# ICBM Maintenance Metrics

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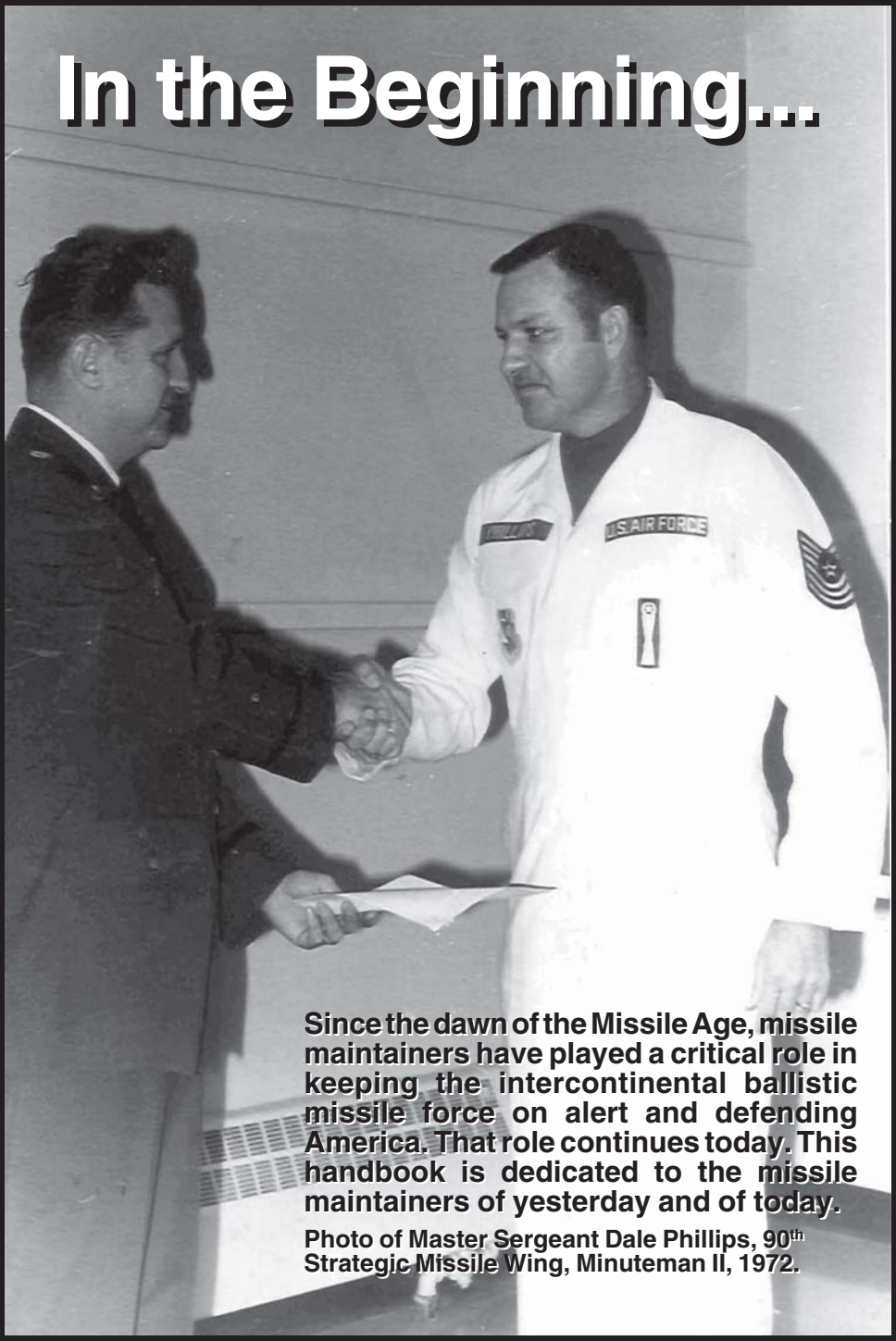
# In the Beginning...




**Since the dawn of the Missile Age, missile maintainers have played a critical role in keeping the intercontinental ballistic missile force on alert and defending America. That role continues today. This handbook is dedicated to the missile maintainers of yesterday and of today.**

**Photo of Master Sergeant Dale Phillips, 90th Strategic Missile Wing, Minuteman II, 1972.**

## Acknowledgments

Grateful acknowledgment is made to all of the members of Air Force Global Strike Command and Air Force Materiel Command who played a part in the development and production of this handbook.

Special acknowledgment is made to Mr Daniel P. Koveleskie, Deputy Chief, Missile Maintenance Division, Headquarters Air Force Global Strike Command. His help was invaluable.

# Foreword

As the Air Force continues to strengthen the nuclear enterprise, it is critical we maintain a safe, secure, and reliable ICBM force with an unwavering commitment to excellence. Today, the ICBM community is focusing on new procedures and management practices to ensure our successes of the past few years endure and nuclear surety remains paramount. A key component to process improvement is accurate and useful performance indicators, or metrics. Good metrics capture the results of our processes and directly link to strategic and tactical system goals.

**Ms Ann L. Mitchell; Air Force Global Strike Command; Director, Logistics, Installations, and Mission Support**

This handbook will not only enable a better understanding of how to measure ICBM processes today, but will also promote understanding and use of metrics effectively to drive improvement. We can never stop learning or assessing; and we can never rest when it comes to nuclear surety. It's a fundamental tenet that what gets measured improves. Diligent application of the principles in this handbook is part of rebuilding a culture of self assessment and continuous improvement based on objective data. As such, this handbook will help encourage critical thinking, improve our ICBM maintenance processes, and make a difference everyday—for our Airmen, our mission, and our nation.

ANN L. MITCHELL, SES-2, DAF
Director, Logistics, Installations, and Mission Support

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# Introduction

The purpose of this handbook is to provide ICBM maintenance leaders at both the wing and major command levels a comprehensive guide to metrics associated with ICBM maintenance management.

The key to effectively managing any process is to understand how that process is performing. The best way to understand and manage a process is to measure it through metrics. When a particular process exists at more than one location, standardization of metrics becomes especially important, as it provides a means of effective evaluation both within and across organizations.

This handbook was developed to provide a quick reference tool to enable managers at Air Force Global Strike Command and Air Force Materiel Command to effectively utilize metrics in their processes. It explains some inherent processes of ICBM maintenance and is a compilation of key metrics used to evaluate these areas.

*When a particular process exists at more than one location, standardization of metrics becomes especially important, as it provides a means of effective evaluation both within and across organizations.*

# Chapter 1
## ICBM Maintenance Metrics Basics

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## Foundations for Metrics

Managers at all levels, in all areas, require tools to better understand their respective processes. Performance indicators, or metrics, are the strongest tools for understanding a process when used correctly. Metrics should follow three basic guidelines.

- Correctly drive decisions and behavior
- Communicate a process clearly and create understanding
- Lead to improvement within a process

If your metrics do not meet these guidelines they should be reevaluated or possibly eliminated.

Metrics are indicators of processes and should be viewed in aggregate. All managers must understand that overemphasis on any particular metric, while ignoring the root cause of a problem, may improve the metric but suboptimize mission performance or create some other problem. Two metrics may be so intertwined that the manager may be unable to distinguish cause from effect. Metrics should be used to identify trends, both positive and negative, and not used as pass or fail indicators. The metrics themselves are snapshots in time, and even the best organizations will occasionally dip below standards. Good metrics analysis, however, will focus the manager on those areas requiring attention.

*Metrics are indicators of processes and should be viewed in aggregate. All managers must understand that overemphasis on any particular metric while ignoring the root cause of a problem may improve the metric but suboptimize mission performance or create some other problem.*

Metrics are not just charts and numbers. They are tools for identifying problems. If the tool does not generate questions concerning processes its value is questionable. When there is no applicable metric for driving unit performance, build one. Watch for filtering of (avoiding or ignoring) the metrics that show the *pain*. They are the metrics with the greatest value. If a metric rarely meets its prescribed standard that may imply either the standard was arbitrarily set too high or significant issues need resolution. Either way, investigation into the circumstances is warranted.

Local commanders at base level should assess the performance of their organizations based on performance indicators (metrics). These indicators reflect the *health of the force*. They provide a quantitative measure of the reliability, maintainability, and availability of the ICBM weapon system to meet nuclear deterrence mission requirements. Good metrics provide trend visibility to thoroughly investigate and analyze process behavior in order to identify areas that need specific management focus and to improve performance. Maintenance managers must understand the importance of providing accurate reports up the chain. This information and the associated analytical assessment is critical to correcting problems and identifying trends. Performance indicators are measures that should be reviewed by the organization at least monthly. They also should be published in the unit monthly maintenance summary.

*Local commanders at base level should assess performance of their organizations based on performance indicators (metrics). These indicators reflect the* health of the force*. They provide a quantitative measure of reliability, maintainability, and availability of the ICBM weapon system to meet nuclear deterrence mission requirements.*

Additionally, these same indicators should be reported to and assessed by higher headquarters and sustainment agencies (numbered Air Force, major command, Air Staff, ICBM Systems Program Office, and depot) in order to determine an aggregate combat capability of the overall force. These organizations also utilize the indicators as a valuable component of their analytical support structure to ensure the Air Force is effectively and efficiently sustaining the ICBM force.

## Fundamental Process Drivers

Production scheduling, workforce management, and maintenance training are processes that are key to maintenance support of the ICBM force and therefore should be measured.

**Production Scheduling.** Within the maintenance group, the maintenance schedule sets the pace, whether it is scheduled or unscheduled maintenance. The maintenance schedule must be built on sound principles that are clearly articulated and vigorously supported by leadership. The ICBM field dispatch is the focal point for scheduling. Resource intensive dispatch activities such as penetrated

sites, open holes, and convoys must be scheduled, integrated, and executed to optimize the efficient use of security forces, helicopter, and maintenance resources.

The establishment of an effective schedule and schedule discipline smoothes the utilization and flow of resources—the people, equipment, and consumables. The schedule becomes a contract that identifies requirements and provides a measure of stability and security for the work effort, as well as a gauge for performance.

*Effective workforce management not only promotes maintenance production capacity; it is also an essential component of weapon system safety and risk management.*

**Workforce Management.** Key to any maintenance activity is the availability of personnel. Effective managers ensure that the right personnel, with the right skills, are ready at the right time to execute the maintenance schedule. Leadership should agree on the basics of personnel management and write them down—weekend duty, training days, compensation days, work load, and so forth. Effective workforce management not only promotes maintenance production capacity, but also is an essential component of weapon system safety and risk management. Adherence to dispatch timeline limitations and team structure integrity all hinge on effective workforce management.

While maintenance will drive dispatch scheduling, it is not the only agency considered. Operations, security forces, and many other organizations are also involved. Supervision must cover the entire maintenance work cycle and strive to keep the schedule consistent throughout the week.

**Maintenance Training.** The key to maintenance success is the ability of a unit to train and prepare individuals to perform his or her assigned tasks. Training must be planned and executed in the prescribed manner so properly trained technicians can do their part to accomplish the maintenance program.

## Understanding Metrics

**Equipment and Mission Analysis.** The maintenance data analysis section provides data analysis and graphical presentations that illustrate how well mission requirements are being met. It is staffed by maintenance analysts—trained

statisticians, whose primary responsibility is to identify impending problems that require action. Its core tasks include analyzing raw data, identifying significant trends and problem areas, and presenting that information to those who can correct problems or deficiencies.

*Maintenance analysts are charged with investigating negative trends in key indicators that affect the health of the force.*

Maintenance analysts are charged with investigating negative trends in key indicators that affect the health of the force. The following are some questions ICBM maintenance analysts may consider to understand these trends and produce actionable information for leadership.

- Which systems are creating high nonmission capable (NMC) rates?
- Are these the systems that normally create high NMC rates? If so, are the rates higher than normal?
- Do NMC rates correspond to scheduled requirements (modifications or depot)? Or are NMC rates driven by unplanned failures and unscheduled off-alerts?
- What are the high-rate driving components, and what is being done (or could be done) to address the problems?
- Are key resources, security forces support, weapons storage area production capacity, or missile maintenance team availability sufficient to respond to current and emerging maintenance requirements?
- Are measures that are out of process control limits caused by normal rhythms (code change, simulated electronic launch Minuteman, hardness surveillance electromagnetic pulse) and seasonal variations in maintenance dispatch activity at northern tier bases? Or has an unexpected increase in maintenance requirements caused disruptions to the scheduling process?
- Are specific weapon systems or equipment causing trend distortions?
- What parts or components are causing not mission capable for supply conditions? Are these normal or is a new problem possibly emerging?
- Is supply support sufficient and responsive? If not, why not? Are stocks adequate?

- Is the lack of training, technical data, or tools and equipment affecting certain systems or Air Force specialties?
- Is it a unit problem or a larger force problem? Compare performance between wings.
- Where are we? Why are we there? And where are we going?

*Maintenance metrics fall into two fundamental categories—leading and lagging indicators. The theory of leading and lagging indicators is one of cause and effect. Leading indicators show a problem first, as they directly reflect maintenance's capability to provide resources to execute the mission. Lagging indicators show firmly established trends.*

**Leading and Lagging Indicators.** Maintenance metrics fall into two fundamental categories—leading and lagging indicators. The theory of leading and lagging indicators is one of cause and effect. Leading indicators show a problem first, as they directly reflect maintenance's capability to provide resources to execute the mission. Lagging indicators show firmly established trends.

A good example of leading and lagging indicators is easily explained by a simple weight-loss scenario. By measuring weight one's progress can be monitored. The likelihood of losing weight is minimal if someone merely steps on a scale once a day expecting to reach his or her goal. In order to reach the desired weight a program must be implemented and other actions must be taken, such as exercise and calorie intake awareness. In order to evaluate success these two areas should be measured. In this scenario both exercise and calorie intake are leading indicators because they affect weight, which is the lagging indicator. As exercise increases and calories decrease the lagging indicator has a better likelihood of improving. What would happen if exercise decreased and calories increased? One would probably fall farther away from the goal. By measuring the cause (leading indicator), in this instance exercise and calorie intake, the effect of weight loss (lagging indicator) will change, hopefully for the better. If not, by simply paying more attention to the leading indicators the probability of the lagging indicators trending in a desired manner increases.

ICBM performance indicators depict leading and lagging indicators with a focus on elements of reliability

and maintainability (ease, accuracy, and economy of performing maintenance actions) that are key to a weapon system support strategy. Essentially, they answer the questions how often does the system break and how efficiently can it be returned to service?

*ICBM performance indicators depict these leading and lagging indicators with a focus on elements of reliability and maintainability (ease, accuracy, and economy of performing maintenance actions) that are key to a weapon system support strategy.*

Leading indicators are those indicators that impact maintenance's capability to provide resources to execute the mission. In supporting ICBM systems, resource intensive maintenance activities requiring weapons convoys and penetrated launch facilities (LF) are key leading indicators to monitoring production capability and resource constraints that may impact the unit's ability to successfully carry out its mission, as displayed by lagging indicator rates.

The key lagging indicators include LF and launch control center capable rates, command management standard alert rate, and the ICBM raw alert rate. The raw alert rate is the primary measure for calculating ICBM availability and the ability to meet mission requirements.

Examples of lagging and leading indicators are as follows.

- **Lagging**
  - RAW—raw alert rate
  - MC—mission capable rate
  - FMC—fully mission capable rate
  - PMC—partially mission capable rate
  - PMCS—PMC for supply rate
  - PMCM—PMC for maintenance rate
  - PMCB—PMC for both maintenance and supply rate
  - NMCM (unscheduled/scheduled [U/S])—Not MC for maintenance, unscheduled or scheduled rate
  - NMCS—Not MC for supply rate
  - NMCB (U/S)—Not MC for maintenance and supply, unscheduled or scheduled rate
  - TNMCM—Total not MC for maintenance (NMCM + NMCB) rate

  - TNMCS—Total not MC for supply (NMCS + NMCB
- **Leading**
  - Delayed discrepancies
  - Dispatch deviation rate (scheduling effectiveness)
  - Cannibalization rate
  - Issue effectiveness rate
  - Stockage effectiveness rate
  - Mission capability part rate
  - Average repair cycle days
  - Inspection flow rate
  - Standby power effectiveness
  - Mean time between failures
  - Mean time to repair

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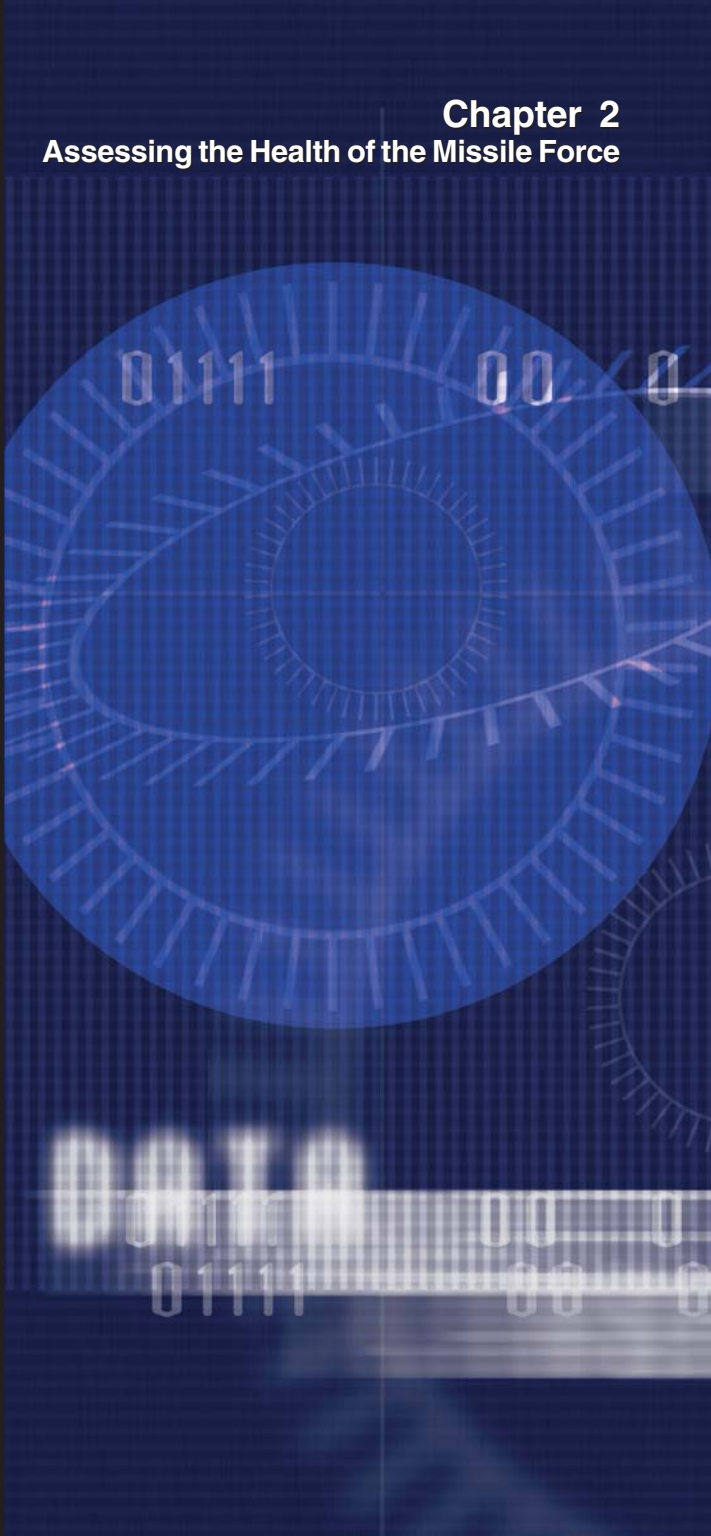


## Maintenance Analysts

The maintenance data analysis section provides data analysis and graphical presentations that illustrate how well mission requirements are being met. It is staffed by maintenance analysts—trained statisticians whose primary responsibility is to identify impending problems that require action. Their core tasks include analyzing raw data, identifying significant trends and problem areas, and presenting that information to those who can correct the deficiencies.

The analysts are the focal point for the maintenance information system (MIS) in the maintenance complex, providing assistance with information availability and data retrieval. Maintenance analysts are experts on the capabilities and limitations of the MIS used to collect raw data from across the maintenance complex. The analysts turn raw data into information (higher headquarters [HHQ] reports, special studies, and maintenance analysis or referrals) used to evaluate the effectiveness and efficiency of a unit's maintenance effort and drive effective decisions by leadership. Some of these products are used only at the unit level, while others are monitored at HHQ.

*One way to gauge a unit's performance is to compare its rates to those of other units Air Force-wide with the same mission. When a unit's rates are very different from like units it may indicate problems. Comparing present performance to past performance and current trends to past trends may also reveal insights into the relative health of a unit.*

## Gauging the Unit

One way to gauge a unit's performance is to compare its rates to those of other units Air Force-wide with the same mission. When a unit's rates are very different from like units it may indicate problems. Comparing present performance to past performance and current trends to past trends may also reveal insights into the relative health of a unit.

## Maintenance Data Integrity

The analysis of ICBM maintenance metrics—the conclusions and recommendations—are only as reliable as the data contained in the MIS. The validity of all metrics is directly related to the integrity of the data that is input by users. Consistency, standardization, and accuracy are key components to achieving data integrity.

Why is data integrity important to technicians in the field? Accurate data translates into better and more reliable equipment. ICBM sustainment agencies use the information to provide historical management information and data on equipment availability and utilization. Availability and status reporting (for example, not mission capable and partially mission capable) data is essential to building Air Force programming documents and substantiating program needs, impacts, and priorities for upgrading or replacing equipment and systems in the field. Building a case to replace aging systems and deteriorating support equipment depends on accurate data from the field.

*Use the Integrated Maintenance Data System to record the cause and duration of every ICBM status condition. The missile launch facility and launch control center designator are the governing identifiers for this system.*

## ICBM Condition Status Reporting

ICBM condition status is reported via the *ICBM Condition Status Report*. AFI 21-202 V1, *Missile Maintenance Management*, requires status monitoring of each launch facility, spare missiles, and designated mission support equipment and vehicles. Accurate and timely reporting provides increased visibility into the health of systems. It promotes swift resolution of urgent problems as well as identifying long-term sustainment needs.

Use the Integrated Maintenance Data System to record the cause and duration of every ICBM status condition. The missile launch facility and launch control center designator are the governing identifiers for this system. These reports include the condition status of the entire ICBM site, including the following.

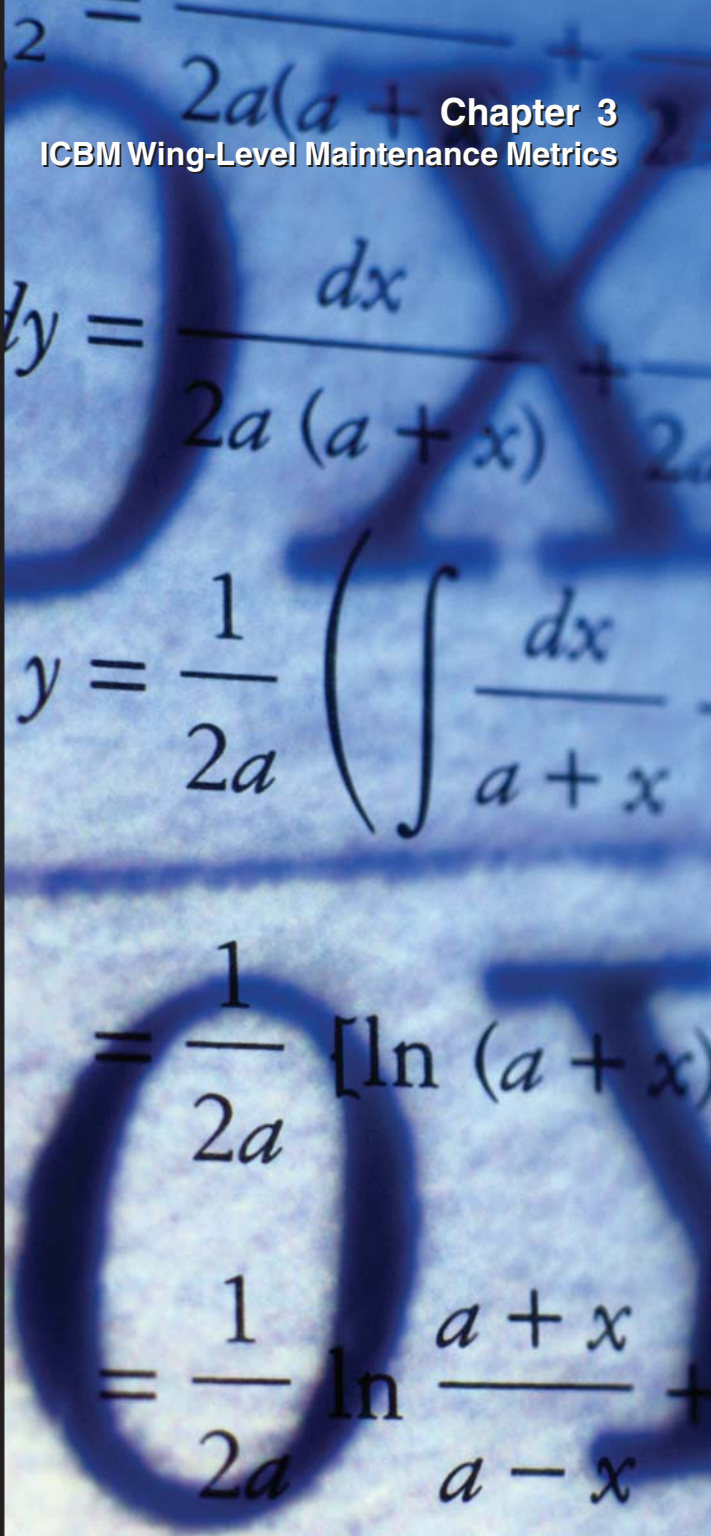
- The missile downstage or Propulsion System Rocket Engine
- Real property installed equipment
- Support equipment
- Any other equipment needed for launch or execute launch command

## Maintenance Status

The daily status summary should focus on yesterday, today, and tomorrow—what the unit did yesterday (dispatch

schedule summary, including number of planned dispatches versus number of actual dispatches and chargeable deviations), today's schedule and current weapon system status, and what's planned for tomorrow. Daily statistics are a snapshot. It may be difficult to see trends by only looking at daily performance once a week. Performance indicators may improve just by virtue of being watched. A robust metrics program should be continually evaluated in order to be effective. Remember, what gets attention, gets fixed.

# Chapter 3
## ICBM Wing-Level Maintenance Metrics



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## Wing-Level Metrics Formula Index

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## Lagging Indicators

**ICBM Raw Alert Rate.** The raw alert rate is the primary measure of Minuteman III availability and is calculated as the percentage of the forces' total active inventory that is mission capable on alert. It is expressed as total active inventory hours, minus scheduled and unscheduled downtime hours. Scheduled and unscheduled downtime hours are derived from depot possessed, not mission capable for maintenance, not mission capable for supply, not mission capable for both (NMCB), and unit possessed not reported hours.

*Total unscheduled downtime accrued is equal to the total A category sortie off-alert total hours, and total scheduled downtime hours accrued is equal to total combined F and L category sortie hours.*

$$\text{Raw Alert Rate} = (T - S - U) / T \times 100\%$$

Where,

$T$ = *Total active inventory hours accrued*
$S$ = *Total scheduled downtime hours accrued*
$U$ = *Total unscheduled downtime hours accrued*

**Formula 1. ICBM RAW Alert Rate: AFGSC 00-20-2 Sup**

Total unscheduled downtime accrued is equal to the total *A* category sortie off-alert total hours, and total scheduled downtime hours accrued is equal to total combined *F* and *L* category sortie hours. Trends in the raw alert rate reflect trends in total downtime due to occurrences of both scheduled and unscheduled downtime causing launch facilities (LF) to become unavailable for launch.

**Command Management Standard (CMS) Alert Rate.** The ICBM CMS alert rate is the percentage of unit possessed (A-category reported) LFs that are either fully mission capable or partially mission capable and reflects the unit's ability to maintain assigned A-category LFs on alert. LFs in categories F or L that are undergoing depot maintenance and modification programs are considered unit possessed not reported and are not counted against the CMS rate. The formula is as follows.

*CMS alert rate = (total possessed hours accrued – U) / (total possessed hours accrued) × 100%*

Where,

*U = Total unscheduled downtime hours accrued*

**Formula 2. Command Management Standard Alert Rate: AFGSC 00-20-2 Sup**

*The number of ICBMs off-alert for scheduled maintenance also provides indications of process control and success in meeting scheduled requirements.*

**Launch Control Center (LCC) Mission Capable (MC) Rate.** The LCC MC rate is the percentage of time that a weapon system is capable of any of its assigned missions. It reflects maintenance's ability to maintain the critical launch command and control required to retain LCCs in-commission.

*LCC MC rate = (MC hours) / (total possessed hours accrued) × 100%*

**Formula 3. Launch Control Center Mission Capable Rate : AFGSC 00-20-2 Sup**

**LF/LCC Partially Mission Capable (PMC) Rate.** The PMC rate is the percentage of time that a weapon system is capable of some of its assigned missions. PMC rates reflect maintenance's ability to maintain operation support systems critical to weapon system performance. Facility hardness and survivability, security systems operation, communication system performance, and guidance accuracy are some of the leading PMC conditions that are monitored.

*LF/LCC PMC rate = (PMCB hours + PMCM hours + PMCS hours) / (total possessed hours accrued) × 100%*

**Formula 4. Launch Facility/Launch Control Center Partially Mission Capable Rate : AFGSC 00-20-2 Sup**

**ICBM Scheduled Off-Alert Rate.** The ICBM off-alert (scheduled) rate primarily indicates ICBM system maintainability and represents number of ICBMs with planned (L and F category) off alert. Additionally, the number of ICBMs off alert for scheduled maintenance also provides indications of process control and success in

meeting scheduled requirements. The rate is calculated as follows.

*Average off alert per day =*
*(total category F and L LFs off alert each day) / (days)*

**Formula 5. ICBM Scheduled Off-Alert Rate: 20 AFI 10-110, Atch 3**

*TNMCS is driven principally by spare parts availability. However, maintenance policies can also affect the rate. For example, the metric can be lowered by consolidating feasible CANNs to as few weapon systems as practical.*

**Total Not Mission Capable for Maintenance (TNMCM) Rate.** The TNMCM rate is a useful metric for determining if maintenance is being performed quickly and accurately. Prioritization of jobs, good workload distribution, adequate facilities, and robust coordination between the maintenance operations center, missile field, and backshops are crucial to minimizing downtime. Look for a relationship between the break and fix rates and NMCM. A high TNMCM rate could indicate heavy workloads (people are over tasked), poor management, training problems, or poor maintenance practices.

*TNMCM rate = (NMCM hours + NMCB hours) /*
*(total possessed hours accrued) × 100%*

**Formula 6. Total Not Mission Capable for Maintenance Rate: AFGSC 00-20-2 Sup**

**Total Not Mission Capable for Supply (TNMCS) Rate.** TNMCS is driven principally by spare parts availability. However, maintenance policies can also affect the rate. For example, the metric can be lowered by consolidating feasible cannibalizations (CANN) to as few weapon systems as practical. The TNMCS rate is based on the number of weapon systems down for parts instead of the number of parts that are back ordered mission capable. While the best situation is for both CANN and TNMCS rates to be as low as possible this is not always possible.

*TNMCS rate = (NMCS hours + NMCB hours) / (total*
*possessed hours accrued) × 100%*

**Formula 7. Total Not Mission Capable for Supply Rate: AFGSC 00-20-2 Sup**

A word of caution: metrics drive performance and should not be optimized in isolation. An attempt to minimize TNMCS at all costs may lead to an undesirable increase in CANN actions. In some extreme cases it may even lead to maintenance feeling compelled to perform undesirable CANNs (those that may be labor intensive or risk damaging the good part) just to keep the TNMCS rate low.

*NMCM time starts when you realize that an NMC condition exists. The time stops when 1) maintenance finishes the repair and the missile achieves strategic alert or 2) when you find a verified NMCS condition. NMCM time resumes when the required supply items arrive.*

**Note:** NMCM time starts when you realize that an NMC condition exists. The time stops when 1) maintenance finishes the repair and the missile achieves strategic alert or 2) when you find a verified NMCS condition. NMCM time resumes when the required supply items arrive. NMCS time starts when all of these conditions exist:

- When a part's requirement affects launch capability.
- Maintenance makes a valid demand on supply.
- Maintenance verifies the impact of the needed part.
- Maintenance and supply together verify that the needed part (serviceable or reparable and not awaiting parts) is not available on base.
- Maintenance stops work on a system, subsystem, or component because the base lacks a needed part.

The NMCS time stops when maintenance receives the supply item or items. If maintenance cannot take delivery of the item when it becomes available, the NMCS time stops at the time supply received the part.

**Average Due-In from Maintenance (DIFM) Days.** This metric will track the average (mean) time, in days, it takes maintenance units to turn in a part to supply. Maintenance has a key role in maintaining the overall supply chain system. If parts are not returned to supply, they are not made available for repair. The faster a part is turned in, the more efficient the supply chain. Ordinarily, DIFM parts should be turned in within 30 days of removal from the weapon system.

*Average DIFM Days = (total # of DIFM days) / (total # of DIFM turn-ins)*

**Formula 8. Average Due-In from Maintenance Days**

## Leading Indicators

**Penetrated Site Rate.** This metric measures the maintenance activity that requires access through the B-plug and includes all priority and nonpriority LFs. The number of penetrated sites each day provides an indication of the tempo in the field required to respond to maintenance requirements. This indicator quantifies the utilization and resource strain, particularly security forces support, required by modification programs, scheduled maintenance, test programs, and unscheduled requirements.

*Total open holes includes a count of all open launcher doors including priority and nonpriority sites.*

Total site penetrations is a count of all penetrations into the launcher equipment room, electrical surge arrestor room, and launch tube entry (no open launcher closure door). Refer to Chapter 6, "References and Supporting Information," for quick reference to LF penetration level codes.

*Average penetrated LFs per day =*
*(total site penetrations) / (days)*

**Formula 9. Penetrated Site Rate: AFGSC 00-20-2 Sup**

**Open Hole Rate.** This metric measures the maintenance activity that requires access to the launch tube through the launcher closure door. The average number of open holes each day provides an indication of the tempo in the field required to meet maintenance requirements. This indicator quantifies the utilization and resource strain, particularly security forces support, that is driven by modification programs, scheduled maintenance, test programs, and unscheduled requirements.

Total open holes includes a count of all open launcher doors, including priority and nonpriority sites. Refer to Chapter 6, "References and Supporting Information," for quick reference to LF penetration level codes. The formula is as follows.

*Average open holes per day = (total open holes) / (days)*

**Formula 10. Open Hole Rate: AFGSC 00-20-2 Sup**

**Convoy Rate (CANN).** The average number of convoys per week provides indications of process control and stability in meeting scheduled requirements based on the known time changes and programs. Process control limits gauge success in scheduling and executing known reentry system field maintenance. Adverse indications may indicate that a closer look at weapons storage area production, missile maintenance team availability, and security forces convoy support is required. Below is the calculation for the average number of convoys per week.

*Average # of convoys per week = [ (total number of convoys) / (total number of maintenance days) ] × 5*

**Formula 11. Convoy Rate: AFGSC 00-20-2 Sup**

**Cannibalization Rate.** The CANN rate is the average number of CANN actions per possessed hours. A CANN action is the removal of a serviceable part from a weapon system to replace an unserviceable part on another weapon system. A CANN action should include a properly sourced supply document number to ensure a demand has been placed on the supply system. This metric is typically used in conjunction with the supply issue effectiveness rate. In most cases a CANN action takes place when base supply cannot deliver the part when needed and mission requirements demand the weapon system be returned to an MC status. Since supply relies on the depot for replenishment, this indicator also can be used, in part, to indicate depot support.

The CANN rate for a specified period of time is calculated as shown in the following formula.

*CANN rate =*
*[ (# of CANNs) / (total possessed hours accrued) ] × 100%*

**Formula 12. Cannibalization Rate**

The number of CANNs is equal to the total count of trainer to weapon system, time compliance technical order (TCTO) to weapon system, and weapon system to weapon system CANNs.

*A CANN action should include a properly sourced supply document number to ensure a demand has been placed on the supply system. This metric is typically used in conjunction with the supply issue effectiveness rate. In most cases, a CANN action takes place when base supply cannot deliver the part when needed and mission requirements demand the weapon system be returned to an MC status.*

**Break Rate.** The percentage of weapon systems that go off alert for a maintenance problem. This metric primarily indicates weapon system reliability. It may also reflect the quality of maintenance performed. For a true evaluation of equipment or system reliability measurements must be taken at the system or subsystem level. It is also an excellent predictor of parts demand. Several indicators that follow break rate are MC, TNMCS, TNMCM, and CANN rates.

*It is important to have equal utilization of available teams. An increase in Mx team UTE could indicate problems in the field.*

*Break rate = [ (# of sorties that go off alert for Mx) / (total sorties possessed) ] × 100%*

**Formula 13. Break Rate: AFGSC 00-20-2 Sup**

**Maintenance (Mx) Team Utilization (UTE) Rate.** The UTE rate is a measurement primarily used in planning a unit's dispatch program. It shows usage of assigned teams and personnel. Since UTE rates are considered for planning, actual UTE rates are used to evaluate the unit's monthly and annual plan. It is important to have equal utilization of available teams. An increase in Mx team UTE could indicate problems in the field.

*Program utilization rate* is the number of dispatches programmed to accomplish the unit's mission. Program utilization rates are normally given in monthly rates and most teams should expect 12 dispatches a month.

*Actual utilization rate* is the number of dispatches or quick reaction maintenance standbys each team has actually accomplished. The formula is as follows.

*Mx team UTE = (total dispatches per month) / (average Mx teams per month)*

**Formula 14. Maintenance Team Utilization Rate: 20 AFI 10-110, Atch 3**

**Delayed Discrepancy (DD) Rate.** Priority 5-7 Discrepancies (AFI 21-202 V1, *Missile Maintenance Management,* Table A2.1) that are not worked in a timely manner provide an indication of scheduling effectiveness and production backlog. This is a leading indicator that should be closely evaluated in comparison to other metrics.

This rate represents the average delayed discrepancies in the workload requirements file across a unit's possessed fleet. Discrepancies are considered delayed when: 1) they are discovered and the decision is made to delay them, or 2) discrepancies are awaiting parts with a valid off-base requisition. Delayed discrepancies may be awaiting maintenance (AWM) or awaiting parts (AWP).

Supply should maintain an aggressive followup program to keep visibility on those parts ordered for AWP delayed discrepancies. Maintenance should try to keep the AWM rate as low as possible. The DD rate can be calculated for ICBM facilities or support equipment. "Systems" denotes the number of LF, LCCs, equipment items, or vehicles (for example transporter-erector [TE] or payload transporter [PT]) for which the DD rate is being calculated.

*Supply should maintain an aggressive follow up program to keep visibility on those parts ordered for AWP delayed discrepancies. Maintenance should try to keep the AWM rate as low as possible. DD Rate can be calculated for ICBM facilities or support equipment.*

*Average AWP = [ (total AWP discrepancies) / (average systems possessed) ] × 100%*

*Average AWM = [ (total AWM discrepancies) / (average systems possessed) ] × 100%*

*Average DD = [ (total delayed discrepancies) / (average systems possessed) ] × 100%*

**Formula 15. Delayed Discrepancy Rate: AFGSC 00-20-2 Sup**

**Dispatch Deviation Rate (Scheduling Effectiveness).** Dispatch schedule deviation rates are used as management indicators to identify how well a unit is executing scheduled dispatches. A deviation is an occurrence different from what was scheduled or planned. For example, both cancellations and late departures are considered deviations. However, not all deviations are considered chargeable in the measure. Definitions of both chargeable and nonchargeable deviations are shown below.

*Chargeable Deviation.* Chargeable deviations are those caused by maintenance delays, security forces availability, and supply. For example, a maintenance deviation may be caused by a maintenance team member arriving late or a supply deviation may be caused by a lack of parts.

*Nonchargeable Deviation.* A nonchargeable deviation is a deviation caused by reasons other than maintenance, security forces, or supply. Weather would be an example of a nonchargeable deviation.

The main focus of the dispatch deviation rate is to strengthen accountability for process improvement. This allows each level of command to improve mission departure reliability performance. The dispatch deviation rate is determined by dividing the number of chargeable dispatch deviations by the total number of scheduled dispatches. It is calculated as follows.

*The 16-hour dispatch rate allows maintenance managers to gauge how effectively field activities workload is being monitored and managed by the maintenance shop and missile maintenance operations center controllers.*

*Dispatch deviation rate = [ (# of chargeable dispatch deviations) / (# of scheduled dispatches) ] × 100%*

**Formula 16. Dispatch Deviation Rate: AFGSC 00-20-2 Sup**

**16-Hour Dispatch Rate.** The 16-hour dispatch rate is determined by dividing the number of dispatches that exceed 16 hours by the total number of dispatches. The duty period for missile maintainers dispatching to the field is a maximum of 16 hours in any combination of on- and off-base duty. Missile maintenance teams who cannot return to base and complete post-dispatch actions within their 16-hour timeline are required to remain overnight at a missile alert facility. The 16-hour dispatch rate allows maintenance managers to gauge how effectively field activities workload is being monitored and managed by the maintenance shop and missile maintenance operations center controllers. The formula is as follows.

*16-hour dispatch rate = [ (# of dispatches exceeding 16 hours) / (total # of dispatches) ] × 100%*

**Formula 17. 16-Hour Dispatch Rate: AFI 21-202 V1, para 2.1.2.3.**

**Standby Power Effective Rate.** Remote ICBM facilities require readily available and reliable standby power systems to retain alert status during commercial power outages and to support extended operations and survivability. The standby power effectiveness rate gauges the reliability, availability, and maintainability of the standby power generation and distribution systems. Decreases in standby power effectiveness should be analyzed to determine root causes and trends in component failure rates, facility infrastructure, technician proficiency, and parts availability.

*Effectiveness = [ (total possessed hours accrued – stby pwr pmc hours) / (total possessed hours accrued) ] × 100%*

**Formula 18. Standby Power Effective Rate: AFGSC 00-20-2 Sup**

**Mean Time to Repair (MTTR).** MTTR is a measure of the time taken to return a facility back to alert status. The time to generate a dispatch and return an LF/LCC back to alert status is affected by many variables to include maintenance team availability, security forces support, vehicles, and special tools and handling equipment. Weather and the maintenance backlog also impact the time required to repair a facility. Some examples of factors that may drive a higher mean time to repair are severe snow storms that delay safe dispatch, equipment limitations such as TEs or PTs, and the appearance of urgent and resource intensive unscheduled activities such as an emergency code change, immediate action TCTOs, or onetime inspections. MTTR should be investigated to determine if it is caused by a seasonal spike or if there is a sustained trend caused by resource or technician limitations that is causing the off-alerts to exceed the maintenance's capacity to repair. MTTR is a good leading indicator to detect problems with efficiency, effectiveness, and resource availability required to promptly return facilities back to alert status.

*MTTR = (total NMC elapsed time) / (total count of NMC when condition status code equals "A","C")*

**Formula 19. Mean Time to Repair: AFGSC 00-20-2 Sup**

*MTTR is a measure of the time taken to return a facility back to alert status. The time to generate a dispatch and return a LF/LCC back to alert status is affected by many variables to include maintenance team availability, security forces support, vehicles, and special tools and handling equipment. Weather and the maintenance backlog also impact the time required to repair a facility.*

# Chapter 4
# Other Categories of Metrics

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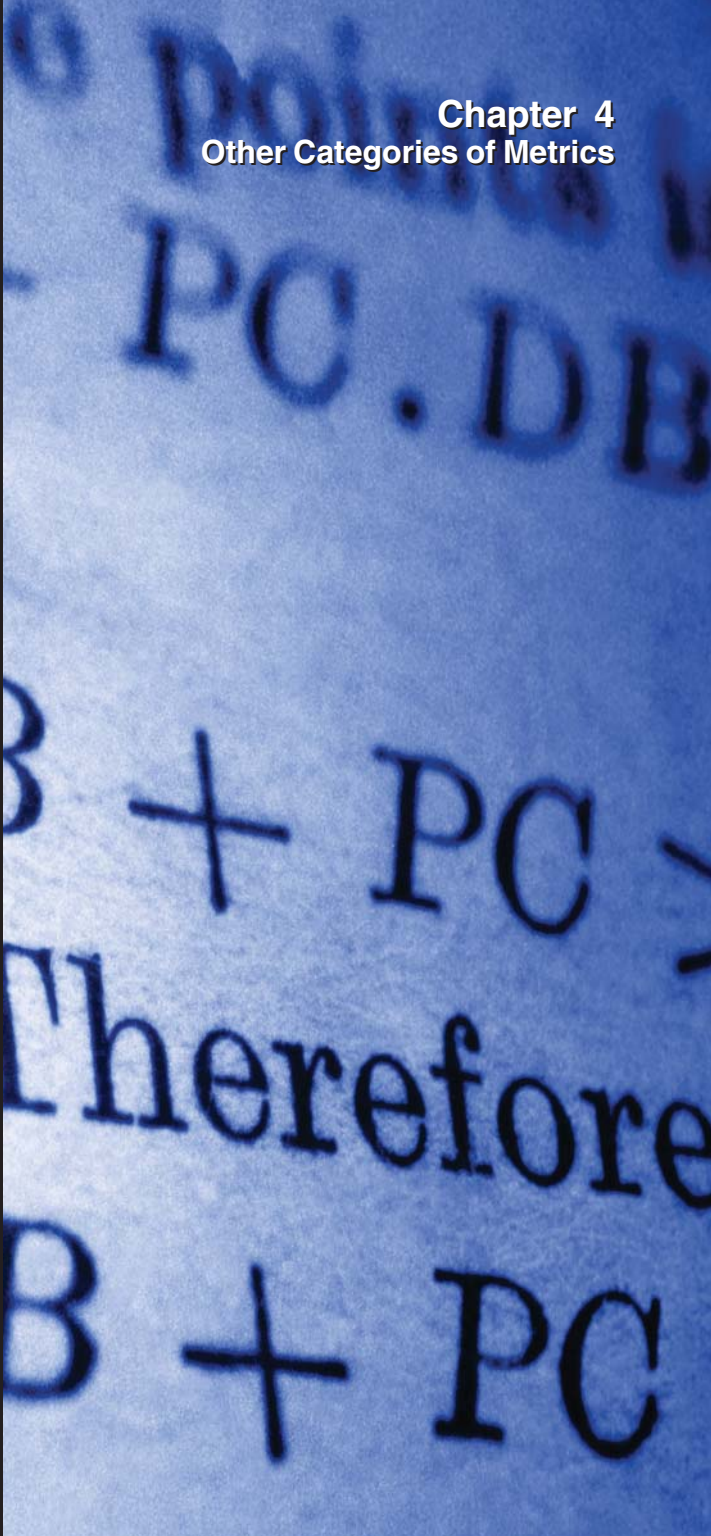

## Other Metrics Formula Index

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## Depot Metrics

**Depot Maintenance.** Depot maintenance is maintenance performed on materiel requiring major overhaul or a complete rebuild of parts, assemblies, subassemblies, and end items, including the manufacture of parts, modifications, testing, and reclamation as required. Depot maintenance serves to support lower (user and intermediate) categories of maintenance by providing technical assistance and performing maintenance beyond their responsibility. Depot maintenance provides stocks of serviceable equipment by using more extensive facilities for repair than are available in lower-level maintenance activities.

*Depot maintenance serves to support lower (user and intermediate) categories of maintenance by providing technical assistance and performing maintenance beyond their responsibility. Depot maintenance provides stocks of serviceable equipment by using more extensive facilities for repair than are available in lower level maintenance activities.*

**Ground Support Vehicle Inspection Flow.** A phase time-distribution interval (TDI) is a tool that shows time remaining until the next programmed maintenance of the ground support vehicle fleet. Maintenance managers use ground support vehicle inspection flow to effectively schedule vehicles for depot inspection, balancing user needs with long-term maintenance requirements. It is common practice to display fleet TDI graphically, facilitating ease of tracking. A perfect phase flow portrays a fleet's evenly spaced progression into inspection (a nearly perfect diagonal line). Average time remaining on a fleet should be approximately half the inspection interval. Beware of gaps or groupings, especially on weapon systems with less than half the time remaining to phase. This involves the following ground support vehicles.

- Transporter-erector
- Payload transporter
- Missile transporter
- Rocket motor semitrailer
- Propulsion system rocket engine transport vehicle

A notional inspection flow is shown in Figure 1.

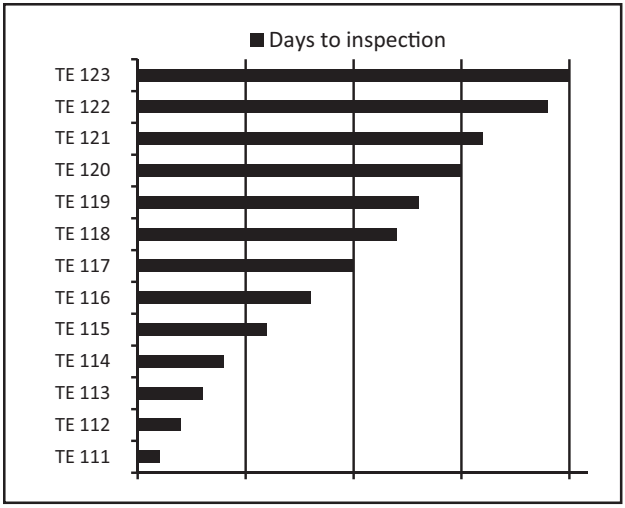


**Figure 1. Notional Inspection Flow**

*The flow through the depot repair process is known as depot repair cycle time, commonly called pipeline time or shop flow days.*

**Shop Flow Days (SFD)** (See AFMCI 21-105, *Depot Maintenance Work Measurement*). In order to ensure Air Force combat units have the required equipment items at the right time and place, Air Force Materiel Command must maintain the ability to replenish base stock levels through the constant flow of recoverable material to and from units. The flow through the depot repair process is known as depot repair cycle time, commonly called pipeline time or shop flow days. The following formula is used to compute SFD standards in calendar days. SFD does not include in transit time from and to the base.

$$SFD = 7.3 \times [ (S / I) + P ] / (D \times H)$$

**Formula 20. Shop Flow Days**

*Where: 7.3 = 7 x (260/250). Seven converts time in weeks to time in days; 260/250 converts weekdays per year to workdays so that the 10 federal holidays are accounted for.*

*S = Standard hours. Includes all occurrence factors for all repair frequencies, and personal, fatigue, and delay*

*time. When an operation with a labor standard takes place concurrent to a process support or unique process support operation (factor P below), only include the standard time for the longer of the two in the equation. Also include all work done on the end item within the resource control center when the work consists of sequential operations performed by one worker only. For work consisting of concurrent operations or operations performed by multiple workers, the labor standard must be reduced accordingly. Only include the standard time for the longest concurrent operation (critical path). Reduce the standard time for operations performed by multiple workers by dividing the operations standard by the number of workers. Be familiar with AFMC 21-105, Attachment 9, for an understanding of personal, fatigue, and delay time.*

*I = Resource Control Center (RCC) constant. Direct labor percent factors expressed as a decimal of productive hours available per shift. The RCC direct labor percent factor is determined by removing the RCC yearly average indirect category time values (that is, duty codes .24, .25, .26, and .29) from the 100 percent availability (the percentage factor for janitorial services in code .26 is not to be included in the development of the RCC yearly average).*

*P = Process support. Develop an average time value for required process steps, both process-related and general. These times will be expressed in hours. Include all occurrence factors for all repair frequencies. Examples of process-related time include plating, curing, heat treat processes, and test warm-ups. General process time includes end item transportation time and queue time. Allowances may also be included, on a prorated basis, for planned delays and transportations such as equipment down for periodic calibration and maintenance and transportation of material from supply. Process support time concurrent to a longer labor operation time is not included. This will not include storage time for awaiting parts. An average process support factor will not be a blanket time value. Backup studies will be used to the extent possible and must be retained for audit purposes.*

*D = Days per week (4, 4.5, 5, 6, or 7)*

**Depot Total Repair Cycle Time.** This is the average time, in days, an unserviceable asset spends in the repair cycle at a depot. It does not include engines or support equipment. The clock begins when maintenance orders a repair cycle asset from supply and ends when the asset (serviceable or unserviceable) is turned in to supply. The time the item is awaiting parts (AWP) in the repair shop is not included. This indicator is primarily a local management tool. To improve the process of repairing parts, the different steps in that process must be measured. This indicator and its components provide this capability.

*The total repair cycle is broken into three segments. The sum of the three steps equals the total repair cycle time. It measures the efficiency during the three major steps in a unit's repair cycle.*

*Depot total repair cycle time =*
*delayed before repair + delayed after repair + repair time – AWP*

**Formula 21. Depot Total Repair Cycle Time**

*Average Repair Cycle Time by Segments (Buckets of Time)*. This is a more detailed look at the total repair cycle days. The total repair cycle is broken into three segments.

- Pre—the time from when a serviceable part is issued from supply until the broken part is received by the backshop for repair.
- Repair—the time a part remains in the shop until repaired, minus time spent AWP.
- Post—the time it takes for the repaired part to be turned back to supply.

The sum of the three steps above equals the total repair cycle time. It measures the efficiency during the three major steps in a unit's repair cycle. The formulas are as follows.

*Average pre-maintenance time =*
*(total # of days in pre-maintenance) / (total # of items repaired)*

*Average repair time =*
*(total # of days in repair – AWP) / (total # of items repaired)*

*Average post-maintenance time =*
*(total # of days in post-maintenance) / (total # of items repaired)*

*Average repair cycle time =*
*(total depot repair cycle time) / (total # of items repaired)*

**Formula 22. Average Repair Cycle Time by Segments**

*MTBMA is the average time between any two given consecutive maintenance actions, whether scheduled or unscheduled. It is also known as mean time between maintenance events since maintenance action and events are used interchangeably.*

**Mean Time Between Failures (MTBF).** The MTBF provides an indication of how long a selected system performs without a malfunction (write-up) that affects mission capability. MTBF may be calculated for one component, one weapon system, or for an entire fleet of weapon systems.

*MTBF = total time / total failures*

**Formula 23. Mean Time Between Failures: AFGSC 00-20-2 Sup**

**Mean Time Between Maintenance Actions (MTBMA).** The MTBMA is the average time between any two given consecutive maintenance actions, whether scheduled or unscheduled. It is also known as mean time between maintenance events since maintenance action and events are used interchangeably. Examples of maintenance actions include, but are certainly not limited to, calibration, cleaning, adjustment, servicing, repair, and removal. MTBMA can also be used to find the average time or life span for certain end items and is an indication of overall performance at the component level.

$$TBMA_{between\ 1\&2} + TBMA_{between\ 2\&3} + \ldots + TBMA_{(\#MA-1)\ \&\#MA\ /\ \#MA-1}$$

Where,

*TBMA = Time between maintenance actions*
*#MA = Number of maintenance actions*

**Formula 24. Mean Time Between Maintenance Actions**

## Supply Metrics

Numerous analytical studies have shown that past demand is often the best predictor of future demand. Therefore, it makes sense for supply to use historical customer demand

data when determining the optimal range (what items to stock) and depth (how many items to stock) of stock for items with past customer demand. *Bottom line: supply doesn't stock what doesn't get ordered.* Additionally, maintainers need to understand that they are not just customers of the supply chain, but also key players. Maintenance must exercise good supply discipline in all maintenance activities. This means not only ordering the correct parts from supply, but also ensuring the appropriate priority code for each order is indicated and returning bad parts back into the system so they can be repaired in a timely manner and made available for future use.

*The MICAP rate is a reflection of the ability of the supply chain to support maintenance operations.*

**Mission Impaired Capability Awaiting Parts (MICAP) Rate.** The percentage of time a weapon system, piece of equipment, or vehicle is inoperable due to a back-ordered part. Hours are accrued for a given month for back-ordered items affecting mission capability. The MICAP rate is a reflection of the ability of the supply chain to support maintenance operations.

$$\text{MICAP rate} = [\ (\text{MICAP hours}) / (\text{total possessed hours accrued})\ ] \times 100\%$$

$$\text{Where MICAP hours} = [\ (\text{stop day} - \text{start day} - 1) \times 24\ ] + [\ (24 - \text{start hour}) + \text{stop hour}\ ]$$

**Formula 25. MICAP Rate**

**Note:** It is not only important to understand the MICAP rate, but also that maintenance actions can create unnecessary MICAPs within the supply system. These unnecessary MICAPs are known as Deletion Code 9 or *Drop 9* actions. High Drop 9 activity may indicate a lack of supply discipline or knowledge of the costs of unneeded supply actions.

**Issue Effectiveness Rate.** The issue effectiveness rate is the percentage of customer requests filled by items in the inventory. Issue effectiveness is based on filling any request, not just requests for items supply is authorized to stock. It is used to measure how well the logistics customer

is supported by supply. Issue effectiveness is usually lower than stockage effectiveness, but it is more representative of a supply customer's view of supply support. It is calculated as follows.

*Issue effectiveness rate =*
*[ issues / (issues + all back orders) ] × 100%*

**Formula 26. Issue Effectiveness Rate**

**Stockage Effectiveness Rate.** The stockage effectiveness rate is the percentage of customer requests filled by items supply is authorized to stock. The significant difference between issue and stockage effectiveness is that stockage effectiveness only includes back orders for items supply is authorized to stock. It measures how well the logistics customer is supported by base supply and depot replenishment. This is especially important since supply cannot possibly stock every possible part and is funded to stock only the most used.

*Stockage effectiveness rate =*
*[ issues / (issues + 2D back orders) ] × 100%*

**Formula 27. Stockage Effectiveness Rate**

*The stockage effectiveness rate is the percentage of customer requests filled by items supply is authorized to stock. The significant difference between issue and stockage effectiveness is that stockage effectiveness only includes back orders for items supply is authorized to stock. It measures how well the logistics customer is supported by base supply and depot replenishment.*

## Training-Related Metrics

Several indicators are useful to show the health of the maintenance training process. The following key indicators are available in a monthly status-of-training presentation the maintenance training organization develops.

**Career Development Course (CDC) Pass Rate.** The CDC pass rate is the percent of people who pass their end-of-course tests. The goal is 95 percent. First and second fail percentages are also available.

*CDC pass rate =*
*[ (# of personnel passing test) / (# personnel taking test) ] × 100%*

**Formula 28. Career Development Course Pass Rate**

**Upgrade Training (UGT) Status.** This career-progression status reflects the percentage of 5- and 7-level technicians in UGT. The goal should be to keep the combined total less than 40 percent—the higher the percentage, the greater the training burden.

*Because of the unique nature of nuclear maintenance, units must not only be concerned with ensuring they have fully qualified technicians, but also that those technicians can work to the exacting requirements of nuclear maintenance.*

*UGT status =*
*[ (# of technicians in upgrade training) / (total # of available technicians) ] × 100%*

**Formula 29. Upgrade Training Status**

**Awaiting Certification Rate.** This metric provides managers the ability to see what percentage of their work force has been upgraded but not working because of a lack of certification.

*Awaiting certification rate =*
*[ (# of technicians noncertified but upgraded) / (total # of available technicians) ] × 100%*

**Formula 30. Awaiting Certification Rate**

**Certified Technician Status.** Because of the unique nature of nuclear maintenance, units must not only be concerned with ensuring they have fully qualified technicians, but also that those technicians can work to the exacting requirements of nuclear maintenance. This metric indicates the percentage of the total assigned workforce that is fully nuclear maintenance certified.

*Certified technician status =*
*[ (# of technicians certified) / (total # of available technicians) ] × 100%*

**Formula 31. Certified Technician Status**

**Certification Reject Rate.** This metric tracks the number of maintenance technicians that go through the certification process but, for whatever reason, fail to be certified. Certification rejection induces turmoil in the personnel management of an organization. The time available to

spend on certifying a technician is very limited, and one failure in certification would be a detriment to the overall mission of the organization. The formula is as follows.

*Training overdues are frequently a measure of readiness, as this measure considers proficiencies that can affect cannot duplicate rates. It may also indicate training problems.*

*Certification reject rate =*
*[ (# of personnel rejected for certification) / (total # of personnel seeking certification) ] × 100%*

**Formula 32. Certification Reject Rate**

**Training Overdues.** This indicator tracks the percentage of overdue training actions. Training overdues are frequently a measure of readiness, as this measure considers proficiencies that can affect cannot duplicate rates. It may also indicate training problems.

**Training No Shows.** This indicator tracks the number of scheduled training events versus the number of events actually attended. The desired number of no shows is zero. Every effort should be made to ensure individuals receive training once they are scheduled so that they can become fully qualified and certified as soon as possible.

# Chapter 5
## Helpful Hints for Data Investigation

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## Analytical Process

Get to know your analyst! Your maintenance analyst will possess the knowledge and skills necessary to apply statistical, analytical, and presentation techniques and manage and maintain a management information system. A 5-level analyst must have knowledge of the following.

- Using desktop computers and software
- Using the database area schematic
- Using the database schema and subschema, identifying logic and structural errors
- Using the Job Data Documentation (JDD) subsystem
- Using Maintenance Data Documentation (MDD) reference materials
- Using the Data Management Utility (DMU)
- Using Database Look (DBLook)
- Using conversational Query Language Processor (QLP)
- Using the Interactive Recovery Utility (IRU)
- Processing online inquiries and background reports
- Using Generated Runstream (GENRUN)
- Using descriptive statistics and predictive analysis
- Computing performance indicators
- Performing time-series analysis
- Completing special studies and documenting referrals

*The analytical process consists of identifying contributory factors, manipulating raw data into meaningful formats; computing management indicators; performing statistical measurements; and creating accurate, complete, and easy- to-understand presentations.*

The analytical process consists of identifying contributory factors, manipulating raw data into meaningful formats; computing management indicators; performing statistical measurements; and creating accurate, complete, and easy-to-understand presentations. An analytical process uses a number of methods—for example, 1) visual observation dependent upon the observer's experience and knowledge and 2) statistically or visually performed comparative analysis—and involves the comparison of two or more like operations or items to identify variations or differences.

Statistical analysis and statistical investigation are the methodical study of data. These methods are used to reveal facts, relationships, and differences about data and data elements, and they are a useful adjunct to comparative and visual analysis. Analysts should use these tools and other methods to perform analytical studies to gain insight into unit performance and enhance process improvement. The Air Force speciality code 2R0X1 career development course (CDC) is a good source of statistical and analytical techniques, and the maintenance data analysis section (MDAS) maintains a current copy of the 5- and 7-level CDC for reference.

*Analysts should not just hand over raw data sheets—that is bean counting. Good analysts will always try, situation permitting, to provide a bottom-line narrative. The leader should not have to analyze the data. That is the analyst's job.*

## Management Contribution to the Analytical Process

Operations and logistics leaders have a significant impact on the usefulness of the MDAS. By challenging the MDAS with analyzing problems they foster the in-depth training of the analysts and help the unit. When leaders have a hunch or a specific agenda it is almost always better that they spell out what they think is going on or what they would like to see, if it can be done. Asking analysts for specific information or data is perfectly legitimate but fails to recognize just how much more they can provide. If analysis knows what the agenda is it is far better prepared to use all the tools at its disposal to uncover or present all the pertinent analyses.

Analysts should not just hand over raw data sheets—that is bean counting. Good analysts will always try, situation permitting, to provide a bottom-line narrative. The leader should not have to analyze the data. That is the analyst's job. It is easy to misinterpret what is really wanted or how it is to be presented.

There needs to be a dynamic relationship between leadership and analysts where the latter feels free to probe for the real agenda. In the end, this saves a lot of time and leaders get far better analyses and information.

Leaders should constantly review how information is being organized and presented. The lack of focus regarding

use of data, improper arrangement of data for analysis, or unclear presentation of results can obscure meaningful information. Leaders should be familiar with how data is developed, interpreted, and presented to ensure accurate presentations for decisionmaking. Studies and analyses specifically targeted for areas of concern are valuable in helping units isolate factors surrounding problem areas.

## Analytical Studies

MDAS will provide the results of investigations, analyses, or studies to work centers. Specific studies are provided to the requester, and a file copy is retained for future reference. Reproducing the study or including it in a monthly maintenance summary achieves widespread dissemination. The study should state assumptions up front and be summarized plainly.

Most studies should begin with some sort of background information. Each study should include the data, research, investigation, and statistical findings, along with its respective sources. Conclusions relevant to the study should be drawn from this information. Finally, the study should include recommendations to address the conclusions relevant to the problem (other issues uncovered can be identified but should be kept separate). The most effective study is one that goes beyond superficial conclusions and helps solve a problem relative to mission performance.

*Most studies should begin with some sort of background information. Each study should include the data, research, investigation, and statistical findings, along with its respective sources. Conclusions relevant to the study should be drawn from this information.*

## Functions of Deficiency Analysis

Deficiency analysts serve a dual role. They provide analytical support to the squadrons and maintenance leaders and they provide technical expertise for the MDAS. Deficiency analysts use analytical data and technical knowledge to identify problems, work with the customer, and help find solutions. They should not limit themselves to pointing out general areas for investigation. They should identify deficiencies applicable to a work center, particular equipment end item, maintenance practice, or management

action. Deficiency analysis responsibilities include the following.

- Review quality assurance (QA) summaries for positive and negative trends.
- Review maintenance data and dispatch information daily to assist in the identification of problems.
- As a minimum, perform monthly reviews of:
  - Deferred discrepancy lists for technical errors or negative trends.
  - Dispatch scheduling deviations for negative maintenance practices and trends that impact workforce and workload stability.
- Monitor and evaluate the maintenance portion of the base repair program and intermediate repair enhancement program.
- Analyze the performance of selected systems, subsystems, and line replaceable units to help determine the source of problems affecting the mission.
- Attend the QA program and product improvement working group meetings, providing trend data as needed.

**Note:** The function of the deficiency analyst is not to become the full-time data integrity team monitor.

## Questions Your Analysts Should Be Asking

The following are questions the assigned analysts have been trained to ask.

- **Weekly Reports**
  - What are the major contributing systems?
  - What are the common write-ups within the major contributing systems?
  - Are there weapon systems with multiple write-ups in the major contributing systems or different systems?

  - Is mission impaired capability awaiting parts (MICAP) information available on weapon systems with high total not mission capable for supply (TNMCS) rates?
  - Are there any previous studies that apply?
  - Are there any systems trends?
  - Are there technical data limitations?
  - Is there a lack of proper tools?
  - Answer the questions: what is the problem, what is the unit doing to resolve the problem, and what does the headquarters staff need to know to resolve the problem?
- **Monthly Reports**
  - What are the major contributing systems?
  - What are the common write-ups within the major contributing systems?
  - Are there weapon systems with multiple write-ups in the major contributing systems or different systems?
  - What type of corrective actions were taken? Do similar discrepancies still reappear?
  - Could cannibalization (CANN) have been a factor?
  - Did the system cause problems with other maintenance indicators?
  - Is MICAP information available on weapon systems with high TNMCS rates?
  - How has the system performed since the last incident?
  - Are there any previous studies or analyses that apply (previous weeklies, studies, and so forth)?
  - How will this impact scheduling of program depot maintenance, major modifications, and time compliance technical orders?
  - Are there any systems trends?
  - Are there technical data limitations?
  - Is there a lack of proper tools?

- Answer the questions: what is the problem, what is the unit doing to resolve the problem, and what does the headquarters staff need to know to work resolution of the problem?

The following hints can be applied to all processes under investigation (breaks, dispatches, and CANNs are used only as examples).

**Technical Information.** Always check with deficiency analysis personnel for answers to technical questions. It's a good idea to review their summaries. Sometimes they've already gathered information on the same systems. Make it a point to talk to the appropriate shops concerning problem weapon systems and components.

**Supply.** The MICAP section of supply should have information on supply issues and actions affecting weapon systems and components with high MICAP occurrences and deviations.

**Trends.** There are various types of trends that should be investigated. Detailed analysis will depend on how much time is available and the type of data being researched.

Ask:

- Are the failures seasonal (more failures in hot or cold temperatures)?
- Are the components that are failing environmentally sensitive (that is, responding to temperature extremes, corroding)?
- Could the failures be operating-time related?
- Do corrective actions point toward lack of training or workarounds caused by lack of parts or proper tools?

After weekly reports and spreadsheets are updated, it's a good time to start looking at historical data for possible trends affecting current data.

## Break Rates

**Verify accuracy of system status:**

- Are start and stop times of NMC conditions correct?
- Do the work unit codes match the identified failed systems on the debrief form?

**Isolate the problem system:**

- Once verification of discrepancy documentation and weapon systems status is completed, what systems stand out?
- Past history?

**Identify components within suspect systems:**

- Does documentation seem reasonable?
- Do start and stop times for maintenance actions agree with status times?

**Track problem items through the backshop:**

- Can the failure be confirmed?
- Can the common repair actions in the shop be identified?

## CANN Rates

- If CANN logs are maintained, do they match what is documented?
- Are there obvious gaps in the CANN log (missing or incomplete data)?
- Are there notes of CANN actions initiated but canceled?

**Isolate the problem:**

- What systems stand out?
- Past history?

**Identify components within suspect systems:**

- Does Integrated Maintenance Data System (IMDS) documentation seem reasonable, or is everything coded to the next higher assembly or subsystem level (that is, actual components not identified)?
- Was the CANN action faster than removing, repairing, or replacing the item?

**Take the list of problem or suspect subsystems and components to QA and the technical representatives.**

- Have the problems been identified previously?
- Have material deficiency reports, safety reports, and so forth been submitted?
- Are there pending modification programs?

**Identify problem systems. Correlate findings with other areas. Is there a common thread with:**

- Causes for NMC or partially mission capable conditions?
- Overall system/component failures in the fleet?
- Problem items in the ICBM Program?

**In General:**

- Are sufficient samples tracked to get an accurate picture?
- If updates to IMDS are backlogged or if IMDS has been down, was time allowed for data to be updated before taking samples?
- Was the sample or monthly average compared with past samples?
- Is there a large change in overall rates?
- Examine data by squadron, flight, and missile.
- Is there a large change in overall rates from one month to another or from one sample to another?
- Could the problem be tied to no availability of IMDS or other documentation problems?

**If possible, compare data with other units that have like missions:**

- Are the numbers comparable?
- Are there similar trends?
- Are there common systems or component problems?

### Instructions

| | |
|---|---|
| AFPD 21-2 | *Munitions* |
| AFI21-103 | *Equipment Inventory, Status and Utilization* |
| AFI 21-118 | *Improving Air and Space Equipment Reliability and Maintainability* |
| AFI 21-200 | *Munitions and Missile Maintenance* |
| AFI 21-202 V1 | *Missile Maintenance Management* |
| AFMCI 21-10 | *Depot Maintenance Work Measurement* |
| AFGSCI 10-901 V1 | *(S) Intercontinental Ballistic Missile (ICBM) Emergency War Order (EWO) Operations (U)* |
| 20 AFI 10-110 | *20 AF ICBM Wing Scheduling Instruction* |

### Air Force Technical Orders

| | |
|---|---|
| 00-5-1 | *Air Force Technical Order System* |
| 00-20-2 | *Maintenance Data Documentation* |

### Manuals

| | |
|---|---|
| AFM 23-110 | *USAF Supply Manual* |

## Launch Facility Penetration Level Codes

| | Narrative | Remarks |
|---|---|---|
| 01 | Topside | |
| 02 | Launcher Support Building | |
| 03 | Personnel Access System | Used when access is limited to PAS (for example, B-Plug or A-circuit lockout). |
| 04 | Launcher Equipment Room | |
| 05 | Electrical Surge Arrestor Room | |
| 06 | Launch Tube | Used for LT entry without LCD open (for example, sump pump maintenance). |
| 07 | Launcher Closure Open | Used when LCD is open at nonpriority sites. |
| 08 | Open Hole | Used when LCD is open at priority sites. |
| 09 | Topside Missile Alert Facility | |
| 10 | Launch Control Center | |
| 11 | Launch Control Equipment Building | |

| | | |
|---|---|---|
| 12 | Outside Fenced Area | Used for HICS line trenching, parts run, and others. |

## Dispatch Deviation and Deferred Codes

| Code | Cause Narrative |
|---|---|
| O16 DFR | Work Day Exceeded 16 hours |
| DFR DFR | Deferred Priority 9 |
| ACR DFR | Awaiting Component R/R |
| SBY DEV | Standby |
| CDR DEV | Darkness/Timeline Restriction |
| COS DEV | On-Site Maintenance/Issue |
| CIN DEV | Inspection |
| CEX DEV | Exercise |
| CVP DEV | Vehicle Problems |
| CCM DEV | TC/TM Problems |
| CSA DEV | Support Agency (KCCC) |
| CSE DEV | Scheduling/DOC Error |
| CPS DEV | Parts/Supply |
| CMH DEV | Maintenance Hold/HQ Directed |
| CWR DEV | Weather - Roads |
| CGS DEV | Guards |
| CDH DEV | Diverted/Higher Priority Maintenance |
| RON DEV | Remain Overnight |
| LCR LATE | Crew Rest |
| LOS LATE | On-Site Maintenance/Issue |
| LIN LATE | Inspection |
| LEX LATE | Exercise |
| LVP LATE | Vehicle Problems |
| LCM LATE | TC/TM Problems |
| LSA LATE | Support Agency (KCCC) |
| LSE LATE | Scheduling/Doc Error |
| LPS LATE | Parts/Supply |
| LMH LATE | Maintenance Hold/HQ Directed |
| LWR LATE | Weather - Roads |
| LTE LATE | Tools/Equip |
| LGS LATE | Guards |
| LDH LATE | Diverted/Higher Priority Maintenance |

| | |
|---|---|
| 107 DFR | AWT 107 Process/Depot Maintenance |
| HPM | Higher Priority Maintenance |
| ARM | Awaiting Rivet Mile |
| NCE DFR | Not Cost Effective |
| NFO DFR | Information Only |
| ABW | Awaiting Better Weather |
| PSD | Awaiting Next PSDU R/R |
| NMG | Awaiting Next MG R/R |
| NCR | Awaiting Next Chromate R/R |
| BAT | Awaiting Next Battery R/R |
| XFR | Awaiting Transfer Evaluation |
| ADM | Awaiting Depot Maintenance |
| ATL | Cancelled Due to Timeline |
| ATE | Awaiting Test Equipment |
| CTE DEV | Tools/Equipment |
| DMS DFR | Deferred Multiple Status |
| AWM | DFR Awaiting Maintenance |
| AWP DFR | Awaiting Parts |
| PDM | Awaiting Depot Maintenance |

## Acronym Glossary

2D – Authorized to Stock
AFGSC – Air Force Global Strike Command
AFI – Air Force Instruction
AFMC – Air Force Materiel Command
AFMCI – Air Force Materiel Command Instruction
AFSC – Air Force Specialty Code
AWM – Awaiting Maintenance
AWP – Awaiting Parts
CANN – Cannibalization
CAT – Camper Alert Team
CDC – Career Development Course
CMS – Command Management Standard
DBLook – Database Look
DD – Delayed Discrepancy
DEU – Diesel Electric Unit
DIFM – Due-In from Maintenance
DMU – Data Management Utility
ECS – Environmental Control System

EMT – Electro-Mechanical Team
ESA – Electrical Surge Arrestor
EWO – Emergency War Order
FMC – Fully Mission Capable
FMS – Facilities Maintenance Section
FMT – Facilities Maintenance Team
GENRUN – Generated Runstream
HHQ – Higher Headquarters
HICS – Hardened Intersite Cable System
HOF – Health of the Force
ICBM - Intercontinental Ballistic Missile
IMDS – Integrated Maintenance Data System
IRU – Interactive Recovery Utility
JDD – Job Data Documentation
KCCC – Keys and Codes Control Center
LCC – Launch Control Center
LER – Launcher Equipment Room
LCEB – Launch Control Equipment Building
LF – Launch Facilities
LSB – Launcher Support Building
MAF – Missile Alert Facility
MAJCOM – Major Command
MC – Mission Capable
MDAS – Maintenance Data Analysis Section
MDD – Maintenance Data Documentation
MICAP – Mission Impaired Capability Awaiting Parts
MIS – Maintenance Information System
MM III – Minuteman III
MMOC – Missile Maintenance Operations Center
MMT – Missile Maintenance Team
MPI – Maintenance Performance Indicator
MSE – Maintenance Scheduling Effectiveness
MTBF – Mean Time Between Failures
MTBMA – Mean Time Between Maintenance Actions
MTTR – Mean Time to Repair
NAF – Numbered Air Force
NMC – Not Mission Capable
NMCB – Not Mission Capable for Both
NMCM – Mission Capable for Maintenance

NMCS – Not Mission Capable for Supply
PMC – Partially Mission Capable
PMCB – Partially Mission Capable for Both
PMCM – Partially Mission Capable for Maintenance
PMCS – Partially Mission Capable for Supply
PMT – Periodic Maintenance Team
PSRE – Propulsion System Rocket Engine
PT – Payload Transporter
QA – Quality Assurance
QLP – Query Language Processor
QRM – Quick Reaction Maintenance
RON – Remain Overnight
RPIE – Real Property Installed Equipment
RS – Reentry System
SE – Support Equipment
SFD – Shop Flow Days
SFUE – Security Forces Utilization Effectiveness
TE – Transporter-Erector
TAI – Total Active Inventory
TCTO – Time Compliance Technical Order
TDI – Time-Distribution Interval
TNMCM – Total Not Mission Capable for Maintenance
TNMCS – Total Not Mission Capable for Supply
U/S – Unscheduled/Scheduled
UGT – Upgrade Training
UTE – Utilization Rate
WRF – Workload Requirements File
WSA – Weapon Storage Area

## Notes

## Notes

# Air Force Logistics Management Agency

*STUDIES / TRANSFORMATION / WARGAMES / PUBLISHING*

Since its inception, the Air Force Logistics Management Agency has grown to be recognized for its excellence—excellence in providing answers to the toughest logistics problems. That's our focus today—tackling and solving the toughest logistics challenges facing the Air Force. It's also our focus for the future and why we are a leader in Air Force Logistics Transformation efforts.

We use a broad range of functional, analytical, and scientific expertise to produce innovative solutions to problems and design new or improved concepts, methods, systems, or policies that improve peacetime readiness and build war-winning logistics capabilities. We provide focused, responsive answers to our customers' needs and problems. Let us put our team of experts to work for you.

Our key strength is our people. They're all professionals from logistics functions, operational analysis sections, and computer programming shops. Virtually all of them have advanced degrees. But more important, virtually all of them have recent field experience. They've been there and done that. They have the kind of experience that lets us blend innovation and new technology with real-world common sense and moxie. It's also the kind of training and experience you won't find with our competitors. Our special blend of problem-solving capabilities is available to every logistician in the Air Force.

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