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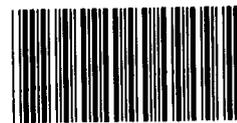
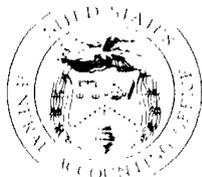
United States General Accounting Office

Report to the Ranking Minority Member,
Committee on Governmental Affairs, U.S.
Senate

May 1992

DEFENSE INVENTORY

Cost Factors Used to Manage Secondary Items



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**National Security and
International Affairs Division**

B-247406

May 14, 1992

The Honorable William V. Roth, Jr.
Ranking Minority Member
Committee on Governmental Affairs
United States Senate

Dear Senator Roth:

As you requested, we are examining the cost considerations underlying the Department of Defense's (DOD) inventory decisions for secondary items.¹ This report is the first part of that effort, and it discusses how DOD develops and uses cost data in making purchasing and stocking decisions for secondary items. DOD is revising and consolidating its inventory management guidance, including the cost factors used to manage secondary items. Thus, we could not make an overall assessment of DOD's cost data accuracy. However, as agreed with your office, we are continuing to assess the accuracy and impact of DOD's inventory cost data and will report on that at a later date.

Results in Brief

Through the economic order quantity formula, the costs of ordering and holding secondary items influence the size of individual orders for items having frequent or high demand. Purchases of items having infrequent or little demand are based on military need rather than optimum order quantities.

In the past, DOD retained secondary item inventory, regardless of its quantity, that pertained to active weapon systems. Recently, DOD revised its policies to encourage disposal of more excess items. As a result, disposals have been increasing. Excess property is sold for a very small percentage of its value. In fiscal year 1990, DOD sold excess property valued at \$9.1 billion for \$138.5 million.

¹Minor end items; replacement, spare, and repair components; and personal support and consumable items. Examples include aircraft and ship components; medical and construction supplies; and food, clothing, and fuel.

Background

At the end of fiscal year 1990, DOD's inventory of secondary items was valued at over \$100 billion. With a reduction in inventory of about \$4 billion in fiscal 1991 and with the revaluation of inventory of about \$14 billion, DOD's secondary item inventory has reached a 7-year low of \$88 billion.² Beginning with fiscal 1991 reporting, the value of inventory will be based on the latest acquisition cost, which includes the initial shipping and handling costs; the value of repairable items requiring repair will be reduced by the cost of repairs; and the value of potential excess stock will be reduced to salvage value.

DOD's principal inventory management entities for wholesale secondary items are the inventory control points, which make purchasing and stocking decisions of assigned secondary items, and the subsidiary supply depots, which receive and store items for issuance to using activities (e.g., shore bases, ships, and submarines).

In their inventory decisions, the inventory control points use cost information associated with ordering and holding stock. For example, they can calculate the number of items to buy by balancing the cost of placing replenishment orders (ordering cost) against the cost of holding items. Similarly, they can identify which items, having no present requirement, are more economical to retain than dispose of by comparing the items' holding cost against the likelihood of having to purchase them again.

The main reasons for DOD to maintain centrally controlled inventories at its supply depots are to obtain lower prices and to improve service to using activities. If items are in stock, a user can receive them without the delays of procuring them from vendors or manufacturers.

Procedures for replenishing depot stocks involve deciding when and how much to order. An order may be placed when the total of the inventory on hand and due in to the supply depots falls to a level that has been established as the reorder point. How much to order depends on whether an item's demand can be forecast. Items that have frequent or high demand are to be purchased in optimum quantities, which are determined by the economic order quantity formula; the formula is designed to minimize total ordering and holding costs. For items with infrequent or little projected demand, such a formula is not used. They may be ordered as needed or, if

²According to DOD supply officials, the DOD Supply System Inventory Report, dated September 30, 1991, will state that the value of DOD's secondary items is \$88.1 billion. At the time of our work, the report had not been finalized.

considered sufficiently critical to military need, they are held in minimum quantities.

DOD directs inventory control points generally to retain secondary items that are essential to the operation of a weapon system in reasonable quantities to support the number of systems in use. Inventory control points are authorized to retain secondary items in up to six stock categories—approved force acquisition objective stock, approved force retention stock, economic retention stock, contingency retention stock, numeric retention stock, and potential excess stock.³ (See p. 22 for a description of these stock categories.) Items determined to be excess are to be processed for disposal.

Cost Factors Affect Purchase Decisions

DOD's policies and procedures describe how the costs of ordering and holding stock are to be considered in making decisions to buy. Ordering cost includes the costs of determining supply needs, processing purchases, and receiving orders. Holding cost includes the cost of having funds tied up in inventory, the cost of storing items, material obsolescence cost, and inventory losses. As shown in table 1, DOD's ordering costs range from \$116 (for small purchases) to \$3,880 (for large purchases), and its holding costs, which are expressed as a percentage of the value of average on-hand inventory, range from 10 to 23 percent.

Table 1: Ordering and Holding Cost Values Used by DOD Components during Fiscal Year 1991

| DOD component | Cost factor | |
|--------------------------|-----------------|-------------------|
| | Ordering | Holding (percent) |
| Air Force | \$543 - \$1,385 | 10 - 13 |
| Defense Logistics Agency | 116 - 2,981 | 12 - 19 |
| Army | 1,181 - 3,880 | 13 - 18 |
| Navy | 244 - 1,820 | 21 & 23 |

Ordering and holding costs influence the quantity to be ordered through the economic order quantity formula. Additional factors in the formula include the quantity of annual demand and the replacement price of the

³DOD is planning to eliminate approved force retention stock and numeric retention stock and to rename potential excess stock as potential reutilization stock.

item. When using the formula, an increase in ordering cost or demand causes a larger computed order quantity, while an increase in the holding cost or the replacement price causes a smaller quantity for any given order. As order quantities increase, the number of procurements and the procurement work load decrease. On the other hand, as order quantities decline, there are increases in the number of procurements and, accordingly, in the work load to process them.

Factors Other Than Cost Primarily Affect Stocking Decisions

Stocking decisions are primarily based on factors other than cost. In October 1985, DOD decided to retain secondary item inventory, regardless of its quantity, that pertained to an active weapon system. In June 1990, DOD revised its policy to encourage disposal of items that exceed reasonable quantities because of the reductions in force structure and the Defense Management Report initiative to reduce costs. As a result, disposals have been increasing. From fiscal years 1988 to 1990, total disposals grew from nearly \$7 billion to almost \$12 billion. (The amounts of disposed property include material other than secondary items; DOD does not maintain separate records of the sale of secondary items that are submitted for disposal.)

Proceeds from the sale of excess property are much lower than the value of the sold material. For example, DOD sold excess property valued at \$9.1 billion (foreign military sales and usable and scrap property sales) during fiscal year 1990 for \$138.5 million (1.5 percent), of which, \$90 million, according to a DOD official, was deposited in the U.S. Treasury⁴ and the remainder (\$48.5 million) was used to reimburse DOD for certain authorized expenses.

There are many reasons for this low rate of return. For example, excess property is first offered to DOD; other federal, state, and local agencies; and private organizations. The remaining property that is offered for sale to the public, according to DOD, is usually in poor condition and of limited use to civilians. Additionally, the value of the property is not the estimated resale value; DOD does not devalue items prior to disposal.⁵

⁴Beginning in fiscal year 1991, all receipts generated from the disposal of excess stock fund secondary item inventory will be credited to the Defense stock funds rather than the general fund of the U.S. Treasury.

⁵Although DOD revalues potential excess stock for reporting purposes, it does not reduce the value of this material in its inventory system.

Scope and Methodology

We performed our work at

- the Office of the Assistant Secretary of Defense (Production and Logistics);
- Air Force, Navy, Army, and Defense Logistics Agency (DLA) headquarters and their logistics commands—Air Force Logistics Command, Naval Supply Systems Command, Army Materiel Command, and DLA; and
- four inventory control points—San Antonio Air Logistics Center; Aviation Supply Office; Armament, Munitions, and Chemical Command; and Defense General Supply Center.

(The Marine Corps was excluded due to the small number of items affected by inventory management policies.)

We identified not only inventory ordering and holding costs but also the role of these costs in managing secondary items.

We used the same computer reports, records, and statistics that DOD uses to manage secondary items, especially those used in making purchase and stocking decisions. We did not independently determine their reliability.

Our work was performed from November 1990 through September 1991 in accordance with generally accepted government auditing standards.

Because DOD is revising its inventory management guidance and its procedures, we are making no recommendations at this time. As agreed with your office, we are continuing to assess the cost factors that have the greatest effect on inventory decisions, including ordering, investment, and obsolescence costs.

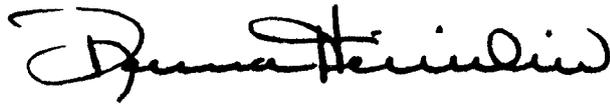
Appendix I contains further details on the results of our work, and appendix II reproduces DOD's written response to our draft report. DOD generally concurred with the draft report and suggested technical and clarifying changes, which were submitted to us during a meeting that was held on March 23, 1992, for providing oral comments. We have incorporated DOD's comments where appropriate.

We are sending copies of this report to the Chairmen, House Committee on Government Operations, Senate and House Committees on Appropriations and on Armed Services; to the Director, Office of Management and Budget; to the Secretaries of Defense, the Air Force, the Navy, and the Army; and to

the Director, DLA. Copies also will be made available to others upon request.

Please contact me on (202) 275-8412 if you or your staff have any questions concerning this report. The other major contributors to this report are listed in appendix III.

Sincerely yours,



Donna M. Heivilin
Director, Logistics Issues

Contents

| | | |
|---|--|----|
| Letter | | 1 |
| Appendix I | | 10 |
| Cost Considerations for Inventory Decisions | Inventory Management Policy | 10 |
| | Development of Cost Information | 11 |
| | Purchase Decisions | 16 |
| | Stocking Decisions | 22 |
| Appendix II | | 26 |
| Comments From the Department of Defense | | |
| Appendix III | | 27 |
| Major Contributors to This Report | | |
| Tables | | |
| | Table 1: Ordering and Holding Cost Values Used by DOD Components During Fiscal Year 1991 | 3 |
| | Table I.1: DOD's Secondary Item Inventory as of September 30, 1991 | 10 |
| | Table I.2: Ordering Costs Used by DOD's Inventory Control Points during Fiscal Year 1991 | 12 |
| | Table I.3: Holding Cost Rates Used by DOD's Inventory Control Points during Fiscal Year 1991 | 14 |
| | Table I.4: Comparison of DOD Demand-Based Versus Nondemand-Based Secondary Items | 18 |
| | Table I.5: Impact of Changes in Ordering Costs on Economic Order Quantity | 20 |
| | Table I.6: Impact of Changes in Annual Demand on Economic Order Quantity | 20 |
| | Table I.7: Impact of Changes in Holding Cost Rates on Economic Order Quantity | 21 |
| | Table I.8: Impact of Changes in Replacement Price on Economic Order Quantity | 21 |
| | Table I.9: DOD Property Disposals for Fiscal Years 1988 Through 1990 | 24 |
| | Table I.10: Proceeds From Disposal Sales for Fiscal Years 1988 Through 1990 | 25 |

Figures

I.1: Economic Order Quantity Formula

19

Abbreviations

DLA Defense Logistics Agency
DOD Department of Defense

Cost Considerations for Inventory Decisions

The Department of Defense (DOD) classifies the items in its material inventories as principal (aircraft, ships, and tanks) and secondary (components for aircraft, ships, and tanks; construction, medical, and dental supplies; and food, clothing, and fuel). As of September 30, 1991, the secondary item inventory was valued at about \$88 billion (table I.1).

Table I.1: DOD's Secondary Item Inventory as of September 30, 1991

Dollars in billions

| DOD component | Inventory | |
|--------------------------|---------------|------------|
| | Value | Percent |
| Air Force | \$38.6 | 44 |
| Navy ^a | 23.8 | 27 |
| Army | 15.1 | 17 |
| Defense Logistics Agency | 10.6 | 12 |
| Total | \$88.1 | 100 |

^aThe Navy's data include Marine Corps inventory valued at \$0.5 billion.

Inventory Management Policy

DOD inventory management guidance for secondary items is being revised and consolidated. According to DOD supply officials, the military services and the Defense Logistics Agency (DLA) do not agree on the ordering and holding cost formulas, and some of the holding cost factors are outdated. They said that these revisions will de-emphasize the use of ordering and holding cost formulas. One official estimated that the revisions will be completed in mid-1992.

Key guidance includes the following:

- DOD Instruction 4140.39, "Procurement Cycles and Safety Levels of Supply for Secondary Items," which includes guidance on the optimum order quantity for consumable items. According to this instruction's general policy statements, reparable items are also covered, to the extent feasible.⁶
- DOD Directive 4140.59, "Determination of Requirements for Secondary Items After the Demand Development Period."
- DOD Directive 4100.37, "Retention and Transfer of Materiel Assets."
- DOD Directive 4160.21, "DOD Personal Property Utilization and Disposal Program."

⁶With the exception of the Air Force, the services also follow this guidance when establishing the optimum order quantity for reparable items.

To implement DOD guidance, the services and DLA have developed detailed inventory management procedures, including the use of cost data. Service and DLA operating procedures are administered by the Air Force Logistics Command, the Naval Supply Systems Command, the Army Materiel Command, and DLA. Their principal inventory management entities are inventory control points and subsidiary supply depots.

Development of Cost Information

To support the needs of using activities, inventory control points are responsible for making the purchasing and stocking decisions affecting assigned secondary items. In their inventory decisions, the inventory control points use cost information associated with ordering and holding stock. For example, they can calculate the optimum number of items to buy by balancing the cost of ordering items against the cost of holding items. In this computation, they also consider an implied shortage cost—the cost of not having an item—to represent the cost of requisitions on back order.

Ordering Cost

Ordering cost includes the costs of determining supply needs, processing purchase actions, and receiving orders. To determine ordering costs, DOD requires the services and DLA to analyze labor and computer-processing costs, which include generation of purchase request, solicitation evaluation, contract administration, material receipt, payment, communications, documentation, and indirect personnel.

The services and DLA calculate ordering costs for different procurement purchases, such as purchase orders, basic order agreements, negotiated contracts, and advertised contracts. At a minimum, DOD requires that these include small purchases of \$25,000 or less and large purchases of more than \$25,000. Currently, the services and DLA use from one to four cost figures for economic order quantity computations. As shown in table I.2, these costs range from \$116 for small purchases to \$3,880 for large purchases.

**Appendix I
Cost Considerations for Inventory Decisions**

**Table I.2: Ordering Costs Used by DOD's
Inventory Control Points during Fiscal
Year 1991**

| Inventory control point | Small purchases | Large purchases |
|---|------------------------|------------------------|
| Air Force: | | |
| Ogden Air Logistics Center | \$838 | \$1,385 |
| Oklahoma City Air Logistics Center | 629 | 929 |
| Sacramento Air Logistics Center | 923 | 1,337 |
| San Antonio Air Logistics Center | 543 | 899 |
| Warner Robins Air Logistics Center | 730 | 1,170 |
| Navy: | | |
| Aviation Supply Office | 244 & 707 | 522 & 1,051 |
| Ships Parts Control Center | 701 & 729 | 1,729 & 1,820 |
| Army: | | |
| Armament, Munitions-Chemical Command | 1,343 | 1,966 |
| Aviation Systems Command | 1,181 | 1,833 |
| Communications-Electronics Command | 1,327 | 2,313 |
| Missile Command | 1,389 | 1,991 |
| Tank-Automotive Command | 1,434 | 3,880 |
| Troop Support Command | 1,408 | 3,190 |
| DLA: | | |
| Defense Construction Supply Center | 116 | 116 |
| Defense Electronics Supply Center | 130 | 130 |
| Defense General Supply Center | 213 | 213 |
| Defense Industrial Supply Center | 225 | 225 |
| Defense Fuel Supply Center | ^a | ^a |
| Defense Personnel Supply Center: | | |
| Medical | 135 | 135 |
| Clothing and Textiles | 2,981 ^b | 2,981 ^b |

^aNot applicable because this inventory control point does not use the economic order quantity formula.

^bThis ordering cost does not reflect the actual cost to effect a procurement for clothing and textiles. It is an adjustment needed to make the order quantity compatible with industry practices.

The services can incorporate multiple costs into their computer models; DLA, however, is limited to one cost factor in its model, which is a combination of ordering and holding costs. To use more than one cost factor would involve costly computer hardware and software changes. DLA has studied the feasibility of changing its inventory management computer system, and it plans to implement a multiple cost inventory system in the future.

DLA has determined the actual ordering costs of its inventory control points for five different procurement purchases. For example, the ordering costs for the Defense General Supply Center are \$45, \$61, \$95, and \$853 for

various types of small purchases and \$1,174 for large purchases. In its economic order quantity computations, the Defense General Supply Center, however, is limited to using one cost factor, which equates to an ordering cost of \$213.

Holding Cost

DOD expresses holding cost as a percentage of the value of average on-hand inventory. It is made up of the cost of having funds tied up in inventory (investment cost), the cost of storing items, the material obsolescence cost, and other inventory losses.

As shown in table I.3, DOD's holding cost rates range from 10 to 23 percent.

**Appendix I
Cost Considerations for Inventory Decisions**

Table I.3: Holding Cost Rates Used by DOD's Inventory Control Points during Fiscal Year 1991

Figures in percent

| Inventory control point | Holding cost component | | | | Total |
|---|------------------------|---------|--------------|--------------|-------|
| | Investment | Storage | Obsolescence | Other losses | |
| Air Force: | | | | | |
| Ogden Air Logistics Center | 6 | 1 | 4 | a | 11 |
| Oklahoma City Air Logistics Center | 6 | 1 | 3 | a | 10 |
| Sacramento Air Logistics Center | 6 | 1 | 6 | a | 13 |
| San Antonio Air Logistics Center | 6 | 1 | 3 | a | 10 |
| Warner Robins Air Logistics Center | 6 | 1 | 3 | a | 10 |
| Navy: | | | | | |
| Aviation Supply Office | 10 | 1 | 10&12 | b | 21&23 |
| Ships Parts Control Center | 10 | 1 | 10&12 | b | 21&23 |
| Army: | | | | | |
| Armament, Munitions-Chemical Command | 10 | 1 | 4 | 1 | 16 |
| Aviation Systems Command | 10 | 1 | 3 | 0 | 14 |
| Communications-Electronics Command | 10 | 1 | 3 | 2 | 16 |
| Missile Command | 10 | 1 | 5 | 2 | 18 |
| Tank-Automotive Command | 10 | 1 | 2 | 0 | 13 |
| Troop Support Command | 10 | 1 | 5 | 1 | 17 |
| DLA: | | | | | |
| Defense Construction Supply Center | 10 | 1 | 6 | b | 17 |
| Defense Electronics Supply Center | 10 | 1 | 8 | b | 19 |
| Defense General Supply Center | 10 | 1 | 6 | b | 17 |
| Defense Industrial Supply Center | 10 | 1 | 7 | b | 18 |
| Defense Fuel Supply Center | c | c | c | c | c |
| Defense Personnel Supply Center: | | | | | |
| Medical | 10 | 1 | 1 | b | 12 |
| Clothing and Textiles | 10 | 1 | 7 | b | 18 |

^aAccording to the Air Force, it includes inventory losses in its obsolescence cost rates.

^bNeither the Navy nor DLA calculates a separate inventory loss rate.

^cNot applicable because this inventory control point does not use the economic order quantity formula.

For two components of holding cost, DOD has specified the rates. In 1970, it fixed 1 percent a year to represent the out-of-pocket costs incurred in storing inventory plus the amortized cost of storage facilities and 10 percent as the rate for investment costs. The services and DLA use the 1-percent storage rate. However, in October 1985, the Air Force lowered its investment cost rate to 6 percent based on a contracted study; the Air Force found that this reduction increased order quantities 10 to 15

percent. The other services and DLA continue to use the DOD prescribed 10-percent investment rate in their economic order quantity computations.

DOD has not specified a rate for the other two holding cost components—obsolescence and other inventory losses—but it has procedures for calculating these rates. DOD defines obsolescence costs as inventory losses due to all causes that render on-hand inventory superfluous to need (e.g., technological obsolescence, inflated forecast of demand, or deterioration beyond the point of use). When calculating the obsolescence rate, however, DOD compares the total value of items that have been transferred to disposal during a fiscal year to the average annual value of on-hand and due-in assets. It does not consider unrequired items still in stock but not yet transferred to disposal. In 1990, we reported⁷ that the Air Force had over 41,000 duct segments, valued at \$4.7 million, in unrequired stock for the F-100 engine. They were being replaced by new and improved parts.

The Navy's computation of the obsolescence rate differs from DOD's method in that it considers the remaining useful life of an item rather than historical disposal data. The Navy sets its obsolescence rate as the reciprocal of the estimated number of years of useful life of an item. For example, a Navy secondary item with a useful life of 8 years would be assigned an obsolescence rate of 12 percent annually. In comparison, the other services and DLA, following DOD guidance, have assigned obsolescence rates for secondary items ranging from 1 to 8 percent (table I.3). A smaller obsolescence rate results in a larger recommended order quantity.

The loss rate for other inventory losses, which includes those due to pilferage, shrinkage, and inventory adjustments, is to be calculated as a fraction of total assets (i.e., net losses in inventory divided by total assets). If there are net gains in inventory, then the loss rate is set at zero. DOD guidance requires the services and DLA to explicitly include an inventory loss rate when computing holding cost. The Army follows this guidance, but Air Force officials said that they include inventory losses in their obsolescence rates. Navy and DLA officials said that they do not compute inventory loss rates because they consider their net losses to be relatively insignificant. For example, in fiscal year 1990, DLA's net losses were \$1.3 million, resulting in a loss rate of .012 percent.

⁷Growth in Air Force and Navy Unrequired Aircraft Parts (GAO/NSIAD-90-100, Mar. 6, 1990).

Shortage Cost

In establishing the quantity of stock to be on hand for continued operation in the event of minor interruptions of normal replenishment or unpredictable fluctuations in demand (safety level), DOD uses a shortage cost that represents the cost of having requisitions on back order. DOD cannot measure the true costs of being out of stock, so it includes an implied shortage cost in the order quantity computation to reduce the likelihood of being out of stock. This cost increases the item's average inventory level.

Purchase Decisions

The services and DLA have similar systems to replenish wholesale depot stock levels; the procedures they follow depend on whether an item's demand can be forecast. Items with frequent or high demands are to be purchased in optimum quantities determined by the economic order quantity formula, which is designed to minimize total ordering and holding costs. Items with infrequent or little demand are not purchased using this formula. They may be ordered as needed or, if considered sufficiently critical, are held in minimum quantities.

The economic order quantity formula factors are ordering cost, annual demand, holding cost rate, and replacement price. These factors influence recommended order quantities according to their values. Other factors, such as procurement lead time, also can affect the inventory level.

Process for Replenishing Stock

Using activities generally submit their requisitions for items to the concerned inventory control point, which notifies a supply depot to issue the items. When issued, the supply depot reports the transaction to the inventory control point.

Normally, an inventory control point attempts to satisfy requisitions through items in stock at a supply depot, from expected receipts, through repairs of previously used items, or by new purchases. Inventory control points place orders when the total of the inventory on hand and due in to the supply depots falls to a level that has been established as the reorder point.

When an inventory control point orders secondary items for depot stock, an order is placed with a vendor or manufacturer through an existing order agreement or a new contract. The quantity that is purchased is allocated to one or more supply depots.

**Determining
Nondemand-based Item
Needs**

Secondary items for which demand is infrequent or there is little demand to justify stocking based on economic factors are called nondemand-based items. These may be categorized as program or essential items. Program items may be ordered as needed to support particular programs of a nonrecurring or sporadic nature, such as a nonrepetitive repair program. They include items, mainly equipment, that are purchased because the items will no longer be produced. Essential items are defined as critical to the military mission and, accordingly, a lack of these items would seriously hamper the operational capabilities of weapon systems. Thus, these may be held in minimum quantities without regard to optimum order quantities.

Essential items consist of insurance items and numeric stockage objective items. Insurance items are subject to infrequent replacement as the result of unexpected occurrences. Normally, a quantity not exceeding two replacement units is authorized to be stocked. Quantities greater than two are authorized when an analysis of factors such as item cost, essentiality, and procurement difficulty indicates that additional quantities should be stocked. Numeric stockage objective items are those for which some demand can be predicted but not to the extent that stocking them can be based on economic factors. Because stock quantities cannot be based on economic factors, the services and DLA use various criteria to determine the quantity to be stocked. For example, depending on an item's cost and its mission essentiality, the Army and DLA keep a minimum of one item in stock. On the other hand, if two particular items are needed each time a maintenance action is performed on a weapon system, the Navy will keep a minimum of two of these items in stock at all times. The Air Force calculates a requirement based on past demand; items are stocked based on this forecast.

**Determining Demand-based
Item Needs**

Secondary items for which demand can be forecast are called demand-based items. With the exception of the Air Force's reparable items, demand-based items are covered by the economic order quantity formula. As shown in table I.4, most of DOD's secondary item inventory investment is in demand-based items.

Appendix I
Cost Considerations for Inventory Decisions

Table I.4: Comparison of DOD Demand-Based Versus Nondemand-Based Secondary Items

Dollars in millions

| DOD component | Demand | | Nondemand | |
|--------------------------|-----------------|-------------|----------------|------------|
| | Value | Percent | Value | Percent |
| Air Force ^a | \$31,201 | 86.9 | \$4,695 | 13.1 |
| Navy | 20,921 | 96.6 | 730 | 3.4 |
| Army | 12,436 | 99.8 | 25 | 0.2 |
| DLA | 8,691 | 82.4 | 1,859 | 17.6 |
| Total^b | \$73,249 | 90.9 | \$7,309 | 9.1 |

^aThe Air Force's reparable items are included in these subtotals. Its demand-based reparable items are valued at \$25,536 million and its nondemand-based reparable items are valued at \$4,035 million.

^bThe difference of \$7,542 million between the sum of the demand-based and nondemand-based secondary items shown in the table and the total secondary item inventory expected to be reported in the Supply System Inventory Report, dated September 30, 1991 (table I.1) is due to unstratified assets, some user-level assets, and Marine Corps inventory.

In determining replenishment needs for demand-based items, DOD considers three factors—safety level requirements, lead time requirements, and economic order quantity.

- Safety level requirement is that quantity of stock required to permit continued operation in the event of minor interruptions of normal replenishment or unpredictable fluctuations in demand.
- Lead time requirement is that quantity of stock required to ensure operation during the period between the identification of a requirement and the receipt of the material.
- Economic order quantity is that quantity of stock that will result in the lowest total costs for ordering and holding inventory.

Safety level and lead time requirements are established by the inventory control points as the reorder point. If on-hand and on-order stocks fall below the reorder point when the economic order quantity replenishment is determined, then the quantity to be ordered is increased to cover that deficiency. To compute the optimum order quantity, inventory control points use the economic order quantity formula (fig. I.1).

Figure I.1: Economic Order Quantity Formula

$$EOQ = \sqrt{\frac{2AD}{IC}}$$

EOQ = economic order quantity
A = order cost amount
D = annual demand
I = holding cost rate
C = replacement price

This formula is designed to compute the order quantity that will meet needs at the lowest total cost for ordering and holding inventory. It considers the economic trade-offs between the cost to order and the cost to hold inventory. The calculation of an economic order quantity uses variable ordering and holding costs. (Fixed costs—defined by DOD as costs that remain constant if 50 percent of the work load is eliminated—are not considered.)

The results of the economic order quantity are adjusted if they fall outside DOD's designated "ceiling or floor." Before February 1992, DOD limited the economic order quantity to a maximum of 36 months of supply and to a minimum equal to either the demand during the administrative lead time or 3 months demand. Since then, DOD has limited the economic order quantity to a maximum of 24 months of supply⁸ and to a minimum equal to the lesser of either the demand during the administrative lead time or 6 months demand. According to a DOD supply official, the maximum is to avoid excessive inventories and the minimum is to prevent overload of the purchasing departments.

Effect of Economic Order Quantity Factors on Order Quantities

When used, the value of an economic order quantity formula factor (ordering cost, annual demand, holding cost rate, and replacement price) influences order quantities. Tables I.5 through I.8 illustrate changes in the values of these factors, and the resulting impact on recommended order quantities. (In each table, the assumed starting values are \$1,966 ordering cost, 24 items annual demand, 16 percent holding cost rate, and \$710

⁸The Defense Authorization Act for fiscal years 1992 and 1993 limits DOD to 2 years worth of inventory for an item unless the head of the procuring organization certifies that a larger order is necessary to achieve greater economy or otherwise necessary for national security.

**Appendix I
Cost Considerations for Inventory Decisions**

replacement price per unit for a computed recommended order quantity of 29. These values are those of an Army cable assembly purchase.)

As shown in table I.5, an increase in the ordering cost amount from \$1,966 to \$2,923 (about 50 percent) will increase the recommended order quantity by 21 percent, while a similar decrease in the ordering cost from \$1,966 to \$1,006 (about 50 percent) will decrease the recommended quantity by 28 percent.

Table I.5: Impact of Changes in Ordering Costs on Economic Order Quantity

| Order cost | Order quantity | |
|--------------|----------------|------------------|
| | Amount | Change (percent) |
| \$45 | 4 | - 86 |
| 1,006 | 21 | - 28 |
| 1,966 | 29 | 0 |
| 2,923 | 35 | 21 |
| 3,880 | 40 | 38 |

Likewise, as shown in table I.6, an increase in the quantity of annual demand from 24 to 36 (50 percent) will increase the recommended order quantity by 21 percent, while a similar decrease in the annual demand from 24 to 12 (50 percent) will decrease the recommended quantity by 31 percent.

Table I.6: Impact of Changes in Annual Demand on Economic Order Quantity

| Annual demand | Order quantity | |
|---------------|----------------|------------------|
| | Amount | Change (percent) |
| 12 | 20 | - 31 |
| 18 | 25 | - 14 |
| 24 | 29 | 0 |
| 30 | 32 | 10 |
| 36 | 35 | 21 |

Conversely, as shown in tables I.7 and I.8, an increase in the values of the holding cost rate or the replacement price will decrease the recommended order quantity, while a decrease in either of these factors' values will increase the recommended quantity.

Table I.7: Impact of Changes in Holding Cost Rates on Economic Order Quantity

| Holding cost (percent) | Order quantity | |
|------------------------|----------------|------------------|
| | Amount | Change (percent) |
| 10 | 36 | 24 |
| 13 | 32 | 10 |
| 16 | 29 | 0 |
| 20 | 26 | - 10 |
| 23 | 24 | - 17 |

Table I.8: Impact of Changes in Replacement Price on Economic Order Quantity

| Replacement price | Order quantity | |
|-------------------|----------------|------------------|
| | Amount | Change (percent) |
| \$71 | 91 | 214 |
| 355 | 41 | 41 |
| 710 | 29 | 0 |
| 3,550 | 13 | - 55 |
| 7,100 | 9 | - 69 |

As order quantities increase, there are corresponding decreases in the number of procurements and the procurement work load. The offsetting cost is a higher investment in inventory. In addition, the use of increased order quantities reduces the flexibility of the supply system to adjust to changes in future demand, which may result in obsolete materials. On the other hand, as order quantities decline, there are increases in the number of procurements and, accordingly, in the work load to process them.

Effect of Order Size on Inventory Levels

The size of individual orders has a direct effect on the inventory level, whether or not the economic order quantity is used. In a simple case where items are used uniformly and orders arrive as soon as the last on-hand item is used, the average on-hand inventory is half the size of the order. Thus, doubling or halving the economic order quantity would likewise double or halve the average on-hand inventory. The effect also can be measured in “real world” situations, but the analysis must include complicating factors, such as safety levels, that may be added to the on-hand inventory.

Factors other than those used in the economic order quantity formula also can affect the inventory level, such as procurement lead time—the total time the supply system takes to process an order and the supplier takes to deliver the item. Furthermore, if items are ordered too soon, earlier arrival than necessary would increase the average inventory level.

Stocking Decisions

DOD directs the services and DLA generally to stock secondary items in reasonable quantities to support the number of weapon systems in use. Decisions about stocking items involve retaining items and disposing of items. In the past, DOD retained inventory, regardless of quantity, that pertained to active weapon systems. Recently, it revised its policies to encourage disposal of more items. As a result, disposals have been increasing. Proceeds from the sale of excess property are much lower than the value of the sold material.

Process for Retaining/disposing of Stock

To equip and sustain peacetime operating levels and war reserves,⁹ inventory control points are authorized to retain secondary items that are classified as approved force acquisition objective stock. While additional items may not be purchased, they may be retained in five other stock categories.

- Approved force retention stock, in addition to the acquisition objective stock, is material that is required to equip and support U.S. forces from when war begins until production equals the increased wartime demand.
- Economic retention stock has no present requirement; however, DOD has determined it to be more economical to retain the stock for future peacetime use instead of satisfying possible future needs through procurements. Items retained in this category must have a reasonably predictable demand.
- Contingency retention stock has no quantifiable requirement or predictable demand; however, DOD has decided to retain the stock for possible contingencies.
- Numeric retention stock is the stock for which disposal is currently infeasible or uneconomical; management has decided to retain it in the supply system.
- Potential excess stock is material beyond all authorized retention limits, but it has not yet been determined to be excess.

DOD is planning to eliminate approved force retention stock and numeric retention stock and to rename potential excess stock as potential reutilization stock. The Army has already eliminated numeric retention stock as a stock category.

⁹War reserves are stocks that are stored in peacetime to satisfy the initial wartime surge; they are intended to sustain wartime operations until resupply takes place.

Inventory control points base their retention decisions on both specific military requirements, including those of allied forces and the Foreign Military Sales Program, and economic reasons. For example, the economic retention limit is computed by using a break-even formula that determines the point that holding costs equal costs to repurchase the items. According to DOD supply officials, the formula computes approximately 7 to 8 years worth of stock for the Navy; 10 years for DLA; variable amounts (depending upon the demand of the item) not to exceed 11 years for the Army; and 15 and 18.5 years for repairable and consumable items, respectively, for the Air Force. The different results are due to dissimilar computer models.

Items beyond peacetime operating levels and war reserves are to be first transferred within DOD. If these items satisfy another organization's requirement, such as being authorized for peacetime requisition, their transfer will be reimbursable to the holding activity. If not needed, reimbursements may include only administration and transportation costs, not the items' cost. Also, items can be transferred on a reimbursable basis to other federal agencies and to allied forces, in accordance with the Foreign Assistance Act.

In addition, inventory control points decide the disposition of items that are declared excess by using activities. Using computer models, inventory control points consider the following factors in sequence: diminishing manufacturing sources, economic factors, and noneconomic factors. One of the crucial elements in this decision process is whether unneeded items can be obtained, if needed, in the future. A decision to return noncritical items from users to depot stock also considers cost—the cost of transporting items in relation to their procurement cost.

Disposal of Inventory

Excess items are to be turned in to the Defense Reutilization and Marketing Office for disposal. In October 1985, DOD decided to retain secondary item inventory, regardless of quantity, that pertained to active weapon systems. In June 1990, DOD revised its policies to encourage disposal of more items because of the reductions in force structure and the Defense Management Report initiative to reduce costs. DOD is concentrating first on items in need of repair, then on stocks held for contingency reasons. DOD also expects to use excess stock in foreign military sales and humanitarian assistance programs.

In addition to transferring or disposing of excess inventory at U.S. locations, DOD must transfer or dispose of U.S. materials in Europe and the

Middle East. For materials in Europe, DOD is to (1) relocate items to other units in the theater, eliminating shortfalls; (2) sell items through the Foreign Military Sales Program; (3) transfer leftover items to the Defense Reutilization and Marketing Office; and (4) return items to the United States as a last resort. For materials in the Middle East, DOD is to (1) submit cancellation requests for any items on back order and no longer required or (2) assign items in storage to the responsible inventory control point for redistribution. Section 107 of Public Law 102-28 requires that virtually all materials be removed from the Middle East once hostilities cease. Items not eligible for return will be transferred to the Defense Reutilization and Marketing Office for disposal.

Proceeds From Sales of Property

DOD sells excess military weapons, equipment, usable material, and scrap to foreign and domestic consumers. During fiscal years 1988 through 1990, the value of disposed DOD property increased from nearly \$7 billion to almost \$12 billion (table I.9).

Table I.9: DOD Property Disposals for Fiscal Years 1988 through 1990

| Disposal method | Value of property | | |
|---|-------------------|----------------|-----------------|
| | 1988 | 1989 | 1990 |
| Intra- and inter-service transfers | \$1,248 | \$1,712 | \$1,753 |
| Transferred to other federal agencies | 117 | 251 | 217 |
| Donations | 293 | 290 | 331 |
| Foreign military sales | 12 | 19 | 46 |
| Sale of unusable property | 1,839 | 2,113 | 3,268 |
| Scrapped | 3,024 | 3,635 | 5,780 |
| Abandoned, destroyed, or used as target | 393 | 221 | 277 |
| Total | \$6,926 | \$8,241 | \$11,672 |

The amounts of disposed property include material other than secondary items; DOD does not maintain separate records on the disposal of secondary items.

For fiscal 1990, DOD reported that the property sold (foreign military sales and sales of usable and scrap property) was valued at \$9.1 billion (table I.9) and that the proceeds from those sales were \$138.5 million (table I.10), or 1.5 percent of the value.

**Appendix I
Cost Considerations for Inventory Decisions**

**Table I.10: Proceeds from Disposal
Sales for Fiscal Years 1988 through 1990**

Dollars in millions

| Type of sale | Proceeds from sales | | |
|-----------------------------------|----------------------------|----------------------------|----------------|
| | 1988 | 1989 | 1990 |
| Foreign military sales | \$0.7 | \$1.1 | \$1.0 |
| Sale of usable property | 49.6 | 61.3 | 65.3 |
| Sale of scrap | 57.2 | 77.2 | 72.2 |
| Subtotal | \$107.6^a | \$139.7^a | \$138.5 |
| Less authorized expenses | -35.2 | -59.6 | -48.5 |
| Deposited in U.S. Treasury | \$72.4 | \$80.1 | \$90.0 |

^aDoes not add due to rounding.

The value of the material is not the estimated resale value; DOD does not devalue items prior to disposal.

According to a DOD official, \$90 million of the proceeds was deposited in the U.S. Treasury and the remaining \$48.5 million was used to reimburse DOD for authorized operations and maintenance expenses incurred in the property disposal program.

Many factors contribute to the low rate of return. For example, excess property is first offered to DOD; other federal, state, and local agencies; and private organizations. According to DOD, the remaining property, which is offered for sale to the public, is usually in poor condition and of limited use to civilians.

Comments From the Department of Defense



PRODUCTION AND
LOGISTICS

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, DC 20301-8000

April 17, 1992

(L/SD)

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "DEFENSE INVENTORY: Cost Factors Used to Manage Secondary Items," dated February 18, 1992 (GAO Code 398051/OSD Case 8961).

The DoD has reviewed the report, and generally concurs with the findings. Suggested technical and clarifying changes were separately provided to your staff. Since the draft report was prepared, the DoD secondary item inventory, as of September 30, 1991, has been determined to be valued at \$88.1 billion.

The DoD appreciates the opportunity to comment on the GAO draft report.

Sincerely,

A handwritten signature in cursive script that reads "Colin McMillan".

Colin McMillan

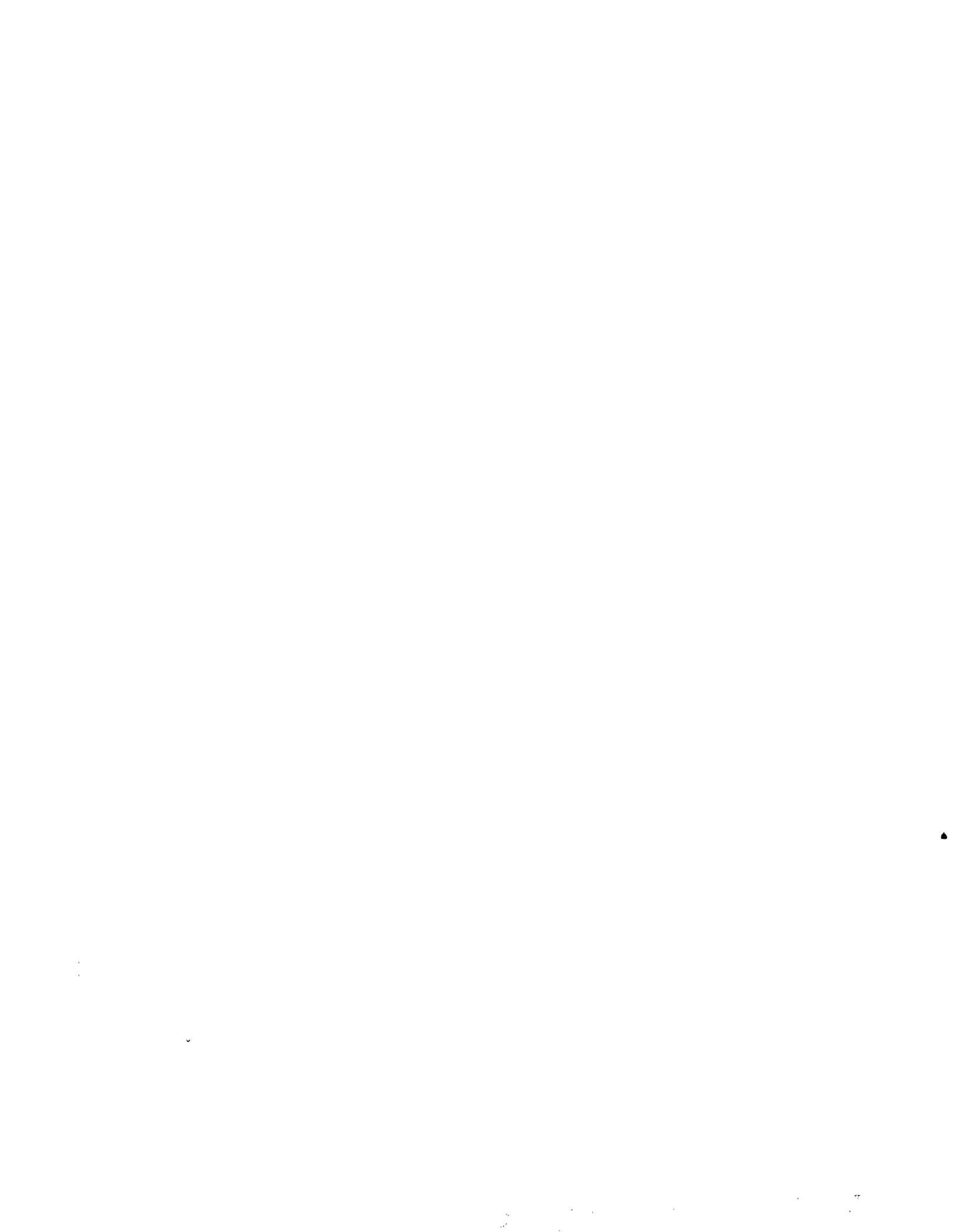
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