GH20-1240-0

System/3 Shop Loading and Control General Information Manual

Program Product

System/3 Shop Loading and Control General Information Manual

Program Number 5702-M51

System/3 Shop Loading and Control is designed to provide current information about production orders and facilities, which management needs to exert proper control over shop floor activity. This control is attainable by analyzing the projected load, determining the orders to be released to the shop, creating and maintaining records pertaining to these orders, and quickly accessing report information. System/3 Shop Loading and Control accomplishes these objectives by:

- Determining the required labor or machine hours necessary to meet a given set of order requirements
- Loading orders to infinite capacity
- Providing infinite load reports
- Providing for release of planned orders
- Preparing a shortage report when components for an order are not available
- Creating files containing open order information
- Preparing shop packets for released orders
- Updating pertinent files upon receipt of information from the shop floor
- Reporting the status of orders in the shop
- Providing priority assignment for shop operations and preparing the work list in priority sequence

This manual describes shop loading and control and provides information to enable the reader to determine the applicability of the program product to his operation and to begin planning for its installation. The audience includes executives, systems analysts, and programmers.

Program Product

First Edition (September 1972)

This edition applies to Version 1, Modification Level 0, of the program product System/3 Shop Loading and Control (5702-M51), and to all subsequent versions and modifications until otherwise indicated in new editions or Technical Newsletters.

Changes are continually made to the information herein. Therefore, before using this publication, consult the latest System/3 Bibliography (GC20-8080) for the editions that are applicable and current.

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PREFACE

This publication contains a brief introduction to System/3 Shop Loading and Control, followed by a discussion of the use of this program product with a production information and control system, a general description, and major advantages of the program product. The reader of this portion of the publication does not require a knowledge of data processing.

A more detailed discussion of the programs as they relate to the functions described in the general description section can be found in the section entitled "Processing Description". The files required in the data base to support this program product are described in the section entitled "Files and Organization". An extensive section on user responsibilities is included, as well as sections about timing and throughput, performance estimates, and control and audit procedures. There are separate sections on programming systems and minimum machine configuration.

The Appendix provides four tables which can be used as an aid to estimate the disk storage requirements for the files described in the section entitled "Files and Organization".

The Glossary contains definitions of terms used in this manual.

CONTENTS

INTRODUCTION

Some of the major problems of production control are caused by the lack of timely information regarding the status of production orders and the amount of work in process. It is important to know which orders are on time, which are behind schedule, where the jobs are at the present time, and the work centers in which they have to be processed. In addition, exceptional conditions such as work center overloads or material shortages should be highlighted for management action.

Many companies have thousands of orders at various stages of production. It is almost impossible to keep accurate, up-to-date records for these orders using manual systems. The major difficulties are the great volume of information that must be considered and the comparatively small amount of time available before a decision is necessary. The problems are further complicated by the uncontrolled flow of work through the plant. Late orders become later, and on-time orders become late. It is incumbent upon production control managers to control the input of orders committed to the shop. To do this they must be equipped with knowledge of the long-range effects of orders on the available facilities.

SYSTEM/3 SHOP LOADING AND CONTROL

System/3 Shop Loading and Control provides a group of programs which are designed to address two general requirements of manufacturers - the ability to (1) plan to capacity and (2) effectively release and control orders in the shop. Both of these topics and their relationship to shop loading and control will be discussed here. A list of terms used in this manual may be found in the glossary.

PLANNING TO CAPACITY

Capacity planning (which is sometimes referred to as master loading, master scheduling, long-range loading, or long-range order scheduling) refers to the balancing of men, material, and other resources against a material or requirements plan on a plantwide basis.

System/3 Shop Loading and Control is designed primarily for use by manufacturing managers, who ask questions like, "Can we expect these orders to be completed on time?", "Must we plan for additional facilities and resources?", and "How much subcontracting must we plan for?"

A system which plans capacity can be viewed as an extension of a requirements planning system. Resources required to meet the material requirements can be determined by loading the manufacturing facilities to infinite capacity.

System/3 Shop Loading and Control furnishes information regarding component, subassembly, and assembly requirements, as obtained from a system such as System/3 Inventory and Requirements Planning, far enough in advance for a user to take corrective action if necessary. This corrective action may take the form of postponing orders, purchasing additional equipment, hiring more men, transferring personnel, or altering the product mix.

RELEASE AND CONTROL OF ORDERS

In releasing and controlling orders for the shop, System/3 Shop Loading and Control considers three types of orders: planned, unplanned, and open.

Planned orders are those for which no resources (raw material, machines, manpower) have been committed. These orders are generated to meet future requirements based on projected demand. However, since projected demand normally varies from month to month, these orders may have to be regenerated to satisfy fluctuating demand.

Unplanned orders are those for which no future requirements are projected. These orders may be the result of unexpected customer orders, rework due to heavy scrap losses, or any unforeseen requirement. Users who do not require a formal planning system would only submit unplanned orders as input to this program product.

Open orders are considered to be released orders, and these two names therefore have identical meaning to System/3 Shop Loading and Control: they are orders for which resources (raw materials, components, etc.) have been committed. These orders are in progress; that is, the planned or unplanned order has become reality. Changes to open orders cannot be made without affecting the shop floor.

The transition from a planned or unplanned order to an open order is accomplished by the order release function of System/3 Shop Loading and Control. When planned orders are released they become open orders. Once the open order data files have been updated to reflect the change in status, the order is considered released, even though production may not yet have started.

An important phase of manufacturing is production control. Typically, an organization prepares a master schedule of planned orders on the basis of a forecast, customer orders, or a combination of the two. The infinite load report produced by System/3 Shop Loading and Control can be used to provide assurance that the work can be done in the time allotted. As production time approaches, the order release phase of System/3 Shop Loading and Control puts production activities in motion through the release of planned orders. For planned or unplanned orders to be released and converted to open orders, material availability must be verified and the necessary paperwork created to ensure that proper instructions and feedback documents are available to the shop floor. At this time, any conditions that cause a discrepancy between what actually exists and what was planned must be brought to management's attention so that corrective action can be taken.

Once open orders have been released to the shop, each manufacturing step must be monitored to ensure execution of the order as planned. Any changes in the order or other dependent orders, and any future plans affecting or affected by that order, must be determined so that management action can be initiated.

The result of this management action must be transmitted to the system. This is accomplished by allowing a manual input to the system which overrides conditions that have occurred or were established at the time the planned order became an open order. Typical examples of such manual input are entering an unplanned order, changing the start date of a planned order, or cancelling an open order.

Programs within System/3 Shop Loading and Control fall into five logical phases: infinite loading, order release, open order status and update, open order maintenance, and work list preparation.

Infinite loading consists of accumulating the required setup, labor, or machine hours by time period for each work center to produce the infinite load report for open and planned orders.

Order release consists of selecting planned orders with start dates that fall into a user-specified time period (release horizon) or processing unplanned orders to determine if sufficient components are available to complete the orders. If they are, the components are allocated or reserved for the orders. If the components are not available, they are reported on the material shortage report. Once allocation has taken place, open order summary and detail records are created. Shop packet information - consisting of a manufacturing routing, operation cards, move cards, material requisition cards, and a stock receipt card - is produced for each released order to accompany the order through the shop.

Open order status and update consists of updating the open order summary and detail files and the item master file with feedback information from the shop and printing open order status reports. Shop feedback information is entered into the system using the operation cards, move cards, material requisition cards, and stock receipt cards which were included in the shop packet. The open order status reports provide the user with information related to the current status of open orders released to the shop floor.

Open order maintenance consists of order completion and order change processing. Order completion processing tags open order summary records for deletion and deletes open order detail records for completed or cancelled open orders. Open order change processing consists of handling open order date/quantity changes and adding or deleting open order detail records.

Work list preparation consists of applying a priority to the remaining operations for open orders. The operations are then sorted into priority sequence within work center for preparation of a work list. The work list indicates to the work center foreman the operations that have the highest overall priority.

SYSTEM/3 SHOP LOADING AND CONTROL INTERFACE WITH A PRODUCTION INFORMATION AND CONTROL SYSTEM

Figure 1 shows the interface of System/3 Shop Loading and Control with a typical production information and control system.

On the basis of past demand, gross requirements of end items and replacement parts can be projected by the inventory planning phase of System/3 Inventory and Requirements Planning. Future requirements may be developed on the basis of intuition and experience, known customer orders, or a combination of these factors. These gross requirements furnish input to a requirements planning function such as System/3 Inventory and Requirements Planning.

The requirements planning function is thus provided with product demand in the form of order or forecast information. Product requirements are translated into gross requirements for parts and subassemblies by exploding and summarizing bills of material. Using the proper manufacturing lead time, component requirements are distributed over the proper time periods. The accumulated gross requirements for each item are checked against available stock (on hand and on order) to determine net requirements. Order quantities as well as required order start dates are then determined by the requirements planning function on the basis of net requirements. Item requirements normally purchased are sent to purchasing, and information for those items normally manufactured is sent to production planning and entered into System/3 Shop Loading and Control.

System/3 Shop Loading and Control works from order start dates for planned orders and due dates for open orders. Using standard times for each operation, it establishes an operation start date. The operation start date is used to load the setup and run hours for the order into each department and work center. Underload and overload conditions are determined as work center loads are accumulated. If the accumulated work center loads indicate severe overloads or underloads, the user can take corrective action such as subcontracting or revising order quantities.

System/3 Shop Loading and Control releases planned and unplanned orders on the basis of order start date and component availability. At the time the order is released, the open order files are updated to reflect the addition of the new records. As the order moves through its manufacturing cycle, shop feedback information must be posted to the open order files to ensure that they reflect the current status of the order. These open order files represent the current shop order information which is used in the calculation of the load in each work center.

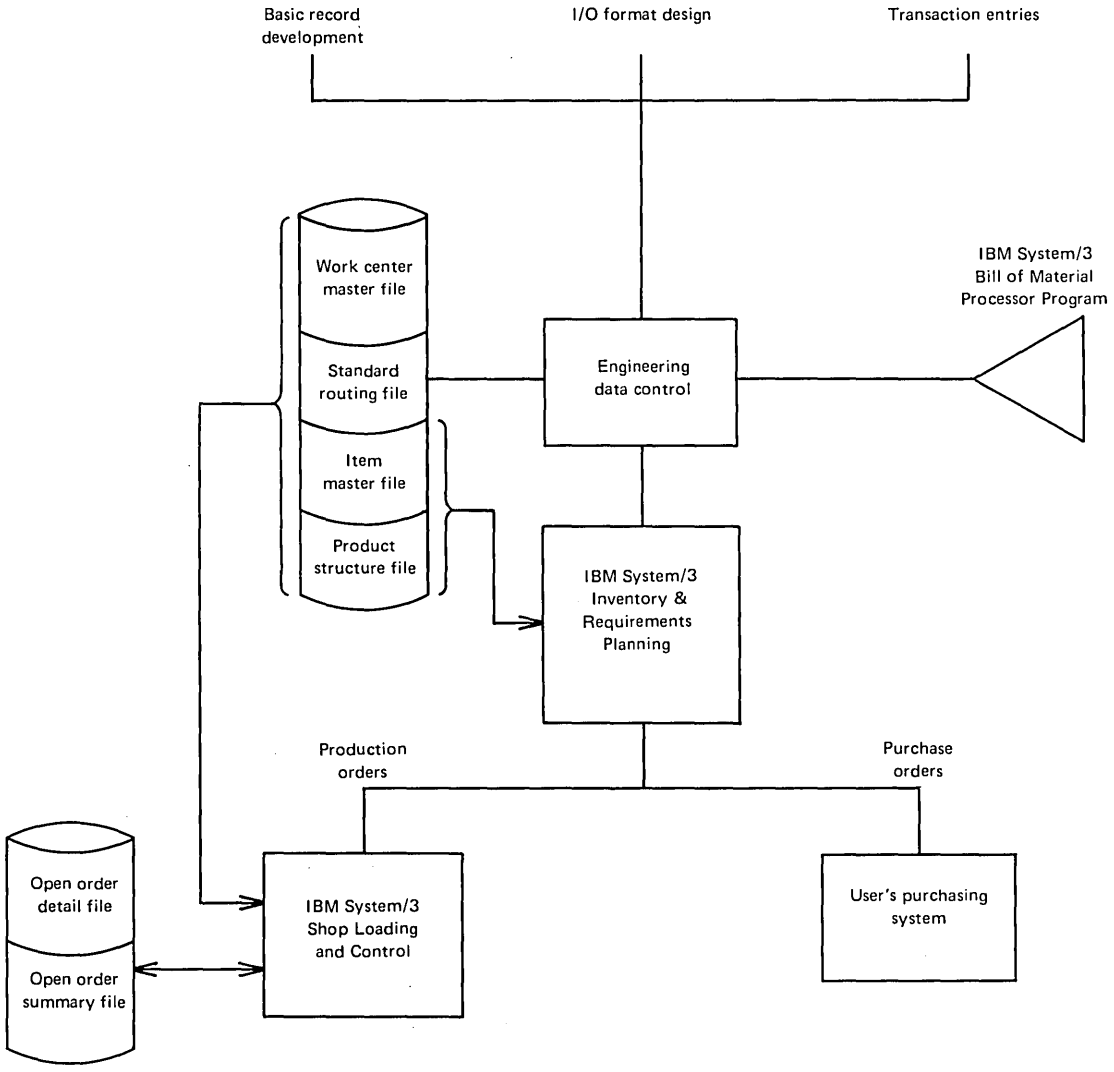


Figure 1. System/3 Shop Loading and Control interface with a typical production information and control system

System/3 Shop Loading and Control consists of five major phases: infinite loading, order release, open order status and update, open order maintenance, and work list preparation.

INFINITE LOADING PHASE

During the infinite loading phase, required setup, labor, or machine hours are accumulated by work center and time period, and the user is furnished with the infinite load report.

The infinite load report lists the resources required, based on planned orders as furnished by System/3 Inventory and Requirements Planning or an equivalent system and on open orders provided by this program product. An example of the infinite load report is shown in Figure 2.

The infinite loading phase is designed to answer such questions as:

"What machine and labor requirements are imposed by these orders?" This information enables the user to anticipate problems long before they occur.

"How can the load best be leveled?" Subcontracting order requirements or providing for overtime in order to meet delivery dates on finished items is not always economically desirable. The infinite load report by work center and time period provides information by which a user may reroute work or reschedule work to a different time period.

"What is the effect of accepting additional orders?" The infinite load report may indicate a high degree of underload. The user can thus decide how much additional work can be absorbed by the plant.

"What is the effect of altering the product mix?" A user may be interested in knowing the effect of emphasizing a more profitable portion of his product line. The infinite load report furnishes him with information regarding the effect on machines and labor of altering his product mix.

INFINITE LOAD REPORT SL&C MANUFACTURING COMPANY 03/28/-- PAGE 1

WORK CENTER - 000000000031
DESCRIPTION - MACHINE-SHOP-LATHE-2
LOCATION - L
PLANNING DATE - 431

PERIOD NUMBER	START DATE	DAYS IN PERIOD	NORMAL HOURS	MAX. HOURS	LOAD HOURS	PERIOD LOAD-TO-CAPACITY RATIO 0% 100% 200%	CUMULATIVE LOAD-TO-CAPACITY RATIO 0% 100% 200%
1	431	5	50.0	55.0	48.1	96 .XXXXXXXXXX	96 .XXXXXXXXXX
2	436	5	50.0	55.0	37.5	75 .XXXXXXXX	86 .XXXXXXXXX
3	441	5	50.0	55.0	28.4	57 .XXXXXX	76 .XXXXXXXX
4	446	5	50.0	55.0	10.5	21 .XX	62 .XXXXXX
5	451	5	50.0	55.0	27.0	54 .XXXXX	61 .XXXXXX
6	456	5	50.0	55.0	72.2	144 .XXXXXXXXXXXXXX	75 .XXXXXXXX
7	461	5	50.0	55.0	100.0	200 .XXXXXXXXXXXXXXXXXXXX	93 .XXXXXXXXX
8	466	5	50.0	55.0	65.7	131 .XXXXXXXXXXXX	97 .XXXXXXXXX
9	471	5	50.0	55.0	87.9	176 .XXXXXXXXXXXXXXXXX	106 .XXXXXXXXXX
10	476	5	50.0	55.0	85.9	172 .XXXXXXXXXXXXXXX	113 .XXXXXXXXXX
11	481	5	50.0	55.0	91.8	144 .XXXXXXXXXXXXXX	115 .XXXXXXXXXXX
12	486	5	50.0	55.0	35.7	71 .XXXXXXX	112 .XXXXXXXXXX
13	491	5	50.0	55.0	.0	0 .	103 .XXXXXXXXX
14	496	5	50.0	55.0	3.9	8 .X	96 .XXXXXXXXX
15	501	5	50.0	55.0	13.2	26 .XXX	92 .XXXXXXXX
16	506	5	50.0	55.0	6.8	14 .X	87 .XXXXXXXX
17	511	5	50.0	55.0	4.9	10 .X	82 .XXXXXXX
18	516	5	50.0	55.0	.0	0 .	78 .XXXXXXX
19	521	5	50.0	55.0	.0	0 .	74 .XXXXXXX
20	526	5	50.0	55.0	19.8	40 .XXXX	72 .XXXXXXX

Figure 2. Infinite load report

ORDER RELEASE PHASE

The order release phase of System/3 Shop Loading and Control encompasses the creation of the necessary machine-readable records and printed information required to release most manufacturing orders.

Order release is initiated by extracting from the item master file those planned orders that have start dates which fall within a user-specified time span or by reading unplanned order cards.

Unplanned orders are those that are not generated by a formal planning system. They include orders resulting from an order point recommendation triggered when an item's inventory balance falls below a preestablished order point as a result of an inventory transaction, or rush orders that are required because of unplanned situations.

Within the order release phase, it is possible to modify and override existing conditions. Through the use of the planned order update card, planned order dates and quantities can be revised at any time. This capability is desirable in that it allows the user to react to daily changes. For example, a planned order not due to be released in the current release horizon may have to be released as soon as possible because of a change in customer commitments.

Included in the processing of the order release phase is a check of the availability of all of an item's components. The component availability check ensures that sufficient components of an item are available to produce the order. This tends to eliminate unnecessary machine queues and keep the work-in-process inventory at the lowest possible level in relation to the amount of work released to the shop.

Component availability for each planned or unplanned order is checked in the following manner. A single-level explosion is performed on the ordered item to access the component chain of records in the product structure file. The item master for each component of the ordered item is accessed from information in the product structure record. The on-hand balance of each component in the component item master record is tested to determine whether there is enough on hand to meet the requirement of the planned order. If the component's on-hand balance is not sufficient, further tests are made to determine whether an open order or even a planned order will be available in time to satisfy the requirement. When determination has been made that all components are or will be available, the amount of the component required by the order to be released is allocated or reserved. The planned or unplanned order is now considered released, that is, the original planned order is deleted and an open order is created. If there are not enough components to produce the order, it is not released, and a material shortage report entry is generated for that order giving the inventory position of each component for the ordered item. An example of the material shortage report is shown in Figure 3.

MATERIAL SHORTAGE REPORT — SL&C MANUFACTURING COMPANY — 3/30/-- PAGE 1

ITEM NO. A3425 TANK COVER ASSEMBLY START DATE 471 DUE DATE 486 ORDER QTY 100

COMPONENT NO.	REQ DTE	REQ QTY	ON HAND	ALLOC QTY	PROD QTY	PURCH QTY	OPEN ORDERS DTE	OPEN ORDERS QTY	OPEN ORDERS DTE	OPEN ORDERS QTY	OPEN ORDERS DTE	OPEN ORDERS QTY	PLANNED ORDERS	
03524	471	100	100	600			461	200	471	200		0	0	SHORT
03584	471	100						0		0		0	200	
03595	471	200	200	100	50	50								
03625	471	200						0		0		0	200	
03675	471	100	200	100	0	0								

Figure 3. Material shortage report

MANUFACTURING ROUTING SL&C MANUFACTURING COMPANY 03/28/-- PAGE 1

ITEM NUMBER	DESCRIPTION	ORDER NUMBER	ORDER QUANTITY	START DATE	DUE DATE
2700006-00	TANK TOP	000100	500	100	125

OPERATION NUMBER	ROUTING DESCRIPTION	WORK CENTER	SETUP HOURS
0010	ROUGH MILL	000000000031	1.5
0020	TURN OUTSIDE DIA	000000000035	.5
0030	CONTOUR INSIDE	000000000041	1.0
00400	BORE CONTERBORE	000000000038	.5
00401	TURN INSIDE DIA	000000000030	.5
00402	DRILL	000000000034	1.0
0050	SLOT ALL SLOTS	000000000036	2.0
0060	FINISH MILL	000000000031	1.5
0070	PART NO AND INSPECT	000000000001	1.0

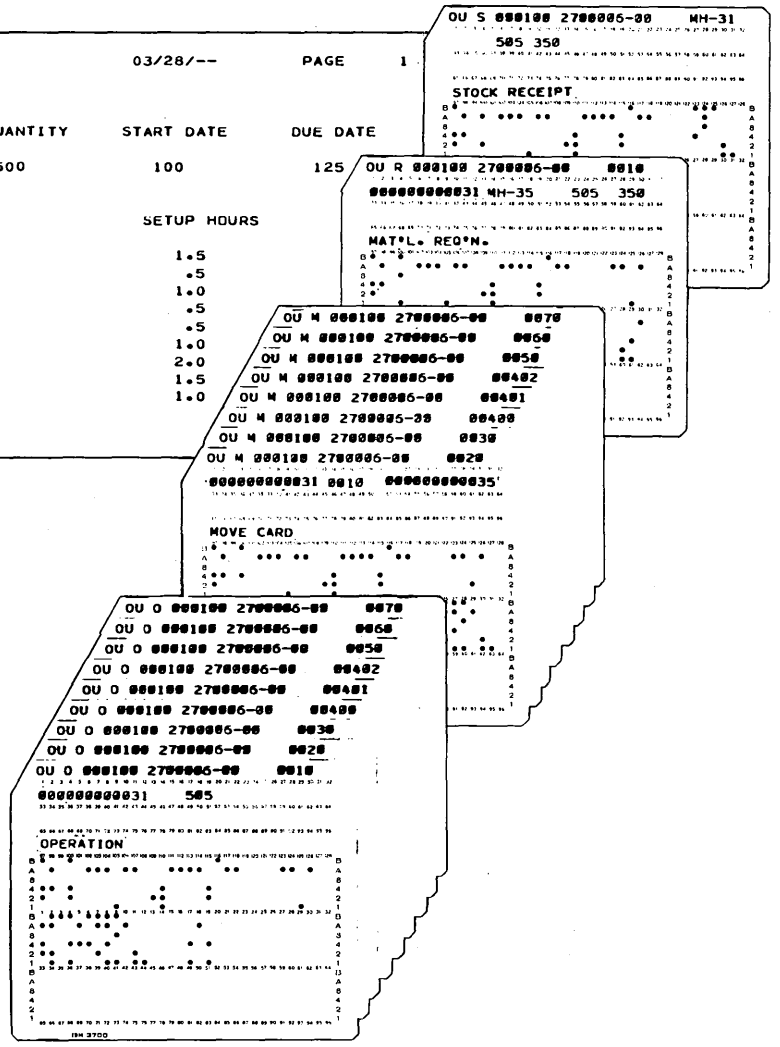


Figure 4. Shop packet information

Only those planned or unplanned orders for which sufficient components are available, or for which the availability tests are overriden, continue through the order release phase. Open order information is created and a sequential order number is assigned for each released order, and the necessary machine-readable records are added to the data base. These records consist of an open order summary record, and open order detail records which are created for the operations to be performed on the open order. The operation information to create the open order detail record is extracted from standard routing records for the ordered items. The open order summary record is linked to the item master record and each open order detail record is linked to its open order summary record. This technique of linking data files provides simple and rapid access to the information.

The last function is the creation of data to be included in a shop packet for each order. The shop packet data - consisting of a manufacturing routing report and operation, move, material requisition, and stock receipt cards - is produced to accompany the order through the shop. These cards are subsequently used to update the status of the order as it progresses through the production facilities. A further discussion of the shop packet cards is included in the section entitled "Open Order Status and Update Phase". An example of the information generated for the shop packet for each order is shown in Figure 4.

OPEN ORDER STATUS AND UPDATE PHASE

This phase updates the open order data base with shop packet cards and extracts information from the data base to produce status reports.

Open order updating modifies the open order data base by processing the material requisition, operation, move, and stock receipt cards that accompany the open order in the shop packet. These cards are used to update the open order files to reflect the actual progress of orders on the shop floor.

The status reports are produced on the basis of an inquiry card which can specify multiple formats. The reports produced include:

- Order summary information by order
- Order detail operations by order
- Open order and open order detail operations by item
- Item information including open orders, planned orders, and gross requirements by item

Two examples of order status reports for order detail operations by order and item information are shown in Figure 5.

ORDER STATUS REPORT BY ITEM — SL&C MANUFACTURING COMPANY — 03/28/-- — PAGE 1

ITEM NUMBER	DESCRIPTION	TYPE	ON HAND	SAFETY STOCK	ALLOCATED	ORD.POLICY	LEAD TIME
2700006-20	TANK	1	75	25	0	D	20

GROSS REQUIREMENTS

DATE	67	77	87
QTY	222	1,000	500

PLANNED ORDERS

DATE	57	67
QTY	1,000	500

OPEN ORDERS

ORDER NUMBER	ORDER STATUS	SCHEDULED START DATE	ACTUAL START DATE	DUE DATE	ORDER QUANTITY	CURRENT OPERATION NUMBER	CURRENT OPERATION WORK CENTER
000090	40	40	50	60	250	0020	000000000021
000150	10	57	0	77	850		

ORDER STATUS REPORT BY ORDER — SL&C MANUFACTURING COMPANY — 03/28/-- — PAGE 1

ORDER NUMBER	ITEM NUMBER	ORDER DESCRIPTION	ORDER STATUS	SCHEDULED START DATE	ACTUAL START DATE	DUE DATE	ORDER QUANTITY	CURRENT OPERATION NUMBER	CURRENT OPERATION WORK CENTER
000110	2700006-00	TANK TOP	10	458	458	483	50	0040	000000000038

OPERATION NUMBER	OPERATION DESCRIPTION	OPERATION STATUS	START DATE	SETUP HOUR	RUN HOURS	COMPLETION DATE	COMPLETION QUANTITY	WORK CENTER
0010	ROUGH MILL	50	458	1.5	3.0	460	50	000000000031
0020	TURN OUTSIDE DIR	50	460	.5	4.0	462	49	000000000035
0030	CONTOUR INSIDE	50	462	1.0	3.5	465	49	000000000041
0040	BORE COUNTER BORE	40	465	.5	5.0	0	0	000000000038
00401	TURN INSIDE DIA	00	0	.5	6.5	0	0	000000000030
00402	DRILL	00	0	1.0	7.0	0	0	000000000034
0050	SLOT-ALL SLOTS	20	0	2.0	4.0	0	0	000000000036
0060	FINISH MILL	10	0	1.5	3.5	0	0	000000000031
0070	PART NO AND INSPECT	10	0	1.0	5.0	0	0	000000000000

Figure 5. Open order status reports

OPEN ORDER MAINTENANCE PHASE

The open order maintenance phase of System/3 Shop Loading and Control provides an accurate open order data base for all open orders in the manufacturing cycle.

Order completion processing is performed once the user has indicated that orders are completed or cancelled. The open order summary records are tagged for deletion, and open order detail records for the completed or cancelled order are deleted.

Open order change processing provides the necessary mechanics to change the date and/or quantity of an open order. An open order can be cancelled by changing the order quantity to zero. The capability of splitting open orders is also provided. Order splitting may become necessary when an existing open order falls below the acceptable scrap loss or when a portion of an order must be expedited to alleviate a shortage of components in an assembly area. Open order maintenance also provides for adding or deleting operations for an open order, by adding or deleting the proper operations in the open order detail file. This may be required when shop supervisory personnel determine that more or fewer operations are required. All essential information about additional operations is entered via card input.

WORK LIST PREPARATION PHASE

The work list preparation phase of System/3 Shop Loading and Control provides a work list for shop personnel. Included in the work list preparation function is the creation of a work list file that contains records of all the remaining operations on each open order that can be started or completed within a user-specified time span called the work list horizon. A priority is applied to these operations by one of three

different priority calculation techniques. A program exit is provided to allow the user to insert his own priority technique.

The work list file records are then sorted by priority within work center. The work center master file, used to obtain specific work center information, and the sorted work list file records provide the data for the generation of the work list report. This report can be used by the shop personnel to sequence their work, giving consideration to the operations identified as critical on the basis of the assigned priorities. Refer to Figure 6 for an example of the work list report.

WORK LIST REPORT — SL&C MANUFACTURING COMPANY — 3/28/-- PAGE 1

WORK CENTER 002000210530
DESCRIPTION D. MACHINE SHOP-LATHE
LOCATION 005
SHOP DATE 201
PRIORITY AVERAGE TRANSIT TIME

STATUS CODES
10 - ACTIVE
20 - CAN BE STARTED
30 - LABOR REPORTED
40 - LABOR COMPLETED
50 - MOVE COMPLETED

ORDER		OPERATION			SETUP	RUN	ORDER	PREVIOUS OPERATION			NEXT OPERATION		
NUMBER	ITEM NUMBER	NUMBER	STATUS	PRTY	HOURS	HOURS	QUANTITY	NUMBER	ST	WORK CENTER	NUMBER	ST	WORK CENTER
000160	A3425	0020	40	1.2	5.0	10.0	350	NONE			0030	10	002000210530
000170	2700006-20	0020	20	1.6	5.0	25.0	200	0010	50	001680000215	0030	10	002000210530
000150	A3640	0020	20	2.0	2.0	15.5	80	0010	50	001730216200	0030	10	004500125012
000263	2900312-15	0020	20	2.4	1.5	16.0	300	0010	40	003201000250	0030	10	004500125012
000160	A3425	0030	20	2.6	1.5	20.0	350	0020	40	002000210530	NONE		
000368	A7314	0030	20	2.8	.5	12.5	72	0020	20	003201000250	0040	10	005503100000
001036	3600113-20	0030	10	3.1	.8	36.0	520	0020	20	019502080000	NONE		
001152	7410036-15	0030	10	3.8	1.0	19.0	250	0020	20	020002074000	0040	10	006202000011

Figure 6. Work list report

ADVANTAGES

System/3 Shop Loading and Control provides the following advantages:

1. Long-range planning for facilities and manpower.

   Requirements for future machine or labor hours are furnished by work center. A user is thus provided with information to make the necessary decisions to take corrective action.

2. Maintenance of up-to-date planned order status on the item master file.

   Planned orders and component gross requirements are updated as a result of changes that have been initiated by user input.

3. Availability check before allocation.

   Before a planned order is released, the components of the item are checked for availability. This check includes the component's on-hand quantity minus the quantity previously allocated plus those open and planned orders that will be available in time to meet the requirement. The components are then allocated for this order.

4. Automatic release of planned or unplanned orders.

   Planned or unplanned orders are released when sufficient component quantities are available. Release includes creation of open orders in the item master file (and deletion of planned orders) and creation of open order summary and open order detail records.

5. Material shortage report.

   For those planned and unplanned orders that cannot be released, a material shortage report is issued showing the required quantity and current inventory position of each component, including on-hand, allocated, open orders, and planned orders. With this information, decisions can be made pertaining to the subsequent release of the orders.

6. Open order data file creation and maintenance.

   The open order summary and open order detail files are created and maintained by System/3 Shop Loading and Control. These data files are the equivalent of a work-in-process file.

7. Shop packet creation.

   Data which can be inserted in a shop packet, including a manufacturing routing and operation, move, material requisition, and stock receipt cards, is generated for each release order.

8. Production information and control system compatibility.

   System/3 Shop Loading and Control may be used to release the planned orders created by System/3 Inventory and Requirements Planning. In addition, it provides open order maintenance for that program product.

9. Flexible input capabilities.

   The system design provides the capability to manually interact with programs through the use of data cards. These include the unplanned order card to release rush orders, order point orders, and planned orders outside the normal release horizon. In addition, planned and open order dates and quantities can be changed and open order detail records can be added or deleted.

10. Order status report capability.

    Multiple reports are produced to provide the user with complete information as to the status of released orders.

11. Order update capability.

    The open order summary, open order detail, and item master files are updated, using the shop packet data cards which reflect the actual production status of each order on the shop floor.

12. Work list report.

    The work list report lists the operations to be completed in priority sequence for each work center. With this report it is possible to initiate a shop discipline that reflects a prescribed sequence in which the operations should be performed.

PROCESSING DESCRIPTION

A processing description follows for the programs in each phase of the program product. The input and ouptut files required by each program are discussed.

INFINITE LOADING PHASE

The purpose of the infinite loading phase is to accumulate loads by time period for each work center for all planned and open orders in a user-specified planning horizon and to produce an infinite load report.

The programs in the infinite loading phase are system run file creation, system run file sort, infinite load, and infinite load report. The system flow of the infinite loading phase is shown in Figure 7.

SYSTEM RUN FILE CREATION PROGRAM

The input to the system run file creation program consists of a parameter card and a work center master file. The parameter card provides such information as the shop date limits of the planning horizon, the number and size of the time periods within the planning horizon, and information which can be included on the infinite load report. Work center data required for the accumulation of the load hours for each work center is extracted from the work center master file.

The parameter card is read and the user-supplied parameters are stored on the system run file. Work center data is extracted from each work center master record and stored in work center records following the parameter record on the system run file. The work center records are also used to store accumulated load information by time period for the number of periods specified in the parameter card. An audit list is provided which shows pertinent work center information.

SYSTEM RUN FILE SORT

The System/3 Disk Sort program is used to arrange the work center records on the system run file in the proper sequence for input to the infinite load program.

INFINITE LOAD PROGRAM

The item master file, standard routing records, open order summary record, and system run file are input to the infinite loading program. The work center records in the system run file are updated with the loads generated as a result of the infinite load processing. The item master file is read consecutively and examined for planned or open orders. For each open order found, the open order summary record is accessed by the order number key contained in the item master record to determine which operations have not been completed so that they can be included in the load accumulation. The standard routing records for the item are accessed by the relative record number in the item master record for all open and planned orders with shop dates that are in the planning horizon. Completed operations are bypassed. The standard hours are extended by the order quantity to arrive at the machine and/or labor hours required for each operation.

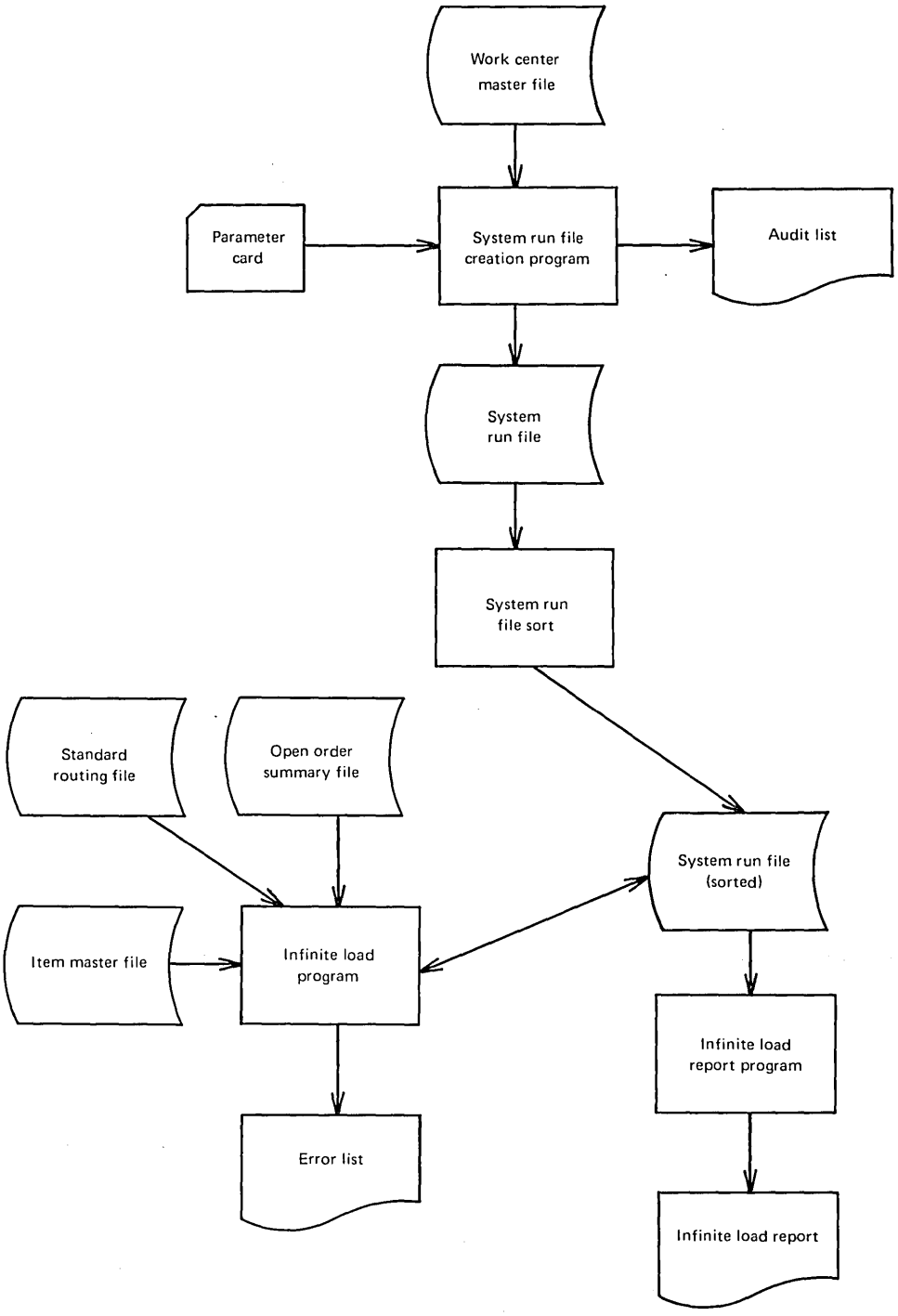


Figure 7. Infinite loading phase system flow

To determine the time period in which machine or labor hours are to be loaded, operation start dates are calculated for each order. Operation duration and transit times must be calculated in order to determine operation start dates.

Operation Duration

Operation duration is that part of a shift or number of days required to perform an operation. For example, an operation which requires 16 hours of machine time may be performed in two days on a one-shift basis. Operation duration in this case is two days. On a two-shift basis, operation time is one day. The program makes use of shift data contained on the system run file. Operation duration is calculated on the basis of:

- Setup time. This is the preparation time in tenths of hours specified in the standard routing record for the operation.
- Run time. This is the time in tenths of hours required to perform the operation. Generally it is determined by multiplying the order quantity by the standard machine and/or labor time for each unit quantity in the order.

Transit Time

Transit time is the physical transportation time between successive operations and can vary from many hours to no time.

The total transit time for the order is calculated from the transit time for each operation in the standard routing record or from one of two values in the program which are initialized by the user if transit time is not provided in the standard routing file. One value for transit time is for operations performed within the same work center, the second for operations not performed in the same work center.

Load Accumulation

For calculation of operation start dates, the order start date for planned orders and the due date for open orders stored in the item master file are used. For open orders, the start date of the current operation is obtained from the date in the open order summary file.

Once the transit times have been calculated, a start date for each operation of each order is determined. The infinite load program subsequently uses this date for accumulating load hours by period and work center.

During load accumulation, it is the function of the infinite load processing to place the operation load hours into the proper time period in the pertinent work center record of the system run file. This requires a knowledge of the operation start date and duration, and specification by the user of the start date and end date of each time period. The load hours for operations with extremely long durations are apportioned into more than one period, depending upon the part of the operation falling into a time period.

Varying Time Period

The system loads operation durations into the proper time periods in the work center records of the system run file. To provide flexibility in planning, short-range and long-range time periods may be specified in the parameter card.

For long-range facility planning purposes, these time periods may be 20 or 30 days. For short-range planning, it is desirable to obtain load reports for shorter time periods. The user specifies the number and size of the time periods desired, for example, 8 time periods of 5 days and 10 time periods of 20 days.

INFINITE LOAD REPORT PROGRAM

The infinite load report is produced from the load information contained in the work center records of the system run file.

The infinite load report shows the accumulated load by time period for each work center. The short- and long-range periods specified by the user are reflected in the infinite load report. The report displays each work center load and highlights overloaded and underloaded conditions. Refer to Figure 2 for an example of the infinite load report.

ORDER RELEASE PHASE

The purpose of the order release phase is to (1) determine which planned and unplanned orders can be released to the shop, (2) update existing files in the data base to record the release of the orders, (3) create new records in the data base to store status information about the order, and (4) create shop paper to accompany the released orders through the manufacturing facility for the purpose of reporting their progress during production. An open order summary record, which contains information about the ordered item, and a number of open order detail records, one for each manufacturing operation to produce the order, are created for each released order. These two types of records, with the necessary data included and with timely and accurate updating from shop feedback transactions, are computer representations of work in process. An inquiry into these files for information about an order should be comparable to going directly to the shop floor.

The programs of the order release phase are planned order update, planned order extract, component allocation, order release, material shortage report, open order detail creation, open order detail addition, and shop packet creation.

Figure 8 shows the system flow of the programs of the order release phase. The planned order update program and the planned order extract program would not be utilized by users who do not require a formal system for generating planned orders. These users would utilize the unplanned order card file in the component allocation program to initiate the release of unplanned orders.

PLANNED ORDER UPDATE PROGRAM

The purpose of the planned order update program is to update the item master file with the changes made in planned order start dates and quantities, using the planned order update card. The planned order update card contains the start date of the planned order that resides on the item master file which is to be revised, and the revised date or quantity. An existing planned order can be cancelled by entering a revised quantity of zero. New planned orders cannot be entered. Component gross requirements that are generated as a result of planned orders for parent assemblies must also be updated to reflect the latest planned order start date and quantity changes. This is extremely important for the order release function in System/3 Shop Loading and Control as well as for the requirements alteration processing option in System/3 Inventory and Requirements Planning.

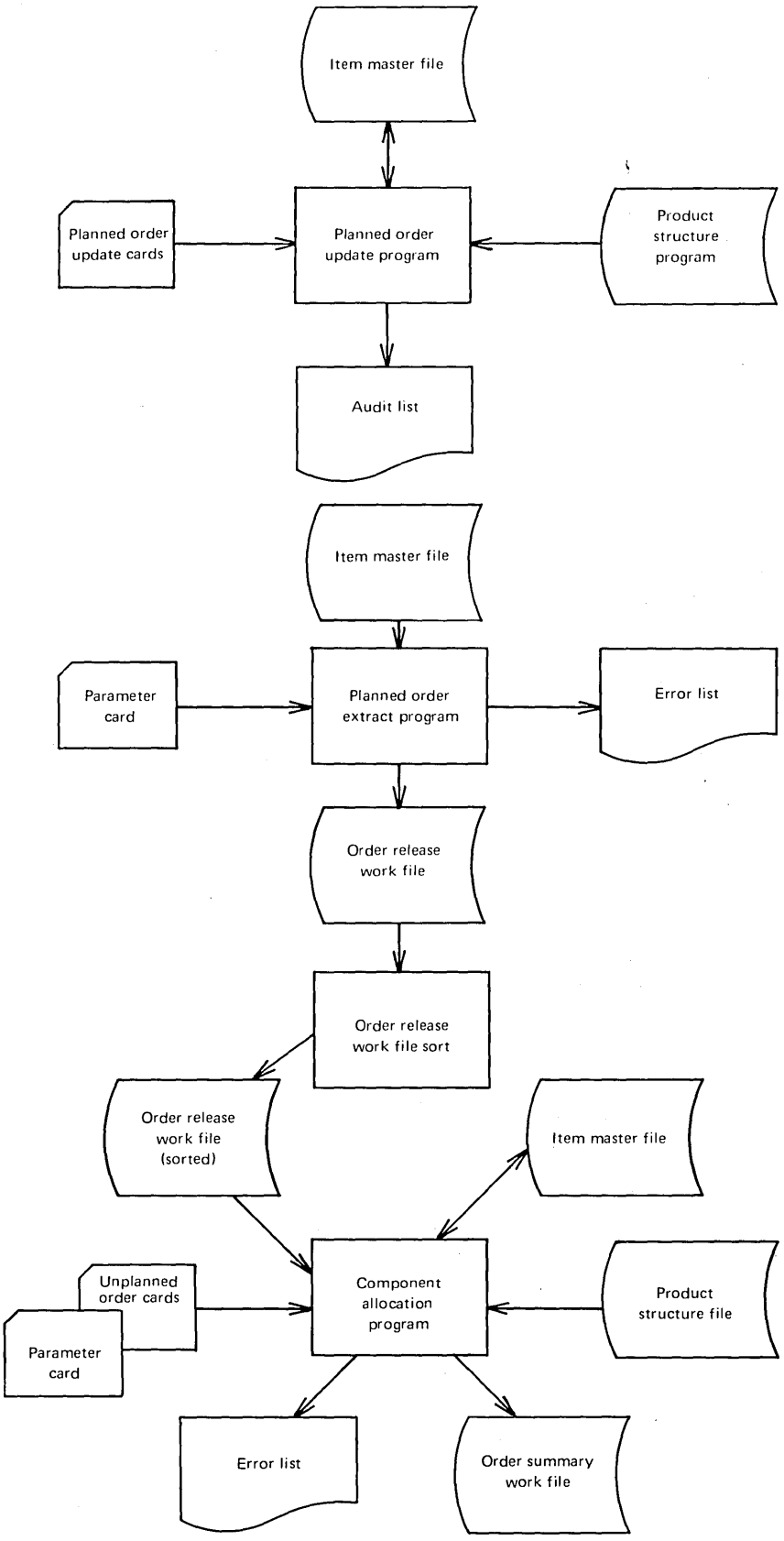


Figure 8. Order release phase system flow (Part 1 of 2)

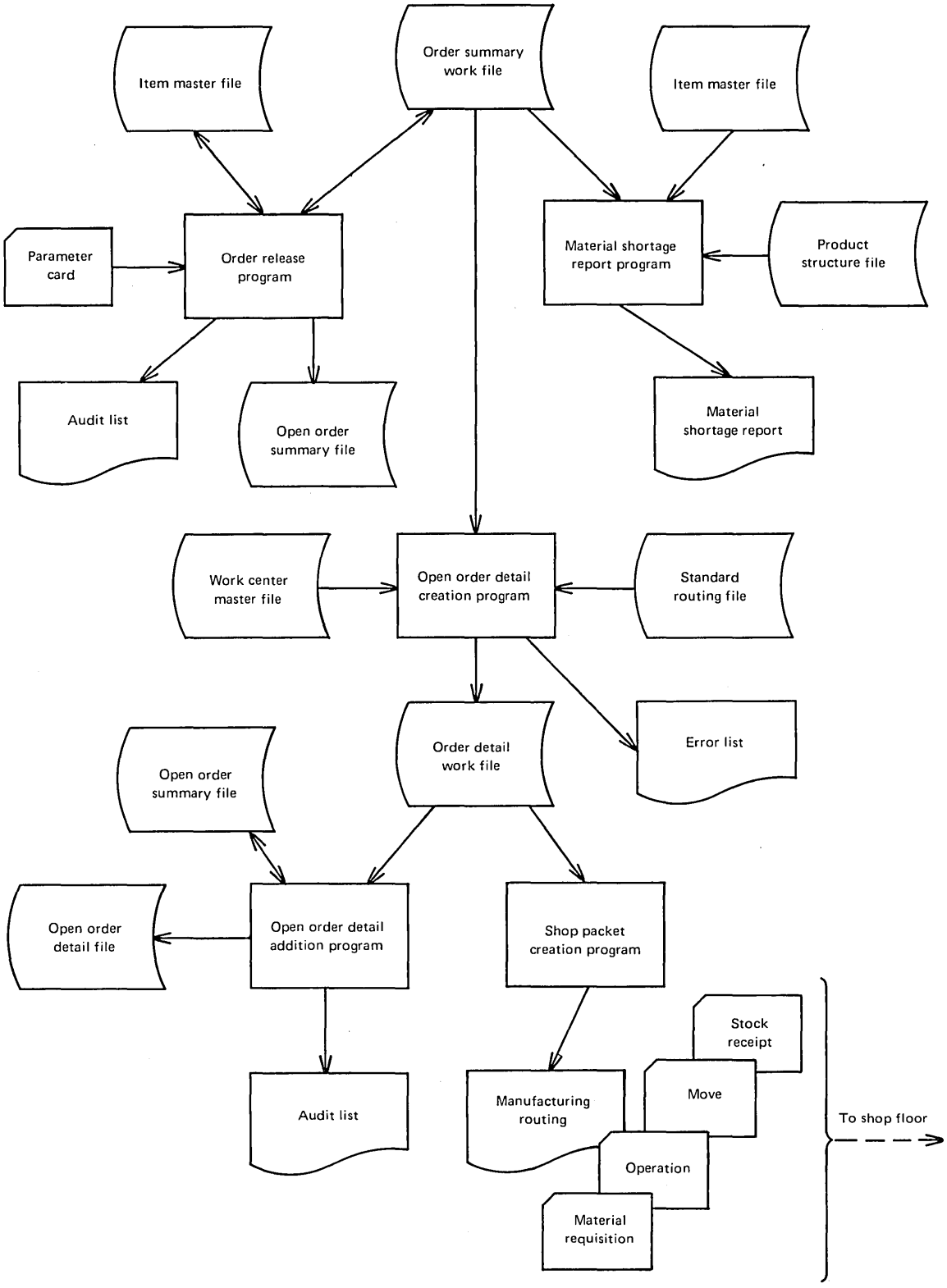


Figure 8. Order release phase system flow (Part 2 of 2)

PLANNED ORDER EXTRACT PROGRAM

The purpose of the planned order extract program is to determine which planned orders stored in the item master file should be considered for release to the shop. Item information for planned orders selected for release is extracted from the item master file and written on a work file for further processing in the order release phase.

The input to the planned order extract program consists of a parameter card, the item master file, and the product structure file. The parameter card is used to input the release horizon date which limits the number of planned orders extracted for release consideration. The item master file contains the planned orders and gross requirements that were created by System/3 Inventory and Requirements Planning or an equivalent system.

Extraction of Planned Orders

The primary function is to extract planned orders based on the release horizon date. The user specifies in the run parameter card the release horizon shop date that represents how far into the future the planned orders on the item master file are to be extracted. It is suggested that the release horizon date be sufficient to cover enough planned orders to provide an adequate backlog of work for the shop until the next execution of the program. If this program is executed every five days, the release horizon date should be seven to ten days from the program run date.

Order Release Horizon

Any planned order with a start date within the order release horizon is subject to release. For example, assume the order release horizon is ten days in the future. All orders that have a start date that falls within ten shop days are subject to release. The order release horizon can be used to regulate the amount of work that is placed on the shop floor. It can be lengthened or shortened to allow more or less work to be released. The order release horizon should be far enough in the future to allow time for preparation of shop paperwork and engineering drawings. However, because releasing an order causes component material to be allocated or reserved, an order should not be released so far in advance that it causes unnecessary reservation of material.

Allocation Priority

Ideally, all the components for the ordered item would be available. But, because of many external conditions that occur after inventory control and requirements planning--for example, machine breakdowns, changes in order size, and late deliveries--such is not the case. Therefore, the orders on the order release work file must compete for the component parts that are presently available. In order to compete, all orders that have been extracted for release could be given an allocation priority. A user exit is provided in the program for this purpose. The priority value might be developed from the cost or the lead time of the item. The priority determines the sequence in which the orders will be checked for component availability in the component allocation program.

The output of the planned order extract program is the order release work file, which contains one record for each planned order with a start date within the order release horizon. These records represent all the planned orders that should be considered for release for the current release horizon.

ORDER RELEASE WORK FILE SORT

The order release work file should be sorted to arrange the records into the most desirable sequence for component availability check processing by the component allocation program. One such sequence is to sort the records by priority (if calculated) within start date sequence. If the sort is not performed, the order release work file records remain in item number sequence. The sort can be performed using the System/3 Disk Sort program.

COMPONENT ALLOCATION PROGRAM

The component allocation program determines whether all components are available for each planned order extracted for release, or for any unplanned orders which may be input to this program. If components are available, the order can be released and allocation of the components of the released order is performed to effectively reserve the components for the order. If any component is not available, the order is not released and an exception record is written on the order summary work file. This file is subsequently processed by the material shortage report program.

The input to component allocation processing can be planned orders on the order release work file or unplanned order cards which are provided for order point orders, rush orders, or any other type of order not included in a formalized planning method. Rush orders could be for items that are normally planned but due to time limitations cannot be processed through the planning phase of the sytem.

It is important to differentiate between order point orders and planned orders. Order point orders are generated as a result of the physical reduction of inventory to or below an order point. Therefore, there are no time series planned orders, open orders, or gross requirements in the item master records for these items.

Two options are available in the processing of unplanned orders. The first is to permit the release of an unplanned order regardless of component availability. This option allows the user to override the program when necessary. The second option is used in connection with the technique for splitting an open order. Open orders can be split in the open order change program of the open order maintenance phase by reducing the order quantity and entering unplanned orders for the difference between the original quantity and the reduced quantity. The component availability check and allocation are bypassed when this option is used, as that processing was performed on the original order. Refer to the open order change program for more information.

Component Availability Check

Regardless of type of input, order release work file or unplanned orders, the component availability check is essentially the same. The sequence of the input orders determines which orders compete first for common components. The item master and product structure files are required input files.

For each planned order subject to release, determination is made as to whether the order requires components. If components are required, the product structure records are used to perform a single-level explosion and determine the component requirements necessary to fill the order quantity. The explosion is similar to that performed in System/3 Inventory and Requirements Planning and therefore provides for product structure lead time adjustment.

For each component, the available on-hand position is first determined by subtracting the allocated quantity from the on-hand quantity. Safety stock is considered a portion of on-hand quantity that is available for use. The available on-hand quantity is compared with the component requirement needed to satisfy the order. If the on-hand quantity covers the component requirement for this order, the next component is checked. If not, open orders of the component are checked to determine whether any due date is earlier than the component requirement date. If so, the open order quantity is compared with the remaining component requirement to determine whether sufficient material to satisfy the requirement is on order. If sufficient material is available, the next component is checked. If not, planned orders for the component are then retrieved if the on-hand and open order position of the component will not satisfy the order requirement. For each component planned order that is reviewed, the determination is made as to whether the planned order will be completed prior to the time it is needed. If the planned order will arrive in time, the order quantity is compared with the remaining component requirement. If the component requirement is covered, an indication is made and the next component is accessed. If there is not sufficient material available, an exception record is written on the order summary work file and the next order release work record or unplanned order is accessed. For components that are order point items, which do not have time series open orders, the total on-order manufacturing quantity field is used to determine material availability.

Availability Tolerances

To provide for realistic material availability checking, two tolerances that can be used singly or in combination are provided. The first tolerance is expressed as the percentage of the component's requirement that must be available by the requirement date. The tolerance percentage is applicable to all orders released. For example, if the tolerance percentage is 95%, 95% of the component requirement must be available before the order is released. The second tolerance is expressed in shop days and is applicable to all components of all orders subject to release. This tolerance is used when the component's open orders and planned orders are being reviewed for component material availability. In this situation, the time tolerance is used to relate the component's open order due date and/or planned order due date with the date that the component is required. Assume that the time tolerance is three days and the component requirement must be satisfied by shop day 205. If an open order for this component is due on day 207 and the time tolerance of three days is applied, the open order is assumed to be available in time to fully satisfy the order requirement. It is suggested that the time tolerance be carefully selected and not be greater than one half of the time period that is being used in requirements planning.

For each order being reviewed for component availability, determination of two conditions occurs. These conditions determine subsequent processing. If all components for this order are available, component allocation is performed and a summary work record is written on the order summary work file. Information is printed on the audit list for the released order represented by the summary work record. If any component for this order is not available, the order is not released and an exception record for this order is written on the order summary work file.

Allocation of Components

As each order is processed, for those components that are time series planned (not order point) the gross requirements are reduced by a total that is the quantity of the released order multiplied by the component quantity per assembly field (in the product structure record). For all components, time series planned or order point, the allocated quantity field is increased by the amount required for this order. A requisition record for each component is written on the order summary work file. For unplanned orders that are being released regardless of material availability, a code in the requisition record indicates whether or not material is available.

The output of the component allocation program is the order summary work file, which is used by the order release, material shortage report, and open order detail creation programs.

ORDER RELEASE PROGRAM

The order release program creates an open order summary record, assigns an order number, and maintains the open order data in the item master record for released orders.

The order summary work file is read consecutively. This file contains summary records followed by requisition records for those items to be released and exception records for those items which must be included on the material shortage report. The exception records are ignored by this program but are read by the material shortage report program.

Open Order Summary Record Creation

When a summary work record is encountered on the order summary work file, a record is added to the open order summary file for this item and the order is considered to be released. The planned order start date and quantity are deleted, and an open order due date and quantity are added in the item master record. This applies only to time series planned items. For unplanned orders other than order point orders that are released, only the open order date and quantity fields are added to the item master record. If the released order is for an order point item, the total on-order manufacturing quantity field in the item master file is updated.

Order Number Assignment

System/3 Shop Loading and Control assigns a sequential order number to open orders. This sequential order number must be used; a user-assigned order number can be used only in addition to this number. The open order number and all additional information required in the open order summary record are assembled and the record is written on the open order summary file. All open orders for each item are chained to the corresponding item master record. That is, the item master record contains the order number key of the most recent open order summary record for that item, and that open order summary record contains the order number key of the next most recent open order for that item, and so forth to the end of the chain. The order number key of the newly released open order is placed in the item master record, and the order number key of the most recent open order in the item master record is placed in the open order summary record being constructed in the work area. The order number is also added to the summary work record in the order summary work file.

The output of the order release program is the updated open order summary file, which now contains records for the newly released open orders and the updated order summary work file.

MATERIAL SHORTAGE REPORT PROGRAM

The purpose of the material shortage report program is to produce a list of planned or unplanned orders with insufficient quantities of available components. These orders, which cannot be released, are determined by the exception records on the order summary work file. The components are reaccessed through the product structure file, and a material shortage report is created indicating the status of each component. The status includes on-hand and allocated position, and open orders and planned orders that will be available in time to help satisfy the order requirement. The report indicates whether the particular component has sufficient quantity on hand to satisfy requirements or whether open orders and planned orders were used to satisfy the requirement. Since this program processes one order at a time, it is important to recognize that, although the material shortage report provides meaningful information, the report will show only the inventory position of each component in relation to the planned or unplanned order. An example of the material shortage report is shown in Figure 3.

OPEN ORDER DETAIL CREATION PROGRAM

The purpose of the open order detail creation program is to assemble standard routing data for each manufacturing operation to be performed for the completion of the currently released open orders. The standard routing data is written on the order detail work file and is used in the open order detail additions program, discussed later, for the creation of open order detail file records.

The order summary work, standard routing, and work center master files are used for the creation of the open order detail records. The order summary work file, which contains summary work records, requisition records, and exception records, is the primary input file. The exception records are bypassed, since they are not required by any later processing.

Each summary work record read is written to the order detail work file. The summary work record contains the relative record number of the first standard routing record of the ordered item. The first standard routing record and the succeeding standard routing records for this item are chained by relative record numbers created by the System/3 Bill of Material Processor. As each routing record is read, an operation record is created and written out on the order detail work file. These operation records will be used in the open order detail addition program to create open order detail records. When the chain of standard routing records for the ordered item is completely processed, a stock receipt record is created and written on the order detail work file. The requisition records on the order summary work file following the summary work record are copied onto the order detail work file.

The order detail work file at the conclusion of the open order detail creation processing contains, for each currently released open order, a summary work record, an operation record for each manufacturing operation, a stock receipt record, and a material requisition record for each component of the ordered item.

OPEN ORDER DETAIL ADDITION PROGRAM

The purpose of the open order detail addition program is to add open order detail records for each open order released in the order release program.

The order detail work file is the primary input for the addition of records to the open order detail file. The open order summary and the open order detail files are also input files. The order detail work file is read to obtain the summary work record and the operation records for each order. Requisition and stock receipt records are ignored.

When the summary work record is read, the appropriate open order summary record is accessed and examined to determine whether it is an active open order. If the open order summary record is active, the operation records following the summary work record on the input order detail work file are accessed. Open order detail records are assembled from the operation records and are written on the open order detail file. The relative record number of the first open order detail record added to the file is stored in the open order summary record. This link, by relative record number, represents the beginning of the chain of open order detail records associated with the open order. Each succeeding operation record on the order detail work file is read and processed. The relative record number linkage between the open order detail records is established as each is added to the open order detail file. When the last open order detail record for the order is processed, the chain is completed for that group of records.

SHOP PACKET CREATION PROGRAM

The purpose of the shop packet creation program is to produce documents which can be placed in a packet to accompany an order through the shop. These documents include the manufacturing routing and operation, move, material requisition, and stock receipt cards. The manufacturing routing lists each operation which must be performed to complete the order. The cards are used to report the progress of the order. The cards are discussed further under "Open Order Update Program" in the section entitled "Open Order Status and Update Phase". The shop packet information is generated from the data on the order detail work file which has been accumulated from the various system files by the previous programs in the order release phase.

The order detail work file is the primary input to this processing. As discussed previously, this file contains the summary work, operation, requisition, and stock receipt records. The summary work record contains information about the order. The operation records, one for each standard routing record for the item, provide detailed manufacturing data. The requisition records contain source information for creating material requisitions. The stock receipt provides data to be used at the stock location after the completion of the last operation. Refer to Figure 4 for an example of the shop packet information.

OPEN ORDER STATUS AND UPDATE PHASE

This phase enables the user to update open order summary and open order detail files with data from the shop feedback documents for the purpose of printing order status reports. The programs of the open order status and update phase are open order transaction edit, open order update, and open order status report. The system flow for the open order status and update phase is shown in Figure 9.

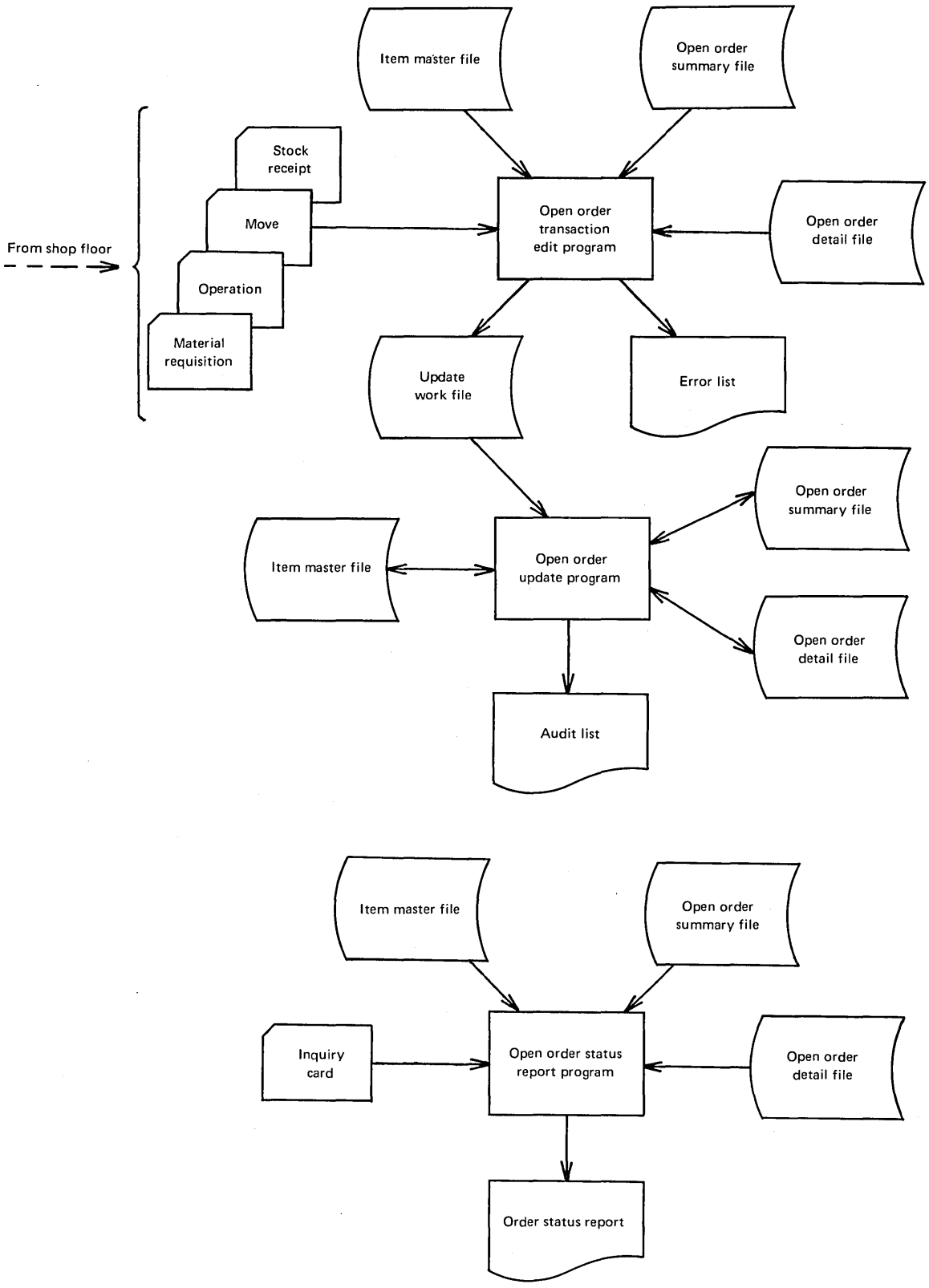


Figure 9. Open order status and update phase system flow

OPEN ORDER TRANSACTION EDIT PROGRAM

The purpose of the open order transaction edit program is to edit the cards of the shop packet which have been returned from the shop floor for updating the open order data base files. These cards were created by the shop packet creation program.

The cards, which are the primary input to the program, must be in a specific sequence prior to being read by the program. The sequence is based on the order number, operation number (the sequence in which the standard routing operations are performed), and card type. The sequence by card type is material requisition, move, operation, and stock receipt.

The editing performed by the program takes two forms: general editing, which determines that the data base records exist for the item number and order number specified in each card; and detailed editing, which determines that the prerequisite cards have been processed and that the quantities reported are accurate. When cards are acceptable to the editing function, a similar record is written on the update work file. This file is subsequently processed by the open order update program to physically update the open order files. When cards are not acceptable to the editing function, the card is bypassed and a message is written identifying the card and the error.

The user may include additional fields in the shop packet cards. If the proper fields are added to the operation and move cards by the user, the update work file could become input to a labor reporting or payroll program. Additional editing processing required for such fields is the responsibility of the user. Program exits are available to indicate where the program may be modified for this purpose.

The output of the program is the update work file and the error list. The update work file contains material requisition, move, operation, and stock receipt records for those cards which were acceptable to the edit. The error list contains those cards not acceptable to the edit.

OPEN ORDER UPDATE PROGRAM

The purpose of the open order update program is to update the data base to reflect the shop production activity. The update work file, which contains operation, move, material requisition, and stock receipt records edited by the open order transaction edit program, is the primary input to this program.

The files which are updated are the open order summary, open order detail, and item master. The necessary records are read from the item master, open order summary, and open order detail files based upon the type of update work file record read by the program.

The operation and move records reflect the status of the open orders in the shop. The material requisition records are returned for processing when the components are issued for an assembly order; they update appropriate on-hand quantities in the item master file. The stock receipt record indicates the completion of an order and triggers the deletion of the corresponding open order summary record and open order detail records. The records update the files as follows:

OPERATION RECORD: The operation record is used to report the number of items completed and, optionally, the operation start date and completion date. It identifies the operation and work center where the operation was performed. The order status of the open order summary record for the order referenced in the operation record is examined to determine whether the order is active or tagged for deletion. If it is active,

the appropiate fields in the open order detail record and the open order summary record are updated as a result of the operation record. These fields include current operation, current work center, current quantity completed, number of operations completed, order status, and operation status.

MOVE RECORD: The move record is used to indicate the completion of a move of the order from one operation to the next.

MATERIAL REQUISITION RECORD: The material requisition record is used to indicate the withdrawal of material from stock prior to the start of an order. The record is a source of input for the control of inventory. The item master record for the ordered item is accessed, the actual requisition quantity is subtracted from the on-hand, and the original required quantity is subtracted from the allocated quantity field.

STOCK RECEIPT RECORD: The stock receipt record is used at the completion of the order to indicate that the material was received in the stockroom. The item master record for the completed item is accessed and the quantity on-hand field is increased by the amount of the quantity completed. The open order date and quantity fields for this order are deleted. The status code in the open order summary record for this open order is then changed to indicate that the order is complete. The record is further processed by the open order completion program.

OPEN ORDER STATUS REPORT PROGRAM

The purpose of the open order status report program is to provide various status reports on items or open orders in the data base.

The inquiry card is the primary input to the program. The inquiry card contains a report code, a format code, and order number and item number fields. The format code determines the format of the report to be produced for the inquiry. The presence of the order number or the item number determines which report is to be generated.

The program reads and validates the inquiry card. If the card is in error, an exception notice is printed and the card is ignored. For all valid cards, the proper report routine is called to produce the required report. The reports which are produced provide summary and detailed operation information by order. An example of an order status report is shown in Figure 5.

OPEN ORDER MAINTENANCE PHASE

The primary purpose of this phase is to perform file maintenance for the item master, open order summary, and open order detail files. This maintenance includes updating the files when a change is made to an active open order, and deleting open order records after open orders have been completed or cancelled. The programs in the open order maintenance phase are open order completion and open order change. Figure 10 shows the system flow of the open order maintenance phase.

OPEN ORDER COMPLETION PROGRAM

The purpose of the open order completion program is to tag open order summary records for deletion and to delete open order detail records from the files to provide storage space for future open orders without extending the size of the files. The item master, open order summary, and open order detail files are the input files.

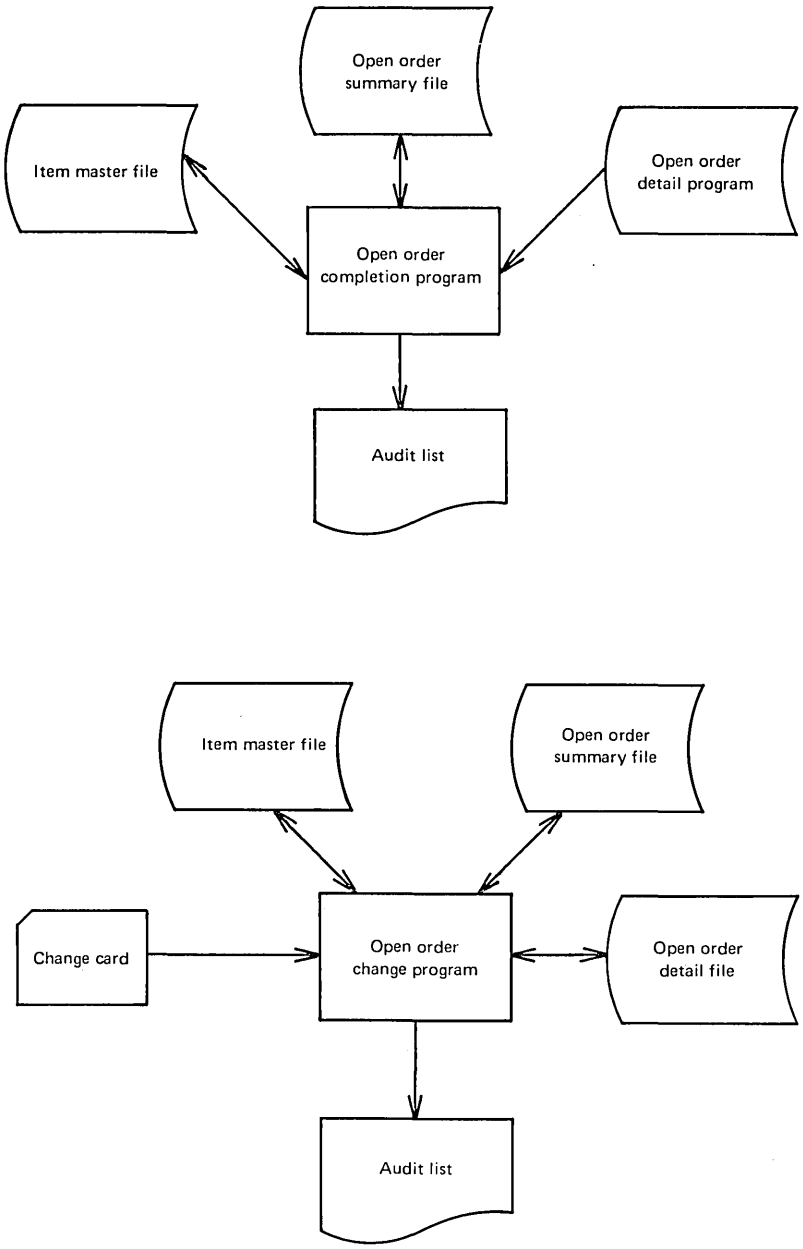


Figure 10. Open order maintenance phase system flow

The open order summary file is read consecutively. The program determines whether an order completion code was entered in the record by the user when the file was updated from shop floor transactions or whether a cancellation code was entered during open order change processing. If a completion or cancellation code exists, the order must be removed from the chain of open orders for this item. The corresponding item master record is accessed and the chain of open order summary records for the item is retrieved until the open order summary record to be deleted is found. The open order completion processing then retrieves the open order detail records and deletes each record. After all the open order detail records have been deleted, the open order summary record activity code is updated to indicate that the

record is to be deleted when the file is reorganized. The chain of open orders which is anchored in the item master record for the item ordered is then updated by removal of the completed order.

OPEN ORDER CHANGE PROGRAM

This program provides maintenance for the item master, open order summary, and open order detail files to reflect order modifications made on the shop floor.

The primary input to open order change processing is the change card. The change card is read and the control fields in that record are compared against the corresponding item master file fields to determine their validity. If one or more input fields are not valid, an exception message is printed and the card is ignored. If the change card is valid, the open order summary record of the order to be changed is accessed and the status code of that record is examined. The status code could indicate whether or not the order can be changed. Typical changes are a decrease or increase in order quantity, a new open order date, or the addition, deletion, or modification of open order detail records.

Order Quantity and/or Date Change

The order quantity and/or the scheduled start date fields in the open order summary record are updated to reflect the change. The open order detail records for this order are then accessed and the appropriate fields are updated. The order quantity or due date in the item master record is then updated.

Open Order Splitting

Open orders can be split by reducing the order quantity and entering unplanned order(s) for the difference between the original order quantity and the new quantity. Refer to the processing description section entitled "Component Allocation Program" for a discussion of the unplanned orders used for order splitting. The file processing for splitting an open order is the same as described above for an order quantity change.

Cancelling an Open Order

An open order can be cancelled by changing the open order quantity to zero. In some instances it may be necessary to cancel an open order prior to its completion. Cancellation may result from (1) an order being scrapped, (2) an unexpected material shortage, or (3) a management decision arising from over-capacity situations. The open order date/quantity fields in the item master file are deleted, and the open order summary record status code is updated to indicate that the order has been cancelled. The open order detail records are not accessed. They are physically deleted by the open order completion processing.

Adding or Deleting Open Order Detail Records

The open order detail records for any order represent the manufacturing operations that must be performed on the order. The addition of one or more open order detail records is processed by this function. The user is responsible for supplying the essential information concerning each new operation in the change card. The program adds the new operation data to the open order detail file and

updates the necessary relative record number chain. An operation can be added anywhere in the chain of existing operations. Some of the reasons for adding operations to an existing order could be rework or a standard routing change.

An existing operation may be deleted by so indicating in the change card. The open order detail chain records are accessed through the open order summary record, and the open order detail record to be deleted is removed from the file. The relative record number fields are updated to reflect the deletion.

WORK LIST PREPARATION PHASE

The purpose of the work list preparation phase is to produce a work list of all open order operations within the work list horizon that have not been completed. A priority is assigned to each operation so that the operations can be sequenced on the work list report by priority. The work list horizon is used to limit the size of the report to show only the operations to be completed in the current and following shifts. A secondary use of this report could be to increase the work list horizon to several weeks or months and sort by order number to get a list of the open order operations by work center.

The programs of the work list preparation phase are order priority calculation, work list file sort, and work list report. The system flow of this phase is shown in Figure 11.

ORDER PRIORITY CALCULATION PROGRAM

The order priority calculation program consecutively reads the open order summary file and processes only open order summary records that have not been completed or cancelled.

Open order detail records are accessed through the relative record number field in the open order summary record. For each open order detail record representing an operation that has not been completed, a priority is calculated and a work list record is written on the work list file. The user can specify the number of operations beyond the current operation for which a priority should be calculated. This specification restricts the size of the work list report and causes it to be more meaningful.

Three order priority techniques are provided in the program. In addition, a user exit is provided so that the user can optionally insert instructions for the calculation of operation priority. The technique selected by the user applies to all orders for a program run.

The first priority technique provided by the program is order due date: the closer the due date, the higher the priority; the later the due date, the lower the priority.

The second priority technique available is shortest operation first. For this priority, the standard operation duration is calculated. Operation duration includes setup time and run time. Operations with shorter operation durations have higher priorities than those with longer durations.

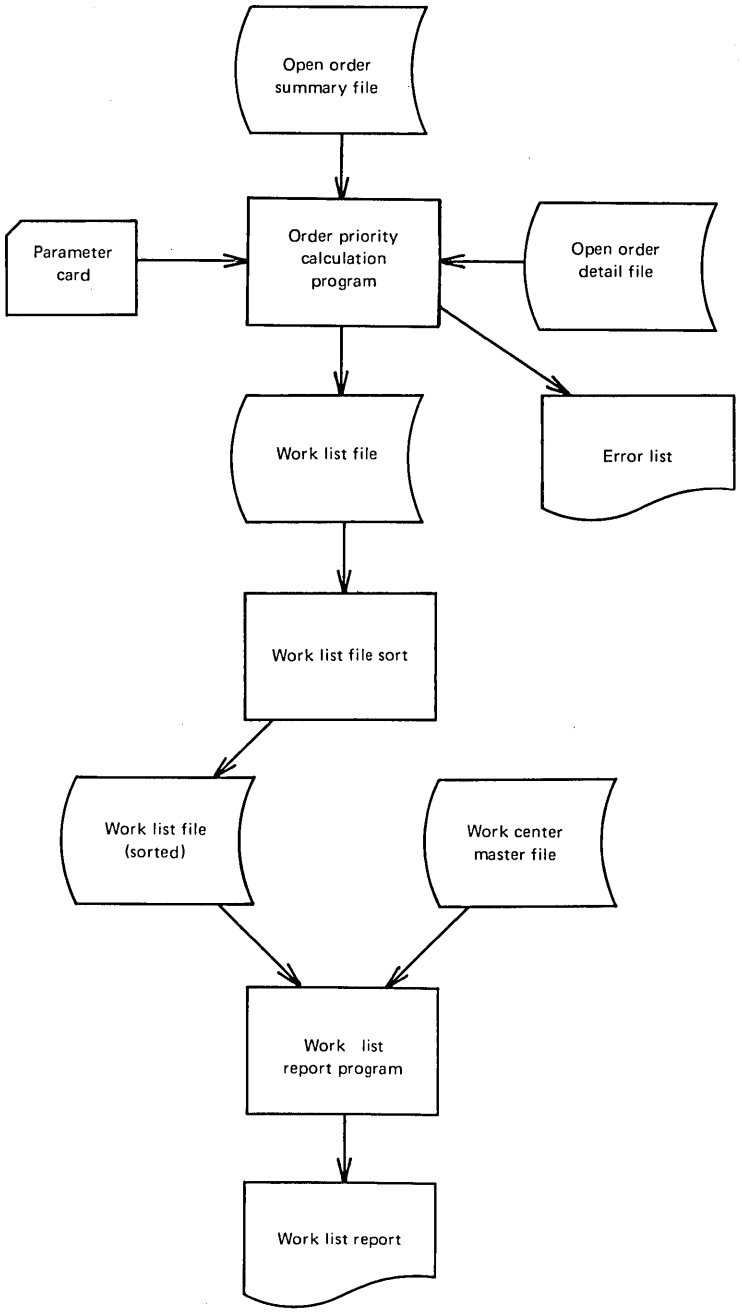


Figure 11. Work list preparation phase system flow

The third priority technique is based on determining the average transit time per remaining operation of an order. The shorter the average transit time, the higher the priority; the longer the average transit time, the lower the priority.

WORK LIST FILE SORT

The work list file is sorted using the System/3 Disk Sort program to arrange the operations included in the work list file into the work center priority sequence in which the operations should appear on the work list report.

WORK LIST REPORT PROGRAM

The work list report program produces a listing of the operations by priority sequence by work center from the sorted work list file. The value of this report depends upon the accuracy and timeliness with which the open orders are updated by shop floor feedback transactions. The operation status code is used to determine whether the operation is currently at the work center, whether all material is available, and whether the operation has been started. This information is extremely important in improving the validity of the work list report. It would be quite misleading to suggest that an order with the highest priority should be worked on next if the order has not yet arrived at the work center.

If the shop feedback is accurate and the open order data base properly updated, the work list report can be run as often as daily to indicate whether shop discipline reflects management's objectives. The work list aids the foreman in deciding which order to work on next, as well as providing him with advance notice of orders that will arrive. This information can be used to prepare for tooling as well as to take advantage of common setups. An example of a work list report is shown in Figure 6.

INTRODUCTION

System/3 Shop Loading and Control requires the item master, product structure, standard routing, work center master, open order summary, and open order detail files. All of these files are contained on disk storage devices. The item master, product structure, standard routing, and work center master files are created and maintained using the System/3 Bill of Material Processor program product (5702-M41). The open order summary and open order detail files are created and maintained by System/3 Shop Loading and Control. For each file, a definition of each field follows the list of fields. Fields listed as required are essential for the processing of System/3 Shop Loading and Control. Fields listed as optional are examples of important data that can be included in the record if the user desires. Optional fields are not essential to the normal operation of the program product. Other fields may be added to any file by the user. For approximate disk storage requirements, refer to the Appendix.

ITEM MASTER FILE

The item master file consists of one record for each item number. The record may include any information needed to describe each item number for the engineering, manufacturing, and financial functions. All fields listed beginning with I$ are required by System/3 Bill of Material Processor and are initialized by that program product. All other fields must be initialized by the user when the file is created. If the user has installed System/3 Inventory and Requirements Planning, all of the required fields and some of the optional fields with the exception of MOSKA and MOPHA will have been initialized. Fields MOSKA and MOPHA are not used by that program product. The following shows the item master file fields that are used by System/3 Shop Loading and Control:

Label	Field Description	Comments	Length in Bytes
I$ACD	Record activity code	Required	1
I$RECN	Relative record number of this record	Required	5
I$LLC	Low-level code	Required	2
I$RACN	Run activity control number	Required	3
I$FACA	Relative record number of first assembly component	Required	5
I$FWUA	Relative record number of first assembly where used	Required	5
I$NMRA	Relative record number of next item number master record in the activity chain	Required	5

Label	Field Description	Comments	Length in Bytes
I$CPMR	Compare portion of the next item in the activity chain	Required	1
I$FROA	Relative record number of first routing operation record	Required	5
I$PN	Item number	Required	User-specified
I$QTY	Quantity work field	Required	Use-specified
MALQT	Allocated quantity	Required	User-specified
MLTCD	Lead time code	Required	1
MLTPR	Lead time - manufacturing	Required	User-specified
MLTPU	Lead time - purchasing	Required	User-specified
MOHTQ	On-hand total quantity	Required	User-specified
MOPOC	Order policy code	Required	1
MPDSC	Item description	Optional	User-specified
MPRPQ	Total on-order manufacturing quantity	Required	User-specified
MPUPQ	Total on-order purchase quantity	Required	User-specified
MSHRF	Shrinkage factor	Optional	User-specified
MTYPN	Item type	Required	User-specified
MUTMS	Unit of measure	Optional	2
MOSKA*	Open order summary record key	Required	6
MOPHA*	Stock location	Optional	User-specified
MGR	Gross requirements fields	Optional	5 per field**
MPO	Planned order fields	Optional	5 per field**
MOO	Open order fields	Required	5 per field**

* Fields not used in System/3 Inventory and Requirements Planning (5702-M52).

**MGR, MPO, and MOO consist of packed fields five bytes long. The number of fields for each is user-specified. Each field of five packed bytes is compressed from an unpacked nine-byte field. Two unpacked fields (one field of three bytes, which represents the shop date, and one field of six bytes, which represents the quantity) are moved into the nine-byte field prior to the pack operation. The shop date occupies the leftmost three bytes, and the quantity occupies the rightmost six bytes in the nine-byte field.

ITEM MASTER RECORD FIELD DESCRIPTIONS

I$ACD is a field which indicates whether the item is active. This field is maintained by System/3 Bill of Material Processor.

I$RECN contains the relative record number of the item. This field is used by System/3 Bill of Material Processor.

I$LLC is the low-level code. It is a number indicating the lowest tier or level at which a particular part number is found in all product structure trees. It is used in checking assembly to subassembly continuity.

I$RACN is a data processing run activity control number.

I$FACA is the relative record number of the product structure record representing the first component of the assembly whose item number is specified by I$PN. Starting with the I$FACA relative record number, all components in the assembly are linked together in an assembly component chain.

I$FWUA is the relative record number of the product structure record representing a use of this item number on a higher-level assembly. Starting with this relative record number, all direct uses of this item on higher-level assemblies are linked together in an item number where-used chain. This chain is not maintained in any logical sequence, but is built as required by the particular processing program.

I$NMRA is the relative record number of the next item number master record in an activity chain. The activity chain is a temporary chain used in maintaining low-level codes. The chain is also used in summarized explosions and implosions.

I$CPMR is the compare portion of the next item number in the activity chain used to check continuity. It is one or more characters of the item number selected by the user.

I$FROA is the relative record number of the first routing record. Beginning with the relative record number stored in this field, all standard routing records for this item are linked together in a standard routing record chain.

I$PN is the item number that may refer to an assembly or a piece part. The user establishes the size to fit his own particular needs.

I$QTY is the working quantity field used for immediate storage in the summarized retrieval routines. It is required and used by System/3 Bill of Material Processor.

MALQT is the total quantity of inventory that has been allocated or reserved.

MLTCD is a code field to indicate whether purchase lead time (P) or manufactured lead time (M) is to be used.

MLTPR is the total time in shop days required to produce the order; it includes setup, run, and transit (move/queue) time.

MLTPU is the time it takes to receive an order for a purchased item from a vendor. It includes internal purchasing cycle and vendor lead time, expressed in shop days.

MOHTQ is the total quantity of inventory on hand for this item.

MOPOC is the order policy code(s) applicable to the item and is used to select specific ordering logic. The available codes are as follows:

A - Discrete order quantity
B - Order point
C - Order quantity or order-up-to level
D - Fixed quantity
F - Part period balancing
G - User method

MPDSC is the item number description. It is used to further identify the item on output reports.

MPRPQ is the total quantity being manufactured for this item.

MPUPQ is the total quantity on order from purchase orders for this item.

MSHRF is the shrinkage factor to be used as a multiplier to adjust the gross requirements to reflect scrap loss, etc.

MTYPN is a code used to define the type of item. The possible codes are as follows:

1 - Assembly and subassembly
2 - Fabricated item
3 - Raw material
4 - Purchased item
5 - User option

MUTMS is the descriptive unit of measure and defines the item master quantity field.

MOSKA is the open order number of the first open order summary record in the open order chain for this item.

MOPHA describes the physical stock location of this item.

MGR is the label that references the gross requirements fields. Gross requirements are stored by date and quantity.

MPO is the label that references the planned order fields. Planned orders are stored by start date and quantity.

MOO is the label that references the open order fields. Open orders are stored by due date and quantity.

PRODUCT STRUCTURE FILE

The product structure file contains one record for each assembly component. Through direct access storage device chaining, one record represents both an assembly component (portion of a bill of material) and the direct usage of the component part on a higher-level assembly. All fields beginning with P$ are required by the System/3 Bill of Material Processor and must be initialized by that program product. Field PSLDT must be initialized by the user. The following shows the fields that are used by System/3 Shop Loading and Control:

Label	Field Description	Comments	Length in Bytes
P$CMRA	Relative record number of the component item master record	Required	5

Label	Field Description	Comments	Length in Bytes
P$PMRA	Relative record number of parent item master record	Required	5
P$NACA	Relative record number of next assembly component record	Required	5
P$NWUA	Relative record number of next assembly where-used record	Required	5
P$PWUA	Relative record number of previous assembly where-used record	Required	5
P$CPC	Compare portion of the component item number	Required	1
P$CPP	Compare portion of parent item number	Required	1
P$QTY	Quantity per assembly	Required	User-specified
PSLDT	Lead time adjustment	Optional	User-specified

PRODUCT STRUCTURE RECORD FIELD DESCRIPTIONS

P$CMRA is the relative record number of the component item master record. The actual item number and other information can be read from the item master record using this relative record number.

P$PMRA is the relative record number of the parent item in the item master file.

P$NACA is the relative record number of the product structure record representing the next component in this assembly. In this manner, all components of an assembly are linked together in an assembly component chain which began in I$FACA of the parent item number master record.

P$NWUA is the relative record number of the product structure record representing another usage of this component item number on a higher-level assembly. In this manner, all direct usages of an item number are linked together in an item number where-used chain, begun in field I$FWUA of the component item master record.

P$PWUA is the relative record number of the product structure record representing another usage of this item number on a higher-level assembly. In this manner, all direct usages of an item number are linked together in a reverse item number where-used chain. The function of this reverse chain is to reduce computer time required in product structure file maintenance.

P$CPC is the compare portion of the item whose usage is represented by this product structure record.

P$CPP is the compare portion of the parent item number and is used for checking purposes.

P$QTY is the quantity of this component used on this parent assembly.

PSLDT is the lead time adjustment of the component in relation to the parent item as indicated by this product structure record.

STANDARD ROUTING FILE

The standard routing file contains one record for each manufacturing operation for each routing. The file may contain alternate operations for any routing if they exist. All fields beginning with R$ are required by the System/3 Bill of Material Processor and must be initialized by that program product. All other fields are initialized by the user. No distinction is made in System/3 Shop Loading and Control between assembly and fabrication routings.

Label	Field Description	Comments	Length in Bytes
R$PTMA	Relative record number of parent item master record	Required	5
R$WCMA	Relative record number of work center master record	Required	5
R$NOPA	Relative record number of next sequential operation	Required	5
R$NWUA	Relative record number of next operation in work center where-used chain	Required	5
R$PWUA	Relative record number of previous operation in work center where-used chain	Required	5
R$CPIM	Compare portion of item number	Required	1
R$CPWC	Compare portion of work center number	Required	2
R$OPNO	Operation sequence number	Required	User-specified
RTSMH	Standard machine hours	Required	User-specified
RTSLH	Standard labor hours	Required	User-specified
RTSSH	Standard setup hours	Optional	User-specified
RTTBC	Time basis code	Required	User-specified
RTTTT	Total transit time	Optional	User-specified
ROPDE	Operation description	Optional	User-specified

STANDARD ROUTING RECORD FIELD DESCRIPTIONS

R$PTMA is the relative record number of the item master record for this routing record.

R$WCMA is the relative record number of the work center master record.

R$NOPA is the relative record number of the next sequential operation.

R$NWUA is the relative record number of the next operation record in a chain of operations that are all performed by a single work center. This chain may be called the work center where-used chain.

R$PWUA is the relative record number of the previous operation performed by the same work center. The resulting chain may be called the reverse work center where-used chain. The purpose of this reverse chain is to reduce processing time in standard routing maintenance.

R$CPIM is the compare portion of the item number. It is used for continuity checking between the operation record and the item master record.

R$CPWC is the compare portion of the work center identification number. This field serves the same purpose as R$CPIM for the item master record.

R$OPNO is the operation sequence number.

RTSMH is a field containing the established standard factor used to calculate hours required to perform this operation. It is specified in hours or pieces per hour depending on the specification of RTTBC. The standard may include setup time if such time is not treated separately.

RTSLH is the established standard labor factor used to calculate the man-hours to perform this operation. It is specified in tenths of hours or units per hour, depending upon the specification of RTTBC. The standard may include setup time if such time is not treated separately.

RTSSH is the field that contains the established standard machine hours required to set up the equipment used for this operation. The hours are specified in tenths.

RTTBC is the code specifying the manner in which the standard machine and labor factors, fields RTSMH and RTSLH above, are to be applied. The codes used for this field by System/3 Shop Loading and Control are:

0 - Standard hours per 10 units (tenths of hours per unit)
1 - Standard hours per 100 units (hundredths of hours per unit)
2 - Standard hours per 1000 units (thousandths of hours per unit)
3 - Pieces per hour
4 - Standard hours irrespective of order quantity

RTTTT is the transit time in tenths of shop days (XX.X).

ROPDE is a short description of this routing operation.

WORK CENTER MASTER FILE

The work center master file contains one record for each work center in the manufacturing facility. Each work center record contains a field which links it to all standard routing records performed in that work center.

Label	Field Description	Comments	Length in Bytes
W$ACD	Activity code	Required	1
W$RECN	Relative record number of this record	Required	5
W$FOWA	Relative record number of first work center where-used record	Required	5
W$WCID	Work center identification number	Required	User-specified
WCDES	Description	Optional	User-specified
WCLOC	Work center location	Optional	User-specified
WHRS1	Normal shift length	Required	User-specified
WCDC1	Normal capacity - shift 1	Required	User-specified
WCDC2	Normal capacity - shift 2	Optional	User-specified
WCDC3	Normal capacity - shift 3	Optional	User-specified
WCMS1	Maximum shift length	Optional	User-specified
WCMC1	Maximum capacity - shift 1	Optional	User-specified
WCMC2	Maximum capacity - shift 2	Optional	User-specified
WCMC3	Maximum capacity - shift 3	Optional	User-specified
WEFIC	Work center efficiency	Optional	User-specified

WORK CENTER MASTER RECORD FIELD DESCRIPTIONS

W$ACD is a field which indicates whether the work center is active. This field is maintained by System/3 Bill of Material Processor.

W$RECN contains the relative record number of this work center record in the work center master file. This field is used by the System/3 Bill of Material Processor.

W$FOWA is the relative record number of the first routing record performed by this work center. Starting with this relative record number, all routing operations performed in this work center can be linked together in a work center where-used chain.

W$WCID is the work center identification number associated with this group of machines. For loading purposes, the work center is generally considered to be a group of like machines. Consequently, work is considered performed equally well on any machine in the group. A machine with unique characteristics can, by itself, be considered a work center. The work center identification can consist of two parts: a department identification and a machine group identification. However, work center identification is treated as one field. A work center can be a labor work center and consist of assembly areas or a pool of setup men.

WCDES is the description normally associated with a work center, for example, milling, annealing, etc.

WCLOC is a code indicating a geographical location of the work center within the plant.

WHRS1 is the normal shift length for this work center.

WCDC1 is the normal number of men or machines available in this work center for the first shift.

WCDC2 is the normal number of men or machines available in this work center for the second shift.

WCDC3 is the normal number of men or machines available in this work center for third shift.

WCMS1 is the maximum shift length for this work center.

WCMC1 is the maximum number of men or machines available in this work center for the first shift.

WCMC2 is the maximum number of men or machines available in this work center for the second shift.

WCMC3 is the maximum number of men or machines available in this work center for the third shift.

WEFIC is the ratio of standard hours to actual hours. Standard hours are often unrealistic and must be adjusted by this factor, which reflects historical data.

OPEN ORDER SUMMARY FILE

The open order summary file contains information about a specific manufacturing order for an item. If an additional order is placed for that item, the information about the second order is contained in another open order summary record which is linked to the first open order summary record for the item. Each open order summary record is linked to the first open order detail record for this order. All fields in this record are initialized by System/3 Shop Loading and Control, either when the record is created or upon receipt of transactions from the shop floor.

Label	Field Description	Comments	Length in Bytes
O$ACD	Activity code	Required	1
O$RECN	Relative record number of this record	Required	5
O$FDOA	First open order detail relative record number	Required	5
O$NOA	Next order summary number - same item	Required	6
O$ODA	Current operation detail relative record number	Required	5
O$ORNO	Order number	Required	6
OSITN	Item number	Required	User-specified
OSSTC	Order status code	Required	2
OSOOQ	Original order quantity	Required	User-specified

Label	Field Description	Comments	Length in Bytes
OSNOP	Number of active open order detail records	Required	User-specified
OSSSD	Scheduled start date	Required	3
OSSDD	Scheduled due date	Required	3
OSNCO	Number of completed operations	Required	User-specified
OSQCP	Quantity completed previously	Required	User-specified
OSCQC	Current operation quantity completed	Required	User-specified
OSTHR	Total hours remaining	Required	User-specified
OSASD	Actual order start date	Optional	3
OSACD	Actual order completion date	Optional	3
OSCON	Current operation number	Optional	User-specified
OSCOW	Current operation work center number	Optional	User-specified
OSODS	Order description	Optional	User-specified

OPEN ORDER SUMMARY RECORD FIELD DESCRIPTIONS

O$ACD is a field which indicates whether the order is active.

O$RECN is the relative record number of this open order summary record in the open order summary file.

O$FDOA is the relative record number of the first open order detail record for the order. All open order detail records for the order are linked together with relative record number chaining, beginning with the relative record number in this field.

O$NOA is the number of the next open order summary record for the same item.

O$ODA is the relative record number of the open order detail record that is currently being processed.

O$ORNO is the number assigned to the shop order for identification.

OSITN is the number of the item for which the order was issued.

OSSTC is a code indicating the current status of the order. The codes used for this field by System/3 Shop Loading and Control are:

10 - Active, not started
40 - Started
50 - Completed
99 - Cancelled

OSOOQ is the ordered quantity.

OSNOP is the total number of operations to be performed to produce the item.

OSSSD is the shop date this order was originally scheduled to start in the shop.

OSSDD is the shop date this order was scheduled to be completed.

OSNCO is the number of operations that have been reported complete.

OSQCP is the quantity that was reported at the end of the last operation.

OSCQC is the number of pieces of this item that have been completed for the current operation.

OSTHR is the sum of the standard hours remaining for the operations that have not been completed.

OSASD is the date the order was actually started in the shop, as determined by information received from the shop.

OSACD is the shop date on which the order was reported complete.

OSCON is the number of the operation currently being performed.

OSCOW is the number of the work center where the current operation is being performed.

OSODS is a field that contains descriptive information about the order.

OPEN ORDER DETAIL FILE

The open order detail file contains one record for each operation performed in the manufacture or assembly of an item in the order. This file is similar to the standard routing file, but it contains additional information about each operation that is unique to each order. An open order summary record is linked to the first open order detail record for that order in this file. Each open order detail record contains the relative record number of the next open order detail record for the order. All fields in this record are initialized by System/3 Shop Loading and Control, either at creation or as a result of transactions from the shop floor.

Label	Field Description	Comments	Length of Bytes
OD$ORN	Order number	Required	6
OD$OSN	Operation sequence number	Required	User-specified
OD$NOA	Next open order detail relative record number - same order	Required	5
OD$WCN	Work center number	Required	User-specified
ODTBC	Time basis code	Required	User-specified
ODSHS	Standard setup time	Required	User-specified
ODSHM	Standard machine time	Required	User-specified
ODSHL	Standard labor time	Required	User-specified
ODSTC	Operation status code	Required	2
ODTQC	Total quantity completed	Required	User-specified
ODSOH	Standard operation hours	Required	User-specified
ODOPD	Operation description	Optional	User-specified
ODASD	Actual start date	Optional	3
ODACD	Actual completion date	Optional	3

OPEN ORDER DETAIL RECORD FIELD DESCRIPTIONS

OD$ORN is the identification number for the shop order. This number is assigned by System/3 Shop Loading and Control.

OD$OSN is a number indicating the sequence of this operation in the routing for this order.

OD$NOA is the relative record number that points to the next open order detail record for this order. In this manner, all operations of an order are linked together in a chain which begins in field O$FDOA of the open order summary record.

OD$WCN is the identification of the work center where the work is to be performed.

ODTBC is a code indicating the manner in which the standard machine and labor factors are to be applied. The codes used for this field by System/3 Shop Loading and Control are:

0 - Standard hours per 10 units (tenths of hours per unit)
1 - Standard hours per 100 units (hundredths of hours per unit)
2 - Standard hours per 1000 units (thousandths of hours per unit)
3 - Pieces per hour
4 - Standard hours, irrespective of order quantity

ODSHS is the standard amount of time required to set up this job.

ODSHM is the established standard for the number of machine hours required to perform this operation.

ODSHL is the established standard for the direct labor hours to perform this operation.

ODSTC is a code indicating the current status of this operation. The codes used for this field by System/3 Shop Loading and Control are:

00 - Inactive
10 - Active
20 - Can be started
40 - Labor completed
50 - Operation completed

ODTQC is the total quantity completed for this operation. This field must be the same length as all other quantity fields.

ODSOH is a field containing the total standard operation hours for this operation. ODSOH = standard setup hours + ((order quantity/time basis value) x (standard machine hours + standard labor hours)), where the time basis value is derived from the time basis code.

ODOPD is a short description of the operation to be performed.

ODASD is the shop date on which this operation was started.

ODACD is the shop date on which this operation was completed.

WORK FILES

System/3 Shop Loading and Control generates and uses six work files. They are the system run file, order release work file, order summary work file, order detail work file, update work file, and work list file. These files are temporary files in that they are regenerated each time a phase of the program product is executed. The user is responsible for correlating the field lengths of these files with the field lengths of the files previously described.

SYSTEM RUN FILE

The system run file is created and used in the infinite load phase. It contains one record with run parameters and one record for each work center stored in the work center master file. The parameter record contains user-specified data, such as number of periods and period length, which is used during the accumulation of work center loads. The work center records contain work center data, such as desired and maximum shift length and capacity, which is used in the accumulation of the load for that work center. The time period fields in which the accumulated load is stored are also contained in the work center record.

ORDER RELEASE WORK FILE

The order release work file is created and used in the order release phase. This file contains records of planned orders, extracted from the item master file, which have start dates that equal or precede the order release horizon date. These records should be sorted by the System/3 Disk Sort Program before being used as input to the component allocation program. The sort could be used to arrange the planned orders in start date sequence.

ORDER SUMMARY WORK FILE

The order summary work file is created by the component allocation program. This file contains three types of records: summary work, material requisition, and exception. The summary work and material requisition records, one for each component of the order item, are generated when all components of an order are available. The exception record is generated if all components for an order are not available.

The order summary work file is input to the order release program, which uses the summary work records to create open order summary records for the open order summary file. This file is input to the material shortage report program, which uses the exception records to generate the material shortage report. Material requisitions are ignored by the order release program and the material shortage report program.

The order summary work file is also input to the open order detail creation program. The summary records and material requisition records are transferred to the order detail work file, discussed below, to be used in other programs of the program product. The exception records are ignored by the open order detail creation program.

ORDER DETAIL WORK FILE

The order detail work file is created by the open order detail creation program. This file contains four types of records; summary work, operation, material requisition, and stock receipt. The summary work records and material requisition records are transferred to this file from the order summary work file. The operation records, one for each primary and alternate manufacturing operation, are created from data contained in the standard routing file. The stock receipt record, generated after creation of the open order detail work records, contains data about the stock location of the order upon completion.

The order detail work file is input to the open order detail addition program. The operation records are used in the open order detail addition for the generation of the records to be added to the open order detail file for the open order specified in the summary work record. Material requisition and stock receipt records are ignored by this program.

The order detail work file is also input to the shop packet creation program. The summary work record is used in preparation of the order data in the manufacturing routing report. The open order detail work records are used to generate operation and move cards for each operation to be performed to complete the order. Material requisition records are used to create material requisition cards, and stock receipt records are used to create stock receipt cards.

UPDATE WORK FILE

The update work file is created by the open order transaction edit program. This file contains records for the operation, move, material requisition, and stock receipt cards that have been returned from the shop floor. The records on this file represent only the cards that comply with the existing restrictions of the open order transaction edit program.

The update work file is input to the open order update program, which updates the item master, open order summary, and open order detail files.

WORK LIST FILE

The work list file is created and used in the work list preparation phase and consists of two types of records: parameter and operation. The parameter record stores run parameter data specified by the user to be used in the generation of the work list report. There is one operation record in the work list file for every active operation in the open order detail file that falls within the work list horizon. The operation record contains a priority value calculated by the order priority calculation program.

The work list file is input to the System/3 Disk Sort program, which arranges the records into a priority within work center sequence. The sorted work list file is input to the work list report program, which prepares the work list.

PARAMETER AND DATA CARDS

Two types of cards are used by the program product: parameter cards and data cards. The parameter cards are used to elect options within a program, specify a horizon date, indicate a calculation technique, and/or provide information to be included on a report.

Data cards are used as input to provide the capability of updating various fields of specific records, adding and deleting records, entering unplanned orders, or requesting status reports from the data base. The data cards include the planned order update card, unplanned order card, change card, and inquiry card. Additional data cards are output of the program product. These include the operation, move, material requisition, and stock receipt cards produced by the shop packet creation program in the order release phase. These cards accompany the order to the shop and become turnaround documents which are input to the open order transaction edit program as the order progresses toward completion.

USER RESPONSIBILITIES

System/3 Shop Loading and Control is a vital link in any production information and control system. Its input is the planned orders of System/3 Inventory and Requirements Planning or a system which provides planned orders in the identical format. It is extremely important that this input be accurate. Accuracy can be attained only through the use of a well-maintained data base, valid input, and a thorough understanding of the results of electing the options that are provided by System/3 Shop Loading and Control.

DATA BASE

The item master file, product structure file, standard routing file, and work center master file are created and maintained by System/3 Bill of Material Processor, which provides a linkage between these files. Programs are provided by System/3 Shop Loading and Control for the creation and reorganization of the open order summary file and the creation of the open order detail file. Programs within System/3 Shop Loading and Control maintain these files. It is the responsibility of the user to select the fields required and to assure that the data is kept accurate.

The collection and proof of the information to be used for the creation of the files can be a major undertaking. The need for accurate input data cannot be overemphasized; therefore, to ensure accuracy it is recommended that the input data be proved offline before it is used to create the files.

When the information available or needed for each file has been determined, the user can design the record formats. Space should be provided for additional information if new applications are to be added. This will save reloading or re-creating the files.

System/3 Shop Loading and Control generates and uses six work files. They are the system run file, order release work file, order summary work file, order detail work file, update work file, and work list file. These files are temporary files in that they are regenerated each time a phase of the program product is executed. The user is responsible for correlating the field lengths of these files with the field lengths of the files previously described.

INPUT

Input data to the programs, in addition to the files, is provided in parameter cards and data cards. The user may add data fields to the input cards, but he is responsible for providing the program code to edit and process this data. This is particularly important with regard to the operation, move, material requisition, and stock receipt cards which are processed by the open order status and update phase. Editing for these cards is performed on the fields used in the sample problem. The user is cautioned to provide additional editing for any fields he might add to these data cards. The accuracy of the open order summary file, open order detail file, and some fields in the item master file could be destroyed without proper editing.

The planned orders in the item master file provide the primary input to System/3 Shop Loading and Control. This input can be provided by System/3 Inventory and Requirements Planning or a similar system. If a

system other than System/3 Inventory and Requirements Planning is used, the planned orders and gross requirements in the item master file must be stored in the shop date and quantity fields as required by System/3 Shop Loading and Control.

The number of date and quantity fields in the item master file for planned orders, open orders, and gross requirements is specified by the user and is limited by record size and disk storage space.

OUTPUT

The program product provides the infinite load report; material shortage report; manufacturing routing, order, and item status reports; work list report; and a number of audit list reports which audit the maintenance of the files. The user may modify any of these reports to suit his needs, and it is his responsibility to provide the program code for the modification of the reports.

The user may desire to add fields to the data cards produced by the shop packet creation function; the cards include the operation, move, material requisition, and stock receipt cards. The user is responsible for the program code to provide the additional fields.

So that errors are minimized, standard procedures should be established for the handling of the cards. The user should also determine how many copies of each card and of the manufacturing routing report should be prepared to be included in the shop packet.

SELECTION OF PLANNING OPTIONS

The descriptions of system functions and their options have been presented in the sequence that they are performed so that the system can be seen in its entirety. Careful study and review of the options will provide knowledge as to their usefulness. By reviewing the options that are available in System/3 Shop Loading and Control, it can be seen that most options require detailed information and, therefore, give a detailed result.

The selection of options is accomplished through the use of parameter cards. The user, after examining the options, is responsible for entering the proper codes in the various parameter cards to select the options of his choice.

The options provided by the parameter cards include specifying the limits of the infinite load planning horizon, the number of periods for which loads are accumulated, the order release horizon date, the work list horizon date, and the processing of unplanned order cards.

TIMING AND THROUGHPUT INFORMATION

Specific timing estimates are not provided, since the options that can be selected and routines that may be provided by the user are many. To assist the user in preparing timing estimates, the primary factors that should be considered for each phase are discussed below. In addition, the user should know how the different files are organized under the System/3 Bill of Material Processor, the various accessing techniques used by that program product, and the time required for the input/output operations.

Each program of shop loading and control should be timed separately; the factors which are grouped by the major processing functions within each program should be used only as guidelines.

For programs that require two or more disk files, it is important to note that there is an increase in the timing for arm movement between files. This increase depends on the number of files that reside on the same drive. This increased arm movement may affect throughput for some programs.

INFINITE LOADING PHASE

SYSTEM RUN FILE CREATION PROGRAM

The parameter card is read and stored on the system run file. The work center master file is read sequentially and data is extracted from each work center record and stored consecutively on the system run file, which is a direct access file. Work center data is listed on the audit list.

For timing estimates the user should include:

- The time to read the work center master file, which contains one record for each work center
- The time to write the system run file. The number of records equals the parameter records plus the work center records.
- The number of lines printed on the audit list

SYSTEM RUN FILE SORT

The timing for the system run file should be based on the timing estimate for the IBM System/3 Disk Sort program. The number of records on the system run file equals one more than the number of work center records.

INFINITE LOAD PROGRAM

The item master file is processed consecutively. If the item master record contains planned orders and/or open orders, the standard routing operations for that item are randomly accessed to be used in accumulating load hours by time period by work center. The open order summary file is randomly accessed to determine whether any operations on the open orders have been reported completed.

For timing estimates the user should include:

- The time to access and read the item master file
- The time to access and read the open order summary file. The number of records equals the number of items with open orders.
- The time to access and read the standard routing file. This is a Bill of Material Processor chain file. The number of records equals the number of items with planned or open orders times the average number of operations per item minus the completed operations for the open orders.
- The time to randomly update the system run file. The number of records equals the number of open and planned orders times the average number of operation records per order.

INFINITE LOAD REPORT PROGRAM

The system run file is read consecutively and the infinite load report is printed for each work center.

For timing estimates the user should include:

- The time to read the system run file. The number of records is one greater than the number of work centers.
- The time to print the report. The number of lines printed for each work center is dependent on the number of heading lines and the number of periods specified in the parameter record.

ORDER RELEASE PHASE

PLANNED ORDER UPDATE PROGRAM

Planned order update cards are read to cause planned order date and quantity fields in the item master file to be changed. The product structure file is randomly processed to explode the components of the item to update the component item master records.

For timing estimates the user should include:

- The time to read planned order change cards
- The time to seek, read, and update the item master file. The item master file is accessed randomly by key from a planned order update card and randomly by relative record number from the product structure records. The number of items is the sum of the planned order cards plus the average number of component items for the updated items.
- The time to read the product structure records for each component
- The time to print the audit list, which contains one line per item

PLANNED ORDER EXTRACT PROGRAM

The parameter card provides the order release horizon, which indicates whether planned orders are to be extracted for possible release. The item master file is input for extracting orders. The

timing for the parameter card and printing of error messages is negligible.

For timing estimates the user should include:

- The time to read the item master file consecutively for extracting orders
- The time to sequentially write the order release work file. This file contains all planned orders within the release horizon.

ORDER RELEASE WORK FILE SORT

The order release work file should be sorted to arrange the extracted planned orders in start date sequence. The timing for the number of records in the order release work file should be based on the timing estimate for the IBM System/3 Disk Sort program.

COMPONENT ALLOCATION PROGRAM

Input consists of the order release work file or unplanned order cards. For each card record or order release work file record, the corresponding item master record is read randomly by key, the component assemblies in the product structure file are randomly processed, and the item master record for each component is randomly accessed by relative record number. When all components for an ordered item are available, a summary work record and material requisition records for each component are written consecutively on the order summary work file. When all components are not available, an exception notice record is written consecutively on the order summary work file.

For timing estimates the user should include:

- The time to read the unplanned order cards or read the order release work file
- The time to access and read the item master records. The number of item master records equals the number of card records or the number of order release work records plus the number of items in the exploded assemblies.
- The time to read the product structure file. The number of records equals two times the number of assemblies in the card record or order release work records times the average number of components per assembly.
- The time required to write the order summary work file. The number of records in this file equals the number of unplanned order cards or order release work file records plus the average number of components for each order allocated.

ORDER RELEASE PROGRAM

For each summary record consecutively read on the order summary work file, an open order summary record is sequentially added to the open order summary file.

For timing estimates the user should include:

- The time required to read the order summary work file. The number of records in this file equals the number of open order summary

records plus the number of requisition records and the number of exception records.

- The time to access and read an item master record. The number of item master records equals the number of summary work records in the order summary work file.

- The time required to add the new open order summary records to the open order summary file. The number of records added is the number of new orders processed during the run.

- The time to print the audit list, which contains one line for each item

MATERIAL SHORTAGE REPORT PROGRAM

For each exception record consecutively read from the order summary work file, the item master file is randomly accessed and the item's components are accessed from the product structure file to produce the material shortage report.

For timing estimates the user should include:

- The time to consecutively read the order summary work file. The number of records in this file equals the total of summary work, requisition, and exception records.

- The time to access and read an item master record. The number of item master records equals the number of summary work records in the order summary work file.

- The time required to read the product structure file. The number of records accessed equals the average number of items per assembly multiplied by the number of exception records.

- The time to print one line on the material shortage report for each exception record and one line for each component of the item

OPEN ORDER DETAIL CREATION PROGRAM

The order summary work file is processed consecutively. After each summary work record is read, the standard routing file is accessed randomly to obtain each item's standard routing records for consecutively generating the open order detail work records for each order. The pertinent work center master record for each operation is accessed randomly for additional information. A stock receipt record for each order and the requisition records are written consecutively on the order detail work file.

For timing estimates the user should include:

- The time required to read the order summary work file. The number of records in this file is described above.

- The time required to access and read the standard routing file. The number of records in this file equals the number of summary work records times the average number of operations per item.

- The time to access and read the work center master file. The number of records accessed in this file equals the number of standard routing records read.

- The time required to write the order detail work file. The number of records in this file equals two times the number of summary work records plus the number of open order detail work records, which is equal to the number of standard routing records read plus the number of requisition records, which is the same as previously calculated.

OPEN ORDER DETAIL ADDITION PROGRAM

The order detail work file is read consecutively. As each order summary work record on that file is read, the corresponding record is randomly read by key from the open order summary file. When each open order detail work record is processed, an open order detail record is randomly added to the open order detail file and is chained to the open order summary record. For each open order detail record added to the file, pertinent information is printed in an audit list.

For timing estimates the user should include:

- The time required to read the order detail work file. The number of records in this file is described above.
- The time required to add records to the open order detail file. The number of records added is equal to the number of open order detail work records in the order detail work file.
- The time required to read the open order summary records for providing linkages to the open order detail file. The number of records read and updated is equal to the number of order summary work records in the order detail work file.
- The time required to print one line in the audit list for each open order detail record added

SHOP PACKET CREATION PROGRAM

The order detail work file is read consecutively. The manufacturing routing report and operation, move, material requisition, and stock receipt cards are generated for each open order released during the execution of the order release phase.

For timing estimates the user should include:

- The time required to read the order detail work file. The number of records in this file is described above.
- The time required to print the manufacturing routing, which contains a heading and one line for each operation required for the order
- The time required to punch operation and move cards for each open order detail work record, a material requisition card for each component of the ordered item, and a stock receipt card for the order

OPEN ORDER STATUS AND UPDATE PHASE

OPEN ORDER TRANSACTION EDIT PROGRAM

The operation, move, material requisition, and stock receipt cards received from the shop are read and edited. The item master, open order summary, and open order detail files are accessed to determine that the item and order data in the cards is valid.

For timing estimates the user should include:

- The number of cards read
- The time required to access and read the item master file. The number of records updated is equal to the sum of the material requisition and stock receipt cards.
- The time required to access and read the open order summary file. The number of records updated is equal to the sum of the operation and stock receipt cards.
- The time required to access and read the open order detail file. The number of records processed for updating is equal to the sum of the operation, move, and material requisition cards times the average number of open order detail records per open order.
- The time required to write a record on the update work file for every acceptable card
- The time required to write one line on the error list for every unacceptable card

OPEN ORDER UPDATE PROGRAM

The operation, move, material requisition, and stock receipt cards received from the shop are read to randomly update the item master, open order summary, and open order detail files.

For timing estimates the user should include:

- The time required to consecutively read the update work file
- The time required to access, read, and update the item master file. The number of records updated is equal to the sum of the material requisition and stock receipt cards.
- The time required to access, read, and update the open order summary file. The number of cards updated is equal to the sum of the operation and stock receipt cards.
- The time required to access, read, and update the open order detail file. The number of records processed for updating is equal to the sum of the operation, move, and material requisition cards times the average number of open order detail records per open order.
- The time required to write one line on the audit list for each update work file record

OPEN ORDER STATUS REPORT PROGRAM

The inquiry cards are read to produce the required status reports.

It is very difficult to estimate timings, since the files are accessed randomly and the number of records processed varies, so that the reports printed can contain a variable number of lines of information.

For timing estimates the user should include:

- The number of inquiry cards read

- The average number of open order summary, open order detail, and item master records read to produce the reports. This is determined by the report format field in the inquiry card and the average length of the chain of records to be accessed for each of the item master and open order summary files.

- The number of print lines required in the various reports

OPEN ORDER MAINTENANCE PHASE

OPEN ORDER COMPLETION PROGRAM

The open order summary file is read consecutively. If any record contains the completion or cancellation code, all the open order detail records for that order are randomly accessed and deleted, and the open order summary record activity code is changed to inactive. The open order summary record key in the item master file, which is randomly accessed, is updated if required.

For timing estimates the user should include:

- The time required to read and update the open order summary file. Only those orders that contain the delete code are updated.

- The time required to read and delete the open order detail records. The number of records processed equals the number of deleted orders times the average number of open order detail records per order.

- The time required to read and update the item master records. The number of records processed is equal to the number of open orders completed or cancelled.

- The time required to write one line on the audit list for each open order processed

OPEN ORDER CHANGE PROGRAM

Open order change cards are used to change the quantity or date of an open order, to add or delete open order detail records, or to cancel an order in the open order summary file.

When the open order date has been changed, the open order summary record, the pertinent open order detail records, and the item master record are randomly read and updated. When operations are added or deleted, the open order summary and open order detail files are updated. When an order is cancelled, the open order summary record and the item master record are updated to reflect the cancellation.

For timing estimates the user should include:

- The time required to read the change cards

- The time required to read and update the open order summary records. The number of records processed is equal to the number of change cards.

- The time required to read and update the open order detail records. The number of records processed equals the total number of change cards times the average number of open order detail records per order.

- The time required to read and update item master records. The number of records processed equals the number of cards read with the open order date or quantity changes.

- The time required to write one line on the audit list for each change card processed

WORK LIST PREPARATION PHASE

ORDER PRIORITY CALCULATION PROGRAM

The open order summary file is read consecutively and searched for orders that have not been completed. The open order detail records for each unfinished open order are randomly accessed. For each open order detail record that is accessed, a priority is calculated and a record is written consecutively on the work list file.

For timing estimates the user should include:

- The time required to read the open order summary file

- The time required to read the open order detail file. The number of records processed equals the number of incomplete orders times the average number of open order detail records per order.

- The time required to write the work list file. The number of records equals the number of incomplete orders times the average number of unfinished open order detail records per order.

WORK LIST FILE SORT PROGRAM

The work list file created by the order priority calculation program is sorted according to the priorities assigned to the incomplete orders. The number of records to be sorted is the same as the number calculated for the work list file. The work list file can be sorted using System/3 Disk Sort or an equivalent program.

WORK LIST REPORT PROGRAM

The sorted work list file and the work center master file are input and the work list report is the output. As each work list record is consecutively read, the specified work center master is accessed randomly by key. Data from each file is then included in the report.

For timing estimates the user should include:

- The time required to read the work list file. The number of records is described above.

- The time required to read the work center master file. The number of records accessed in this file equals the number of operation records in the work list file.

- The time required to produce the work list report. The number of lines on the report, in addition to page headings, equals the number of records in the work list file.

PERFORMANCE ESTIMATES

The following data represents samples of performance times for each phase of System/3 Shop Loading and Control. The intent of this data is to provide a sample estimate of monthly computer utilization required for this program product.

Two estimates are provided for each model of the System/3 computer. The smaller figure (Column A) is stated for a configuration composed of the fastest models of the input/output devices stated in the section entitled "Minimum Machine Configuration" with the addition of two 5445 disk storage drives. The larger number (Column B) is stated for the minimum machine configuration for the respective models.

A number of factors which could affect the estimates were not considered. These include:

1. Location of files in terms of the disk drives on which they reside, as well as relative location of files which reside on the same drive

2. Record lengths of other than multiples or submultiples of the sector length

3. A significant amount of user code added to the program

4. Keyboard entry for any input record

5. Number of additions to master files since the last file reorganization

The figures shown are based on the following assumptions:

1000	item master records with open and planned orders
5	items per assembly
5	operations per order
50	work centers
1000	open orders

The summary includes the processing volume assumptions used in estimating these times. The times shown are in minutes per phase.

Phase	Run Frequency	Model 10		Model 6	
		A	B	A	B
Infinite Load - 1000 items with open and planned orders - 10 periods in infinite load report	Monthly	20	70	40	90
Order Release - 100 planned orders released per week	Weekly	50	110	135	180
- 10 unplanned orders released per day	Daily	10	20	15	30
Open Order Status and Update - 400 shop transactions - 300 lines of status reports	Daily	15	30	45	60

Phase	Run Frequency	Model 10		Model 6	
		A	B	A	B
Open Order Maintenance					
- 10 open order changes	Daily	5	5*	5	5*
- 100 open order completions	Weekly	5	10*	10	25
Work List Preparation					
- 50 work center lists @ 6 operations per w/c	Daily	10	40	25	50

A summary of the daily, weekly, and monthly processing time estimates is as follows:

Model 10

Phase	Daily		Weekly		Monthly	
	A	B	A	B	A	B
Infinite Load					20	70
Order Release	10	20	50	110		
Open Order Status and Update	15	30				
Open Order Maintenance	5	5*	5	10*		
Work List Preparation	10	40				
Totals	40	95	55	120	20	70

This yields a monthly utilization range of approximately 20 to 43 hours.

Model 6

Phase	Daily		Weekly		Monthly	
	A	B	A	B	A	B
Infinite Load					40	90
Order Release	15	30	135	180		
Open Order Status and Update	45	60				
Open Order Maintenance	5	5*	10	25		
Work List Preparation	25	50				
Totals	90	145	145	205	40	90

This yields a monthly utilization range of approximately 44 to 70 hours.

*Estimates of less than 5 minutes were specified as 5 minutes.

The sample estimates above are for general planning purposes. To provide a more accurate estimate for his installation plan, the user should work out timings based on the specifics of his plan and system configuration. It is again emphasized that processing volume factors (such as average number of items per assembly, average number of operations per order, etc.) and file considerations (such as location on disk, frequency of reorganization, etc.) can significantly affect the estimate.

All input/output operations are performed using routines that include standard System/3 Disk System Control Program input/output error detection and recovery procedures.

Where possible, fields are verified for correct format and proper range of values and, where applicable, are available for audit list generation. Audit lists and error logging are provided whenever updating is performed on the data base files.

All programs furnish sufficient information, upon the detection of an error, to allow the user to analyze the problem, take corrective action, and, if a halt occurs, to continue when possible.

The user should devise external controls and reasonability checks for the validation of data. System/3 Shop Loading and Control applies no control over the user-specified content of disk records.

Audit lists provide a record of which information is originally or currently included in a file and therefore may be used in the reconstruction of certain records.

RECONSTRUCTION

There must be a periodic backup of all disk storage files. Since relationships among files are represented by linkages, companion files must be backed up at the same time. Disk packs may be used as the backup medium. These backup copies of files must then be saved in the event that a later system problem results in erroneous disk files that cannot be easily reconstructed. From one backup point to another, all maintenance transactions which have been processed against the files must be determined by a comparison of the time and effort required to back up the files versus the time and effort required to reprocess all transactions against the file since the last backup. A very likely point to provide backup follows lengthy batch runs where a very limited amount of user input results in a high degree of change to the disk files. Backup prior to file reorganization is essential.

If a system failure should occur, the user must determine the nature of the failure. Included in this responsibility is the determination of the extent of damage to the files. Where the error is limited and isolated, the user may apply limited disk patches against the file to restore it to the proper condition. Where error is extensive or widespread, the file backup must be used to restore the disk files, and all transactions since that backup copy was made must be reprocessed to make the file current. Also included in the recovery procedure must be the isolation of the cause of failure. Where failure has resulted from a programming error, corrective action must be applied to prevent the same error from again causing system failure.

The programs required for the compilation and execution of the System/3 Shop Loading and Control are:

Program Name	Model 10 Program Number	Model 6 Program Number
System/3 Disk System Control Program	5702-SC1	5703-SC1
System/3 Disk RPG II Program	5702-RG1	5703-RG1
System/3 Disk System Disk Sort Program	5702-SM1	5703-SM1

The program product provides source code written in RPG II. The System/3 Bill of Material Processor (5702-M41) is required for the creation and maintenance of the item master, product structure, standard routing, and work center master files.

MINIMUM MACHINE CONFIGURATION

The minimum system configuration for System/3 Model 10 is as follows:

Device or Feature	
Processing Unit (16K)	5410 A14
Multi-Function Card Unit Attachment	4100
Printer Attachment	3970
Multi-Function Card Unit	5424 Model A1
Printer	5203 Model 1
Printer Attachment	5558
Disk Storage Drive	5444 Model 1

The minimum configuration for System/3 Model 6 is as follows:

Device or Feature	
Processing Unit (16K)	5406 B4
Printer Attachment	3901
Data Recorder Attachment	3210
Printer (85 CPS)	5213 Model 1
Disk Storage Drive	5444 Model 1
Data Recorder Model 1	5496
S/3 Model 6 Attachment	7501

Sufficient disk capacity is required to contain the system program and user data files. Tables 1 through 4 in the Appendix of this manual may be used. In addition, consult the appropriate System/3 manuals to determine total file requirements.

For the Model 6, special consideration must be given to the user's input/output volume requirements with respect to the equipment capabilities. The speed of the I/O devices (for example, the printer and data recorder) has a significant effect on the overall throughput, and must be thoroughly examined and evaluated relative to the user's overall system requirements.

In addition to the Disk System Control Program, a minimum of 13K bytes is required to compile and execute the programs.

For the Model 10 user, improved performance will result with additional core storage capacity, as the overlay requirements will be reduced or eliminated.

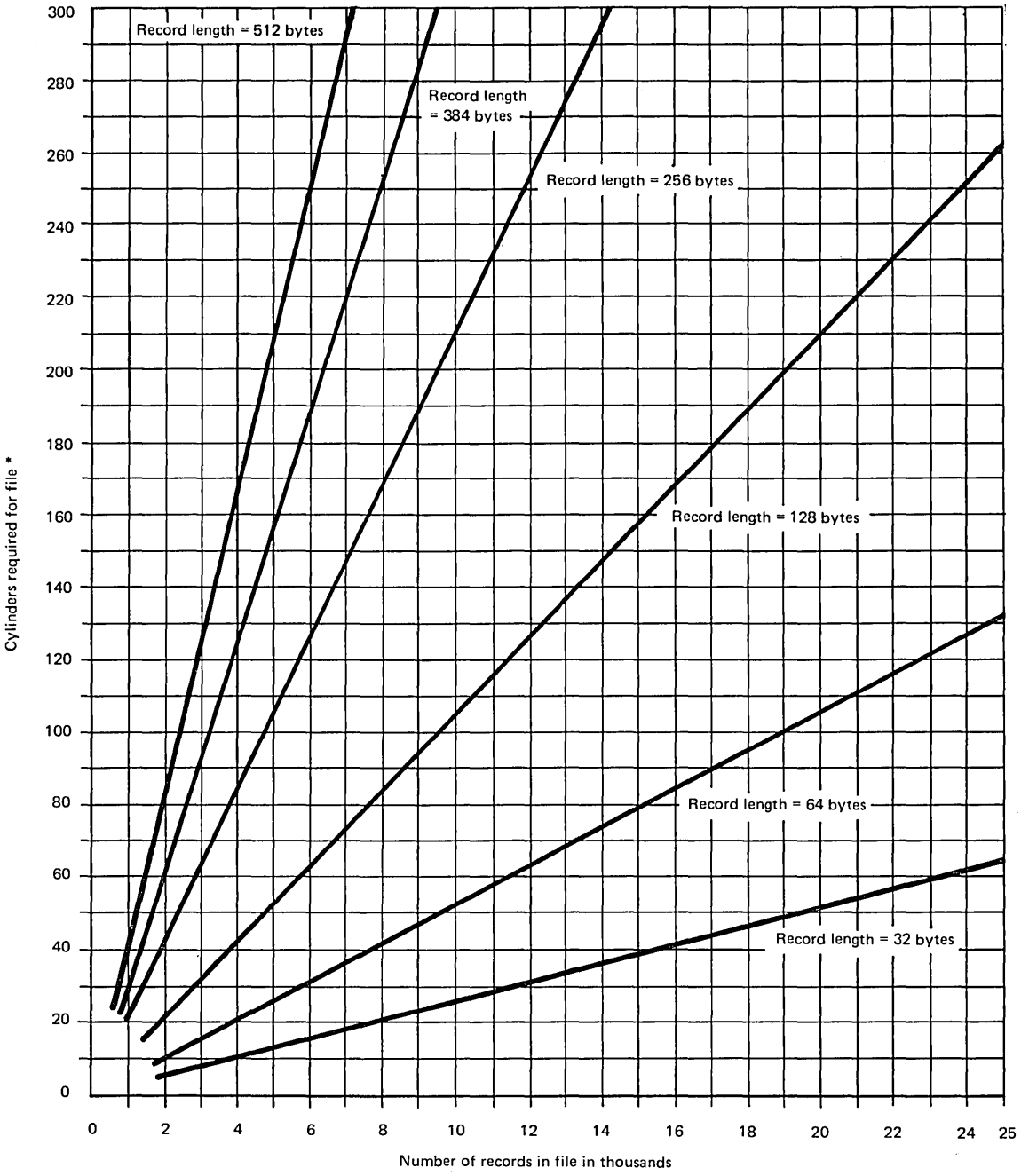
APPENDIX: DISK STORAGE REQUIREMENTS

Four tables are provided as an aid for estimating disk storage requirements for System/3 Shop Loading and Control. Tables 1 and 2 can be used to quickly approximate the number of cylinders required to store a given number of records of various lengths for the 5444 and 5445 Disk Storage Drives, respectively. To use Table 1 or Table 2, select along the horizontal axis the line which represents the number of records to be stored in a file. Follow the selected line until it intersects the diagonal line which most closely represents the desired record length. Follow the closest horizontal line to the left and read the number of cylinders required to contain the file.

As an example, assume that the data base must contain 8000 item master records of a length of 384 bytes, 25,000 product structure records of a length of 32 bytes, 25,000 standard routing records of a length of 64 bytes, 75 work center records of a length of 128 bytes, 2000 open order summary records of a length of 128 bytes, and 10,000 open order detail records of a length of 128 bytes. Tables 1 and 2 indicate the file storage required to contain the files would be as follows:

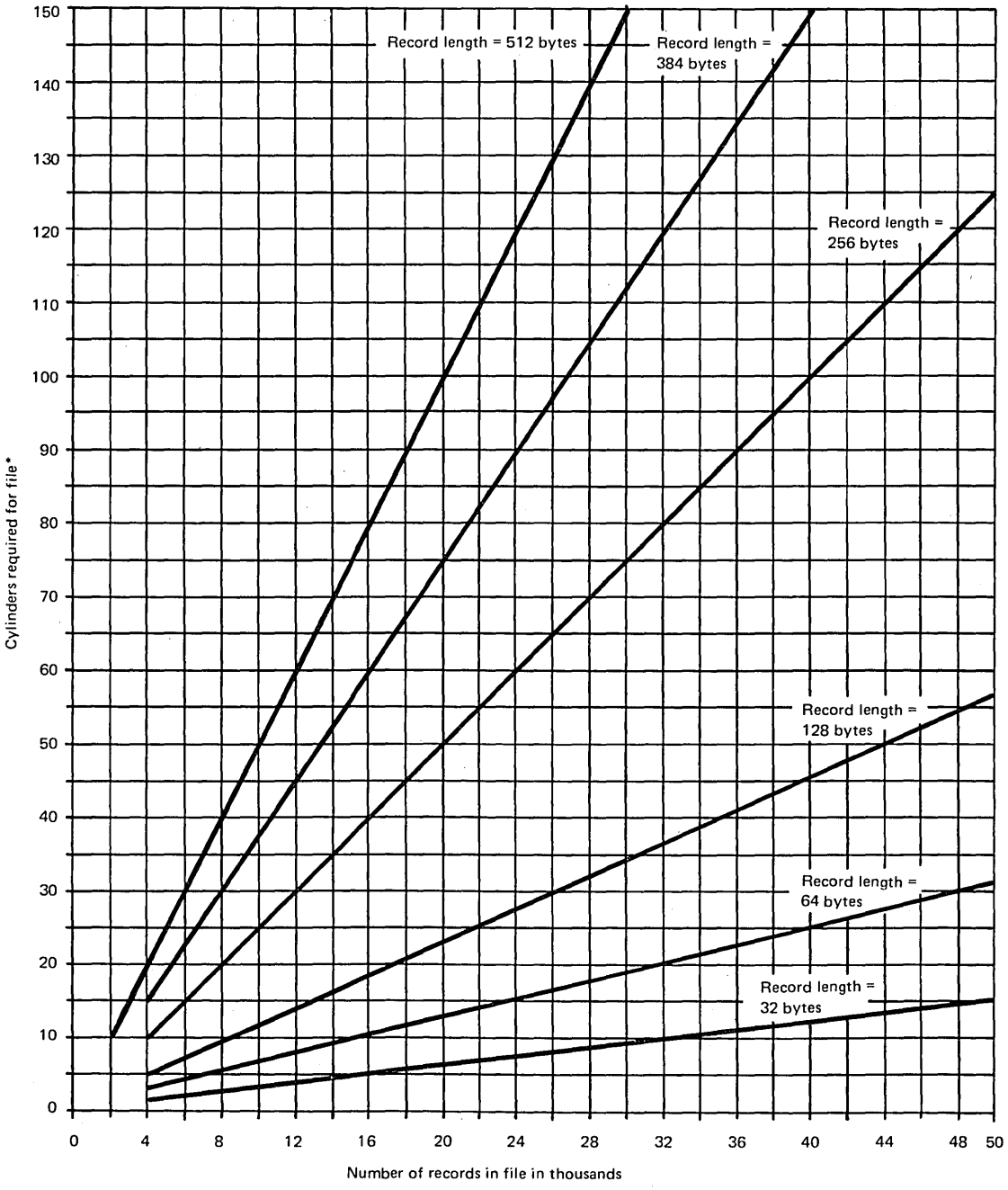
	Table 1	Table 2
Item master -	255 cylinders	30 cylinders
Product structure -	65 cylinders	8 cylinders
Standard routing -	132 cylinders	17 cylinders
Work center master -	1 cylinder	1 cylinder
Open order summary -	22 cylinders	3 cylinders
Open order detail -	105 cylinders	13 cylinders

Table 1. File Allocation for 5444 Disk Storage Drive



* Record storage area only; index area for indexed file is not included.

Table 2. File Allocation for 5445 Disk Storage Drive



* Record storage area only; index area for indexed file not included.

Tables 3 and 4 are provided to determine the number of tracks or cylinders required to contain the index of an indexed sequential file for the 5444 and 5445 Disk Storage Drives, respectively. An index record must be in the index for every record in an indexed sequential file. The index record contains the record key plus a three-byte disk address for the 5444 Disk Storage Drive and the record key plus a four-byte disk address for the 5445 Disk Storage Drive. The index of an indexed sequential item master file of 8000 records contains 8000 index records. To use Tables 3 and 4, read down the column labeled Key Length to the required key length and read across to the number of index records in a sector, track, or cylinder for that key length. Divide the number of records in the file by the number of index records per sector, track, or cylinder to determine the number of sectors, tracks, or cylinders required to contain the index. The results should be rounded up to the next whole number.

As an example, assume the item master records discussed previously in the example for Tables 1 and 2 contained a key length of 9 bytes, the work center master records had a key length of 12 bytes, and the open order summary records had a key length of 6 bytes.

For the item master file, Table 3 indicates that 504 index records can be contained on one track or 1008 index records on one cylinder. Dividing 8000 by 504 and 1008 and rounding up results in 16 tracks or 8 cylinders, respectively, required to contain the index for the item master file. Table 4 indicates that 380 index records can be contained on one track or 7600 index records on one cylinder. Dividing 8000 by 380 and 7600 and rounding up results in 22 tracks or 1 cylinder and 2 tracks, respectively, required to contain the index for the item master file.

For the work center master file, Table 3 indicates that 17 index records can be contained in one sector. Dividing 75 by 17 and rounding up results in 5 sectors. Table 4 indicates that 16 index records can be contained in one sector. Dividing 75 by 16 and rounding up results in 5 sectors being required to contain the index. Since partial index tracks are rounded to a full track, one track is required to contain the index for the work center master file for either type of drive.

For the open order summary file, Table 3 indicates that 672 index records can be contained on one track or 1344 in one cylinder. Dividing 2000 by 672 or 1344 and rounding up results in 3 tracks or 1 1/2 cylinders required to contain the index for the open order summary file. Table 4 indicates that 500 index records can be contained on one track. Dividing 2000 by 500 results in 4 tracks being required to contain the index for the open order summary file.

Table 3. Index Area for Index Sequential Files (5444 Disk Storage Drive)

Key Length In Bytes	INDEX RECORDS		
	Per Sector	Per track	Per cylinder
2	51	1224	2448
3	42	1008	2016
4	36	864	1728
5	32	768	1536
6	28	672	1344
7	25	600	1200
8	23	552	1104
9	21	504	1008
10	19	456	912
11	18	432	864
12	17	408	816
13	16	384	768
14	15	360	720
15	14	336	672
16	13	312	624
17	12	288	576
18	12	288	576
19	11	264	528
20	11	264	528

Table 4. Index Area for Index Sequential Files (5445 Disk Storage Drive)

Key Length in Bytes	INDEX RECORDS		
	Per sector	Per track	Per cylinder
2	42	840	16800
3	36	720	14400
4	32	640	12800
5	28	560	11200
6	25	500	10000
7	23	460	9200
8	21	420	8400
9	19	380	7600
10	18	360	7200
11	17	340	6800
12	16	320	6400
13	15	300	6000
14	14	280	5600
15	13	260	5200
16	12	240	4800
17	12	240	4800
18	11	220	4400
19	11	220	4400
20	10	200	4000

GLOSSARY

Capacity. Number of machine or labor hours during a time period that work center facilities are available for use.

Capacity planning. Function of determining capacity requirements for men and machines. Can imply both infinite loading and finite loading.

Component requirements. This is the quantity of a component part that must be available before the order for the assembly or higher-level part can be released to the shop.

Normal capacity. Capacity estimated to be available for loading purposes, normally the present operating level of the plant.

Infinite loading. Determination of loads (man-hours or machine hours) by work center and time period imposed by order requirements, regardless of available capacity of the work centers.

Lead time. Number of days required for an order or item to be made, assembled, or purchased.

Open order. Order which is in the process of being issued to the shop floor or vendor, or which is partially complete. Represents a firm commitment for an order expected to be received in inventory at some future date.

Percent tolerance. Value used in the order release phase to indicate what percentage of the total component quantity must be available to allow the order to be released. For example, a value of 95 would indicate that if 95% of the component requirement were available, the component would be considered available.

Period. Segment of time (day, week, month) for which load hours are accumulated.

Planned order. Order reflecting future item requirements after deduction of inventory and open orders.

Planning horizon. Time range for which capacity planning is to be performed.

Plant. The entire physical facility for which the capacity planning system is run.

Release cycle. Time required to prepare the necessary documents and draw material from inventory before a production order can begin.

Routing. Information indicating the sequence in which work is to be performed for the fabrication or assembly of an item.

Shop. Subdivision of the plant, usually characterized by functions common to several work centers.

Shop calendar. Dating technique which eliminates nonwork days and numbers the remaining days, typically from 001 to 999, thus giving 999 consecutive work days (about four calendar years).

Shrinkage factor. Factor applied to an order requirement to reflect spoilage during production or rejected purchased material. Not used when a gross requirement is covered by inventory.

Time tolerance. Value used in the order release phase to indicate the number of days after a component requirement date that open or planned orders may be considered in fulfilling the component quantity requirement.

Transit time. Time from the completion of one operation to the start of the next.

Work center. Basic production facility in a plant considered for capacity planning. For loading purposes, generally considered to be a group of like machines; consequently, work is considered performed equally well on any machine in the group. A machine with unique characteristics can, by itself, be considered a work center. A work center can also consist of assembly areas or a pool of setup men, for example.

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