July 1993

Changes to the Air Force's Policy for Calculating Wartime Spares Requirements

AF101R1

Virginia A. Mattern

Prepared pursuant to Department of Defense Contract MDA903-90-C-0006. The views expressed here are those of the Logistics Management Institute at the time of issue but not necessarily those of the Department of Defense. Permission to quote or reproduce any part except for Government purposes must be obtained from the Logistics Management Institute.

Logistics Management Institute
6400 Goldsboro Road
Bethesda, Maryland 20817-5886

PREFACE

During 1990 and 1991, the Logistics Management Institute's research program for the Air Force focused on improving the Air Force policy on the sizing of the aircraft reparable spare parts ("spares") inventory needed to support wartime operations. Since then, the Air Force has changed its structure and operations in a way that affects that policy and the terminology used to describe spare parts packages. In this report, we refer to the structure and operating procedures as they were when the policies were developed. We mention major changes that affect the new policy, and although we do not discuss those changes in any detail, we indicate some important areas in which the Air Force needs to restudy the new policy in light of recent developments.

In mid-1992, the Air Force made changes in its major command structure. The Strategic Air Command's conventional warfare mission was eliminated and those functions were incorporated in two other commands. What was the Tactical Air Command became the Air Combat Command, and it is now responsible for both fighters and bombers. The Air Mobility Command, formerly the Military Airlift Command, is now responsible for airlift and tankers.

Another recent change relates to spare parts packages that support wartime tasking. In this report, we refer to those kits as war readiness spares kits (WRSK) and base-level self-sufficiency spares (BLSS) kits. Because of recent policy changes (the spare-is-a-spare policy, discussed in Chapter 6), the Air Force now refers to WRSK as mobility readiness spares packages and BLSS as in-place readiness spares packages.

In a second major change in 1992, the Air Force moved toward two-level maintenance from its current three-level maintenance process. Under the current process, the first level is on the flight line and it entails removing and replacing broken parts. At the second level, known as the intermediate level, personnel test broken parts and perform simple repairs. Third-level maintenance is performed at a depot, a central industrial facility for major repairs and overhauls.

The Air Force plans to reduce its use of intermediate-level repair for avionics and engines. Under the new two-level maintenance process, parts formerly fixed at the intermediate level will be fixed at the depot. The Air Force implementation plan calls for moving to two-level maintenance (for selected items and weapon systems) by the end of the decade. That new process will affect wartime policy because intermediate-level maintenance will no longer deploy. The policy we discuss in this report may then change significantly. We note where the new maintenance policy may affect any current policy.

LMI

Executive Summary

CHANGES TO THE AIR FORCE'S POLICY FOR CALCULATING WARTIME SPARES REQUIREMENTS

For years, the Air Force has computed wartime spare parts ("spares") requirements under a policy that was somewhat inconsistent and often misunderstood. To develop a more consistent and credible approach to computing those requirements, the Logistics Management Institute worked with the Air Staff to develop new policies and procedures. Our report primarily describes the new Air Force policy and its rationale.

The old policy for setting the spares requirement for the "first 30 days" of a conflict required the Air Force to buy a minimum number of spares for each item, known as the "pipeline floor." (Note: The pipeline is the projected average number of demands for each item.) "Safety-level" spares then were added to cover uncertainty in failures. Safety-level spares requirements supported an aircraft availability goal, known as the direct support objective (DSO), for day 30 of the war.

The two major deficiencies related to the old approach were the following:

- Buying the pipeline floor is inefficient because it does not consider the benefit an item provides relative to its cost.
- The DSO was not based upon the tempo of operations; in particular, it did not address the surge (by fighter aircraft) that occurs during the first week of any conflict.

To address those deficiencies, the Air Force approved and implemented the following policy changes for the first 30 days of war:

- It began using multiple DSOs.
- It eliminated the pipeline floor, except for hard-to-cannibalize items.

- It provided the Tactical Air Force with a DSO formula based upon the minimum number of aircraft needed to fly the planned wartime tasking.
- It allowed the Military Airlift Command to use an availability-based cost-minimization technique (instead of fixed safety level) with resupply.

By buying smarter, the Air Force can realize greater capability at less cost under the new policy.

During the "second 30 days" of a conflict, the depot establishes resupply. The units can then operate with fewer spares on hand than they could during the first 30 days of war. The sustaining wartime requisitioning objective (SWRO) was developed to address that change in requirement. The SWRO sets the level of spares that a unit requires when resupply is available. The Air Force has approved and partially implemented its computation. Adopting the SWRO can ease the burden on the depots during a sustained war.

The changes to Air Force policy discussed here provide improved support and cost savings. The changes enable the Air Force to fly its planned wartime tasking while reducing the Air Force (net) buy requirement by 14 percent. Of course, Air Force policies and procedures for determining wartime spares requirements must be viewed as evolutionary. As Air Force operations change to reflect new national security strategies, requirements policies and procedures must be reviewed and changed appropriately.

CONTENTS

	Page
Preface	iii
Executive Summary	v
Tables	x
Figures	xi
Chapter 1. Background	1-1
Introduction	1-1
Wartime Concept of Operations	1-1
The First 30 Days	1-1
The Second 30 Days	1-2
The Long-Term Conflict	1-3
Wartime Spares Computation History	1-3
Conventional Kit	1-3
WRSK/BLSS Authorization Computation System (D029)	1-3
Dyna-METRIC	1-4
Aircraft Sustainability Model	1-4
Chapter 2. Policy Changes – The First 30 Days of War	2-1
The Old Policy	2-1
Confidence Level	2-2
Dual Direct Support Objectives	2-2
The Pipeline Floor	2-5
Definition	2-5
Reasons for the Pipeline Floor	2-8
Consequences of Removing the Pipeline Floor – Debunking the Folklore	2-9
Recommended Pipeline Floor Policy	2-10
Pipeline Floor Summary	2-11
More Specific Buy Kits	2-12
Background	2-12
Status	2-13
Combined Effects of Policy Changes	2-14

CONTENTS (Continued)

	Page
Chapter 3. Specific Major Command Policy Issues During the First 30 Days of War	3-1
Tactical Air Force	3-1
Direct Support Objective	3-1
Background	3-1
Minimum Fully Mission Capable	3-2
Military Airlift Command	3-4
Variable Safety Level	3-4
Repair and Resupply Concept	3-5
Base-Level Self-Sufficiency Spares Kits	3-5
War Readiness Spares Kits	3-5
Number of BLSS Kits	3-6
Summary	3-6
Strategic Air Command	3-7
Repair Concept Development	3-8
Implementation Status Update	3-9
Chapter 4. Policy Changes – The Second 30 Days of War	4-1
Sustaining Wartime Requisitioning Objective	4-1
Direct Support Objective	4-1
Follow-on Spares Kit	4-2
To Buy or Not to Buy	4-2
Status Update	4-4
Sustaining Wartime Requisitioning Objective	4-4
Follow-on Spares Kit	4-4
Chapter 5. Other War Reserve Materiel	5-1
Computing the Requirement	5-2
Weaknesses of the Current Computation	5-3
Variable-Safety-Level Method	5-3
Range of Items	5-3
Steady-State Pipeline Algorithm	5-3
Computation Driven by Month 1	5-5
Calculation Recommendations	5-6
Status Update	5-6

CONTENTS (Continued)

	Page
Chapter 6. Evolving Issues	6-1
Spare-is-a-Spare Policy	6-1
Background	6-1
The New Policy	6-1
Asset-Based Computations Policy	6-2
Offsetting WRM Requirements with Peacetime Operating Stock Requirements	6-2
Operations Desert Shield/Desert Storm: Lessons Learned About Demand Forecasting	6-3
Demand Forecasting	6-3
Recommendations	6-3
New War Plans	6-5
Summary	6-6
Chapter 7. Summary and Recommendations	7-1
Introduction	7-1
The First 30 Days	7-1
The Old Policy	7-1
The New Policy	7-1
Specific Major Command Policy Issues During the First 30 Days of War	7-2
Tactical Air Force	7-2
Military Airlift Command	7-2
Strategic Air Command	7-3
The Second 30 Days	7-4
Sustaining Wartime Requisitioning Objective	7-4
Direct Support Objective	7-4
Follow-on Spares Kit Needs Re-evaluation	7-5
Other War Reserve Materiel	7-5
The Air Force Should Re-evaluate OWRM	7-5
Evolving Issues	7-6
Asset-Based Computations	7-6
Demand Forecasting	7-6
Appendix A: War Readiness Spares Kit: Comparison of Old and New Policies	A-1 – A-3
Appendix B: Glossary	B-1 – B-4

TABLES

		Page
2-1.	Cost, Confidence, and Expected Not Mission Capable Supply Relationship	2-3
2-2.	Dual Direct Support Objectives	2-5
2-3.	The Cost of the Pipeline Floor: Examples	2-8
2-4.	The Cost of the Pipeline Floor	2-9
2-5.	Stability: Comparison of Kit Cost	2-10
2-6.	Comparison of Kits Built Under Various Pipeline Policies	2-11
2-7.	An Example: Extra Safety Level	2-13
2-8.	Specific Kits Cost Less	2-14
2-9.	Comparison of Kits Bought Under Old and New Policies	2-15
3-1.	Primary Aircraft Authorization and Spare Aircraft	3-3
3-2.	New Fighter Direct Support Objectives	3-4
3-3.	Comparison of Old and New Policies	3-7
3-4.	New Military Airlift Command Kits	3-8
4-1.	F-16C Aircraft Follow-on Spares Kit	4-3
4-2.	F-15C Aircraft Follow-on Spares Kit	4-3
5-1.	Gross Requirement Reductions	5-6
6-1.	Operation Desert Storm/WMP-5 Flying Comparison	6-4
6-2.	Comparison of Actual Versus Predicted Operation Desert Storm Parts Failures	6-4
7-1.	Primary Aircraft Authorization and Spare Aircraft	7-3

FIGURES

		Page
2-1.	Kit Cost Versus Confidence Level	2-3
2-2.	Typical Wartime Tasking for F-15C Aircraft	2-4
2-3.	Pipeline Computation: RR Line Replaceable Unit	2-6
2-4.	Pipeline Computation: RRR Line Replaceable Unit	2-6
2-5.	Pipeline Dynamics	2-7
2-6.	Generic Kits Contain More Parts	2-12
5-1.	Wartime Spare Parts Requirements Over Time	5-1
5-2.	Double Counting the Pipeline	5-4

CHAPTER 1

BACKGROUND

INTRODUCTION

In this report, we document recent changes in the Air Force policy concerning computing wartime requirements for aircraft reparable spare parts ("spares"). Previously, elements of the policy were confusing and inconsistent. Its complicated terminology made discussion among policymakers and policy implementers difficult. The Logistics Management Institute (LMI) worked with Headquarters, United States Air Force/Directorate of Supply, to develop a more consistent, more credible, and more easily understood approach to computing wartime spares requirements. We proposed improvements to wartime spares policy and, ultimately, they were approved by senior Air Force officials. This report documents the approved new policy and its rationale. It also discusses the status of some current wartime spares initiatives.

WARTIME CONCEPT OF OPERATIONS

The Air Force operates differently during different phases of a war. During the "first 30 days," war plans require deployed Air Force units to be self-sufficient. During the "second 30 days," additional support (i.e., equipment and manpower) deploys, and operating locations become connected with a depot. By day 60, the Air Force expects to operate in a "steady-state" mode – i.e., deployed units will be fully connected to depot repair and resupply.

The First 30 Days

During the first 30 days of a conflict, some Air Force units will fight in place and others will deploy. Base-level self-sufficiency spares (BLSS) kits support units that fight in place, and those units also take advantage of base repair operations, which are available from the first day of the war.

War readiness spares kits (WRSK) support deploying units. Those units must live out of their WRSK for the first 30 days; the depot does not resupply them during that time (although the units retrograde broken parts).

The kits contain remove and replace (RR) items and remove, repair, and replace (RRR) items. For some aircraft types – the F-16, for example – deployed units have only RR capability during the first 30 days of the war. [Under the future Air Force two-level maintenance (2LM) process, no avionics intermediate-level maintenance would be available, and virtually all WRSK items would be RR.]

The Tactical Air Force (TAF) plans to surge during the first 7 days of the war, during which time fighter aircraft will fly many sorties each day.[1] For the next 23 days, the planes will fly less than on the first 7 days but more than they would typically fly during the same period in peacetime. The sorties are assumed to begin and end at the same location.

The Strategic Air Command (SAC) will fly a flat program (i.e., its aircraft will fly one long sortie each day). If a plane is not available, the sortie is generally lost. As with the TAF, sorties are assumed to begin and end at the same location.

The Military Airlift Command (MAC) operates much differently from the TAF and SAC. Since materiel and personnel continue to deploy during the second 30 days, MAC planes are heavily tasked for 60 days. Their WRSK and BLSS kits support 60, instead of 30, days of combat. MAC planes fly circuits, or "channels." The channel begins at a CONUS base that is supported by BLSS. The depot resupplies those CONUS bases. The plane flies a circular, overseas route that includes many landings, and the MAC places assets from a single WRSK along the route. During the final leg of the route, the plane returns to the original CONUS base.

The Second 30 Days

During the second 30 days of a conflict, the Air Force makes the transition from the surge to steady state. Under the existing three-level maintenance concept, it would deploy more equipment, personnel, and spare parts. With that additional support, deployed units would have greater capability to repair items at their operating locations. Furthermore (and regardless of which maintenance concept

---

[1]The newly published *War Mobilization Plan* (March 1993) calls for a 10-day surge for most fighter aircraft.

applies), the depot has begun resupplying the deployed units by day 31. TAF aircraft again decrease their flying hours to a level that is slightly higher than the peacetime level.

The Long-Term Conflict

In the long-term, the industrial base will supply the war. Until then, the Air Force will use other war reserve materiel (OWRM) to resupply the operating locations and to fix parts that the operating units have retrograded.

WARTIME SPARES COMPUTATION HISTORY

The policy on wartime spares requirements reflects the limitations of computation algorithms and computer software and hardware. As new techniques become available, the policy should be re-evaluated. The recent history of wartime spares requirements computations illustrates the connection between those limitations and policy.

Conventional Kit

The Air Force first computed its WRSK/BLSS requirements using a very simple computation -- determining the average quantity needed in resupply for each item and buying exactly that many. We now call that kit the "conventional" kit, and we call the quantity bought the "pipeline." Since that simple computation ignored the variability in failures and in repair capability, it did not require buying additional spare parts (safety level) to cover unexpected outcomes. (The MAC began calling its kits "conventional" long after the Air Force abandoned the conventional kit method described here. The MAC conventional kit did include safety level. The method of computing its quantities is described in Chapter 3.)

WRSK/BLSS Authorization Computation System (D029)

In the late 1970s, the Air Force began using the WRSK/BLSS Authorization Computation System (referred to as the D029 system) to compute requirements. That system recognized the need to buy additional spares as safety level to guard against uncertainty. The D029 system used a marginal analysis technique to find the least-cost mix of additional (above the minimum pipeline buy) spare parts to attain a specific capability. Marginal analysis techniques rank the candidate items in decreasing order of benefit per cost. Buying from that list in the order indicated ensures that items that give greater performance per dollar will be acquired earlier.

Actually, the D029 system had two performance goals. One was to limit the number of allowable backorders, and the other limited the number of allowable downed aircraft.

Dyna-METRIC

Dynamic Multi-Echelon Technique for Recoverable Item Control (Dyna-METRIC) enhanced the D029 marginal analysis capability, most notably by recognizing the difference between line replaceable units (LRUs) and their shop replaceable unit (SRU) subassemblies. For almost a decade, the Air Force has used Dyna-METRIC to *assess* wartime stocks. To make requirements determination consistent with assessments, the Air Force had at one time *planned* to implement Dyna-METRIC in the requirements system. Dyna-METRIC requires as an input the number of allowable downed aircraft and a user-defined target probability (confidence level) of achieving the goal. The confidence level is a modeling requirement, not part of the policy.

Aircraft Sustainability Model

The Aircraft Sustainability Model (ASM), developed by LMI and sometimes known as modified Dyna-METRIC, is the most recent model the Air Force uses to compute wartime spares requirements. The Requirements Execution Availability Logistics Module (REALM) of the Weapon System Management Information System (WSMIS) began using the ASM for requirements computation in the late 1980s.

The ASM improved the Dyna-METRIC LRU/SRU tradeoff logic. While the ASM is compatible with Dyna-METRIC (its answers can be validated by Dyna-METRIC), it has a different structure that enables it to provide increased capabilities with less computer resources. For those reasons, Dyna-METRIC was not used (as had been planned) in requirements determination.

The ASM can use, but does not require, a confidence-level target. Nevertheless, when the Air Force first used the ASM to compute requirements, it used a confidence-level target.

The ASM's increased capabilities allowed the Air Force to re-evaluate the wartime spares policy. Many of the policy changes discussed in this report directly result from the ASM's increased capabilities.

CHAPTER 2

POLICY CHANGES – THE FIRST 30 DAYS OF WAR

This chapter addresses policy changes related to building WRSK and BLSS kits. The Air Force uses WRSK and BLSS kits to support the first 30 days of a conflict (when resupply is assumed to be unavailable). The changes discussed in this chapter have already been reviewed, approved, and implemented by the Air Force.

THE OLD POLICY

In this section, we discuss the policy as it existed in 1990. The Air Force wartime spares requirement calculation began with a minimum buy quantity, known as the "pipeline floor," for each part. The pipeline comprises the average number of demands for each item. "Safety-level" spares were added to the pipeline to cover uncertainty related to the prospective failure of spares. Safety-level spares requirements were computed to support a not mission capable-supply (NMCS) goal on day 30 of the war. For fighter aircraft, the NMCS goal was 25 percent. For example, a kit to support a TAF squadron with a 24 primary aircraft authorization (PAA) would have enough stock to ensure that the expected NMCS aircraft were six or less on day 30.

The implementation, however, differed from the policy. Instead of using the NMCS goal, the *probability* of reaching the NMCS goal was used. The actual procedure sized the requirement to provide a probability, or confidence level, of 80 percent of reaching the NMCS goal. While that is a subtle distinction, we will show it had a significant cost impact.

The mix of safety-level spares was determined by a marginal analysis technique. (Marginal analysis techniques are designed to achieve an operational goal at least cost.) Air Force policy did not give specific guidance on the type of marginal analysis technique to be used.

Reviewing the old policy and its implementation raised many questions. What is the value of buying the pipeline floor? Why is there a target only for day 30? Is 80 percent a suitable confidence-level target? An analysis of those questions led to changes in policy.

CONFIDENCE LEVEL

When using marginal analysis to compute a requirement for spare parts, the algorithm must have a goal, or "stopping rule," to know when it has "bought" enough additional spares. The old Air Force goal was to buy enough spares so that the probability of having a certain number of planes down for supply on day 30 (e.g., 25 percent for the TAF and 17 percent for the SAC) was 0.80 (for WRSK).

Empirically, a target of an 80 percent confidence level usually results in an expected NMCS value that is lower than the goal stated in the policy. Figure 2-1 and Table 2-1 show the typical relationship between confidence level and ENMCS. An 80 percent confidence level corresponds to an expected NMCS of 5.7 for a 24 PAA F-15C kit, while the allowed number of NMCS aircraft was six. Using confidence level as the stopping rule made the Air Force buy more spare parts than called for in the policy.

Unlike Dyna-METRIC, the ASM can stop "buying" spare parts when the expected NMCS hits its target. Stopping on the expected NMCS was consistent with policy and more straightforward than the use of a confidence level. Therefore, the Air Force approved and implemented the expected NMCS stopping rule.

The Air Force also changed its optimization algorithm. Instead of optimizing on confidence level, the new algorithm optimizes on expected availability. In other words, the old algorithm found the least-cost mix of spare parts to meet the *probability* of meeting the target. The new algorithm finds the least-cost mix of spare parts to meet the expected value – or average – target.

DUAL DIRECT SUPPORT OBJECTIVES

The old policy focused exclusively on day 30 of the conflict, specifying a desired number of aircraft immediately available for combat (or conversely, an allowable number of aircraft down) on that day. That emphasis reflects the treatment of *consumable* materiel such as fuel, rations, and ordnance. Without replenishment,

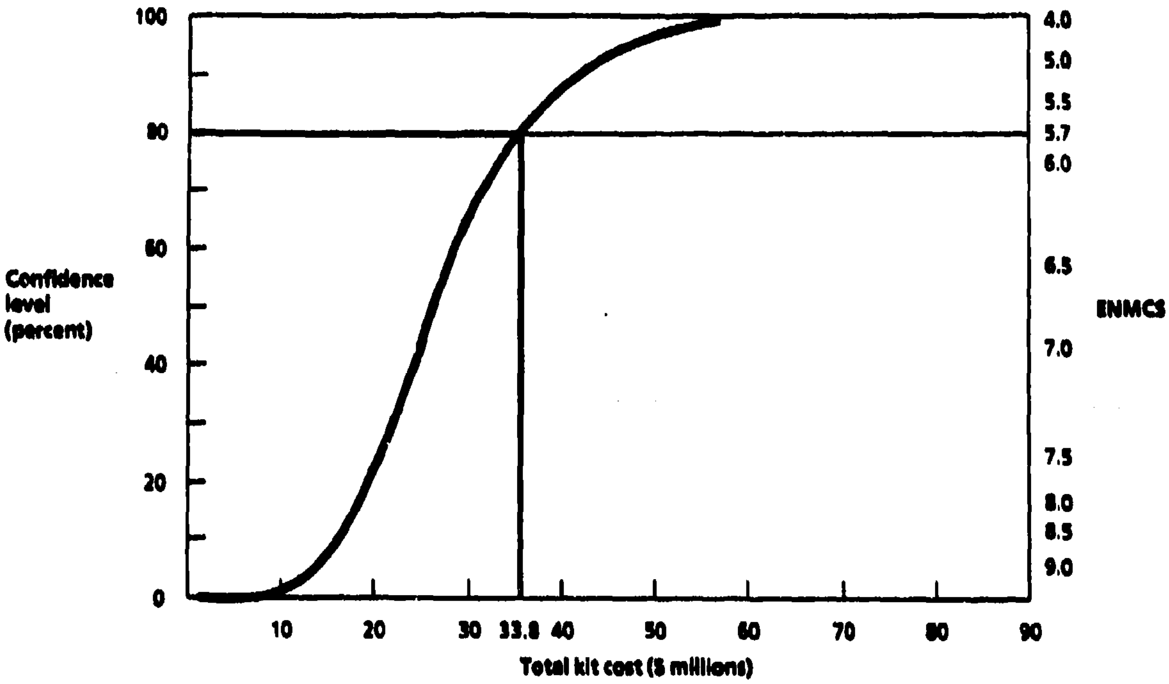


FIG. 2-1. KIT COST VERSUS CONFIDENCE LEVEL

TABLE 2-1

COST, CONFIDENCE, AND EXPECTED NOT MISSION CAPABLE SUPPLY RELATIONSHIP

Confidence level	Cost ($ millions)	ENMCS
73%	$30.6	6.0 ← New stopping rule
Old stopping rule → 80%	$33.8	5.7

having "enough" of consumable materiel on day 30 of the conflict implies having "enough" earlier than day 30.

Unlike consumable items, reparable spares are sensitive to the tactics and tempo of the conflict. For instance, a deploying TAF unit might need *more* spares to fly the first 7 days of a high-activity surge than it would need to fly the latter part of the 30-day period. After day 7, the TAF generally flies fewer sorties each day (so not as many aircraft are needed) and, for some deploying units, a maintenance facility – which takes several days to set up – begins to produce repaired parts.

Figure 2-2 illustrates the "surge" problem. It displays typical wartime tasking for the F-15C aircraft. For a 24 PAA F-15C squadron, the old policy allowed six planes down for supply on day 30. In other words, 18 planes are expected to be available. We will refer to the goal of the number of planes available for combat as the direct support objective (DSO).[1] Given a reasonable "turn rate" (which determines the number of sorties an aircraft can fly each day), 18 available planes more than meet the tasking in the last part of the scenario (days 8–30). However, 18 planes are not enough to meet the surge requirements.

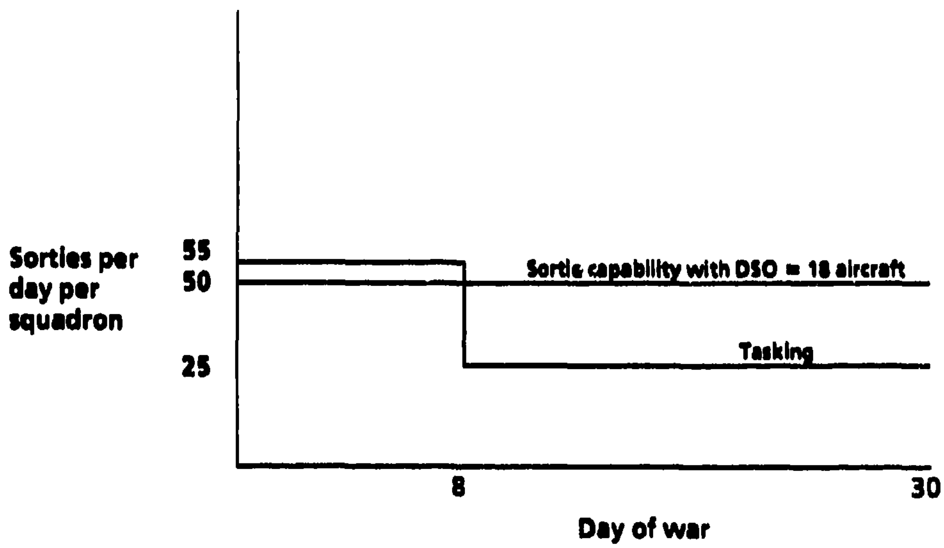


FIG. 2-2. TYPICAL WARTIME TASKING FOR F-15C AIRCRAFT

To solve the surge problem, the DSO can be set not just on day 30 but throughout the scenario. A single goal had been defined for two reasons:

- The belief that adequate performance on day 30 implies adequate performance throughout the scenario
- The lack of any technique for looking at more than 1 day.

[1]The old policy actually referred to the number of planes allowed *down* as the DSO!

Figure 2-2 illustrates the error in the first reason; the ASM provides the solution to the second reason. The ASM can meet two objectives, one on day 7 and the other on day 30 (or any other days deemed appropriate).

Table 2-2 compares two kits: one built using one day 30 DSO and the other built using dual DSOs. Suppose we need 20 fully mission capable (FMC) aircraft on day 7 and 18 FMC aircraft on day 30. The ASM can build a kit that will simultaneously achieve both objectives, to an 80 percent confidence, for a cost of $39.0 million.[2] The old kit, optimized for day 30 only, cost $37.0 million.

TABLE 2-2

DUAL DIRECT SUPPORT OBJECTIVES

Option	Cost ($ millions)	Day 30		Day 7	
		Confidence (DSO = 18)	FMC	Confidence (DSO = 20)	FMC
Single DSO	$37	80%	18.4	64%	19.7
Dual DSOs	$39	80%	18.6	80%	20.2

The cost increase is modest and could be offset by decreasing the DSO for day 30. The planning scenario generally requires less than 75 percent of the aircraft beyond the surge period. To provide greater operational support at minimal cost, the Air Force approved and implemented dual DSOs.

THE PIPELINE FLOOR

Definition

A component's pipeline is the average number of those components in resupply (e.g., base repair, en route from the depot) at a moment in time. Resupply from the depot is assumed to be unavailable during the first 30 days of a conflict.

[2]We use the old policy stopping rule to isolate the impact of dual DSOs; we will look at the impact of the combined changes at the end of this chapter.

For a RR item (when no resupply takes place) the pipeline on day 30 is the total expected number of demands over the 30-day period. Figure 2-3 shows a sample calculation for the pipeline on day 30 for a RR item.

Control box with (fictional) data:

Demand rate = 0.00125 per flying hour
Flying hours over 30 days = 2,400

Pipeline on day 30 = expected number in resupply

= demand rate × 30-day flying hours
= 0.00125 × 2,400
= 3.0

FIG. 2-3. PIPELINE COMPUTATION: RR LINE REPLACEABLE UNIT

Figure 2-4 shows a sample day 30 pipeline calculation for a RRR item. In that example, we assume the item can be repaired in 5 days (with a 2-day setup time at the beginning of the scenario). By the end of day 30, all failures before day 26 have been repaired and returned to service; so the pipeline on day 30 is the sum of failures occurring between day 26 and day 30.

Computer with (fictional) data:

Demand rate = 0.01154 per flying hour
Repair setup time = 2 days
Repair time = 5 days

Pipeline on day 30 = expected number in resupply

= demand rate × (day 26 – 30 flying hours)
= 0.01154 × 260
= 3.0

FIG. 2-4. PIPELINE COMPUTATION: RRR LINE REPLACEABLE UNIT

In both the RR and RRR examples, the pipeline on day 30 is 3.0. While both components have the same pipeline value on day 30, the pipeline quantities vary over time. Figure 2-5 shows that variation.

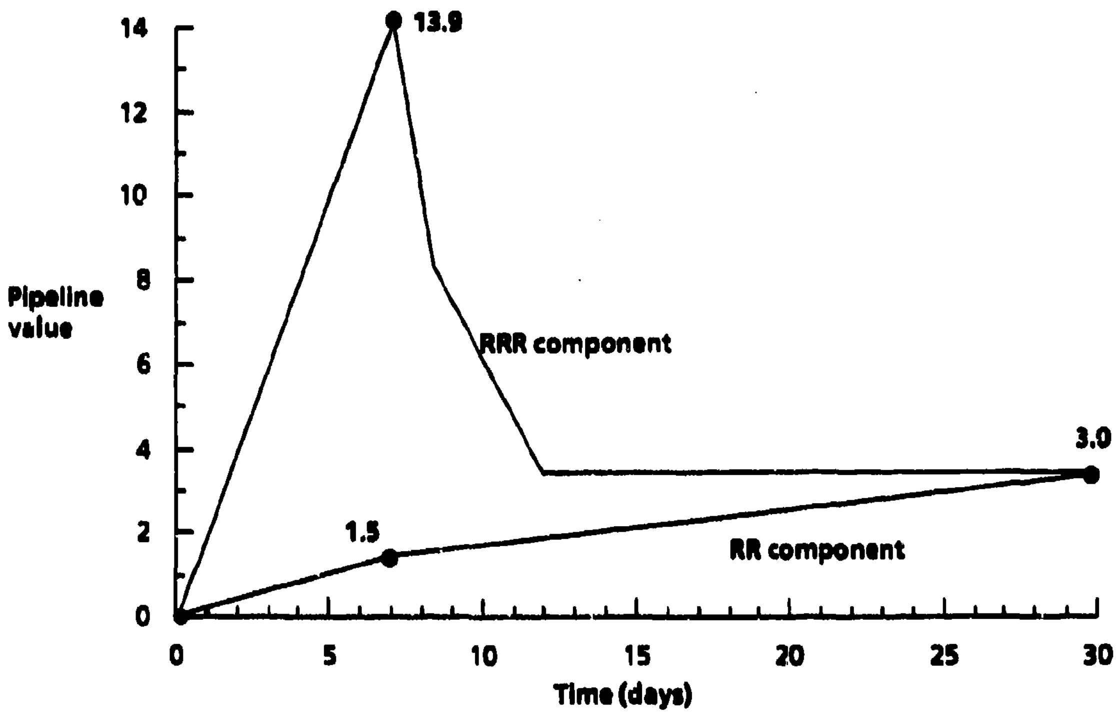


FIG. 2-5. PIPELINE DYNAMICS

In the absence of resupply, the RR component has an ever-increasing pipeline. For a RR component, the pipeline equals demand. We expect that the maximum number of planes that will be grounded, by the RR component, will be three on day 30.

The up-and-down slope in Figure 2-5 of the RRR pipeline shows the effects of repair. After day 7, maintenance personnel repair the item faster than it breaks. The surge effects are washed out by day 12 (a repair time after the surge).

Air Force Regulation (AFR) 400-24 defines the pipeline floor as "the expected number in resupply over the support period." As Figure 2-5 shows, that definition is ambiguous. Under the old policy, the minimum buy was an item's peak pipeline value over the course of the scenario. The minimum buy quantities for our sample items would be 3 for the RR item and 14 for the RRR item.

The RR item illustrates how costly the pipeline floor policy could be. Recall that the RR item grounds at most three aircraft. Under the old policy, those items had to be bought, regardless of cost, even though (for a 24 PAA TAF squadron) six aircraft were allowed down on day 30. Table 2-3 shows examples, from a 24 PAA F-15C WRSK, of items where the pipeline floor policy forced the Air Force to buy spare parts whereas an unconstrained calculation procedure would not.

TABLE 2-3

THE COST OF THE PIPELINE FLOOR: EXAMPLES

National stock number	Unit cost ($)	Number bought	
		With pipeline floor	Without pipeline floor
1270010635567FX	101,431	2	0
2915012648648PT	243,450	6	0
5841012348535FX	277,457	2	0

Reasons for the Pipeline Floor

Many reasons have been given for the existence of the pipeline floor policy. Some of them address valid concerns that could not be addressed more directly previously. Others fall into the category of "folklore." Folklore covers reasons for needing the pipeline floor that are widely believed but have not been validated or quantified. Discussed below are some of the major arguments and counter arguments, including folklore, that have been given for needing to buy the pipeline floor levels.

First, all other things being equal, a kit purchased under a pipeline floor policy, will cause fewer cannibalization actions than will a kit purchased without a pipeline floor. That is true, but cannibalization actions can be controlled more cost-effectively in ways other than by buying the pipeline floor for every item.

Second, the floor supposedly provides some stability in the requirement from year to year. Changing demand rates and repair factors cause most of the instabilities. Those same changing rates and factors also cause the pipelines themselves to be unstable.

Third, the peak floor quantities provide protection during the surge period. (Remember that under the old single DSO policy, the surge flying hours were not explicitly covered by the day 30 requirement. Dual DSOs address this problem.)

Fourth, wartime spares are used to make up for peacetime supply and repair deficiencies. While never stated as an official justification for the floor, some in the supply community argue that the floor provided the "fat" needed to enable units to fulfill their peacetime objectives. Using wartime spares policy to address peacetime supply deficiencies is questionable. Under the new "spare-is-a-spare" (s-s) policy, where items are not classified as peacetime or wartime stock, the argument becomes irrelevant. (The s-s policy is discussed in Chapter 6.)

Consequences of Removing the Pipeline Floor – Debunking the Folklore

Table 2-4 illustrates the high cost of the pipeline floor policy by comparing the cost of an F-15C kit built with and without the floor. To reach the same confidence level, the kit with the floor costs $3.2 million more than the kit built without the floor. By using unconstrained marginal analysis, the kit built without the floor is the least-cost kit for meeting the 80 percent confidence goal (again, we use the old policy to isolate the effect of removing the pipeline floor).

TABLE 2-4

THE COST OF THE PIPELINE FLOOR

Method	Cost ($ millions)	Confidence	Day 30 FMC	Cannibalization actions
Without floor	33.8	0.80	18.3	501
With floor	37.0	0.80	18.4	251

The table also shows that eliminating the floor results in a significant increase in cannibalization ("cann") actions. However, it is possible to control cannibalization actions more precisely by using an item exception to buy the floor only for "hard-to-cann" items. Alternatively, cannibalization actions can be controlled directly by using an optimization algorithm that maximizes expected availability while minimizing cannibalization actions.

Another reason given for using pipeline floors is the belief that the floor policy reduces the instability in kit requirements. In other words, if the pipeline floor was dropped, the variation in range, depth, and kit cost from year to year would increase. Table 2-5 compares, for two weapon systems, kits with the same kit serial number drawn from two different D029 (i.e., WRSK/BLSS computation system) data bases.

TABLE 2-5

STABILITY: COMPARISON OF KIT COST

Data base	F-15C		F-16C	
	With floor	Without floor	With floor	Without floor
March 1987 D029 ($ millions)	48.3	40.3	33.1	32.1
March 1988 D029 ($ millions)	38.9	31.1	34.8	34.2
Difference (%)	– 19.5	– 22.8	5.1	6.1

Table 2-5 shows that the floor itself does little to ensure kit stability. The F-15C kit is unstable, with or without the floor. The F-16C kit is somewhat stable, with or without the floor. The greatest cause of instability is changing demand rates and repair factors. Those rates and factors influence both the pipeline floor quantities and the marginal analysis quantities.

Recommended Pipeline Floor Policy

Historically, the pipeline floor quantity did provide some protection against requiring an unreasonable number of cannibalization actions during the first 30 days of the war. The cannibalization problem can be addressed directly by identifying those items that are difficult to cannibalize. The Air Force has defined an item to be "hard-to-cann" if it takes more than 4 hours to complete the cannibalization action or if the part has a significant breakage rate during cannibalization.

The pipeline floor policy was amended to cover only hard-to-cann items. Those items are now identified during the kit review process, and a special flag is added in the REALM data base. Table 2-6 compares kits built with a pipeline floor for all items, for no items, and for hard-to-cann items only. As expected, when more items are floored, the kit costs more but has fewer cannibalization actions. The kit with the floor for hard-to-cann items still has substantially more cannibalization actions than the kit with the floor for all items. The Air Force did review those results and believes it can perform that level of cannibalization actions during the course of 30 days because all the required actions are "easy canns."

TABLE 2-6

COMPARISON OF KITS BUILT UNDER VARIOUS PIPELINE POLICIES

Kit building method	Cost ($ millions)	Confidence	Day 30 FMC	Cannibalization actions
With floor for all items	37.0	0.80	18.4	251
With floor for hard-to-cann items	34.9	0.80	18.3	478
Without floor	33.8	0.80	18.3	501

Pipeline Floor Summary

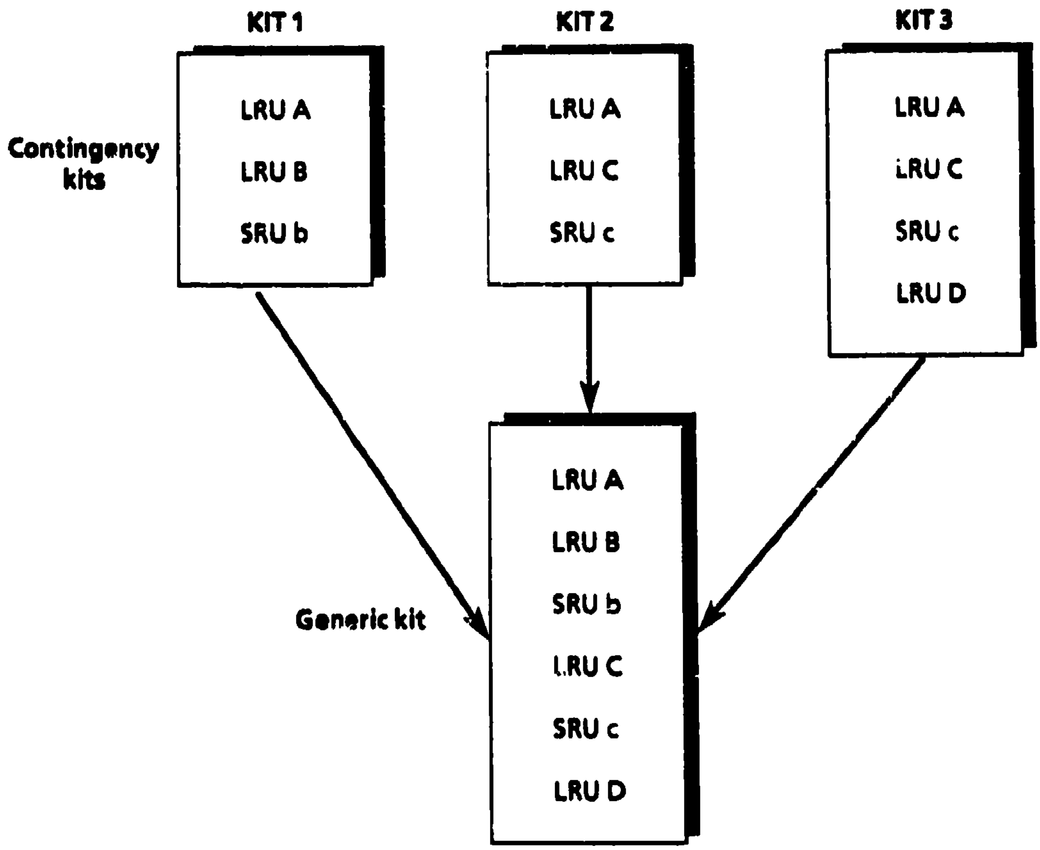
Although the Air Force had some valid reasons for its old pipeline floor policy, those reasons were offset by the high cost of the policy. In addition, an inconsistency occurred between the requirements computation, which used a floor, and the way dollars were actually spent, without a floor.

Some potential problems, formerly avoided by buying the pipeline floor level, can be addressed explicitly under the new policy. Hard cannibalization actions can be constrained by using a "no cann" flag. The surge period can be protected by using a day 7 DSO. The Air Force approved and implemented dropping the pipeline floor from the kit requirements computation, except for hard-to-cann items.

MORE SPECIFIC BUY KITS

Background

The Air Force currently computes the WRSK/BLSS buy requirement by using generic (buy) kits. A generic kit contains all the reparable spare parts in every contingency (fielded) kit associated with it. Generic kits have greater range than unit-specific kits. Figure 2-6 illustrates the composition of a generic kit.



Note: LRU = line replaceable unit; SRU = shop replaceable unit.

FIG. 2-6. GENERIC KITS CONTAIN MORE PARTS

The nature of aircraft availability causes item safety levels to increase as more parts enter the requirements calculation. (The more parts on an aircraft, the greater likelihood that *some* item will ground the plane.) If the contingency kits are very different from each other, the number of distinct parts in the generic "buy kit" increases and therefore the cost increases. (When the contingency kits are similar to one another, this effect is not as great.) The additional cost comes from buying more safety level than necessary.

Table 2-7 shows how a generic kit can cause the Air Force to buy extra safety level. The requirement, when computed individually, is three for most of the contingency kits. However, when computing the requirement for all the kits together (the generic kit), four spares emerge as the requirement. Every kit with that national stock number (NSN) will get the same level computed for the generic kit – four. Therefore, four extra parts will be bought, costing $1.2 million more than would have been spent otherwise.

TABLE 2-7

AN EXAMPLE: EXTRA SAFETY LEVEL

NSN	Cost	Number bought						
		Kit 1	Kit 2	Kit 3	Kit 4	Kit 5	Kit 6	Generic Kit
5841011007363	$296,600	3	3	3	4	–	3	4

Note: Savings equal 4 (one each for kits 1, 2, 3, and 6) × $296,600 = $1,186,400. Kit 5 does not contain the item. Analysis based upon F-15C Tactical Air Command contingency kits.

Table 2-8 illustrates how using more specific buy kits can save money. The Air Force could save $15.6 million by making the buy kit, with six associated contingency kits, more specific. The contingency kits are very different from each other. While the numbers (i.e., range) of items in the kits are similar, the actual items in the kits differ. The diversity among the kits causes the generic kit method to produce a more costly requirement. (When contingency kits are similar, neither the generic kit range nor cost increases significantly.)

Status

The Air Force approved using more specific buy kits. Follow-up analysis showed that the Air Force was moving toward using more specific buy kits. Many buy kits had only one contingency kit associated with them. When a buy kit had more than one contingency kit, the contingency kits often were similar.

TABLE 2-8

SPECIFIC KITS COST LESS

Kit	LRUs	SRUs	Cost ($ millions)		Savings ($ millions)
			Generic method	Specific method	
1	272	123	17.2	13.6	3.6
2	271	123	17.1	13.5	3.6
3	273	123	17.1	13.6	3.5
4	272	132	24.3	23.8	0.5
5	295	117	22.1	20.6	1.5
6	249	117	17.9	15.0	2.9
Total			115.7	100.1	15.6
Generic	388	152	27.6		

COMBINED EFFECTS OF POLICY CHANGES

The Air Force approved and implemented the following policy changes for the first 30 days of combat:

- Using an expected availability goal (instead of confidence level)
- Optimizing on expected availability (instead of confidence level)
- Using multiple DSOs
- Dropping the pipeline floor except for hard-to-cann items
- Using more specific buy kits.

Table 2-9 shows a comparison of kits bought under the old and new policies. (Throughout this chapter we have used one F-15C kit with serial number 0F015C0T246A to show results. Appendix A shows results for other weapon systems.) The kit built under the new policy costs $5.8 million less than an old policy kit. The new policy kit has the same number of hard cann actions on both day 7 and day 30, even though it has more total cannibalization actions. Available aircraft reflect the surge tasking on day 7 and less strenuous tasking on day 30. By buying smarter, the new policy can provide greater capability at less cost than the old policy.

TABLE 2-9

COMPARISON OF KITS BOUGHT UNDER OLD AND NEW POLICIES

Kit policy	Cost ($ millions)	Day 7			Day 30		
		FMC	Total canns	Hard canns	FMC	Total canns	Hard canns
Old policy	$ 37.0	19.7	77	5	18.4	251	27
New policy	$ 31.2	20.5	99	5	16.1	473	27

CHAPTER 3

SPECIFIC MAJOR COMMAND POLICY ISSUES DURING THE FIRST 30 DAYS OF WAR

Chapter 2 addressed policy issues common to all major commands (MAJCOMs). Due to their distinct mission(s), each MAJCOM has unique operations that require specific policy guidance. This chapter discusses both resolved and pending MAJCOM issues.

TACTICAL AIR FORCE

The TAF's primary mission is to plan, conduct, and coordinate offensive and defensive air operations. That mission includes ensuring that forces are combat-ready for rapid deployment and employment.

The TAF WRSK/BLSS must support squadrons that fly several relatively short sorties each day. Those sorties begin and end at the same location. For most TAF weapon systems, wartime plans call for a week-long surge period at the beginning of the war. A deployed squadron is entirely supported by WRSK until the depot establishes resupply.

Direct Support Objective

Background

Empirical evidence has shown that some aircraft will be down for reasons other than supply. Field exercises at Eglin Air Force Base, in the late 1970s, showed that typically four aircraft were not mission capable for reasons other than supply. That observation led to allowing four planes down for supply reasons in early versions of Air Force policy. (There was no reason to supply planes that would be down anyway.)

Other factors should also influence the DSO; for instance, an evaluation of the threat, which dictates the number of aircraft the United States needs in a conflict. The number of required aircraft depends on daily sortie targets and the number of aircraft simultaneously in the air. Tactics and tempo must play a role in setting the supply goal.

The approach to setting the DSO should also be credible and defensible. The DSO should reflect operational concerns while yielding kit costs that are affordable. The old policy of allowing 25 percent of the aircraft down on day 30 for supply reasons was difficult to defend. All tactical aircraft had the same target, though they had different tasking and utilization rates. A joint LMI-Air Staff study, in response to a Defense Management Review, produced the following approach to setting the target.

Minimum Fully Mission Capable

The new approach to setting TAF DSOs is based upon the minimum number of aircraft needed to fly the planned wartime tasking. As discussed in Chapter 2, fighter aircraft tempo changes over the scenario so that fighters use two DSOs. The following hypothetical example illustrates the idea.

Suppose a 24 PAA F-15C squadron flies 66 sorties per day for the first 7 days and 36 sorties per day after that. Assume the maximum turn rate – the number of times a plane can be flown in a day, known as the high surge rate – is 3.5 throughout the scenario. The minimum number of FMC aircraft would be

$$\frac{66}{3.5} = 18.9 \textit{ for day } 7$$

and

$$\frac{36}{3.5} = 10.3 \textit{ for day } 30.$$

Notice that the DSOs represent average targets and are not integers. Unlike Dyna-METRIC, the ASM allows for a fractional DSO. Fractional DSOs are particularly important for small PAAs when it is possible that less than one plane (on average) would be allowed NMCS.

Spare aircraft are added to cover contingencies such as ground aborts, maintenance downtime, and the need for aircraft on ready alert. The number of spare aircraft are based on operations, with two spare planes for every 24 aircraft as the baseline. For squadrons with fewer than 24 aircraft, cost considerations led to decreasing the ratio of spare aircraft to authorized aircraft.

To ensure a minimum force structure, a floor was also placed on the DSO calculation. The new formula for calculating TAF DSOs is as follows:

$$DSO = Max\left(\frac{\textit{Daily sortie requirement}}{\textit{Turn rate}} + \textit{Spare aircraft}, 63 \textit{ percent of PAA}\right)$$

where the number of spare aircraft is dependent on squadron size and 63 percent of the PAA is the DSO floor. [*Daily sortie requirement* is the planned number of sorties per squadron, and the *Turn rate* is the high surge rate. Both come from the *War Mobilization Plan (WMP) – Volume 5.*] Table 3-1 shows the relationship between PAA and spare aircraft.

TABLE 3-1

PRIMARY AIRCRAFT AUTHORIZATION AND SPARE AIRCRAFT

PAA	Spare aircraft
< 12	0.0
12–17	0.5
18–23	1.0
24–35	2.0
36–47	3.0
48–59	4.0

Note: For every 12 after that, add 1.0 more.

Table 3-2 shows the new fighter DSOs (for 24 PAA squadrons) for day 7 and day 30 (using the 1986 version of the WMP). For all 24 PAA fighter squadrons, the old DSO was 18 on day 30. One exception to the new TAF DSO formula is the F-111. The F-111 is treated like a bomber and has an 83 percent DSO on both day 7 and day 30.

A similar formula is *not* used for the MAC and the SAC. Both the MAC and SAC fly flat programs with long missions (low turn rates). The MAC's and SAC's DSOs are 93 and 83 percent, respectively. The DSOs for the MAC and SAC should be re-evaluated based upon tactics and tempo.

TABLE 3-2

NEW FIGHTER DIRECT SUPPORT OBJECTIVES

Mission design series fighters	Day 7	Day 30
A-10A	21.1	15.0
F-4G	22.8	15.0
F-15A/B/C/D	20.4	15.0
F-15E	19.4	17.9
F-16A/B/C/D	22.4	15.0

MILITARY AIRLIFT COMMAND

The MAC's primary mission is to provide airlift capability. To deliver passengers and cargo far from home, the MAC uses airbridges or channels. Unlike TAF planes, MAC planes fly sorties that involve landings at several locations before returning home. The MAC aircraft fly specified routes and are serviced at several locations. The MAC places spare parts along the channel but also allows for repair of parts and lateral resupply. Their CONUS bases have field-level RRR capability, and the forward supply points have RR capability.

Substantial airlift is still needed during the second month of a war (when maintenance equipment is deployed and resupply from the depot begins). To ensure the follow-on support needed, the MAC's policy is to build 60-day kits (compared with 30-day kits for the TAF and SAC).

Variable Safety Level

Historically, the MAC used a fixed safety-level method to compute its requirements. Using a fixed safety level means, for each component, buying a fixed number of standard deviations above its pipeline floor. To improve economic efficiency and add consistency across the MAJCOMs, the MAC began using the same availability-based cost-minimization technique used by the TAF. That general technique was modified to reflect the MAC's unique operations.

Once the MAC began using a VSL requirements calculation, it had to refine the treatment of issues such as resupply times, which have more effect in a VSL computation than a fixed safety-level computation. The following discussion explains how MAC-defined parameters are used in a VSL computation.[1]

Repair and Resupply Concept

Base-Level Self-Sufficiency Spares Kits

The MAC's CONUS bases are supplied with RRR BLSS kits. Since the units are already in place, base repair capability is available on the first day of a war.

The depot will continue to transport parts to the base without any interruption (making "ordering and shipping" of the parts available from day 1). Since the average CONUS order and ship time for reparable spare parts (resupply time from the depot) is about 12 days, the MAC chose that as its new wartime standard.

War Readiness Spares Kits

The MAC's forward locations are supplied with a hybrid WRSK. No repair is available at the forward, operating location. The kit does, however, contain RRR items. Units retrograde unserviceable RRR items on MAC channel aircraft to a regional repair location (usually a CONUS base).

The resupply time for RRR items is the typical time needed to retrograde, repair, and forward transport an item. Average base repair time is 6 days, which is allowed because the repair location does not have additional stock to support the WRSK location. With relatively few landings, the MAC estimates it takes 14 days to both retrograde and return an item. Therefore, the MAC requires a resupply time of 20 days for RRR items. Operations Desert Shield/Desert Storm experience validated those times. In computing the kit requirement, it is assumed that all items retrograded can be returned in 20 days.

The RR items (and SRUs from RRR LRUs) are sent to the depot for repair. To allow time for transportation to and from the depot, RR items have a 30-day resupply time (they will be available, in-theater, on day 31).

---

[1]For more detail on the development of the MAC concept, see LMI Report AF001TR1, *Computing Military Airlift Command War Readiness Spares Kits*. Eichorn, Frank L. March 1991.

Number of BLSS Kits

Half of the MAC's flying hours are supported by BLSS and the other half are supported by WRSK. Traditionally, the MAC had computed a single BLSS and a single WRSK. The MAC segmented the one BLSS kit among its BLSS bases. For WRSK, the MAC segmented the kit along the plane's channel route, based on the anticipated number of landings for each location.

The MAC's actual operations use more than one BLSS base. Computing the requirement based upon a single location can underestimate the requirement. A single kit costs less than multiple kits because it allows more cannibalization actions. A single kit allows cannibalization across the entire fleet; multiple kits (one per base) allow cannibalization only at a base. Allowing the maximum number of cannibalization actions is not necessarily prudent during wartime when operations are strained.

The MAC changed its policy to build multiple BLSS kits, which better reflected MAC operations and allowed for more conservative cannibalization. Incorporating the new computational policies discussed in Chapter 2 (especially dropping the pipeline floor except for hard-to-cann items) made multiple kits affordable.

At the time of LMI's analysis, the MAC was operating five BLSS bases for the C-5 and seven for the C-141 aircraft. During Operations Desert Shield/Desert Storm, the MAC found it was servicing all of its C-5 aircraft at only two bases and its C-141 aircraft at four bases. Since the MAC was satisfied with operations during Operations Desert Shield/Desert Storm, it will compute kits accordingly.

Summary

The MAC will build 60-day WRSK and BLSS kits using a VSL technique. The MAC will continue to build a single WRSK but will build multiple BLSS kits. A 20-day resupply time for RRR items and a 30-day resupply time for RR items will be used to compute WRSK requirements. The policy changes discussed in Chapter 2 also apply to the MAC requirements calculation.

Table 3-3 compares C-5 WRSK and BLSS kits computed under the old and new policies. Under the new policy, WRSK and BLSS kits cost substantially less than under the old policy. There are fewer FMC aircraft under the new policy because the old policy overshot the target availability rate (93 percent).

TABLE 3-3

COMPARISON OF OLD AND NEW POLICIES

(C-5 WRSK and BLSS kits)

Kit type	Old policy		New policy	
	Cost ($ millions)	FMC[a]	Cost ($ millions)	FMC
BLSS	34.7	52.1	26.3[b]	51.2
WRSK	57.1	52.6	40.2	51.3

[a] PAA equals 55.
[b] Computed using five BLSS bases.

Since the time of the original LMI analysis (the results of which are shown in Table 3-3), the MAC has made several changes. One change, discussed earlier, was to decrease the number of BLSS bases. The MAC also substantially changed the kit composition. Under the old policy, the MAC did not even use the standard requirements computation (fixed safety level) for 65 percent of the kit items. Instead, these item requirements were computed manually off-line. Moving to a VSL computation increased the MAC's confidence in the computation; it now uses the manual computation for only about 10 percent of the items in the kit.

Table 3-4 shows C-5 and C-141 WRSK and BLSS kits developed on the basis of the more recent changes incorporated into the requirements computation. Those kits have more parts with computed requirements and were built using the new policy (including fewer BLSS bases).

STRATEGIC AIR COMMAND

The SAC has both nuclear and conventional tasking. The WRSK and BLSS kits support the SAC's conventional tasking. The SAC's conventional mission is to project power with its bombers. Tankers, reconnaissance, and command and control systems support that mission.

TABLE 3-4

NEW MILITARY AIRLIFT COMMAND KITS

Weapon system	Kit type	Cost ($ millions)	FMC	Total canns	Hard canns
C-5[a]	BLSS	72.8[b]	51.2	78	42
C-5	WRSK	106.2	51.2	334	31
C-141[c]	BLSS	59.2[d]	111.6	468	328
C-141	WRSK	122.4	111.7	387	93

[a] PAA equals 55.
[b] Computed using two BLSS bases.
[c] PAA equals 120.
[d] Computed using four BLSS bases.

The SAC WRSK supports small squadrons (usually seven aircraft) that typically fly one long sortie each day. With so few planes per squadron, if a plane is unavailable, the sortie is usually lost. Like TAF sorties, SAC sorties begin and end at the same location. Like MAC flying hours, SAC planned flying hours tend to be flat across the first 30 days.

Repair Concept Development

Today, SAC requirements are calculated in a manner that is similar to TAF requirements. Those requirements are based upon a DSO of 83 percent on day 30. The pipeline floor is bought only for hard-to-cann items. No resupply is available during the first 30 days of a conflict.

We have worked with the SAC to refine its kit concept. The SAC plans to build independent and dependent kits that are supported by one regional repair center. When building an independent/dependent kit, the Air Force computes the requirement by acting as if the squadrons are one. In the SAC's case, instead of building two, seven-PAA kits, the SAC would build one kit, usually to support 14 aircraft. (Some of the dependent squadrons might have fewer than seven aircraft.) Because of pooling effects, the requirement is less for larger squadrons. The kits are then segmented by giving a full seven-PAA kit to the independent squadron. The dependent squadron gets the remaining parts.

Implementation Status Update

The SAC independent/dependent kit concept has been approved. The Air Staff has not yet issued guidance on building the kits; several implementation details still need to be resolved. In particular, the treatment of SRUs must be clarified.

Tentative transportation and repair times have been set at 10 days to set up repair and 20 days to repair and return an item. Since 30 days will pass before an item is returned, the kit will essentially become a RR kit. The benefit of SRUs will not be recognized, so it is unlikely that SRUs will be bought to fix the broken LRUs at the regional repair facility. More analysis is needed before changes to the SAC WRSK computation can be made.

CHAPTER 4

POLICY CHANGES – THE SECOND 30 DAYS OF WAR

The Air Force wartime operations concept calls for units to be self-sufficient during the first 30 days of a conflict. By day 31, the depots are assumed to have established resupply to the operating locations. The Air Force's old policy did not address transitioning from the wartime surge period to the steady-state period. This chapter discusses the development of policy to bridge that gap.

SUSTAINING WARTIME REQUISITIONING OBJECTIVE

Operating units use WRSK and BLSS kits when no resupply is available from the depot. Once the depot establishes resupply, the unit can operate with fewer spare parts on hand. The Sustaining Wartime Requisitioning Objective (SWRO) is the level of spare parts (by item) that the unit can function with when resupply has been established. Once the number of spare parts at the operating unit falls below the SWRO, the unit can requisition the depot for another part.

Calculating the SWRO level is similar to calculating the WRSK/BLSS level. All computations are done using the ASM. The SWRO calculation differs from the WRSK/BLSS calculation in that all weapon systems have maintenance capability beginning on day 31. (Under 2LM maintenance, all units would be, and remain RR.) In other words, some items that used a RR concept during the first 30 days will use a RRR concept once additional maintenance equipment and personnel arrive on day 31. Another difference (by definition) is that the Air Force has established resupply from the depot by day 31.

DIRECT SUPPORT OBJECTIVE

Operating tempo during the sustained wartime period is similar to flying hours during peacetime. We have recommended that the Air Force use peacetime availability targets, by weapon system, as its DSO during the second 30 days of war. Peacetime targets, reflecting both flying hours and programmed maintenance, usually are about 85 percent aircraft available.

For the MAC and SAC, peacetime weapon system availability targets are close to their day 30 DSOs. The TAF peacetime availability target is higher than the target that the TAF DSO formula (discussed in Chapter 2) would produce for the second 30 days. Generally, during the second 30 days, the TAF DSO formula would set the availability target at 63 percent – a balance between the desires of the operational commander for high availability and the cost in spares to provide higher availability. Once resupply is available, a higher availability can be attained at a lower cost.

FOLLOW-ON SPARES KIT

Recall that the SWRO is a *level* that defines the number of spare parts that a unit needs during sustained combat. Any additional spare parts that the unit needs to meet those levels are provided in follow-on spares kits (FOSKs). Since the MAC builds 60-day WRSK and BLSS kits, it is unlikely that the Air Force would authorize FOSKs for MAC aircraft.

The FOSK requirement (for each item) is the SWRO less the WRSK/BLSS requirement. In other words, FOSKs fill in the difference between what is already on hand at the operating location and what the unit needs during long-term combat. Once a unit is at its SWRO level, normal requisitioning procedures start.

To Buy or Not To Buy

Since resupply is being re-established and the flying hours are lower than for the first 30 days – for most items, the number of spare parts needed in the second 30 days will be less than in the first 30 days. A few items will have an additional small requirement during the second 30 days of combat. Those parts usually are SRUs used to repair LRUs after the arrival of intermediate maintenance or RR LRUs with a high failure rate.

In most cases, the Air Force could fill the FOSK requirement from peacetime operating stock (POS) either from the home base or from units that did not deploy. Tables 4-1 and 4-2 show the FOSK (net) buy requirement when FOSK is sourced only from WRSK and POS at the unit's home base.

Table 4-1 shows that 48 F-16C aircraft have an additional buy requirement of $0.8 million for 180 SRUs. Table 4-2 shows the F-15C requirement, covering 54 aircraft, is a more significant $5.1 million for both LRUs and SRUs. If, upon deployment, the FOSK could be drawn from worldwide stocks, the buy requirement would be smaller. In November 1991, the Air Force Supply Wartime Panel Working Group (AFSWPWG) recommended treating the requirement not sourced with WRSK/POS as a "memo" requirement (a requirement displayed for information but not bought).

TABLE 4-1

F-16C AIRCRAFT FOLLOW-ON SPARES KIT

Kit: 0F016C0D4880A (computed as 2 × 24-PAA WRSK)	Cost ($ millions)	Range	
		LRUs	SRUs
WRSK requirement	51.6	374	0
SWRO	12.6	237	227
FOSK requirement	2.8	0	227
POS offset	25.3	352	225
FOSK – POS	0.8	0	180

Note: Seventy-eight percent of SWRO is sourced with WRSK. Ninety-four percent of SWRO is sourced with WRSK and POS. The POS offset shown is the maximum potential offset. The remaining unsourced FOSK is negligible.

TABLE 4-2

F-15C AIRCRAFT FOLLOW-ON SPARES KIT

Kit: 0F015C0D5480A (computed as 3 × 18-PAA WRSK)	Cost ($ millions)	Range	
		LRUs	SRUs
WRSK requirement	35.3	223	172
SWRO	46.4	271	206
FOSK requirement	14.3	177	123
POS offset	34.5	258	138
FOSK – POS	5.1	31	41

Note: Sixty-nine percent of SWRO is sourced with WRSK. Ninety-four percent of SWRO is sourced with WRSK and POS. The remaining unsourced FOSK is small but significant.

STATUS UPDATE

Sustaining Wartime Requisitioning Objective

The Air Force has yet to finalize its policy. Using standard Air Force software (REALM), computing SWROs is straightforward. We believe the Air Force should formally approve using peacetime availability targets in the SWRO calculation and implement that calculation.

Follow-on Spares Kit

The 2LM initiative would change the Air Force deployment concept during the second 30 days. The old war plans called for deployment of additional maintenance support (arriving on day 31). Under 2LM, the equipment and maintenance personnel will not deploy. Under 2LM, FOSK may be unsuitable; a totally new concept for support beyond day 30 may need to be developed.

CHAPTER 5

OTHER WAR RESERVE MATERIEL

After day 30, other war reserve materiel (OWRM) augments WRSK/BLSS and POS until industrial production meets total war needs. Unlike WRSK/BLSS and FOSK, which are used to support in-theater operations, OWRM spares are, for the most part, used at depots. They are spare parts needed to resupply the operating locations and the SRUs needed to fix parts that have been retrograded from the operating location. Figure 5-1 shows the time phasing of wartime spare parts requirements.

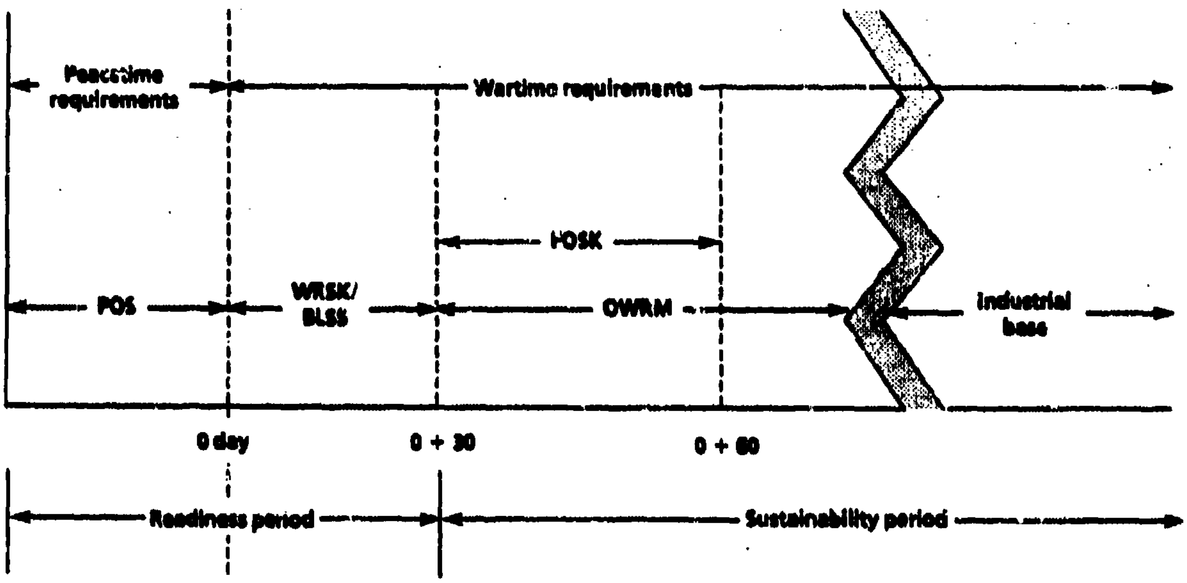


FIG. 5-1. WARTIME SPARE PARTS REQUIREMENTS OVER TIME

In recent years, the OWRM requirement has been larger than the WRSK/BLSS requirement and about the same size as the peacetime requirement. Since the Air Force OWRM requirement is in addition to POS and WRSK/BLSS, the requirement seemed high. The OWRM supports a wartime scenario that has less flying and more resupply than the surge period. Planned flying hours beyond day 90 are approximately at the peacetime level. Why would the OWRM requirement be so much higher than the WRSK/BLSS requirement? One would expect the OWRM requirement to be small, consisting mainly of high-condemnation LRUs and SRUs needed for depot repair of LRUs (items that would not be adequately covered by WRSK/BLSS).

The Air Force has not funded the OWRM requirement in recent years, to some extent because the requirement was too large to be credible. This chapter examines some weaknesses of the OWRM requirement computation and makes recommendations to improve that calculation. The Air Force has not yet approved or implemented these recommendations.

COMPUTING THE REQUIREMENT

By definition, OWRM only covers items that are critical to the wartime program. Specifically, the item must have a mission item essentiality code (MIEC) of AE, AF, BE, BF, CE, or CF and have a WRSK/BLSS requirement or a war program. (Note: An "A" as the first character means that item failure would render the weapon system not mission capable; a "B" means not wartime/assigned mission capable; a "C" means not fully mission capable. The second character of the MIEC shows how important the component is to its subsystem. An "E" means critical and an "F" means that the operation will be impaired if the component fails.)

For purposes of making a requirements calculation, the following assumption is made: the war lasts 1 year and takes place during the "extended" fiscal year (for a March data base, the extended year begins 1 ½ fiscal years after the asset cutoff date). The Air Force computes a wartime requirement, for each item, for each month of the war, and determines the maximum requirement over the war year.

The Air Force calculates that requirement by using a VSL method. The procedure stops "buying" spare parts when the weapon system's (identified by the system management code) fill rate target of 92 percent is reached. The requirements data bank (RDB), now under development, will use an aircraft availability technique (instead of a fill rate) to compute the OWRM requirement.

Since OWRM is what the Air Force needs above POS and WRSK/BLSS (remember that we are recommending that the Air Force does not buy FOSK spares), the POS and WRSK/BLSS requirements are subtracted from the peak OWRM requirement. The WRSK/BLSS requirement is the pre-stocked/pre-positioned requirement computed in REALM. The POS requirement is simulated within the OWRM computation system using the analogous VSL technique but using peacetime demand rates, repair factors, and flying hours. The final OWRM requirement is the sum of the item requirements, which may be based upon different months of the war (item A's peak may occur in month 2 and item B's peak in month 4).

WEAKNESSES OF THE CURRENT COMPUTATION

Variable-Safety-Level Method

The VSL method has well-known weaknesses such as not addressing indenture. Additionally, the POS simulation used in the OWRM calculation is inconsistent with the actual POS requirements calculation, which uses an aircraft availability method. The OWRM VSL method is already slated to be changed to an aircraft availability method in the RDB.

Other weaknesses in the OWRM computation can be corrected immediately. Most of the modifications discussed in the sections below are easy to implement.

Range of Items

The item essentiality code is a reasonable way to select items needing OWRM assets. While the general criterion is good, it is set too broadly. The current method includes 82 percent of reparable spare parts and 95 percent of reparable items with a POS or WRSK/BLSS buy requirement.

Dropping items that are not essential to the wartime/assigned mission (those with a "C" in the first position) would still leave 59 percent of reparable spare parts and 74 percent of items with a buy requirement. Dropping C-coded items would save $300 million from the gross OWRM requirement (the gross requirement does not count assets already on hand).

Steady-State Pipeline Algorithm

The regulation: *Operational Requirements – Recoverable Consumption Item Requirements System* (D041), describes the standard Air Force VSL procedure to compute pipeline quantities. That procedure works under a steady-state environment typical of peacetime. It is not designed for a dynamic environment such as that envisioned by the war plans.

The steady-state method ignores the timing of demands. Timing of demands is relatively unimportant when working with a fairly constant activity level but becomes important when activity level changes dramatically, such as when making the transition from peacetime flying to wartime flying surge levels. Using a steady-state algorithm when activity level is changing can cause double counting of demands occurring during the surge period.

Figure 5-2 illustrates that using a steady-state algorithm can double count the demands during the surge. The requirement on day 30 covers (among other things) the order and ship (OST) pipeline and the depot repair pipeline (DRT). For day 30, those pipelines indicate the number of parts expected to be in repair or transit until day 30 of the war.

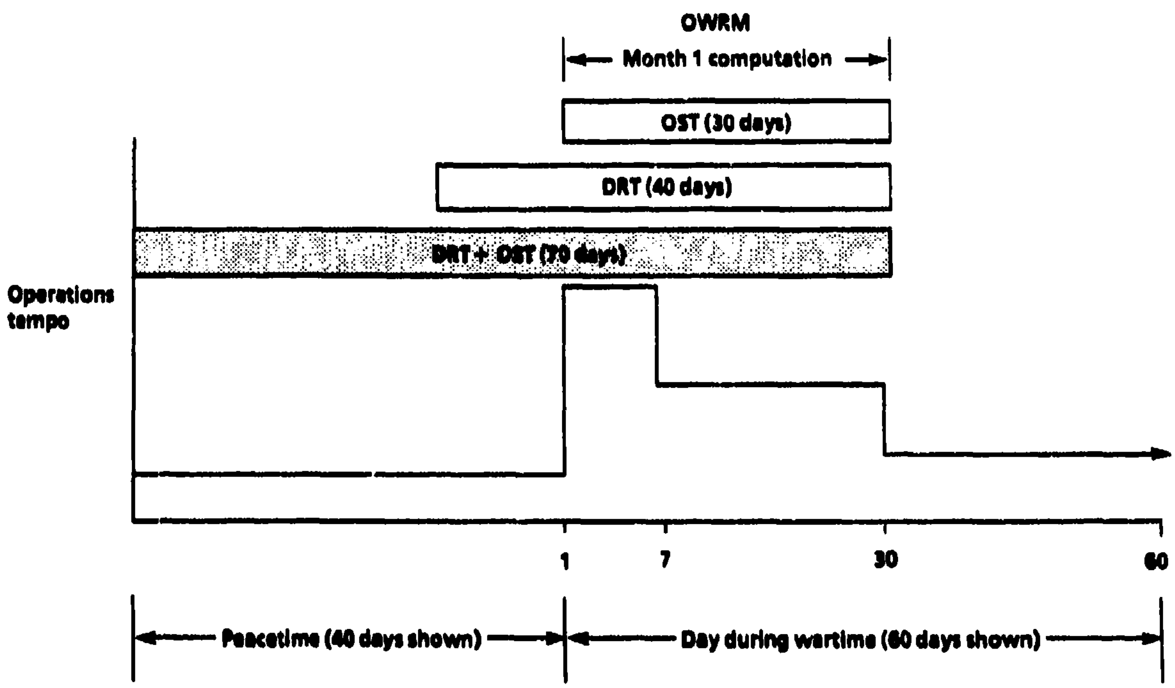


FIG. 5-2. DOUBLE COUNTING THE PIPELINE

Currently, the requirements system does not look at the timing of DRT relative to OST. For ease, the calculation simply looks at the demands previous to day 30 for each individual pipeline (in Figure 5-2, the unshaded bars). In our example, OST is 30 days and DRT is 40 days, so the calculation looks at how many parts are expected to be ordered and shipped from day 1 to day 30 of the war and how many parts enter repair from 10 days before the war to day 30.

In reality, a single demand cannot be covered by both the OST and DRT pipelines at the same time (illustrated in Figure 5-2 by the shaded bar). To illuminate that point, suppose no demands occur during peacetime and exactly one demand occurs each day during the surge period. During the 70 days covered by the DRT and OST pipelines, 30 demands would have occurred (zero demands for each of the 40 days during peacetime and one demand for each wartime day). The current OWRM pipeline calculation would project that 60 demands would occur (30 in the OST pipeline and 30 in the DRT pipeline, with 0 for the first 10 days covered by the DRT pipeline).

The procedure used in the ASM and Dyna-METRIC is more appropriate. It recognizes the timing effect and is designed precisely for a shifting scenario. The difference between the steady-state and dynamic methods is most pronounced for the month 1 surge period. Correcting the double counting reduces the gross OWRM requirement by $1.0 billion.

Computation Driven by Month 1

For most items, the month 1 OWRM requirement dominates. The month 1 gross requirement (calculated including the proposed changes discussed to this point) is $2.6 billion above the POS and WRSK/BLSS requirements! Yet WRSK/BLSS stocks are supposed to completely cover month 1 activity.

Since OWRM spare parts are supposed to support the period after the surge, why is the surge period (month 1) included in the computation? Dropping month 1 from the OWRM requirement reduces the gross OWRM requirement by $800 million.

Dropping month 1 from the OWRM calculation does not mean we are dropping any demands. For example, the month 2 calculation recognizes all outstanding peacetime and wartime demands that occurred up to day 60 of the war. It simply does not make sense to include day 30 in the OWRM calculation because, by definition, OWRM supports post-day 30 activity and WRSK/BLSS supports the first 30 days.

CALCULATION RECOMMENDATIONS

We have recommended that the Air Force make the following three changes to both the current (i.e., D041) OWRM calculation and the future RDB calculation:

- Limit the range of items to those that impact assigned wartime mission.
- Use a Dyna-METRIC-like pipeline computation.
- Bring the OWRM computation in line with its definition by dropping the month 1 calculation.

Additionally, when the RDB becomes operational, using the AAM will produce a better mix of spares and be compatible with the peacetime computation. Table 5-1 summarizes the savings from the proposed initiatives.

TABLE 5-1

GROSS REQUIREMENT REDUCTIONS

(Billions of dollars)

Recommendation	Savings
Use AAM	$0.8
Limit range of items	0.3
Use Dyna-METRIC pipeline calculation	1.0
Drop month 1 calculation	0.8
Total	$2.9

Incorporating the new war plans into the OWRM requirements calculation should produce further savings. The new war plans emphasize a regional, rather than worldwide, war scenario.

STATUS UPDATE

The Air Force is investigating the idea of going further than LMI's recommendations. Instead of reducing the OWRM requirement, the Air Staff is considering the feasibility of eliminating OWRM altogether. The final decision has not yet been made. Additionally, the Office of the Secretary of Defense recently issued policy eliminating OWRM. That policy will not take effect until OSD publishes associated instructions.

The new OSD policy allows for "core war reserves," which are pre-positioned at the wholesale level. Given the new policy and the Air Force's movement to 2LM, we anticipate the need to restudy both FOSK and OWRM. It is possible that a new computation will be needed to meet the changing needs of Air Force operations.

CHAPTER 6

EVOLVING ISSUES

The Air Force continues to examine and revise its war reserve materiel (WRM) policy. This chapter discusses the "spare-is-a-spare" (s-s) policy, lessons learned from Operations Desert Shield/Desert Storm, and issues related to new war plans.

SPARE-IS-A-SPARE POLICY

Background

Under the old WRM policy, the Air Force managed and accounted for WRSK/BLSS, OWRM, and POS separately. While WRM spares could be "borrowed" for peacetime usage, a spare part purchased with WRM funding was, from an accounting perspective, always a WRM part. Spare parts could migrate from POS to WRM, but the reverse could never happen.

In theory, the Air Force physically segregated WRM parts from POS assets on pallets that could quickly deploy. In practice, assets were borrowed freely from WRM for peacetime use. Conversely, during Operation Desert Shield, the Air Force augmented its deploying WRSK from POS stocks.

The old policy made parts accounting and management cumbersome. The requirements system allowed WRM assets to migrate to POS when the WRM requirements decreased, but policy required that those assets still be counted as WRM. In addition to accounting problems, the policy resulted in a cumbersome and labor-intensive effort to identify the funded levels of WRM for each item. This "requisition schedule" produced a large, recurring workload for item managers and MAJCOM WRSK monitors.

The New Policy

In the new s-s policy, reparable spare parts will no longer be categorized as WRM or POS. The WRM and POS parts will instead be grouped together in a category called readiness spares. Mobility readiness spares packages replace WRSK; in-place readiness spares packages replace BLSS. (Recall that, in this report, we have continued to use the WRSK/BLSS terminology.) The immediate effect of the s-s policy is elimination of the need for a requisition schedule and simplification of the accounting rules.

Implementing the s-s policy raises several peacetime and wartime spare parts issues. This chapter discusses wartime issues.

Asset-Based Computations Policy

As part of the WRSK/BLSS policy change package discussed in Chapter 2, the Air Force approved using an asset-based requirements computation for WRSK/BLSS.[1] An asset-based computation considers the assets already on hand. Recognizing the value of already available assets makes the buy requirement smaller than when the computation acts as if no assets are available and produces a "zero-based" kit.

Implementing asset-based computations, as originally designed, becomes difficult under the new s-s policy because there is no longer a meaningful WRM asset starting position. The s-s policy would cause WRSK/BLSS to be sourced from all available stocks (formerly both POS and WRM spare parts). The asset-based computation could cause the size of the kits to increase continually because it would recognize value from a much larger pool of assets than when the policy was originally proposed. ("Capping" logic in the proposed algorithm can limit that growth, but the potential to greatly increase the range and depth of the kits still exists.)

We believe that the asset-based computation is still a good policy. Given the new s-s policy, LMI recommends that the implementation of the asset-based computation be revisited. Under the s-s policy, the asset-based computation could be implemented in the D041 system (instead of REALM) in a way that would result in both the minimum kit size and the minimum total (peace and war) buy quantity.

Offsetting WRM Requirements with Peacetime Operating Stock Requirements

Since the Air Force no longer distinguishes between wartime and peacetime assets, the same spare parts can support both peacetime and wartime activities. An

[1]Dynamic Research Corporation, Systems Division. *Asset-Based WRSK/BLSS Requirements Computations Implementation Plan*, CDRL Sequence Number 001. July 1991.

item that provides a safety level during peacetime can deploy during wartime. Recognizing that relationship can make the total readiness buy requirement smaller.

The Air Staff has asked LMI to estimate the potential savings from offsetting WRM requirements with POS requirements. LMI will also investigate implementation issues.

OPERATIONS DESERT SHIELD/DESERT STORM: LESSONS LEARNED ABOUT DEMAND FORECASTING

Demand Forecasting

Wartime demand rate forecasts are extrapolated from peacetime experience. The demand rates are based upon failures per some unit of operation, usually flying hours. Sometimes the MAJCOMs adjust the worldwide peacetime demand rate to reflect their command-specific failure experience. The demand rates (per flying hour) are then combined with the wartime flying profile to project wartime demands.

A commonly stated empirical observation is that the more a plane flies, the less it fails. Experience in Vietnam, in exercises such as CORONET WARRIOR, and in Operation Desert Storm indicates that actual demands are not linear with flying hours.

During Operation Desert Storm, many aircraft flew fewer, but longer, sorties than called for in the War Mobilization Plan (WMP) – Volume 5. For instance, a typical F-15C squadron flew 85 percent of its 30-day sorties but 236 percent of its planned 30-day flying hours. Table 6-1 compares actual versus planned fighter sorties. Table 6-2 shows that Operation Desert Storm actual failures were generally much lower than predicted.

Recommendations

Difficulty in demand forecasting is not new. While demands do not appear to be linear with flying hours, no reasonable alternative has yet been discovered. For instance, demands per sortie do not universally predict failures better than demands per flying hour.

TABLE 6-1

OPERATION DESERT STORM/WMP-5 FLYING COMPARISON

Aircraft	Operation Desert Storm actual flying as a percentage of planned flying	
	30-day sorties (%)	30-day flying hours (%)
F-15C	85	236
F-15E	65	88
F-16C	91	142

TABLE 6-2

COMPARISON OF ACTUAL VERSUS PREDICTED OPERATION DESERT STORM PARTS FAILURES

Demand prediction results	Percent of kit items with demand prediction pattern, by aircraft			
	F-15 (%)	F-16 (%)	C-5 (%)	C-141 (%)
Operation Desert Storm demands < predicted	88	86	56	69
Within 25 percent of prediction	5	8	2	5
Operation Desert Storm demands > predicted	7	6	42	26

Previous LMI analysis[2] showed that exponential smoothing (a technique that weighs more recent data more heavily) is a better predictor than the eight-quarter moving average currently used in the D041 system. Using exponential smoothing would improve both peacetime and wartime demand rate forecasts. We also found that actual Operation Desert Shield data were better predictors of Operation Desert Storm failures than peacetime history data.

[2]See LMI Report AF601R1. *Evaluation of Demand Prediction Techniques*. Sherbrooke, Craig C. March 1987.

Operations Desert Shield/Desert Storm demonstrated that the Air Force can resupply critical spare parts during a wartime surge. That experience suggests that the Air Force may be better served by setting up supply procedures that allow flexible and responsive resupply during wartime than by relying on accurate demand predictions. The Air Force needs a system that captures aircraft failure experience early during combat and that quickly updates future combat demand predictions accordingly.

NEW WAR PLANS

In response to the recent dramatic geopolitical changes, Air Force war plans have evolved from an emphasis on a worldwide conflict toward a more regional perspective. For example, the logistics resources must be sufficient to support a major contingency in Southwest Asia, perhaps with a concurrent conflict in Korea. Even these plans of significantly smaller scale than those of a few years ago are under review, and the Air Force may reduce them further by eliminating the concurrent activities of today's war plan.

Whatever form the new war plans take, they are likely to contain an emphasis on force projection rather than forward deployment. Force projection necessitates minimizing the Air Force's "mobility footprint." In other words, the Air Force must deploy with as little materiel as possible. Unfortunately, some recent Air Force initiatives work at cross-purposes to this desire. Two-level maintenance, for example, which moves most engine and avionics maintenance to the depots, could change RRR kits to larger and more expensive RR kits.

When the most likely threat was a global war centered in Europe, squadrons based in Europe were tasked to fight in place. Regional conflicts, like Operation Desert Storm, would require European-based squadrons to deploy. The United States Air Force in Europe has requested replacing some of its BLSS kits with WRSK. But WRSKs are generally larger and more expensive than BLSS kits because in-place squadrons are larger and have more repair capability than those that deploy. Also, BLSS kit requirements are offset by POS assets located at the BLSS base. The Air Force does not currently offset WRSK.

The Logistics Management Institute has been working with the Air Force to develop strategies to counter the trend toward larger kits. Those strategies take advantage of rapid resupply and emerging technologies for better asset visibility and redistribution. The Air Force should incorporate such strategies into its evolving requirements determination process.

SUMMARY

Developing a WRM policy is a dynamic process. As the world political situation changes and more experience is gathered, policy is refined. This chapter has discussed some of the policy changes currently under review. Chapter 7 summarizes all of the policy changes discussed in this report and presents our recommendations.

CHAPTER 7

SUMMARY AND RECOMMENDATIONS

INTRODUCTION

This report documents recent changes in the Air Force policy on computing wartime spare parts requirements. Elements of the previous policy were confusing, incomplete, and inconsistent. LMI worked with Air Force policymakers to develop a more consistent and credible approach to computing wartime spares requirements.

THE FIRST 30 DAYS

The Old Policy

To determine the wartime spare parts requirement, the Air Force began with a minimum-buy quantity, known as the "pipeline floor." The pipeline floor is the average number of demands for each spare part. "Safety-level" spares were added to the floor to cover uncertainty in failures. Safety-level spares requirements were computed to support a not mission capable-supply (NMCS) goal on day 30 of the war. The implementation differed from the policy. The actual mathematical computation sized the spare parts requirement to provide a probability (confidence level) of reaching the NMCS goal of 80 percent.

Reviewing the old policy and its implementation raised many questions: what is the value of buying the pipeline floor? Why is there a target only for day 30? Is 80 percent a suitable confidence level target? The answers to those questions led to policy changes.

The New Policy

The Air Force approved and implemented the following policy changes for the first 30 days of the war:

- It is using an expected availability goal (instead of the confidence level).
- It is optimizing on expected availability (instead of the confidence level).

- It is using multiple DSOs.
- It is dropping the pipeline floor except for hard-to-cannibalize items.
- It is using more specific buy kits.

SPECIFIC MAJOR COMMAND POLICY ISSUES DURING THE FIRST 30 DAYS OF WAR

Tactical Air Force

The old policy of allowing 25 percent of the Tactical Air Force (TAF) aircraft down on day 30 for supply reasons was difficult to defend. All tactical aircraft had the same target, though they had different tasking and utilization rates. Based upon LMI's analysis, the Air Force approved and implemented setting TAF DSOs on the basis of the minimum number of aircraft needed to fly the planned wartime mission. To ensure a minimum force structure, a floor was placed on the DSO calculation. The new formula for calculating TAF DSOs is as follows:

$$DSO = Max\left(\frac{\text{Daily sortie requirement}}{\text{Turn rate}} + \text{Spare aircraft}, 63\ \text{percent of PAA}\right)$$

where, the number of spare aircraft is dependent on squadron size and 63 percent of the PAA is the DSO floor. [The *Daily sortie requirement* is the planned number of sorties per squadron; the *Turn rate* is the high surge rate. Both come from the *War Mobilization Plan (WMP) – Volume 5*.] Table 7-1 shows the relationship between PAA and spare aircraft.

The TAF treats the F-111 different from other fighter aircraft. The F-111 is treated as a bomber with an 83 percent DSO on both days 7 and 30.

Military Airlift Command

The Air Force had been using a fixed safety-level method to compute MAC (60-day) wartime requirements. A fixed safety-level computation recommends the purchase of a fixed number of standard deviations above the pipeline floor. To improve economic efficiency and add consistency across the MAJCOMs, the MAC began using the same availability-based cost minimization technique used by the TAF. To use the availability technique, the MAC had to refine the treatment of

TABLE 7-1

PRIMARY AIRCRAFT AUTHORIZATION AND SPARE AIRCRAFT

PAA	Spare aircraft
< 12	0.0
12 – 17	0.5
18 – 23	1.0
24 – 35	2.0
36 – 47	3.0
48 – 59	4.0

Note: For every 12 after that, add 1.0 more.

issues, such as resupply times, that have more effect in a variable safety level computation than a fixed safety-level computation.

In line with LMI's recommendation, the MAC now builds a single WRSK with a 20-day resupply time for RRR items and 30-day resupply time for RR items. The MAC builds multiple BLSS kits with a 12-day resupply time for both RRR and RR items.

Strategic Air Command

Today, the Air Force calculates SAC requirements in a manner that is similar to TAF requirements. The requirements calculation uses an 83 percent DSO and recommends the purchase of the pipeline floor only for hard-to-cannibalize items. No resupply is available during the first 30 days of a military conflict.

The SAC is refining its kit computation on the basis of an independent/dependent-kit concept. In the SAC's case, instead of building two seven-PAA kits, the SAC would build one kit, usually to support 14 aircraft. Due to pooling effects, the requirement for kits is less for larger squadrons; the kits are then segmented for two squadrons.

The SAC independent/dependent-kit concept has been approved. The Air Staff has not yet issued guidance on building the kits. Several implementation details still need to be resolved.

Tentative transportation and repair times have been set at 10 days to set up repair and 20 days to repair and return an item. Since 30 days will pass before an item is returned, the kit will essentially be a RR kit. The benefit of SRUs will not be recognized, so it is unlikely that SRUs will be bought to fix the broken LRUs at the regional repair facility. More analysis should be completed before changes to the SAC WRSK computation can be made.

THE SECOND 30 DAYS

Sustaining Wartime Requisitioning Objective

Once a depot establishes resupply, an operating unit can function with fewer spare parts on hand. We developed the SWRO to address that requirement change. The SWRO is the level of spare parts that the unit can function with when resupply is available. Once the number of spare parts at the operating unit falls below the SWRO, the unit can requisition new parts. The Air Force has approved and partially implemented the SWRO computation.

The SWRO calculation is similar to the WRSK/BLSS calculation. All computations are done using the Aircraft Sustainability Model (ASM). The SWRO calculation differs from the WRSK/BLSS calculation in that all weapon systems have maintenance capability beginning on day 31. (Under 2LM, all units would be, and remain RR.) In other words, some items that have a RR concept during the first 30 days will have a RRR concept once additional maintenance support arrives on day 31. Another difference between the SWRO and WRSK/BLSS calculations is that the Air Force has established resupply from the depot.

Direct Support Objective

Operating tempo during the sustained wartime period is similar to flying hours during peacetime because the combat tempo normally slows down.

We recommend, and the Air Force has already agreed to use, peacetime availability targets (by weapon system) as the DSO during the second 30 days.

Follow-on Spares Kit Needs Re-evaluation

The SWRO is a level that defines the number of spare parts that the Air Force needs during sustained combat. Any additional spare parts that the Air Force needs to meet those levels is provided by FOSK.

The FOSK requirement (for each item) is the SWRO minus the WRSK/BLSS requirement. In other words, FOSK fills the difference between what is on hand and what the unit needs during long-term conflict. The Air Force Supply Wartime Panel Working Group (AFSWPWG) recommended that FOSK requirements not sourced with WRSK or POS be treated as a "memo" requirement (i.e., a requirement displayed for information but not bought). Recent Air Force policy changes (e.g., 2LM) caused the AFSWPWG to recommend re-evaluating the FOSK concept.

OTHER WAR RESERVE MATERIEL

Until industrial production can be geared up to meet total wartime needs, the Air Force uses OWRM to augment WRSK/BLSS and POS. Unlike WRSK/BLSS and FOSK, which support in-theater operations, OWRM spares are used at the depot. They are the LRUs used to resupply the operating locations and the SRUs needed to fix parts retrograded from the operating locations.

We recommend that the Air Force make the following changes to both the current (i.e., D041) OWRM calculation and the future RDB calculation (the Air Force has not yet approved these recommendations):

- Limit the range of items to those that impact assigned wartime mission.
- Use a Dyna-METRIC-like pipeline computation.
- Bring the OWRM computation in line with its definition by dropping the month 1 calculation.

The Air Force Should Re-evaluate OWRM

Recent OSD guidance eliminates OWRM and replaces it with "core war reserves." The Air Force may need to develop an entirely new spares concept to cover both FOSK and OWRM. At the very least, the Air Force should re-evaluate those concepts before it implements changes to the computations.

EVOLVING ISSUES

Asset-Based Computations

The Air Force has approved using an asset-based requirements computation for WRSK/BLSS. An asset-based computation considers the assets already on hand. Recognizing the value of available assets makes the buy requirement smaller than when the computation operates as if no assets are available and produces a "zero-based" kit.

Implementing asset-based computations, as originally designed, becomes difficult under the new Air Force spare-is-a-spare (s-s) policy. Under that policy, reparable spare parts will no longer be categorized as wartime or peacetime spares. The s-s policy would cause WRSK/BLSS to be sourced from all available stocks (what was formerly both POS and WRM spare parts). Such sourcing could cause the size of the kits to increase substantially because value would be recognized from a larger pool of assets than when the policy was originally proposed.

Given the new s-s policy, LMI recommends that the implementation of the asset-based computation be revisited. Under the s-s policy, the asset-based computation could be implemented in the D041 system (instead of REALM) in a way that would result in the minimum kit size while still using all available assets.

Demand Forecasting

Accurate demand forecasting is difficult. Given the essential limitations of demand forecasting, the Air Force needs to set up flexible supply procedures. The Air Force should capture failure experience data early in a conflict and then update its wartime support requirements accordingly. At the same time, the Air Force should aggressively pursue improving its demand forecasting, especially for wartime, as the accuracy in wartime demand forecasting is unacceptable.

APPENDIX A

WAR READINESS SPARES KIT: COMPARISON OF OLD AND NEW POLICIES

WAR READINESS SPARES KIT:

COMPARISON OF OLD AND NEW POLICIES

Table A-1 compares WRSK costs, fully mission capable aircraft, and cannibalization actions ("canns") under the old and new policies.

TABLE A-1

WRSK: COMPARISON OF OLD AND NEW POLICIES

Kit	PAA	Policy	Cost ($ millions)	Day 7			Day 30/Day 15		
				FMC	Total canns	Hard canns	FMC	Total canns	Hard canns
0F015C0R0660A[a]	6	Old	15.5	4.9	5.6	1.6	4.6	15.6	3.7
		New	10.7	4.7	3.9	0.4	3.9	16.2	1.6
0F015E0T2460A	24	Old	82.9	21.4	32.2	1.4	18.5	226.2	21.3
		New	76.5	21.0	65.6	1.4	18.1	472.3	21.4
0A010AMT2460A	24	Old	4.1	21.9	11.6	1.5	18.6	76.3	9.2
		New	2.3	21.1	32.7	1.3	16.4	137.5	8.7
0F111F0T186DA	18	Old	42.4	15.7	17.0	2.3	13.9	96.2	14.8
		New	51.8	16.5	9.6	0.4	14.9	43.4	5.4
0F016CMT1860A	18	Old	23.6	15.8	40.3	14.7	13.8	161.2	59.1
		New	21.1	16.3	5.7	2.9	11.8	85.3	25.1
0F016CMT2460A	24	Old	29.0	21.3	63.7	23.1	18.4	260.7	89.6
		New	29.7	22.4	4.2	1.9	16.2	109.3	28.4
0B052G0S076AA	7	Old	50.0	N/A	N/A	N/A	5.7	27.6	3.3
		New	51.7	N/A	N/A	N/A	5.9	2.4	0.1
KC135R0S1060A[b]	10	Old	7.4	N/A	N/A	N/A	8.5	18.0	0.0
		New	7.3	N/A	N/A	N/A	8.3	6.5	0.0

Notes: Kit costs exclude "not optimized" (NOPed) items. PAA = primary aircraft authorization, and N/A = not applicable.

[a] Kit for 15 days of support. All other kits are for 30 days of support.

[b] No hard-to-cannibalize items in kit.

APPENDIX B

GLOSSARY

GLOSSARY

AAM	=	Aircraft Availability Model
AFSWPWG	=	Air Force Supply Wartime Panel Working Group
ASM	=	Aircraft Sustainability Model
BLSS	=	base-level self-sufficiency spares
D029	=	WRSK/BLSS Authorization Computation System
DRT	=	depot repair time
DSO	=	direct support objective
Dyna-METRIC	=	Dynamic Multi-Echelon Technique for Recoverable Item Control
ENMCS	=	expected not mission capable-supply
FMC	=	fully mission capable
FOSK	=	follow-on spares kit
LRU	=	line replaceable unit
MAC	=	Military Airlift Command
MAJCOM	=	major command
NMCS	=	not mission capable-supply
NSN	=	national stock number
OST	=	order-and-ship time
OWRM	=	other war reserve materiel
PAA	=	primary aircraft authorization
POS	=	peacetime operating stock
RDB	=	requirements data bank
REALM	=	Requirements Execution Availability Logistics Module of WSMIS
RR	=	remove and replace

RRR	=	remove, repair, and replace
SAC	=	Strategic Air Command
SRU	=	shop replaceable unit
s-s	=	spare-is-a-spare
SWRO	=	sustaining wartime requisitioning objective
TAF	=	Tactical Air Force
VSL	=	variable safety level
WMP	=	War and Mobilization Plan
WRM	=	war reserve materiel
WRSK	=	war readiness spares kit
WSMIS	=	Weapon System Management Information System
2LM	=	two-level maintenance

REPORT DOCUMENTATION PAGE

Form Approved
OPM No. 0704-0188

1. AGENCY USE ONLY *(Leave Blank)*

2. REPORT DATE
July 1993

3. REPORT TYPE AND DATES COVERED
Final

4. TITLE AND SUBTITLE
Changes to the Air Force's Policy for Calculating Wartime Spares Requirements

5. FUNDING NUMBERS
C MDA903-90-C-0006
PE 0902198D

6. AUTHOR(S)
Virginia A. Mattern

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Logistics Management Institute
6400 Goldsboro Road
Bethesda, MD 20817-5886

8. PERFORMING ORGANIZATION REPORT NUMBER
LMI-AF101R1

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Director of Supply
Headquarters, U.S. Air Force
The Pentagon, Room 4E260
Washington, D.C. 20330

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
A: Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The report describes changes to Air Force wartime reparable spares requirements computations that enabled the Air Force to fly its planned wartime tasking while reducing the buy requirement. Changes include using availability targets on multiple days of a conflict, setting targets based on planned wartime tasking, eliminating minimum buy quantities (except for hard-to-cannibalize items), and setting new levels once resupply is available.

14. SUBJECT TERMS
Wartime spares requirements, pipeline floor, direct support objectives, sustaining wartime requisitioning objective

15. NUMBER OF PAGES
76

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298, (Rev. 2-89)
Prescribed by ANSI Std. 239-18
299-01