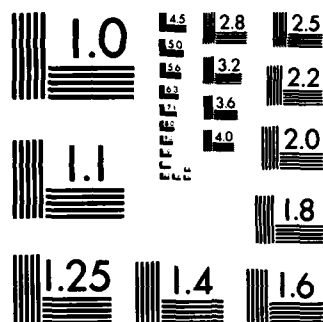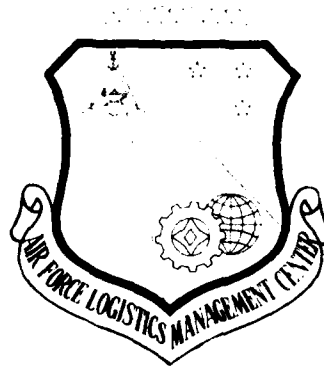END

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AIR FORCE LOGISTICS MANAGEMENT CENTER

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PIVET READY: MAINTENANCE/SUPPLY INTERFACE
INTERIM REPORT
AFLMC PROJECT NO. 820301

By

Maj Thomas R. Hughes
Maj Ken B. Faulhaber
Capt John M. Turner III
Capt Andrew J. Ogan
Capt Joseph P. Racher Jr.

October 1982

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AIR FORCE LOGISTICS MANAGEMENT CENTER

GUNTER AFS, AL. 36114

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ABSTRACT

Under tasking from HQ USAF/LEXY we reviewed the current reparable pro-
cessing system by evaluating current policy and procedures, and identifing
problems that hinder responsiveness. We were asked, based on our findings,
to recommend policy and procedural changes that would produce a simpler, more
responsive, and nonduplicative system that maintains effective control of
asset requirements. We were particularly interested in finding where efforts
were duplicated by Maintenance and Supply. We found when parts are available,
the reparable processing system is responsive and effective. However, if
assets are not available, the reparable processing system becomes extremely
complicated. To ease these complications we offered recommendations in five
broad areas: Improve Repair-Cycle Asset Management, Improve Repair-Cycle
Analysis Techniques, Increase Base Repair Capabilities, Revise Stock-Leveling
Computation for Repair-Cycle Assets, and Refine Organizational Interfaces.

Accession For	
NTIS GRA&I	X
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EXECUTIVE SUMMARY

In the fall of 1981 the Rivet Ready initiative was developed to improve maintenance effectiveness and to insure resource availability. A major part of this initiative was a review of the maintenance/supply interface at the retail level. This review was to identify improvements to insure the right part was available where and when needed. We were tasked by HQ USAF/LEY to conduct a thorough review of the base-level maintenance/supply interface. A major emphasis of this review was to identify improvements to the repair-cycle, asset-control system.

Reparable processing at base level was thoroughly examined. We were particularly interested in finding where efforts were duplicated by Supply and Maintenance. We found when parts are available at base level the reparable processing system is responsive and effective. However, if assets are not available at base level, the reparable processing system becomes extremely complicated. To ease these complications several improvements were identified.

One major area designated for improvement was the movement of the reparable assets through the maintenance repair functions. The first-in, first-out repair concept was identified for replacement by a system that prioritizes repairs based on need. The management product necessary to support this concept can be developed prior to PHASE IV conversion.

The analysis of repair-cycle systems was also selected for improvement. Current analytical programs are fragmented and in many cases ineffective. Those programs considered effective address individual problems and rarely address system problems. We developed a comprehensive repair-cycle analysis program that identifies system and individual problems.

A third area for improvement was base-level repair capabilities. Although most Air Force bases repair 95-98 percent of items they are authorized to

repair, only 41 percent of recoverable items are actually repaired at base level. The others are sent to depots (44 percent) or condemned (15 percent). The use of Repair Level Analysis during the Operational Test and Evaluation of new weapon systems is recommended to identify incorrectly assigned source, maintenance and recoverability codes before the assets reach the field. Further analysis may show that many expensive expendables may be repaired at base level. Base-level personnel should emphasize the use of AFTO Forms 135, Repair Change Request, to identify these assets.

A deficiency was found in the computation of repair-cycle time, a major element in the establishment of stock levels, especially for those assets normally repaired by the base. Using these realistic repair times would involve major software changes that will not be possible until conversion to the PHASE IV systems has occurred.

Finally, we designated several changes to the interface between Maintenance and Supply. First, the Maintenance/Supply Liaison (MSL), Mission Capable (MICAP) Control Center, and Demand Processing should be collocated, yet retain separate identities. This will reduce extensive duplication and encourage a teamwork approach for solving spares shortage problems. Second, the responsibility for the War Readiness Spares Kit (WRSK) status and for WRSK withdrawals should be transferred from the senior materiel officer to the senior maintenance officer on base. Third, high-flow parts should be moved closer to the flightline and shops. Fourth, awaiting-parts (AWP) assets should be retained in the maintenance shops and the Supply AWP monitor moved to the MICAP Section to enhance lateral support for these assets. Fifth, the total management and control of Time Compliance Technical Orders (TCTOs) and Time Change Items (TCIs) should be consolidated within maintenance, thus eliminating numerous redundant management actions. Last, automation of the maintenance/supply interface is

strongly recommended. The Delta Airlines Technical Operations Center at Atlanta and the test of the Automated Maintenance System (AMS) at Dover AFB were reviewed. These operations clearly demonstrate numerous advantages to automating the maintenance/supply interface.

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CHAPTER 1

THE PROBLEM

SECTION A - BACKGROUND

In the Fall of 1981, HQ USAF/LEY instituted a program called RIVET READY

which has as its objectives improving maintenance effectiveness and ensuring

the proper quantity/quality of required resources. As a method of achieving

these objectives, three Rivet Ready working panels were developed: the

Resource and Requirements Panel, the Personnel and Training Panel, and the

Policy and Procedures Panel. The three working panels make recommendations to

a Rivet Ready steering group comprised of the operational MAJCOM LGs,

AFLC/LO/MA/XR, AFRES/LG, NGB/LG, and chaired by HQ USAF/LEY. The overall

intent is to separate maintenance policy from procedures and write a new

AFR 66-XX to replace AFRs 66-1 and 66-5. The new AFR 66-XX will document Air

Force maintenance policy and allow major commands more latitude to develop

policies and procedures to fit their needs.

At the first Policy and Procedures Panel meeting in December 1981, various

policy objective statements were developed. Among them was one concerning the

maintenance/supply interface at the retail (base) level which said, "The

Maintenance/Supply Interface needs to get the right part to the right place at

the right time." This statement was included in Chapter One of the first

draft of AFR 66-XX. Chapter Two specified that the maintenance/supply

interface system must be kept simple, direct, controllable, and survivable.

The Policy and Procedures Panel recommended that we study how reparables/

consumables should be controlled.

As a result of the Policy and Procedures Panel recommendation and the

presentation of the draft AFR 66-XX (Chapters One and Two) to the Rivet Ready

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Steering Group, the AFLMC was tasked by AF/LEY to study the base repair-cycle, asset-control system and recommend improvements.

SECTION B - STATEMENT OF THE PROBLEM

This project was undertaken as a result of a general perception that maintenance capabilities at the base level might be enhanced via improvements in the interface between Maintenance and Supply. The prime element in making the interface more effective is responsiveness; that is, the maintenance/supply interface should be flexible and adaptable enough to meet the rapidly changing needs of base-level users, rather than to support a set of rigidly fixed rules imposed at various organizational levels.

PURPOSE: The purpose of this study was to review and evaluate the current reparable processing system from both a maintenance and a supply perspective. Primary emphasis during this review was placed on those maintenance/supply interfaces where certain modifications would improve system responsiveness in the control and management of reparable assets.

OBJECTIVES: The specific objectives of the study were to:

a. Review the repair-cycle, asset-control system, as it relates to the control and management of repair-cycle assets, to improve responsiveness. [Repair cycle assets are items with expendability, recoverability, repairability code (ERRC) of XD1, XD2, XD3, or XF3 which can normally be economically repaired either by base or depot maintenance.]

b. Evaluate current policy and procedures and identify problems that hinder responsiveness.

c. Recommend policy and general procedural changes that yield a system that is more responsive, simpler, and nonduplicative, yet maintains effective control.

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SECTION C - FACTORS BEARING ON THE PROBLEM

SCOPE: The repair-cycle, asset-control system was studied in detail, primarily at the base level from both a maintenance and a supply perspective. The study included the policies and procedures in effect under both AFR 66-1 and AFR 66-5, as well as procedures outlined in AFM 67-1. The flow of data from base level to AFLC and MAJCOM was also examined to determine the vertical flow of information and its uses to higher headquarters. Emphasis was placed on base-level (retail) responsibilities; however, depot (wholesale) responsibilities were also reviewed to insure effectiveness/support was not compromised by returning items for depot repair that were authorized for repair at base level.

ASSUMPTIONS:

a. The method of operation in wartime will be the same as in peacetime with the exception of the processing of reparables during the first 30 days of a war. (During this period it is Air Force policy to remove, replace and hold reparables until intermediate maintenance is established (remove and replace - R&R), vice remove, repair and replace (R,R&R).

b. Policy and procedural changes to increase system responsiveness would necessarily have to be evolved over time. Testing and implementation of the new policies would likewise have to be accomplished to avoid severe system disruptions and to accommodate the learning process.

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CHAPTER 2

DEVELOPMENT

SECTION A - METHODOLOGY

This project was accomplished in the following basic steps: First, the
present repair cycle asset control system, as it exists in both AFR 66-1 and
AFR 66-5 organizations, was flow-charted and viewed from a maintenance
perspective. Concurrently, AFM 67-1 supply procedures pertaining to the
control and management of repair-cycle assets were also flow-charted and
reviewed. Second, the system, as charted, was verified to insure the charts
accurately reflected the current system. Third, AFLC's process of determining
requirements was compared with base-level processes. The intent was to avoid
changes at base level that would disrupt or adversely impact the AFLC wholesale
processes. If the effort to improve the maintenance/supply interface at base
level led to recommendations that might affect AFLC's process of determining
requirements, then we coordinated with AFLC/LO/MA to determine potential
impacts. Fourth, the systems and processes were evaluated with a view towards
improving responsiveness by simplifying policy and procedures/processes, and
improving the interaction of various maintenance/supply functions. Fifth,
recommendations for change were made .

SECTION B - APPROACH

The methodology outlined was used for each maintenance/supply interface
examined. Each interface was reviewed to determine if it was needed, if a
redundant process existed, and if a process could be deleted. Where processes
were verified as required, they were evaluated for effectiveness/efficiency.
Duplications between Supply and Maintenance were of major interest. In the
areas examined, no function, form, report, meeting, or organizaton was held

sacred. As a result, our findings and recommendations address a wide variety of processes and functions. The remainder of this chapter addresses both general and specific findings of the study. Chapter Three includes a discussion of the study recommendations and concludes with a summary of our main recommendations.

SECTION C - GENERAL FINDINGS

A review of the base-level repair process revealed that when a required part is on the shelf in Supply, the system is relatively simple, as Figure 2-1 shows. The customer merely orders it from Supply, and the part is delivered. (Note that the example is based on a Tactical Air Command (TAC) system with the part ordering occurring in the Aircraft Generation Squadron (AGS)).

The same holds true for removal, repair and replacement (R, R & R) of a reparable asset, as Figure 2-2 illustrates. In this example, when the Component Repair Squadron's (CRS) individual shops order the required parts and they are available, they are delivered to the shop; the shop replaceable unit (SRU) is repaired and returned to Supply for issue to satisfy the next demand. However, when the part ordered is not on the shelf, the base is forced into the exception mode and the system becomes quite involved and complex, as Figure 2-3 illustrates. This represents the worst case when the part ordered is not available in supply and the next lower assembly must be ordered to satisfy the requirement. The 43 steps detailed in Table 2-1 represent communications, movement of the part, or the processing of paperwork required as the base personnel order and verify procedures when parts are not available on the base. It is a complicated system.

The study addressed the effectiveness of the present repair cycle asset control system to determine how large a problem actually existed in processing reparables at base level. Current data indicates that many items that flow

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ASSET IS AVAILABLE - FLIGHTLINE

FIGURE 2-1

6

ASSET IS AVAILABLE - SHOP

AGS
SPECIALIST

1

AGS
SUPPORT
SECTION

2

7

3

RCM

8

CRS

4

DEMAND
PROCESSING

5

MS&D

6

RCSU

9
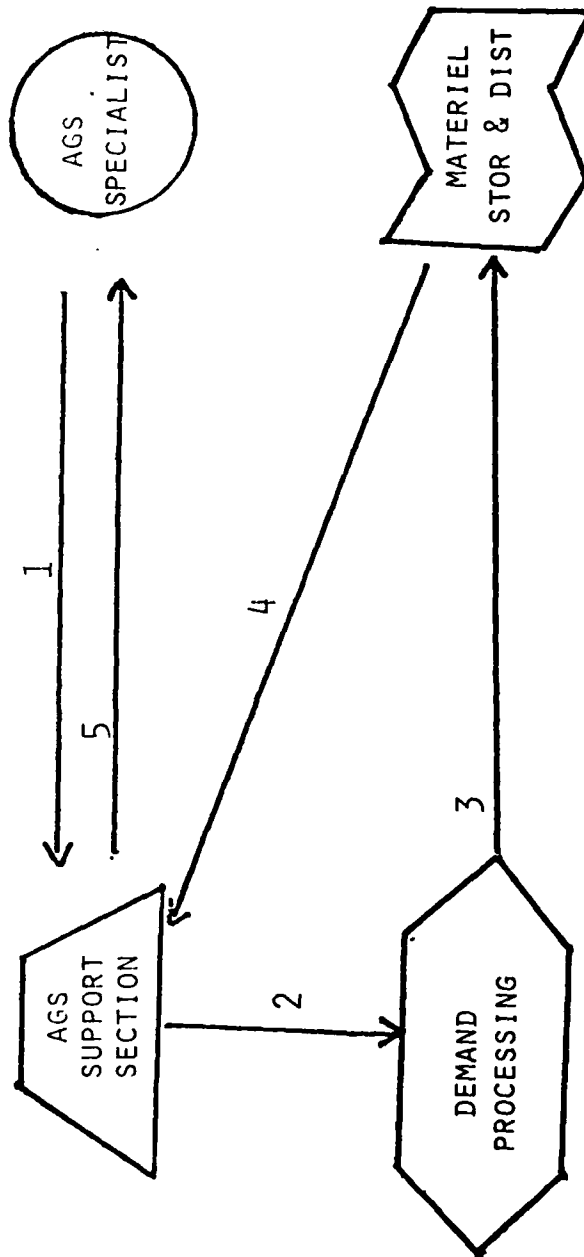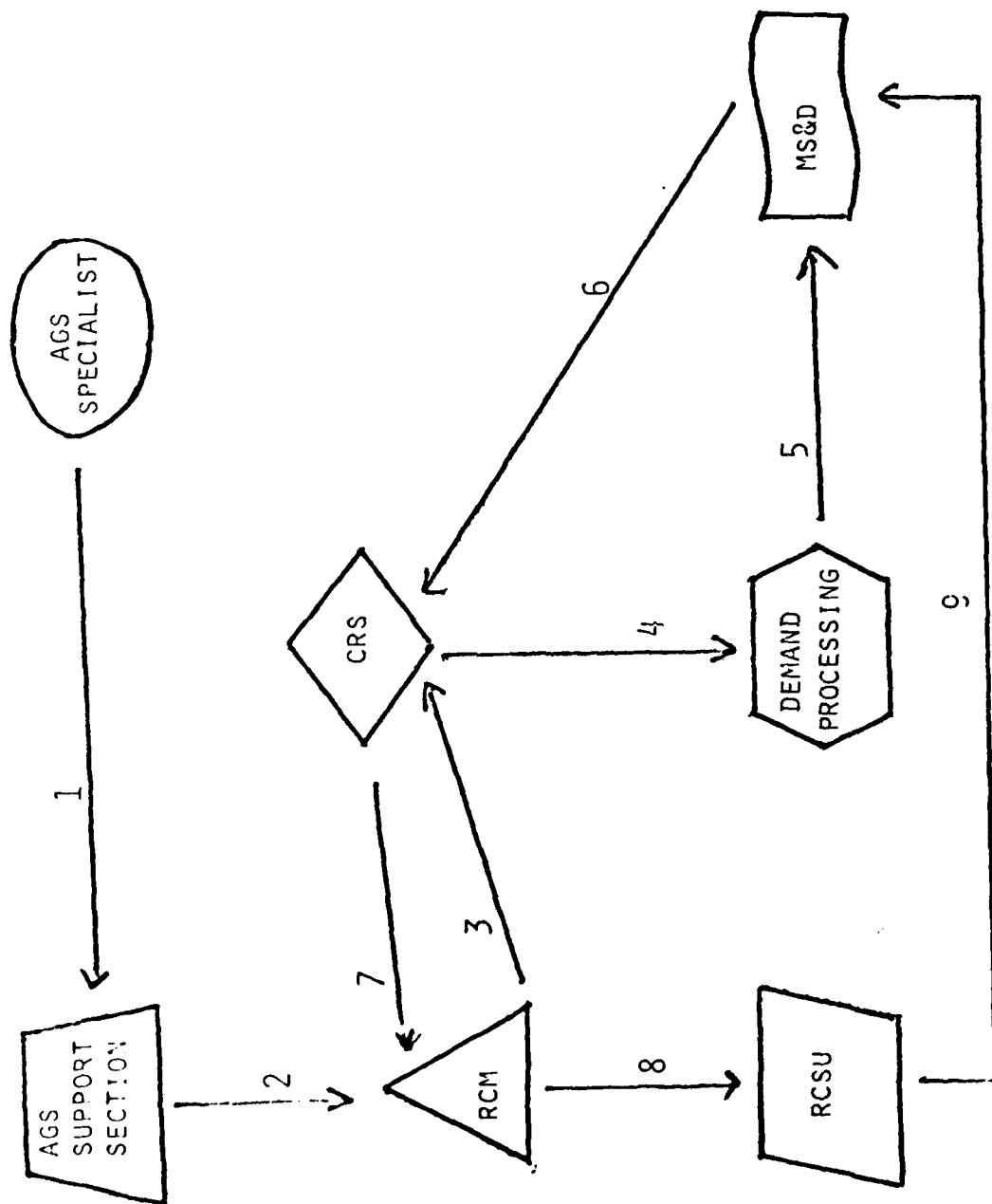
FIGURE 2-2

ASSET IS NOT AVAILABLE

EXCEPTION MODE
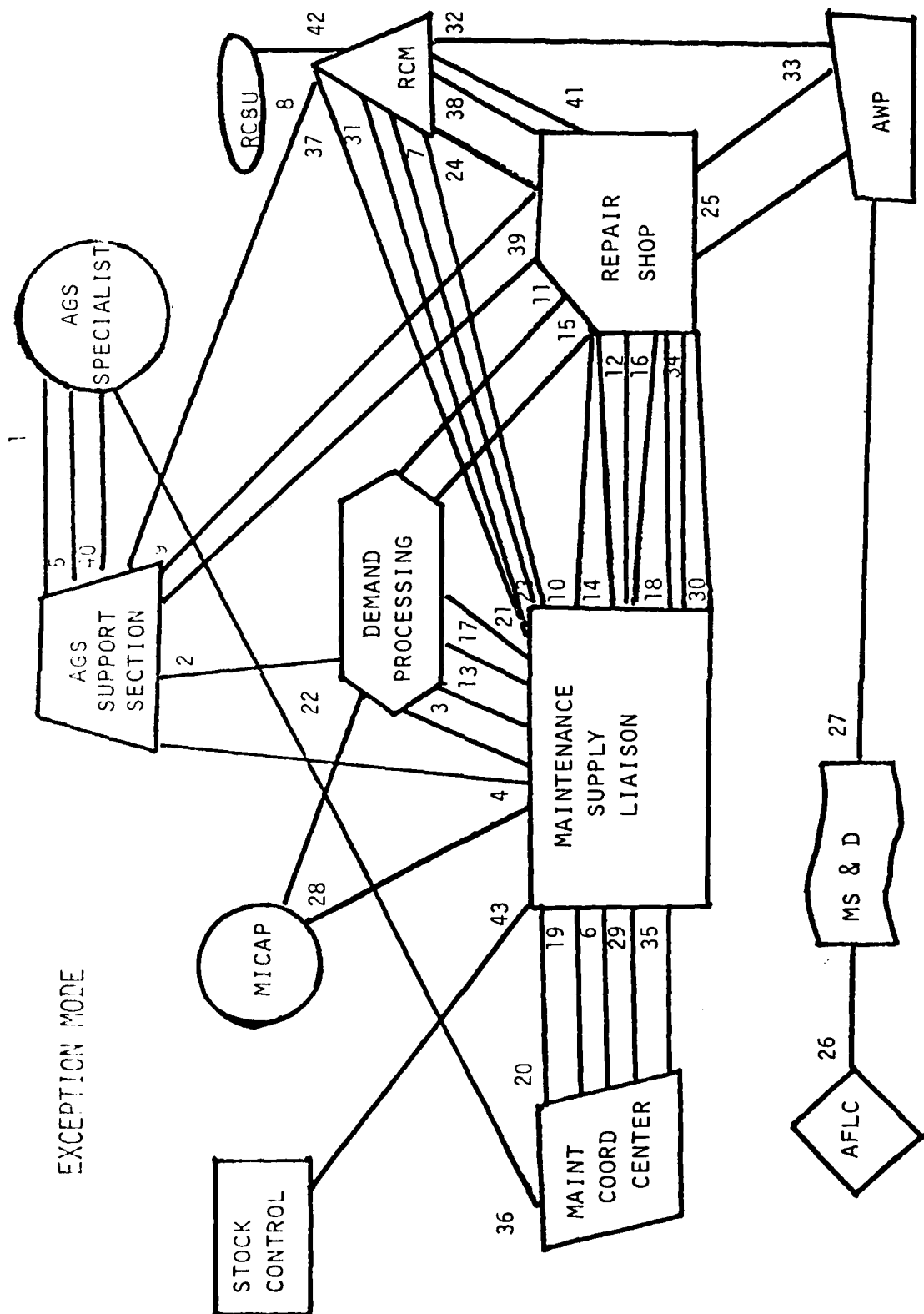
FIGURE 2-3

43 STEPS TO ORDERING A PART

1. Identify parts ordering information to Support Section.

2. Aircraft Generation Squadron (AGS) Support Section orders parts thru Base Supply Demand Processing Unit (DPU).

3. DPU takes order (Doc #1) and notifies Maintenance/Supply Liason (MSL) via I023 computer management notice or by phone of the "kill."

4. MSL calls AGS Support Section and notifies them of the "kill."

5. Support Section tells specialist of the "kill" on Doc #1.

6. MSL tells Job Control of potential MICAP.

7. MSL calls Repair Cycle Monitor (RCM) to pickup Line Replaceable Unit (LRU) for R&R (TRN) (Job Control would like to pull it from the WRSK now, but MSL won't do it until the shop verifies it MICAP.)

8. RCM goes to AGS Support Section to pick up Hot TRN.

9. RCM takes LRU to shop.

10. MSL calls shop to find out if LRU can be repaired.

11. Shop orders Shop Replaceable Unit (SRU) thru DPU.

12. Shop calls MSL and advises that Doc #2 goes with Doc #1.

13. D/P notifies MSL of kill on Doc #2.

14. MSL calls shop and tells them of kill on Doc #2.

15. Shop orders bit and piece on Doc #3.

16. Shop tells MSL that Doc #3 goes with 2 and 1.

17. D/P processes Doc #3, gets kill and tells MSL.

18. MSL verifies final MICAP and determines that LRU can go to AWP area.

19. MSL completes verification and takes AF Form 2414 to Maintenance Coordination Center or Job Control (MACC) for final approval.

TABLE 2-1

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20. MACC confirms MICAP status, provide MSL with verification and gives AFTO Form 349 for MMICS input and subsequent scheduling.

21. MSL LRU Doc #1, as memo against aircraft, leaves Doc #2 killed. Backorder Doc #3 to be delivered to AWP area.

22. DP turns over Doc #3 to MICAP Control (which verifies similarly to MSL).

23. MSL calls RCM and tells him to take LRU to AWP storage.

24. RCM goes to shop, signs for part and picks it up.

25. RCM takes part to AWP storage.

26. Material Storage and Distribution (MS&D) receives bit and piece (B&P), processes it and sends to pickup and delivery for issue.

27. MS&D delivers bit and piece to AWP storage area.

28. MICAP Control receives management notice of bit and piece receipt and notifies MSL.

29. MSL notifies MACC.

30. MSL notifies shop so shop scheduling can be accomplished.

31. MSL directs RCM to AWP area to deliver LRU & B&P to shop.

32. RCM goes to AWP and picks up property.

33. RCM delivers property to shop.

34. Shop receives property, repairs, tells MSL of completion and of repair cycle days and action taken for Doc #1, LRU.

35. MSL tells MACC that MICAP is solved and provides AFTO Form 349 for scheduling.

36. MACC notifies and tasks AGS for installation of LRU on aircraft.

37. MSL calls and tasks RCM to take LRU from shop to flightline.

38. RCM goes to shop and picks up LRU.

39. RCM delivers LRU to flightline.

TABLE 2-1 (CONT'D)

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40. AGS Support Section receives LRU and gives to specialist to install.

41. Shop forwards bottom half of AFTO Form 350 for TRN data for SRU to MSL via RCM.

42. RCM returns AFTO Form 350 to office, Logs TRN data and submits form to RCSU for processing and consumption.

43. MSL calls stock control and requests due out cancellation on Doc #1 - LRU, and gives them action taken and net repair cycle days.

TABLE 2-1 (CONT'D)

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through the base repair cycle require most, if not all, of the 43 steps listed in Table 2-1. In 1981 the stockage effectiveness rate was 73 percent, this means that on the average, with every fourth demand, assets were not available in Base Supply to satisfy a requirement. Approximately 25,000 hard MICAPS per month occurred throughout the Air Force in 1981. Additionally, there were 17,000 potential MICAPs per month, 13,000 of which were satisfied by WRSK withdrawals, and 4,000 by cannibalization. Also, approximately 21,000 base-level AWP requisitions per month were sent to AFLC in 1981, half of which were ERRC XD or XF (recoverable items) indicating that the AWP problem is not limited by any means to XB3 (expendable, base level) items.

As indicated in the preceding paragraph, all too often not enough of the right parts were available where and when needed. We are attempting to improve the complicated reparable processing system by offering our findings and recommendations in the following five broad areas:

Improve repair cycle asset management.

Improve repair cycle analysis techniques.

Increase base repair capabilities.

Revise stock leveling computation for repair cycle assets.

Refine organizational interfaces.

Following is a discussion of the specific findings under each area. The specific recommendations under each major heading are explained in Chapter Three.

SECTION D - SPECIFIC FINDINGS

IMPROVE REPAIR CYCLE ASSET MANAGEMENT

The processing of broken assets through the repair cycle system is a major element of the repair process at the base level. A great deal of management

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attention is devoted exclusively to how effectivly and efficiently repair activities move assets through the repair cycle. Yet, the management tools to push the assets through the system in accordance with base-level needs and the products to evaluate the effectiveness of this process are lacking.

Currently, routine priority assets flow through the repair cycle largely on a first-in,first-out (FIFO) basis. The Due-In From Maintenance (DIFM) Listing, or R-26, lists all assets issued to maintenance for which another similar item is undergoing repair. The R-26 serves as a scheduling tool by providing the individual maintenance shops an indication of those assets that must be returned to supply once repair is completed. The DIFM listing focuses attention, via a delinquency criterion, on those assets that have exceeded certain established standard repair times. While the expeditious movement of assets through the repair process is a desirable goal, varying mission impacts and stockage positions dictate that certain assets be repaired and processed before all others. The Air Force logistics community has recognized this need, and the current processing of repair cycle items somewhat takes this recognition into account.

For example, there are two major programs at base to expedite the repair of certain key assets. The first involves those assets that can ground weapon systems (Mission Capable or MICAP incidents). While the R-26 provides no information concerning these MICAP incidents, the maintenance technician is usually apprised of such conditions through the Job Control function within the Deputy Commander for Maintenance (DCM) complex. At the time of notification, the maintenance shop must locate the asset and expedite repair. The R-26 provides no real help in this area. The second program, however, is visible via the R-26 listing. Critical items that are identified as AFLC- or base-critical are identified on the R-26 and afforded, at least on paper,

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expedited treatment. There are, however, three major problems associated with the program. First, the critical item program at base level is not dynamic. Assets identified as critical may or may not be problems at base level due to rapidly changing requirements. Also, assets that are creating problems at any given base may not be coded as critical Air Force wide to facilitate exception management. Second, the AFLC program suffers from many of the same problems as those identified as base-critical. In addition, the update procedures tend to be quite cumbersome. Finally, while the assets are coded as critical they are scattered throughout the R-26 and are not grouped together, thereby making their management more difficult.

Outside these two programs, the bases are left to manage the repair process according to the delinquency criteria established in the R-26 listing. Base-level managers focus primary repair emphasis on those DIFM assets that are or will soon become delinquent. A major problem associated with this approach was identified in the Air Force Inspector General Functional Management Inspection (FMI) report entitled, "Repair of USAF Aircraft and ICBM Components," PN 81-632. In the report, the inspectors found assets with positive serviceable balances were being repaired before assets with no serviceable balance in the warehouse or in WRSK/Base Level Support Spares (BLSS) stocks. The FMI recommended the DIFM listing be redesigned to reflect stock balances and criticality.

IMPROVE REPAIR CYCLE ANALYSIS TECHNIQUES

The second major finding centered on repair cycle analysis techniques. The evaluation and analysis of the base-level repair cycle program is a fragmented operation. Various publications and regulations (Figure 2-4) require the formation of groups to monitor, manage, and report on different aspects of the repair process. Many MAJCOM manuals, regulations and

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PUBLICATIONS REQUIRING MANAGEMENT OF BASE REPAIR PROCESS

(1) AFM 67-1, Air Force Supply Manual, Vol I, Part One requires the base senior materiel office to review weekly, in conjunction with the chiefs of Supply and Maintenance, the DIFM listing (R-26) and all MICAP requisition which were terminated with a delete code "9" (reported in error) and delete code "0" (cancellation).

(2) AFR 66-14 Equipment Maintenance Policies Objectives, and Responsibilities, requires bases to review all of the not reparable this station (NRTS) actions to determine if changes could and should be made to the maintenance capability, and to set up a system to screen all reparable materials to make sure that only unserviceable items are sent to the appropriate repair activity.

(3) AFR 66-1, Maintenance Management Vol II, and AFR 66-5, Production Oriented Maintenance Organization (POMO), requires an analysis of the base repair program to provide managers and work center supervisors with the data needed to manage work center repair capabilities.

(4) TO-00-20-3, Maintenance Processing of Reparable Property and the Repair Cycle Asset Control System, provides procedures for evaluating base repair capability, or self-sufficiency, and for maintenance processing of reparable property.

(5) TO-00-25-195, Source, Maintenance, and Recoverability (SMR) Coding of Air Force Weapons, Systems, and Equipments, defines the SMR coding structures which are used to portray the maintenance decisions and methods of support for systems entering the Air Force inventory. Additionally, this technical order provides the methodology by which using activities could request a SMR code change using the AFTO Form 135, Base-Level Change Request.

(6) AFR 66-1 and 66-5 requires base-level maintenance managers to publish monthly summaries of the effectiveness of their maintenance efforts and to establish a baseline for determination of item repair rates.

FIGURE 2-4

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supplements to Air Force directives require base-level managers to evaluate their base repair capability using a variety of forums, including weekly MICAP/DIFM meetings, monthly reparable review boards, and problem-centered supply/maintenance interface meetings. These forums address specific segments of base repair systems, such as parts ordering or parts flow. Each group is assigned a segment of the process to govern, but no one group maintains overall management responsibilities for the repair cycle process.

The effectiveness of these meetings is dependent upon the abilities of those attending to arrive at a structured analysis approach that fulfills that management group's responsibilities. Where significant emphasis has been placed on the management functions of the various repair cycle committees, there has been overall improvement in the repair process. However, as a general rule, only portions of the management groups function well. In some cases, the groups serve no useful purpose in the management of the repair process at base level.

In examining this area, two major problems were identified which cause the conditions just cited. First, there is no overall structure for the evaluation and analysis of the repair process. Each management committee is left to determine which facet of the repair process to attack and how. The relative importance and influence of the groups will increase or decrease, depending on the management emphasis (both at squadron and wing level). In addition, the caliber of the managers will reflect the relative importance of each facet of the repair process to the wing commander and his deputies. The problem is that the base-level managers must be cognizant of the entire repair process and its internal relationships. This can be a major accomplishment in itself.

A second problem is the informational limitations. Any attempt to

integrate repair cycle management requires a great deal of manual data manipulation to collect data and analyze it. There are no data processing packages in-being to adequately support the base-level manager in his analysis of the repair cycle system. Although there are a number of repair cycle products, any analysis must be performed manually under the present system. It is this type of informational limitation that prevents in-depth analysis of the repair process regardless of the management involvement.

INCREASE BASE REPAIR CAPABILITIES

The third major finding involved base repair capabilities. Most Air Force bases are achieving a relatively high (95-98%) percentage of base repair self-sufficiency on those items they are authorized to repair. However, Air Force wide, only 41 percent of recoverables are repaired at base level. Forty-four percent are sent to depot because they are not authorized for base-level repair (coded not reparable this station - NRTS) for various reasons, and the remaining 15 percent are condemned. Additionally, some high cost/critical items which could be repaired at base level are coded as consumable items not to be repaired. Base personnel need to focus on these high cost/critical items for which a repair capability can be developed relatively easily and cheaply. A method for review should be developed and incorporated into the reparable review boards with Supply doing the research to identify the potential items for repair and Maintenance's shop chiefs providing the repair expertise.

REVISE STOCK LEVELING COMPUTATION FOR REPAIR CYCLE ASSETS

The fourth major finding involved revising the repair cycle demand level computation. Because of the proposed changes to the R-26 and DIFM management and repair concepts, the length of time that assets spend in the repair process may be greatly changed. Noncritical assets may wait in the repair shop much longer

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than currently allowed, while the critical spares may spend much less time in repair. The repair times reported for leveling purposes may be skewed toward noncritical items in plentiful supply. Consequently, the method used in accumulating and recording repair times for reparable assets should be changed.

Current methodology used in determining the repair-cycle demand level (RCDL) for Air Force repair-cycle assets may not realistically address repair-cycle time (RCT) for items processed through base-level repair shops. RCTs based on current computation methods contribute to insufficient stockage of some assets in Base Supply and overstockage of others. The current method of determining the RCDL for a given asset is shown in AFM 67-1, Volume II, Part II, Chapter 11. The RCDL is based largely on the base's capability to return an asset to serviceable condition after it becomes unserviceable. Base Supply must attempt to maintain adequate stocks of each repair-cycle asset to compensate for its lost use during undergoing repair. The repair-cycle, demand-level formula is expressed as:

$$RCDL = \text{Repair Cycle Quantity + Order/Ship Time Quantity + NRTS/Condemned} \tag{1}$$
$$\text{Quantity + Safety Level Quantity + Price Adjust Factor (.5 or}$$
$$\text{.9 depending on unit cost)}$$

A major element in the equation is the repair-cycle quantity, especially for those assets commonly repaired at base level. This is the quantity of any given repair-cycle asset which should be on hand in supply to compensate for the loss of the item during repair accomplished at the base level. The repair-cycle quantity is computed as:

$$RCQ = \text{Daily Demand Rate (DDR) X Percent of Base Repair (PBR) X Repair} \tag{2}$$
$$\text{Cycle Time (RCT)}$$

where:

$$DDR = \frac{\text{Cumulative Recurring Demands}}{\text{(Current Date - Date of First Demand)}} \tag{3}$$

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$$PBR = \frac{(\text{No. Units Repaired} \times 100)}{(\text{No. Units Repaired} + \text{No. NRTSs} + \text{No. Units Condemned})} \qquad (4)$$

Repair cycle time is the measure of lost utility in terms of time. The RCT for a single asset is currently computed as the time between issue (ISU) date of a serviceable asset, and the turn-in (TIN) date of a like serviceable asset. When no serviceable asset is issued from Supply, and Maintenance accomplishes a turnaround (TRN) or remove, repair, and reinstall action, the RCT is simply the TRN days minus the days the asset was awaiting repair parts (AWP). These formulas follow:

$$RCT = \text{TIN date} - \text{ISU date} - \text{AWP days} \qquad (5)$$

or:

$$RCT = \text{TRN days} - \text{AWP days} \qquad (6)$$

The RCT for a single asset is programatically averaged in the Univac 1050-II, Base Supply computer, with other transactions on like assets to obtain an average RCT for all assets with the same or interchangeable stock numbers. This is accomplished as shown:

$$\text{Stock Number RCT} = \frac{\text{Total RCT}}{\text{Total repairs}} \qquad (7)$$

This average RCT is then used along with DDR and PBR to compute the repair cycle quantity (RCQ).

A hidden aspect in the computation of the RCDL is that RCT is limited programmatically in the U-1050-II computer by repair standard limits based on an item's expendability, recoverability, repairability code (ERRC). When an item exceeds the ERRC repair standards, it automatically receives the ERRC standard RCT. ERRC repair standard limits are as follows:

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ERRC		Standard
XD1	(Depot expendable under SCARS program)	6 days
XD2	(Depot expendable under AFRAMS program)	9 days
XD3	(Depot expendable Line Replaceable Unit)	6 days
XF3	(Field expendable asset)	9 days

The ERRC standards can be overridden if the shop chief submits a request for repair exception time and receives approval.

While the base-level computer uses the ERRC standards as limits in computing the base-level RCDL, AFLC receives the actual or unrestricted RCT for the purpose of determining wholesale stock levels. The ERRC standard repair-time limitation therefore creates potential disparities between wholesale and retail stock levels. So even if there are adequate worldwide spare assets at the wholesale level, there is a good probability that assets with a real RCT, which is above the standard, will not have sufficient levels at the base.

The RCT equation is a major part of this problem since it assumes that when an asset has been issued from Supply and no like asset has been turned in, the like item is either awaiting parts or being repaired. This assumption fails to address the complexities of processing reparable items through a repair shop. Shops normally have several items for repair at any given time. Due to manpower and machine limitations, repair priorities must be established and a backlog or queue is formed (See Figure 2-5). High priority items are processed at the head of the queue while lower priority items are moved to the rear of the queue. High priority items are usually those assets which are in high demand and short supply. Lower priority assets are usually plentiful, and there is no pressing need to repair them and get them turned in quickly.

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CURRENT
RCT METHOD

SHOP BACKLOG AND REPAIR CYCLE TIME (RCT)

	Pri. 4	Pri. 3	Pri. 2	Pri. 1
Shop Queue	Other Reparable	Other Reparable	Item B Hydraulic Actuator	Item A Hydraulic Motor
	Awaiting Maintenance (AWM)	Awaiting Maintenance (AWM)	ISU 360 day TIN 364 day RCT = 4 days	Removed 360 day TRN 360 day RCT = 1 day
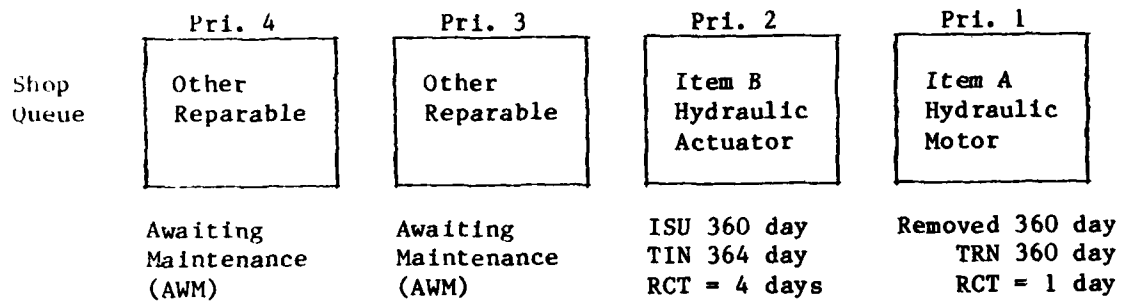
FIGURE 2-5

Consequently, those parts in short supply are usually processed first and receive low repair-cycle time, which results in lower stock levels. The routine parts are processed on a first-in,first-out basis; they wait in the queue and build up RCT until they reach the ERRC limit. When this happens, the imbalance continues until management takes special action to correct the situation. The example below illustrates how the current method deteriorates stock levels:

On Julian day 360, the FMS Hydraulic Shop has two assets in the shop for repair. Item A is a hydraulic motor which is "zero balance" in Supply and has caused an aircraft to be grounded. Item B is a hydraulic actuator for which a replacement has been issued the same day, and is to be repaired for turn in to Supply. The shop has only one hydraulic test stand and can only repair one of the items at a time. Naturally the shop repairs item A first. Item A was removed from the aircraft on day 360 and was repaired and reinstalled (TRN'd) the same day. The RCT for this transaction was:

$$RCT = TRN \text{ days } (1) - AWP \text{ days } (0) = 1 \text{ day} \qquad (8)$$

Because of a heavy workload on the flightline, the shop chief elected to delay working on Item B. On day 364, two more parts arrived for repair and the shop chief decided to repair the actuator. It was repaired and turned in (TIN) to supply the same day. Its RCT was:

$$RCT = TIN \text{ date } (364) - ISU \text{ date } (360) - AWP \text{ days } (0) = 4 \text{ days} \qquad (9)$$

The part that was in plentiful supply received 4 days RCT while the item in short supply received only 1.

In the above example, it appears that the system works exactly opposite to the way it should operate. Although this is not always the case, this situation can occur quite frequently.

REFINE ORGANIZATIONAL INTERFACES

The last major finding centered on refining the maintenance/supply interfaces at the organizational level. While numerous processes and functions were examined in detail, the major thrust of this effort involved a thorough review of the many interfaces between the maintenance and supply organizations. The major objective of this review was to identify redundant steps to reduce the work involved in processing reparable assets. A review of Figure 2-3 and Table 2-1 on pages 8 and 9 illustrates the many steps now used to manage reparables.

Several areas were identified for improvement. The first area involved the management of aircraft/engine/vehicle/communications-grounding incidents (MICAP) by the Maintenance/Supply Liason (MSL) within Maintenance and the MICAP Section within Base Supply. This area was a primary target of the study since both the MSL and MICAP sections are charged with tracking each incident. As a result, both sections keep duplicate forms, records and display boards, and consequently spend time each day keeping each other current.

Other areas identified for possible refinements involved WRSK withdrawal procedures, the management of assets in AWP status, and the management of time compliance technical order (TCTO) kits and time change item (TCI) parts. Redundancies of effort were identified in each of these areas and recommendations for improvements are presented in Chapter Three under the major heading of "Refine Organizational Interface."

CHAPTER 3

RECOMMENDATIONS

This chapter contains the study recommendations for each of the five major
areas under which findings were discussed in Chapter Two. The first
recommendation deals with improving repair-cycle asset management.

SECTION A - IMPROVE REPAIR CYCLE ASSET MANAGEMENT

To improve the management of repair-cycle assets once they enter the
repair process, the primary parts-management tool, the R-26 DIFM listing, must
be altered. To reflect the base's processing priority needs, the R-26 should
show the various MICAP, zero-balance, critical-item, and stock positions used
to determine order of repair. The priority scheme and definitions are
contained in Figure 3-1. The first category identifies those items grounding
weapon systems. The next two categories identify out-of-stock conditions
that could adversely impact readiness. The critical items and Not Reparable
This Station (NRTS) categories address Air Force-wide problems by directing
management and repair attention toward those items affecting AFLC repair
processes and asset availability at other bases. The remaining categories
prioritize the remaining possible conditions at the base.

The current sequencing options allow the R-26 to be run in document
number, maintenance location and document number, or type account/stock number
sequence with page ejects within each category. Page ejects appear for such
elements as system designator, organization/shop code, type account, and
maintenance location. These sequencing options should be retained. However,
the categories cited in Figure 3-1 should be used to further divide the assets
within each option. This categorization of assets by need would replace the

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Categories/Definitions of Proposed R-26

Category	Definitions
1. MICAP Conditions	1. Any asset in the repair cycle that is causing a major end item to be grounded (aircraft, missile, engine, vehicle, LRU, or communication equipment).
2. WRSK Zero Balance	2. Any asset with a zero balance WRSK detail.
3. BLSS Zero Balance	3. Any asset with a zero balance BLSS detail.
4. Critical Items	4. Any asset coded as AFLC-, Base-, or MAJCOM-critical. Those assets in a zero balance position will be listed first, followed by assets with stocks on hand. These would be listed in order of days of supportability remaining.
5. Not Reparable This Station	5. All assets with a percentage of base repair falling below a given level. (This level could be a MAJCOM option based on weapon system, repair capabilities, etc., and could vary from base to base). Zero balance items would be listed first followed by assets with stocks on hand prioritized by days of supportability remaining.
6. POS Zero Balance	6. All POS assets with zero balance stockage position.
7. WRSK/BLSS Serviceable Balance	7. All assets with WRSK or BLSS serviceable balance, listed by days of supportability remaining.
8. POS Serviceable Balance	8. All POS stocks with serviceable balances listed by days of supportability remaining.

FIGURE 3-1

current procedure of repairing assets on a first-in,first-out basis within the arbitrary time standards mentioned previously. This represents a change in maintenance repair philosophy and practice. Consequently, it is strongly suggested that all references to standard repair times or to assets designated delinquent based on these times be deleted. Rather, the emphasis should be on working those items that are needed the most. Once the high-priority items have been returned to Supply, the other lower priority assets could be repaired.

All data elements necessary for the proposed R-26 are currently used today except for days of supportability (DOS). This new element would be used to project how many days of support each asset could be expected to provide. It would also allow for a further refinement of maintenance scheduling by need. This element is derived by dividing the serviceable balance by the daily demand rate (DDR). For example, an asset with a serviceable balance of one each and a DDR of .02 would yield the following days of supportability:

$$\text{Serviceable balance (1)} \div \text{DDR (.0200)} = 50 \text{ days} \tag{10}$$

Once the DOS is determined for an asset in the repair cycle it would be decreased by one for each day the asset remained in repairable status. When the serviceable balance changes, this element would be recomputed. The intent of this provision is to give maintenance personnel a means of determining when they need to generate the next repair for each specific stock number. By including only the assets available for issue, the scheduler knows how much time is available before the next repair must be generated.

As with the current R-26 DIFM listing, a summary portion should be provided. The primary purpose of such a summary is to furnish a general overview of the repair cycle program. The current summary lists totals by DIFM status codes, with primary emphasis on total number of delinquents and the

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percent of total assets that are delinquent. The proposed summary would not reflect any delinquency data. Rather, summaries by the categories listed previously (Figure 3-1) would be presented. Since maintenance repair actions under this concept places primary emphasis on filling holes in aircraft and WRSK/BLSS, and filling empty warehouse shelves, no references to delinquent assets or time standards should be presented. If an asset is not required at the local level to fill holes or at the wholesale level (critical or probable NRTS), it could remain in the repair cycle for extended periods of time.

Figure 3-2 illustrates how such a summary might look. A review of this figure reveals a summary by squadron. It represents a snapshot in time of the current workload and its distributions among the various maintenance shops. A total number of DIFM assets in each repair category is presented, with the number of AWP assets indicated in parentheses. Each category is summed through all shops for a squadron total. This presents a picture of where each shop's workload and the overall squadron's workload are located. These workload figures might be comparable between shops to identify possible bottlenecks in the flow of assets through the repair cycle. The Average Shop Queue Times (ASQT), discussed later, should not be compared from shop to shop. For instance, in the example shown, a queue time of 4.5 for 114ES may be excellent, while a queue time of 3.1 for 127 PR may be poor. This is, of course, due to the different maintenance actions required between shops.

As mentioned earlier, this summary data only represents a snapshot of the repair cycle system. While it may be meaningful to experienced managers, it would be most useful if captured and compiled for future trend and workflow analysis. Each R-26's summary data would be retained on an internal computer file for future repair cycle analyses. This data could be compiled and

PROPOSED ???? SUMMARY

S-DR	ASGT	W-CAP (AMP)	WRSK/BLSS (AMP)	CRIT (AMP)	MRTS (AMP)	O BAL POS (AMP)	OTHER WRSK/BLSS (AMP)	OTHER POS (AMP)
114 ES	4.5	2(0)	2	1(1)	4	1	3	1
118 EL	0.6	5	0	2	3(1)	0	2	0
123 EG	2.5	0	4	1	0	0	3	2
127 PR	3.1	2	2	3(2)	0	4	0	1
SQUADRON SUMMARY		9(1)	8	7(3)	7(1)	5	8	4

Figure 3-2

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accumulated in weekly, monthly, and quarterly increments for presentation and review. Trends in queue times and workload would be readily apparent for necessary management actions. For example, an increase in queue time without a corresponding increase in workload would indicate a possible problem area within the repair-cycle system. Conversely, decreasing queue times with a constant or increasing workload should indicate to management that something has been done to improve the repair cycle system. Management could then examine the reasons for this improvement for possible use in other repair shops.

In summary, the R-26 DIFM listing presented above is designed to meet two basic objectives not currently being achieved. First, this revised R-26 should provide the maintenance scheduler and shop chief with a complete workload scheduling tool. Additionally, this product will allow for the scheduling of work based on a true priority of need. It is recognized that this approach would be most useful and effective in a real time environment. For example, Delta Airlines employs the equivalent of an automated, real time R-26 at their Technical Operations Center in Atlanta, GA. Their system has proven quite successful. Second, this revised R-26 should provide a management tool that addresses system problems. The current approach highlights individual assets that have remained in the system beyond acceptable or standard time limits. Little insight is provided to the manager relative to system weaknesses, bottlenecks in work flows, or areas in which problems are developing. As a consequence, emerging problem areas are not evident until individual items become affected through extended processing times. Even then the individual item is expedited through the repair cycle, and the system problem causing the original delay is normally never uncovered

or corrected. The intent of the R-26 DIFM summary illustrated in Figure 3-2 is to provide management with the capability to address system problems. The accumulation of this data over various time increments would provide management an insight into the true health of the repair cycle system.

SECTION B - IMPROVE REPAIR CYCLE ANALYSIS TECHNIQUES

The second recommendation involves improving repair cycle analysis techniques. In evaluating the base-level, repair-cycle analysis program, the problems associated with informational limitations and the lack of an overall analysis structure (described in Chapter Two) were viewed as the most serious. We recognized that bases did not need nor want a management program that prescribed specific answers for the variety of activities who need to use the system. Rather, an approach was sought which would provide base-level management a basic overview of the repair-cycle system, as well as the flexibility to investigate or "fix" their respective systems as needed. In essence, two major directions were taken. The first direction involved the development of one entity to manage the repair cycle process, while the second concerned the data structure necessary to support the management system.

One entity is required to manage the repair-cycle process because the overall management approach is far too fragmented. The proposal to reduce this problem is to develop one management structure comprised of the Wing Vice Commander, the Deputy Commander for Maintenance, the Deputy Commander for Resources Management, the Maintenance Control Officer, the Chief of Supply, and those other agencies or activities that are deemed necessary. The Wing Vice Commander will act as chairman of the committee. The committee's organizational responsibilities are to act as the umbrella organization for the management of the base-level, repair-cycle system. All base-level analyses and reports on the condition of the repair process would flow through this management group. As

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individual problems are discovered, this group could charter individual projects to examine the impacts on the base and propose solutions. These projects might be carried out by individual project managers or by lesser committees that are appointed by, and report to, this overall management group.

The areas of responsibility for this management group would include DIFM management, the AWP process, all MICAP incidents, and any other activities relating to the repair process. The agendas for each meeting would be developed according to the requirements at each base. The objective is to provide a framework, rather than rigid taskings, for the evaluation of the individual base-level processes and related problems. A proposed structure for the meetings follows, and the management products that are recommended to support that structure are included.

One of the primary problems with the management structures at base level is that the information necessary to conduct analyses is often dependent on the people available to manually sift through published documents. Management products designed specifically to support the repair-cycle management committee should be developed. The products should be designed with two objectives in mind. First, the base-level managers should have maximum flexibility in determining the frequency, type, and quantity of information drawn from these support documents. For example, a number of calling options should be available which let the base managers call by stock number, by organization or shop code, by work unit code (WUC), or by criteria (input by the managers) to determine the number of transactions/items to be examined. Second, the information displayed on these management products should be almost "rip and read" in format. The objective here is to reduce the manual operations as much as possible while obtaining meaningful information for the base-level, repair-cycle management committee.

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With this in mind, a series of report outputs that might prove helpful to base-level management were developed. Much of this information was drawn directly from existing reports available from the UNIVAC 1050-II. The difference here is that this information would be captured for further manipulation within the repair-cycle management group. The outputs displayed throughout the remainder of this section examine four major areas: MICAP incidents, AWP conditions, DIFM status, and future requirements.

MICAP conditions should be analyzed in two ways: First, some determination should be made regarding the number of transactions that specific repair cycle assets have had on MICAP conditions. In other words, the assets that generate a number of MICAP hours or incidents should be highlighted so that appropriate action could be taken on base to resolve the problem. In addition, these MICAP conditions should be looked at in terms of the systems that are impacted by MICAP incidents. All possible base management actions should be investigated. Figure 3-3 illustrates the types of information that are proposed to support this investigation. Second, the method used to satisfy the MICAP requirement needs to be highlighted to management. Figure 3-4 illustrates the types of information needed to determine where the parts are coming from. With this information, the management group can look at the base-level repair effectiveness and determine necessary management actions. One final product will support this investigation. If a number of requisitions are supporting the MICAP effort for repair-cycle assets, a final piece of information is provided (Figure 3-5) to show base managers the quality of support coming from the depots.

Awaiting parts management does not normally receive a great deal of management interest at base level. However, a great number of repair-cycle assets are tied up in the AWP system. Of interest to management should be the

HIGH VOLUME RC PARTS

NSN	NOMENCLATURE	NUMBER OF TRANSACTIONS	ORG/SHOP	WUC	NMCS INCIDENTS
Repaired Items					
XXX	XXX	XXX	XXX	XXX	XX
NRTS'd Items					
XXX	XXX	XXX	XXX	XXX	XX

FIGURE 3-3

MICAP INCIDENTS

NSN	NOMENCLATURE	ORG/SHOP	WUC	CAUSE CODE	HOW FILLED
					Requisition
					Repair
					Cann
					Cancelled

FIGURE 3-4

MICAP REQUISITIONS

DEPOT	NUMBER OF REQUISITIONS	AVERAGE RESPONSE TIME	OUTSTANDING NUMBER	REQUISITIONS AVG. AGE

FIGURE 3-5

AWP CONDITIONS

NSN	NOMENCLATURE	WUC	NSN	PARTS ON ORDER NOMENCLATURE	STATUS

FIGURE 3-6

AWP conditions currently found, what systems are being affected, and how good the support from the depots is to supply the needed parts. Figures 3-6 and 3-7 depict reports that would display that information to the base managers. As stated at the outset, options should be developed to enable the base to strip out only those pieces of information that are required by the base. With this information, the base-level group could track depot support rendered on repair-cycle parts. Management attention could then be focused on the depot when overall supportability falls below acceptable levels.

Analyses of the DIFM process requires more management information than is currently available. Specifically, repair-cycle managers need to know the distribution of the workload throughout the repair process, whether that workload is moving, and how work is progressing on DIFM priorities. The distribution of the workload (Figure 3-8) can be drawn from the DIFM summary contained in the revised R-26 listing previously described in this report. A major option of this output would indicate queue times that exceed standards established by the repair cycle management group. The information tells managers where the workload is and whether it is moving or not. In addition, provisions in the report should allow for the shredding out of this information by WUC, organization, and shop. The final report (Figure 3-9) shows progress on DIFM priorities such as the MICAP or WRSK categories on the R-26. This report contains a listing of the various stock numbers that are being worked under the R-26. The management group has the option to pull all or portions of each section of the R-26 for evaluation and examination. In addition, management can set minimum standards for selection of the information. This information shows management not only the items in work, but the maintenance resources available to complete the work.

Analyzing the repair process itself and providing management the necessary

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AWP REQUISITIONS

DEPOT	NUMBER OF REQUISITIONS	AVERAGE RESPONSE TIME	OUTSTANDING NUMBER	REQUISITIONS AVG. AGE

FIGURE 3-7

DIFM WORKLOAD DISTRIBUTION

ORG/SHOP	QTR TRANSACTIONS	ASQT	MONTH TRANSACTIONS	ASQT	WEEK TRANSACTIONS	ASQT
ASQT > XX DAYS						
ASQT INCREASE > X%						

FIGURE 3-8

DIFM PRIORITIES

CATEGORY	NSN	NOMENCLATURE	ORG/SHOP	DAYS IN REPAIR

MANPOWER
RESOURCES

MACHINE
RESOURCES

FIGURE 3-9

information to resolve problems comprise only half the job. Changes in the environment outside the local base-level logistics arena that might impact the repair process must be identified and evaluated. Examples of such changes might be deployments, exercises, sortie surges, disruptions in the transportation channels due to strikes, etc. Each of these situations must be evaluated to determine the impact they might have on the local repair process. The overall management structure identified here must function to identify impacts and to initiate actions as necessary to minimize those impacts.

The proposed analyses structure and supporting management products have been developed to provide base-level managers the means to control and analyze the overall repair process. This approach is designed to give structure and support without directing the agenda or designating an approved method of evaluation and assessment. The management products that will support this structure are designed to provide quality information in a format that requires minimal manual data extraction.

Some of the information contained in the figures is available only as Phase IV comes on line. At that time, some of the operational, maintenance, and supply information can be joined with the common data base.

SECTION C - INCREASE BASE REPAIR CAPABILITIES

A third recommendation entails two methods to increase the percent of base level repair. Increasing the use of repair level analysis (RLA) during Operational Test and Evaluation (OT&E) on new weapon systems is the first method. The second method encourages the use of AFTO Form 135, Repair Change Request, by base level personnel on current weapon systems.

Repair-level analysis attempts to provide an effective support posture on the most economical basis consistent with the specific operational requirements of the system. In effect it is an analysis to determine whether

it is more cost-effective to repair at base, at depot, or to discard. Repair-level analysis is performed primarily by the contractor throughout the validation, development and production phases of a weapon system life cycle. It may also be applied during the operational phase to review, refine, and revise existing maintenance policies. In reality, it is not done during the operational phase because the analysis completed in the first phases results in the expenditure of funds for acquisition of support equipment, thus limiting the opportunity for cost avoidance. The Air Force provides the contractor with information on broad operational and maintenance concepts such as the number of squadrons, planned deployments, kinds of deployments, utilization rates, mission capable rates, and the operational environment. The contractor provides the Air Force with the mean-time-between-failure/mean-time-between-demand (MTBF/MTBD) figures which often prove difficult to verify. Additionally, the cost figures are originating costs and do not consider future changes or equipment modifications. If any inaccurate or unrealistic data is used in the repair level analysis, the result could be insufficient spare parts, technical data, support equipment, or training in the field.

The repair-level analysis is not an end. Rather, it is a means or tool to aid in determining whether to discard an item upon failure or to repair it at base or depot level. It was intended to be used along with such tradeoff factors as availability, reliability, maintainability, spares, AGE, facilities, and personnel. However, due to high-level interests in keeping costs down, repair-level analysis tends to be the driving force in the decision process. Hence there is considerable reluctance to override the established repair level during the weapon system acquisition process. Consequently, once the weapon system reaches the field, it is often too late to make meaningful changes to the repair level due to the huge amounts of

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money already invested. As a result, the base must either live with the consequences of any errors made and develop workarounds, or be forced into the exception mode of repair, because there are not enough spares available.

It is recommended that more emphasis be placed on use of repair-level analysis during OT&E. Before an item reaches the field, those areas indicating high usage with probable understated MTBF/MTBD and inaccurately assigned Source, Maintenance and Recoverability (SMR) codes should be determined. Repair-level analysis should then be re-accomplished on those selected items with inappropriate MTBF/MTBD and the SMR codes changed as required. Waiting to make the discard-vs-repair decision until after the weapon system is in the field is often too late to prevent MICAP and nonoperational conditions, and puts an unnecessary burden on field personnel.

On weapon systems that are already in the field, however, it is recommended that Base Maintenance personnel increase their use of the AFTO Form 135, Repair Change Request. A recent Air Force Inspector General Functional Management Inspection (IG FMI) report PN 81-632, Repair of USAF Aircraft and ICBM Components, indicated that base personnel were reluctant to attempt SMR code changes because of a lack of knowledge of the form or little faith in the Air Logistic Center's (ALC's) response. The IG report revealed the ALC did in fact respond within one month after receipt and gave the AFTO Forms 135 a relatively high priority. Base managers need to give more importance and attention to reviewing base self-sufficiency and to submitting changes to the SMR codes. Such attention is especially important on high-cost/critical items that are coded "discard" when they could be repaired relatively easily and inexpensively. This could be made an agenda item for the base-repair cycle committee which was discussed previously.

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SECTION D - REVISE STOCK-LEVELING COMPUTATION FOR REPAIR-CYCLE ASSETS

The fourth major recommendation emphasizes revising the repair-cycle, demand-level computation. Stock-leveling formulas in AFM 67-1, Vol II should be revised to reflect "real" repair-cycle time.

A recent Air Force move to begin using average repair times on TRN transactions is a positive step toward improving repair-cycle time computations. However, this move still leaves the potential for slow-moving assets to build up unrealistically high RCTs. If the revised repair concept, via the R-26, is adopted, repair priorities will then become more readily apparent. The following method for calculating RCT is designed to overcome this problem as well as eliminate the need for ERRC standard time limits.

The proposed method smoothes out RCTs by spreading shop backlog time evenly over all the parts processed through a given shop over a period of time. This smoothing is accomplished by first assigning each repair-cycle asset and its interchangeables to a primary workcenter (PWC). The PWC records actual in-work (INW) time for each assigned reparable as it is repaired (shops already do this step with DIFM updates). In-work time for each item repaired is recorded and accumulated in supply records for each like asset. When the asset/repair documentation is processed through Supply, the computer programatically determines how long the item was in the shop's backlog or the "shop queue time" (SQT) by:

$$SQT = TIN\ date - ISU\ date - AWP\ days - INW\ days \qquad (11)$$

In our previous example in Chapter Two, SQT from the two items processed would be:

$$SQT\ Item\ A = TRN\ days\ (1) - AWP\ days\ (0) - INW\ days\ (1) = 0\ days \qquad (12)$$

$$SQT\ Item\ B = TIN\ date\ (364) - ISU\ date\ (360) - AWP\ days\ (0) - INW\ days\ (1) = 3\ days \qquad (13)$$

Now to spread the SQT evenly over all the assets processed, an average SQT

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(ASQT) is calculated for the <u>workcenter</u>. This is found by:

$$ASQT = \frac{(SQTa + SQTb + SQTc + ...)}{Total\ Items\ Repaired} \tag{14}$$

Again in our example, ASQT would be:

$$ASQT = \frac{(SQTa\ (0) + SQTb\ (3))}{Total\ Items\ Repaired\ (2)} = 1.5, \text{ which could be rounded up to 2 days} \tag{15}$$

ASQT is cumulative over time and is recalculated as each transaction is processed, providing continuous updates to the RCDL calculation. Now RCT can be calculated for each individual stock number by simply summing the item INW days, dividing by the total number of repairs for the stock number, and adding the ASQT to the result. Returning to our example, RCT would be computed as follows:

$$RCT\ Item\ A = \frac{Total\ INW\ days\ (1)}{Total\ Transactions\ (1)} + ASQT\ (2) = 3\ days\ RCT \tag{16}$$

$$RCT\ Item\ B = \frac{Total\ INW\ days\ (1)}{Total\ Transactions\ (1)} + ASQT\ (2) = 3\ days\ RCT \tag{17}$$

The AWP time has already been deducted from the individual transactions in the SQT calculation. Calculation of RCT in this manner represents a more equitable distribution of lost utility time for repair. Item A's RCT was increased by 2 days while Item B's RCT was reduced by 1 day (See Figures 3-10 and 3-11 for comparison).

Adding to the complexity of this RCT problem is the recommendation for increased repair capability at base level. Not only does increasing the repair authorizations at base exacerbate the queueing problem, but such increases also profoundly impact on the repair-cycle demand level (RCDL). As repair authority increases at base level, there is no guarantee that such repair movements will be accompanied with more skilled personnel or support equipment. As such, the queueing problem just described might grow worse for some shops that have large repair requirements. In addition, as base self-

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FMS HYDRAULIC SHOP

SHOP BACKLOG AND RCT

Pri. 4	Pri. 3	Pri. 2	Pri. 1

Shop
Queue

Other Reparable	Other Reparable	Item B Hydraulic Actuator	Item A Hydraulic Motor

Awaiting Maintenance (AWM)	Awaiting Maintenance (AWM)	ISU 360 day TIN 364 day RCT = 4 days	Removed 360 day TRN 360 day RCT = 1 day

FIGURE 3-10

FMS HYDRAULIC SHOP

SHOP BACKLOG AND RCT

Pri. 4	Pri. 3	Pri. 2	Pri. 1

Shop
Queue

Other Reparable	Other Reparable	Item B Hydraulic Actuator	Item A Hydraulic Motor

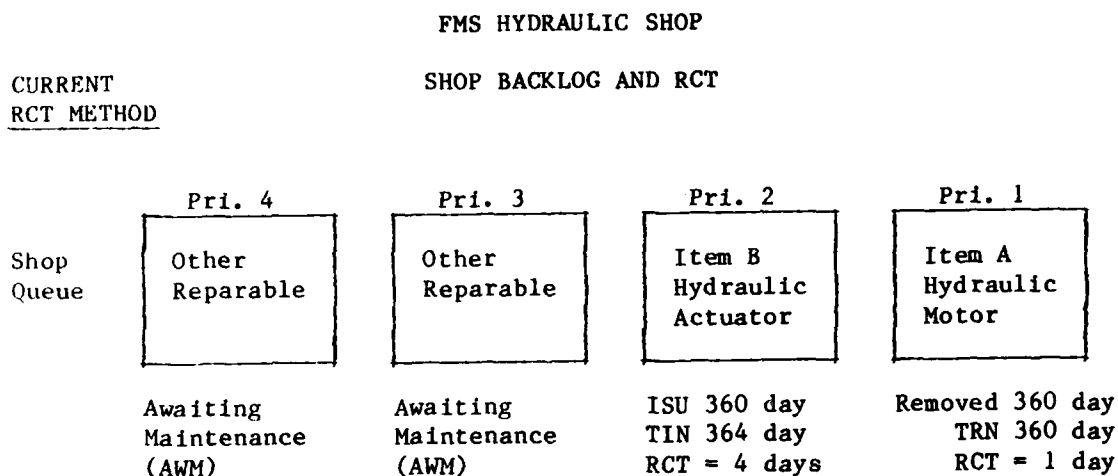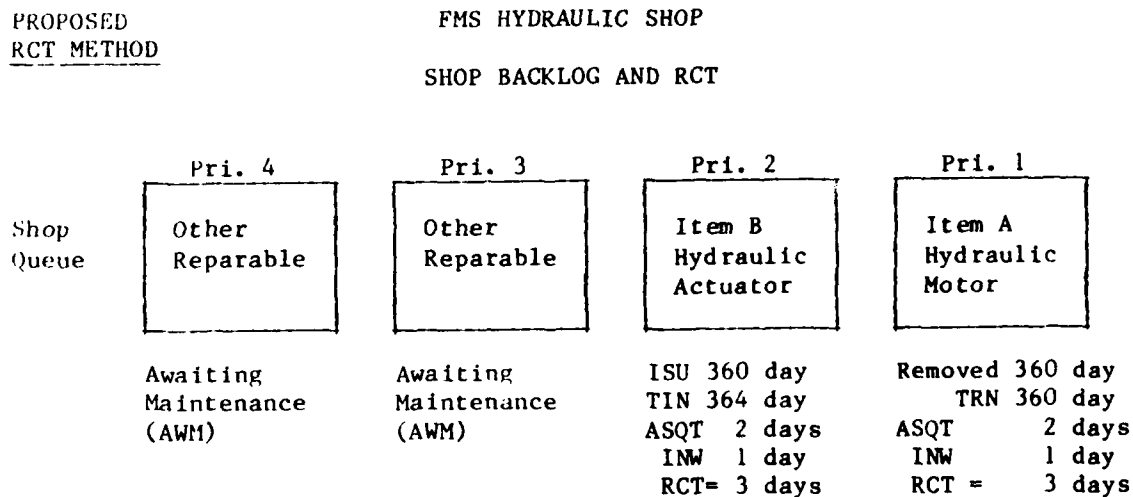| Awaiting Maintenance (AWM)	Awaiting Maintenance (AWM)	ISU 360 day TIN 364 day ASQT 2 days INW 1 day RCT= 3 days	Removed 360 day TRN 360 day ASQT 2 days INW 1 day RCT = 3 days

FIGURE 3-11

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sufficiency expands, the repair-cycle quantity portion of the demand-level computation becomes the primary determiner of stock levels, while the order/ship time and NRTS/condemned quantities have a much reduced impact.

As an added benefit, workcenter ASQT provides maintenance and supply managers with a highly visible performance indicator for repair shops. Abnormal fluctuations in ASQT for a given shop would show that something had changed to raise or lower the shop's average backlog, requiring management attention to correct deficiencies or praise efficiencies. However, it should be noted that static comparison between ASQTs of different shops would not be valid. Another benefit of the proposed calculation is that wholesale levels would also receive more accurate RCT based on actual in work time plus average shop-queue time. This would enhance the distribution of worldwide assets.

This proposed method will require additional computer space and processing time in the supply computer, and may not be feasible until Phase IV computers are on line. But considering the potential benefits offered by the new method, and the criticality of properly managing repair-cycle assets, it should be placed high on the priority list for future improvements in base supply automation.

SECTION E - REFINE ORGANIZATIONAL INTERFACES

The last major recommendation deals with refining the maintenance/supply interface at the organizational level and consists of several proposals.

The first proposal deals with collocating Maintenance/Supply Liaison (MSL), MICAP and Demand Processing, preferably adjacent to Job Control. This would provide maintenance access to a supply computer in those cases where they do not have one. It would reduce dual record keeping in MSL and MICAP since status boards and control logs/forms are currently kept in both areas and substantial time is spent in verifying the accuracy of each record. While

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each section would retain their current chain of command, this recommendation

would encourage more of a supply/maintenance partnership. It would also

increase visibility in dealing with those problems that are causing MICAP

conditions and preventing mission accomplishment. The Supply AWP monitor

would also work from this office and would be encouraged to use the telephone

to track lateral support on selected problem items. Currently, AWP monitors

are usually located within the Reparable Processing Center area or the

Reparable Asset Control Center. While they are required to seek lateral

support, they normally communicate their requirements via messages. This

approach is extremely ineffective because a flood of AWP message traffic often

ends up in the wastebasket. Use of the phone should establish rapport between

AWP monitors, as is the case today with personnel of the MICAP sections.

Also, locating the AWP monitor in MICAP would make AWP problems and their

operational impacts more visible.

The second proposal deals with liberalizing War Readiness Spares Kit

(WRSK) withdrawals. Currently, the senior supply officer is charged with the

responsibility of controlling access to the WRSK and must authorize use of the

last item in the WRSK. In practice, if Maintenance wants the last item, they

will eventually get it, but it will probably require coordination between the

Deputy Commander for Maintenance (DCM) and the Deputy Commander for Resources

(DCR). Much time will be lost, as well as possibly a mission. It is

recommended that the DCM be given both the authority and responsibility for

WRSK usage. It is the DCM and his staff who currently make the decision to

cannibalize or to go MICAP if the required part is not available. They should

also be given the authority to use the WRSK instead of cannibalizing without

having to go to Supply for permission. Currently, it could take 22 steps

(Figure 2-3) before the WRSK can legitimately be considered as an alternative

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supply source—and then only if the part would restore the system to fully

mission capable (FMC) status. The DCM should be given the responsibility to

determine whether it is more cost-effective and beneficial to use the WRSK vs

cannibalizing or going MICAP. This recommendation would allow Maintenance to

shortcut those 22 steps legally; it could potentially result in faster repair

of aircraft, reduced cannibalization, and increased maintenance morale. Also,

Maintenance would take greater interest in the WRSK since they would be held

fully responsible for the status of the WRSK prior to a deployment.

Maintenance, and not Supply, would be responsible for the M-rating of the

WRSK. A drawback of this recommendation is that, with the possibility of

increased WRSK usage, the Supply workload will probably be increased in regard

to removing assets from and refilling the WRSK. However, Tactical Air Command

(TAC) has adopted this approach under their Combat Oriented Supply

Organization (COSO) and have reported considerable success with it.

A third proposal is to encourage the movement of high-demand parts closer

to the flightline and shops. High-flow parts would be determined by the shop

chief, MSL and Supply based on demand history; they might include, for

example, those items with a demand level of two or higher. What would

actually be included should be left up to base management with periodic review

and validation. This study encourages the use of forward supply points and

warehouses to get those fast moving parts closer to where they are needed.

A fourth proposal deals with storing awaiting parts (AWP) assets in the

maintenance shops. Currently, when an asset goes to AWP status, it is

physically removed from the shop and stored in an AWP holding area that is

usually controlled by supply personnel and normally located in the Reparable

Asset Control Center. Shop chiefs are encouraged to review computer runs of

what is in AWP status and physically go to the AWP holding area to consolidate

the like items. This consolidation can be accomplished by cross-cannibalization or by having the assets transported to their shops for cannibalization action, and then returned to the AWP area for safe keeping. In practice, too often it is "out of sight, out of mind." By storing AWP assets in the respective shops, visibility is increased over what is in AWP status. This increased visibility makes it easier to cross-cannibalize and, due to the space limitations of many shops, actually encourages the shop chief to try to cross-cannibalize to make more room. Of course, this results in the benefit of creating additional serviceable spares which aids in mission accomplishment. It also takes Supply out of the business of storage and control of AWP assets while decreasing the requirement to move AWP assets back and forth between Supply and Maintenance, thus reducing the potential of damage due to handling and transporting the items. A drawback of this recommendation is that the risk of creating a "hulk," or of taking parts without proper documentation, increases. However, if proper controls are instituted and shop chiefs are made to understand that they are responsible for the assets assigned to their work center, the benefits of increased visibility, accessibility and simplicity will far outweigh the risks of creating hulks.

A fifth proposal is to give Maintenance control of time compliance technical order (TCTO) and time change item (TCI) parts once they are issued to the base and the kits are complete. Currently, both Supply and Maintenance keep a set of records concerning TCTOs and TCIs. This requires a monthly meeting to reconcile both sets of records. By giving Maintenance the total responsibility for control, Supply will no longer be required to keep a set of records and the monthly reconciliation meeting will be eliminated. Nothing additional will be added to maintenance responsibilities since they are

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ultimately responsible for completing the TCTO/TCI anyway.

The last proposal under the broad area of refining organizational interfaces is to automate the maintenance/supply interface and make it an on-line, real-time system. Several maintenance management processes have been automated at Dover AFB, DE as part of an Air Force test of the Automated Maintenance Systems (AMS) (See AFLMC Report number 760720-1, June 1981.). The results of the implementation of the first five increments have been extremely positive. Visibility of assets has increased because of the real time computer assistance. Open discrepancies can be tracked more easily, and aircraft history by tail number is more visible, resulting in increased maintenance trouble-shooting ability and decreased dependence on the telephone. The percent of discrepancies requiring parts has dropped significantly over a three-year period from 22 percent to 7 percent in the Avionics Maintenance Squadron and from 8 percent to 3 percent in the Field Maintenance Squadron. Additionally, the total number of supply transactions per aircraft has declined approximately 25 percent while sorties flown and actual flying hours have increased.

Automation has also worked extremely well at the Delta Airlines Technical Operations Center. Delta has an automated maintenance/supply interface system which gives them worldwide spares visibility as well as real time shop visibility. Each work center has a remote terminal and printer for parts control and ordering. Parts are ordered through the remote, which feeds an automated stock retriever. The stock retriever controls 80,000 parts and has the capability to control 120,000 parts. It delivers the part to a holding area where, depending on its size, the part is sent to the shop through a pneumatic tube system or delivered by vehicle. The average part takes 30 minutes from time of order to delivery. Once it is issued, it becomes the

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sole responsibility of Maintenance. Delta's real-time computer system enables management to call up a part number and get instant visibility as to where each of their parts are, when they entered the shop, when they're needed, and what the stock level is. The system can best be described as a real time R-26 DIFM list. Delta's experience with automation of ordering, control, and management of recoverables proves it is a workable concept. The Air Force will be testing a similar concept at Dover in 1983 as part of the AMS test. We recommend the Air Force press ahead with automating maintenance/supply management as soon as possible and give it a high priority.

The major commands were briefed on the recommendations addressed in this report in June 1982 and were asked for their response. Most of the comments were favorable, and all were in support of any changes that would place more parts on the shelf when they were needed. The main area of disagreement concerned the six recommendations to refine organizational interfaces. Table 3-1 summarizes the various command responses to that specific area.

Of the ten major commands that responded to collocating MSL, MICAP and Demand Processing, six were in favor and four were against. This recommendation met with the most resistance of any. However, three of the four negative responses were qualified: USAFE would accept a readiness center concept; SAC believed that Supply should participate in maintenance management but not necessarily as a collocated unit; and AFCC assumed that Materiel Control would move in with MICAP, thus taking the supply expertise away from the workcenters which already are not close enough to Base Supply.

Six of the seven MAJCOMs that responded to the recommendation to liberalize WRSK withdrawals were in favor. Only SAC was reluctant to touch the WRSK.

All seven of the MAJCOMs that responded to the recommendation to move high-

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MAJCOM RESPONSES TO "REFINE ORGANIZATIONAL INTERFACES" RECOMMENDATIONS

MAJCOMS

Recommendation	AFSC	USAFE	TAC	PACAF	AFCC	ATC	AFRES	MAC	ESC	SAC
1. Collocate MSL, MICAP, and Demand Processing	Yes[1]	No[2]	Yes	Yes	No[3]	Yes[4]	Yes	No	Yes	No[5]
2. Liberalize WRSK withdrawals	Yes	Yes	Yes	7	7	7	Yes	Yes	Yes	No
3. Move high-flow parts closer to flightline	Yes	Yes	Yes	7	7	7	Yes	Yes	Yes	Yes[6]
4. Store AWP in shops	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes[6]
5. Give Maintenance control of TCTOs and TCIs	Yes	No	Yes	7	7	7	Yes	No	Yes	Yes[6]
6. Automate	Yes	Yes	Yes	7	7	Yes	Yes	Yes	Yes	Yes

1. LGM Yes, LGS No

2. Not under present procedure - A Readiness Center (undefined) would be acceptable.

3. Because not enough material controllers, (2) Mat controllers must perform other duties besides MSL, (3) most workcenters are not close enough to Base Supply (AFSC assumes mat control moves in with MICAP).

4. Supply personnel should still be assigned to Supply for maintenance/supply adversary relationships. Consolidation should include DPU, Research and Repair Cycle support unit and be called "Mission Support."

5. Do not totally agree. Supply should participate in maintenance management but not necessarily as a collocated unit.

6. May have merit but must be closely reviewed to insure no additional workload is placed on Maintenance.

7. No reply to specific recommendation received.

TABLE 3-1

flow parts closer to the flight line were in favor. However, SAC indicated such a move must be closely reviewed to insure no additional workload is placed on maintenance personnel.

Nine of the ten major commands were in favor of storing awaiting parts assets in maintenance shops. MAC was not in favor, and SAC again indicated the recommendations may have merit but must be closely reviewed to minimize the workload impact on Maintenance.

Five of seven major commands that responded to the recommendation to give Maintenance sole control of TCTOs and TCIs were in favor; USAFE and MAC were opposed to the recommendation. SAC again indicated that while it has merit, it must be closely reviewed to minimize the impact on Maintenance.

All eight MAJCOMs that responded were in favor of automating the maintenance/supply interface. A summary of the MAJCOM responses to the six recommendations is shown in Table 3-2.

In Summary, this chapter has made recommendations in five broad areas as depicted in Table 3-3. In the first area, improving repair-cycle management, the major thrust is to revise the R-26 DIFM listing to provide the shop chief with a complete workload scheduling tool and to provide a management tool that addresses system problems. Associated with the improved R-26 is the recommendation to delete the 6- and 9-day delinquency criteria that currently exist, and manage and repair according to need.

The second broad area involves improving repair-cycle analysis techniques. One of the two major recommendations includes developing one managment entity, a repair-cycle committee, comprised of the Wing Vice Commander, the DCM, the DCR, the Maintenance Control Officer, and the Chief of Supply. Additional people could be assigned as the committee deems necessary to act as an umbrella organization for the management of the base-level, repair-cycle

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MAJCOM RESPONSE SUMMARY			
	MAJCOM		
Recommendation	Yes	No	No Specific Response
1. Collocate MSL, MICAP and Demand Processing	6	4	0
2. Liberalize WRSK withdrawals	6	1	3
3. Move high-flow parts closer to flightline	7	0	3
4. Store AWP in shops	9	1	0
5. Give Maintenance control of TCTOs and TCIs	5	2	3
6. Automate	8	0	2

TABLE 3-2

TABLE 3-3

SUMMARY OF MAJOR STUDY RECOMMENDATIONS

1. Improve Repair-Cycle Asset Management

    A. Revise R-26 DIFM listing

        1. Provide shop chief with complete workload scheduling tool

        2. Provide management tool that addresses system problems

    B. Delete DIFM delinquency criteria

2. Improve Repair-Cycle Analysis Techniques

    A. Develop one management entity to act as umbrella organization for management of base-level, repair-cycle system

    B. Develop management products specifically to support repair-cycle management committee

3. Increase Base Repair Capabilities

    A. Increase use of RLA during OT&E on new weapon systems

    B. Encourage use of AFTO Form 135, Repair Change Request, by base-level personnel

4. Revise Stock-Leveling Computation for Repair-Cycle Assets

    A. Change method of computing repair-cycle time to reflect "real" repair cycle times

        1. Current method: $\text{Stock Number RCT} = \dfrac{\text{Total RCT}}{\text{Total Repairs}}$

            where RCT = TIN date − ISU date − AWP days

        2. Proposed method: $\text{Stock Number RCT} = \dfrac{\text{Total INW days}}{\text{Total Transactions}} + \text{ASQT}$

            where $\text{ASQT} = \dfrac{\text{SQT(a)} + \text{SQT(b)} + \ldots}{\text{Total items repaired}}$

            and SQT = TIN date − ISU date − AWP Days − INW Days

5. Refine Organizational Interfaces

    A. Collocate MSL, MICAP and demand processing

    B. Give DCM control of WRSK withdrawals

    C. Move high-flow parts closer to the flightline/shops

    D. Store AWP assets in maintenance shops

    E. Give Maintenance the control of TCTOs and TCIs

    F. Automate maintenance/supply interface

system. The other major recommendation is to develop management products specifically to support this repair-cycle management committee.

The third broad area is concerned with increasing base repair capabilities in two ways. Increasing the use of repair-level analysis during OT&E on new weapon systems is one method. Encouraging the use of the AFTO Form 135, Repair Change Request, by base-level personnel on current weapon systems is the other.

The fourth area deals with revising the stock-leveling computation for repair-cycle assets. The specific recommendation is to revise the present method of computing repair-cycle time to reflect "real" repair-cycle time. This is accomplished by averaging the total shop queue time and adding it to the actual in-work time for each specific stock number (RCT = INWKTIME + ASQT).

The last broad area is concerned with the recommendations to refine the organizational interfaces. These specific recommendations and the MAJCOM responses to them have been discussed previously in this report and are depicted in Table 3-1 and 3-2.

In conclusion, it is believed that the recommendations in this report, if implemented, will result in a system for the control and management of assets that will be more responsive to the needs of the Air Force. This system will be simpler than the present systems, will be nonduplicative, yet will maintain effective asset control.

LIST OF ABBREVIATIONS

AF — Headquarters, United States Air Force

AF/LEY — HQ USAF/Directorate of Maintenance and Supply

AF/LEYM — HQ USAF/LEY Maintenance Policy Division

AF/LEYS — HQ USAF/LEY Supply Policy and Energy Management Division

AFLC — Headquarters, Air Force Logistics Command

AFLC/LO — HQ AFLC/Deputy Chief of Staff, Logistics Operations

AFLC/MA — HQ AFLC/Deputy Chief of Staff, Maintenance

AFLC/XR — HQ AFLC/Deputy Chief of Staff, Plans and Programs

AFLMC — Air Force Logistics Management Center

AFM — Air Force Manual

AFRAMS — Air Force Recoverable Assembly Management System

AFRES/LG — Headquarters, United States Air Force Reserves, Logistics

AFTO — Air Force Technical Order

AGS — Aircraft Generation Squadron

ALC — Air Logistics Center

AMS — Automated Maintenance System

ASQT — Average Shop Queue Time

AVG — Average

AWM — Awaiting Maintenance

AWP — Awaiting Parts

BLSS — Base Level Support Spares

COMO — Combat Oriented Maintenance Organization

COSO — Combat Oriented Supply Organization

CRS — Component Repair Squadron

DCM — Deputy Commander for Maintenance

DCR	– Deputy Commander for Resources
DDR	– Daily Demand Rate
DFM	– DIFM detail change card
DIFM	– Due In From Maintenance
DOS	– Days of Supportability
DPU	– Demand Processing Unit
EG	– Organizational shop code (usually Egress)
EL	– Organizational shop code (usually Electric)
ERRC	– Expendability, Recoverability, Repairability Code
ES	– Organizational shop code (usually Engine)
FIFO	– First In First Out
FMC	– Fully Mission Capable
FMI	– Functional Management Inspection
FMS	– Field Maintenance Squadron
HQ	– Headquarters
ICBM	– Intercontinental Ballistic Missile
IG	– Inspector General (Air Force Inspection and Safety Center
IWM	– In Work in Maintenance
ISU	– Issued from Base Supply
LRU	– Line Replaceable Unit
MACC	– Maintenance Coordination Center (Job Control)
MAJCOM	– Headquarters, Major Air Command
MICAP	– Mission Capability
MMICS	– Maintenance Management Information Control System
MS&D	– Material Storage and Distribution
MSL	– Maintenance/Supply Liaison

MTBD   - Mean Time Between Demands

MTBF   - Mean Time Between Failures

NGB   - Headquarters, National Guard Bureau

NGB/LG   - Headquarters, National Guard Bureau, Logistics

NMCS   - Not Mission Capable for Supply

NRTS   - Not Repairable This Station

NSN   - National Stock Number

OT&E   - Operational Test and Evaluation

PBR   - Percent of Base Repair

Phase IV - Next generation of base level computers

POMO   - Production Oriented Maintenance Organization

POS   - Peacetime Operating Stock

PP   - Organizational shop code (usually Propulsion Branch)

PWC   - Primary Work Center

QTR   - calendar quarter

RCDL   - Repair Cycle Demand Level

RCM   - Repair Cycle Monitor

RCQ   - Repair Cycle Quantity

R&R   - Remove and Replace

R,R&R   - Remove, Repair and Replace

RCSU   - Repair Cycle Support Unit

RCT   - Repair Cycle Time

RLA   - Repair Level Analysis

SCARS   - Serially Controlled Asset Reporting System

SMR   - Source, Maintenance and Recoverability code

SQT   - Shop Queue Time

SRU   – Shop Replaceable Unit

TAC   – Tactical Air Command

TCI   – Time Change Item

TCTO   – Time Compliance Technical Order

TEX   – Transaction Exception code

TIN   – Turn In

TRN   – Turn around

USAF   – United States Air Force

WRSK   – War Readiness Spares Kit

WUC   – Work Unit Code

XB   – Expendable Item, Base

XD   – Expendable Item, Depot

XF   – Expendable Item, Field

APPENDIX A

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BIBLIOGRAPHY

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