product is given to the phase dock chief at the pre-dock meeting for verification/correction in IMDS of all items out of configuration during the PH inspection?

Answers to Self-Test Questions

008

1. The capability of maintenance to support this contract.
2. Check the maintenance and aircraft capability to support the annual plan.
3. The number of times an aircraft must fly per month/year to meet the annual requirements.
4. Use as much as required, ensuring seasonal variations are considered.
5. Each MAJCOM.
6. NLT 25 days before the beginning of the quarter.
7. (1) Known special missions, (2) PDM schedules, (3) HHQ commitments, (4) lateral command support requirements.
8. NLT 14 days before the next quarter.
9. To ensure proper and effective use of resources.
10. Current month and next two months.
11. Your MAJCOM.

009

1. Preventive maintenance.
2. NLT the second weekly scheduling meeting of the month.
3. The group and wing CCs.
4. To compensate for non-unit controlled factors.
5. (Number of sorties) divided by (1 minus the attrition factor).

010

1. The weekly schedule.
2. All the known maintenance, such as dock inputs, arrival/departure of PDM aircraft, TCTOs, training requirements, corrosion control, wash schedules, and so forth.
3. Any four of the following:
   (1) Aircraft takeoff and landing times.
   (2) Configuration requirements.
   (3) Munitions requirements.
   (4) Fuel loads.
   (5) Special or peculiar mission support requirements.
   (6) Alert requirements.
   (7) Exercise vulnerability.
   (8) Deployments.
   (9) Off-base sorties.
   (10) On-equipment training requirements.
   (11) Other special requirements.
4. Selecting the proper aircraft to fly a specific mission.
5. Engine and equipment failures.
6. PS&D.

011

1. Unscheduled.
2. To inform the controlling agency and PS&D of discrepancies on your assigned aircraft.
3. (1) Required launch time, (2) mission length, (3) ETIC, and (4) date of a scheduled maintenance action or hours remaining to scheduled maintenance action.

4. Added or deleted missions; failure of the aircraft or equipment to perform its assignment; component or system failures; and non-availability of flight crews.
5. Something other than what was planned.
6. Your MAJCOM.
7. Ground deviation.
8. Addition, cancellation, early takeoff, ground abort, late takeoff, and spare.
9. Air deviation.
10. Air abort; air abort, IFE; early landing; IFE; late landing.
11. (1) Daily maintenance meetings, (2) telephone, (3) e-mail, or (4) letter.

012

1. EWO.
2. Contingency.
3. PS&D, in conjunction with the AMU, wing weapons manager, and MXS personnel.
4. The hour sequence of all actions necessary to launch aircraft when required by EWO or contingency.

013

1. To achieve maximum use of components consistent with the economic operation of aerospace equipment without jeopardizing flight or operational safety.
2. Age-related.
3. In conjunction with the HPO, HSC, PH, PR, MIN or MAJ ISO, scheduled PDM, and so forth nearest to the replacement date.
4. (1) Select calendar and hourly TCIs.
   (2) Select calendar time change life-sustaining items.
   (3) Select CADs/PADs.
5. Expiration of DOI (service life).
6. 31 January 2024.

014

1. All aircraft assigned as of 15 June.
2. October, January, April, and July.
3. Chapter 4; Table 4–1.
4. 1 through 6.
5. 1 August.
6. No earlier than 60 days, but not later than 45 days.
7. 90 to 120.
8. QVR, Suspense Validation.

015

1. PS&D.
2. The owning scheduling agency (PS&D, EM, AGE, armament, munitions, and PMEL).
3. QA.
4. The appropriate TCTO managing agency (PS&D, EM, or munitions).
5. Maintenance managers.
6. The supply TCTO monitor.
7. PS&D.
8. RDS.

016

1. Job flow.
2. JFP—job flow package delete.
3. 1.
4. JML.
5. PS&D scheduler.
6. PS&D scheduler.

017

1. Load, change, delete, and inquire about inspections, time changes, and profiles for all equipment, except engine components, to the IMDS database.
2. ITF—inspection/time change/TCTO forecast.
3. (1) Equipment ID for a specific MDS, TMSM, or end-item WUC; (2) all data serial numbered items for a specific part number; (3) a single equipment ID and all engines installed on that equipment; (4) a single equipment ID and (5) all items installed on that equipment; and operating time and cycles for the J–79 series engines.
4. ZSC–scheduled maintenance.
5. PS&D scheduler.
6. ISP—inspection load/change/delete/inquiry all equipment, except engines.
7. IAE—equipment installation.
8. Equipment removal and equipment installation.
9. ISP—inspection load/change/delete/inquiry all equipment, except engines.
10. SHD—significant historical data.

018

1. The owning work center (e.g., fuel systems section for fuel cell records).
2. Send only those documents necessary to ensure safety of flight and current aircraft status to the temporary location.
3. The same as active Air Force units, semi-annually.
4. AF RDS.
5. 5-duty days.
6. Annually.

019

1. Airframe and engine operating times and cycles, TCTO documentation, TCI component operating times, time remaining to the next inspection, backordered supply document numbers, and open and deferred discrepancies.
2. At least every 30 days.
3. PS&D.

020

1. AFI 21–103.
2. Funding, manpower authorizations, and supplies.
3. (1) The hours it possesses the aerospace vehicle, (2) changes in aerospace vehicle possession, (3) status conditions that affect an aerospace vehicle's ability to perform assigned missions, and (4) flying hours and sorties.
4. The Air Force, ANG, or AFR units.
5. The MAJCOM AVDO.
6. PS&D.
7. Exception.

8. MOC.
9. MOC and maintenance management production.
10. Unit AVDO.
11. AVUM and AVDO.
12. Daily, monthly, and yearly.
13. MMA.
14. Gain, loss, and termination.

021

1. USAF turbine engines and modules.
2. On-line inquiries or background reports.
3. Time changes, inspections, and TCTOs on the engines.
4. To load engine, module, and tracked component records to IMDS.
5. CCY, MC, and LCF.
6. For each flight or the last flight of the day, after an attempted flight (if engines were started), after each ground or test cell operation, when serially controlled items are removed or installed, and each time an engine is removed or installed.
7. EHR and ETTR.
8. Diagnostic.

022

1. December, March, June, and September.
2. Inventory.
3. TMS, serial number, TCC, transaction date, and reporting sequence number.
4. All CEMS-reporting activities, except depots.
5. STL—Serial Number Detail Listing.
6. Negative.
7. CEMS CDB.
8. Two-character.
9. Gain, loss, and non-gain/loss.

023

1. To ensure selected serially controlled or TCIs are identified and loaded to the MIS database.
2. Identify parts discovered out-of-configuration.
3. Into configuration tables.
4. PS&D provides a copy of IMDS screen 990, Configuration Tracked Item Inquiry.

Complete the unit review exercises before going to next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to AFCDA.

12. (008) Who devises procedures to ensure the maintenance activity receives its quarterly allocation of flying hours?
    a. Wing commander.
    b. Operations group.
    c. Major command.
    d. Logistics group.

13. (008) As a minimum, the long-range plan shows the known maintenance requirements for the
    a. prior, current, and next month.
    b. current and next two months.
    c. next three months.
    d. current month.

14. (008) When should additional maintenance requirements (e.g., time compliance technical order programs, programmed depot maintenance schedules, and scheduled inspections) be plotted on the scheduling boards and on an Air Force Form 2401, Equipment Utilization and Maintenance Schedule?
    a. No later than (NLT) the 15th of the month.
    b. At the beginning of the current month.
    c. NLT the 25th of the month.
    d. As they are received.

15. (009) When maintenance receives the operational requirements, who notifies operations of the maintenance capability?
    a. Maintenance operations center.
    b. Maintenance data systems analysis.
    c. Aircraft maintenance unit supervision.
    d. Plans, scheduling, and documentation.

16. (009) Once the monthly maintenance plan is developed, which commander reviews it for final approval?
    a. Maintenance group.
    b. Operations group.
    c. Vice wing.
    d. Wing.

17. (009) The monthly maintenance plan is prepared by maintenance
    a. plans, scheduling, and documentation.
    b. data systems analysis.
    c. operations center.
    d. supervision.

18. (010) The purpose of the weekly utilization and maintenance plan is to
    a. present requirements for the current week.
    b. present operational requirements for the current week.
    c. refine the monthly plan and provide additional details to it.
    d. provide a complete detailed listing of all deviations from the previous week.

19. (010) Once published, the weekly schedule is used to
    a. provide the final planning schedule that must not be deviated from in any way.
    b. provide the final planning guide for maintenance and operations.
    c. indicate the basis for developing the attrition factor.
    d. develop and refine a daily schedule.

20. (011) Which organization chooses the debriefing option your unit uses?
    a. Logistics group.
    b. Major command.
    c. Maintenance group.
    d. Operations squadron.

21. (011) The purpose of daily planning is to verify the daily portion of the weekly maintenance plan with
    a. the maintenance data systems analysis section.
    b. maintenance personnel.
    c. the major command.
    d. operations.

22. (011) Which organization determines criteria to measure and evaluate your unit's mission accomplishment in the weekly flying schedule?
    a. Operations squadron.
    b. Operations group.
    c. Major command.
    d. Wing.

23. (012) When a sortie generation is finished, who attends a post exercise/contingency "hot wash" meeting to evaluate flow plans for changes or improvements?
    a. Debrief analyst.
    b. Aircraft crew chief.
    c. Maintenance data systems analysis.
    d. Plans, scheduling, and documentation.

24. (013) When are accessories designated as time change items (TCI) replaced?
    a. As directed by the operations group commander.
    b. When the aircraft is at depot.
    c. At specified intervals.
    d. When worn out.

25. (013) What conference reviews the time change items (TCI) that may be candidates for depot change because of accessibility or other factors?
    a. Annual workload.
    b. Annual time change.
    c. Time change forecast.
    d. Time change replacement.

26. (014) When cartridge-actuated device/propellant-actuated device items are forecasted annually to the item manager, what month and day is the forecast submitted?
   a. 1 August.
   b. 1 October.
   c. 30 October.
   d. 30 September.

27. (014) The aircraft maintenance unit (AMU) plans, scheduling, and documentation section orders noncartridge-actuated device/propellant-actuated device or engine time change items up to 60 days and not less than 10 days prior to the need date on an Air Force Form
   a. 2005.
   b. 2407.
   c. 2410.
   d. 2444.

28. (015) Plans, scheduling, and documentation (PS&D) monitors time compliance technical order (TCTO) status and briefs unaccomplished TCTOs within how many days of grounding at the maintenance group level each week?
   a. 60.
   b. 30.
   c. 75.
   d. 45.

29. (016) What Integrated Maintenance Data System (IMDS) transaction identification code (TRIC) provides the capability to query the database to obtain information pertaining to job standards and the ability to query a job flow package using any three of the available formats?
   a. TDI.
   b. JFF.
   c. JFI.
   d. JFP.

30. (016) The long-range inspection dock forecast for all assigned aircraft is monitored daily and, *as a minimum*, this forecast includes the
   a. past week, plus current week.
   b. past month, plus current month.
   c. current week, plus the next two weeks.
   d. current month, plus the next two months.

31. (016) Which Air Force (AF) or AF technical order (AFTO) form is used as an aid to plan and conduct the pre-inspection meeting?
   a. AF Form 223.
   b. AF Form 2410.
   c. AFTO Form 349.
   d. AFTO Form 2001.

32. (017) Which Integrated Maintenance Data System (IMDS) transaction identification code (TRIC) is used to load, change, delete, and inquire about inspections, time changes, and profiles for all equipment except engines, and establishes inspection or time change requirements for an item of equipment?
   a. TCI.
   b. JML.
   c. JFF.
   d. ISP.

33. (017) What background Integrated Maintenance Data System (IMDS) transaction identification code (TRIC) provides the capability to list maintenance requirements and forecasts of time changes and inspections for equipment specified in the input?
    a. PRA.
    b. JML.
    c. TDI.
    d. COT.

34. (017) What Integrated Maintenance Data System (IMDS) transaction identification code (TRIC) provides the current operating time for equipment and parts?
    a. JML.
    b. PRA.
    c. COT.
    d. TDI.

35. (018) Which item is required to be kept in the aircraft jacket file?
    a. Morning and afternoon maintenance production meeting times.
    b. Three years of automated suspense records.
    c. Air Force Technical Order Form 95.
    d. Flight crew duty day schedules.

36. (018) A review of the aircraft jacket files and associated decentralized records is completed
    a. semi-annually.
    b. monthly.
    c. weekly.
    d. daily.

37. (018) Which Air Force technical order (AFTO) form is used to document significant historical maintenance actions?
    a. 34.
    b. 43.
    c. 55.
    d. 95.

38. (018) When transferring a piece of equipment, the Air Force Technical Order (AFTO) Form 95 is forwarded
    a. with the equipment.
    b. to the applicable overhaul depot.
    c. to the plans, scheduling, and documentation section.
    d. to the item manager handling that applicable stock class of equipment.

39. (019) An aircraft document review (ADR) is completed for units using fully automated Air Force Technical Order (AFTO) 781-series forms *at least* every
    a. 30 days.
    b. 40 days.
    c. 50 days.
    d. 60 days.

40. (019) For cannibalized aircraft, you conduct an aircraft document review (ADR) *at least* every
    a. 30 days.
    b. 45 days.
    c. 50 days.
    d. 60 days.

41. (020) Who assigns and distributes aerospace vehicles throughout the United States Air Force (USAF)?
    a. Unit aerospace vehicle distribution officer (AVDO).
    b. Major command AVDO.
    c. Headquarters USAF.
    d. Wing AVDO.

42. (020) Which aerospace vehicle distribution officer (AVDO) is the *primary* point of contact for aircraft inventory and status reporting within an organization?
    a. Unit AVDO.
    b. Major command (MAJCOM) AVDO.
    c. Air Force Materiel Command (AFMC) AVDO.
    d. Headquarters United States Air Force (HQ USAF) AVDO.

43. (020) When an aircraft is transferred from one unit to another, who is responsible for the aerospace vehicle distribution officer (AVDO) function or inventory?
    a. Unit aerospace vehicle utilization monitor.
    b. Plans, scheduling, and documentation.
    c. Headquarters United States Air Force.
    d. Major command AVDO.

44. (020) What are the three major possession reporting transactions?
    a. Transfer, gain, and loss.
    b. Loss, transfer, and crash.
    c. Termination, loss, and gain.
    d. Gain, termination, and crash.

45. (021) For what two major types of engine data does the base-level segment of the Comprehensive Engine Management System (CEMS) serve as the initial collection point?
    a. Component operational and inspection.
    b. Inspection and time change replacement.
    c. Engine status and component operational.
    d. Engine status and time change replacement.

46. (021) What Comprehensive Engine Management System (CEMS) application is used for requesting products from the database, and browsing, submitting, and viewing products out of CEMS?
    a. Time Sharing Option.
    b. Equipment Status Update.
    c. Required Item Installation table.
    d. Information Management System.

47. (021) What is the purpose of collecting accumulated hour and event data on engines?
    a. Provide feedback to the manufacturer on how the engine is performing.
    b. Aids the major command in deciding the frequency of life limited parts.
    c. Enable engine managers to know the condition of engine parts at all times.
    d. Shows the operations group commander how the engines are being used.

48. (022) The Comprehensive Engine Management System (CEMS) central database quarterly inventory report is prepared and distributed on what day of the reporting month for that quarter?
    a. 5th.
    b. 10th.
    c. 15th.
    d. 20th.

49. (022) How often is the database reconciliation listing for time compliance technical order (TCTO) status completed on engines?
    a. Monthly.
    b. Quarterly.
    c. Annually.
    d. Semi-annually.

50. (022) The annotated copy of the time compliance technical order (TCTO) reconciliation report must be mailed to the Comprehensive Engine Management System (CEMS) central database within how many days from the date of the report?
    a. 10.
    b. 20.
    c. 30.
    d. 40.

51. (023) In aircraft configuration management (ACM), what type of data is loaded to track aircraft configuration?
    a. Job control numbers.
    b. National stock numbers.
    c. Stock record account numbers.
    d. Air Force-approved part numbers.

52. (023) In aircraft configuration management (ACM), who makes changes to the configuration tables in the Reliability and Maintainability Information System (REMIS) when required by a time compliance technical order (TCTO) modification?
    a. Phase dock chief.
    b. Maintenance personnel.
    c. Configuration specialist.
    d. Host database management.

53. (023) In auditing configuration records, the plans, scheduling, and documentation (PS&D) section validates installed items that do *not* have an established configuration table by running
    a. an inquiry using screen 810, Parts Tracked Inquiry.
    b. a report using screen 892, Non Tracked Equipment Listing.
    c. a transaction using screen 352, Parts Turn-Around Transaction.
    d. an inquiry using screen 189, Parts Status, Location, and Estimated Job Completion Inquiry.

Please read the unit menu for unit 3 and continue ➔

Unit 3. Technical Order Management

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TECHNICAL ORDERS are known as the keystone of the support bridge in the acquisition process of new weapon systems or equipment. TO 00–5–1, *Air Force Technical Order System*, governs Air Force technical orders (AFTO). The TO is the only link between the people who design the weapon system and those who operate and maintain it. The AFTO system is established as the only official medium for disseminating technical information, instructions, and safety procedures pertaining to AF systems and equipment. Notice that not all TOs are written on equipment or material; some are on general subjects (e.g., the TO system). A TO constitutes a military order issued in the name of the Chief of Staff of the Air Force (CSAF), and by the order of the Secretary of the Air Force (SECAF). Therefore, TO compliance is mandatory. In this unit, you will learn more about TOs, including the different types. In addition, you will learn about the administration and management of TOs and associated forms.

3–1. Technical Order System

There is no doubt about it, you belong to one of the largest and most diverse organizations in the world. Although it's an enormous organization, everyone must know how to perform their duties in a specific way. What do you think would happen if every section, shop, or technician were free to make up their own procedures for doing their jobs? It's easy to see this simply cannot be allowed to happen; instead, there must be a common core of directives for everyone. To meet this demand, the TO system was developed. In this section, we discuss the management aspects of the TO system as it applies to the maintenance complex. The intention is to provide basic guidance for TO users and account custodians in the maintenance environment.

024. The technical order system

A technical order, as the title implies, contains technical information issued to tell you how to inspect, install, operate, maintain, modify, and overhaul equipment and material maintained by the Air Force. TOs provide the means for communicating between the manufacturer and the user in the field.

Scope of technical orders

All AF systems and equipment, except those identified in AFPD 63–1 and 20–1, *Integrated Life Cycle Management*, are operated and maintained according to procedures described in the TOs. The Air Force does not field systems without verified TOs to support their operation and maintenance. You can recommend changes to the TO system by following the procedures outlined in 63–1 and 20–1 and to individual TOs by following the procedures in TO 00–5–1.

Types of technical orders

There are over 70,000 TOs used throughout the Air Force for a variety of different jobs and tasks. All of these TOs fall into one of five major types (fig. 3–1) of TOs authorized for use. These types include operations and maintenance (O&M) TOs, methods and procedures TOs (MPTO), index type, abbreviated, and time compliance technical orders (TCTO).

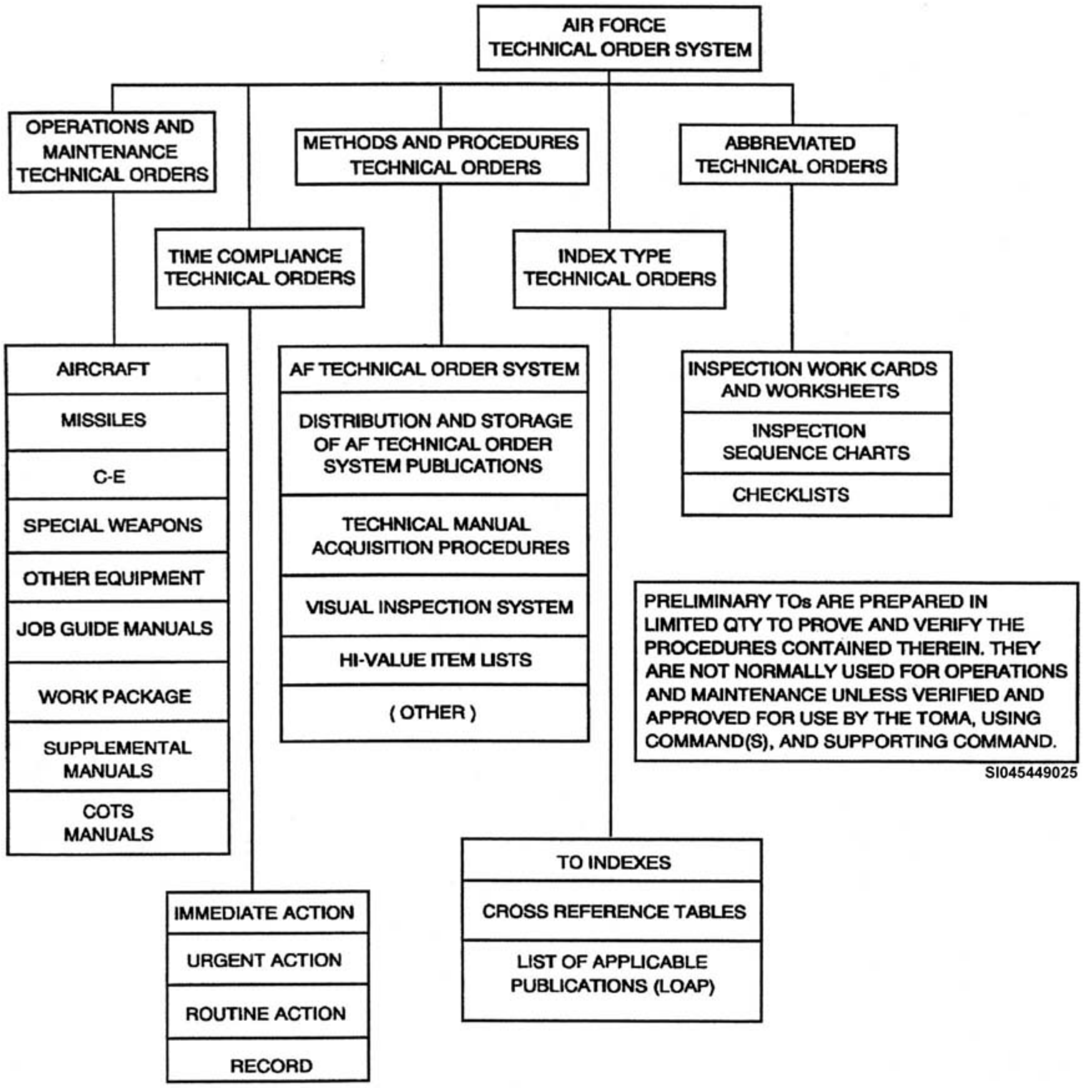

Figure 3–1. Types of technical orders.

Operations and maintenance technical orders

O&M TOs are designed to meet the needs of personnel engaged in or being trained to operate, maintain, service, overhaul, install, and inspect items of equipment and material. The O&M TO may deal with a specific aircraft, missile, C-E system, or end-item of equipment, or may be a general TO dealing with a subject area (e.g., welding or painting procedures). The technical manual (TM) type of O&M TO is somewhat like the manual or handbook you get when you buy a fine camera, power lawnmower, or outboard motor; the difference is the TM is usually more detailed and complete. When the equipment is small and simple, all the information might be in one TM. When the TOs for any system are too large to use easily, there may be a separate TM for each type of maintenance. On complex weapon systems (e.g., aircraft or missiles), the systems are divided further. Each division is called a section and has a unique TO number. *Sectionalized publications* like these are easier to handle and enable specialists to locate technical data more rapidly.

Methods and procedures technical orders

MPTOs establish policies, and detail safe methods and procedures for preventive maintenance, PR inspections, and AF product improvement. Therefore, the MPTO differs from a TM, which deals with specific aircraft, missiles, or other items of equipment. Once published, MPTOs tell the "what, when, why, and how" of general subjects. An easy way to identify MPTOs is they almost always start with 00.

Index type technical orders

These TOs provide a means of selecting needed TOs, show the status of all TOs, and, in certain instances, group the TOs pertaining to specific items of equipment. The following table gives a brief description of the types of indexes issued. The second number in the index TO number indicates the type of index.

Index Type Technical Orders	
Type	**Description**
TO catalogs	The TO catalog is a database application containing a combined numerical listing of TOs applicable to all categories of equipment, classes of publications, and data about the publication.
TO indexes	There are separate indexes covering special classes of TOs (e.g., nuclear weapons support). This type of TO includes numerical and alphabetical indices, and cross–reference tables.
Lists of Applicable Publications (LOAP)	These TOs provide a listing of all TOs applicable to a specific military system and related commodities. These TOs facilitate selection of, or familiarization with, publications for the system covered.

Abbreviated technical orders

Obviously, it is difficult to carry around bulky TMs for instructions on various tasks, such as inspecting or lubricating equipment; therefore, checklists, inspection workcards, and sequence charts were developed in condensed form as abbreviated TOs. Use these to make your job a little easier.

Time compliance technical orders

Have you ever had your car recalled by a car manufacturer? The car manufacturer discovers through test, research, and the consumer that a particular model of car has some type of defect. After the manufacturer discovers this defect, it sends out notices for the car. The recall notice includes the make, model, and year of the cars affected. In the Air Force, the TCTO is virtually the same as a car recall. Through test, research, and the user of the equipment, the AFMC or the manufacturer discovers a defect in the equipment or a need to modify it. After they discover the defect or decide to modify a component, AFMC issues a TCTO. TO 00–5–15, *Air Force Time Compliance Technical Order Process,* governs the TCTO process. TCTOs must be completed within a specified amount of time. TCTOs give instructions for imposing temporary flight restrictions on a particular type of aircraft, performing a one-time inspection of aircraft or equipment, or modifying aircraft or equipment. Like the recall notice, the TCTO identifies the type, model, and year of affected equipment. Determine the time allowed to complete a TCTO by the degree of danger caused by the discovered condition. The three TCTOs authorized for use are as follows:

1. Immediate action.
2. Urgent action.
3. Routine action.

How technical orders are numbered

Sometime during your early school years, you went to the school library for the first time. It may have been a confusing experience at first, but soon you learned books in a library had a title and number. The title, of course, was determined by the author and printed on the book by the printer. The book also had a number! At first, you probably wondered what the number meant, and who, if anyone, could understand it. Well, the librarian usually determined what number was placed on the book and put it there. The librarian used a system, created before he or she became a librarian, to compose the exact number placed on each book.

Unlike books in a school library, the books in the TO system have their title and number printed on them when they are received. The title describes, thoroughly and briefly, the contents of the book. A comparatively simple system has been devised which that makes use of numbers, letters, dashes, and parentheses, to describe the contents of TOs. Each TO has an identifying number; a numbering specialist in the USAF TO system assigns the number in accordance with TO 00–5–18, *USAF Technical Order Numbering System*. TOs have assigned numbers to do the following:

- Identify categories or groupings.
- Provide a means for users to identify TOs.
- Provide a means to identify and establish requirements for required distribution of TOs.
- Provide a sequence for filing TOs.

Numbering system

TO numbers are composed of groups separated by dashes, and each group is further divided into parts (e.g., 1F–16C–6). The number of parts within any group varies according to the TO data being numbered in a specific category. Each part of a group consists of one or more numeric characters, or one or more alpha characters. A total of seven groups may be used in the TO numbering pattern. TO data is identified, in most categories, by using only the first three or four basic groups. The remaining groups are primarily used to extend the TO number to identify specific sections of sectionalized TOs; supplemental manuals; and supplement, checklist, and workcard sequence numbers.

Each group, or part, of a TO number has a definite meaning. The first part identifies the category of the TO. In this career development course, we focus the discussion of TOs on the categories you are most likely to use. The first category you should be familiar with is category 1, aircraft TOs. Now, let’s break down an aircraft TO number, starting with the first group. You already know the first number of the TO gives the category. A letter follows the first number, identifying the major group of equipment (e.g., B for bombers, F for fighters, or C for cargo aircraft). The first group of a category 1 TO number, including parts 1 and 2, are listed in the following table for each type of aircraft:

Category	Type of Aircraft
1	General
1A	Attack
1B	Bomber
1C	Cargo
1E	Electronic
1F	Fighter
1H	Helicopter
1L	Observation
1T	Trainer
1U	Utility

The second group is a further breakdown of the first, and identifies a specific type or model of the major group of equipment. Examples of this part include 52 (1B–52), 15 (1F–15) or 130 (1C–130).

The second part can also show a further breakdown by identifying the series of the equipment (e.g., A, B, C, etc.). The following table shows an example of the first two groups put together:

TO 1B–52D	Bomber Aircraft, Model 52, series D
1	Category 1 TO (aircraft)
B	Basic mission, bomber
–52	Aircraft production model
D	Aircraft production series

This numbering system is also true for engines. The letter following the first number identifies the type of engine as a jet (J), rocket (K), or reciprocating (R). The second group gives a further breakdown as to the model of the engine. The following table shows an example:

TO 2J–1J	Jet Engines, general
2	Category 2 TO (airborne engines and associated equipment)
J	Jet engines
–1J	General

The third group of a TO number primarily identifies the type of TO, instruction, or procedure (for general TOs, this group identifies a specific TO). This group can use one or two parts. Part one consists of one or more numbers reserved to indicate a specific type of TO. Part two consists of alpha characters indicating a series of checklists, workcards, supplements, and other functions.

Let's look at an example of a TO with three groups in the following table:

TO 1B–52D–1	
1	Category 1 TO (aircraft)
B	Basic mission, bomber
–52	Aircraft production model
D	Aircraft production series
–1	Reserved for flight manuals

When a TO has four groups, the fourth group identifies the section. It also identifies a supplemental manual or indicates the sequence number of specific TO data in a series of inspections, supplements, or functions. Let's look at a breakdown of TO 1C–130A–2–3 in the following table:

TO 1C–130A–2–3	
1	Category 1 TO
C	Basic mission, cargo or transport
–130	Aircraft production model
A	Aircraft production series
–2	Reserved for maintenance instructions
–3	Identifies a section covering hydraulic systems

If a TO number is extended by sectionalizing or establishing supplemental numbers, the use of five or more groups may be necessary to complete the TO number. Group five can consist of one to two parts used in the same manner as group four. Let's breakdown TO 1F–16C–2–14–1 in the following table:

TO 1F–16C–2–14–1	
1	Category 1 TO
F	Basic mission, fighter
–16	Aircraft production model
C	Aircraft production series
–2	Reserved for maintenance instructions
–14	Identifies a section for integrated electronic central radar beacon system, speech security system
–1	Identifies the first supplement manual

NOTE: As we mentioned earlier, the examples used here are for category 1 TOs. For complete instructions and explanations of all category TOs, consult TO 00–5–18.

Figure 3–2 shows a TO number breakdown for a general category and a category 1 TO.

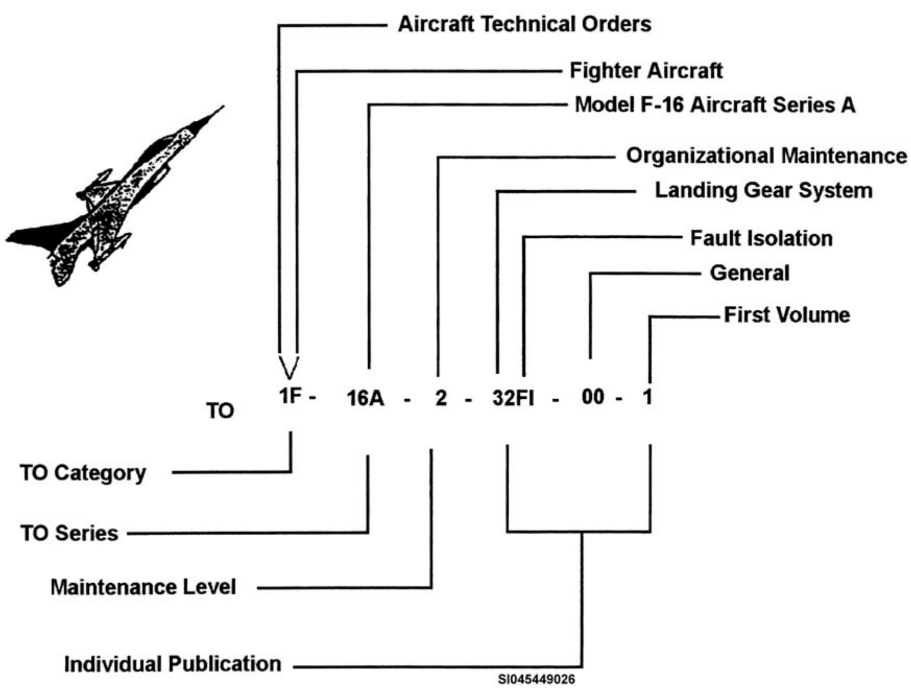

Figure 3–2. Technical order number breakdown.

Technical order catalog, indexes, and cross-reference tables

Before we end the discussion of the TO numbering system, let's talk a little about the TO catalogs, indices, and cross-reference tables. You can use these tools to help you find a particular TO. All categories of equipment in the Air Force are listed in the AF TO catalog. The catalog contains numerical indices and cross-reference tables. The catalogues are numbered in TO category "0," with the numerical catalog and indices in sub-group "–1," and the cross-reference table in sub-group "–4." The numerical indices list all TOs by category of equipment (e.g., all aircraft are in category 1, engines are in category 2, and landing gear components and associated equipment are in category 4).

Cross-reference tables list all the TOs applicable to a common qualifier. If you know the part number of a particular piece of equipment, you can locate the applicable TOs by doing a search by part number. Since TO catalog, indices, and cross-reference tables are constantly supplemented, they give us a way to keep our TOs current. The more you work with TOs, the more confident you will become; eventually, you will be able to locate any information you need easily.

025. Technical order management

The proper and efficient management and administration of the TO process is important to ensure that accurate, current, and clear technical guidance is available and used by all maintenance organizations and personnel. In this lesson, we will discuss the TO management duties and responsibilities at base level.

Technical order distribution office

The GP/CC establishes the technical order distribution office (TODO) to administer organization TO requirements at the group level, in support of assigned group missions and activities. Each unit appoints and trains an alternate for each TODO and technical order distribution account (TODA) custodian. For applicable TO policy and procedures, reference TO 00–5–1, and AFPD 63–101/20–101, *Integrated Life Cycle Management*.

Group technical order distribution activities

The three levels of TO distribution activities that provide basic TO system support to group-level AF organizations are described in the following table:

Group TO Distribution Activity Level	Functions
Group lead TODO (normally assigned to the QA office)	Oversees the TO administrative services being provided by the other TODOs in the group and advises the group CC on matters concerning availability of TOs in the organization. Assists other organization TODOs with resolution of TO availability and distribution problems. Assists organization personnel to establish new TODO TM accounts when required by mission changes, expanded TO library requirements, or unit deactivation.
Unit TODO	Submits AFTO Form 43, USAF Technical Order Distribution Office (TODO) Assignment or Change Request, to establish, change, or cancel TODO TM accounts. Completes and maintains other documentation required to establish TODO and corresponding TM accounts. Establishes and maintains TO requirements and distribution records for the TODO main library (if applicable) and for sub-account libraries. Establishes and services TODAs in organization shops or offices where one or more TOs are required to accomplish assigned missions.
TODA	Obtains an account number from the TODO. Notifies the TODO promptly of any personnel changes or deactivation of the TODA. Establishes TODA sub-accounts as required. Conducts and documents routine TO catalog checks and annual TO library inventories. May delegate routine checks and library inventory to the TO library custodian.

NOTE: There are other functions and responsibilities each level of TO distribution activities must perform. These functions can be reviewed in TO 00–5–1 and AFI 63–101/20–101.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

024. The technical order system

1. Why are TOs issued?

2. What are the five major types of TOs?

3. What type of publication enables specialists to locate technical data quicker?

4. Which TO is published to tell the "what, when, why, and how" of general subjects?

5. Under what major type of TO do checklists, inspection workcards, and sequence charts fall?

6. What type of TO is an urgent action TO?

7. What does each part of a TO number group contain?

8. What does the first part of a TO number identify?

9. When a TO number has four groups, what does the fourth group identify?

025. Technical order management

1. What is the responsibility of the GP/CC regarding TO management?

2. What are the levels of TO distribution activities that provide basic TO system support to group-level AF organizations?

3. Who assists other organization TODOs with resolution of TO availability and distribution problems?

3–2. Time Compliance Technical Orders

TCTOs are similar to a vehicle manufacturer's recall of a certain vehicle make and model. The Air Force's way of recalling equipment is to issue a TCTO to provide instructions for modifying military systems or commodities within specified time limits, initiate special one-time inspections, or impose temporary restrictions on systems or commodities. TCTOs, as the name implies, must be completed within a specified amount of time. The time allowed to complete a TCTO is determined by the degree of urgency or danger caused by the discovered condition. This degree is determined by engineers capable of making such determinations for your type of aircraft or equipment. In this section, we will discuss the general purpose and different types of TCTO.

026. Purpose of time compliance technical orders

TCTOs are the authorized method of directing and providing instructions for modifying military systems and end items (other than T modifications), and performing or initially establishing one-time inspections. TCTOs are grouped according to the urgency of the instructions. The urgency determines how quickly the TCTO must be completed.

Time compliance technical order policy

TO 00–5–15 prescribes policies and procedures for the AF TCTO process. Other publications that apply in specific areas remain the source document for their particular processes. Examples of these include Air Force Manual (AFMAN) 23–122, *Materiel Management Procedures*; AFI 23–101, *Air Force Materiel Management*; Air Force Handbook (AFH) 23–123, *Materiel Management Handbook*. TO 00–5–15 repeats coverage, as necessary, to assist management; references to the source documents are made throughout this text as appropriate. The procedures described in this TO serves as a guide for MAJCOM-approved modifications.

HQ USAF/ILMM (Directorate of Maintenance, Maintenance Management Division) is responsible for establishing basic TCTO policy, and approving policy and procedure changes. Recommended changes are submitted via the AFTO Form 22, Technical Manual (TM) Change Recommendation and Reply. The TO manager reviews submissions and recommends approval or disapproval. When the recommended change involves policy, it must also be reviewed by the Air Force Centralized Technical Order Management (CTOM) committee, and approved by HQ USAF/ILMM. The MAJCOM includes field operating agencies (FOA) and direct reporting units (DRU).

Document modifications

TCTOs are used to document all permanent modifications, update changes, and retrofit changes to standard AF systems and commodities. TCTOs are authorized by TO 00–5–1. They provide instructions for modifying military systems or commodities within specified time limits, initiate special "one time" inspections, or impose temporary restrictions on systems or commodities. TCTOs may be used to notify affected personnel of computer program identification number item changes.

Software-only changes

Software-only changes to baseline computer programs are normally announced by TCTO. When multiple CPINs apply to a series of system TOs, they may be included in one TCTO. Software-only changes to computer programs used exclusively by activities collocated at the same ALC do not require a TCTO unless otherwise directed by the operational/support configuration management procedures.

Alternative methods used to announce software-only changes include message, letter of transmittal, or electronic bulletin board. If these methods are used, the single manager (SM), Computer Program Identification Numbering System (CPINS), or time change manager (TCM) must coordinate procedures with the affected using commands, and establish positive measures to ensure configuration control of the entire inventory. TCTO numbers and data codes are used with these alternative methods.

Applicable organizations

The TCTO process applies to all AF agencies, including the AFR and ANG. It does not apply to CE or medical equipment, or general-purpose (GP) vehicles. Special-purpose vehicles (e.g., fire trucks, 463L loaders, etc.) are modified using the TCTO process. Vehicular TCTOs are exempt from the Configuration Control Board (CCB) process. Generally, TCTOs are required only after the Air Force assumes configuration control of a system or commodity. Engineering change proposals (ECP) control modifications prior to this point.

P modification

Modifications may be of two types, P or T. Only P modifications are documented through TCTOs. P modifications may change, add, or delete any configuration item. Test bed aircraft modified with T or P changes issued as TCTOs, which affect aircraft emergency rescue procedures, must be reported to Headquarters (HQ) Air Force Civil Engineer Center (AFCEC)/CEXF according to Air Force Materiel Command Manual (AFMCMAN) 21–1.

Permanent safety (PS) modifications are routine modifications with safety implications. The TCTOs developed from these modifications carry an additional safety indicator in red capital letters above the title on the first page. This marking does not reflect the designation of urgency, but is used when the risks are too high if the hazard is not corrected within the compliance period.

Levels of accomplishment

TCTOs are issued for a designated maintenance level based on primary responsibility for accomplishment in keeping with readily available skill levels and facilities. The three levels of accomplishment are organizational, intermediate, and depot.

A TCTO designated for organizational and intermediate levels of accomplishment does not prohibit accomplishment by depot-level maintenance. The designation of depot level does prohibit accomplishment by organizational or intermediate-level maintenance unless the current and specific authority is possessed by the activities' MAJCOM. The SM, in coordination with the using command, determines the TCTO level of accomplishment for TCTOs. Let's look at the criteria for each level of accomplishment.

Organizational and intermediate

Organizational and intermediate level of accomplishment are normally designated when TCTOs are immediate, urgent, or safety. They are also designated as such when they require minimum out-of-commission or down time of systems and equipment, and involve relatively small man-hour expenditures; this is done within the concept of maintenance performed by a using organization (base level) on its assigned equipment. Designation of TCTOs for organizational or intermediate level accomplishment must be with the using command's agreement to complete the work within the compliance period.

TCTOs exceeding 8 clock-hours or 25 man-hours are not classified as organizational or intermediate level; instead, they go up to the depot level of accomplishment. However, there are exceptions that may be negotiated on individual TCTOs between the using command and SM.

Depot

Depot level of accomplishment is designated when the requirements of the TCTO are less urgent, require extensive out-of-commission time for systems and equipment, or involve large man-hour expenditures, extensive shop facilities, and special skills. Depot-level TCTOs require the work to be accomplished by a specific modification program, use of an on-site or field team, or integration into existing depot work packages, equipment repair, or overhaul programs.

027. Types of time compliance technical orders

As we mentioned previously, the time allowed to complete a TCTO is determined by the degree of urgency or danger caused by the discovered condition. AFMC engineers determine the necessity of implementing TCTOs for your type of aircraft or equipment. In this lesson, we will discuss the different types of TCTOs and how the TCTOs are acted upon by the maintenance organization.

In accordance with TO 00–5–15, there are three basic TCTO categories authorized for use—immediate, urgent, and routine action. These three categories are generally referred to as the types of TCTO (fig. 3–3).

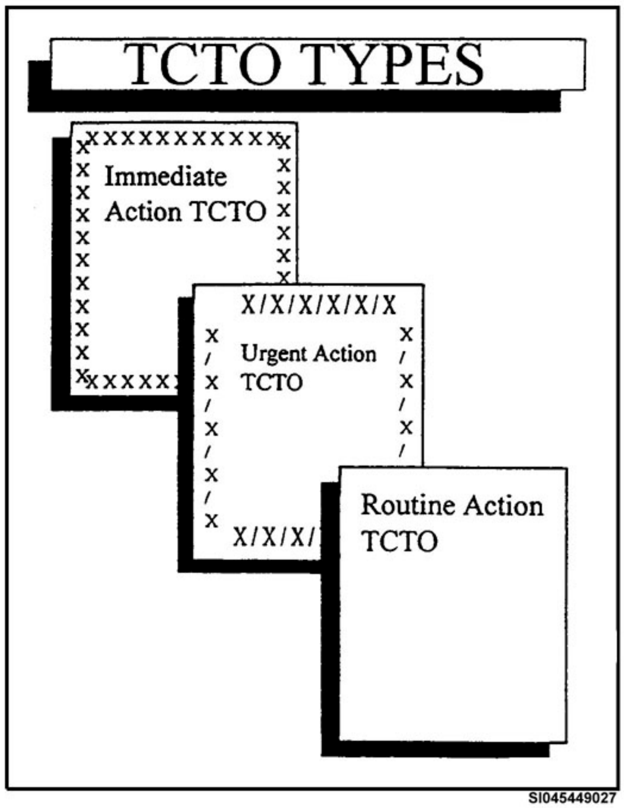

Figure 3–3. Types of time compliance technical orders.

The degree of urgency is indicated in the instructions by specifying when compliance is to be completed (figs. 3–4 through 3–6). These categories are further divided into types and levels (e.g., inspection, safety, organizational/intermediate [O/I] level, etc.). All TCTOs are issued by the responsible TCTO/modification manager under the authority of the responsible SM.

CATEGORY & TYPE OF TCTO	COMPLIANCE PERIOD (Note 1)	REMOVE FROM SERVICE (Note 2)	MAXIMUM RESCISSION DATE (Note 3)
IMMEDIATE ACTION TCTO:			
All Categories (Note 4)	Immediately	Immediately	1 year after issue
URGENT ACTION TCTO:			
All Categories	From 1 to 10 days	Upon expiration of compliance period	1 year after issue
INTERIM ROUTINE ACTION, O/I LEVEL SAFETY INSPECTION TCTO:			
All Categories	From 11 to 35 days	Upon expiration of compliance period	1 year after issue
ROUTINE ACTION, O/I LEVEL SAFETY TCTO:			
Category 1-Aircraft; Category 2-Airborne Engines; Category 31-Ground C-E Eqpmt; Aerospace and Non-Aerospace Commodities	From 11 to 90 days	Upon expiration of compliance period	2 years after issue
Categories 14-Life Support	From 11 to 120 days	Upon expiration of compliance period	2 years after issue
Categories 21-Guided Missiles; Category 35-SE (LGM only)	From 11 to 270 days	Upon expiration of compliance period	2 years after issue
ROUTINE ACTION, O/I LEVEL TCTO:			
Category 1-Aircraft; Category 2-Airborne Engines; Category 31-Ground C-E Eqpmt; Aerospace and Non-Aerospace Commodities	From 90 to 270 days	Upon expiration of compliance period	3 years after issue
Categories 21-Guided Missiles; Category 35-SE (LGM only)	From 90 to 540 days	Upon expiration of compliance period	3 years after issue

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Figure 3–4. Time compliance technical order categories and compliance, part 1.

CATEGORY & TYPE OF TCTO	COMPLIANCE PERIOD (Note 1)	REMOVE FROM SERVICE (Note 2)	MAXIMUM RESCISSION DATE (Note 3)
ROUTINE ACTION, O/I LEVEL TCTO, BASED UPON MAINTENANCE PRACTICE:			
Category 2-Airborne Engines, On Condition Maintenance (OCM) Concept	Upon an event, such as next scheduled inspection, Regional Engine Maintenance Organizational, etc. (Upon failure is not authorized)	On a date established by the SM with MAJCOM approval	10 years after issue
All other categories	Upon an event, such as next scheduled inspection, Jet Engine Intermediate Maintenance (JEIM), removal from Emergency War Order (EWO), number of landings, etc. (Upon failure is not authorized)	On a date established by the SM with MAJCOM approval	5 years after issue
ROUTINE ACTION, DEPOT LEVEL SAFETY TCTO (Note 5):			
All Categories	From 11 to 90 days	Upon expiration of compliance period	1 year after issue
ROUTINE ACTION, DEPOT LEVEL TCTO (Note 6 & 7):			
All Categories	Upon Depot Maintenance (if scheduled)	Until completion of Depot Maintenance	10 years after issue
ROUTINE ACTION, DEPOT LEVEL RECORD TCTO:			
All Categories	Upon Depot Maintenance (if scheduled)	Until completion of Depot Maintenance	10 years after issue

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Figure 3–5. Time compliance technical order categories and compliance, part 2.

NOTES:

1. The compliance period may be any number of days between the days indicated in this column. It represents the time allowed to accomplish a TCTO upon receipt of special tools, kits, parts, TCTO, and affected manuals; or TCTO only if kits are not required.

2. For all TCTO Categories and Types, other than Immediate Action, the Remove from Service date is as specified, **OR** 60 days prior to the TCTO Rescission Date, whichever comes first.

3. This column designates the maximum TCTO life and does not preclude a shorter, more realistic TCTO life as determined by the appropriate authority based on type of affected system or commodity, level of accomplishment, extent of rework and accomplishment schedule. The Weapons Directorate, SAALC/ NW, CCB is authorized to determine the appropriate rescission date for 11N-series TCTOs used by the Air Force. The rescission date for 11N-series TCTOs may be less than but not greater than 54 months.

4. Commodity category TCTOs will not be used as the means of initially removing a system from service. In this instance, a system category TCTO is written against the system to effect removal action, and an appropriate commodity category TCTO of the same urgency shall be prepared to effect the necessary retrofit change. The system category TCTO shall be signed off to release the system for flight or operation after accomplishment of the commodity category TCTO.

5. Routine Action, Depot Level, Safety TCTOs shall not exceed the Routine Action, Organization/Intermediate Level, Safety TCTO matrix elements. When a deviation to this policy appears to be necessary the Configuration Control Board (CCB) with written coordination from the affected commands, may authorize a waiver.

6. For Routine Action Depot Level TCTOs other than Safety, a compliance period of other than "Upon Depot Maintenance"(e.g., for Field Team Maintenance) may be specified when the SM and MAJCOM concur.

7. Depot Level TCTOs shall not be issued against aircraft engines which do not have established overhaul intervals, unless support teams (contractor/organic) are scheduled to accomplish the entire inventory within a predetermined time frame specified in the TCTO. In such instances the rescission date shall be established as the scheduled completion date plus 6 months.

Figure 3–6. Time compliance technical order compliance information.

Immediate action time compliance technical orders

Immediate action TCTOs are issued under the governing factors of safety conditions. These conditions, *if not corrected*, could result in fatal or serious injury to personnel, or extensive damage to or destruction of valuable property. These conditions involve an intolerable risk. The urgency of these TCTOs requires immediate action to ground aircraft, prevent launch of missiles, and discontinue operation of ground (C-E) systems or use of related SE, personnel equipment, engines, or munitions. When possible, corrective actions are included in immediate action TCTOs.

An immediate action TCTO is identified by the words IMMEDIATE ACTION printed in red at the top center of the first page with a border of red Xs included around the first page (XXX) (fig. 3–3). In addition to providing distinctive identification, the red Xs correspond to the symbol used on maintenance forms. Because of the critical nature, immediate action TCTOs are placed on a high-priority basis and CCs must ensure they are distributed to all affected personnel *within four hours after receipt*. The maximum rescission date for immediate action TCTOs is one year.

Urgent action time compliance technical orders

Urgent action TCTOs are issued under the governing factors of combat necessity or potentially hazardous conditions that could result in injury to personnel, damage to property, or unacceptable reductions in combat efficiency. Such conditions compromise safety or involve risks considered tolerable only within specified time limits.

The urgency of these TCTOs requires compliance within 1–10 days after receipt of the TCTO or after receipt of kits, parts, or tools, if required. If compliance is not accomplished by the expiration of the time limit, action is then taken to ground or remove from service affected equipment.

Urgent action TCTOs are identified by the words URGENT ACTION printed in red at the top center of the first page. In addition, there is a series of red diagonals alternately spaced with red Xs (/X/X/X) printed around the border of the first page (fig. 3–3). CCs ensure distribution of urgent action TCTOs is made to all affected personnel within 24 hours of receipt.

Routine action time compliance technical orders

Routine action TCTOs are issued for any conditions not covered under immediate or urgent action TCTOs. These conditions include conditions that involve degrees of risk considered to be tolerable within broad time limits.

Governing factors are equipment or procedural deficiencies of material, mechanical, operational, or tactical nature, the uncorrected existence of which could be any of the following:

- Constitute a hazard through prolonged use.
- Have a negative effect on operational efficiency.
- Reduce tactical or support utility.
- Reduce operational life or general service utilization of systems or equipment commodities.

Routine action TCTOs may also provide enhancements to equipment or system capabilities. The procuring activity is authorized to withhold the release of non-safety routine action TCTOs for a maximum of 90 days to permit simultaneous release of two or more TCTOs requiring work in the same general area. This procedure is authorized for all systems and commodities to reduce access and button-up maintenance man-hours when subsequent TCTOs are known to be approved and in process.

Commodity time compliance technical orders

A commodity TCTO is issued for a specific part or serial numbered item. There are certain systems (i.e., parachute and armament equipment) that require commodity TCTOs to modify or improve the safety of that piece of equipment. Commodity TCTOs may be issued under any of the three previous types of TCTOs (immediate, urgent, or routine action). An easy way to manage commodity TCTOs where the actual serial numbers are not known is to assign permanent serial numbers using procedures in TO 00–20–2, *Maintenance Data Documentation*. If equipment or parts do not have serial numbers assigned (i.e., air chucks and pilot clipboards), use bulk quantity numbers to create serial numbers (e.g., if there are 50 air chucks, use serial numbers 1–50).

The compliance periods and rescission dates are based on the type of TCTO under which the commodity TCTO is issued. If the item must be removed from the weapon system specifically to perform the commodity TCTO, then a companion TCTO may be issued in conjunction with the commodity TCTO. The exception to this is aircraft engines. Engines tracked in the CEMS have a single TCTO with instructions for performing the modification of the engine, whether or not it is installed on the aircraft.

Interim time compliance technical orders

When circumstances preclude timely publication of a formal TCTO, instructions may be issued by electronic means in an interim format. This applies to all TCTO types, with the coordination and approval of the affected lead command. Interim time compliance technical order (ITCTO) supplements are issued against only one specific TCTO. When changes to an ITCTO are required, they are provided in an ITCTO supplement or a replacing ITCTO. Furthermore, ITCTO supplements are used when required to transmit urgent changes to formal TCTOs, and may also be used to make minor technical corrections that do not affect the scope, material, or work required of formal TCTOs.

Immediate action, urgent action, and routine safety inspection TCTOs with less than 35-day compliance periods are normally issued as ITCTOs, as this gets the information out quickly; a formal publication may take much longer.

Air Force Materiel Command Instruction (AFMCI) 21–302 provides requirements, responsibilities, and procedures for preparing, coordinating, and distributing ITCTOs and ITCTO supplements.

Later in this CDC, we discuss more about TCTO requirements and the full procedure in completing TCTOs from receipt to completion.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

026. Purpose of time compliance technical orders

1. Describe the purpose of TCTOs.

2. Policies and procedures for the AF TCTO process are prescribed in which TO?

3. What kind of changes to baseline computer programs is normally announced by TCTO?

4. The TCTO process does not apply to what kind of equipment?

5. Who determines the TCTO level (organizational, intermediate, or depot) of accomplishment?

6. What level of accomplishment is designated when the requirements of the TCTO are less urgent, require extensive out-of-commission time for systems and equipment, or involve large man-hour expenditures, extensive shop facilities, and special skills?

027. Types of time compliance technical orders

1. What type of TCTO is issued if conditions could result in fatal or serious injury to personnel, or extensive damage to or destruction of valuable property?

2. What type of TCTO requires grounding aircraft, preventing missile launches, and discontinuing operation of ground (C-E) systems or use of related SE, personnel equipment, engines, or munitions?

3. What type of TCTO has a compliance period of 1–10 days after receipt of kits, parts, and tools, if required?

4. What type of TCTO has a series of red diagonals alternately spaced with red Xs (/X/X/X) printed around the border of the first page?

5. CCs ensure distribution of urgent action TCTOs is made to all affected personnel within how many hours of receipt?

6. How are immediate, urgent, and routine action safety inspection TCTOs with less than 35-day compliance periods normally issued?

3–3. Maintenance Records Management

Can you imagine the state of the maintenance world if we did not have a means of informing each person the status of every piece of equipment requiring service or maintenance? Without a means of recording aircraft and equipment status, you would never know how the weapon system was configured. You would never know what inspections, servicing, or maintenance had been done, were in progress, or were overdue. In fact, you probably would not be needed because all the aircraft would have crashed or ceased to fly long ago. To prevent this chaos from happening, the AFIs related to weapon system maintenance direct a records management program. This program provides for proper documentation of forms, and the administrative duties and responsibilities of key maintenance staff agencies. We begin by familiarizing you with some weapon system maintenance records, so you will better understand the management of records.

028. Weapons system records

The AFTO 781-series forms provide a complete status and record for AF weapons systems. Although used primarily for on-equipment maintenance, the AFTO 781-series forms play an important role in the success of the mission. Maintenance personnel, who directly work on aircraft, are certified to document and clear various types of AFTO 781-series forms entries. These forms may also be used on non-piloted aerospace vehicles (e.g., missiles).

As part of understanding maintenance activities, familiarizing ourselves with the AFTO 781-series forms used for on-equipment maintenance makes us understand the language of the maintainers. In this lesson, we discuss general information about AFTO Forms 781A, 781D, 781E, 781H, 781J, and 781K, as well as, the general documentation required.

The purpose of the AFTO 781-series forms is to provide a record of maintenance, inspection, service, configuration, status, and flight record for certain AF weapon systems. In addition, automated AFTO 781-series forms are available through the IMDS terminal and should be used whenever possible. All related information on the AFTO 781-series forms can be found in TO 00–20–1.

Although we will focus on only a few of the specific AFTO 781-series forms, here's a list of all the AFTO 781-series forms used:

- 781A, Maintenance Discrepancy and Work Document.
- 781B, Communication Security Equipment Record.
- 781C, Avionics Configuration and Load Status Document.
- 781D, Calendar and Hourly Item Inspection Document.
- 781E, Accessory Replacement Document.
- 781F, Aerospace Vehicle Flight Report and Maintenance Document.
- 781G, General Mission Classifications—Mission Symbols.
- 781H, Aerospace Vehicle Flight Status and Maintenance Document.
- 781J, Aerospace Vehicle Engine Flight Document.
- 781K, Aerospace Vehicle Inspection, Engine Data, Calendar Inspection and Delayed Discrepancy Document.
- 781L, Record of Removal/Installation of Controlled Cryptographic Items (CCI).
- 781M, Status Symbols and Functional System Codes.
- 781N, J–79 Engine Run-up Record.
- 781P, Support General Documentation Record.

NOTE: Not all of these may be required on your particular weapons system.

Commonly used forms

As a part of performing document reviews, you review many of the forms for accuracy. Although you will not review all of the AFTO 781-series forms, you should have an understanding of the forms.

To simplify reading this material, the forms are not covered in form number sequence, but in the sequence you might find them arranged in the binder. TO 00–20–1 establishes the arrangement of forms in the binder as follows: AFTO 781, 781H, and 781A. The MXG/CC determines the arrangement of all other forms, as long as they are arranged after the AFTO Form 781A. In addition, forms arrangement in the binder must be "standardized" on all assigned aerospace vehicles.

AFTO Form 781F, Aerospace Vehicle Flight Report and Maintenance Document

While the 781F was not mentioned in the previous paragraph, it is still listed here ahead of the paragraphs on AFTO Forms781, 781H, and 781A because it is used as a cover sheet for the report and has basic information about the equipment maintained (e.g., standard reporting designator [SRD], serial number, and owning organization) (fig. 3–7).

AFTO Forms 781 Series

The series of AFTO Forms 781 provide space for recording flight crew, space member, and mission accomplishment information, but most importantly, record takeoff and landing times (fig. 3–8). After these times are verified by the pilot, the total flying time is then updated into the IMDS by the maintenance debrief. When this updating is done, the AFTO Form 781 is forwarded to the unit operations section. Your MAJCOM may direct this form also be forwarded to PS&D.

AFTO Form 781H, Aerospace Vehicle Flight Status and Maintenance Document

The 781H is used to document maintenance status and servicing information, and provide reference as to the status of aerospace vehicles, aircrew training devices, or air-launched missiles. This form also indicates the status and history of inspections (figs. 3–9 and 3–10).

1. ID NUMBER A5992	5. DEDICATED CREW CHIEF (DCC) TSgt Nippet
2. PILOT Capt Iceman	6. ASST DCC SSgt Whitticker
3.	7. ASST DCC SrA Smith
4. STANDARD REPORTING DESIGNATOR ATC	8. ASST DCC

AEROSPACE VEHICLE REPORT

AND

MAINTENANCE DOCUMENT

HOURS AND MINUTES TO HOUR AND TENTH CONVERSION TABLE			
	1 or 2 minutes - .0 hour	21 thru 26 minutes - .4 hour	46 thru 51 minutes - .8 hour
	3 thru 8 minutes - .1 hour	27 thru 33 minutes - .5 hour	52 thru 57 minutes - .9 hour
	9 thru 14 minutes - .2 hour	34 thru 39 minutes - .6 hour	58 thru 60 minutes - Next whole hour
	15 thru 20 minutes - .3 hour	40 thru 45 minutes - .7 hour	

10. DOD ACTIVITY ADDRESS CODE	11. CUSTOMER ID CODE	12. MISSION DESIGN SERIES	13. SERIAL NUMBER
FP1234	CJ	F-15E	85-0992

14. ORGANIZATION	15. LOCATION	16. STATION CODE
80TH FLYING TRAINING WING	SHEPPARD AFB, TX	VNSS

17. SERVICE CAPACITY		INTERNAL	EXTERNAL	TOTAL	18. INVENTORY COMMAND	PPIC
A FUEL CAPACITY	POUNDS	13,550	22,100	35,550	A ASSIGNMENT AETC	TA
	'GALLONS ~~OR LITERS~~'					
		EACH ENGINE	AUXILIARY TANKS			
B OIL CAPACITY HALF PINTS, ~~PINTS, QUARTS, GALLONS OR LITERS~~		48	0		B POSSESSION AETC	TA

AFTO FORM 781F, 20020617 (IMT-V1) PREVIOUS EDITION IS OBSOLETE AEROSPACE VEHICLE FLIGHT REPORT AND MAINTENANCE

SI045449036

Figure 3–7. AFTO Form 781F.

(THIS FORM IS SUBJECT TO THE PRIVACY ACT OF 1974 - SEE REVERSE)

I — MISSION DATA

1. DATE (YYYYMMDD)	2. MDS	3. SERIAL NUMBER	4. UNIT CHARGED FOR FLY HOURS/HARM-CODE	5. LOCATION
20060801	F-15E	85-0922	123rd FTW	Sheppard AFB, Texas

FLT NO	MISSION NUMBER 6	MISSION SYMBOL 7	FROM (ICAO) 8	TO (ICAO) 9	TAKE OFF TIME (Z) 10	LAND TIME (Z) 11	FLIGHT TIME 12	13. LANDINGS: TOUCH AND GO	13. LANDINGS: FULL STOP	13. LANDINGS: TOTAL	SORTIES 14	SPECIAL USE 15
1		T1A	SPS	SPS	2110	2310	2.0	1	1	2	1	
2												
3												
4												
5												
6												
7												
8												
16. OPERATING UNIT	[redacted]					GRAND TOTALS	2.0	1	1	2	1	

II — AIRCREW DATA

FLYING ORGN 17	SSN 18	LAST NAME 19	FLT AUTH DUTY CODE 20	FLIGHT TIME: PRIM 21	SEC 22	INSTR 23	EVAL 24	OTHER 25	TOTAL 26	SORTIES 27	FLT CONDITIONS: PRIMARY NIGHT 28	PRIMARY INST 29	SIM INST 30	NVG 31	RESERVE STATUS 32	COMBAT: TIME 33	SORTIES 34	COMBAT SPT: TIME 35	SORTIES 36
123	123-45-6789	Iceman	IP			2			2	1									

37. MAINT REVIEW	38. PILOT REVIEW	39. OPS REVIEW	40. ARMS PROCESSING COMPLETED — INPUT: DATE	INPUT: INITIALS	AUDIT: DATE	AUDIT: INITIALS
[signature]	[signature]	[signature]	28 Oct 2004	[initials]	28 Oct 2004	[initials]

AFTO Form 781, 20020617 (IMT-V1) PREVIOUS EDITION IS OBSOLETE ARMS AIRCREW/MISSION FLIGHT DATA DOCUMENT

SI045449037

Figure 3–8. AFTO Form 781.

1. FROM	2. TO	3. MDS	4. SERIAL NUMBER
20041027	20041027	F15E	85-0922

5. Certification of PR, PR/BPO, PR/TH, TH, BPO, QT, ICT, WAI, PLI

FLT NO	TYPE	ACCOMPLISHED BY	COMPLETED DATE	COMPLETED TIME	FLT NO	TYPE	ACCOMPLISHED BY	COMPLETED DATE	COMPLETED TIME
	PR	Dillard 00234	20041027	0300					
1	TH	Owens 37221	20041027	1000					

6. STATUS DATA — 7. FLIGHT CONDITION DATA

SEE AFTO FORMS 781A AND 781K FOR EXPLANATION OF THE STATUS SYMBOLS

STATUS TODAY		BOX NO	EXCEPTIONAL RELEASE (Enter Box No)	FLT NO	COND AFT FLT	PILOT'S SIGNATUARE (Enter After Each Flight)	OVER TEMP ENCTRD	AUX ENG OR APU OPERATION
~~1~~ (X)	13	3	[illegible signature]	1	OK	Capt Iceman	—	—
~~2~~	14	5	[illegible signature]	2				
~~3~~ (X)	15			3				
~~4~~ (X)	16			4				
~~5~~	17			5				
6	18			6				
7	19			7				
8	20			8				
9	21			9				
10	22			10				
11	23			11				
12	24			12				

8. MUNITIONS/ GUNS	STATUS 781A	L E N / P I	L E N / P I	L E N / P I	L E N / P I	L E N / P I	L E N / P I	TOTAL TODAY

9. AIRFRAME TIME — 10. LANDINGS — 11. [redacted]/JFS STARTS — 12. ENGINE CYCLE DOCUMENTATION

FLIGHTS	AIRFRAME TIME	FULL STOP	TOTAL	NO	ENG	NO	ENG	NO 1 ENG	NO 2 ENG	NO 3 ENG	NO 4 ENG	NO 5 ENG	NO 6 ENG	NO 7 ENG	NO 8 ENG
PREVIOUS	12000.0	348	648	12		58									
1	2.0	1	1	1		1									
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
TOTAL	12002.0	349	649	13		59									

AFTO FORM 781H, 20020617 (IMT-V1) **AEROSPACE VEHICLE FLIGHT STATUS AND** SI045449038

PREVIOUS EDITION IS OBSOLETE.

Figure 3–9. AFTO Form 781H (front).

13.	SERVICING DATA																					
	FUEL (*Pounds, Gallons or Liters*)			OIL (*Half pints,* ~~*pints, quarts, gallons or liters*~~)																OXY PRESS OR QTY	NITROGEN	WATER
	OCTANE OR GRADE	QTY SRVCD	TOTAL IN TANKS	1		2		3		4		5		6		7		8				
				SER	IN	SER	IN	SER	IN	SER	IN	SER	IN	SER	IN	SER	IN	SER	IN			
Pre Tot	JP-8	O-G	24,000 P	0	48	0	48													10L	—	
1	JP-8	O-G	7,500 P	1	48	0	48													2L	—	
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11																						
12																						
13																						
14																						
15																						
16																						
17																						
18																						

14.	SERVICING CERTIFICATION (*Signature, Employee Number, and Station at Which Servicing is Accomplished*)		
	BY	AT	DATE
1	[signature] 42311	SHEPPARD AFB, TX	20041027
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

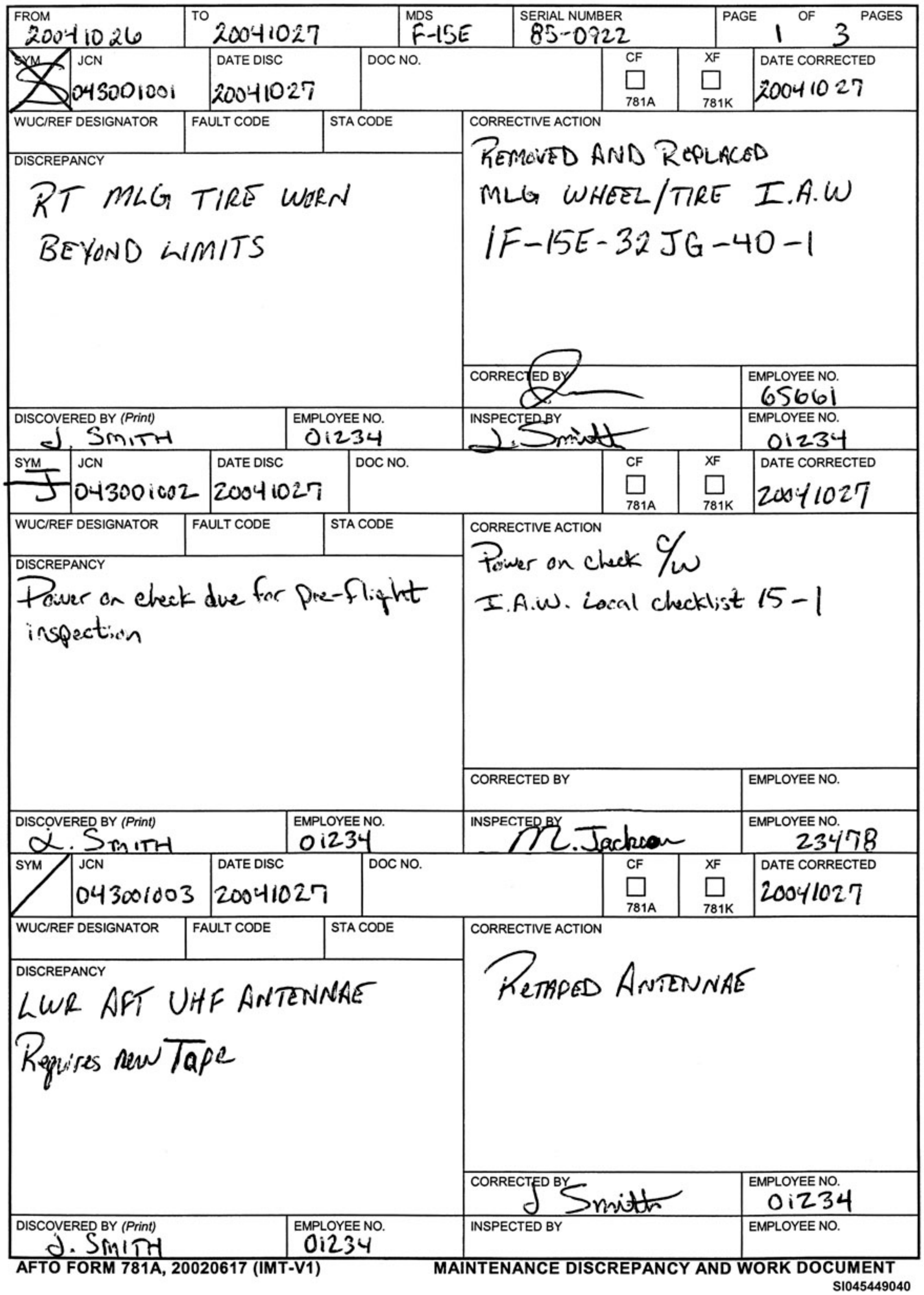
AFTO FORM 781H, 20020617

SI045449039

Figure 3–10. AFTO Form 781H (back).

AFTO Form 781A, Maintenance Discrepancy and Work Document

The 781A is used to document each discrepancy discovered by aircrew or maintenance personnel, and the corrective actions for those discrepancies. However, discrepancies resulting from battle damage are not documented on the 781A (fig. 3–11).



FROM 20041026 | TO 20041027 | MDS F-15E | SERIAL NUMBER 85-0922 | PAGE 1 OF 3 PAGES

SYM | JCN 043001001 | DATE DISC 20041027 | DOC NO. | CF ☐ 781A | XF ☐ 781K | DATE CORRECTED 20041027

WUC/REF DESIGNATOR | FAULT CODE | STA CODE

DISCREPANCY: RT MLG TIRE WORN BEYOND LIMITS

CORRECTIVE ACTION: REMOVED AND REPLACED MLG WHEEL/TIRE I.A.W 1F-15E-32JG-40-1

CORRECTED BY | EMPLOYEE NO. 65661

DISCOVERED BY (Print) J. SMITH | EMPLOYEE NO. 01234 | INSPECTED BY J. Smith | EMPLOYEE NO. 01234

SYM | JCN 043001002 | DATE DISC 20041027 | DOC NO. | CF ☐ 781A | XF ☐ 781K | DATE CORRECTED 20041027

WUC/REF DESIGNATOR | FAULT CODE | STA CODE

DISCREPANCY: Power on check due for Pre-flight inspection

CORRECTIVE ACTION: Power on check C/W I.A.W. Local checklist 15-1

CORRECTED BY | EMPLOYEE NO.

DISCOVERED BY (Print) J. SMITH | EMPLOYEE NO. 01234 | INSPECTED BY M. Jackson | EMPLOYEE NO. 23478

SYM | JCN 043001003 | DATE DISC 20041027 | DOC NO. | CF ☐ 781A | XF ☐ 781K | DATE CORRECTED 20041027

WUC/REF DESIGNATOR | FAULT CODE | STA CODE

DISCREPANCY: LWR AFT UHF ANTENNAE Requires new Tape

CORRECTIVE ACTION: RETAPED ANTENNAE

CORRECTED BY J. Smith | EMPLOYEE NO. 01234

DISCOVERED BY (Print) J. SMITH | EMPLOYEE NO. 01234 | INSPECTED BY | EMPLOYEE NO.

AFTO FORM 781A, 20020617 (IMT-V1) MAINTENANCE DISCREPANCY AND WORK DOCUMENT

SI045449040

Figure 3–11. AFTO Form 781A.

AFTO Form 781J, Aerospace Vehicle Engine Flight Document

The 781J is used to document aerospace vehicle operating time and engine data (e.g., oil change time, engine over temperatures encountered, and engine cycles). The maintenance technician is responsible for making the entries on the AFTO Form 781J (fig. 3–12).

FROM 20060801 | TO | MDS F15E | SERIAL NO. 850922 | PAGE 1 OF 1 PAGES

AIRCRAFT AND ENGINE OPERATING TIME, CYCLE AND OIL ADDED (Half Pints, ~~Pints, Quarts~~)

DATE	AIRFRAME TIME	OIL SAMPLE	ENGINE POS # 230259 OIL ADD	OIL CHANGE TIME 12004 ENGINE TIME	CYCLES	ENGINE POS # 230517 OIL ADD	OIL CHANGE TIME 13876 ENGINE TIME	CYCLES	ENGINE POS # OIL ADD	OIL CHANGE TIME ENGINE TIME	CYCLES	ENGINE POS # OIL ADD	OIL CHANGE TIME ENGINE TIME	CYCLES
PREVIOUS TOTAL	11,528.6		1	12010.1			13882.1							
20041004	3.5		0	3.5			3.5							
TOTAL	11,532.1	X	0	12013.6			13885.6							
20041005	4.4		0	4.4			4.4							
TOTAL	11,536.5		0	12018.0			13890.0							
20041006	.5		0	.5			.5							
TOTAL	11537.0		0	12018.5			13890.5							
20041006	Document Review complied with this date – TIMES ARE CORRECT –													
TOTAL	11537.0		0	12018.5			13890.5							
20041007	2.0		0	2.0			2.0							
TOTAL	11539.0		0	12020.5			13892.5							
20041008	1.0		0	1.0			1.0							
TOTAL	11540.0		0	12021.5			13893.5							
20041011	1.6		1	1.6			1.6							
TOTAL	11541.6		0	12023.1			13895.1							
TOTAL														
TOTAL														
TOTAL														
TOTAL														
TOTAL														
TOTAL														
TOTAL														
TOTAL														
20041031														
CARRIED FORWARD														

AFTO FORM 781J, 20020617 *(Reverse)* SI045449041

Figure 3–12. AFTO Form 781J.

AFTO Form 781K, Aerospace Vehicle Inspection, Engine Data, Calendar Inspection and Delayed Discrepancy Document

The 781K records aircraft inspection type, frequency, last completed and next due date or time, depot-level inspection date and time, last completed, and short-term special inspection items (figs. 3–13 and 3–14). Short-term inspection items are those having an interval of less than six months or any hourly interval of less than the PR inspection interval. The back of the form is used for urgent action and outstanding routine action TCTOs, and delayed discrepancies transcribed from the AFTO Form 781A.

AFTO Form 781D, Calendar and Hourly Item Inspection Document

The 781D is used to list calendar and hourly inspection items peculiar to the aerospace vehicle or equipment, if sufficient space is not available on the AFTO Form 781K.

AFTO Form 781E, Accessory Replacement Document

The 781E provides data to facilitate compliance with replacement requirements. It's also used to provide the necessary data for reporting discrepancies when a maintenance information system (MIS) product isn't used. Additionally, the 781E provides a record of the items of equipment and accessories replaced at the number of aircraft hours or calendar periods specified in the –6 TO.

FROM	TO	MDS	SERIAL NUMBER
20060801	20060801	F-15E	85-0922

A. AEROSPACE INSPECTION STATUS

NEXT PERIODIC, MAJOR, OR PHASED INSPECTION DUE NO.	PH 2				
TYPE	COMPL	NEXT DUE	COMPL	NEXT DUE	
PHASE #1	14,000	14,800			
PHASE #2	14,400	15,200			

B. ENGINE DATA

PSN	ENG SER NO	ENG CHANGE DUE TIME	PSN	ENG SER NO	ENG CHANGE DUE TIME
1	GE00231005	15,895	5		
2	GE00231799	12,755	6		
3			7		
4			8		

C. CALENDAR AND HOURLY INSPECTION SCHEDULE

INSPECTION ITEM	FREQUENCY	NEXT DUE	NEXT DUE	NEXT DUE	NEXT DUE
25 HR BPO	25HR	14250.0			
OIL SAMPLE	20HR	14245.0			
RECORDS REVIEW	14DAYS	20041030			
EGRESS FINAL DUE	30DAYS	20041105			
INSPECTION OF 47 L/R FOR CRACKS	100HR	14300.0			

AFTO FORM 781K, 20020617 (IMT-V1)
PREVIOUS EDITION IS OBSOLETE

AEROSPACE VEHICLE INSPECTION, ENGINE DATA, CALENDAR INSPECTION AND DELAYED DISCREPANCY DOCUMENT
SI045449042

Figure 3–13. AFTO Form 781K (front).

D. DELAYED DISCREPANCIES, URGENT ACTION, AND OUTSTANDING ROUTINE ACTION TCTO's					
SYM	JOB CONTROL NUMBER	DELAYED DISCREPANCIES OR TCTO NUMBER AND PUBLICATION DATE	DOCUMENT NUMBER	GROUND DATE/TIME	TRANSFER BY EMPLOYEE NUMBER
/	043061055	1F-16E-1899 INITIATOR MOUNT POST CORRECTION		20050516	
/	043061060	1F-16E-1910 R2 WIRE HARNESS H127		20050612	
/	043070001	INSTALLATION OF 2118952-5 AIR DATA PROBE	X675TB41022003		
/	043070006	REAR COCKPIT GLARE SHIELD RUBBER STRIP TORN	X675TB41302008		
OPEN ITEMS CARRIED FORWARDED TO NEW AFTO FORM 781K		SIGNATURE and EMPLOYEE NO.			

AFTO FORM 781K, 20020617 SI045449043

Figure 3–14. AFTO Form 781K (back).

Time compliance technical order 781-series forms documentation

It is imperative the information in the AFTO 781-series forms is accurate and correctly entered to ensure success of the mission. Without proper documentation, there is a waste of valuable time, energy, and resources. Proper documentation is part of any maintenance action; without it, the job isn't complete.

Symbols and their uses

Symbols are used on maintenance documents to make important notations instantly apparent. They reflect the operating, servicing, inspection, and maintenance status condition of the aircraft or support system. Using the proper symbol is essential because aircraft and equipment status shouldn't be taken lightly! An improper symbol can possibly result in death or serious injury to personnel or damage to equipment. To make proper entries in the maintenance documents, you must fully understand the correct use of these symbols. TO 00–20–1 contains the symbols and their use. Let's look at the symbols most frequently used.

Red X

The red X symbol shows the most serious condition on the aircraft. The red X indicates the aircraft is considered unsafe or unfit for flight or use; the aircraft is not considered airworthy until the grounding condition is corrected and tested, and the symbol is cleared or downgraded.

Red W (ground-launched missile use only)

A red W symbol for ground-launched missiles is used to reflect a condition of an item of SE or real property installed equipment (RPIE) that is inoperative for its intended use and that requires careful attention because of the following:

- A condition at a missile site that will prevent successful launch, flight impact, or C2 of the launch or flight.
- A condition off-site that will prevent the operation of a major end item of powered or nonpowered SE.
- A condition at a missile trainer that will prevent its operation.

TO 00–20–1 has more detailed procedures concerning the red W symbol.

Red dash (—)

The presence of the red dash symbol on the AFTO Form 781A indicates the condition of the aircraft is unknown and a more serious condition may exist. The red dash indicates a special inspection is due or, in some cases, overdue. It also indicates a part or system requires an operational check or an FCF is due. The red dash is used during in-progress inspections when conditions (shift change, work stoppage, etc.) necessitate an entry in the AFTO Form 781A, as determined locally.

Red diagonal (/)

A red diagonal in the symbol block of the 781A indicates an unsatisfactory condition exists, but not serious enough to ground the aircraft. A red diagonal is entered immediately in the appropriate maintenance documents when an urgent action or category I, routine action safety modification TCTO is received.

Clearing red symbol entries

For a 7-level maintenance craftsman, clearing red X entries is one of his or her most important jobs—one that should never be taken lightly. Craftsmen are held responsible for all maintenance they clear. As ones who sign off a red symbol, they must be familiar with the TOs used to complete the task.

Changing a red symbol entry

From time-to-time, these symbols must be changed because the symbol was entered in error, or it must be upgraded or downgraded. Once entered, symbols are never erased.

Symbol entered in error

If a symbol was entered in error by the person who initiated the entry, the same person initials over the symbol, writes "symbol entered in error, discrepancy and correct symbol reentered on page (No.), item (No.)" in the CORRECTIVE ACTION block, and signs the CORRECTED BY block.

Upgrading a symbol

If an individual of higher authority within the maintenance or repair activity believes a condition is more serious than represented by the symbol, he or she changes the symbol. The procedure is to draw a line through the name of the individual who made the entry, and then enter his or her signature, grade, and employee number above or beside the signature block.

Downgrading a red X

A red X can be downgraded if any supervisory person believes a condition is less serious than represented by the symbol. If this is the case, then that person must bring the matter to the attention of the GP/CC or any personnel specifically authorized to downgrade red symbol entries. A red X can also be downgraded for a one-time flight provided the aircraft is or can be made airworthy under tightly controlled operating conditions, from a remote location to the aircraft's home station or depot facility for repair with possible stops en route. Only the authorizing official or representative approved by the GP/CC to downgrade red X conditions enters a statement in the CORRECTIVE ACTION block which reads essentially "Symbol downgraded from a red X to a red diagonal. Reentered page (No.), item (No.)." The entry for a one-time flight should read, "Symbol changed from a red X to red diagonal for the purpose of a one-time flight to (name designated location)." Individuals who enter the remarks assume responsibility for their action by initialing over the symbol and entering their signature, grade, and employee number in the INSPECTED BY block. In the one-time flight scenario, a red dash is entered in the next open block with the original discrepancy and a descriptive statement of temporary repair or inspection performed to make the aircraft air worthy for a one-time flight. Also, enter any restrictions to normal flight or operation of systems. Upon return to home station or other destination (e.g., depot), the symbol is upgraded to its original red X condition.

029. Weapon system forms documentation

Managing maintenance records is a gigantic task. There is detailed guidance available in the forms-related AFIs, TOs, and operating instructions (OI) that direct what forms to complete pertaining to every activity all maintenance personnel perform.

Standardization and compliance

Complete weapon system forms documentation according to TOs 00–20–1 and 00–20–2. Two agencies in the maintenance group—PS&D and QA—are delegated by the MXG/CC to ensure the records management program meets the requirements of all applicable maintenance instructions and policies. Using the following table, we will briefly look at these two agencies, highlight their respective key role, and describe one of their main functions regarding records management:

Agency	Key Role	Main Function
PS&D	Standardization	Develops written guidance to ensure standardization across the wing concerning maintenance procedures and documentation.
QA	Compliance	Evaluates and inspects unit maintenance management procedures, including locally developed forms, publications, OIs, and so forth, for accuracy, intent, and compliance.

Using the maintenance information system

When the MIS is available (e.g., IMDS or G081), it is directed to use automated forms. As a minimum, AFTO Forms 781A, 781J, and 781K, and AFTO Form 95, generated by the applicable MIS, constitute automated aircraft/equipment forms. Manual forms produced by a computer program do not meet the intent of automated forms. Preprinted manual aircraft forms are not authorized for use in units with an available MIS.

Exception to the maintenance information system

Units without an MIS and authorized to use manual aircraft forms maintain the current and last three months' worth of closed aircraft forms in the aircraft jacket file. Locally developed databases are not allowed to be used in lieu of the IMDS or G081.

Supervisor responsibilities

The workcenter supervisor and section chief ensure all discrepancies, completed maintenance actions, inspections, serially controlled components, TCTOs, deferred discrepancies, and so forth, are documented and input in the MIS as soon as possible, but no later than the end of the current duty day. When the MIS is down, use MMA-developed procedures to document maintenance actions manually. As soon as the system is operational, ensure the appropriate MIS documentation is completed.

Documentation

Support general work is documented with the following prefixed WUC:

- 02—Wash only.
- 03—Scheduled inspections or maintenance.
- 04—Special inspections.
- 09—Shop support general.

All other support general data is not required to be entered into the MIS as per TO 00–20–2.

Prerequisites for red X clearance

Clear all red X discrepancies from the aircraft forms and MIS prior to flight. Units are directed to develop local procedures to ensure red X discrepancies discovered during time-sensitive maintenance completed during red ball or end-of-runway (EOR) operations are input and cleared from the forms prior to flight, and every effort is made to input and clear the discrepancy in the MIS prior to flight.

NOTE: Develop procedures to ensure that when the MIS is down, the user completes the appropriate documentation as soon as the system is operational.

Units may create job flow packages in the MIS to automate required documentation of repetitive complex tasks (e.g., engine change, PH inspection, flight control maintenance, etc.). Each time the governing publication changes, or at least annually, QA alerts the office of primary responsibility (OPR) to review the appropriate job flow packages.

Aircraft documents

As a minimum, enter any red X symbol conditions generated during the performance of an inspection (PH, ISO, HSC, or HPO) into the MIS and on an AFTO Form 781A. Minor discrepancies may be tracked on an AFTO Form 349, Maintenance Data Collection Record, or locally developed listings. Maintenance technicians must enter any minor discrepancies still open at the time the "fix" phase is complete into the AFTO Form 781A or AFTO Form 781K, and the MIS. All red X discrepancies are cleared from the aircraft forms (AFTO Form 781) and MIS prior to flight.

Weapon system document reviews

Aircraft document reviews on AFTO 781-series forms for locally possessed aircraft are conducted by flightline maintenance functions (by dedicated crew chief [DCC] or alternate), PS&D, EM, and supply to ensure the accuracy and validity of entries**.**

The PS&D section complies with ADR requirements. ADRs validate and correct any errors on airframe and engine operating times and cycles, TCTO documentation, TCI component operating times, time remaining to the next inspection, backordered supply document numbers, and open and deferred discrepancies. Complete an ADR at least every 60 days for units using fully automated AFTO 781-series forms. Units without access to an MIS and authorized to use manual AFTO 781-series forms must complete an ADR at least every 30 days. Also, complete an ADR when an aircraft is transferred (including Hanger Queens), deployed for more than 30 days, before and after scheduled inspections (PH or ISO), before and after storage, and after fatigue tests. For CANN aircraft, conduct ADRs at least every 30 days. MAJCOM and group CCs may shorten the ADR interval as needed. (You will learn more about ADRs later in the CDC).

Document management

PS&D's documentation functions keep historical documents and maintenance data essential to planning and scheduling maintenance. The documentation activity is an essential link in the processing of related forms for TCTOs and TCIs. As part of documentation, there are three main areas of responsibility:

- Keeping individual documents for end items, subsystems, and components according to the TO 00–20–series, automated management systems' documentation, AFI 21–103, AFI 33–322, *Records Management Program*, and the applicable –6 TOs.
- Using MIS automated history (when the MIS is available) in place of AFTO Forms 95 to document significant historical events on aircraft, engines, and equipment.
- Establishing files and properly disposing of documents according to AFI 33–322 and TO 00–20–1. Complete disposition of documents according to AFI 33–364, *Records Disposition—Procedures and Responsibilities*, as specified by the AF Records Disposition Schedule (RDS). Equipment records decentralized to sections maintaining installed-on equipment are filed by, and the responsibility of, the owning work center. Debrief may maintain the last seven pulled sets of 781s from the aircraft forms binder in a consolidated file.

Weapon system maintenance practices

There are established procedures for certain aircraft/equipment problems and tasks that require special attention. They are in the form of discrepancies (repeat/recurring and cannot duplicate [CND]) entered in maintenance forms (AFTO Form 781) and a special procedure called in-process inspection (IPI).

Repeat/recurring discrepancies

Clearing repeat/recurring discrepancies entered in aircraft forms requires special procedures. These types of discrepancies require additional maintenance supervisory involvement to ensure thorough troubleshooting. Only 7-skill level or higher and civilian-equivalent personnel can clear the appropriate symbol as per TO 00–20–1.

Could not duplicate discrepancies

Maintenance personnel make every effort to duplicate the circumstances that created the reported discrepancy. The discrepancy may be cleared only after thorough troubleshooting.

When the discrepancy cannot be duplicated, the technician documents CND in the corrective action block and clears the symbol as per TO 00–20–1. When any corrective action involves more than one work center, personnel having the primary responsibility for the repair do not initial over the symbol until all participating workcenter personnel complete and document their work. Each work center makes a separate form entry referencing the original discrepancy. The additional form entries are referenced in the corrective action block of the original discrepancy as per TO 00–20–5.

In-process inspections

An IPI is an additional inspection or verification step at a critical point in the installation, assembly, or reassembly of a system, subsystem, or component. These inspections are TO, MAJCOM, or locally directed, and are completed by qualified personnel as identified in the special certification roster (SCR). The weapon system lead command, as defined in AFPD 10–9, *Lead Command Designation and Responsibilities for Weapons Systems,* determines minimum IPI requirements and incorporates these requirements into applicable TOs.

In-process inspections list

Maintenance supervision compiles a list of squadron tasks requiring IPIs. The list includes WUC, nomenclature, specific TO, paragraph, and step number within the TO task where the IPI is needed. When developing the IPI list, consult with QA on trends or problem areas that continually warrant extra supervisory attention. Squadrons submit their on- and off-equipment lists to QA for consolidation, MXG/CC approval, and publication as the group IPI listing. IPIs are reviewed annually for applicability.

NOTE: Some IPIs are already specified in applicable technical data. There is no requirement to include TO-directed IPI tasks in the local listing.

Procedure

Document the IPI due in the discrepancy block of the original discrepancy or as a separate entry in the AFTO Form 781A, AFTO Form 244, Industrial/Support Equipment Record, or appropriate work document, and in the MIS. If the IPI is a separate entry in the AFTO Form 781A or AFTO Form 244, place the IPI on a red X. When an IPI is a separate entry, document IPI compliance in the “Corrective Action” block of the AFTO Form 781A and sign the “Inspected By” block. Ensure the original discrepancy references the page and item numbers of the IPI entries. The person performing the task enters the required IPI step and notifies a qualified IPI certifier at the appropriate step. The certifier complies with the IPI, and enters their signature and employee number next to the IPI statement in the corrective action block. The qualified technician who ultimately clears the discrepancy ensures the IPI was completed and properly documented.

For maintenance actions where a different work center is required to perform an IPI, the prime work center creates a WCE or job for the IPI. The individuals signing the red X and IPI do not need to be the same.

Off-equipment in-process inspections

IPIs are documented in the same manner as on-equipment IPIs and use the AFTO Form 350, Reparable Item Processing Tag. Document engine off-equipment IPIs in the engine work folder. IPI documentation in an automated system is not required for off-equipment engine work.

Data integrity teams

AFI 21–101 and applicable MAJCOM directives establish data integrity teams (DIT). Units form DITs led by MMA, has at least one representative from each squadron that repairs aircraft, to include PS&D, MOC, maintenance supply liaison/logistics readiness squadron (MSL/LRS), EM, debrief, and QA on an as needed basis. DITs are created to:

- Ensure the unit has complete and accurate data in the MIS and aircraft forms.
- Identify and quantify problems within the unit preventing complete and accurate documentation.
- Identify and correct the root causes for poor data integrity.

The DIT is the final authority in resolving any MIS entries, and, therefore, requires the complete backing of senior unit leadership. A DIT is not required for contract or civil service maintenance organizations unless specified in the statement of work (SOW).

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

028. Weapons systems records

1. What is the purpose of the AFTO 781-series forms?

2. What form is used to document maintenance status and servicing information and provide reference as to the status of aerospace vehicles?

3. What form is used to document vehicle operating time and engine data?

4. The back of this form is used for urgent action and outstanding routine action TCTOs, and delayed discrepancies transcribed from the AFTO Form 781A.

5. Why are symbols used on maintenance documents and what do they reflect?

6. What does the red X indicate?

029. Weapons systems forms documentation

1. What two agencies in the maintenance group ensure the records management program meets the requirements of all applicable maintenance instructions and policies?

2. When does QA alert the OPR to review appropriate job flow packages?

3. What functions are involved in conducting ADRs?

4. Why does clearing repeat/recurring discrepancies entered in aircraft forms require special procedures?

Answers to Self-Test Questions

024

1. To tell you how to inspect, install, operate, maintain, modify, and overhaul equipment and material maintained by the Air Force.
2. (1) O&M, (2) MPTOs, (3) index type, (4) abbreviated, and (5) TCTOs.
3. Sectionalized publications.
4. Methods and procedures.
5. Abbreviated.
6. Time compliance.
7. One or more numeric character, or one or more alpha characters.
8. The category of the TO.
9. The section, as well as a supplemental manual or indicates the sequence number of specific TO data in a series of inspections, supplements, or functions.

025

1. Establish the TODO to administer organization TO requirements at the group level, in support of assigned group missions and activities.
2. Group lead TODO, unit TODO, and TODA.
3. Group lead TODO.

026

1. They are the authorized method of directing and providing instructions for modifying military systems and end items (other than T modifications), and performing or initially establishing one-time inspections.
2. 00–5–15.
3. Software-only.
4. CE or medical equipment, or GP vehicles.
5. The SM, in coordination with the using command.
6. Depot.

027

1. Immediate action.
2. Immediate action.
3. Urgent action.
4. Urgent action.
5. 24.
6. ITCTOs, as this gets the information out quickly; a formal publication may take much longer.

028

1. Provide a record of maintenance, inspection, service, configuration, status, and flight record for certain AF weapon systems.
2. AFTO Form 781H.
3. AFTO Form 781J.

4. AFTO Form 781K.
5. To make important notations instantly apparent; the operating, servicing, inspection, and maintenance status condition of the aircraft or support system.
6. The aircraft is considered unsafe or unfit for flight or use; the aircraft is not considered airworthy until the grounding condition is corrected and tested, and the symbol is cleared or downgraded.

029

1. PS&D and QA.
2. Each time the governing publication changes, or at least annually.
3. Flightline maintenance functions (DCC or alternate), PS&D, EM, and supply.
4. To ensure thorough troubleshooting.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to AFCDA.

54. (024) How many major types of technical orders (TO) are authorized for use?
    a. Three.
    b. Four.
    c. Five.
    d. Six.

55. (024) Which type of technical order (TO) is designed to meet the needs of personnel engaged in or being trained to operate, maintain, service, overhaul, install, and inspect items of equipment and material?
    a. Operations and maintenance.
    b. Methods and procedures.
    c. Abbreviated.
    d. Index.

56. (024) Which type of technical order (TO) provides a means of selecting needed technical orders (TO), showing the status of all TOs, and, in certain circumstances, grouping the TOs pertaining to specific items of equipment?
    a. Index.
    b. Abbreviated.
    c. Methods and procedures.
    d. Operation and maintenance.

57. (024) Which type of index technical order (TO) lists all TOs needed for the specific military system and related commodities covered?
    a. Numerical TO index.
    b. List of Applicable Publications (LOAP).
    c. Alphabetical listing of equipment to technical publications number groups.
    d. Cross reference table of TO numbers to applicable date code number groups.

58. (024) Which group of a technical order (TO) number primarily identifies the type of TO, instruction, or procedure?
    a. Fourth.
    b. Third.
    c. Second.
    d. First.

59. (025) What is a function of the technical order (TO) distribution account?
    a. Assist organization personnel to establish new technical order distribution office (TODO) technical manual accounts.
    b. Assist other organization TODOs with resolution of TO availability and distribution problems.
    c. Establish and maintain TO requirements and distribution records for the TODO main library.
    d. Conduct and document routine TO catalog checks and annual TO library inventories.

60. (026) Exceeding what time factors normally causes a time compliance technical order (TCTO) to be classified as depot-level maintenance?
 a. 8 clock-hours or 25 man-hours.
 b. 8 clock-hours or 35 man-hours.
 c. 16 clock-hours or 25 man-hours.
 d. 16 clock-hours or 35 man-hours.

61. (027) How many basic time compliance technical order (TCTO) categories are authorized?
 a. One.
 b. Two.
 c. Three.
 d. Four.

62. (027) Commanders must ensure distribution of immediate action time compliance technical orders (TCTO) to all affected personnel within how many hours of receipt?
 a. Two.
 b. Four.
 c. Six.
 d. Eight.

63. (027) Which time compliance technical order (TCTO) is issued under conditions that could result in injury to personnel, damage to property, or unacceptable reductions in combat efficiency?
 a. Safety.
 b. Urgent action.
 c. Routine action.
 d. Immediate action.

64. (027) Which kind of time compliance technical order (TCTO) is issued specifically for part or serial numbered items?
 a. Mission essential.
 b. Routine action.
 c. Commodity.
 d. Interim.

65. (028) Which Air Force Technical Order (AFTO) Form is used to document maintenance status and servicing information, and provide reference as to the status of aerospace vehicles?
 a. 781J.
 b. 781H.
 c. 781G.
 d. 781D.

66. (028) Which Air Force Technical Order (AFTO) Form is used to list calendar and hourly inspection items peculiar to the aerospace vehicle or equipment if sufficient space is *not* available on the AFTO Form 781K?
 a. 781P.
 b. 781J.
 c. 781D.
 d. 781A.

67. (028) Which symbol on an aircraft form indicates the condition of the equipment is unknown and a more serious condition may exist?
 a. Red diagonal.
 b. Red dash.
 c. Red X.
 d. Red W.

68. (029) What is the key role of plans, scheduling, and documentation (PS&D) in the maintenance group records management program to meet the requirements of all applicable maintenance instructions and policies?
    a. Training.
    b. Inspection.
    c. Compliance.
    d. Standardization.

69. (029) Besides the current month's aircraft forms, how many months' worth of closed aircraft forms are allowed in the aircraft jacket file when the Maintenance Information System is unavailable and the unit is authorized to use manual aircraft forms?
    a. Last one.
    b. Last two.
    c. Last three.
    d. Last six.

70. (029) All red X discrepancies must be cleared from the aircraft forms and Maintenance Information System (MIS) prior to
    a. flight.
    b. towing.
    c. servicing.
    d. inspection.

Please read the unit menu for unit 4 and continue ➔

Unit 4. Advanced Statistics

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UP TO THIS POINT in your career, you've had many opportunities to apply your statistical knowledge towards helping your unit identify and eliminate problem areas within your organization. Your knowledge of descriptive statistics, statistical process control, correlation and trend analysis, and extrapolation are very useful, but can be expanded with advanced statistics. This unit begins with hypothesis testing, to help you when you are attempting to reach a decision or making assumptions about the populations involved. In this unit, we'll continue with specific parametric tests to help with hypothesis testing, and then follow up with nonparametric tests that aid when parametric tests will not work. Once again, we will review the 12-step analysis process by listing several questions within each step so that you can explain how to use these statistics and when to apply this process while conducting a special study. Furthermore, you will determine when to prepare for a special study and why you get paid to think to find solutions. You may need to review developing a hypothesis and the 12-step analysis process in your journeyman CDC to assist you as you go through this section. Finally, we'll conclude the unit with special studies.

4–1. Hypothesis Testing

Hypothesis testing procedures have long been used by research investigators to make decisions about populations on the basis of information from samples. The same procedures can be used in certain analyses situations. In this section, we'll review the steps in testing a hypothesis and cover statistical test.

030. Hypothesis testing procedures

In statistics, a hypothesis is a statement about a population in which the statement is typically represented by a parameter value—numerical value that describes the population. The objective of a statistical test is to test a hypothesis concerning the values of one or more population parameters.

We gather data in an effort to present evidence about the hypothesis. When testing a hypothesis there are certain steps to follow.

Step 1. Setting up two competing hypotheses

Hypotheses can be stated in several forms, but basically there are two types of hypotheses that you need to know—null hypothesis and its alternate hypothesis. Another name for the null hypothesis is the given hypothesis.

Null hypothesis

The null hypothesis is phrased in a way that tells you what to expect by giving a specific value to work with. The null hypothesis is symbolized as H_0. The null hypothesis assumes that everything is fine, there is no problem, and there is no significant difference between two or more population samples. This is the hypothesis that is actually tested. An example of a null hypothesis is as follows:

> H_0: There is no significant difference in the population means of time required to do the job for groups A and B. (This is your testable hypothesis.)

Alternate hypothesis

The alternate hypothesis will be of most interest to you. It is the hypothesis you accept if the null hypothesis is rejected. Normally, the alternate hypothesis is what you believe to be true (i.e., that there *is* a significant difference between two or more population samples). An alternate hypothesis may be denoted by the symbol H_1 or any symbol that best describes its content.

> H_1: The population means of groups A and B are significantly different. (If the null hypothesis is rejected, the alternate is available for acceptance.)

Step 2. Choose a statistical test

Since there are many tests available, there has to be some rational basis for choosing a specific test. To choose an appropriate test, consider such things as the type, the purpose and the power of the test, data classification, and sample size.

Step 3. Set a level of significance or alpha

As an analyst, you must determine the probabilities of arriving at incorrect determinations when formulating your hypotheses and setting up your testing procedures. You do this by setting the level of significance, thereby minimizing the chance of making an error. The most common alpha value is 0.05 or 5%. You may also choose 0.01 (1%) and 0.1 (10%).

Step 4. Calculate the test statistic

You gather the sample data and calculate the test statistic. The statistic is compared to the critical value of the sampling distribution as determined by the *level of significance*. The test statistic is calculated under the assumption the null hypothesis is true. However, there is a standard error and assumptions such as the normality of data. You compute the test statistic using formulas associated with a particular statistical test.

Step 5. Make a test decision

In this step you will make a decision to either reject the null hypothesis or fail to reject the null hypothesis. Confidence in your decision is based on the level of significance used in the comparison.

Step 6. State the overall conclusion

After making a decision about the null hypothesis, you will summarize the results of the overall conclusion of the test.

031. Statistical tests

Since there are many tests available for testing the significance of difference, there has to be some rational basis for choosing the one test most applicable. You should look at many things in determining which test to use (some of these were stated previously).

A statistical test is a procedure or set of rules that makes it possible to decide whether to accept or reject a hypothesis. There are many statistical tests available that can be applied in various types of situations. Associated with every statistical test is a set of basic assumptions and measurement scale requirements. The basic assumptions and the measurement scale requirements of a statistical test specify the conditions under which the test is considered valid. Unless these conditions are met, the test cannot be used. Statistical tests can be divided into two main types—*parametric* and *nonparametric* tests.

Parametric tests

Parametric tests measure parameters, such as the mean, standard deviation, and so forth. They make strong or extensive basic assumptions about the parameters and shape of the populations from which the data being analyzed come. For example, parametric tests require samples come from populations that are *normal distributions* and that the data be based on interval or ratio measurement scales. Also, some parametric tests require that the populations have equal variances.

Benefits and drawbacks of parametric tests

Parametric tests are stronger than nonparametric tests; therefore, always use a parametric test if possible. In parametric tests, the data must comply with the basic assumptions associated with it. Sometimes, however, these assumptions are extremely difficult to comply with. If the data does not meet these parametric basic assumptions, do not use them—select a nonparametric test instead.

Basic assumptions

Refer to foldout (FO)1 as you study the assumptions for parametric testing. You will find in most cases, data must meet a previous test requirement before additional tests are conducted in a series, because the basic assumptions of the higher tests include assumptions verified with the previous tests. To illustrate this procedure, we'll use the strongest type of parametric test—the test for a difference in means of samples. The test for means is located in the upper right-hand section of FO1 and requires the basic assumptions that follow;

- The classification of data must be truly quantitative, thereby limiting you to the use of the *interval and ratio measurement scales*.
- The *random* samples must be *independent* of each other and contain *continuous data*. They should also be from a *normal distribution*. The following two methods are used to meet this assumption:
  1. Normality may be determined using the graphical method.
  2. The distribution, if not normal, may be adjusted by using the T test for outliers to eliminate extreme values.
- The random samples should display *homogeneity of variance*. Homogeneity is defined as being similar or alike. In statistics, then, the basic assumption of homogeneity of variance implies that there is no significant difference between the variances of the samples. The following two methods are used to prove or disprove this basic assumption:
  1. F test for homogeneity of two variances.
  2. Cochran's C test for homogeneity of three or more variances. (**NOTE:** This is a more advanced method that we will not cover in this CDC.)

Nonparametric tests

Nonparametric tests are those that have less rigid requirements and *make no assumptions* about the shape of the populations from which the samples come. Most nonparametric tests can be applied to data from ordinal, interval, or ratio scales, and some, such as the nonparametric chi-square tests, can be applied to data from a nominal scale. Nonparametric tests have a more general application and are usually easier to work with than parametric tests. However, when all basic assumptions are met, parametric tests are the most powerful. The power of a test is defined as the probability of rejecting the given hypothesis when it is, in fact, false.

Test procedure flowchart

Nonparametric tests *do not make assumptions* about the shape of the distribution or the parameters. When one of the previously mentioned assumptions cannot be met, the flowchart directs you toward the appropriate nonparametric test. Although not as powerful as parametric tests, they are excellent substitutes when the basic assumptions that are associated with parametric tests cannot be met. These tests are arranged on the flowchart in the order of their power or strength. The order of test procedures from the strongest to the weakest is as follows:

1. Parametric tests
2. Nonparametric ranking tests
3. Nonparametric chi-square tests (χ^2)

Assumptions

A few assumptions are associated with the use of nonparametric tests. Ranking-type nonparametric tests require the ordinal scale measurement or higher, and the variable under study must display an underlying continuity (an exact breakpoint between ranks). Category-type nonparametric tests require a nominal scale measurement or higher, and the data classes must be mutually exclusive. As with any test, random samples must be independent, except for correlation.

Finding the sampling distribution

If you are testing a null hypothesis with a sample size of 20, how would you know when to accept or reject the hypothesis? How would you know if your test findings were good or bad, average or extreme? You could take 100,000 samples with a sample size of 20 and determine the difference between each sample. Then, you could test the difference between any two samples and compare it to the distribution that you made to see if it falls in some extreme region. You could do this for every test, which could become laborious.

Instead, tables have been developed by prominent statisticians to save you the trouble of developing your own sampling distribution. Each test has a particular table of sampling distribution baseline values, known as *critical values*, for specified levels of significance. The critical value is that value associated with a specified level of significance that signifies the beginning of the extreme region. Use these critical values to compare with your computed test statistics. By doing this, you determine if your sample differences are within the extreme regions in the sampling distribution.

Hypotheses tests normally take the same name as the distributions that they are compared with. For example, the chi-square test (χ^2) uses the χ^2 table for comparison, the big T test uses the T table, the little t test uses the t tables, the Z test uses the Z table, the F test uses the F table, and so on.

Learning the routing procedures in FO1 will simplify the process of choosing the appropriate test, the assumptions for the test, and the respective sampling distribution.

Sequence of statistical tests

Now that you know how discrete and continuous data fit in with the four measurement scales and parametric and nonparametric tests, let's discuss the sequence you would apply these tests. Looking at FO1, you see a complicated-looking chart used in the sequencing of statistical tests. You must determine the state of the following six items as you follow the flowchart:

- whether the data is discrete or continuous,
- if the data is normal,
- if there are any other outliers,
- whether the data displays homogeneity of variance,
- if the data displays homogeneity of means, and
- whether the samples display homogeneity.

Determine if the data is discrete or continuous

Looking at the left side of this chart you see the words "discrete" and "continuous." You know that discrete data uses the nominal and ordinal scales, whereas continuous data uses the interval and ratio scales. If the data is discrete, try to convert it to continuous, if possible, to apply parametric rather than nonparametric tests.

Determine if the data is normal

If using continuous data, check to see if it is from a normal distribution through the use of normal probability graph paper. This means each sample must be normal. If even one sample is not normal, the entire set of data is not normal, so you would follow the nonparametric route. Follow the normality testing technique you learned when studying continuous probability.

Determine if there are any outliers

If there are extremely high or low values that do not appear to conform to a straight line, apply the T test for outliers. These values are potential outliers or extreme values, and you use a statistical test to determine if they are truly outliers. If you find them to be true outliers, eliminate them from your data (because it would distort your information) and continue with parametric testing. Later, investigate to find out why they are outliers. If the values are not outliers, continue with the parametric testing. Outliers do not always exist. There may be no outliers, one or more outliers in a sample, or one or more outliers in several samples.

Determine whether the data displays homogeneity of variance

This may seem like a rather hairy item, but all we are really asking is, "Is there approximately an equal amount of spread of data among the samples?" This is the beginning of the analysis of variance (ANOVA). You may recall the *variance is the standard deviation squared* s^2. If samples have approximately an equal amount of spread, continue along your parametric route. However, if the spread among the samples is statistically different, the samples do not display homogeneity of variance and require nonparametric testing. Although samples may be normal, the spread of one sample cannot be significantly smaller or larger than the spread in another sample, if you are to apply additional parametric testing.

Determine if the data displays homogeneity of means

Again, homogeneity means likeness. In this case you are looking for likeness of means or average. According to the flowchart in FO1, if you answer "no" to the question of homogeneity of means, you would investigate. This means a potential problem area exists and you must investigate to determine the probable cause. The investigation may be in the form of a referral to deficiency analysis, a discussion with Quality Assurance or workcenter supervisors, or possibly even an investigation of your own. On the other hand, if you answer "yes" to the question of homogeneity of means, stop your investigation.

Determine whether the samples display homogeneity

This question, which involves the use of a nonparametric route, would arise in one of three cases:

1. The data is discrete and cannot be converted to continuous.
2. The data does not meet the basic parametric assumption of normality.
3. The data does not meet the basic parametric assumption of homogeneity of variance.

Any of these situations would require nonparametric testing. If you answer "yes" to the question of homogeneity of samples, stop your investigation. If you answer "no" to the question of homogeneity of samples, investigate and determine why the difference in samples. From the flowchart in FO1, you can determine the appropriate testing sequence depending on whether the data is discrete or continuous.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

030. Hypothesis testing procedures

1. How is the null hypothesis denoted?

2. Define null hypothesis.

3. Which hypothesis is actually tested?

4. Define alternate hypothesis.

5. Which factor of hypothesis testing determines the level of confidence in your decision?

031. Statistical tests

1. Define parametric and nonparametric tests.

2. Which type of statistical test uses data from a normal distribution?

3. Parametric tests use data from which measurement scales?

4. List the assumptions and tests necessary to compare the means of two samples of size 40.

5. Nonparametric tests use data from which measurement scales?

6. Which tests can be used with a nominal scale?

7. What do you use to determine if your sample differences are within the extreme regions in the sampling distribution?

8. What six items must you determine as you go through the proper sequence of statistical tests?

4–2. Parametric Tests

As you recall, parametric tests are those that make strong assumptions about the shape of the data distribution. Since all tests make some assumptions about the data, we will classify as *parametric* only those tests that are located in the parametric route of FO1. You may need to refer to FO1 as you progress through this section. After the data has been determined to be continuous, several tests follow: the T test for outliers, the ANOVA using the F test for two samples, and the test of means using the t and z tests. You will learn how to perform these tests in the following lessons.

032. T test for outliers procedures

An outlier is a value in a distribution that has a high probability of assignable cause. You're familiar with this concept in working with control charts—if you say the value is out of control, it exceeds your probability limit.

If the data shows extreme values as either high or low, these extremes are called outliers. The problem for the analyst is, "Are the differences between the outliers and the rest of the observations great enough to warrant an investigation as to the cause, or are the differences just random or chance differences?"

The T test is used to test extreme values (both high and low) to determine if they are outliers or if they are part of the process under study. The *first step* in determining if you have a possible outlier in a data series is to plot the data on graph paper. By looking at the plotted data, you can determine if a value is either high or low when compared to the remainder of the numbers. If you feel that a value is a possible outlier, you could use a T test to prove it statistically. Then you can eliminate it from further computations.

Another way of stating this statistically is to ask, "Did the outlying value come from the same population as the remainder of the values?" The T test for detecting outlying observations helps you answer this question to decide if an outlier warrants further investigation and if it should be excluded from further computations. A T test is a *one-tailed test* because only one tail of your sampling distribution is used—the tail that included your outlier. To determine the basic assumptions for the test, refer to FO1.

Compute the T statistic by using one of the following formulas:

$$T_L = \frac{X_L - \overline{X}}{s} \text{ or } T_S = \frac{\overline{X} - X_S}{s}$$

Where:

X_L = The largest value of the series.

X_S = The smallest value of the series.

$\overline{X}$ = The sample mean of the series.

s = The standard deviation of the series.

NOTE: The big T table (FO2) was developed using *degrees of freedom* (df), n – 1, as a divisor in computing the standard deviation because, in a normal distribution, as n grows smaller, S becomes less representative of σ (sigma). One degree of freedom is lost when S is used as an estimate of σ for small samples. Therefore, most tables made from samples of normal distributions use the following formula:

$$s = \sqrt{\frac{\sum X^2 - \frac{(\Sigma X)^2}{n}}{n-1}}$$

Use this formula when computing "s" for the T test.

Continue with the T test, and take the computed T statistic and compare it to the distribution of critical values shown in FO2. When T_L or T_S, for a given sample size, is equal to or greater than the critical value in the table, you know that the value is significantly different from its population average. If H_0 has been used as the given hypothesis, you reject H_0 when T statistic > T critical value. Confidence levels for the T test may be determined by using any of the three significance levels in the table. The T table gives confidence levels of 95, 97.5, and 99 percent. The following table shows their equivalence in terms of alpha (α).

Confidence level	95%	97.5%	99%
Alpha α	.05	.025	.01

To illustrate the procedure, assume that a sample size of 8 has a mean of 16.5, a standard deviation of 3.2, and a high value of 31. To test the value of 31 to determine if it is an outlier, first apply the formula:

$$T_L = \frac{X_L - \overline{X}}{S}$$

$$T_L = \frac{31 - 16.5}{3.2}$$

$$T_L = 4.53$$

Next, compare your T test statistic to the critical value in the table for a given alpha level. As an arbitrary number, use .05 as your alpha. Then, when n = 8 and α = .05 (or the 95% confidence level), the T critical value = 2.03 (from the table). Therefore, T statistic 4.53 > 2.03 (the T critical value). You can now say the probability is greater than 95 percent, that 31 is an outlier in your distribution and not due to chance. The extreme value should be excluded from further computations.

033. Calculating F test for variance between two samples

You can study the variance of two samples using a test called the F test for variance. Using the F test for variance, calculate a value for F using information from the two samples. Compare this F statistic with the F critical value in FO3 to determine whether to accept or reject the hypothesis that the variances are equal.

Purpose of the analysis of variance

The purpose of an ANOVA is to provide a method of testing the statistical significance of the difference among the means of several samples. This method provides an indication as to whether the observed differences among the means of the samples may or may not be ascribed to sampling fluctuations. The ANOVA approach uses the F test for two samples.

F test

The F test determines whether or not the basic assumption of homogeneity of variance can be met. The F test is a very powerful parametric test in ascertaining the assumption of homogeneity of variance. Its purpose is to determine if significant differences exist between two variances.

F-test terminology

Variance is the mean of the squared deviations from the arithmetic mean. The positive square root of the variance is called the *standard deviation*. In other words, variance is simply the square of the standard deviation or just another way of measuring the dispersion of data about the mean.

Homogeneity refers to equality, or the state of being alike. When you refer to the homogeneity of the variance, you mean that the variance is equal or at least not significantly different, and that the dispersions or spreads of the data in each of the samples are about the same. To determine the basic assumptions for the test, refer to FO1.

You find the term “df” used in many statistical tests. For the majority of tests, the df is the *sample size minus one*. Without getting into an overly complicated explanation of this term, suffice to say that, for example, if you choose a sample size of 10 values and you desire the mean of the values to be 5, you have freedom to choose the first nine values. The tenth and last value is determined by the desired mean and the previous nine choices.

F-test formulas and values

The formulas and symbols used in the F test for two samples are:

1. $$\text{F test statistic} = \frac{S^2\ \text{(largest variance)}}{S^2\ \text{(smallest variance)}}$$

2. $$\text{Variance of sample A} = S_A^2 = \frac{\Sigma X_A^2 - \frac{(\Sigma X_A)^2}{n_A}}{n_A - 1}$$

Where:

ΣX_A^2 = the X values squared and then summed, sample A.

ΣX_A = the sum of X values, sample A.

n_A = the sample size, sample A.

3. $$\text{Variance of sample B} = S_B^2 = \frac{\Sigma X_B^2 - \frac{(\Sigma X_B)^2}{n_B}}{n_B - 1}$$

Where:

ΣX_B^2 = the X values squared and then summed, sample B.

ΣX_B = the sum of the X values, sample B.

n_B = the sample size, sample B.

We will not go through all the calculations but, instead, present examples to illustrate the procedure.

Example: Suppose that $S_A^2 = 227{,}000$ and $S_B^2 = 104{,}000$ with $n_A - 1 = 20$ and $n_B - 1 = 25$. You first apply the formula and determine the F test statistic.

$$\text{F test statistic} = \frac{227000}{104000}$$

$$\text{F test statistic} = 2.18$$

When you have determined the F test statistic, compare it to the F critical value in FO3. In determining the F critical value, three values are needed:

1. Alpha = .05.
2. df for the larger variance = $n_A - 1 = 20$.
3. df for the smaller variance = $n_B - 1 = 25$.

Using the sampling distribution of the F critical values when $\alpha = .05$ (FO3), you find the df for the large variance, 20, across the top of the table. Then, down the left side of the table, you find the smaller variance, 25. Where the column and row meet, you find the F critical value of 2.01.

Now that you have the F test statistic of 2.18 and the F critical value of 2.01, you can compare them. If you can show that the F test statistic is equal to or greater than the F critical value, you have the basis, statistically speaking, for rejecting the null hypothesis of homogeneity of the two variances. Since 2.18 > 2.01, you are 95 percent sure that your two variances are significantly different.

Interpolation

In determining the critical value for the same problem, both degrees of freedom were found on the table and the critical value was found at the intersection of those two values. You may have to compute the critical value if one or both of the degrees of freedom are not listed separately on the table but are between two listed degrees of freedom.

Locating the general critical value

For our example, we will use 20 and 34 as the degrees of freedom and .01 as the level of significance. Looking at FO3, you see the df of 20 for the larger variance on the top row of the table. In contrast, you find 34 on the left side on the table between 30 and 40. By following these two df's over the table to 20, you find the values of 2.55 and 2.37, respectively. Your critical value lies somewhere between these two values.

Locating the exact critical value

Use the following procedure to locate the exact critical value:

1. Find the difference between the two df's between which your df lies (40 – 30 = 10).
2. Find the difference between the first df of the table and your df (30 – 34 = 4).
3. Divide the difference between the two table df's into the difference between the first table df and your desired df (4/10 = .4).
4. Find the difference between the critical values on the table for the two df's between which your df lies (2.55 – 2.37 = .18).

5. Multiply the difference computed in step 4 by the value computed in step 3 (.4 × .18 = .072).
6. You now have the difference that you must move from the critical value of your first df to get the critical value of your desired df. In this example, the critical values are decreasing as the df's increase. So subtract the value computed in step 5 from the first df (2.55 – .072 = 2.478). If the critical values had been increasing, you would have added the value from step 5 to the first critical value.

034. Calculating t test for difference in means of two small samples

Once the homogeneity of variance of the means is established, we go further to test the means themselves. The parametric mean tests complete the series of the parametric route when the basic assumptions can be met. There are two tests that can be used depending on the size of the samples: the t test for small samples and the z test for large samples.

The t test is a very strong parametric test for evaluating the significance of the difference between the means of two small samples. Since the means of two groups are nearly always different, the question to be evaluated is whether their difference is a random or chance variation, or whether the difference is too large to be explained as a random or chance variation. Sample size is usually less than 30 for each sample.

We're interested in testing our null hypothesis: H_0: $\mu_1 = \mu_2$. What you are trying to establish is that the variance between the two sample means are the same or $\overline{X}_A = \overline{X}_B$.

Two similar formulas can be used, depending on available information:

$$\text{t test statistic} = \frac{\overline{X}_A - \overline{X}_B}{S_{D_{\overline{x}}}}$$

OR

$$\text{t test statistic} = \frac{\overline{X}_A - \overline{X}_B}{s_{est}\sqrt{\frac{1}{n_A} + \frac{1}{n_B}}}$$

Where:

$\overline{\mathbf{X}}_{\mathbf{A}}$ = mean of the first sample.

$\overline{\mathbf{X}}_B$ = mean of the second sample.

$\mathbf{S}_{\mathbf{D}\overline{\mathbf{X}}}$ = standard error of the difference between the means of the two samples, such that:

$$S_{D_{\overline{x}}} = \sqrt{\frac{\Sigma X_A^{\ 2} + \Sigma X_B^{\ 2}}{n_A + n_B - 2}\left(\frac{1}{n_A} + \frac{1}{n_B}\right)}$$

Where:

ΣX_A^2 = Sum of squares of the X values for sample A.

ΣX_B^2 = Sum of squares of the X values for sample B.

n_A = Sample size of sample A.

n_B = Sample size of sample B.

$S_{D\overline{X}}$ can also be written this way since our sample size is less than 30:

$$S_{D_{\overline{x}}} = S_{est}\sqrt{\left(\frac{1}{n_A} + \frac{1}{n_B}\right)}$$

Where:

S_{est} = estimate of the combined standard deviation of Samples A and B.

n_A = Sample size of sample A.

n_B = Sample size of sample B.

The two formulas for standard error of the difference between the means of the two samples are the same. We briefly explain why:

The first $S_{D\overline{X}}$ equation can be broken into two square root equations:

$$S_{D_{\overline{x}}} = \sqrt{\frac{\Sigma X_A{}^2 + \Sigma X_B{}^2}{n_A + n_B - 2}}\sqrt{\left(\frac{1}{n_A} + \frac{1}{n_B}\right)}$$

We are testing the difference of the means of two small samples of an unknown large population, so we estimate the standard deviation based on the assumption that the sample standard deviation is less than the standard deviation of the population. We apply the standard deviation for samples as:

$$s = \sqrt{\frac{\Sigma X^2 - \frac{(\Sigma X)^2}{n}}{n - 1}}$$

Since we are estimating the standard deviation:

$$\Sigma X^{\ 2} \cong \Sigma X^2 - \frac{(\Sigma X\ )^2}{n}$$

The estimated standard deviation then becomes:

$$s = \sqrt{\frac{\Sigma X^2}{n - 1}} \text{ such that } s^2 = \frac{\sum X^2}{n - 1} \text{ or } (n - 1)s^2 = \sum X^2$$

Therefore:

$\Sigma X_A{}^2 = (n_A–1)s_A{}^2$.

n_A = sample size of sample A.

$s_A{}^2$= standard deviation squared of sample A or the variance of sample A,

AND

$\Sigma X_B{}^2 = (n_B–1)s_B{}^2$.

n_B = sample size of sample B.

$s_B{}^2$= standard deviation squared of sample B or the variance of sample B.

Substituting ΣX_A^2 and ΣX_B^2 into our $S_{D\bar{X}}$ equation, we get:

$$S_{D_{\bar{x}}} = \sqrt{\frac{(n_A - 1)s_A^2 + (n_B - 1)s_B^2}{n_A + n_B - 2}} \sqrt{\left(\frac{1}{n_A} + \frac{1}{n_B}\right)}$$

Notice that the variances of samples A and B are combined into the $S_{D\bar{X}}$ equation.

We can simplify the combined variances as the estimated standard deviation of the two samples. Therefore:

$$S_{est} = \sqrt{\frac{(n_A - 1)s_A^2 + (n_B - 1)s_B^2}{n_A + n_B - 2}}$$

The $\mathbf{S_{D\bar{X}}}$ (standard error of the difference between the means of the two samples) can be rewritten:

$$S_{D_{\bar{x}}} = S_{est} \sqrt{\left(\frac{1}{n_A} + \frac{1}{n_B}\right)}$$

To find the means of the two samples we use:

$$\bar{X}_A = \frac{\Sigma X_A}{n_A} \text{ and } \bar{X}_B = \frac{\Sigma X_B}{n_B}$$

Where:

ΣX_A = the sum of the values in sample A.

ΣX_B = the sum of the values in sample B.

n_A = sample size, sample A.

n_B = sample size, sample B.

After your test statistic is determined by using either of the formulas, you are ready to make the comparison with the t table (FO4).

Let's look at how to compute an example t test statistic. For our example, we are comparing two samples of man hours required to repair identical aircraft radar equipment between two different bomber models (B–52H and B–52G). We will assume the basic requirements of normality and homogeneity of variance have been met. We are concerned that the average man hours required to repair are significantly different between the two samples. Sample A has 11 values or n_A=11; sample B has14 values, or n_B=14. The following table shows the two samples:

Sample 'A'		Sample 'B'	
5.4	3.9	5.7	8.7
4.2	4.5	6.3	9.4
4.7	4.3	6.9	7.6
4.1	4.1	5.9	7.3
4.2	——-	7.2	7.8
3.1	——-	7.8	7.9
4.8	——-	9.2	8.1

Before computing the statistic, you must state your hypothesis and set your significance level.

> H_0: There is no significant difference between the means of sample A and sample B.
>
> H_a: There is a significant difference between the means of sample A and sample B.

You set your level of significance at .01 for this example and compute the test statistic. Your rejection rule for the result will be to reject H_0 if the computed t statistic ≥ the t critical value for the given α and df. You use the table of t critical values in FO4 to make your comparison.

You use the second formula presented to compute the t statistic for your example.

$$\text{t test statistic} = \frac{\overline{X}_A - \overline{X}_B}{s_{est}\sqrt{\frac{1}{n_A} + \frac{1}{n_B}}}$$

Your first step is to compute the mean of both samples.

$$\overline{X}_A = 4.3 \quad \overline{X}_B = 7.5571$$

Now you need to compute s_{est} (estimate of combined standard deviation) for the samples. To compute this you need the variance for each sample.

$$s^2_A = .336 \quad s^2_B = 1.2565$$

Making the substitutions in the formula for s_{est} you have:

$$s_{est} = \sqrt{\frac{(11-1).336 + (14-1)1.2565}{11+14-2}} = \sqrt{\frac{19.6945}{23}} = \sqrt{.8563} = .9254$$

You now have a value of .9254 for s_{est} that you can substitute into the t statistic formula and compute its value.

$$t = \frac{4.3 - 7.5571}{.9254\sqrt{\frac{1}{11} + \frac{1}{14}}} = \frac{-3.251}{.9254\sqrt{.1623}} = \frac{-3.251}{.3728} = -8.720$$

To complete your test, you must obtain the t critical value for α=.01 and df=23. The df is derived by the sum of both sample sizes minus 2 (11+14–2). Looking at the table for t critical values (FO4), you find 2.807. Now compare and decide: If 8.720 (computed t test statistic) ≥ 2.807 (t critical value), reject H_0. With your rejection rule holding true, you must reject the null hypothesis. You can say that there is a significant difference between the average time to repair the airborne radar equipment between the two aircraft models and that an investigation should uncover the reason for the difference.

035. Calculating z test for difference in means of two large samples

The z test is a very strong parametric test for evaluating the significance of the difference between two means, each calculated from large samples. This test is very similar to the t test. Since mean results between two groups are nearly always different, you must decide whether their difference is a random or chance variation or whether the difference is too large to be explained as a random or chance variation. The test is usually used in connection with analysis of two large samples. The size of each sample should be 30 or more.

Data chosen for the test must meet the requirements or basic assumptions shown in FO1. As in the t test, either one of the two formulas shown may be used:

$$\text{z test statistic} = \frac{\overline{X}_A - \overline{X}_B}{S_{D_{\overline{X}}}}$$

OR

$$\text{z test statistic} = \frac{\overline{X}_A - \overline{X}_B}{\sqrt{\frac{S_A^2}{n_A} + \frac{S_B^2}{n_B}}}$$

Where:

$\overline{X}_A$ = mean of sample A.

$\overline{X}_B$ = mean of sample B.

$S_{D_{\overline{X}}}$ = Standard error of the difference between the two means.

Solution of the mean values is as follows:

$$\overline{X}_A = \frac{\Sigma X_A}{n_A} \text{ and } \overline{X}_B = \frac{\Sigma X_B}{n_B}$$

Where:

ΣX = summation of the values in the sample.

n = sample size.

Solution for standard error of the difference is as follows:

$$S_{D_{\overline{X}}} = \sqrt{S_{\overline{X}_A}{}^2 + S_{\overline{X}_B}{}^2}$$

Where:

$S_{\overline{X}_A}$ = the standard error of the first mean.

$S_{\overline{X}_B}$ = the standard error of the second mean.

$$S_{\overline{X}_A} = \frac{S_A}{\sqrt{n_A}} \quad \text{or} \quad S_{\overline{X}_A}{}^2 = \frac{S_A{}^2}{n_A}$$

and

$$S_{\overline{X}_B} = \frac{S_B}{\sqrt{n_B}} \quad \text{or} \quad S_{\overline{X}_B}{}^2 = \frac{S_B{}^2}{n_B}$$

Where:

S = The standard deviation of the sample.

n = sample size.

$$S_A = \sqrt{\frac{\Sigma X_A{}^2}{n_A - 1}}$$

$$S_B = \sqrt{\frac{\Sigma X_B{}^2}{n_B - 1}}$$

Where:

ΣX^2 = the sum of the X values squared and summed.

n = sample size.

The $S_{D\bar{X}}$ equation then becomes:

$$S_{D_{\bar{x}}} = \sqrt{\frac{s_A^{\,2}}{n_A} + \frac{s_B^{\,2}}{n_B}}$$

This procedure may look quite complicated, but as you study you will see that several of the computations have been completed already. Most computations were used previously in verifying the basic assumptions of the test. As mentioned, the difference between the t and the z test are *the size of the samples used*. At this stage, you should have no trouble solving the formulas since only substitution and basic math are necessary. We continue now with comparing the z test statistic to the table.

Another difference between the two tests is the use of the table for comparison. Since the test is called a z test, the z distribution or normal curve tail area table is used for comparison. If the z statistic is found to be equal to or greater than the z critical value at the predetermined alpha, then you know the means are significantly different. Use $\alpha = .05$ and assume a z statistic of –2.611 as you look at the normal curve tail area table in FO5, view B.

Disregard the negative sign in the statistic because the table has only positive critical values. The z test is a two-tailed test because no direction is indicated within the distribution.

If you formulated a two-tailed hypothesis, the alpha of .05 is divided by two, giving you .025 on one end of the curve and .025 on the other end. Looking for .025 in the body of the normal curve area table, you find .0250 in the .06 column and opposite 1.9. This represents a z value of 1.96.

If the computed z statistic is ≥ z critical value derived from FO5, view B, you reject the null hypothesis. As you can see, the z statistic of 2.611 is greater than 1.96; therefore, you know that the sample means are significantly different, and you are over 95 percent sure of your answer.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

032. T test for outliers procedures

1. What is the purpose of a T test?

2. What is the first step in determining if an outlier exists in a data series?

3. Compute a T statistic when $\bar{X} = 6$, $X_S = 1.2$, and $S = .8$.

4. What action is taken when the T test statistic is > T critical value?

033. Calculating F test for variance between two samples

1. What does the F test do for the analyst?

2. Compute an F test statistic when $S_A^2 = 38$, $S_B^2 = 92$.

3. What is the df value for a sample size of 24?

4. What is the indication when you state a null hypothesis and the F test statistic is < F critical value?

034. Calculating t test for difference in means of two small samples

1. Compute $S_{D\bar{X}}$ for a t test if $\Sigma X_A^2 = 300$, $\Sigma X_B^2 = 180$, $n_A = 14$, and $n_B = 22$.

2. Determine the df needed for the t test in question 1 above.

035. The z test for difference in means of two large samples

1. Compute a z statistic when $\bar{X}_A = 24$, $\bar{X}_B = 30$, and $S_{D\bar{X}} = 4$.

2. Compute $S_{D\bar{X}}$ for a z test when $S_{\bar{X}_A} = 48$, $S_{\bar{X}_B} = 66$.

3. What table of probability is used with the z test for means?

4–3. Nonparametric Tests

When sample data cannot meet the assumptions required for parametric tests, use a less powerful nonparametric test. Nonparametric tests compare samples by using ranks or by measuring sample results to expected outcomes. The tests that use ranks are the stronger of the two types and consist of the Mann-Whitney U test and the Kruskal-Wallis H test. The test that measures sample outcomes based on expectations is the Chi-square test.

036. Calculating Mann-Whitney U test for differences of two samples

The Mann-Whitney U test is one of the most powerful nonparametric tests. The test is a distribution-free technique for evaluating the significance of the difference between two independent samples. It can be used with almost any sample size, which makes it an excellent substitute for the parametric t or z test when the basic assumptions of normality or homogeneity of variance cannot be met. The test requires data of at least the ordinal scale, which possesses an underlying continuous distribution.

To illustrate how the Mann-Whitney U test is applied, use the data in the following table, which shows man hours required by work centers 1 and 2 to perform the same type of job. You'll see the sample from work center 1 has fewer of the higher values than the sample from work center 2. Did this difference in the samples occur by chance, or did it occur because work center 2 actually takes longer to do the job? In other words, does the population of work center 2 consist of higher values than the population of work center l?

Data for Mann-Whitney U test			
(1) Work Center 1	(2) R_1	(3) Work Center 2	(4) R_2
5.4	4	6.1	8
6.0	7	7.9	18
6.8	13	6.6	12
7.4	16	7.2	15
6.3	10	7.7	17
5.5	5	8.9	19
4.5	2	5.6	6
4.6	3	6.9	14
2.7	1	6.2	9
		6.5	11
	$\Sigma R_1 = 61$		$\Sigma R_2 = 129$

H_0: There is no significant difference between the population of work centers 1 and 2.

H_1: The population of work center 2 consists of higher man-hour values than work center 1.

NOTE: As you look over the ranks of these two samples, you may find value ties between the samples. These ties have the effect of weakening this test. When you have many ties across the samples and feel they have weakened the test, verify your results with another test. Usually, you'll do this with the chi-square test. However, ties are not a problem if they occur within one of the two samples.

First, all the values in the two samples are pooled and *ranked as though they were one sample*.

Looking at columns 1 and 3 of the previous table, rank number 1 is given to the smallest value, 2.7, and rank 2 to the next smallest value, 4.5, and so on until all the values are ranked. The ranks of work center l are recorded in the column headed R_1 (rank of work center 1), and the ranks of work center 2 are recorded in the column headed R_2 (rank of work center 2). The next step is to sum the ranks for each sample, as shown on the table. Then two possible U's are computed, using these two formulas:

$$U_1 = (n_1)(n_2) + \frac{(n_1)(n_1 + 1)}{2} - \Sigma R_1$$

$$U_2 = (n_1)(n_2) + \frac{(n_2)(n_2 + 1)}{2} - \Sigma R_2$$

Where:

n_1 = Sample size of sample 1

n_2 = Sample size of sample 2

ΣR_1 = Sum of the ranks for sample 1

ΣR_2 = Sum of the ranks for sample 2

Looking at the previous table, you can see that $n_1 = 9$, $n_2 = 10$, $\Sigma R_1 = 61$, and $\Sigma R_2 = 129$. Substituting in the formulas, U_1 and U_2 are computed as follows:

$$U_1 = (n_1)(n_2) + \frac{(n_1)(n_1 + 1)}{2} - \Sigma R_1$$

$$U_1 = (9)(10) + \frac{(9)(9 + 1)}{2} - 61$$

$$U_1 = 90 + 45 - 61$$

$$U_1 = 74$$

and

$$U_2 = (n_1)(n_2) + \frac{(n_2)(n_2 + 1)}{2} - \Sigma R_2$$

$$U_2 = (9)(10) + \frac{(10)(10 + 1)}{2} - 129$$

$$U_2 = 90 + 55 - 129$$

$$U_2 = 16$$

As you can see, there are two U statistics. The *smaller U value is always selected as the U test statistic*. In this case, U_2 has the smaller value, which is 16. So the U test statistic is 16. The U test differs somewhat from the others in that the value is significant when U test statistic ≤ U critical value.

Another element of the U test is that a U sampling distribution may consist of any one of several tables. This is necessary because small samples tend to be unstable in representing their populations. This, in turn, requires a table for each different small sample size. Probabilities associated with the U statistics are shown in FO6 and FO7. When the larger sample size is equal to or less than eight, use FO6. When the larger sample size range is from 9 to 20, use FO7. When the sample size is greater than 20, the sampling distribution of U rapidly approaches the normal distribution. In this case, you can use FO5, view B, the normal curve tail area table.

In the last example with a U_2 statistic of 16, make your comparison at alpha = .05. Entering the table on FO7 with an n_1 of 9 and an n_2 of 10, you find the critical value is 24. Applying the test criteria, you know that the U test statistic is significant if $16 < 24$. Since this is the case, the probability is greater than 95 percent that work center 2 actually takes longer to do the jobs.

When the largest n value is less than 8, you simply select the appropriate portion of FO6 and enter the table with your U test statistic and smallest n value. The body of the table gives the actual probability that the U value is due to chance.

When the sample size is greater than 20, the distribution approaches a normal distribution, and the tables on FO6 and FO7 do not apply. The U test statistic, in this case, must be converted to a z deviate. The U statistics for n_1 and n_2 are computed in the same manner as previously illustrated with the smaller of the two used to compute the z deviate. The z deviate is computed by the formula:

$$Z = \frac{U - \frac{(n_1)(n_2)}{2}}{\sqrt{\frac{(n_1)(n_2)(n_1 + n_2 + 1)}{12}}}$$

As an example, if you solved the above formula and got 2.14, use the normal curve tail area table, FO5, view B. You enter the table with a z of 2.14 and come out with a .0162 probability of occurrence. If alpha has been set at .05, the U statistic is significant because .0162 < .05. If a two-tailed, nondirectional test is used, you may divide the alpha level by 2 before making the comparison in the table.

037. Kruskal-Wallis H test procedures

The Kruskal-Wallis H test is a one-way analysis of variance by ranks test. Since sample values almost always differ somewhat, the question arises as to whether the differences among the samples show significant population differences or represent merely chance variations, such as are to be expected among several random samples from the same population. The H test is an excellent substitute for the parametric F test for means when the basic assumptions of the F test cannot be met. This test evaluates the significance of differences among three or more independent samples, through the use of ranks. The test requires data of *at least the ordinal scale*, which has an underlying continuous distribution.

Computation of the H test statistic uses the formula:

$$H = \frac{12}{N(N+1)}\left[\frac{(\Sigma R_1)^2}{n_A} + \frac{(\Sigma R_2)^2}{n_B} + \frac{(\Sigma R_3)^2}{n_C}\right] - 3(N+1)$$

Where:

$(\Sigma R_1)^2$ = Ranks of sample 1 summed and squared.

$(\Sigma R_2)^2$ = Ranks of sample 2 summed and squared.

$(\Sigma R_3)^2$ = Ranks of sample 3 summed and squared.

n_A = Size of sample 1.

n_B = Size of sample 2.

N = total number of values in the study using all ranks.

NOTE: The above formula is for three samples, but it can be extended to include any number of samples. Also, the values 12 and 3 are constants, regardless of the values of other terms.

To illustrate how the H test statistic is computed, use the data shown in the table.

Month	Sample 1	Sample 2	Sample 3
Mar	17.2	6.0	16.4
Feb	15.5	6.1	24.5
Jan	15.8	6.8	13.7
Dec	15.5	6.9	12.2
Nov	17.1	7.2	14.1

The *first step* is to count the values in the study. In this case, there are 15, therefore, N = 15.

The *second step* is to count how many values there are per sample. In this example, there are 5 values per sample, therefore:

$n_1 = 5$

$n_2 = 5$

$n_3 = 5$

The *third step* is to rank the data from 1 for the lowest value to 15 for the highest value. Whenever ties (the same values) are encountered, they are given the average of the ranks that the ties occupy. Looking over the 15 values, you look for the lowest value and give it a rank of 1, regardless of what sample this value is in, and place the rest of the values in order.

Ranks 1–15	**All Values**
1	6.0
2	6.1
3	6.8
4	6.9
5	7.2
6	12.2
7	13.7
8	14.1
9 = 9.5	15.5
10 = 9.5	15.5 ties
11	15.8
12	16.4
13	17.1
14	17.2
15	24.5

Now that you know the rank of each value in the study, you can place them back in their corresponding samples and place the rank next to each value as in the following table.

Month	**Sample 1**	**R_1**	**Sample 2**	**R_2**	**Sample 3**	**R_3**
Mar	17.2	14	6.0	1	16.4	12
Feb	15.5	9.5	6.1	2	24.5	15
Jan	15.8	11	6.8	3	13.7	7
Dec	15.5	9.5	6.9	4	12.2	6
Nov	17.1	13	7.2	5	14.1	8

NOTE: As with the Mann-Whitney U test, many value ties across samples have the effect of weakening the H test. When this occurs, the analyst should consider the option of using the weaker chi-square test instead.

The *fourth step* is to sum the ranks of each sample:

$\Sigma R_1 = 14 + 9.5 + 11 + 9.5 + 13$

$\Sigma R_1 = 57$

$\Sigma R_2 = 1 + 2 + 3 + 4 + 5$

$\Sigma R_2 = 15$

$\Sigma R_3 = 12 + 15 + 7 + 6 + 8$

$\Sigma R_3 = 48$

The *fifth step* is to square the individual sums:

$(\Sigma R_1)^2 = (57)^2 = 3249$

$(\Sigma R_2)^2 = (15)^2 = 225$

$(\Sigma R_3)^2 = (48)^2 = 2304$

Now you have all the values needed to compute the H test statistic.

$$H = \frac{12}{N(N+1)}\left[\frac{(\Sigma R_1)^2}{n_A} + \frac{(\Sigma R_2)^2}{n_B} + \frac{(\Sigma R_3)^2}{n_C}\right] - 3(N+1)$$

$$H = \frac{12}{15(15+1)}\left[\frac{(3249)}{5} + \frac{(225)}{5} + \frac{(2304)}{5}\right] - 3(15+1)$$

$$H = .05(1155.6) - 48$$

$$H = 9.78$$

Now that the H test statistic has been computed, you can proceed to find the probability of this H test statistic of 9.78. The H test is a one-tailed test and uses one of two tables for its sampling distribution (FO8).

When there are exactly three samples and none of them has a sample size greater than five, use the table of probabilities for the Kruskal-Wallis H test.

The table of critical values for chi-square is used when: (1) there are exactly three samples and at least one sample has a sample size greater than five or (2) there are more than three samples, regardless of sample size.

Your test statistic is significant if the probability from the Kruskal-Wallis H test table is less than the prescribed alpha or if the H test statistic is greater than the chi-square critical value from the table of critical values for chi-square. When the chi-square table (FO9) is used, you set the alpha level and df. The df is equal to k –1 where k equals the number of samples under study. In our example, we used the Kruskal-Wallis H test table (FO8) because we have only three samples of size five. Look for the part of the table that shows the probability when:

$$n_1 = 5,\ n_2 = 5,\ \text{and}\ n_3 = 5$$

The part of this table appropriate to this example actually does not show 9.78. The highest value shown is 8.000, which has a probability of .009. You can reason then that the probability of an H test statistic as large as 9.78 would be very small, smaller than .009. In this situation, if you had stated a null hypothesis of no significant difference, you would have a basis for rejection since the probability (.009) is equal to or less than the prescribed alpha (.05). This means that there is a significant difference among the three samples.

038. Chi-square test procedures

The chi-square test (χ^2) is a nonparametric test that measures goodness of fit. It places data into categories (such as items of different colors) and tests whether a significant difference exists between the observed number of frequencies falling into each category and the number of frequencies expected to fall into each category.

You can use the χ^2 test for any number of samples. If you use only two categories, the expected frequencies in each category must be at least five. If you use more than two categories, the expected frequencies in each category must never be less than one, and only 20 percent of the categories can have a frequency count of 1, 2, 3, or 4.

When you use only one sample with the χ^2 test, you must compare its data to a theoretical or presumed expected distribution. The formula for the χ^2 test statistic is:

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

Where:

O = observed frequencies per category.

E = expected frequencies per category,

and

$$E = \frac{\Sigma O}{K}$$

Where:

K = total number of categories.

The text table χ^2 data illustrates how the χ^2 statistic is developed. Suppose you want to know if there is a significant difference in the number of defects discovered on three pieces of equipment. You use the χ^2 test to solve the problem and the χ^2 data table to organize your computations.

χ^2 Data					
Column A	**B**	**C**	**D**	**E**	**F**
	O	E	O – E	$(O - E)^2$	$\frac{(O-E)^2}{E}$
Equipment A	18	14	4	16	1.143
Equipment B	16	14	2	4	0.286
Equipment C	8	14	–6	36	2.571

Next, you complete columns D, E, and F using the data given. Finally, you sum the column F values for the χ^2 statistic.

You are now ready to use the χ^2 table in FO9 to make the comparison. To determine the χ^2 probability from the table, you need two values other than the χ^2 statistic. They are alpha (α), which is set at .01 for this example, and the df of the sample. When only one sample is used, the degrees of freedom are computed by:

df = K – 1

and for this example:

df = 3 – 1

df = 2

Looking at the table on FO9, simply apply the df value to the left vertical column and move to the right until you reach the column headed .01, the alpha value. At this point, you find the χ^2 critical value of 9.210. The category observed frequencies are significantly different when the χ^2 statistic > χ^2 critical value. Therefore, in your example 4.00 < 9.210, so you know that your probability of difference is less than 99 percent.

When more than one sample is used with the χ^2 test, the value of E varies for each category and is somewhat more difficult to compute.

Use the data in the following table to illustrate the χ^2 procedure when two or more samples are evaluated. Remember, you are looking for significant differences between categories, not between samples. Again, you determine if the number of defects on different types of equipment is significantly different. You begin by placing the observed frequencies in the table. Then you find E (expected frequencies) for each sample category by multiplying the column observed totals by the nonobserved totals and dividing their product by the grand total. For example:

$$E = \frac{\text{(Row total)(Column total)}}{\text{Grand total}}$$

Defects by equipment type						
Sample	**Observed/ Expected**	**A**	**B**	**C**	**D**	**Row Totals**
1	O	17	12	18	12	59
	E	16.32	13.50	17.57	11.61	59
2	O	14	16	19	13	62
	E	17.15	14.18	18.47	12.20	62
3	O	21	15	19	12	67
	E	18.53	15.32	19.96	13.19	67
Column Total	O	52	43	56	37	188
	E	52	43	56	37	188

Sample Number 1, Category A, E = (59)(52) over 188 = 16.32

Sample Number 2, Category B, E = (59)(43) over 188 = 13.50

Sample Number 3, Category C, E = (62)(52) over 188 = 17.15

Continue in this manner until each E value has been computed.

Next, take these O and E values and compute χ^2 statistic.

Where:

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

You organize the formula computations as shown in the following defects table. After you compute the statistic, to establish the df and alpha values.

For a multi-sample χ^2 test:

$$df = (K - 1)(r - 1)$$

Where:

K = number of categories.

r = number of rows or samples.

In this example, this equates to:

df = (4 – 1)(3 – 1)

df = (3)(2)

df = 6

Defects by Equipment Category						
Sample	**K**	**O**	**E**	**O–E**	**$(O–E)^2$**	$\frac{(O-E)^2}{E}$
1	A	17	16.32	0.68	0.4624	0.028
	B	12	13.50	–1.50	2.2500	0.167
	C	18	17.57	0.43	0.1849	0.011
	D	12	11.61	0.39	0.1521	0.013
2	A	14	17.15	–3.15	9.9225	0.579
	B	16	14.18	1.82	3.3124	0.234
	C	19	18.47	0.53	0.2809	0.015
	D	13	12.20	0.80	0.6400	0.052
3	A	21	18.53	2.47	6.1010	0.329
	B	15	15.32	–0.32	0.1024	0.007
	C	19	19.96	–0.96	0.9216	0.046
	D	12	13.19	–1.19	1.4161	0.107
χ^2 statistic = 1.588						

Looking at the table in FO9, with df = 6 and alpha = .05, you find your chi-square critical value is 12.592. Since 1.588 (test statistic) < 12.592 (critical value), you know there is no significant difference between the categories.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

036. Calculating Mann-Whitney U test for differences of two samples

1. How are the two samples treated when assigning ranks for computing a U test statistic?

2. If $n_1 = 10$, $n_2 = 11$, $\Sigma R_1 = 72$, and $\Sigma R_2 = 159$, compute the U test statistic.

3. You computed two U values. Which U value do you select as the U test statistic?

037. Kruskal-Wallis H test procedures

1. To use an H test, the data must come from at least which measurement scale?

2. What effect will value ties across samples have on the H test?

3. What sampling distribution test do you use when more than three samples are used with the H test?

4. Compute an H statistic when $(\Sigma R_1)^2 = 5041$, $(\Sigma R_2)^2 = 10609$, $(\Sigma R_3)^2 = 1296$, $n_1 = 7$, $n_2 = 8$, and $n_3 = 5$. (Work with three decimal positions.)

038. Chi-square test procedures

1. State the purpose of the χ^2 test.

2. What is the minimum of expected frequencies when using the χ^2 test?

3. How is E determined when only one sample is used in a χ^2 test?

4. What is the indication when the χ^2 test statistic > χ^2 critical value using H_0?

4–4. Predictive Analysis

In this section, you examine the overall analysis process as it relates to your job as a maintenance analyst. It is critical that you have a good working knowledge of the entire analysis process from start to finish. You need to have a systematic program to collect and manipulate data, set up correct parameters, and interpret the results. As a prerequisite for conducting in-depth analysis, you must know what data is available and how to use it to identify a problem impacting your units' performance. In short, both data flow and data use, including job data documentation (JDD), set the stage for the analysis process.

039. Reasoning behind the 12-step analysis process

As previously discussed in this volume and in your journeyman upgrade training, you have learned how to be an effective analyst; you must know where you are going and have a good idea of how to get there. This requires a plan of attack. The 12-step analysis process provides an effective and logical plan to follow. Never forget that your primary responsibility is to provide meaningful information that will enable maintenance managers and supervisors to make sound managerial decisions. By carefully following the 12-step analysis process, knowing your responsibilities and data sources, and avoiding common statistical pitfalls, you will be able to provide this required information with a high level of confidence in its accuracy.

As you work your way through this lesson and learn about the various statistical tests, the ways to collect data, and how to interpret the results, keep in mind the 12 steps in the framework of the analysis process will guide you in a more concise and logical way by keeping assumptions at a minimum and always building upon itself. This works from the simplest to most complex of data analysis. At this point, since some of you may not be familiar with the statistical tests involved with maintenance analysis, we will go over the 12-step analysis process in a general way, keeping specific test details to a minimum. Refer to foldouts 10 through 22 as a guide during your special study.

Perform an analysis

Your commander may suspect there is a problem and request you perform an analysis, or you may find something you believe warrants investigation. However, ***YOU*** should be the first to identify problems or trends before it comes from your leadership. In either situation, begin the analysis by clearly defining the problem statement. This helps you and anyone else who might work on the study to pinpoint exactly what to look for. A clearly defined statement of the problem helps keep you focused on your purpose. For example, you may suggest that cannibalizations are increasing. You may state the problem as a hypothesis, "Cannibalizations are on the increase," and proceed from there to prove or disprove your theory. Since hypothesis testing was discussed earlier in this volume, we will not revisit it here; review that information before continuing if you need to refresh your memory.

Begin

Speaking of placing things in the proper perspective, begin by gathering the facts, keeping assumptions to a minimum, not jumping to conclusions, asking yourself several important questions, and to always remember that as analyst you do not guess—you test.

- Is the problem clearly defined?
- Has the scope of the analysis been defined?
- Is there a simple explanation?
- Are the facts real?
- Are all the facts there, or are more facts available elsewhere?
- How do the facts compare to what you expected?
- Can you mold the facts to tell the story accurately?
- How do you think the story will end?

- Identify and examine everything that affects your interpretation of the facts.
- Are problems caused by something or someone? How and why?
- Should procedures be changed?
- Has the facts pointed to a corrective-action(s) which leads to a recommendation(s)?

Sketch of the process

When you perform the preceding, you will have completed a thumbnail sketch of the 12-step analysis process. Success of the process requires that you be totally objective. Fairly and accurately assess the condition of the organization and the weapon system. The 12-step analysis process is a multifaceted approach used by analysts to solve management problems. There will be times that you will use each step of the process and at others you will only use some of the steps. These are the processes, rarely in order, repeated many times, never ending. The problems you encounter determine the steps you will follow.

Process

The 12-step approach to the analysis process is a continuous cycle, illustrated in figure 4–1 and FO10. Each step is labeled so you can follow it more easily. In the following paragraphs, we take a more detailed look at each of the steps in the process.

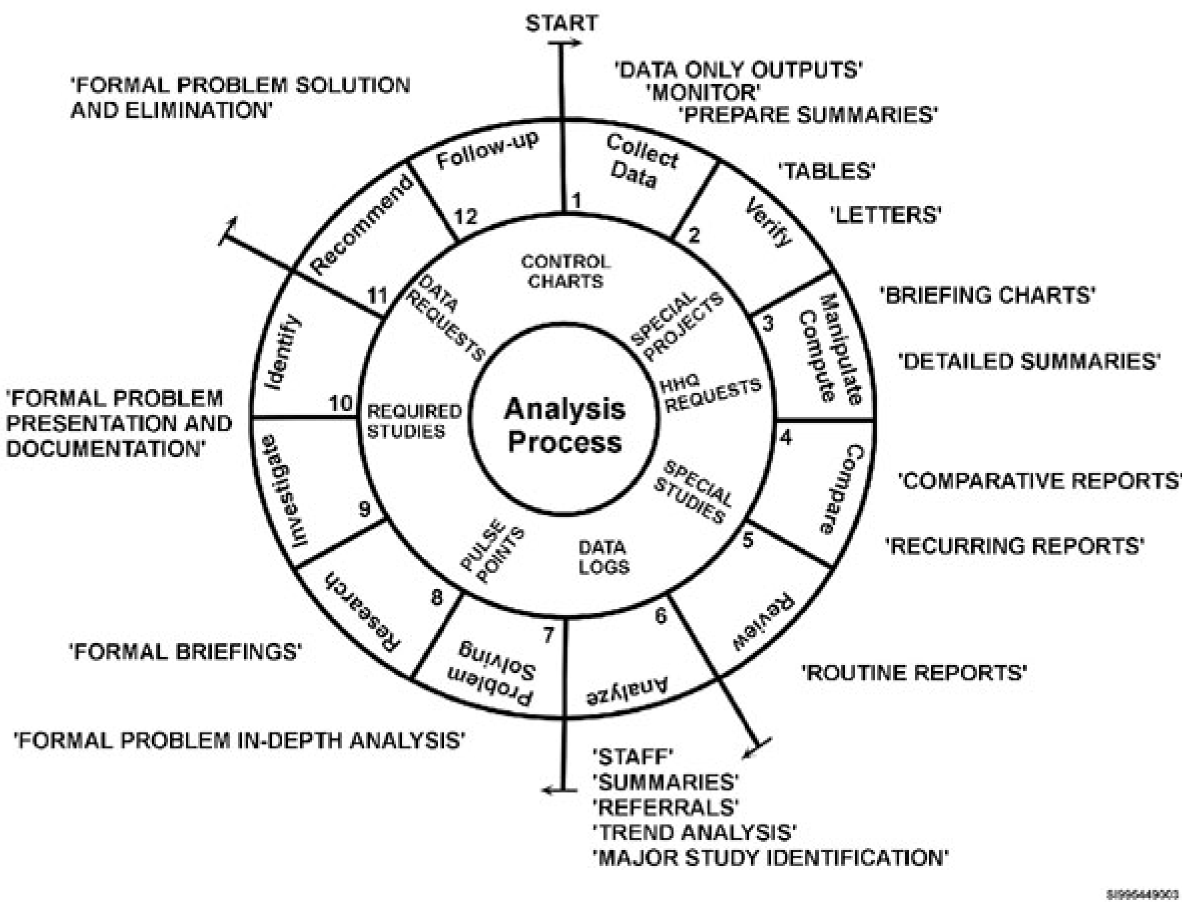

Figure 4–1. The 12-step analysis process.

040. Applying the 12-step process principles

You must be able to apply the 12-step analysis process to real-world problems with a high degree of confidence in the results. Since an important part of the process deals with statistical tests and their interpretation, you must be familiar with the operating concept of statistical analysis.

In your journeyman upgrade training, you became familiar with the procedures you follow when conducting a statistical study. Using the same problem, let’s apply the 12-step analysis process but discuss further “how”, “why”, and “when” each step is used and the relationships between the steps.

Problem

You will find that the same scenario was used in volume 4 of your upgrade training to journeyman under “Applying the 12-step analysis process.” You may find it helpful to review before continuing this lesson.

Suppose the group commander feels your base (base A) is having a higher not mission capable due to maintenance (NMCM) rate than normal. For comparison purposes, we have obtained 12 months’ NMCM percent’s and percent of overtime man-hour data (fig. 4–2), for your base and a base with a similar mission and equipment. You must determine if a problem actually exists. You will be presented questions within each step. The answers determine your next course of action.

NMCM Rates			Percent of Overtime Man-hours	
Month	***Base A***	***Base X***	***Base A***	***Base X***
Jan	7.5	3.7	6.9	4.8
Feb	4.3	4.1	5.3	4.7
Mar	4.1	4.3	5.2	4.5
Apr	4.6	3.6	5.3	4.6
May	4.7	4.5	5.4	5.2
Jun	4.9	4.5	5.5	4.7
Jul	5.1	4.2	5.4	5.3
Aug	5.0	4.4	5.4	5.1
Sep	5.1	3.9	5.5	4.9
Oct	5.4	4.5	5.4	4.8
Nov	5.3	4.1	5.9	5.0
Dec	5.7	4.2	6.6	4.7

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Figure 4–2. NMCM rates and overtime man hours.

Collect data

Before you collect any data ask this question. Is there a simple explanation? If you answered yes, provide the answer and document your findings. If the question is no, then start collecting the data and ask these questions as you refer to FO11:

- What data is needed?
- Who has the data or information on the subject?
- Are there any other sources?
- What additional information can be obtained?
- How will it be used?
- What data do we have?
- How long will it take to collect?

Once you have collected the data, ask yourself "is more data required?" If you are unsure, then make sure the problem is clearly defined. If the problem is not clearly defined go back to the data itself or the one who identified the problem.

You have collected 12 months of NMCM rates and overtime man-hour rates for your base and base X. Look back over the questions above and determine if they have been answered before moving to the next step. Remember not to overlook any available source. Use existing maintenance summaries, reports, telephone calls, and anything else you may think of. It is never a bad move to collect as much data as you can to begin, just make sure it is not meaningless data. Experience helps you determine what you should go after.

Verify

As you verify the data refer to the 12 step analysis FO12 and ask these questions:

- Are the sources reliable?
- Is there a second source to verify or use to check the data or information with?
- Is this in a TO or publication?
- Is this individual a subject matter expert?
- Is this the right data?
- Is another source needed?
- Is this all the data needed including past performance and standards?
- Have all sources been checked for additional data related to scope of study?
- Is there data to be manipulated, computed or graphed?
- Is a review of new data going to clarify information?
- Has data been analyzed previously?
- Can anything be inferred by new information?
- Is the research complete?
- Is the investigation complete?
- Have all problems been identified and solutions worked through?

You cannot overemphasize the verification step! Even though it is the second step in the 12–step analysis process, it is the first step that makes or breaks credibility; therefore, verify all data you use. Verification occurs many times throughout the 12–step analysis process as outlined in the questions above. It also requires you understand the data systems and other sources from which you draw your information.

As you answer these questions, verify the12 months of NMCM rates and overtime man-hour rates for your base and base X allowing you to continue to the next step.

Remember your findings and conclusions will only be as good as the data collected or your available data. This occurs throughout each of the 12-step in the analysis processes.

Manipulate/compute

As you move to the manipulate/compute step refer to the 12-step analysis FO13 and ask these questions:

- What is the best way to show the data?
- Have other types of graphs and charts been looked at to display the data?
- Have all descriptive statistics been calculated?
- Did the data need to be converted from nominal and ordinal to ratio or interval?
- Does the data need to be converted?

- Have all descriptive statistics been calculated?
- Have the calculations been verified?
- Have charts, graphs and tables been developed?
- Is like data, standards or past performance available to compare it to?

The most common approach is to arrange maintenance data in a chronological order. Figure 4–2 has been set up in this way. As you decipher your conclusions to these questions, your end result of manipulating and computing will illustrate a graphic representation to easily observe possible relationships or differences of the12 months of NMCM rates and overtime man-hour rates for your base and base X. When you have demonstrated this, you are ready to move on to the next step. Figures 4–3 and 4–4 show NMCM and overtime data plotted graphically. Remember that your findings and conclusions will only be as good as your data.

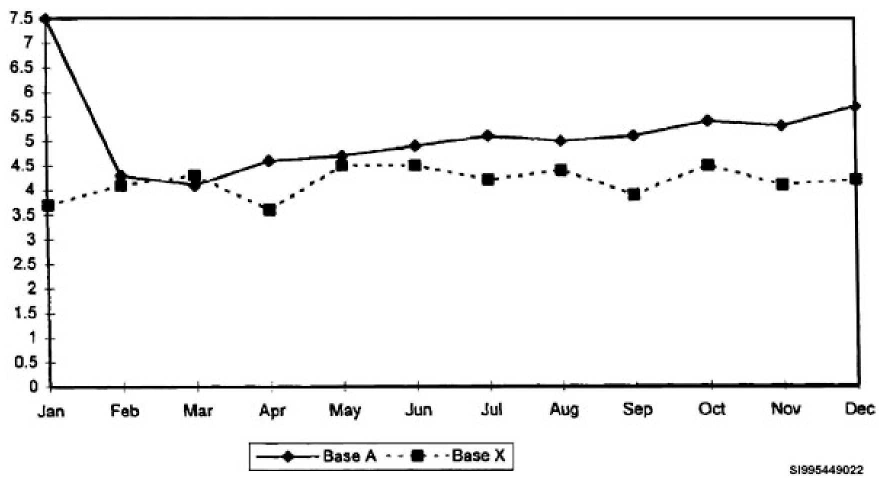

Figure 4–3. NMCM rates.

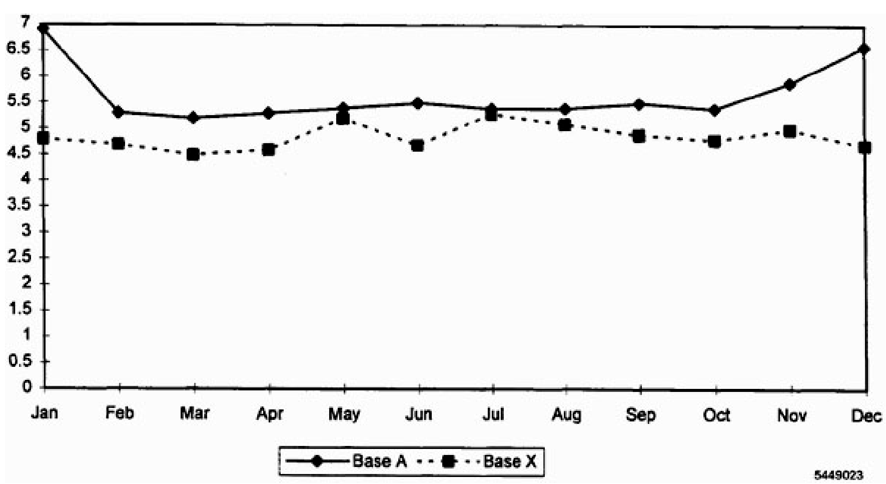

Figure 4–4. Overtime rates.

Compare

As you move to the compute step, refer to the 12-step analysis FO14 and ask these questions:

- Are there more deviations than expected?
- Is there a trend?

- Is it stable?
- Is it positive or negative?
- Are there data points that need to be explained?
- Did the data show increases or decreases where anticipated?
- Did it meet goals or standards?
- How does it compare to other organizations, units, and benchmarks?
- Can a critical evaluation of the data be accomplished?
- Does the data follow patterns of past performance?
- Is this all the data required or available?
- Have the calculations been verified?
- Has everything been calculated or charted?
- Have all charts and tables been compared to standards, past performance, or expected results?

By speculating your answers from these questions, in comparing the 12 months of data, you should come to the assumption that a problem does exists. As an analyst it is up to you to find out the "WHY." One never assumes; one proves. Through the field of statistical analysis, you will have to use statistical testing to prove or disprove this hypothesis regardless of what the metrics portray.

Review

As you move to the review step, refer to the 12–step analysis FO15 and ask these questions:

- Was the original concern sufficiently explained?
- Was the original question the correct one to ask?
- Should the original concern be restated?
- Are there extreme values in the data?
- Are answers available for obvious questions?
- Are there seasonal or cyclic variations?
- Are there abrupt changes in the data?
- What caused these changes?
- Was a summary of information developed?
- What is the next process based on available data?
- Is more data required?
- Has information and data been verified?
- Are there more calculations to do?
- Was it compared to similar data or standards?
- Is the concern answered?

While asking yourself these simple questions when reviewing the 12 months of data, look within your MMA section and have fellow analyst to assist in this step. Gather the experience of others and get their perspective. You will find most analysis products end at this step. Accuracy is the key at this point. This is when you will find yourself thinking outside the box. What data or information has gone unnoticed? This is an ongoing step throughout all the steps just like the verification step.

Analyze

The better you understand statistical testing and what it tells you the easier it will be to accept or reject your hypothesis statement. The steps you learned to perform the statistics from your journeyman CDCs and the hypothesis testing flow chart FO1 will help you navigate the statistical process. Analyzing the data, drawing appropriate conclusions, and presenting findings are crucial in this step. Through this set of instructions you need to know *what*, *when*, *why* and *how* to apply the analysis process to study real-world problems. The analysis step proves or disproves our hypotheses statement.

As you move into the analyze step, refer to the 12-step analysis FO16 and ask these questions:

- What is the makeup of your organization?
- What is the structure of the unit?
- What is the mission of the unit?
- Who are the agencies with a stake in or are responsible for the process?
- What are the meaning and application of each statistic used?
- What other tools are available (Pareto, seasonal variations, control charts, linear regression, extrapolation, cause and effect diagram, etc.)?
- Do you know what the statistics tell you?
- What are the elements that make up a particular statics?
- Are they meaningful?
- What effect does a change in one element have on the statics?
- What effect does one statistics have on the values of other statics?
- How accurate are your sources of data?
- Has the null hypotheses been stated?
- Is this nominal or ordinal data?
- Can the data be converted?
- Is data from a normal distribution?
- Have the proper sequence of hypotheses tests (parametric: Shapiro Wilks normality test, T-test outliers, F-test, Cochran's C test, ANOVA test, t-test for samples, z-test large, z-test proportions or non-parametric: Mann-Whitney U, Kruskal-Wallis H, chi square tests, Kendall's S test, Pearson's or Spearman's correlation) been performed?
- Has the correct level of significance been specified?

Referring back to the original problem statement of base A having a higher NMC rate due to maintenance higher than normal compared to base X, have you performed the necessary statistics in the analysis step to either prove or disprove your original hypotheses statement? Does base A have a higher NMC rate? Have you proved your commander's assumption correct or not? If so, what would be your next course of action? Even up through this step of analysis, you may still have to go back to your first step and collect more data.

Problem solving

As you move into problem solving, refer to the 12-step analysis FO17 and ask these questions:

- Does the analysis indicate a problem?
- Do we need to restate the problem?
- What are the significant test results?
- What do the results mean with reference to the problem in plain English?
- What factors can be eliminated by the test results?
- What areas need to be researched (static information) and/or investigated (people, processes, hands-on)?
- DOCUMENT EVERTHING INFERRED!

- Is all the data available?
- Have the calculations been verified?
- Are there more calculations to do?
- Was it compared to similar data or standards?
- Was a review completed?
- Is the concern answered?
- Is there more to be analyzed?

Has your analysis confirmed a problem actually exists from the original issue presented by your group commander that should be a concern? If not, further research might be required to determine the actual problem.

Research

As you move into research, refer to the 12-step analysis FO18 and ask these questions:

- What information is available?
- Can other sections help solve this problem?
- Can you relate pertinent information to the problem and significant test statistics?
- What questions still remain?
- What are the root causes of the problem?
- What pubs and tech data is available?
- Who has logs with information?
- Are there any databases with more data?
- Is all the data available?
- Have the calculations been verified?
- Have all charts and calculations been completed?
- Was it compared to similar data or standards?
- Was a review completed?
- Is the concern answered?
- Is there more to be analyzed?
- Can anything else be inferred?

At this point, you must gather all the reference data needed (e.g., Google a topic of interest) to successfully support your findings. In an actual situation, this is where you make phone calls to collect factual and opinion data from shop chiefs, maintenance people, mechanics, QA, coworkers, and so forth. While you can probably think of many reasons for these high rates, you must be patient and ensure you thoroughly investigate the subject before reaching a conclusion.

Investigate

As you move to the investigate step, refer to the 12-step analysis FO19 and ask these questions:

- This step requires movement away from the office and out to the field!
- Were questions asked?
- Have all ideas been solicited?
- Have statements been verified or is information conflicting?
- Has the process been witnessed?
- Have parts been viewed?

- Are the parts small enough to show in briefings?
- Are surveys required to get additional information?
- Why does the problem exist?
- Has a stop gap (Band-Aid) been applied to temporarily mask the problem?
- Are other problems discovered as part of the problem?
- Is all the data available?
- Have the calculations been verified?
- Have all charts and calculations been completed?
- Was it compared to similar data or standards?
- Was a review completed?
- Is the concern answered?
- Is there more to be analyzed?
- Can anything else be inferred?
- Is more research required?

The investigate step goes along in researching the problem. This involves moving out from behind your desk to dissect the data you have researched. What did you find when you visited the maintenance shops that are experiencing high amounts of maintenance actions? Have you talked to the subject matter experts about what they identified as problem areas? Does your research and investigation regarding the problem correlate? Have you identified what the problem is based on your research up to this point? Remember to stay on track, any additional information not significant to your investigation should be followed up at a later time.

Identify

As you move to the identify step, refer to the 12-step analysis FO20 and ask these questions:

- What is the cause of the problem?
- What are the contributing factors?
- What problems were found that are unrelated to original problem?
- Were all deficiencies that caused the problem identified?
- Has the objective been kept in sight?
- Document EVERYTHING that has been identified.
- Do the conclusions reached fix the problem?
- Have noncontributing factors been identified?
- Is all the data available?
- Have the calculations been verified?
- Have all charts and calculations been completed?
- Was it compared to similar data or standards?
- Was a review completed?
- Is there more to be analyzed?
- Can anything else be inferred?
- Is more research required?
- Is the investigation complete?
- Is the concern answered?

At this point, have you identified the problem that is present from your analysis and investigating? Make sure to document all the reasons that caused the problem. This prepares you in putting together your recommendation(s).

Recommend

As you move into the recommendation step, refer to the 12-step analysis FO21 and ask these questions:

- What are the possible solutions?
- What are the causes and the effects of the problem?
- Were conclusions drawn from the data, research, and investigations performed?
- What recommendations are appropriate?
- Is everything documented?
- Has an outline been created?
- Are the materials organized?
- Is a written narrative appropriate?
- Has it been edited?
- Is a briefing required?
- Who is the audience?
- What do they know about the concern/problem?
- What is the best type logic to use when organizing the information for a written narrative or briefing?
- Are the recommendations meaningful?
- Was the objective met (to identify the cause and provide a logical explanation)?
- Is reference material available to format the written narrative?
- Is all the data available?
- Have the calculations been verified?
- Are there more calculations to do?
- Was it compared to similar data or standards?
- Is the concern answered?
- Was a review completed?
- Is there more to be analyzed?
- Can anything else be inferred?
- Is more research required?
- Is there more to investigate?
- Was something missed?
- What type of out brief is expected (formal or informal)?
- In preparing a briefing of the study; did you remember to consider all audiences?
- Have you written up findings in a memo/report and verbally briefed individuals with concern?
- File report in follow-up folder?
- Have you presented briefing and copy of study to individuals who need to know?

- Has enough time passed since closing study?
- Let time pass.

Have you identified the cause and recommended a logical solution(s)? When you present a meaningful study, leadership should adopt your recommendation(s). Presenting a study will be further discussed in another volume. Do not worry your recommendation(s) is not adopted; you achieved your objective by providing a rational explanation of the problem presented. At this point it seems you are done, but there is one more vital step.

Follow-up

As you move into the follow-up step, refer to the 12-step analysis FO22 and ask these questions:

- Is the analysis complete?
- Has sufficient time passed?
- Have positive results been sustained?
- Has the process changed?
- Has it reverted to the old way?
- Was the proper action taken?
- Was the study and results a success?
- Has all significant data/information been monitored?
- Have follow-up actions been documented?
- Has management been informed?
- Is continuous monitoring still necessary?
- Collect data?

You must follow up on the study for it to be affective! Have you checked to see if the applied solution(s) has actually solved the problem? Has the NMCM rate gone down, leveled off, or increased? Asking similar questions indicates if further study is needed to find resolution. You have to stay on top of the whole process until you are sure affective actions have been presented to management to use in resolving the problem(s).

041. Operating principles to preparing and presenting findings/special studies

Most people in your career field have *NEVER* seen or done a study of any type! There are three primary reasons for this:

- They or their leadership see little or no value for the amount of time/effort spent on it.
- They *DO NOT KNOW* how to do one period!
- They are intimidated by the analysis process itself.

Special studies of any kind are your job! The more special studies you do, the better you get at it. With knowing this information people often wonder, why should I even bother doing them at all then? Special studies is a great tool for you to identify the following:

- Any areas needing process improvements.
- Development of skills to help towards promotion.
- The opportunity to educate leadership on the capabilities you have (builds your credibility).
- Recognition for your people and section.
- Studies are a great time and fun to do. YES—FUN!

What constitutes a special study?

Often, people in your career field do not realize what constitutes a special study to take place. Some normally think of them as huge projects that take months if not years to complete. (Some studies do, but most do not take that long.) Some studies can be small, fast, and as short as a one page report. Most studies can be done around your routine work over a few days or weeks depending on how long the study takes. Special studies are your tool for studying and highlighting problems occurring in your maintenance community. Even if it is a minor issue that can affect things Air Force-wide, it is your duty as analysts to *SHOW THE PAIN*!

When it comes to conducting a special study of any type, there are four basic required elements that you will need:

1. Identify clearly what the problem is.
2. Gather all of the information (what data is needed, what source documentation will be used, who to talk to, etc.)
3. Analysis (all parts as a whole) is needed to *THINK.*
4. Summarize everything; come up with any conclusions from your findings and any recommendations that can be made from it.

When doing these studies, you need to see if your analysis is germane to the problem identified.

When creating a special study report, there is a basic format used in the analysis community:

- BACKGROUND: Why is the study being done?
- INVESTIGATION: What did you look at? Are you looking for any particular reason? Is there something that was excluded and if so, how will it be explained.
- FINDINGS: What were all the factors bearing on the problem?
- CONCLUSIONS: What is germane to the problem? What is the result from the facts that were gathered in relation to the problem?
- RECOMMENDATIONS (MUST Dos): States who needs to do what; places the basis of the recommendations on the conclusions that were previously identified; and *MUST* address the problem.

Everything that is done with the study must tie back in to the original problem. In a way, you are generating change in procedures and that is the objective of doing studies.

Things to know up front

When you are doing any type of study or investigation, you need to know a few things up front before just diving in:

- Make sure you clearly define and state the problem. If you do not do this, you will end up traveling down “bunny trails.” In other words, you will be investigating things that will steer you away from the actual problem.
- Be absolutely brutal on your editing of *EVERYTHING* you include in your reports. This includes any charts, people that you talked with, and even your writing of the report itself.
- Go *OUT* to seek your answers; only a few things can be done from behind the computer.
- Make sure you brainstorm early on how you are going to engage the study.
- *Do not* expect any “thanks” from the people you are doing these for; there are very few people that are ever happy you are in their business. It is our job to be in their business, and this is supposed to be a thankless job.
- Do not let others’ questions drive the study. You are the expert. If you let other people lead you, they will end up taking you in the wrong direction.

The Ten Commandments of Analysis

Most people think they know the commandments but in reality they cannot even name or even explain them. People that think this way are unlikely to take the time to research a problem with any great care or precision. Let this list keep you motivated in your search for answers.

1. *Analysis without special studies is NOT analysis*—it is straight up 'bean counting' data processing at the lowest order.
2. The 12–Step Approach to Analysis takes a *team effort* to complete.
3. There is always a way to measure something.
4. You must *clearly define the problem*, and then work toward a solution.
5. All of your facts and numbers will generate questions and steer you to their answers. *Opinions mean absolutely nothing*!
6. Harness LOGIC and REASONING in the relentless drive to answer the question *WHY*.
7. Analysts get paid to *think*—computers do not.
8. Good analysis will *prove or disprove* something, bad analysis will lead to even more problems.
9. The best analysis results in some form of positive change.
10. An analyst's job is *never finished*. It is always continuous.

Every tool used in analysis is a language of its own. Learn how to interpret those languages to others that do not know, and watch your work come to life! Any analysis section not producing decent special studies will never have the respect of the leadership it works for because it does not take the analysis craft seriously enough to do anything but the basics.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

039. Reasoning behind the 12–step analysis process

1. Determine how you would begin performing the analysis process?

2. Explain why the 12–step analysis process is a multifaceted approach in solving management problems?

040. Applying 12–step analysis process principles

1. How often should you collect data or ask if data is available?

2. Differentiate the Analyze step from the Problem-solving step?

3. Explain the differences between Research and Investigate steps?

4. If base X commander comes to you and states there is a negative increasing trend in a lagging indicator. Describe the steps you would take to prove or disprove it? Explain why? (Use FO1 and FO10 to help answer this question.)

5. You find out that while conducting your correlation analysis of the TNMCS rate vs CANN rate, you discover that there is no Homogeneity of Variance. What would be your next step? Explain why? (Use FO1 and FO10 to help answer this question.)

041. Operating principles to preparing and presenting findings/special studies

1. How do you determine if your analysis is relevant in identifying the problem?

2. When you have proven or disproven something, what have you done?

Answers to Self-Test Questions

030

1. H_0.
2. The null hypothesis assumes that everything is fine, there is no problem, and there is no significant difference between two or more population samples.
3. Null hypothesis
4. The hypothesis available for acceptance if the null hypothesis is rejected.
5. The significance level used in the comparison.

031

1. Parametric tests make strong basic assumptions about the parameters and the shape of the populations. Nonparametric tests have less rigid requirements and make no assumptions about the shape of the populations.
2. Parametric.
3. Interval and ratio.
4. (1) Samples must be independent and randomly selected.
   (2) Data must be of the ratio or interval scale.
   (3) Data must be continuous and normally distributed.
   (4) Samples must display homogeneity of variance.
5. Ordinal, interval, ratio, and nominal.
6. Chi-square tests.
7. Critical values.
8. (1)Whether the data discrete or continuous; (2) if the data normal; (3) if there are any outliers; (4) whether the data display homogeneity of variance; (5) if the data display homogeneity of means; and (6) whether the samples display homogeneity.

032

1. To test extreme values (both high and low) to determine if they are outliers or if they are part of the process under study.
2. Plot the data on graph paper.
3. 6.
4. The extreme value should be eliminated from further computations.

033

1. It determines if there is a significant difference between two variances.
2. 2.42.
3. 23.
4. The variances are not significantly different.

034

1. $\sqrt{\frac{300+180}{14+22-2}\left(\frac{1}{14}+\frac{1}{22}\right)} = 1.285$
2. 34.

035

1. $\frac{24-30}{4} = 1.5$
2. $\sqrt{48^2 + 66^2} = 81.61$
3. Normal curve tail area table.

036

1. As one sample.
2. $U_1 = 93$; $U_2 = 17$.
3. The smallest one.

037

1. Ordinal.
2. Excessive ties tend to weaken the test.
3. Chi-square test.
4. 2.87.

038

1. It tests whether a significant difference exists between the observed number of frequencies falling in each category and the number of frequencies expected to fall in each category.
2. If you use two categories, the expected frequencies must be at least five. If you use more than two categories, expected frequencies per category must never be less than one.
3. $E = \frac{\Sigma O}{K}$
4. There is a significant difference between the observed frequencies and the expected frequencies in our categories or samples.

039

1. Begin by gathering the facts, keeping assumptions to a minimum, not jumping to conclusions, asking yourself several important questions, and to always remember that as analyst you don't guess; you test. Is the problem clearly defined? Has the scope of the analysis been defined? Is there a simple explanation? Are the facts real? Are all the facts there, or are more facts available elsewhere? How do the facts compare to what you expected? Can you mold the facts to tell the story accurately? How do you think the story will end? Identify and examine everything that affects your interpretation of the facts. Are problems caused by something or someone? How and why? Should procedures be changed? Has the facts pointed to a corrective-action(s) which leads to a recommendation(s)?
2. There will be times that you will use each step of the process and at others you will only use some of the steps. These are the processes, rarely in order, repeated many times, never ending. The problems you encounter determine the steps you will follow.

040

1. Throughout each of the 12 steps in the analysis processes.
2. The analysis step proves or disproves your hypotheses statement. The problem solving step is taking your analysis to confirm that the initial problem statement is actually a concern.
3. In the Research step you gather all the reference data needed to successfully support your findings. You make phone calls to collect factual and opinion data from shop chiefs, maintenance people, mechanics, QA, coworkers, and etc. In the Investigate step you move out from behind your desk and visit the maintenance shops and talk to the subject matter experts about what they have identified as problem areas.
4. Referring to FO10 "The Analysis Wheel" walk through each of the steps: Collect Data, Verify, Manipulate & Compute, Compare, Review, Analyze, Problem Solving, Research, Investigate, Identify, Wrap-up, and Follow-up. During the analyze step refer to (FO1) Hypothesis Testing Flow Chart and follow the hypothesis of trend route by using the Kendall's test for significance of trend to prove or disprove the increasing trend in lagging indicators.
5. Referring to FO10 "The Analysis Wheel" walk through each of the steps: Collect Data, Verify, Manipulate & Compute, Compare, Review, Analyze, Problem Solving, Research, Investigate, Identify, Wrap-up, and Follow-up. During the analyze step refer to FO1 Hypothesis Testing Flow Chart and follow the hypothesis of correlation route. Since no Homogeneity of Variance was found looking at the hypotheses testing flow chart (FO1) you would have to drop down and perform the Spearman's Rank of Correlation Coefficient instead of the Pearson's.

041

1. Even if it is a minor issue to something that can affect things Air Force wide, it is our duty as analysts to SHOW THE PAIN! If you are showing the pain your analysis is relevant.
2. Good analysis results in some form of positive change by proving or disproving something. Bad analysis will lead to more problems.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

Do not return your answer sheet to AFCDA.

71. (030) Which type of hypothesis assumes there is a significant difference between two or more population samples?
    a. Alternate.
    b. Directional.
    c. Null or given.
    d. Directional given.

72. (030) When conducting hypothesis testing, you *minimize* the chance of making an error by setting a
    a. sample size.
    b. control limit.
    c. level of variance.
    d. level of significance.

73. (031) Which characteristic *best* applies to a parametric type of statistical test?
    a. It uses discrete data.
    b. It consists of ranking tests.
    c. It uses the ordinal measurement scale.
    d. The random samples should be from a normal distribution.

74. (031) Which statistical test makes no assumptions about the shape of the populations from which the samples come?
    a. Parametric.
    b. Directional.
    c. Nonparametric.
    d. Nondirectional.

75. (031) How do you treat outliers that you find during parametric testing?
    a. Stop parametric testing and invalidate the test.
    b. Keep them with the data and continue with the testing.
    c. Eliminate them from the data and continue with the testing.
    d. Stop parametric testing and use nonparametric testing instead for the outliers.

76. (032) In parametric testing, a T test is a one-tailed test because
    a. only one factor is used.
    b. only one tail of your sampling distribution is used.
    c. both tails of the sampling distribution are used together.
    d. one tail of the sampling distribution is subtracted from the other.

77. (033) In parametric testing, the purpose of an F test is to determine
    a. goodness of fit.
    b. the existence of outliers.
    c. if significant differences exist between two modes.
    d. if significant differences exist between two variances.

78. (033) What does the mean of the squared deviations from the arithmetic mean represent?
    a. Variance.
    b. Significance.
    c. Homogeneity.
    d. Standard deviation.

79. (034) For a T test, what should the sample size be for differences between sample means?
    a. Less than 10.
    b. Less than 30.
    c. Larger than 30.
    d. Larger than 50.

80. (035) The z test is considered a two-tailed parametric test because
    a. it is used with small samples.
    b. no direction is indicated in the distribution.
    c. the direction is indicated in the distribution.
    d. of the normal curve area table for its distribution.

81. (036) When the basic assumption for a z test for means *cannot be met*, which test should you use?
    a. T test for outliers.
    b. Kruskal-Wallis test.
    c. Chi-square (χ^2) test.
    d. Mann-Whitney U test.

82. (036) In nonparametric testing, why is the U test statistic converted to a z deviate when the sample size is greater than 20?
    a. No table exists for comparing U statistics.
    b. z deviates are easier to work with than U statistics.
    c. The U statistic can be compared to the table of U critical values.
    d. The sampling distribution of U rapidly approaches the normal distribution.

83. (037) What is the *minimum* number of independent samples needed for the Kruskal-Wallis H test?
    a. 1.
    b. 2.
    c. 3.
    d. 4.

84. (037) The Kruskal-Wallis H test requires data from *at least* which scale?
    a. Ratio.
    b. Interval.
    c. Ordinal.
    d. Nominal.

85. (038) In nonparametric testing, what number of samples can the χ^2 test be used for?
    a. No more than two samples.
    b. Any number of samples.
    c. Three to five samples.
    d. Only one sample.

86. (039) You have determined a special study is needed and have identified a negative trend impacting the fleet’s lagging indicators. As you begin asking questions, which one of your answers would be an assumption?
   a. I do not have all of the facts.
   b. The problem is clearly defined.
   c. The pro-super thinks it could be due to a faulty pump.
   d. The hydraulic pump procedures need to be investigated.

87. (040) If base X commander identified that there is a decrease in a leading indicator, what would you use to support that statement?
   a. z-test for proportions.
   b. T-test for outliers.
   c. Kendall’s S test.
   d. Chi-square test.

88. (040) You have presented a special study and your recommendations have been taken in consideration. What is your *next step*?
   a. Brief work centers on corrective action.
   b. Discard the report and all findings.
   c. Report numbers to the major command (MAJCOM).
   d. Schedule a follow-up.

89. (041) When preparing to present a special study report, what is the basic format used in the analysis community?
   a. Background, Investigation, Findings, Conclusions, and Summarize.
   b. Background, Identify, Findings, Conclusions, and Recommendations.
   c. Background, Investigation, Findings, Conclusions, and Recommendations.
   d. Background, Investigation, Findings, Special Study, and Recommendations.

90. (041) When you have proven or disproven something, you have presented
   a. an analysis that resulted in a positive change.
   b. an analysis that led to more problems.
   c. a solution that solved the problem.
   d. an analysis that uncovered nothing.

Student Notes

Glossary

Symbols, Abbreviations, and Acronyms

α	alpha
σ	sigma
°C	degree Celsius
°F	degree Fahrenheit
ACC	Air Combat Command
ACM	aircraft configuration management
ADR	aircraft document review
AETC	Air Education and Training Command
AF	Air Force
AFB	Air Force base
AFCEC	Air Force Civil Engineer Center
AFCSM	Air Force computer system manual
AFH	Air Force handbook
AFI	Air Force instruction
AFMAN	Air Force manual
AFMC	Air Force Materiel Command
AFMCI	Air Force Materiel Command instruction
AFMCMAN	Air Force Materiel Command manual
AFPD	Air Force policy directive
AFR	Air Force Reserve
AFTO	Air Force technical order
AGE	aerospace ground equipment
AHE	automated history entry (TRIC)
ALC	Air Logistics Complex
AMC	Air Mobility Command
AMU	aircraft maintenance unit
AMXS	aircraft maintenance squadron
ANG	Air National Guard
ANOVA	analysis of variance
ASD	average sortie duration
ATC	action taken code
AVDO	aerospace vehicle distribution officer

AVUM	aerospace vehicle utilization monitor
BAI	backup aircraft inventory
BPO	basic post-flight
CAD	cartridge-activated device
CAF	Combat Air Force
CANN	cannibalized
CC	commander
CCB	Configuration Control Board
CCI	controlled cryptographic items
CCY	calculated cycle
CD	compact disc
CDB	central data base
CDC	career development course
CE	civil engineering
C-E	communications-electronics
CEMS	Comprehensive Engine Management System
CND	cannot duplicate
CONUS	continental United States
COT	current operating time (report)
CPIN	computer program identification number
CPINS	Computer Program Identification Numbering System
CSAF	Chief of Staff of the Air Force
CTOM	Centralized Technical Order Management
DCC	dedicated crew chief
DD	deferred discrepancy
df	degrees of freedom (sample size minus one)
DIT	data integrity team
DLR	direct line reporting
DMMIS	Depot Maintenance Management Information System
DOD	Department of Defense
DOI	date of installation
DOM	date of manufacture
DRU	direct reporting unit
ECM	electronic countermeasures
ECP	engineering change proposal

ECR	engineering change request
EHR	event history recorder
EIM	engine inventory manager
EIMSURS	Equipment Inventory, Multiple Status, Utilization Reporting Subsystem
EM	engine management
EMDL	engine manager’s daily listing
EOR	end-of-runway
EOT	engine operating time
ETIC	expected time in commission
ETTR	engine time and temperature recorder
EWO	emergency war order
FCF	functional check flight
FHP	Flying Hour Program
FMC	fully mission capable
FO	foldout
FOA	field operating agency
FSE	flying scheduling effectiveness
FTD	field training detachment
FW	fighter wing
GCSAS	Generic Configuration Status Accounting Subsystem
GLC	geographic location
GP	general purpose or group
GSD	General Support Division
GSU	ground station unit
GTM	master identification/inspection schedule report (TRIC)
GUI	graphical user interface
HAZMAT	hazardous material
HHQ	higher headquarters
HMC	how malfunction code
HPO	hourly post-flight
HQ	Headquarters
HSC	home station check
HUTE	hourly utilization
IAE	equipment installation (TRIC)
ID	Identification

IFE	in-flight emergency
IM	item manager
IMDS	Integrated Maintenance Data System
IMS	Information Management System
IPI	in-process inspection
ISO	Isochronal
ISP	inspection load/change/delete/inquiry all equipment except engines (TRIC)
ITCTO	interim time compliance technical order
ITF	inspection/time change/TCTO forecast (TRIC)
JAATT	joint air/airborne transportability training
JCN	job control number
JDC	job data collection (TRIC)
JDD	job data documentation
JDM	job data documentation menu (TRIC menu)
JFF	job flow package shop data
JFI	job flow package inquiry
JFP	job flow package
JML	job standard master listing
JST	job standard
LAN	local area network
LCF	low cycle fatigue
LCN	logistics control number
LO	low observable
LOAP	List of Applicable Publications
LRS	logistics readiness squadron
LRU	line replaceable unit
MAF	Mobility Air Force
MAJ	major
MAJCOM	major command
MASO	munitions accountable systems officer
MC	mission capability or manual cycle
MDC	maintenance data collection
MDS	mission design series
MIN	minor
MIS	Maintenance Information System

MMA	Maintenance Management Analysis
MMI	man-to-machine input
MO	maintenance operations
MOC	maintenance operations center
MOF	maintenance operations flight
MP/U	maintenance personnel per operational unit
MPTO	methods and procedures technical order
MRT	mean repair time
MSD	Materiel Support Division
MSE	maintenance scheduling effectiveness
MSL	maintenance supply liaison
MTBM	mean time between maintenance
MTE	multiple tracked equipment
MXG	maintenance group
MXS	maintenance squadron
N/A	not applicable
NAF	numbered Air Force
NDI	nondestructive inspection
NHA	next higher assembly
NLT	no-later-than
NMC	nonmission capable
NMCM	not mission capable due to maintenance
NMCS	not mission capable supply
NRTS	not reparable this station
O&M	operations and maintenance
O/I	organizational/intermediate
OCF	operational check flight
OCONUS	outside Continental United States
OG	operations group
OI	operating instructions
OO-ALC	Ogden-Air Logistics Complex
OPLAN	operation plan
OPR	office of primary responsibility
OS	operational squadron
OSS	operations support squadron

PAD	propellant-actuated device
PAI	primary aircraft inventory
PC	personal computer
PDM	programmed depot maintenance
PE	periodic
PEC	program element code
PH	phase
PMC	partially mission capable
PMEL	precision measurement equipment laboratory
POC	point of contact
POL	petroleum, oil, and lubricants
POS	peacetime operating stock
PPS	Product Performance Subsystem
PR	pre-flight
PRA	planning requirements (TRIC)
PS	permanent safety
PS&D	plans, scheduling, and documentation
PSN	part/serial number
PWC	performing work center
QA	quality assurance
QEC	quick engine change
QPA	quantity per assembly
QVR	suspense validation inquiry (TRIC)
R&M	reliability and maintainability
RAC	rapid action changes
RAP	Ready Aircrew Program
RDS	Records Disposition Schedule
REMIS	Reliability and Maintainability Information System
RPIE	real property installed equipment
RSP	readiness spares package
SBSS	Standard Base Supply System
SC&D	stock control and distribution
SCR	special certification roster
SE	support equipment
SECAF	Secretary of the Air Force

SEL	part/serial number load/change/inquiry/delete (TRIC)
SF	security forces
SHD	significant historical data (TRIC)
SM	single manager
SMC	system management center
SOW	statement of work
SPM	system program manager
SPO	System Program Office
SRAN	stock record account number
SRD	standard reporting designator
SSI	system-to-system input
STL	serial number detail listing (TRIC)
SUTE	sortie utilization
TACC	Tanker and Airlift Control Center
TCC	transaction/condition code
TCI	time-change item
TCM	time change manager
TCTO	time compliance technical order
TDI	time distribution program (TRIC)
TDY	temporary duty
TEF	type make series modification (TMSM) engine forecast
TH	thru-flight
TM	technical manual
TMDE	test, measurement, and diagnostic equipment
TMS	type model series
TMSM	type make series modification
TO	technical order
TODA	technical order distribution account
TODO	technical order distribution office
TRAP	tanks, racks, adapters, and pylons
TRIC	transaction identification code
TSgt	technical sergeant
TSO	time sharing option
TWCF	Transportation Working Capital Fund
UTE	utilization

USAF	United States Air Force
WCE	work center event
WDM	workday month
WG	Wing
WLT	weapons load training
WRM	war readiness material
WSMIS	Weapon System Management Information System
WUC	work unit code
ZSC	scheduled maintenance/scheduled maintenance (job standard assigned, TRIC)

Student Notes

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