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DESIGN OF A COMPUTER-BASED MANUFACTURING CONTROL AND INFORMATION SYSTEM FOR AN ENTERPRISE PRODUCING ELECTRIC MACHINERY

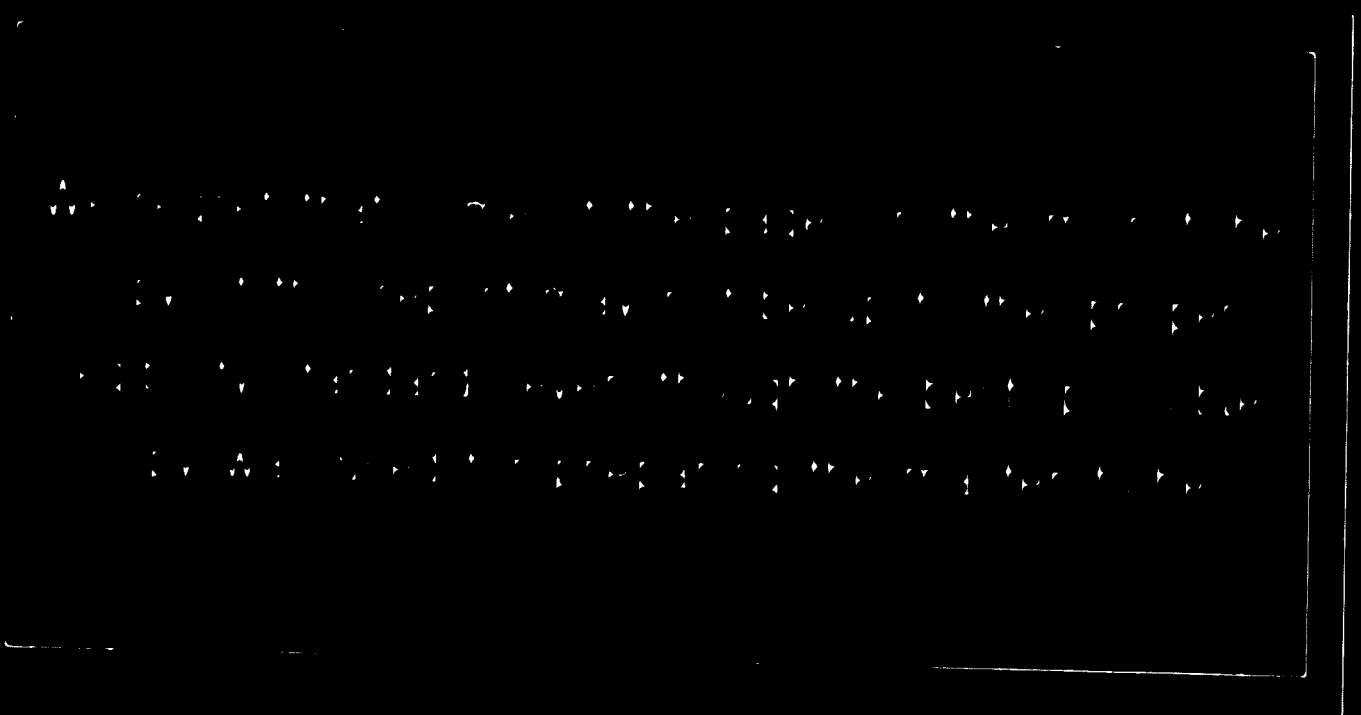
ID/HUN/74/010

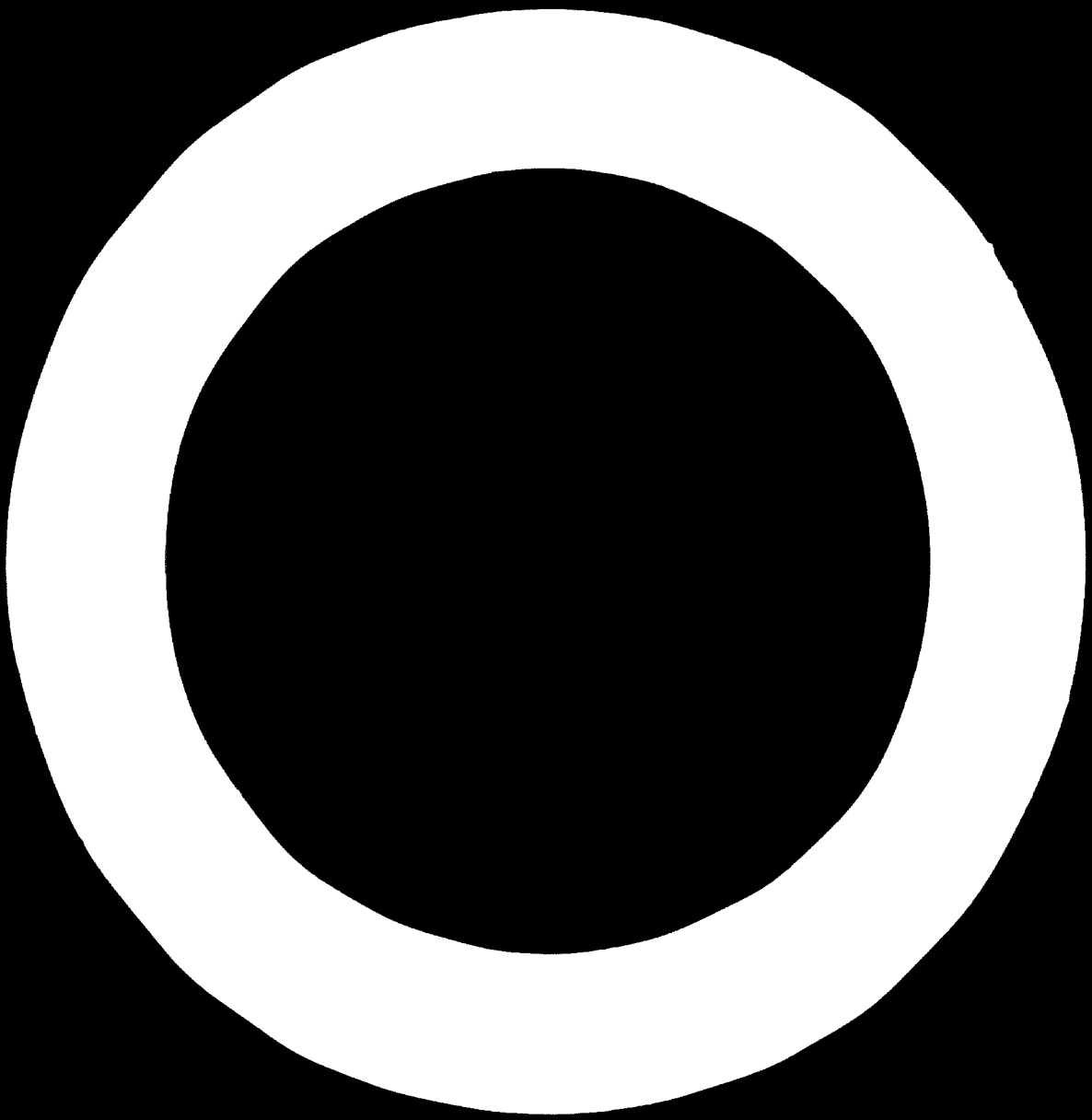
HUNGARY.

Technical report:
SYSTEMS ARCHITECTURE (175)

Prepared for the Government of Hungary by the
United Nations Industrial Development Organization,
executing agency for the
United Nations Development Programme

United Nations Industrial Development Organization





United Nations Development Programme

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DP/HUN/74/010

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Technical report: Systems architecture

Prepared for the Government of Hungary
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Horst D. Klette, operations research and computer programming expert

United Nations Industrial Development Organization
Vienna, 1975

Explanatory notes

The following abbreviations are used in this report:

CPU	Central processing unit
EDP	Electronic data processing
EVIG	Egyesült Villamosgépgyár (United Electric machine works)
SFC	System flow chart

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SUMMARY

This study describes a number of electronic data processing (EDP) application modules that will form the architecture of a new computer-based integrated production management system for the enterprise EVIG. (See section A.)

The study gives an over-all review of the existing system and covers specifically its relation to the creation of manufacturing sequencing. (See section B.)

A general and detailed design of module BR/02 (master routing/technological file) was developed for the new integrated manufacturing control system and is given in section C of this study.

INTRODUCTION

The project "Design of a Computer-Based Manufacturing Control and Information System for an Enterprise Producing Electric Machinery" (IS/HUN/74/010) is a continuation of an earlier project (IS/HUN/72/004). The enterprise, EVIG, is a major manufacturer of electric motors and equipment. It has nine manufacturing units and produces a wide range of electric motors, hand tools, cable fittings, ferrous and non-ferrous castings, industrial electronics and electrical equipment. The enterprise has access to third generation computing equipment.

The project results from the high priority that management has given to organization and information systems design. The company wants to improve its organizational structure and line of control through the implementation of an integrated management and control system, broadening simultaneously its in-house systems design competence.

The growth and demands for hardware and software for manufacturing control systems have increased steadily in industry during the last 20 years. Today, most of the large manufacturing companies have designed or are in the process of designing their own computer-based manufacturing control systems.

Thus, the main objective of the project was to design a manufacturing control system including the generation of major records and files. After the general outline and module priority were established, the project team was divided into smaller groups, each responsible for a phase of general design, detailed design and implementation of the modules. In designing the data base modules, care was taken that all usable data from the existing system should be captured and transferred to the new system.

I. DESIGN OF A COMPUTER-BASED MANUFACTURING CONTROL AND INFORMATION SYSTEM

A. Architecture of the new MIS system

Manufacturing information systems with the availability of third generation computers, disk storage devices and general application packages (provided by the computer equipment manufacturers) are capable of assisting the management of many enterprises with new and improved techniques for the use of data and information processing. The scope of computer supported information systems varies from enterprise to enterprise. Each system, however, may be considered as being composed of a number of applications. The system under discussion consists of nine major system modules.

Description of the system

The information system may be considered as a system trying to maintain a balance between the demands placed upon the manufacturing enterprise and the inventory which consists of physical stock and committed orders for production and purchasing. If the available inventory and open orders equal the known requirements a balance situation exists. In this event the manufacturing and purchasing activities would continue to follow their previously established plans. However, if requirements for finished goods, spare parts etc. are higher than the planned inventory (that is, inventory available for the time period considered), recommendations (for the short items) are made to the production planning and control and/or the purchasing function. The recommended orders, if committed, restore the inventory requirements balance. Changes in requirement or inventory may result in a situation of excess inventory.

The analysis is performed by the requirement planning module. Its output is a list of recommended items to make and/or buy.

The quantities, which may be economically optimized, are identified with start and end dates. Exceptions in requirement or inventory are also identified. If excess inventory exists, either in physical stock or in orders, then the fact is highlighted.

Purchased items are issued to vendors and received by the enterprise warehouses. The problem of planning the purchasing activity is supported by the purchase module. The physical inventory module accounts for the movement of inventory into and out of the warehouses.

Manufacturing items, after review by the production planning and control function, are released to the manufacturing floor. The order release module is intended to support management with the problem of releasing work to the manufacturing floor.

The planning of short-term activities on the manufacturing floor and controlling the execution of this plan are supported by the manufacturing control module.

The basic records modules support all of the modules. Its support is the EDP foundation of this system or, in other words, it is the "data base" of the system. It provides both technical feasibility to the system and a necessary means of achieving module integration.

The generalized approach to the system design enables data for further modules to be added to the data base at any time. Further, the data base can be changed without affecting any module programs which have already been written. This feature can be appreciated during an expansion of the user's data processing.

Modular programming techniques are used for all modules programs. Modules are defined and arranged together in a hierarchical structure and each may be individually tested before it is assembled with other modules. Furthermore, from the user's point of view, this architecture makes it simple to modify the system.

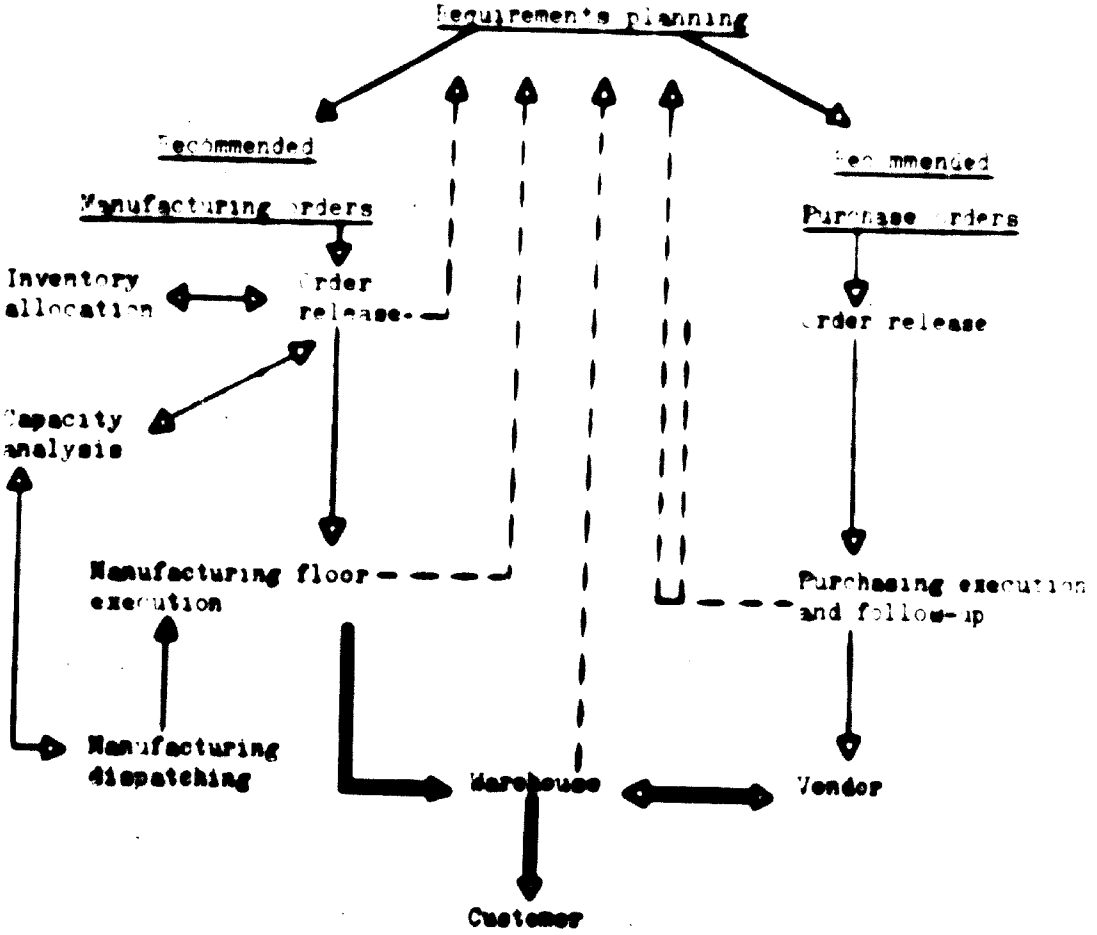
Figure I indicates the relationship of application, planning and feedback. Control, as always, must be executed by management. The information system, to the extent devised by management, may identify and alert management to problems in the short and intermediate time range.

Brief description of the system modules

Common data entry module. The verified punched cards from different source data documents (each module has at least one source data document) are the input for the common data entry module. The information from these cards is sorted, merged and edited. It is put on to magnetic tape files and constitutes the input data for various modules.

Basic records 01 module. This application provides maintenance of the basic data required to support the entire information system. This module

Figure 1. Manufacturing planning and control system.
Computer application module interfaces.
Manufacturing master production plan, order entry



[illegible] to "data base" of the system. The data base is supported by:

a) Item number description, planning and control constants;
b) Bill of material structure records definitions.

Master production schedule. This application provides the "planning" component that specifies the [illegible] of [illegible] of end items during the manufacturing process.

Physical inventory system. This application maintains the physical inventory records. Warehouse personnel are provided data collection terminals and procedures on a current basis.

Requirements planning module. This application summarizes the data generated by the master schedule. It provides management with information which:

Determines net finished product requirements
Determines net component item requirements
Plans economic lot size or order quantities
Offsets requirements by considering lead times
Provides exception and order requirement reports for management review

Order release module. This application provides management with the orderly and controlled release of manufacturing orders to work in process and provides information to the warehouse about items to issue, where and when.

Manufacturing floor control module. This module provides management with a systems capability of improving manufacturing and control activities. To perform these tasks accurately the module requires feedback from the manufacturing floor about the status of the work in process.

Purchasing module. The main function of this application is to provide management with a systems capability of tracking and generating exception alarms for externally supplied items.

Common print module. The purpose of the common print module is to have one print main line program for all the discussed modules and those to be added in the future. The print main line program branches out to subroutines to accommodate the specific print requirements of each module.

Objectives and flow charts of the system modules

It is assumed that the reader has some familiarity with information processing via computers and an understanding of manufacturing information processing problems.

Common data entry module. The objectives of this module are to:

Accept all the different source document data in card format as input

Output source data (sorted, edited, formated) on magnetic tapes suitable for use as the input source for the different modules

EVIC's computer system as the data processing device. (See figure II for system flow chart (SFC).)

Basic records 01 module. The information system design that satisfies the needs of a manufacturing enterprise requires that the information be up-to-date and easily maintained. In other words the main objective in an integrated manufacturing information system is very much concerned with methods of creating and maintaining large data files. In addition, the system must be flexible enough to satisfy multiple uses. The basic records 01 module satisfies these requirements in a single file of item master data and product structure data. This file needs to be captured only once at its source. It simplifies file maintenance, eliminates costly duplications of effort and improves the probability of providing accurate up-to-date information for all areas of the enterprise. The framework for the module is supported by an IBM application package which creates, maintains and retrieves the item number master record file and the product structure record file. (See figure III for SFC.)

Basic records 02 module. This module will be discussed in detail in section C of this chapter.

Physical inventory module. The primary objective of this application is to provide basic information about the status of on-hand or warehouse inventories. This information specifically includes the following:

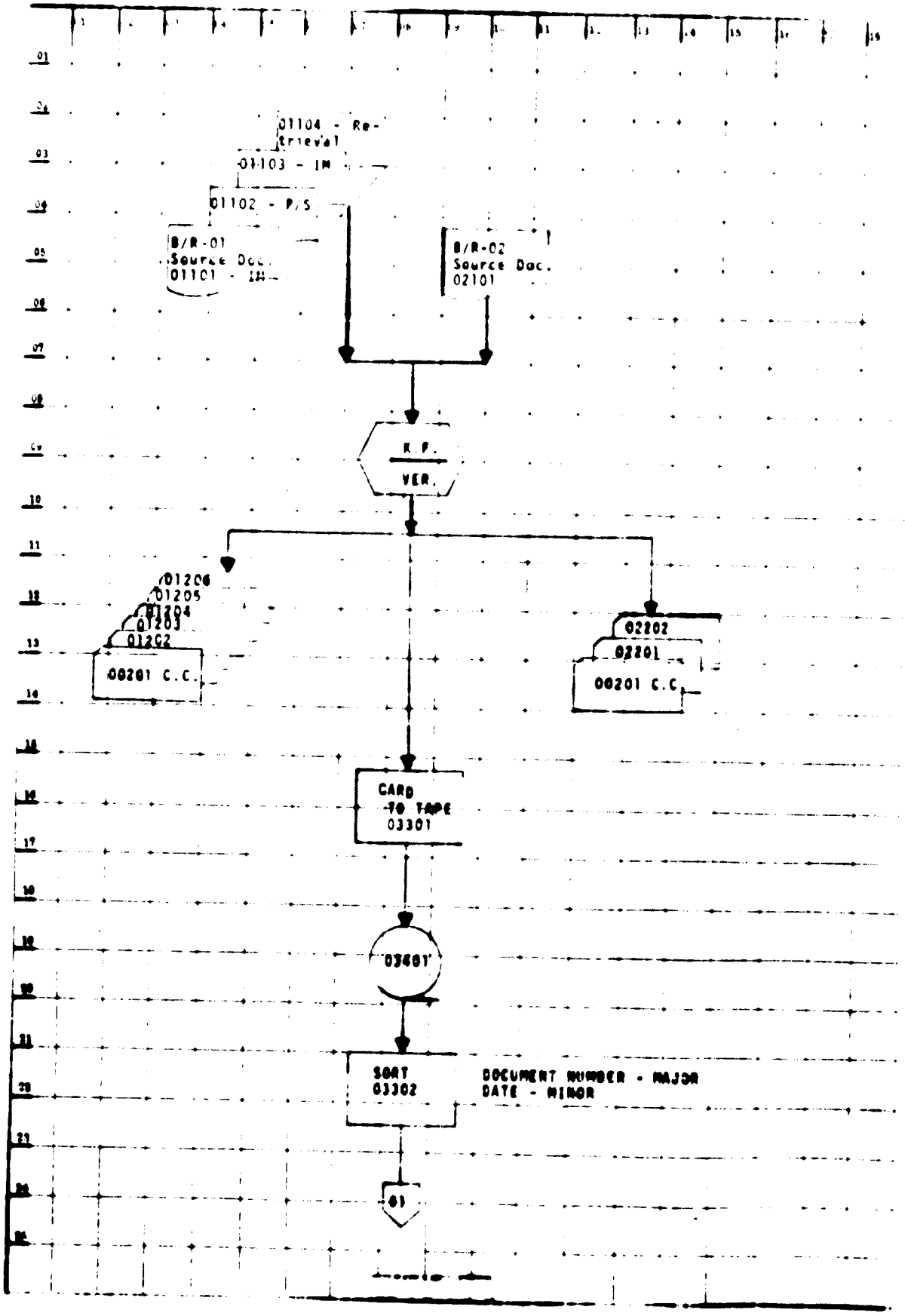
Current balance on hand

Safety stock level, zero balance or negative balance level notifications

Quantity on hand allocated to in-process demands

The secondary objective is to monitor daily warehouse activities. Daily monitoring is provided for several reasons:

Figure 11. System flow chart. Common data entry module (3



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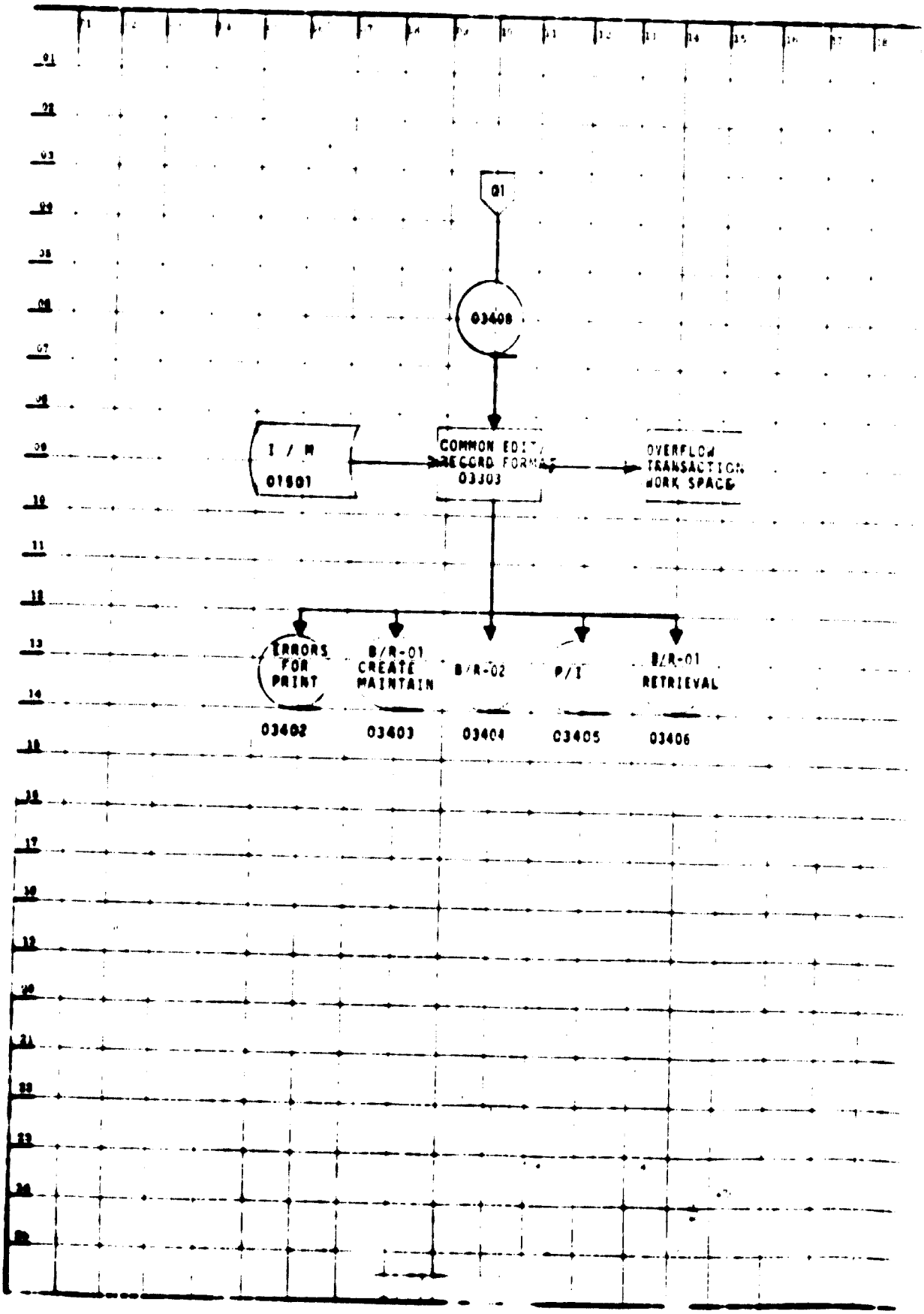
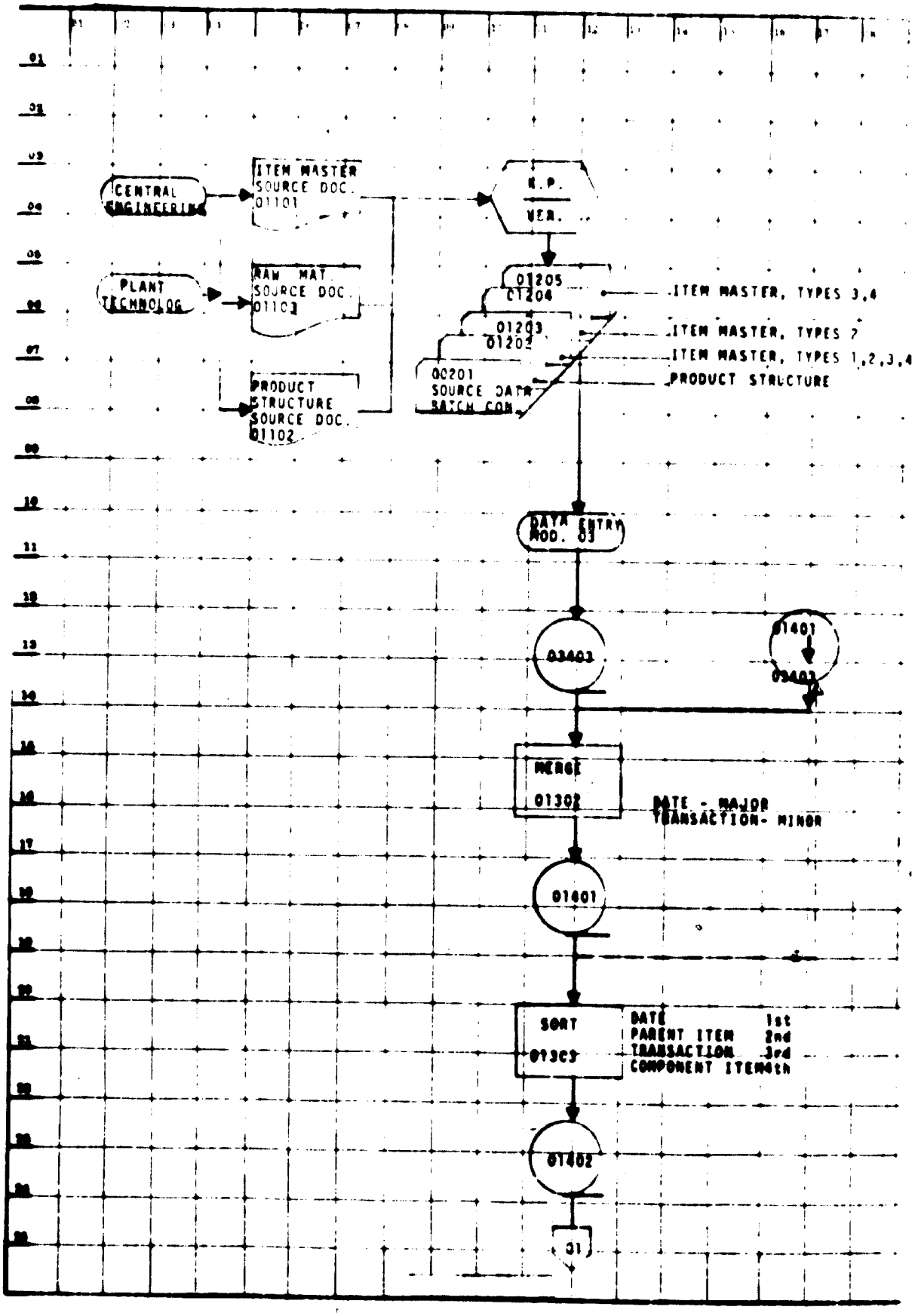


Figure III. System flow chart. Basic records of 1 module



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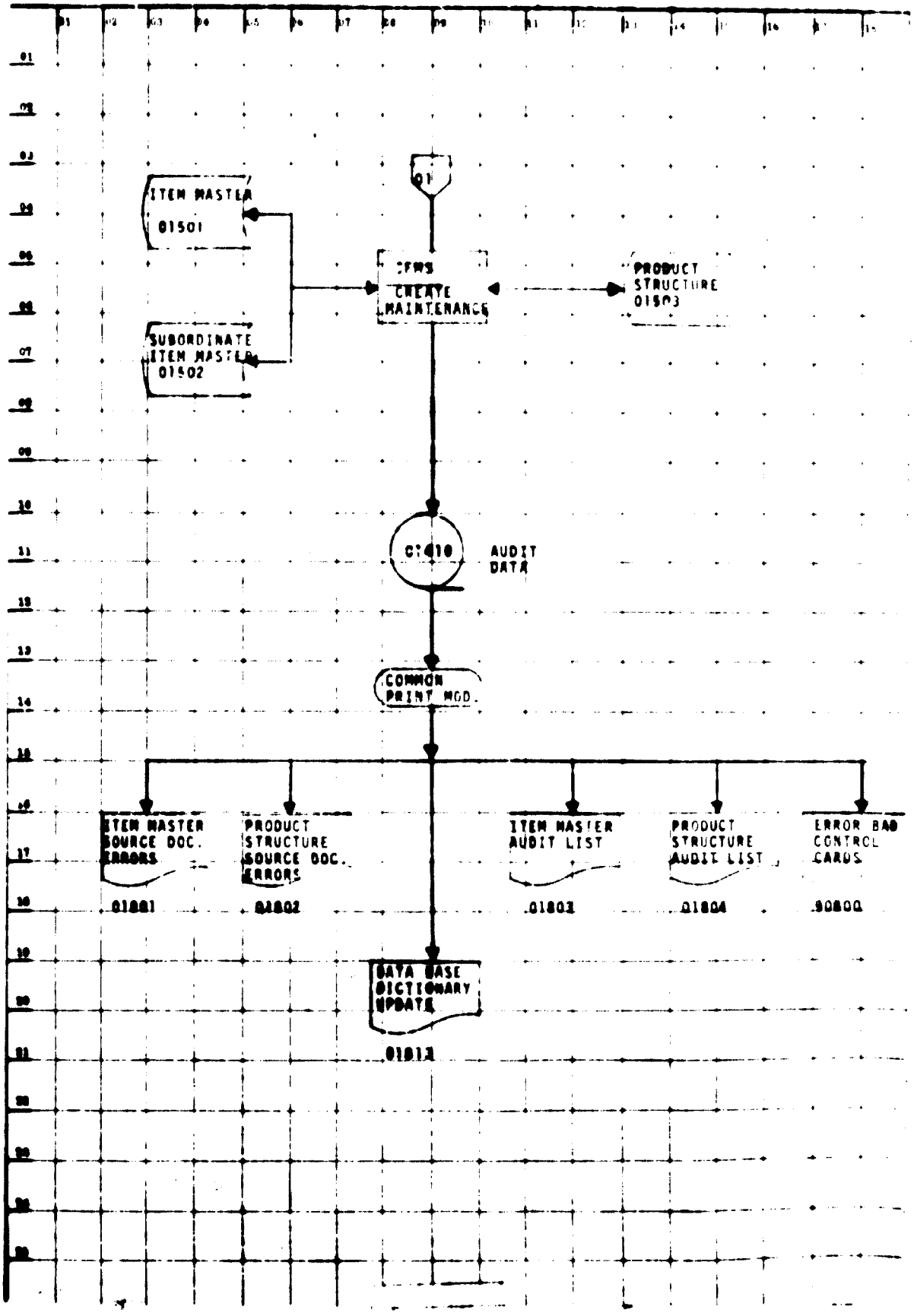
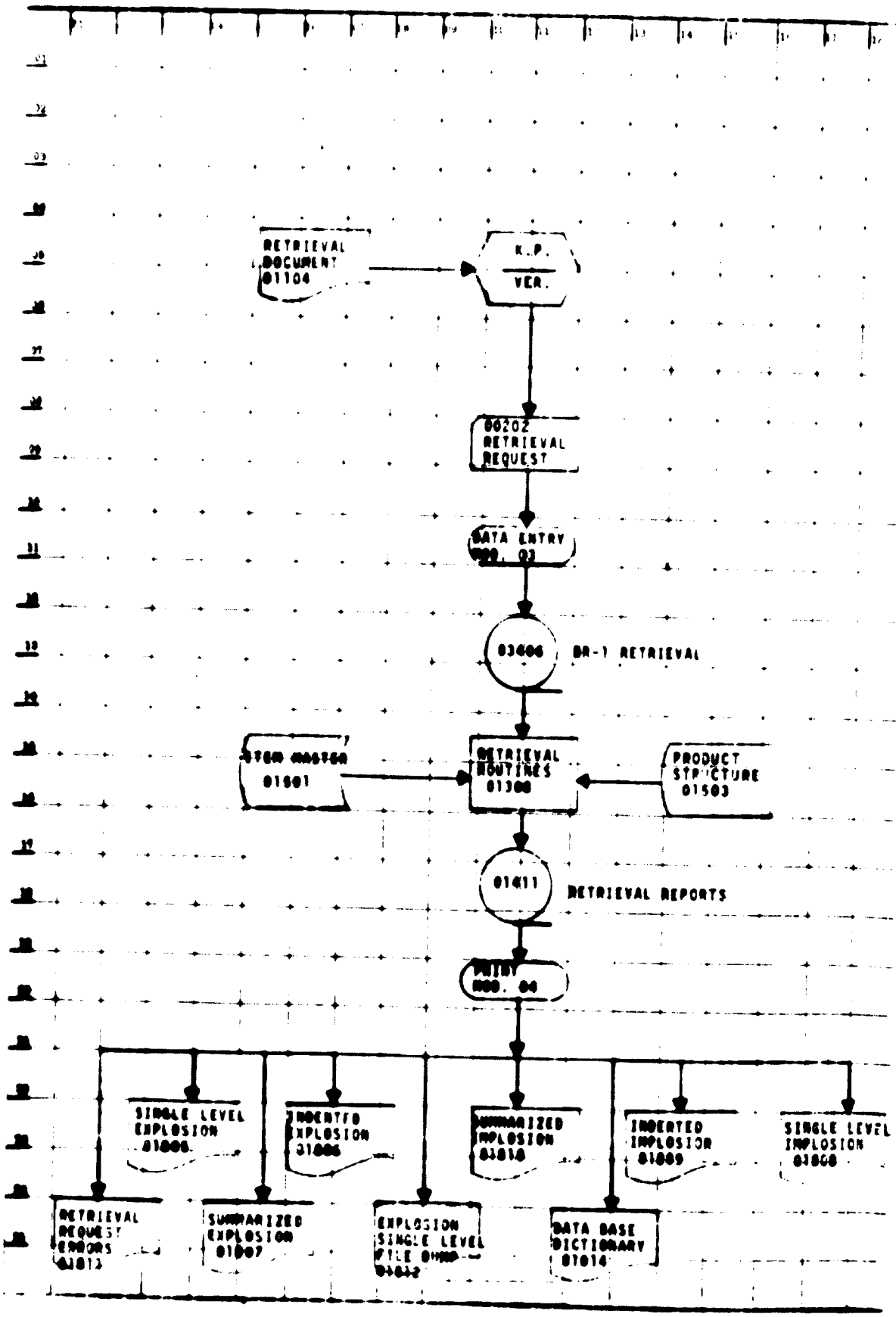



RETRIEVAL DOCUMENT 01104
K.P. VER.
00202 RETRIEVAL REQUEST
DATA ENTRY
03406 BR-1 RETRIEVAL
ITEM master 01501
RETRIEVAL ROUTINES 01308
PRODUCT STRUCTURE 01503
01411 RETRIEVAL REPORTS
SINGLE LEVEL EXPLOSION
INDENTED EXPLOSION 01006
SUMMARIZED IMPLOSION 01010
INDENTED IMPLOSION 01009
SINGLE LEVEL IMPLOSION 01008
RETRIEVAL REQUEST ERRORS 01012
SUMMARIZED EXPLOSION 01007
EXPLOSION SINGLE LEVEL
DATA BASE DICTIONARY 01014

(a) Accurate maintenance of physical on-hand stock balance in the item master file is essential if the information system is to provide a reliable management tool;

(b) User discipline: reliability, persistence and adherence to application rules and procedures is a must for the information system to function successfully;

(c) It is important to identify and correct faulty recordings of warehouse activities as soon as possible. (See figure IV for SFC.)

Requirements planning module. The objectives of this application are to determine raw materials, detail items, purchased items, subassemblies and assemblies needed to execute the finished-product plan that has been manually generated. In other words, it provides a level by level explosion of the complete production program of finished products, including service or repair items as well as end products. The aim is to determine requirements as quickly and as accurately as possible, as well as react quickly to changes in forecasts, order calculations of enterprise policy. To be effective the system should be able to do the following:

Determine net finished product requirements

Determine gross component requirements

Determine net component requirements

Plan lot-sized requirements on the basis of manufacturing or procurement lead times

React to revised orders or forecasts through requirements alteration

Make available only the information desired

Provide exception notices for management action (See figure V for SFC.)

Order release module. The objective of this module is to release work and material to the manufacturing process. This objective may be broken down into the following specifics:

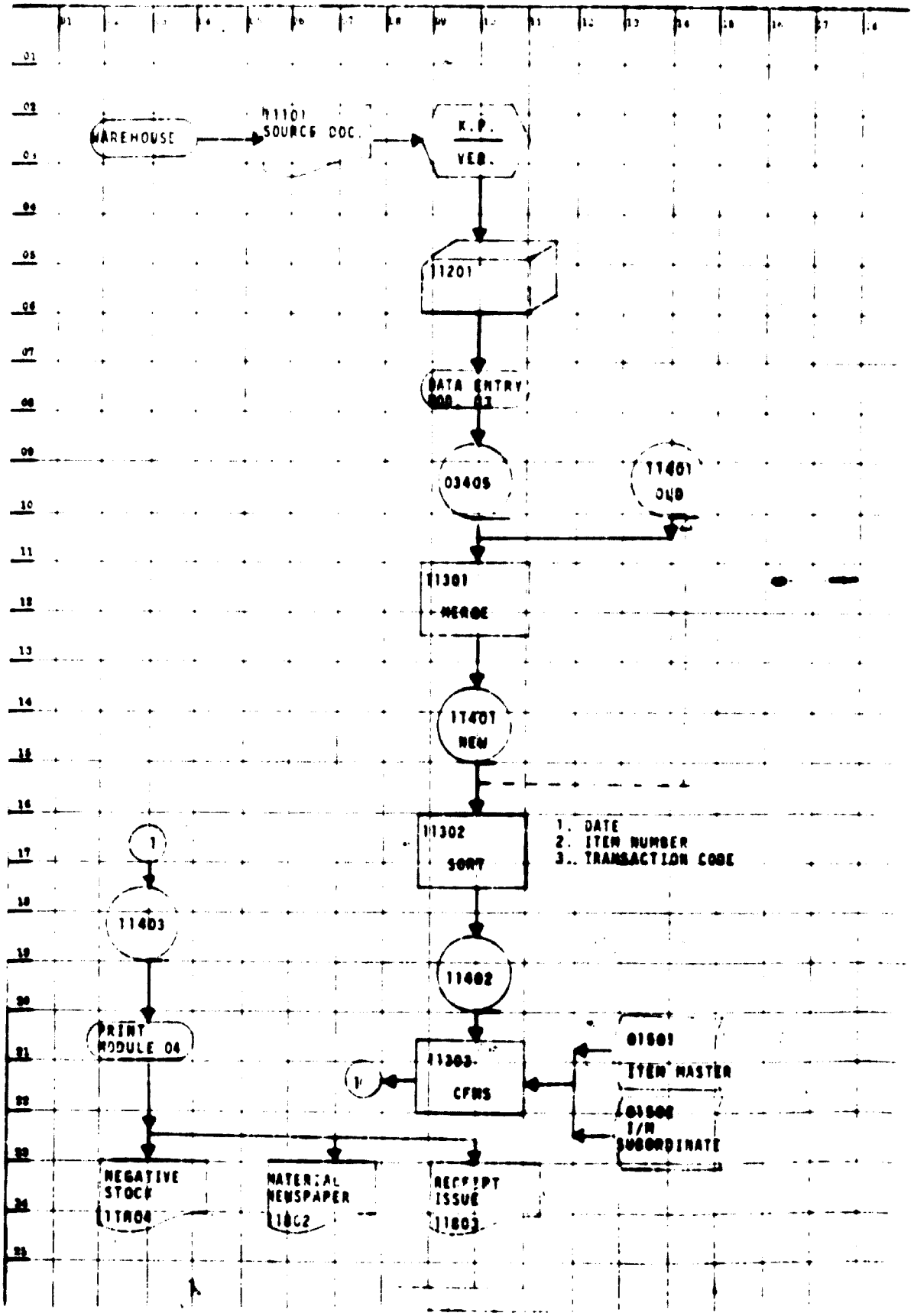
Provide ability to release internal manufacturing orders and make change to released orders

Provide ability to change bill of material or requisition issue authorizations

Provide ability to initiate and change warehouse issue lists to external (outside of the enterprise) sources

Generate requisitions for internal issue for use by the physical inventory module

Figure IV. System flow chart. Physical inventory module



Provide ability to generate necessary paper work for manufacturing floor use; this is to include: (a) shop operation control card; (b) order release summary lists; and (c) shop movement documents

Provide status data for specified items in process or all released work in process

Generate a closed orders history report

Generate a monthly scrap/labour summary report (See figure VI for SFC.)

Manufacturing floor control module. The principal objective of the manufacturing floor control module is to collect manufacturing floor activity data and maintain the manufacturing open-order file. This in turn supports the generation of status reports via the order release module. The secondary objective is to summarize the labour data obtained by various labour accounts and make labour comparisons between actual and standard hours. (See figure VII for SFC.)

Purchasing module. The objectives of this application are:

To provide the system with data about vendor orders

To provide answers to questions regarding orders, quantities, dates and vendors

To reduce duplicate manual file keeping, by providing a means whereby accurate and singular records may be maintained

To identify and react faster to out-of-control supply conditions (See figure VIII for SFC.)

Common print module. The objectives of this module are:

To print all the required report outputs of the system

To use EVIC's computer system as the data processing device (See figure IX for SFC.)

B. Present routing system

At the request of the EVIC management, a study to analyse EVIC's present routing system was undertaken. The objectives of the study were as follows:

1. Documenting the existing system: (a) source documents; (b) card, paper, tape, magnetic tape file description; (c) program description and functions; and (d) programme outputs.
2. Establishing the validity of report outputs.
3. Identifying the system errors in program and hardware.

Figure .. System flow chart, requirements planning module (gross and net

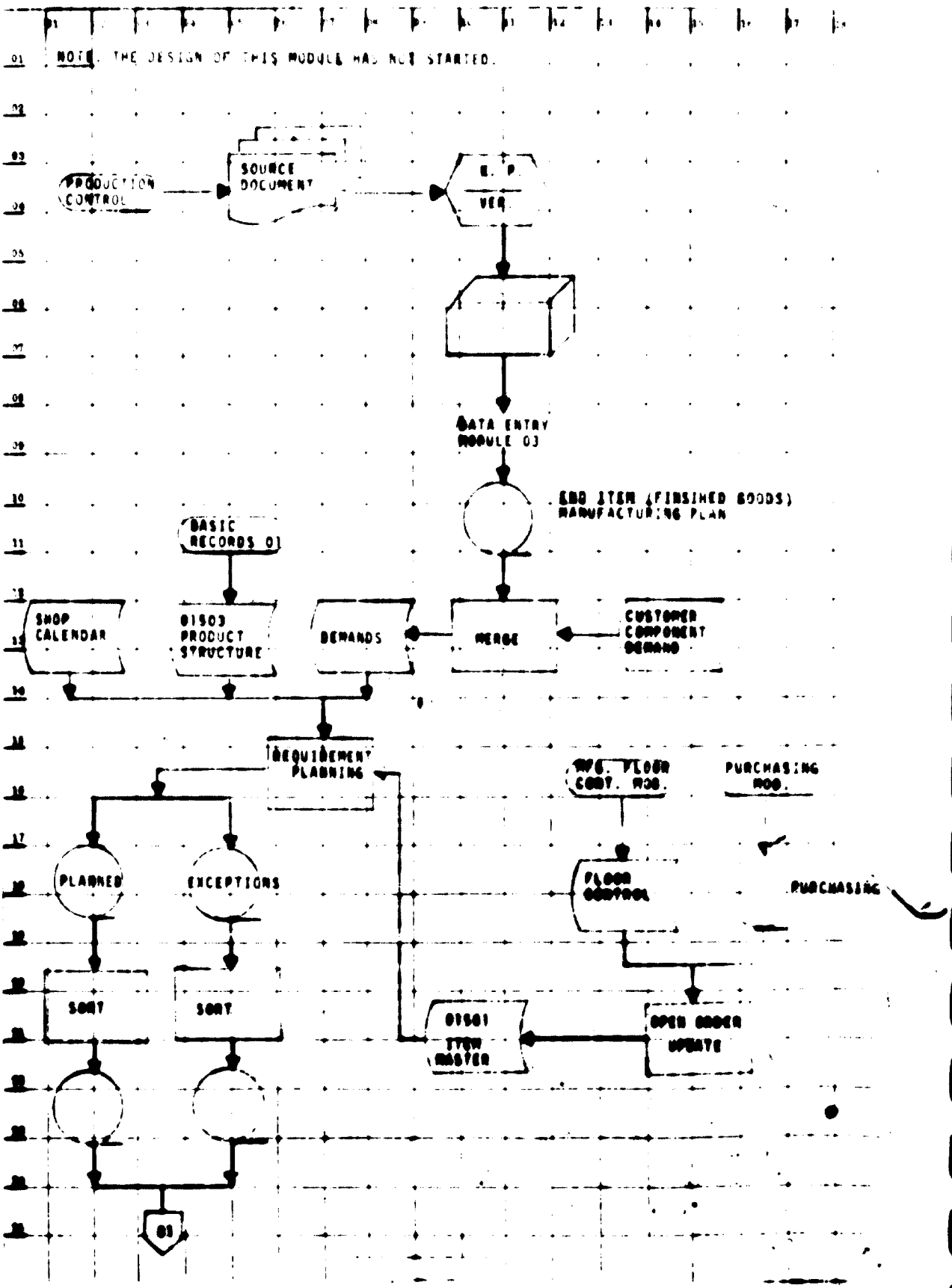


Figure V (continued)

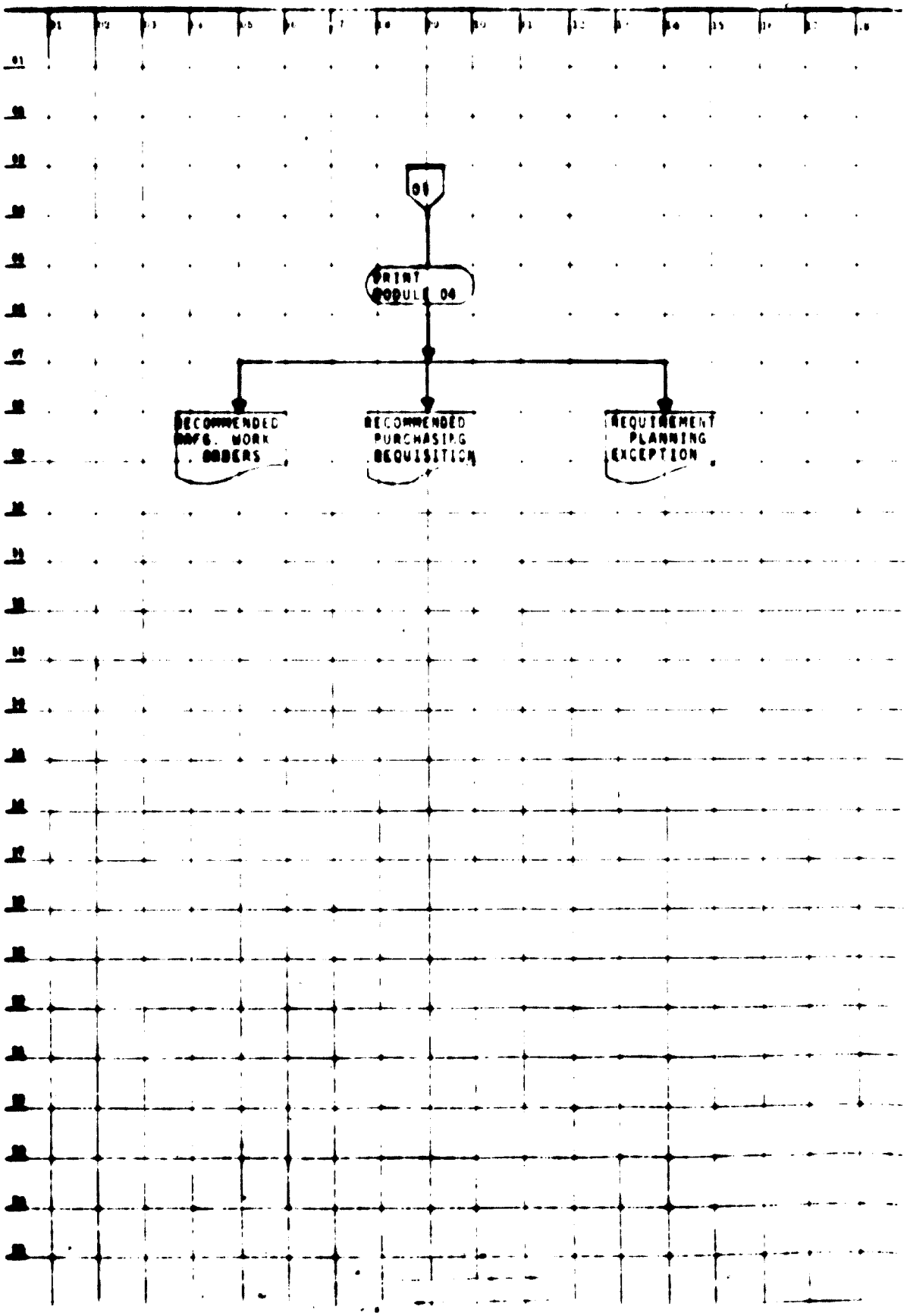


Figure 11. System flow chart. Order release module

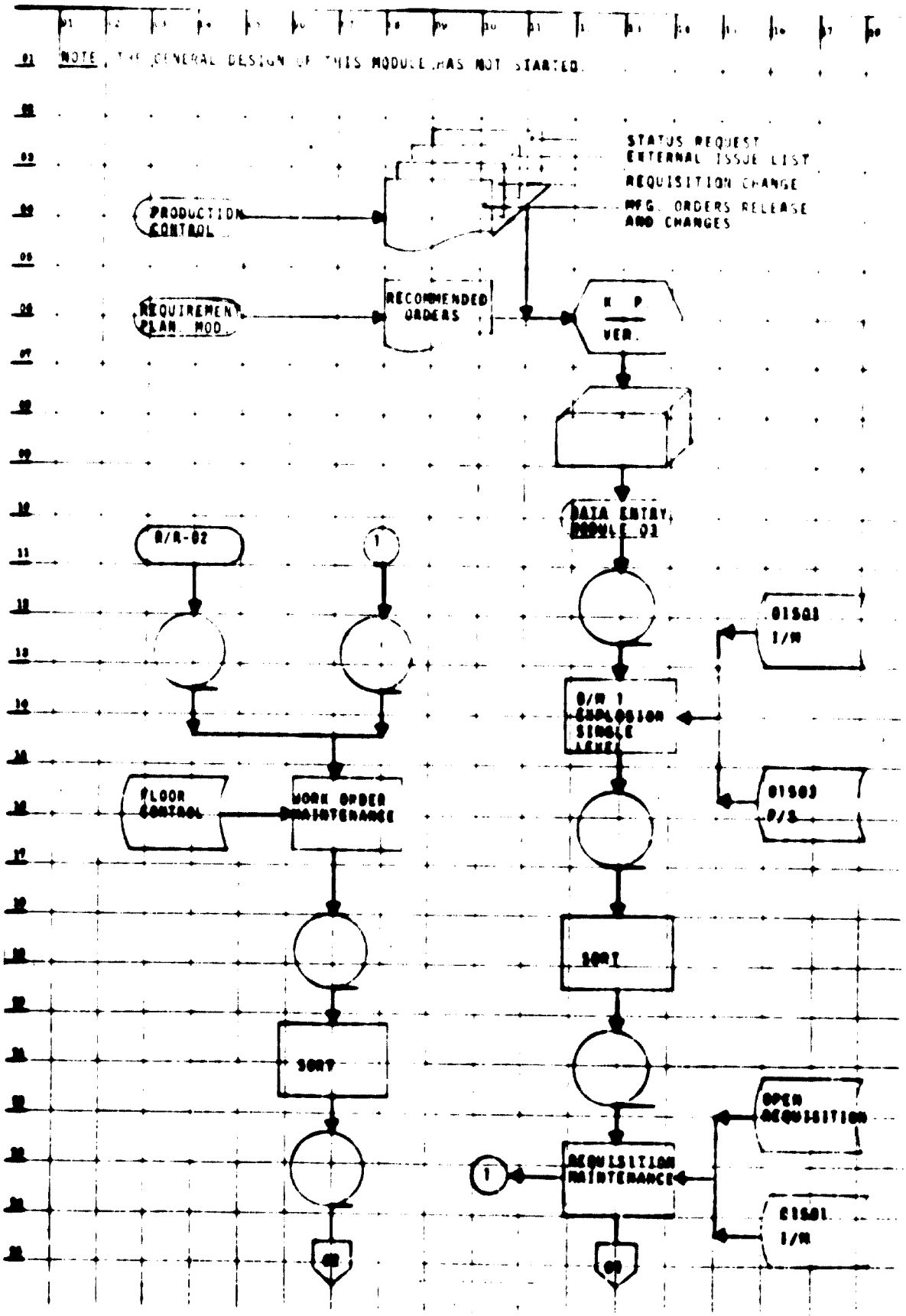


Figure 7I (continued)

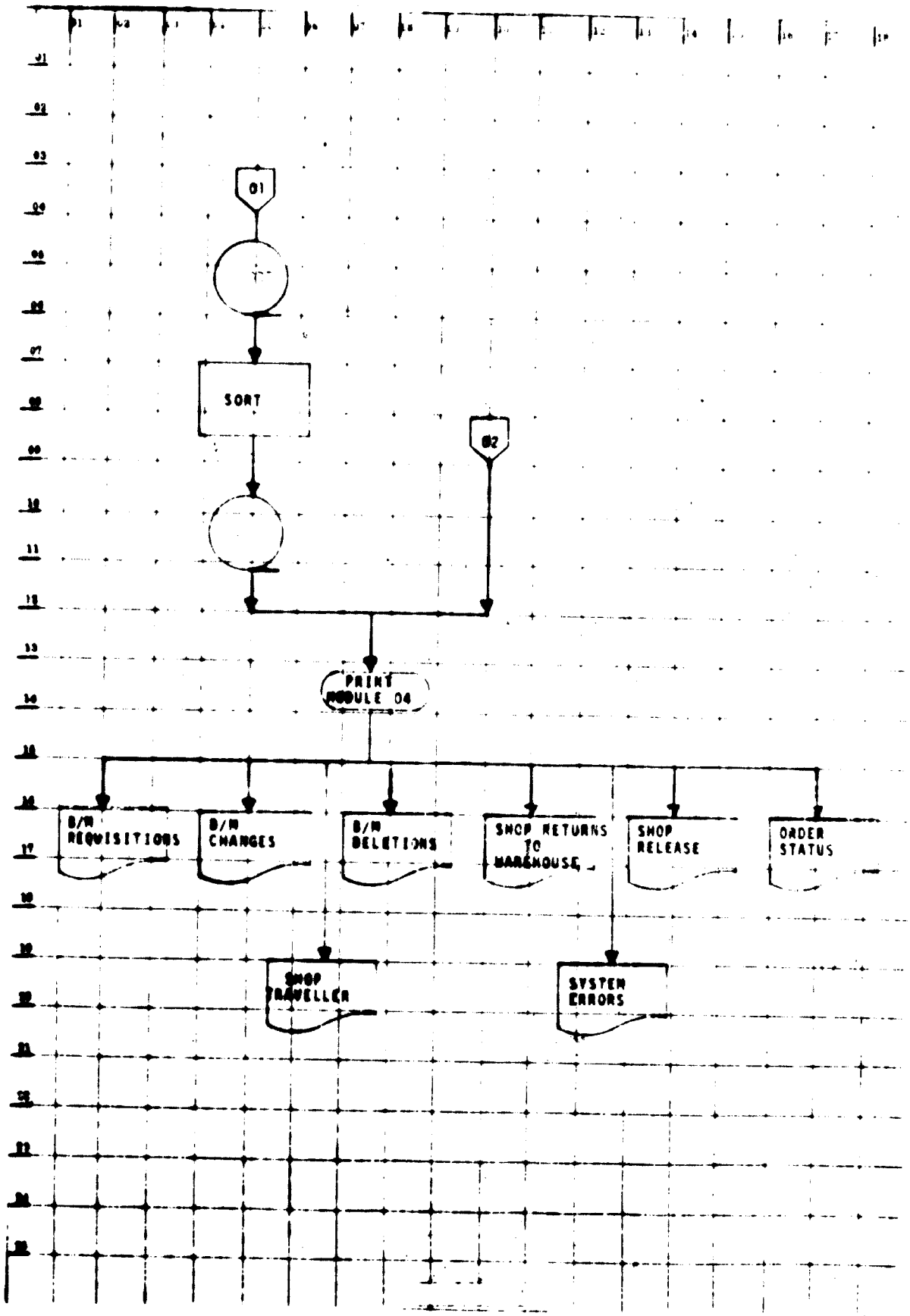


Figure .II. System flow chart. Manufacturing floor control module

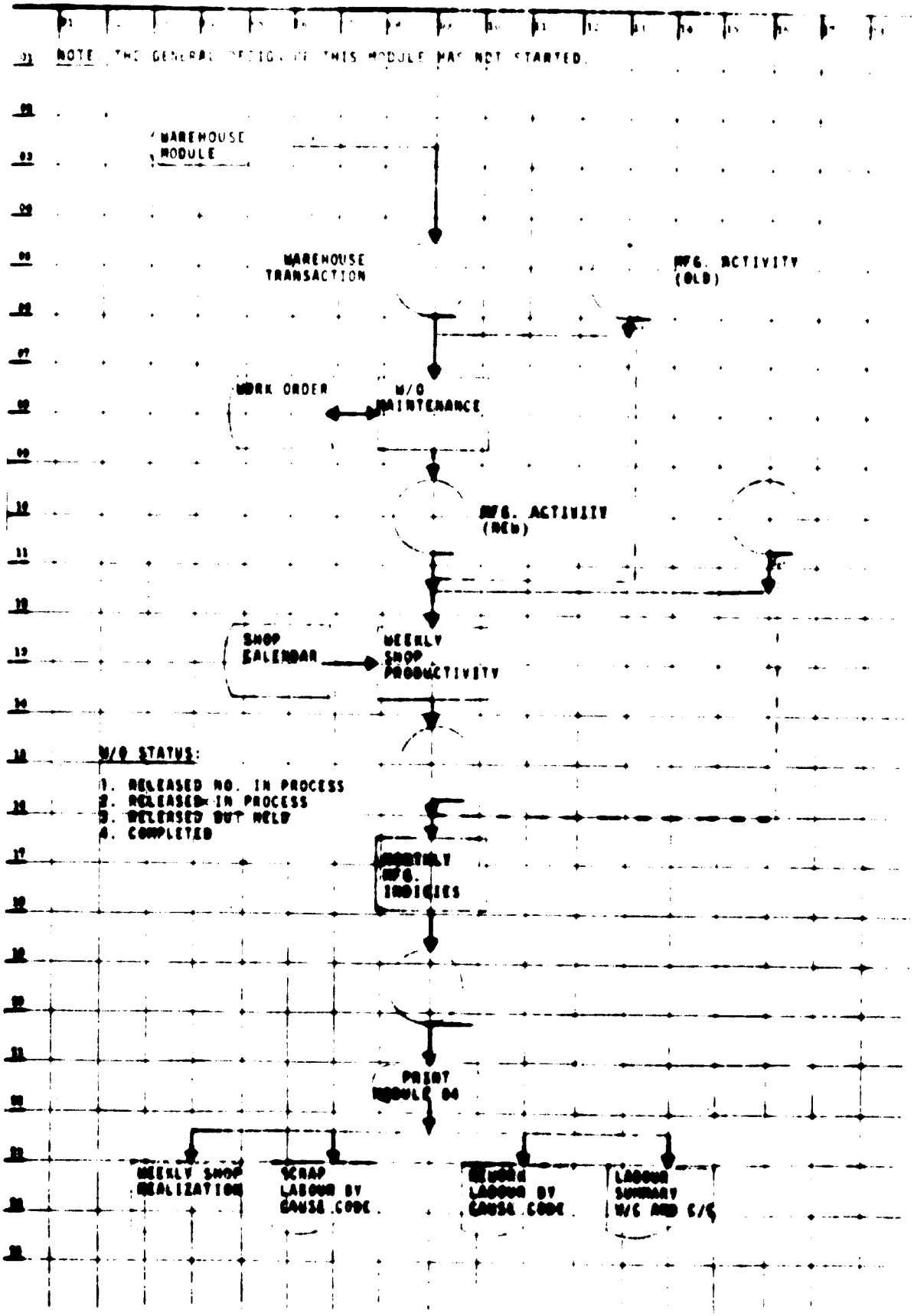


Figure VIII. System flow chart. Purchasing module

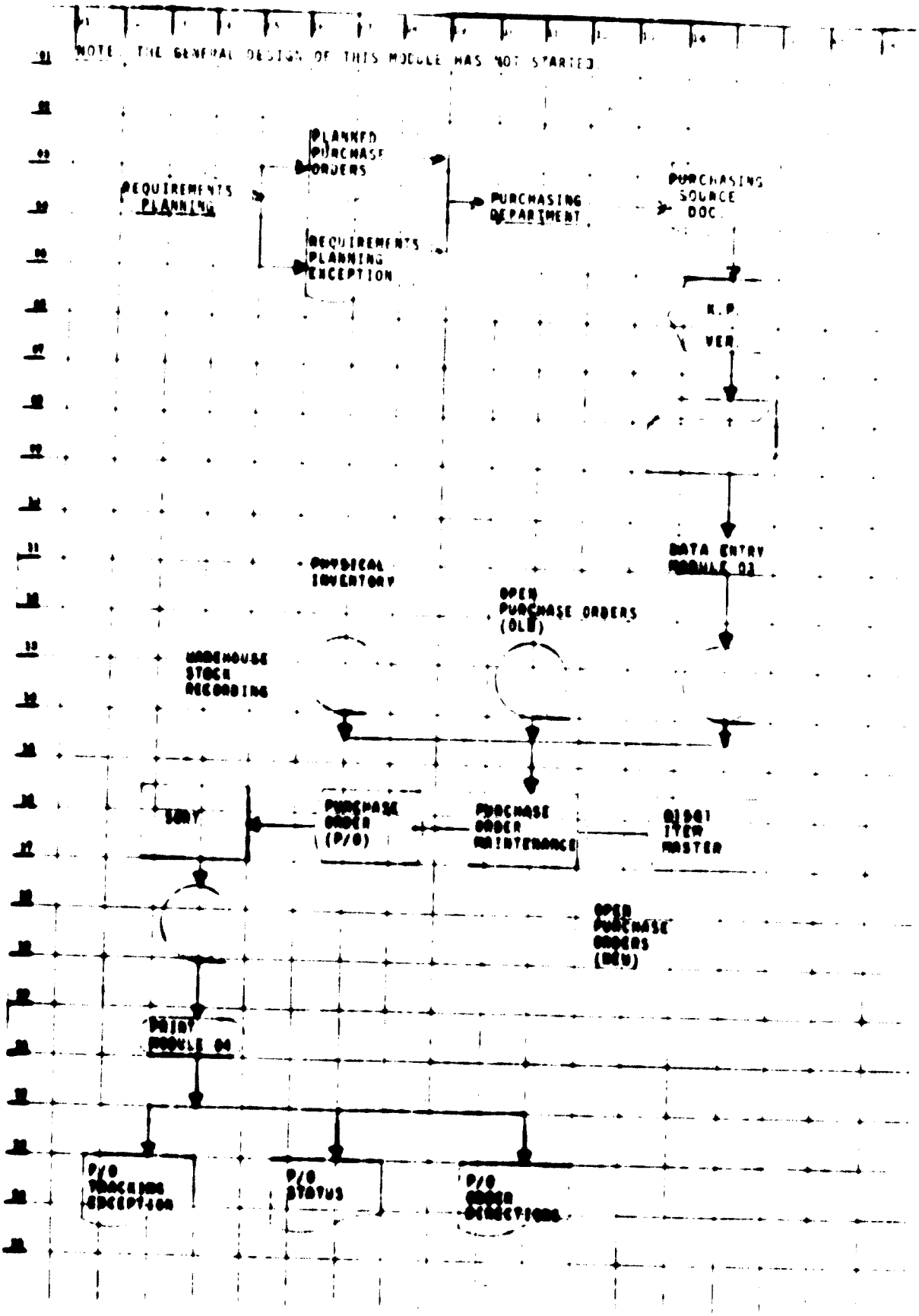
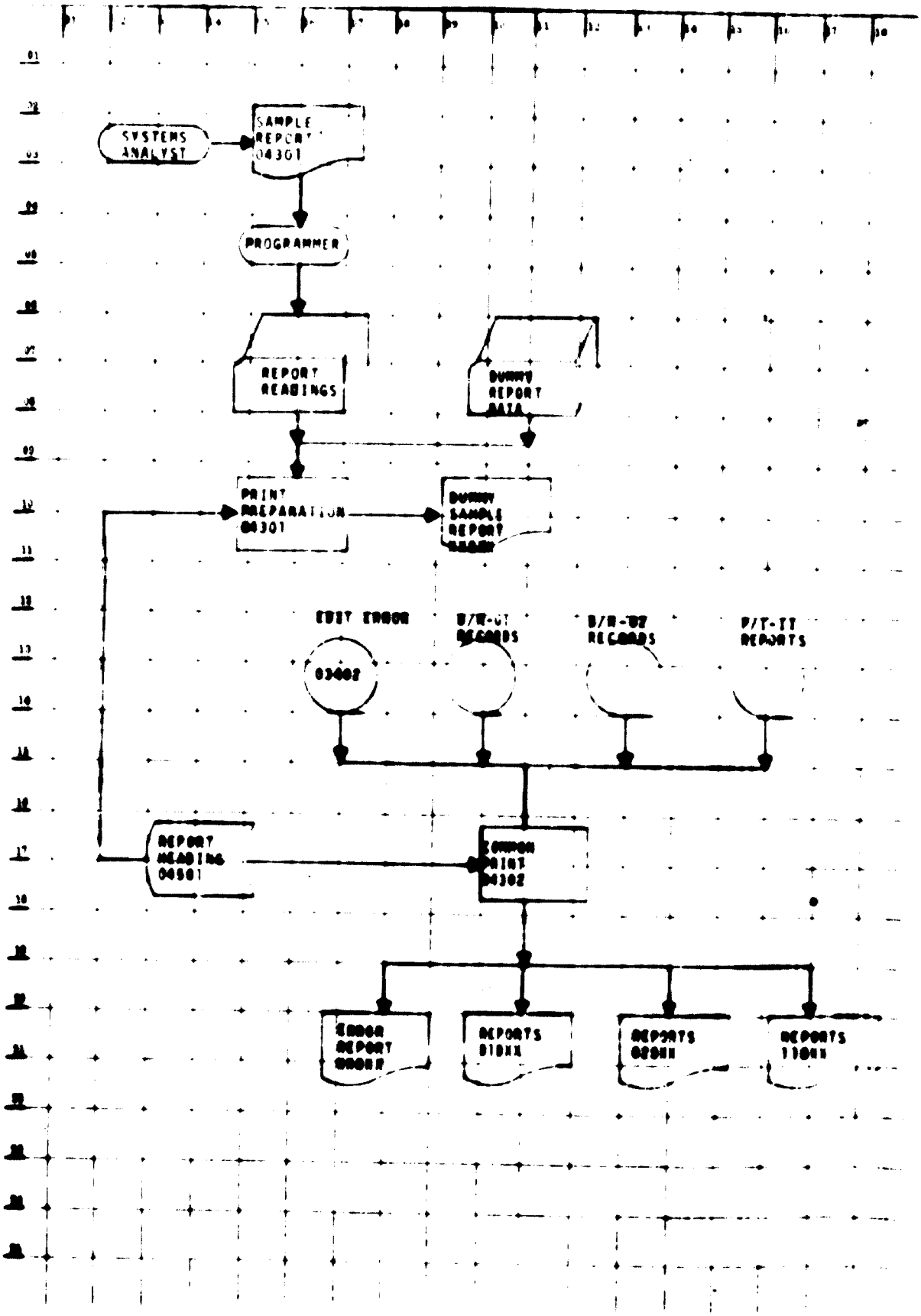


Figure IX. System flow chart. Common print module



The results of the study with respect to the objectives were as follows:

1. System documentation was established.
2. The contents and function of the report outputs were described.
3. The most likely areas where errors are introduced into the system were identified. They are:

   Lack of user's manuals; this shortcoming introduces serious voids on the part of the user in understanding how the system is supposed to operate

   Incomplete or non-existent edit programs

   Non-existent "test data"; hence the system operates with untested data

   Questionable design philosophy of the maintenance program in the area of the execution of the transaction codes (see "Program function description", point 7 in this section)

   Non-existence of a retrieval transaction code

   Non-existence of procedures to correct faulty data elements within the routings

   Questionable hardware design in the "optima" system; a detailed study of the subject in question was not carried out because of lack of support needed for this task

Description of the system

The system has two basic functions as illustrated in figure X:

1. Creation of new routings
2. Maintenance of routings

The present system has two means of entering input data: (a) card records; and (b) paper tape. The punch card input is used as a line correction maintenance function. The latter correction feature will be discussed later. Paper tape is used for the creation of new routings and the add/maintenance function. The paper tape records are created by an "optima" hardware system. The two functions supported by paper tape, create and add transaction, are treated as one function in the system.

Both types of input data are merged, after being edited and sorted, into one magnetic tape file. This file and the master routing file are then processed in the maintenance program to produce a new up-to-date master routing file. The system creates the following output documents: (a) list of new and corrected routings; (b) list of corrected data; and (c) error lists.

Figure X. System flow chart. EWIG's master routing system

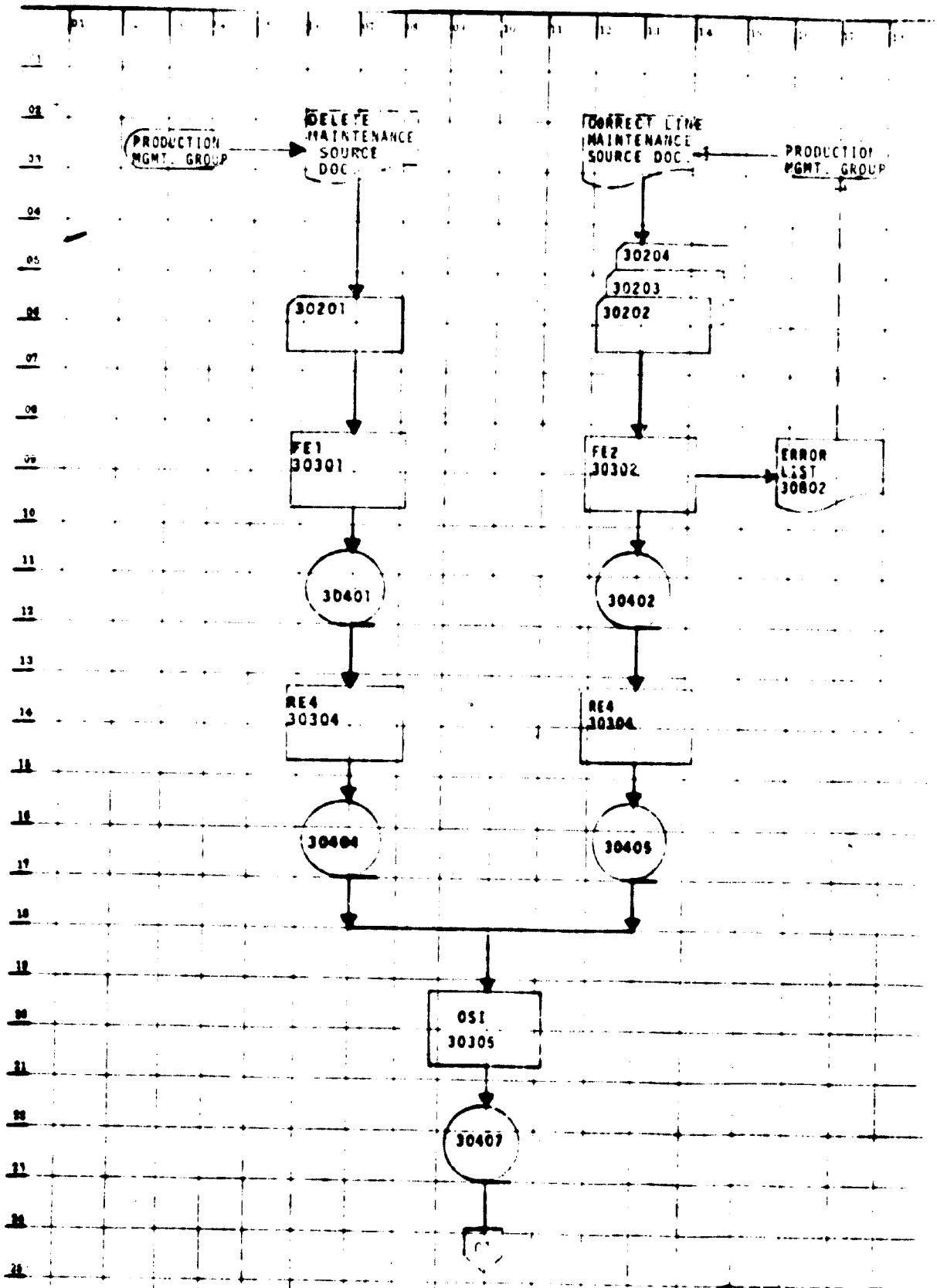


Figure 7 (continued

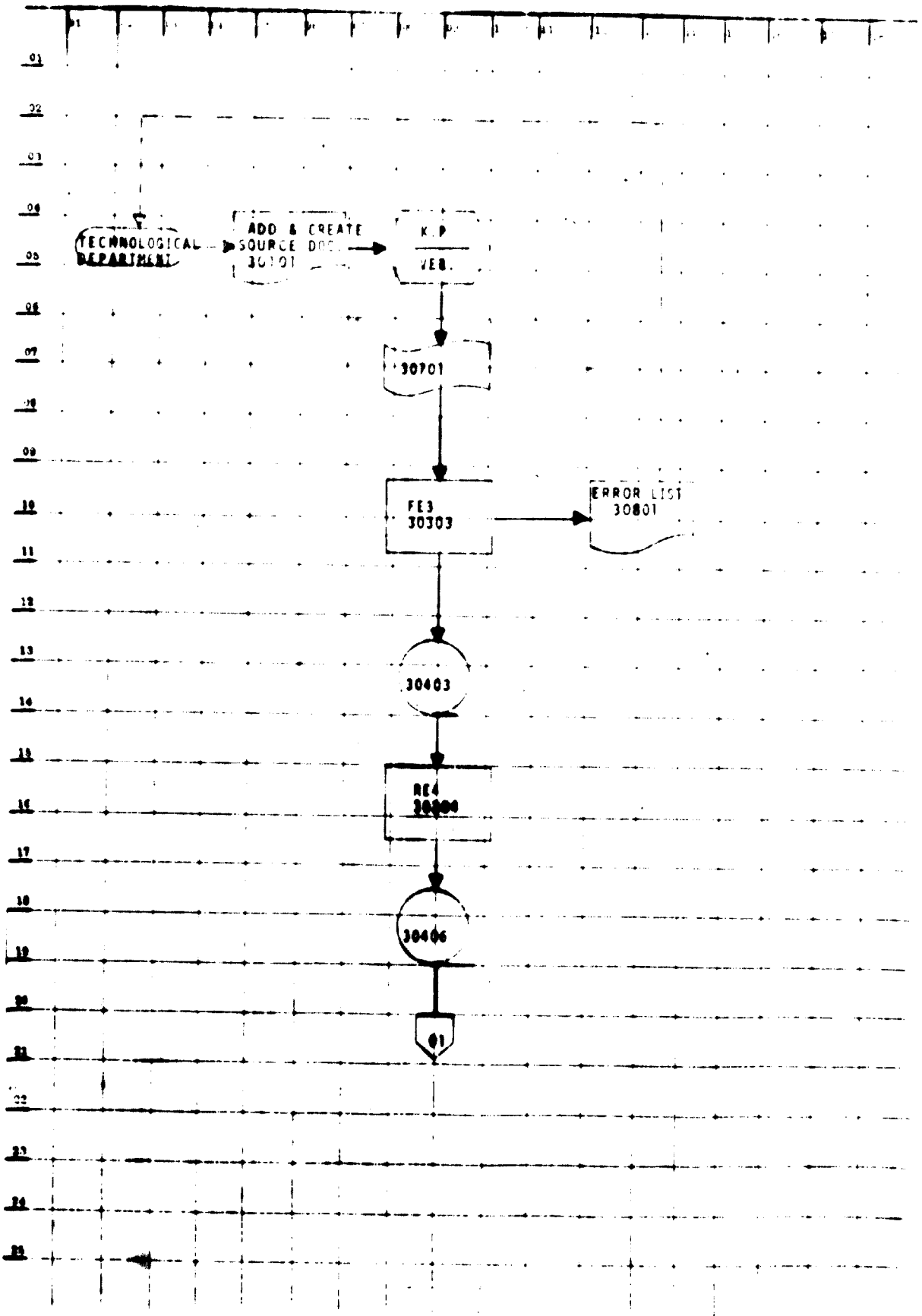
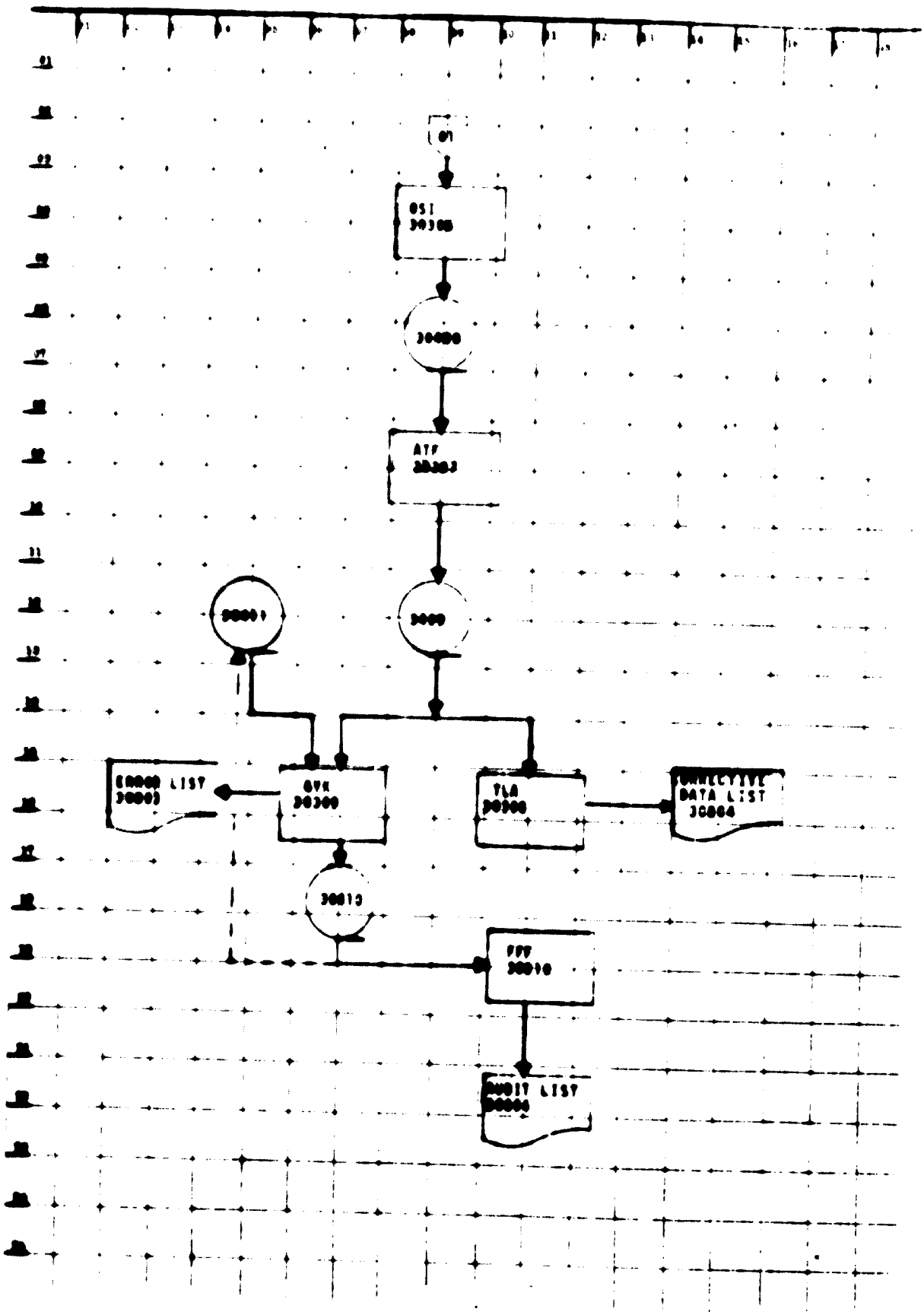


Figure 1 (continued)



The EDP part of the system is based on fixed file record length. One hundred and ninety words of 24 bits each make up the fixed record length.

Additional functions supported by the system, but [illegible] the scope of the study, include:

1. Material issue list.
2. Merging of the master routing file with the monthly production requirement data. This merging results in the production of the routings which are released to the manufacturing floor.

Input source data documents

Input source data document for creation 30101

This document is illustrated in figure XI. It can be noted that the form is not pre-printed and consists of blank fields only. There are no filed headings or length of field descriptions on the input source data document. There exists a user manual, however, to instruct the technological department about field contents and field lengths. (See annex I for the user instruction manual.)

The keypunch department has a set of keypunch instructions to perform this job after the source data document for creation is converted into paper tape format. See annex II for keypunch instructions.

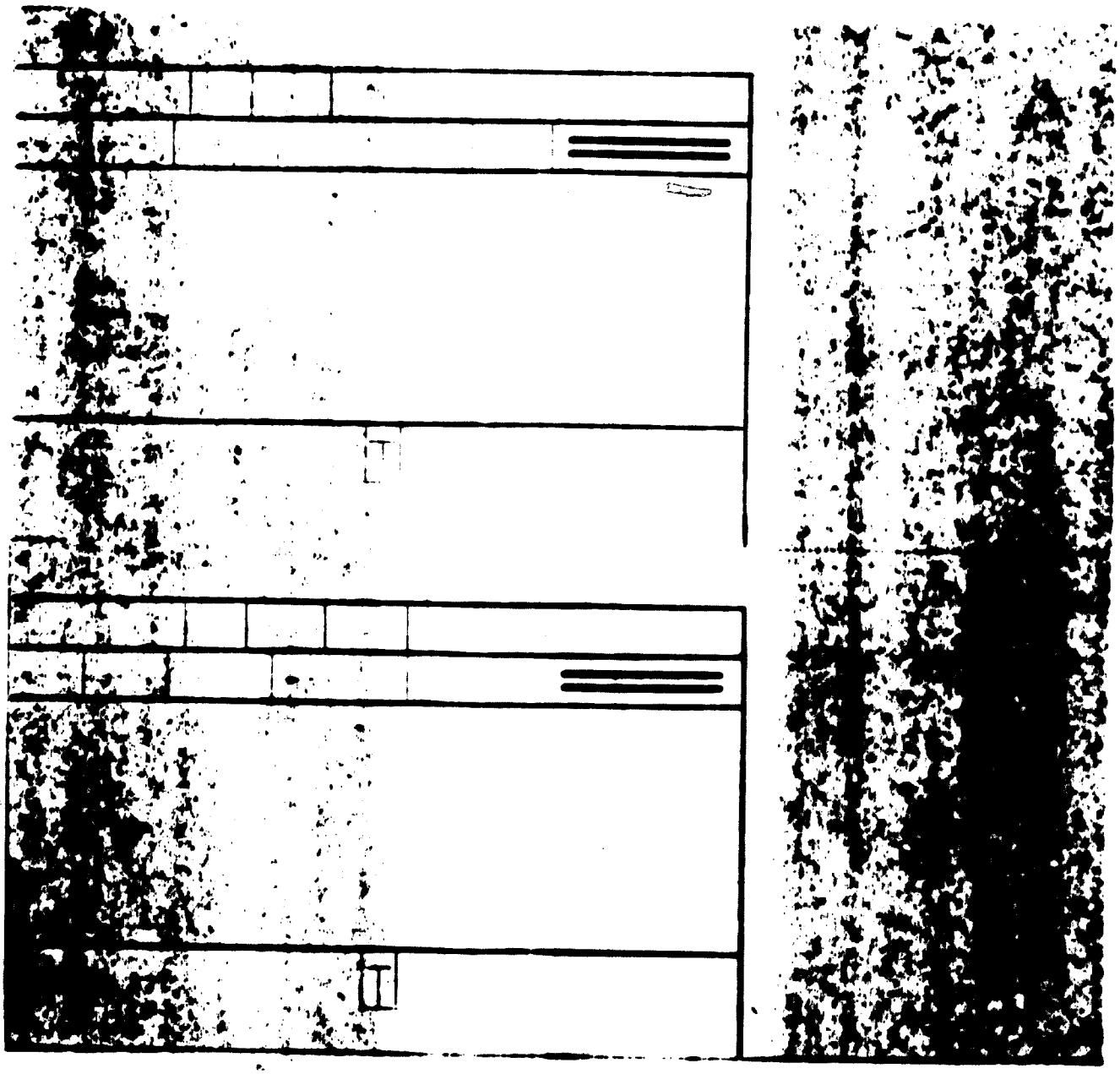
Input source data document for maintenance

This document does not exist in the present system. The input data is delivered to the keypunch department on any kind of paper. With the help of "master keypunch cards" the data is transferred from the paper to punched cards. This process requires a lot of experience and know-how on the part of the keypunch operator.

Output reports

The team was not able to find any report documentation, i.e. layout definitions, for the output. This type of documentation generally defines report keys, field(s) description spacing, reports total etc. Therefore, it is only possible to describe the contents and function of the output reports in general. Most of these reports are produced without report heading and column description labels. In addition no report numbers and date information are put onto the reports.

Figure A1. Input source data document for creation



To all in formation of the system the team has created [illegible] and numbers (see the system flow chart).

Error report list

The system produces three types of error lists:

(a) Error list 30[illegible]. This list is produced from program PE[illegible]. (See system flow chart figure 4.) The error list is printed out when all transaction are printed out on the error list. The errors are not detected by the program edit [illegible] and are sorted out the system.

(b) Error list 30[illegible]. This report is produced from program PE[illegible] and should record all rejected data from the last error [illegible] transaction. In reality some data that should be rejected are passed on to the subsystem programs and are not printed out. The [illegible] error [illegible] transaction may be with user to error the first, or the second, or both [illegible] of operation of the routing report. The user can also correct [illegible] of the two description lines of the operation records.

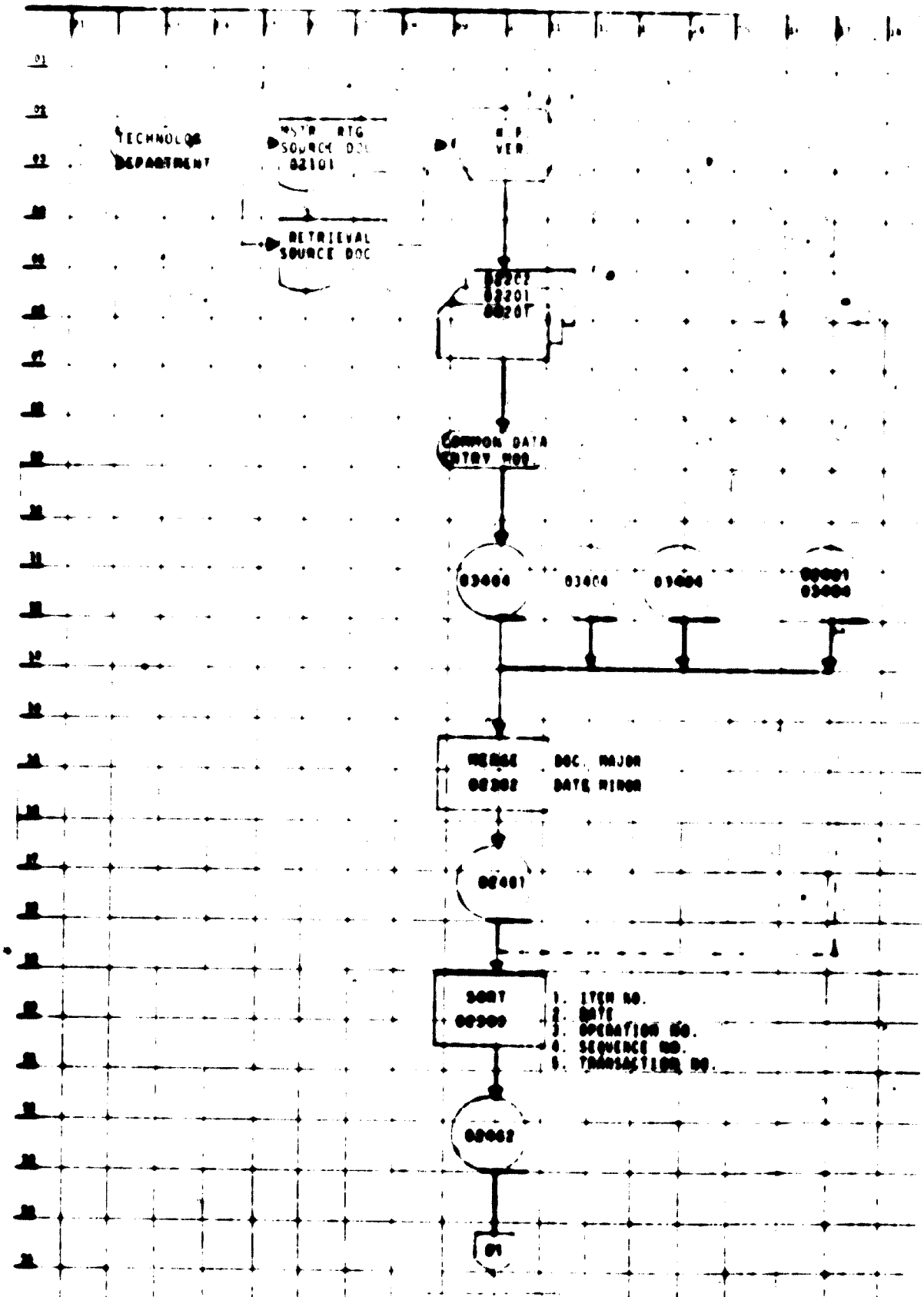
(c) Error list 30[illegible]. All maintenance transaction which couldn't be matched with existing routing records should be detected by the TYK program and printed out on the error list 30[illegible].

These error lists, produced by the computer center, are sent to the production management group. This group is a section of the organization department. This group has the responsibility of resolving errors which appear on the error lists. However, the group does not have any procedure or guideline to determine how or why an error should be corrected. The production management group, who receives the only copies, simply identifies, dates and files these reports.

Corrective data list 30804 (See figure X.)

This report is produced from the TLA program and lists all routings that were maintained during the last computer run. It lists the routings in ascending order and the operation numbers of the routing in descending order. The asterisks behind the routing and operation numbers are used to decode the maintenance transaction as shown in the table below.

Figure III. Activity routing form



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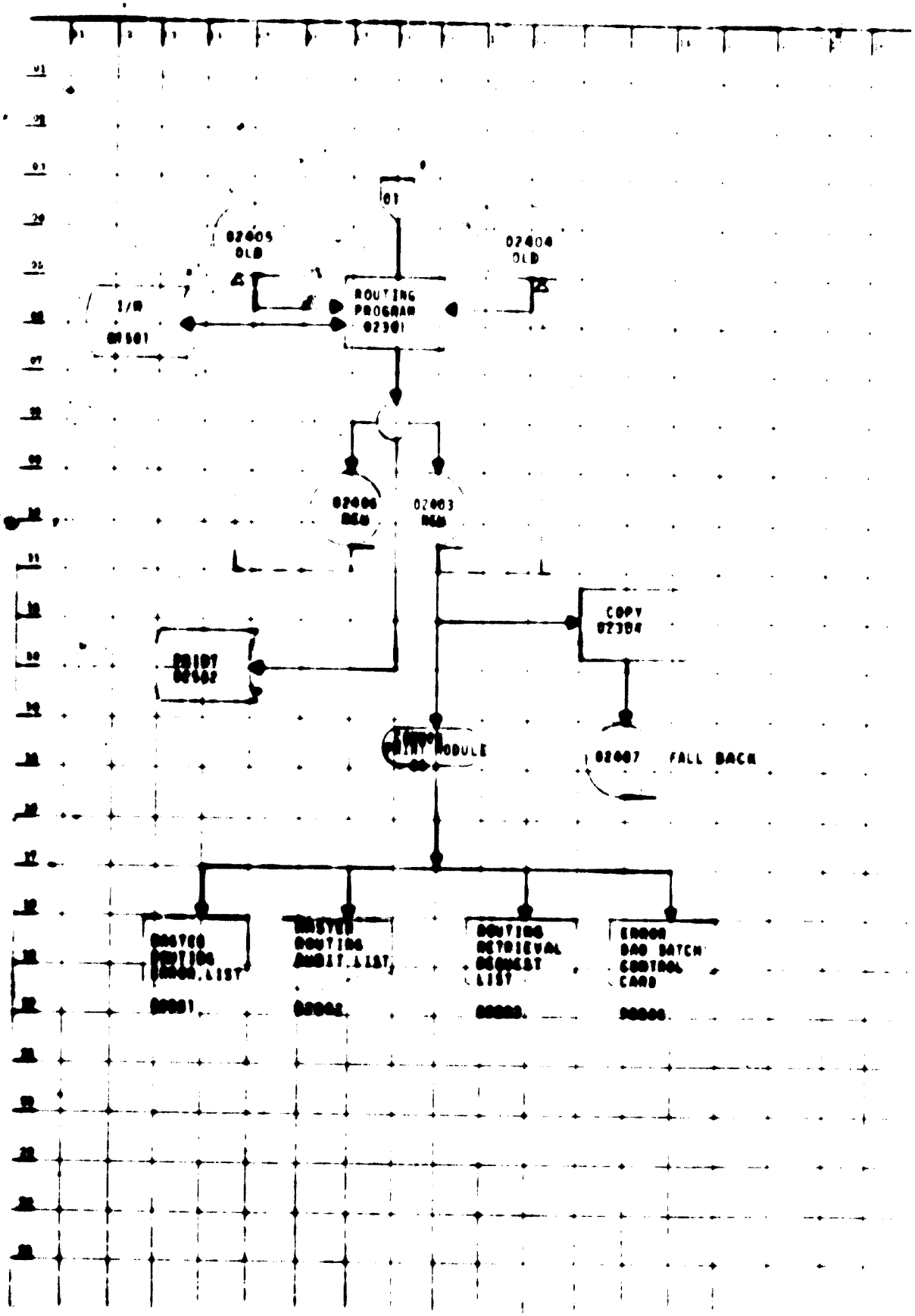


R[illegible]	Operation number	Transaction
)	)	Creation of routing or add new operation
(	*	Delete operation
**	)	Delete old routing and create new routing
**	-	Delete completed routing

Note :) - No asterisk behind the number
* - One asterisk behind the number
** - Two asterisks behind the number
- - Blank instead of the number

This list is used randomly by the production management group, for verification of new routings.

Audit master routing list (See figure X.)

The format of this list (see illustration in figure XII) is the same as the creation input source data document except that field headings exist. The report is sent from the computer centre directly to the production preparation section. This section reviews the routing operation on the list and corrects those that are incorrect by marking the report. The routings with incorrect records are separated from the good routings and sent to the production management group. This group decides the means of correction, according to instructions (see annex III for instructions). They then prepare source data for the keypunch department. The corrected data enter the system in the next maintenance run of the program. Maintenance of the master routing is performed monthly.

Card file layouts

The maintenance of the routing program requires four different card layouts, described below.

1. Delete, card format 30201

Field number	Card column	Description
1	1 - 8	Routing number
2	9 - 10	Sequence number
3	11 - 12	Operation number
4	80	Record end sign

2. Correct first header line, card format 30202

Field number	Card column	Description
1	1 - 8	Routing number
2	9 - 10	Sequence number
3	11 - 12	Operation number
4	13 - 15	Demand/product
5	16 - 19	Demand/unit
6	27 - 34	Material number
7	35 - 44	Size
8	45	Record end sign

3. Correct second header line, card format 30203

Field number	Card column	Description
1	1 - 8	Routing number
2	9 - 10	Sequence number
3	11 - 12	Operation number
4	13 - 15	Cost centre
5	16 - 19	Work centre
6	20 - 24	Tool number
7	23 - 30	Unit run time/100
8	31 - 33	Set-up time
9	34 - 37	Next work centre
10	38	Record end sign

4. Correct description line, card format 30204

Field number	Card number	Description
1	1 - 8	Routing number
2	9 - 10	Operation number

Field number	Card number	Description
3	11 - 12	Sequence number
4	13 - 60	Description
5	61	Record end sign

Paper tape layout (create, add) 30701

The system uses the paper tape as input media for the create function and the add transaction of the program.

Field number	Word number	Description
1	0 - 1	Routing number
2	2	Operation number
3	3	Requirement/product
4	4 - 5	Requirement/unit
5	6 - 7	Material number
6	8 - 11	Material size
7	12	Cost centre
8	13	Work centre
9	14	Tool number
10	15	Run time/100
11	16	Set-up time
12	17	Next work centre
13	18	Add transaction code = 1
14	19	Filler (binary zero)
15	20 - 35	1. Description line
16	36 - 51	2. Description line
17	52 - 67	3. Description line
18	68 - 83	4. Description line
19	84 - 99	5. Description line
20	100 - 115	6. Description line
21	116 - 131	7. Description line
22	132 - 147	8. Description line
23	148 - 163	9. Description line
24	164 - 179	10. Description line

Tape file layout

1. Delete tape file layout 30401, 30404

(a) Record type to delete entire routing.

Field number	Word number	Description
1	0 - 1	Routing number
2	2 - 17	Fillers (binary zero)
3	18	Delete transaction code = 1
4	19 - 179	Fillers (binary zero)

(b) Record type to delete operation(s) from routing record.

Field number	Word number	Description
1	0 - 1	Routing number
2	2	Operation number
3	3 - 17	Fillers (binary zero)
4	18	Delete transaction code = 3
5	19 - 179	Fillers (binary zero)

2. Line correction tape file layout 30402, 30405

(a) Record type to correct first header line

Field number	Word number	Description
1	0 - 1	Routing number
2	2	Operation number
3	3	Requirement/product
4	4 - 5	Requirement/unit
5	6 - 7	Material number
6	8 - 11	Material size
7	12 - 17	Fillers (binary zero)
8	18	Correction transaction code = 2
9	19 - 179	Fillers (binary zero)

2) Record type [illegible] correct second header line.

Field number	Word number	Description
[illegible]	[illegible]	Routing number
		Operation number
	[illegible]	Filler (binary zero)
[illegible]	[illegible]	Cost centre
	[illegible]	Work centre
[illegible]	[illegible]	Tool number
[illegible]	[illegible]	Run time/100
	[illegible]	Set-up time
[illegible]	[illegible]	Next work centre
[illegible]	[illegible]	Correction transaction code = 2
11	[illegible] - 179	Fillers (binary zero)

3) Record type [illegible] correct description line.

Field number	Word number	Description
1	0 - 1	Routing number
2	2	Operation number
3	3 - 17	Fillers (binary zero)
4	18	Correction transaction code = 2
5	19	Fillers (binary zero)
6	20 - 179	Description fields

3. Type file layout 30403, 30406, 30407, 30408, 30409, 304010, 304011

Field number	Word number	Description
1	0 - 1	Routing number
2	2	Operation number
3	3	Requirement/product
4	4 - 5	Requirement/unit
5	6 - 7	Material number
6	8 - 11	Material size

Field number	Word number	Description
		Run time
		Next work station
		Filler (binary zero)
		Description line
		Description line
		Description line
		Description line
		Description line
		Description line
		Description line
		Description line
		Description line
		Description line

Description of the program function

The team encountered great difficulty in understanding the current system program because there was no documentation, in particular, there were no descriptions for routing programs. The program descriptions should be developed parallel to programming development. Failure to do this will result in either great delay or in lowering the quality of the description. The programmer will have to develop new priorities or neglect critical aspects encountered during the development stage.

This section gives a broad description of each program. There was no attempt made to understand the edit logic program because none of the error lists produced were used by the enterprise. It was assumed that the sort program is a standard utility program and does not need any explanation.

1. **EDI program 30301**

   Input: punched card 30201.

   Output: magnetic tape file 30401.

Program function: converting punched card records to magnetic tape records.

Frequency of operation: once a month.

Execution time: 10 minutes.

FE2 program 30302.

Input: punched card 30202, 30203, 30204.

Output: magnetic tape file 30402; error list 30802.

Program function: converting punched card records to magnetic tape records.

Frequency of operation: once a month.

Execution time: 10 minutes.

3. FE3 program 30303

Input: paper tape 30401.

Output: magnetic tape file 30403; error list 30802.

Program function: converting paper tape records to magnetic tape records and editing the input data. Rejecting the faulty records found and creating an error list.

Frequency of operation: once a month.

Execution time: 60 minutes.

4. FE4 sort program 30304

Input: magnetic tape file 30401, 30402, 30403.

Output: magnetic tape file 30404, 30405, 30406.

Program function: utility sort.

Sort sequence: 1. Routing number.

2. Operation number.

Frequency of operation: once a month.

Execution time: 50 minutes.

5. OS1 merge program 30305

Input: tape file 30404, 30405.

Output: tape file 30407.

Program function: the merging of the two tapes, one with the line correction records and the other with the delete records, is as follows: if the program finds a match in the routing number fields (field 1) it will formate and write first the delete record(s) on the output tape followed by the formated line correction record(s). Otherwise the line correction records and the delete records are processed separately and put on to the output tape. The records on the output tape are sorted in:

Major: Routing number (ascending)

Minor: transaction code.

Frequency of operation: once a month.

Execution time: 50 minutes.

6. OSI merge program 30306

Input: tape file 30406, 30407.

Output: tape file 30408.

Program function: merging of the create and add transaction records with the merged tape of the line correction and delete transaction records. The output tape file is then sorted as follows:

1. Routing number (ascending)
2. Operation number (ascending)
3. Transaction codes

The transaction codes are processed in the sequence shown below:

Sequence	Transaction	Code
1	Delete	3
2	Line change	2
3	Create/add	1

Frequency of operation: once a month.

Execution time: 10 minutes.

7. ATP program 30307

Input: tape file 30408.

Output: tape file 30409.

Program function: processing of necessary corrections to the new created routing records, if required, and putting the corrected new routing records and other transaction records on to the output file. The output file is then sorted as follows:

1. Routing number (ascending)
2. Operation number (descending)
3. Transaction code

Frequency of operation: after successful run of program 30305.

Execution time: 15 minutes.

8. TLA program 30308

Input: tape file 30409.

Output: corrective list 30805.

Program function: producing an output report of all routing numbers (ascending) and their operation numbers (descending) that were involved in a transaction in the last run of program 30300.

Frequency of operation: after completion of program 30300.

Execution time: [illegible].

[illegible] program 30309

Input: tape file 30409, 30411.

Output: tape file 30410; error list 30803.

Program function: this is the maintenance program of the routing system. Routings without maintenance activity and new routings are transferred as is to the output tape. Deletion transaction of entire routings are not transferred on to the output tape. If a deletion transaction of an entire routing or operation is read and followed by an add of new routing or operation (same routing number), the program overwrites the old record(s), line by line. When the old operation has more records than the new operation, the old records that were not overwritten are added at the end of the new operation records. All transactions, except the creation of a new routing, that were not found on the existing master routing tape file are printed on to the error list 30803. If a match is found between the master routing file 30411 and the transaction file 30409, the transaction is processed and the routing put on to the new master routing file 30410. If the old routings are not assessed during a maintenance run the records are put on to the new master routing file. This file is in the following sequence:

Major: routing number

Minor: operation number

Frequency of operation: once a month.

Execution time: 300 minutes.

10. [illegible] program 30310

Input: tape file 30409 and 30410.

Output: routing list 30804.

Program function: merging the two input tape files and processing only the routings with records on both files, that is, creating an audit list of all corrected and new routings.

Frequency of operation: after completion of program 30308 and 30306.

Execution time: 300 minutes.

C. Design specification of the basic records (D module)

General documentation outline

Each specific application should be supported by a set of documentation. This documentation is first created at the general design phase of an application. The detail level of the documentation increases as the phases of application development take place.

1. Outline

Section number	Description
	Narrative application overview
	System (application menu) flow chart
3	Source input documents
4	Report outputs
5	Card file layouts
6	Tape file layouts
7	Disk file layouts
8	Program functional narratives/logic diagrams/program source and listings
9	Application module quantitative data
10	Keypunch/verify instructions
11	Paper tape layout

2. Documentation numbering guide

(a) Format: xxxxx

- sequential number with media code
- media code
- application identification - specific
- application identification - major

(b) Major application code

0 - Basic records/data entry

1 - Physical inventory/order entry/material requirements planning

3 - Present system

2, 4-9 - Not assigned

(c) Specific application codes

01 - B/R-I - Basic records-I (item master, subordinate item master, product structure, raw material)

02 - B/R-II - Basic records-II (master routing)

03 - Data entry

04 - Common print

05 - B/R-III - Basic records-III (raw material, purchased parts, item master)

11 - Physical inventory

15 - Material requirements planning

40 - Present routing system

(d) Media code

1 - Source document

2 - Card file

3 - Program

4 - Tape

5 - Disk

6 - MCP/Ver

7 - Paper tape

8 - Report output

3. Number assignment - general interface role

The specific application creating the file, report program etc. is responsible for establishing the document number.

4. Transaction numbering guide

(a) Format: nnnn

- nn — sequential number within specific application code
- nn — specific application code

(b) General

Transaction codes are assigned to add, change and delete records or data elements within records. Transaction numbers should be assigned so that when utility sorting is performed on the transaction numbering field the resulting sequence is: add; change; delete.

Description of the basic records and files

A fundamental concept in the design and implementation of the new EVIC system is to create the new system with a team approach, bringing together the various functions with specialist knowledge, skills and experience to ensure interdepartmental and interdisciplinary participation. Each team member will share in the group responsibility for creating an efficient integrated system and data base. The new EVIC information system must be made an integral part of the organization (Factory No. 1), and the management of the organization must be involved in all phases of the system effort to make sure the new system will [illegible].

Introduction to the basic records of files

The basic records or modules represent the smallest part of the information elements of the integrated data base within EVIC's ELDP manufacturing control system. The other two categories of data elements are (a) [illegible] description and (b) product structure. These two modules of the basic information elements are supported by an IBM application. The IBM application consists of programs that are integrated but [illegible] and independent of each other. This modular structure will allow a step-by-step design and implementation of EVIC's manufacturing control system. The sequence of the implementation can be decided by EVIC's special requirements and should be approved by EVIC's management.

The IBM application package provides EVIC with programs that load, maintain and reorganize basic files. It is designed to organize and maintain a central information system, linking, thereby, product structure records and manufacturing process descriptions with the item master file. This approach differs from the manual or automatic information systems, the design of which strongly reflects the functional areas of the organization (i.e. sections, departments). These systems frequently serve the data stored in the various departmental files that are wholly or partially duplicated. Information systems with such data files have serious drawbacks. Time is wasted on updating the overlapping files. The files are seldom synchronised. Information that should flow from one department to another often does not arrive in complete form, moves slowly and, on arrival, is most likely out of date. The work of maintaining basic information files tends to be put off and often is never accomplished.

[illegible]

[illegible] module supports data input from the manufacturing engineering department (plant technologist). The basic [illegible] module strongly depends on the basic records 01 module. The interrelationship of these two modules is described below.

Assume that the user accesses the system for a part, [illegible] the item number (drawing, part number) does not exist in the basic records 01. The system would reject the request and would create an error report. On the other hand the system would only flag a request with the right item number but non-existing routing data. The plant technologist is asked to put into the data base basic information elements which will reflect on the user's output requirements. The specific input requirements (source data) and the error and output reports are described in a later section of this study. Examples of basic information elements established by the manufacturing engineering group include description and sequence of operation, cost centre, work centre, run time, set-up time, tool number and cost/limit. The basic data of the basic records 02 module specify the logical sequence of operations during the manufacturing process of detail parts and of assembly. The technologist will supply this information and is also responsible for maintaining the basic records 02 module.

Error lists and audit lists are needed for maintaining the basic records of the module. Error lists show the input data that were rejected by the data base because the input criteria were not met. The wrong input data must be corrected by the technology department before they are accepted by the data base. Audit lists give original and current information included in the data base. The audit lists are used for two purposes. First, for the reconstruction of certain records and secondly, as everyday working documents.

Execution of the basic records 02 module

There are four major phases in the execution of this module: (a) source data preparation; (b) source data input; (c) data base maintenance; and (d) module user report.

The source data are prepared by EVIC's technology department. The source document contains data base information and must be carefully prepared because any incorrect information that gets on to the data base will create errors in

the new EVIC information system. It is important that a user manual [illegible] for it. This manual should describe precisely the steps to be [illegible] out the source document for the basic records in each . The technology department should look at its own work before it is forward it to the data [illegible] at a.

The source data input is performed by EVIC's keypunch department. The source data must be keypunched and verified according to the keypunch instruction manual. The instructions for a particular source document are to be found under the source document number. After keypunching is finished the organization department will send the card decks of input data to the SZUV computer centre and the keypunch department will return the source document to the technology department.

The data base maintenance is done by SZUV computer centre. All reports are sent to EVIC for the module user reports.

The module user report reviews the computer outputs with the source documents. The main objective of this work is to assure correct data base input. Ideally, this module should be run every day during the implementation period and once a week during the operational period.

Initial implementation period

During the inital implementation period a start-up system is created. In this period it has not yet been decided if the entire data base could be developed at once or broken down into parts. This decision will depend on how many data fields of the old system can be used in the new system. A system that supports a three-month production is considered the most functional.

It is recommended that the initial implementation be done by a technology department group. This group will decide on the method of work and identify and prepare the necessary source documents. The duration of the initial implementation period will depend on the amount of old system data that could be used, the desired rate of implementation and the availability of the resources and the computer time.

Operational usage period

Operational usage starts after the implementation of the B/B-02 module is considered to be completed. Operational usage is an integral part of the

[illegible] department's everyday work activity. It is essentially a maintenance activity. Changes and additions to data put in to the data base during the [illegible] will take place. The additions of new data to the data base [illegible] during the operational phase.

[illegible]

[illegible] consists of three sub-modules: (a) creation and maintenance; (b) retrieval; and (c) reorganization. The first two sub-modules are [illegible] department oriented. The third one is reorganization department oriented.

In the first sub-module program the initial information is put into the master routing and pending files. If errors have been discovered in the routings, the entire routings are put into the pending file. The routings without errors are put into the master routing file. All maintenance work for the master routing and pending files is also done under this program. Although the data base is created under the basic records 01 application module, certain portions of the data base can be started and maintained under this program.

The new input data and any changes to the input data must be edited. The data that do not meet the editing criteria are not accepted on to the master routing file and the data base. The technology department is advised of this on the source data error list. Data that have met the editing criteria are added to the system and signalled to the technology department on the audit list(report output list). The audit list gives the information about the contents of the master routing file.

Data can be retrieved through the retrieval module (routing retrieval). Routings are a type of retrieval used to prepare a sequential list of all the operations required to manufacture a detail part or put together an assembly. This list can be used as a reference document or, if extended by production factors, as a manufacturing work order.

System flow chart

See figure XII, page 40.

Source input documents

1. Master routing 02101 (see figure XIII)
2. Retrieval 00101 (see figure XIV)

Figure XIII. Master routing source input document

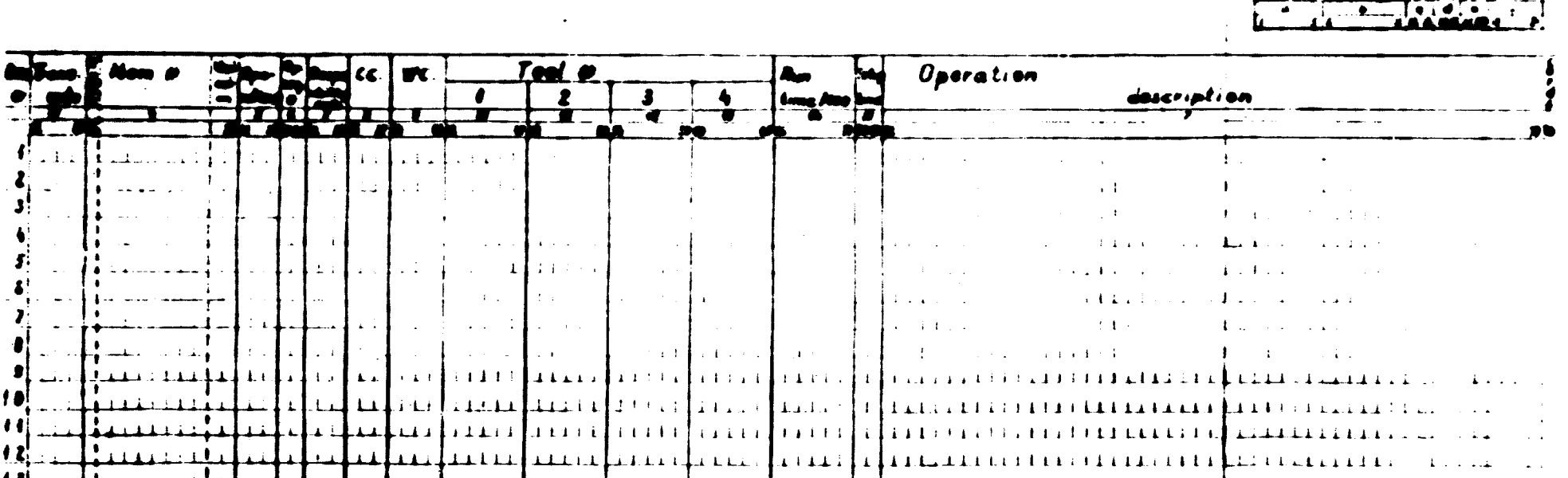
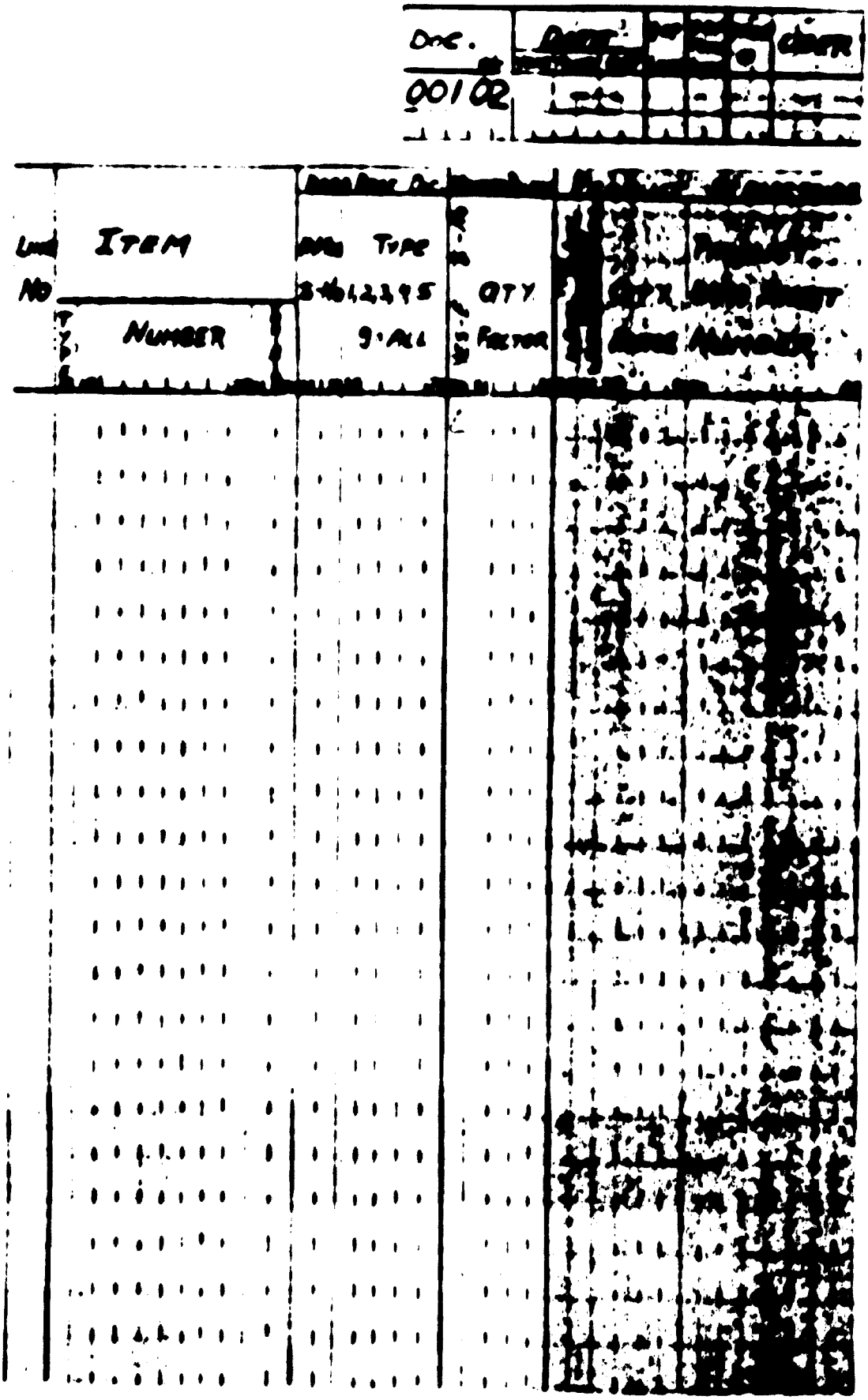


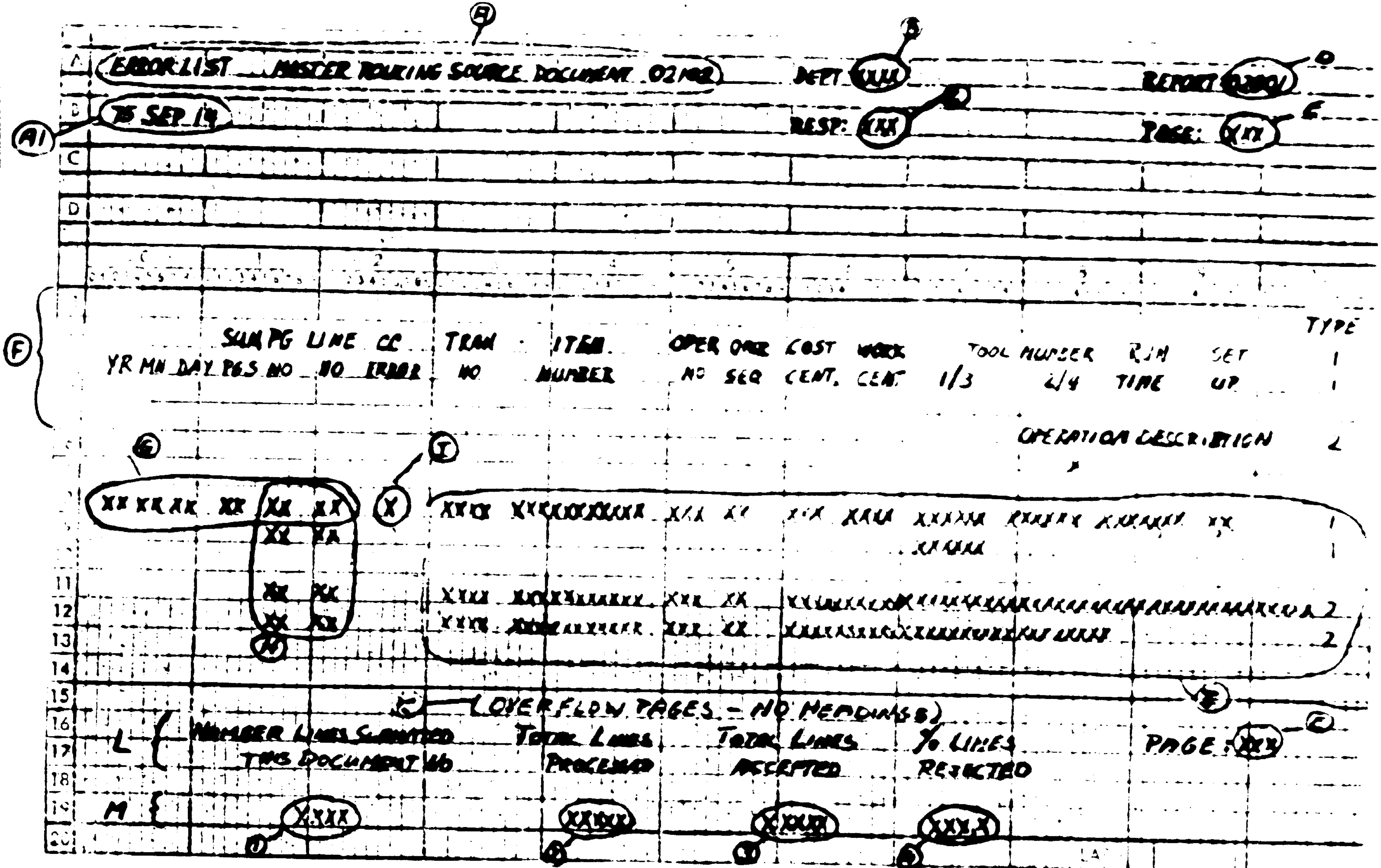
Figure XIV. Retrieval source input document



Report [illegible]

'. **Error list 32501** (see figure XV)

Report key	Field description	Creation rule
A	Report title	From field [illegible] of the batch control card and [illegible]
A'	Report date	Program generated
B	Department number	From field [illegible] of the batch control card; if field is bad use default department default table
C	Responsibility code	From field [illegible] of the master routing type [illegible] card
D	Report number	From field [illegible] of the batch control card and [illegible]
E	Page number	Program generated
F	Lines 1, 2, 3, 4, 5	Program generated
G	Control card data	Printed when: '. Control card data are bad but source data can be processed '. Source data are rejected '. Once per rejected source document, regardless of the number of bad source data lines
H	Page number, line number	Printed for each bad source data record
I	Bad control card	Printed if the batch control card has a minor error
J	Source data	Rejected source data elements only are printed
K	Overflow page headings	Not printed
L	Lines 16, 17	Program generated
M	Line 19	'. Number of lines submitted in this document number; fields equal sum of field five of all batch control cards for this source document The sum of field 5 is relative to this processing sum and not to the data contained in the batch control cards


ERROR LIST MASTER ROUTING SOURCE DOCUMENT 02102
DEPT XXX
REPORT 0300
75 SEP 19
RESP: XXX
PAGE: XXX
SUM PG LINE CC TRAN ITEM OPER OVR COST WORK TOOL NUMBER RUN SET TYPE
YR MN DAY PGS NO NO ERROR NO NUMBER NO SEQ CENT. CENT 1/3 2/4 TIME UP 1
OPERATION DESCRIPTION 2
(OVERFLOW PAGES - NO HEADINGS)
NUMBER LINES SUBMITTED THIS DOCUMENT NO
TOTAL LINES PROCESSED
TOTAL LINES ACCEPTED
% LINES REJECTED
PAGE: XXX
A
A1
B
C
D
E
F
G
H
I
K
L
M

2. Number of lines processed; this field equals a count of source data records actually processed

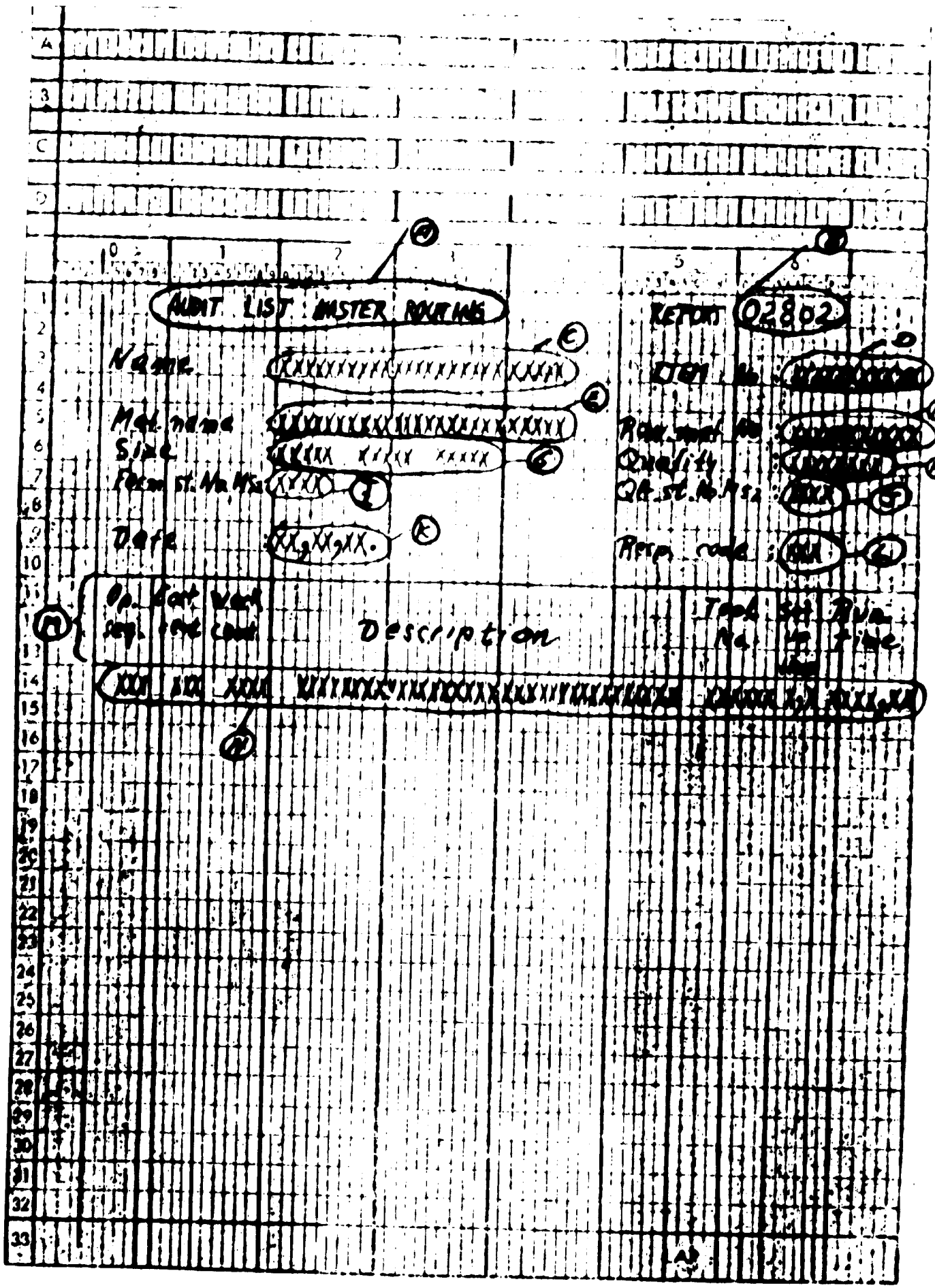
3. Total lines accepted; this field equals the count of source data records processed and accepted

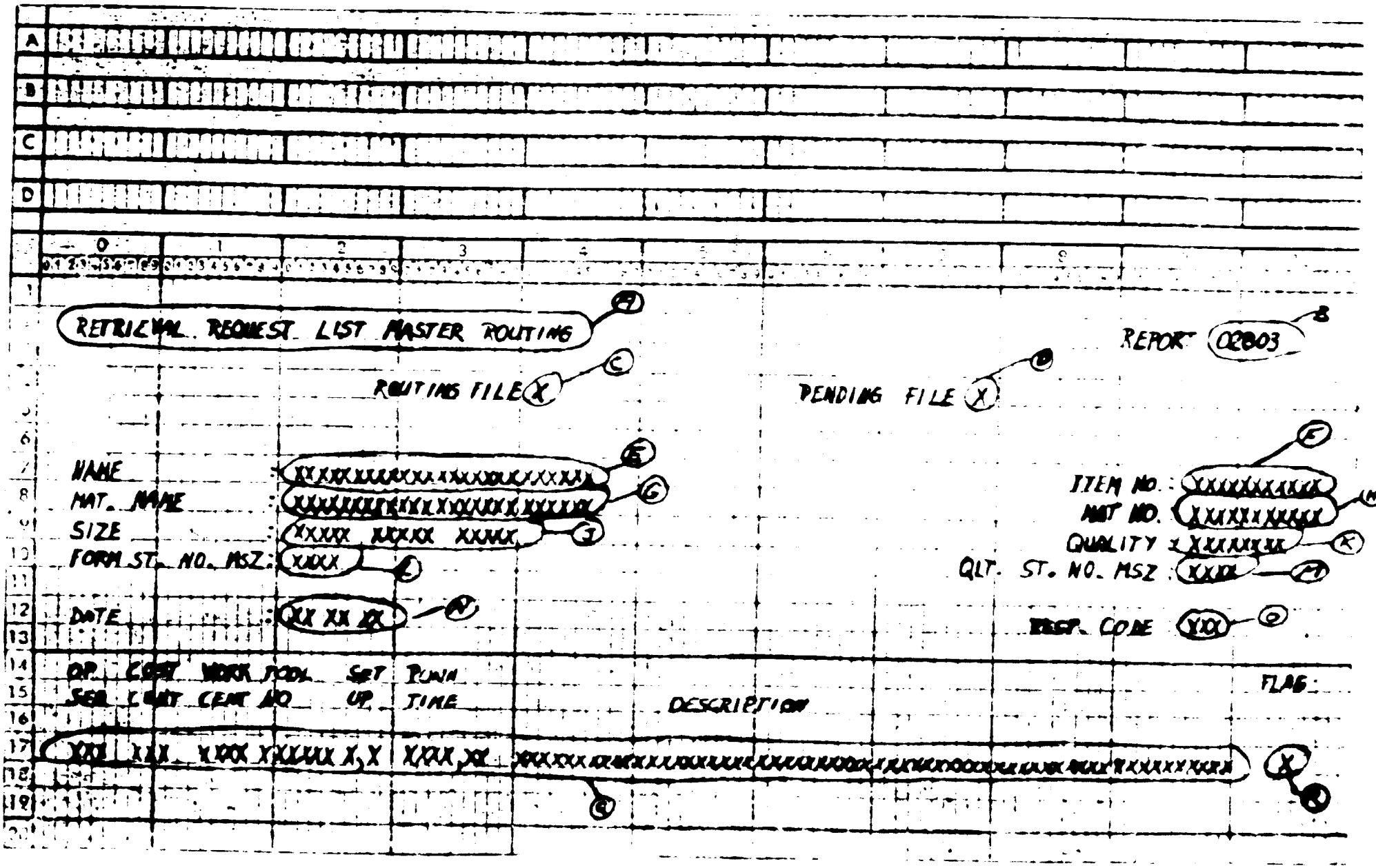
4. Percent lines rejected; this field is computed as follows:

$$\frac{\text{Field 2 value} - \text{Field 3 value}}{\text{Field 2 value}} \times 100$$

2. **Audit list 02302** (see figure XVI)

Report key	Field description	Creation rules
A	Report title	Program forced
B	Report number	
C	Name of the item	
D	Item number	
E	Raw material description	
F	Raw material number	
G	Raw material detail size	
H	Quality standard number	
I	Hungarian standard form	
J	Hungarian standard quality	
K	Date	
L	Responsibility code	
M	Field 11, 12, 13	
N	Source data	


AUDIT LIST MASTER ROUTING
REPORT 02802
Name
Mat. name
Size
Form st. No.
Date
Op. Seq. No.
Work Cent.
Description
Tool No.
Time


RETRIEVAL REQUEST LIST MASTER ROUTING
REPORT QR803
ROUTING FILE X
PENDING FILE X
NAME XXXXXXXXXXXXXXXXXXXXXXX
MAT. NAME XXXXXXXXXXXXXXXXXXXXXX
SIZE XXXX XXXX XXXX
FORM ST. NO. MSZ XXXX
DATE XX XX XX
ITEM NO. XXXXXXXXXX
MAT NO. XXXXXXXXXX
QUALITY XXXXXXX
QLT. ST. NO. MSZ XXXX
REGP. CODE XXX
OP. SEQ. WORK CENT. MCH. TOOL NO. SET UP TIME RUN TIME
DESCRIPTION
FLAG
XXX XXX XXXX XXXXXX X,X XXXX.XX
X

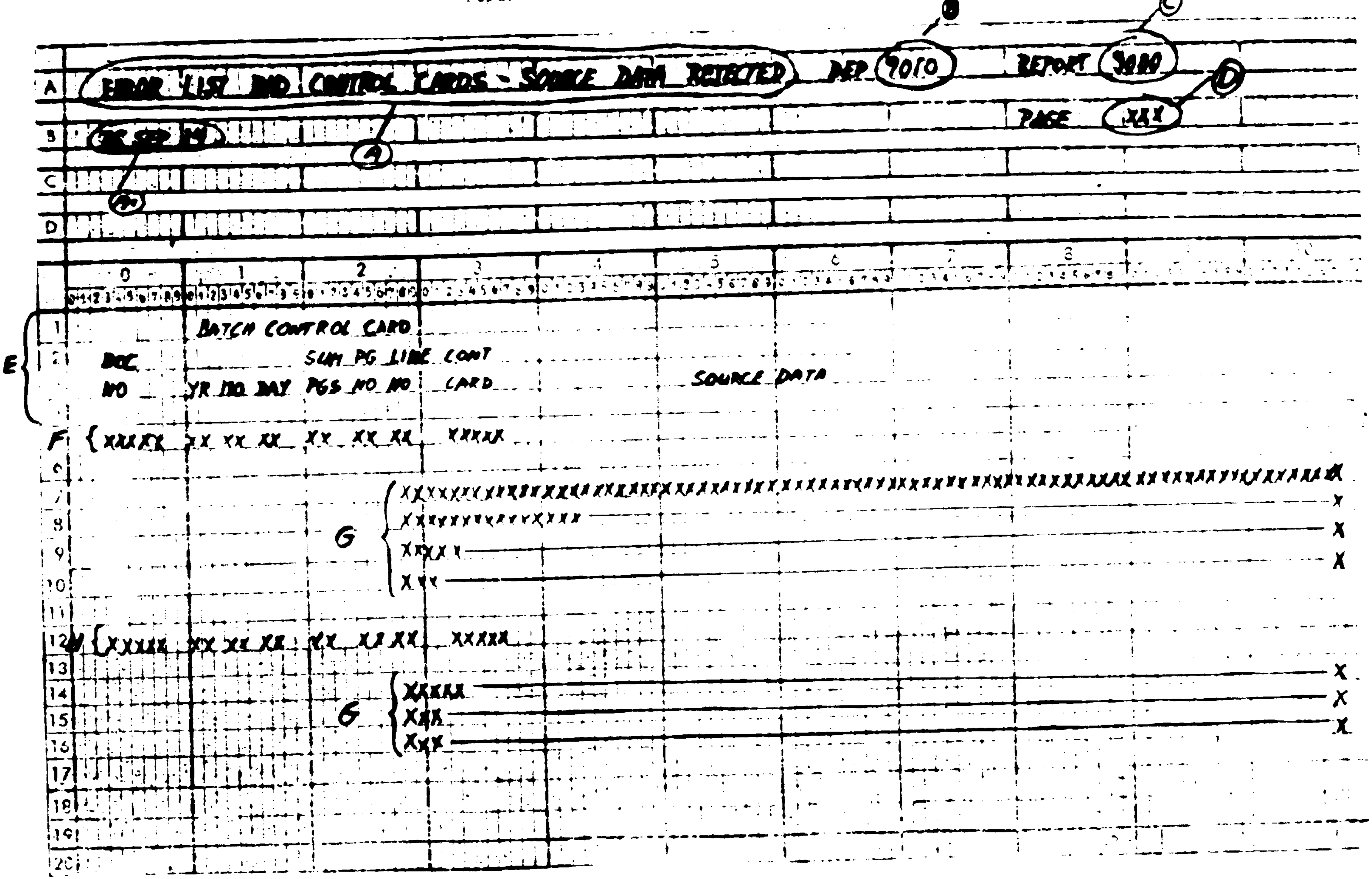
3. Retrieve request list 02503 (see figure XVII)

Report key	Field description	Creation rule
A	Report title	Program forced
B	Report number	
C	Routing existence on master routing file	
D	Routing existence on pending file	
E	Name of item	
F	Item number	
I	Raw material description	
H	Raw material number	
J	Raw material detail size	
K	Quality standard number	
L	Hungarian standard form	
M	Hungarian standard quality	
N	Date	
O	Responsibility code	
P	Field 14, 15	
Q	Source data	
R	Bad record flag	

4. Error list bad control cards 00800 (see figure XVIII)

Report key	Field description	Creation rule
A	Report title	Forced by program logic
A1	Report date	Computer system date
B	Department number	Forced to equal 9010
C	Report number	Forced by program logic
D	Page number	Program generated; printed on over-flow pages
E	Line 1, 2, 3, 4	No headings printed on overflow pages

Figure XIII.



ERROR LIST NO CONTROL CARDS - SOURCE DATA REJECTED
DEP 9010
REPORT 3000
PAGE XXX
BATCH CONTROL CARD
DOC NO
YR MO DAY
SUM PG LINE CONT
PGS NO NO CARD
SOURCE DATA
A
B
C
D
E
F
G

F	Control card data	Printed on this report whenever document number and/or control card I.D. fields do not pass edit checks
G	Source data	Cards are printed; no attempt is made to edit these source data

Card file layouts

1. Batch control card format 0220:

Field number	Card column	Description
1	1 - 5	Document number
2	6 - 7	Year prepared
3	8 - 9	Month prepared
4	10 - 11	Day of month prepared
5	12 - 13	Number lines this page
6	14 - 15	Total pages submitted
7	16 - 17	This page number
8	18 - 21	User department number
9	76 - 80	Control card I.D. '00201'

2. Master routing type 01 card format 0220:

(a) 0201 - add transaction

Field number	Card column	Required (R) Optional (O)	Description
1	1 - 5	R	Document number
2	6 - 7	R	Year prepared
3	8 - 9	R	Month prepared
4	10 - 11	R	Day of month prepared

Field number	Card column	Required (R) Optional (O)	Description
5	12 - 15	R	Transaction code
6	16	R	Type of item
7	17 - 24	R	Item card
8	25 - 26	R	Item variation
9	27 - 29	R	Operation number
10	30 - 31	R	Operation sequence
11	32 - 34	R	Responsibility code
12	35 - 37	R	Cost centre
13	38 - 41	O	Work centre
14	42 - 47	O	First tool number
15	48 - 53	O	Second tool number
16	54 - 59	O	Third tool number
17	60 - 65	O	Fourth tool number
18	66 - 71	R	Unit run time (*10)
19	72 - 73	O	Set-up time
20	74 - 79		Filler
21	80	R	Card type number *10

(b) **Maintenance transactions**

Fields required: R

Fields that can be changed: C

Field number	Create transaction	Add transaction	Change transaction	Delete transaction
1	R	R	R	R
2	R	R	R	R
3	R	R	R	R
4	R	R	R	R
5	R	R	R	R
6	R	R	R	R

Field number	Create transaction	Add transaction	Change transaction	Delete transaction
	R	R	R	R
	R	R	R	R
	R	R	R	R
10	R	R	R	R
11	R	R	C	
12	R	R	C	
13	R	R	C	
14	R	R	C	
15	R	R	C	
16	R	R	C	
17	R	R	C	
18	R	R	C	
19	R	R	C	
20				
21	R	R	C	

(c) Edit rules - master routing card 00201

Check sequence	If	Then
1	Field 1 ≠ 02101	Go to next document logic
2	Field 2 ≠ 0200 or 0201 or 0202 or 0203	Reject transaction
2A	Field 21 ≠ 1	As per check 28
3	Field 2 = 4 year, month and day check (see control card 00201 for checks)	Put current system date into proper fields (tape file)
	If field 5 = 0200 do following checks:	
4	Field 6 ≠ 1, 2, 5	Reject field and put on error file 03402. Create record type 6 and turn field 10 to Y of this record; then turn pending flag 10 (record type 1) field 18 to Y
5	Field 7 ≠ 8 digit numeric	Reject field and put on error file 03402. Create record type 6 and turn field 10 to Y of this record if not done in previous checks. Turn pending flag (record type 1) field 18 to Y if not done in previous checks

Check Sequence	If	Then
	Field 1 ≠ 1 digit numeric	As per check 5
	Field 2 ≠ 1 digit numeric	As per check 5
	Field 3 ≠ 1 digit numeric	As per check 5
7	Field 4	
	Byte 1 ≠ 0 Byte 1 + 2 ≠ 1 digit numeric	As per check 5
	Field 4	As per check 5 if one of the conditions are not met
	(i) Byte 1 =	
	(ii) Byte 1 = 1 or 2, Byte 2 ≠ 1 or 2	
	(iii) Byte 1 = 3 or 4, Byte 2 ≠ 1 or 2 or 3 or 4	
	(iv) Byte 1 = 5, Byte 2 ≠ 1 or 2 or 3 or 4 or 44 or 45 or 46	
	(v) Byte 1 = 45, Byte 2 ≠ 1 or 2 or 3 or 4 or 5 or 6	
	(vi) Byte 1 = 6, Byte 2 ≠ 1 or 2 or 3 or 4 or 5 or 6	
	(vii) Byte 1 = 7, Byte 2 ≠ 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15	
11	Field 5 cannot find match with look-up table (not yet specified)	As per check 5
12	Field 6 ≠ 6 digit numeric or blanks	As per check 5
13	Field 15 (same as check 12)	
14	Field 16 (same as check 12)	
15	Field 17 (same as check 12)	
16	Field 18 ≠ 6 digit numeric or blanks (except last digit must be numeric, right justified)	As per check 5
17	Field 19 ≠ 2 digit numeric or blanks	As per check 5

Check sequence	If	Then
4	Field 20 ≠ Blanks	As per check 5
4a	Field 1 = 1	Create record type 3
	Field 3 ≠ field 3 of previous record, or previous record = 000	As per check 5 Note: Operation number not in right sequence (decreasing instead of increasing)
4	Field 3 = field 3 of previous record field 4 then field 10 ≠ field 10 + 1 of previous record field 10	As per check 5 Note: wrong sequence number
5	Condition as check 4 but field 21 ≠	As per check 5 Note: wrong card type
6	Field 1 = 001 and field 10 = 01	Check as per 5 Note: wrong card type
24	Condition as check 23 but next record is read	As per check 5 Note: wrong card type
25	Field 1 ≠ 001 and field 10 ≠ 01 and field 21 ≠ 2	As per check 5 Note: wrong card type
26	Field 10 ≠ 02 and field 21 ≠ 2	As per check 5
27	(i) Field 20 ≠ blanks	As per check 5
	(ii) Field 1 through field 21 ≠ 80 numeric digits or blanks	As per check 5
28	Field 6, 7, 8 has no match with item master file	Reject transaction put on error file. Create record type 6 and turn field 10 of this record to Y. Put record on pending file and flag field 18 of record type 1
29	Field 4 = 0201 or 0202 or 0203	Perform checks 4 through 29 but reject whole transaction with erroneous field(s) and put the record on the error file 3404 only

3. **Master routing type 02 card format - 02202**

(a) **0201 - add transaction**

Field number	Card column	Description
1	1 - 5	Document number
2	6 - 7	Year prepared

Field number	Card column	Description
3	8 - 9	Month prepared
4	10 - 11	Day of month prepared
5	12 - 15	Transaction code
6	16	Type of item
7	17 - 24	Item number
8	25 - 26	Item variation
9	27 - 29	Operation number
10	30 - 31	Operation sequence
11	32 - 79	Operation description
12	80	Card type number * *

(b) **Maintenance transaction**

Fields required: R

Fields that can be changed: C

Field number	Create transaction	Add transaction	Change transaction	Delete transaction
1	R	R	R	R
2	R	R	R	R
3	R	R	R	R
4	R	R	R	R
5	R	R	R	R
6	R	R	R	R
7	R	R	R	R
8	R	R	R	R
9	R	R	R	R
10	R	R	R	R
11	R	R	C	
12	R	R	C	

(c) **Edit rules - master routing card 02202**

Check sequence	If	Then
1	Field 1 ≠ 02101	Go to next document logic
2	Field 5 ≠ 0200 or 0201 or 0202 or 0203	Reject transaction

Check sequence	If	Then
2A	Field 21 ≠ 2	As per check 11
3	Field 2 + 3 + 4 year, month, day check (see control card 00201 for checks)	Put current system date into proper fields (tape file)
	If field 5 = 0200 do following checks	
4	Field 6 ≠ 1, 2, 5	Reject field and put on error file 03402. Create record type 6 and turn field 10 of this record to Y. Turn pending flag (record type 2) field 8 to Y
5	Field 7 ≠ 2 digit numeric	Reject field and put on error file 03402. Create record type 6 and turn field 10 of this record to Y if not done in previous checks. Turn pending flag (record type 2) field 8 to Y if not done in previous checks
6	Field 8 ≠ 2 digit numeric	As per check 5
7	Field 9 ≠ 3 digit numeric	As per check 5
8	Field 10 ≠ 2 digit numeric	As per check 5
9	Field 10 = 02 and field 12 = 02	As per check 5
10	Field 10 = 02 and field 9 ≠ previous record field 9	As per check 5
11	Field 9 = field 9 of previous record and field 10 ≠ field 10 + 1 of previous record	As per check 5
12	Field 11 = all numeric and/or blank characters	As per check 5
13	Field 6, 7, 8 has no match with item master file	Reject transaction put on error file. Create record type 6 and turn field 8 of this record to Y. Put record on pending file and flag field 8 of record type 2

Check sequence	If	Then
14	Field = 0201 or 0202 or 0203	Perform checks 4 through 29 but reject whole transaction with erroneous field 3 and put the record on the error file 03404 only

Note: Field 1 through field 3 of both card types (02201 and 02202) should be checked for identical numeric contents for the same operation number for a given routing record set. If this check fails, erroneous fields should be put on the error file 03402 and if the transaction code = 0200, the entire faulty routing should be put on the pending file 02404 and flagged.

4. **Retrieval request card format - 00202**

Field number	Card column	Required (R) Optional (O)	Description
1	1 - 5	R	Document number 00102
2	6 - 7	R	Year prepared
3	8 - 9	R	Month prepared
4	10 - 11	R	Day of month prepared
5	12	O	Item type
6	13 - 20	O	Basic item number
7	21 - 22	O	Item variation
8	23 - 24	O	Item dictionary request Yes = IR No = blank
9	25 - 29	O	Item type for which item dictionary is to be created 9 = all item types. Item numbers 1, 2, 3, 4 and 5 may be specified
10	30	O	Master routing retrieval Yes = 1 No = blank
11	31 - 34	O	Master routing quantity factor
12	35	O	Product structure retrieval type 1 = explosion 2 = implosion

Field number	Card column	Required (R) Optional (O)	Description
[illegible]	[illegible]	O	Product structure retrieval variation 1 = single level 2 = indented 3 = summarized
14	37 - 40	O	Product structure quantity factor
15	41 - 43	O	Production data sheet number
[illegible]	[illegible] - 80	R	Card control number "00202"

Tape file layouts

Tape file layout 03404, 02405 and 02406

Field number	Byte number	Description
1	1 - 11	Item number: type - basic - variation
2	12 - 17	Date: year/month/day
3	18 - 21	Transaction number Record type 4 = "9999" Record type 5 = "9999"
4	22 - 25	Operation number Record type 3 = "000" Record type 4 = "000" Record type 5 = "000"
5	26 - 27	Sequence number Record type 3 = "00" Record type 4 = "00" Record type 5 = "00"
6	28	Record type 1 = Master routing operation data 2 = Master routing description 3 = Item master 4 = Retrieval 5 = Delete master routing 6 = Create header record

(a) **Record type 1**

Field number	Byte number	Description
7	29 - 31	Responsibility code
8	32 - 34	Cost centre

Field number	Byte number	Description
9	35 - 38	Work centre
10	39 - 44	Tool number 1
11	45 - 50	Tool number 2
12	51 - 56	Tool number 3
13	57 - 62	Tool number 4
14	63 - 68	Unit run time/100
15	69 - 70	Set up time
16	71 -118	Description
17	119 -122	Filler
18	123	Pending flag Y/N

(b) **Record type 2**

Field number	Byte number	Description
7	29 - 122	Operation description
8	123	Pending flag Y/N

(c) **Record type 3**

Field number	Byte number	Description
7	29 - 39	Raw material number
8	40 - 64	Raw material description
9	65 - 69	Hungarian standard form
10	70 - 77	Quality standard number
11	78 - 82	Hungarian standard quality
12	83 - 97	Raw material detail size
13	98 - 102	Quantity raw material pieces per detail
14	103 - 104	Unit of measure
15	105 - 123	Filler

(d) **Record type 4, 5**

Field number	Byte number	Description
7	29 - 122	Filler
8	123	Pending flag Y/N

(e) Record type 6

Field number	Byte number	Description
	29	"Record missing field" - operation number 001 "0" not missing "9" missing
8	30	"Record missing field" - operation number 002 "0" not missing "9" missing
9	31	"Record missing field" - operation number 999 "0" not missing "9" missing
10	32	Bad data elements exist Y/N

2. Tape file layout 2403, 2404

Field number	Byte number	Description
1	1 - 11	Item number: type - basic - variation
2	12 - 14	Operation number record type 3 = 000
3	15 - 16	Operation sequence number Record type 1 = 00 Record type 2 ≠ 00 Record type 3 = 00

(a) Record type 1

Field number	Byte number	Description
4	17 - 19	Responsibility code
5	20 - 22	Cost centre
6	23 - 26	Work centre
7	27 - 32	Tool number 1
8	33 - 38	Tool number 2

Field number	Byte number	Description
9	39 - 44	Tool number 3
10	45 - 50	Tool number 4
11	51 - 56	Unit run time/100
12	57 - 58	Set-up time
13	59 - 93	Description

(b) **Record type 2**

Field number	Byte number	Description
5	17 - 93	Operation description

(c) **Record type 3**

Field number	Byte number	Description
4	17 - 27	Raw material number
5	28 - 52	Raw material description
6	53 - 57	Hungarian standard form
7	58 - 65	Quality standard number
8	66 - 70	Hungarian standard quality
9	71 - 85	Raw material detail size
10	86 - 90	Quantity raw material pieces per detail
11	91 - 92	Unit of measure
12	93	Filler

3. **Tape file layout 2405, 2406**

Field number	Byte number	Description
1	1 - 11	Item number: type - basic - variation
2	12 - 14	Operation number Record type 3 - 000
3	15 - 16	Operation sequence number Record type 1 - 00 Record type 2 / 00 Record type 3 - 00
4	17	Pending flag Y/N

For record types 1, 2 and 3 see above

Description of programs

1. Program number 02403 - sort

Input: tape file 03401.

Output: tape file 03402.

Program function: IBM utility sort.
Sort sequence: 1. Item number
2. Date
3. Operation number
4. Sequence number
5. Transaction code

Planned frequency of operation: after completion of program number 02302.

Execution time:

2. Program number 02302 - merge

Input: tape file 03404, data prepared (major), transaction code (minor).

Output: tape file 03401. (If number of input files exceeds 3 then tape file 3401 must be remerged with other 03404 files.) Data prepared (major), transaction code (minor).

Program function: A standard IBM merge utility program.

Planned frequency of operation: prior to execution of program 02301, and if there are two or more 03404 files to be processed.

Execution time:

3. Program number 2304 - copy

Input: tape file 02404.

Output: tape file 02407.

Program function: a standard IBM copy utility program. All master routing files involved in a maintenance run must be backed up following a successful completion of the run.

Planned frequency of operation: after completion of program 02301.

Execution time:

4. Program number 02301 - master routing

Input: tape file 02402, 02404, 02405 and disk file 01501.

Output: tape file 02403, 02406 and disk file 02502.

(a) General

The input (tape file 02402) for this program must be in the form of routing record groups. These routing record groups are ordered by item number. The input data for the master routing program are sorted in the following

sequences:

1. Item number (ascending)
2. Date
3. Operation number
4. Sequence number
5. Transaction code

The plant technologist determines the sequence of operations within each routing group. This sequence is the one in which the operation records for a routing are maintained. The master routing file, tape file 02402, and the pending file, tape files 02403, 02404 are created and maintained by a "tape swing approach". These files are arranged by item number (ascending).

The program has the "main line approach" which includes all the input and output instructions, the general housekeeping and putting the records in the work area. After the records have entered the work area the program tests the main item and branches into different routines (processing) depending upon the transaction code.

The program consists of five major transaction processing routines. One processing routine exists for each transaction code. The transaction codes and the sequence in which they are processed are:

1. Create
2. Add
3. Change
4. Delete
5. Retrieval

A subroutine is also provided for the calculation of "manufacturing lead time" parameters. This routine can be entered by all transaction codes, an exception being the retrieval transaction. After an edit transaction record has been processed the processing routine for the given transaction code returns control to the main line program. The main line program then determines which of the five processing routines should next be called in and response to the next transaction record. After all transaction records for a given routing are processed the main line program executes I/O functions.

After this point the master routing records of the entire routing will be loaded from the work area on to either the master routing, tape file 02403, or

pending file, tape file or log. Print records are created and put on to the disk file (PRT) when the edit transaction has been processed to the master routing file.

(b) Manufacturing lead time calculation

To provide the system with manufacturing lead time data it is necessary to calculate the following fields which exist in the item master file.

MLTPR contains a queue/move time factor. A look-up-table will be provided by the user to establish the basic queue/move time between one department cost centre to another (every operation has a queue/move time). This approach to determine queue/move time requires the introduction of department numbers, since the information and material flow, in the present system, cannot be determined accurately. The department number scheme is also required for future applications (order release module, shop floor control module, physical inventory module etc.).

MLTQC contains conversion factor to convert the value in field MLTPR into shop days. Since the MLTPR look-up-table is given in shop days the conversion factor = 1.

MLTSU contains the total set-up time for this item. MLTSU = $\sum_{n=10}^{n=999}$ FIELD 13 of record type 1. (n = operation number)

MLTSC contains the necessary conversion factor to convert the field MLTSU to shop days. The user will be required to provide this factor for the different departments in a look-up-table.

MLTRN contains the total run time for this unit/100. MLTRN = $\sum_{n=10}^{n=999}$ FIELD 14 of record type 1. (n = operation number)

MLTRC contains the necessary conversion factor to convert the value in field MLTRN to shop days. (The same look-up-table as in subparagraph 2.4 can be used.)

After calculation of all production lead time fields, these fields should be loaded in the respective existing item master file fields. At the same time the routing flag in the item master file should be set. (MRPF bit numeric 2.)

(c) Create transaction routine

The create transaction code = 0200. The function of this transaction code is to create records for an entirely new master routing record set.

Routing with faulty record fields. If the first record of a new routing is a header card (record type 6 of tape file [illegible]), the first record of the new routing has record data fields. The record is a dummy record created by the common edit program (03303) and [illegible]. The header card directs the program [illegible] for the subject item number and the pending [illegible] must have been established and the record(s) with [illegible].

Routing with correct record fields. If no header card is found in the first record for a correct routing, which starts with operation number field = 10 and the operation sequence field = 0', passes the record required for the manufacturing lead time calculation (see above "manufacturing lead time subroutine"). After executing this subroutine the record will be formatted and returned to the main line program which will then put records into master routing file, [illegible] and print disk file [illegible].

(1) Add transaction routine

The transaction code for this routine is equal to 0001. The function of this transaction is to add a whole record to an existing routing record set which exists either on the pending file or on the master routing file.

After an add transaction is read and the record put into the work area, the program now looks for a match of field 1 (item number) in the pending or the master routing file.

Match found on the pending file 02405. The entire routing records for the same item number are loaded into the work area. The add transaction record is now inserted into the proper descending order sequence. As an add transaction is processed the proper "record missing field" in the header record is updated.

Note: The common edit program 03303 when creating record type 6 (file number 03404) set fields 7, 8 and 9 to "9" when the required operations records of a specific routing were missing. Field 10 was set to "9" when one or more source data records had data element errors.

After processing all add transactions of a given item number the main line program checks the routing records for pending flags in an on condition. If there are any, return the routing records to the pending file 02406. Otherwise, calculate the manufacturing lead time. After this subroutine program is processed the main line puts the records on to the master routing file 02403 and puts proper records to the print disk file 02502.

[illegible] master routing record. Load entire routing record [illegible] work area and merge the said transaction record [illegible]. If there are other transaction [illegible] for the current item number, record type [illegible] about the [illegible]. Record type [illegible] new manufacturing [illegible]. After completion of manufacturing lead time computation, [illegible] the [illegible].

[illegible] change transaction routine

This routine has the transaction code 020. The function of this routine is to provide a method to change fields in the record group which makes up a master routing set. The following fields of record type 1 and 2 may be changed.

Field [illegible] - [illegible]

Field [illegible] - operation number

Field [illegible] - [illegible] sequence number

The change transaction is read and put into the work area. The program finds the matching routing record, which requires field changes. This record may exist either on the pending file 02405 or master routing file 02404.

Routing records found on the pending file 02405. Routing records are [illegible] into the work area and the necessary change transaction is processed. The operation and sequence number of the change transaction record are matched with the pending file record of the same item number. Now the other corresponding fields of this record are changed if different from the field contents of the change transaction record.

Note: Only correct maintenance records can get on to file 02402 (see common edit programs 02303). Hence pending flag of a changed erroneous field will be turned off. This process requires an updating of field 10 of the dummy header card.

After the program has processed all transaction for the subject item number, the main line program is called in. This program checks the "bad data elements exist" field of record type 6 for an on condition. If the field is in an "on condition" put the routing records on to the pending file 02406. Otherwise calculate manufacturing lead time and put the records on to the master routing file 02403 and proper records to the print file 02502.

Routing record found on the master routing file [illegible]. The most used routing record is moved into the work area and the header transaction record. If one or more of the following fields change then the program must recompute the manufacturing lead time:

Field	Description	Record
5	Cost centre	1
6	Work centre	1
11	Unit run time	1
12	Set-up time	1

The current routing records will be put on file [illegible]. Appropriate print records are put on to file.

(f) Delete transaction routine

The routine has the transaction code [illegible]. The function of the routine is to delete entire routing from the master routing or pending file. It is not possible to delete any records which have operation numbers 000, 001 or 999. After deleting a record type 1, all type 2 records belonging to the delete operation are deleted automatically from the routing. All records for a given item number routing will be deleted if the operation field and sequence field in the transaction record contain zeros. It is possible to delete description records (record type 2) only. The delete transaction record is put into the work area. The program searches for the specific routing records on the pending or master routing file.

Routing on pending file. The records that should be deleted are put into the work area. The delete transaction is then processed. The deletion of a record that had a pending flag in an on condition requires the updating of the dummy header card. After all transactions are processed for the subject item number, the main line program is called in for checking for bad data elements (record type 6 field 10). If the record is free from bad data elements the manufacturing lead time factors are calculated and the routing records are put on to file 02403. Appropriate print records are put on to file 02502. If any pending flags still exist the routing records are put on the file 02406.

Routing on master file 02404. After loading the records into the work area the delete routine is processed. If there are no other transactions to be processed for the current item number and records type 1 have been deleted, new

manufacturing lead time factors have to be calculated. After processing the manufacturing lead time subroutine, the main line handles the necessary I/O functions.

(g) Retrieval transaction routine

Retrieval source document 00101 is assigned to the retrieval routine. The nature of this routine is to retrieve the information on the pending and master routing file when requested. The retrieval routings are selected from either the pending file 02402 or routing file 02403 and put to the print file 02501.

II. CONCLUSIONS AND RECOMMENDATIONS

A. General

It is the carefully considered opinion of this expert that EVIC's EMC-440 computer configuration lacks the power, both with regard to hardware and software, to handle the processing of the integrated system desired by EVIC and proposed by the team to the management.

This does not exclude the use of the 440 configuration for processing of certain data elements. Therefore, the study team developed the data entry module based on the use of the EMC configuration. The work performed and conclusions reached by the team were influenced by the almost non-existent system documentation and the lack of organization department support to provide machine test time and test data.

The top management of EVIC should put more emphasis on developing and implementing an integrated data processing system. The enterprise must break away from the unit-record based system, which uses medium-sized tape/disk computers. The concept of EVIC's present system leads to the creation of a number of more or less independent automatic procedures with a large number of sequentially organized files and a large-scale maintenance problem. Since it contributes little to the actual control of the manufacturing process involved and still less to the over-all control of the organization, it is strongly recommended that more resources be put into an integrated system. The following measures should be taken.

1. Freeze all new system development and maintenance work on EVIC's present system.
2. Transfer data input from the organization department to user departments.
3. Utilize the manpower released for the new EVIC integrated system developed by the UNIDO team.
4. Build conversion programs for the new EVIC/UNIDO system from EVIC EDP data.
5. Start to program common data entry module and common print module programs for running on EMC-840.
6. Clear up and implement cost centre, work centre and department numbering scheme.

B. Systems analysts

It is proposed that the level of knowledge of EVIG's present systems analysts be increased by means of the following activities.

1. All systems analysts should attend a programming course in higher level languages.

2. The current systems analysis course should continue and be upgraded to include teaching of basic economics.

3. The management should look for the following qualifications when employing new systems analysis personnel:

(a) A university degree;

(b) Minimum of two years experience in the function in which they will be doing systems work;

(c) At least six months programming experience in higher level languages, preferably PLI and COBOL.

C. Programming department

It is essential for EVIG's information systems work that EVIG create a programming department with senior programming knowledge. It is therefore strongly recommended that EVIG's management immediately hire or contract ten to fifteen experienced programmers with a minimum experience of five years. This recommendation can neither be overlooked nor postponed for consideration at another time, since an integrated manufacturing system cannot become a reality without applying good programming techniques.

D. Hardware/software

The creation of an integrated system capable of supporting decision type functions as well as those which are purely routine has radically altered the requirements that must be met by the systems effort. The new requirements can be satisfied only by developing a new technical concept and employing the most modern third/fourth generation hardware and software. It is therefore recommended that the enterprise establish a five-year contract with an Hungarian institute that uses a third/fourth generation computer and has access to the necessary software packages for an integrated manufacturing system.

Furthermore, it is recommended that the enterprise look into the availability of terminals, which is necessary for the feedback of such data as inventory movements, product work status etc., of a modern integrated manufacturing system. The following outline should be considered in selecting a terminal.

1. The terminal should feature integrated circuitry, electronic scanning and editing, be designed to operate in a factory environment and be tolerant of the sand, dust, dirt and grease normally encountered there. It should also be able to operate in a wide range of ambient temperatures and relative humidities.

. Keyboard and reader nomenclature:

(a) Power on/off. Supplies power to the terminal;

(b) Transaction key. Push button keys with indicators. These keys are used to select a particular transaction to be performed. One transaction key is used at a time. When pressed, it will light up and automatically identify the inputs for that transaction (cards, badge, variable data etc.);

(c) Kercolumn select/error. Push-button key with indicators. This row of tutorial keys will light up after the appropriate transaction key has been pressed. Only the columns that require manual entry of data will light select/error indicators;

(d) Variable data keys. Push-button keys with indicators. These keys are used to enter variable data and light up as each key is pressed;

(e) Transmit bar. This bar is used to initiate the transmission of data to the central processing unit (CPU);

(f) Wait indicator. An indicator that lights up when the transmit bar is pressed, indicating that a message is being transmitted to the CPU;

(g) Message received indicator. An indicator that lights up when CPU acknowledges the transmitted message without error;

(h) Error indicator. An indicator that flashes when condition (i) exists and burns steadily when condition (ii) exists:

(i) Entry error has been made and the transmit bar is pressed;

(ii) Invalid message received at CPU;

(i) Enter badge. Indicator/switch. This indicator light informs the operator that a badge must be inserted for the selected transaction. This switch allows the operator either to reject the badge just entered or to make a new badge entry before transmitting the data to CPU;

(j) Badge ready. An indicator that lights up if the badge data have been read successfully;

(k) Enter card. Indicator/switch. Same operation as enter badge, except that a card must be inserted for the selected transaction;

(l) Card ready. Same function as badge ready, except that the card data have been read successfully;

(m) Badge hold slot. A badge is inserted in this slot if the badge data for multiple transmissions are required;

(n) Reset. Indicator switch. An indicator lights up when an error has been detected while reading a badge or a card. The switch is pressed to allow the operator to make a re-entry;

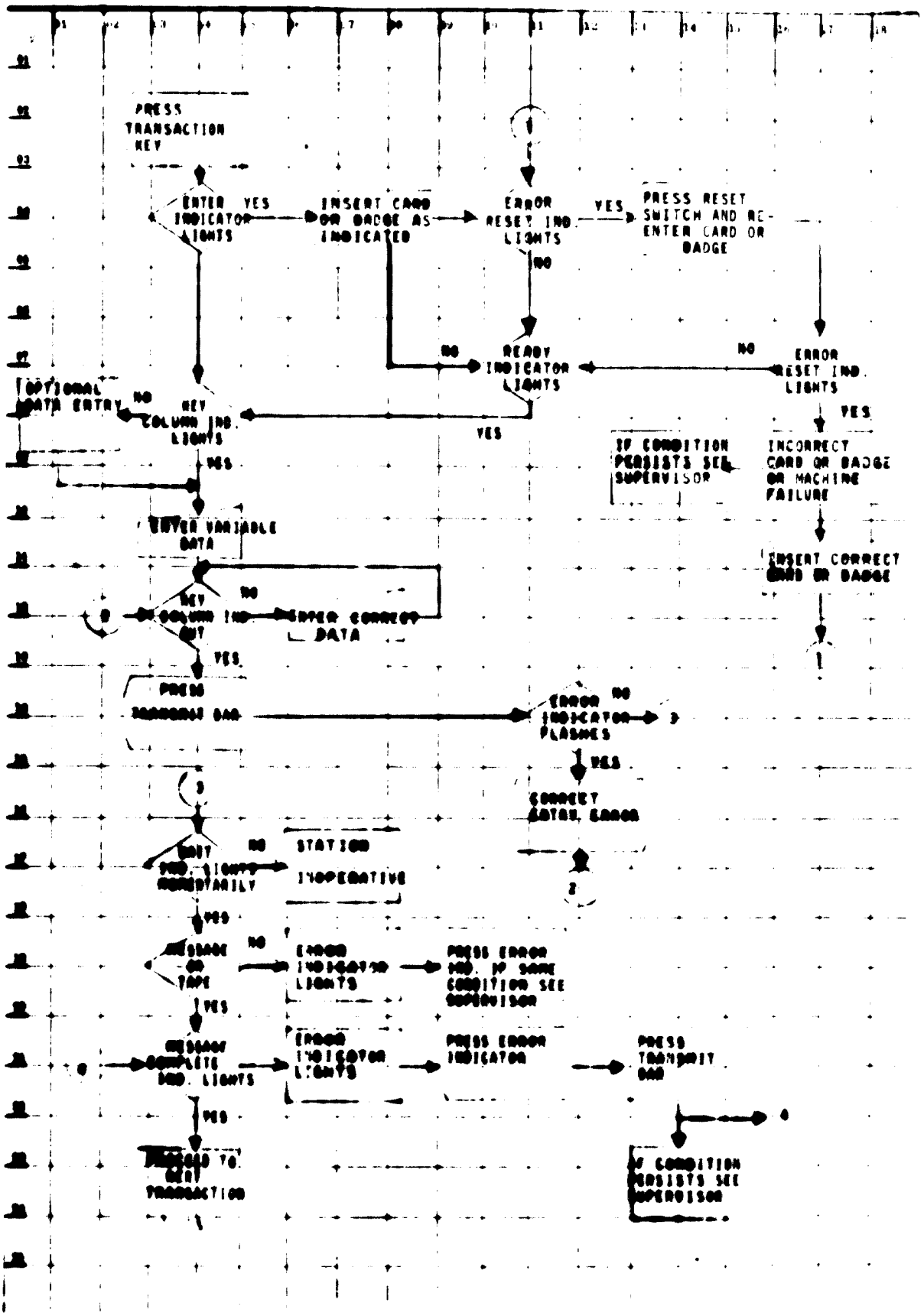
(o) Badge/card insert slot. A badge or a card is entered in this slot when the "enter badge" or the "enter card" indicator is lit;

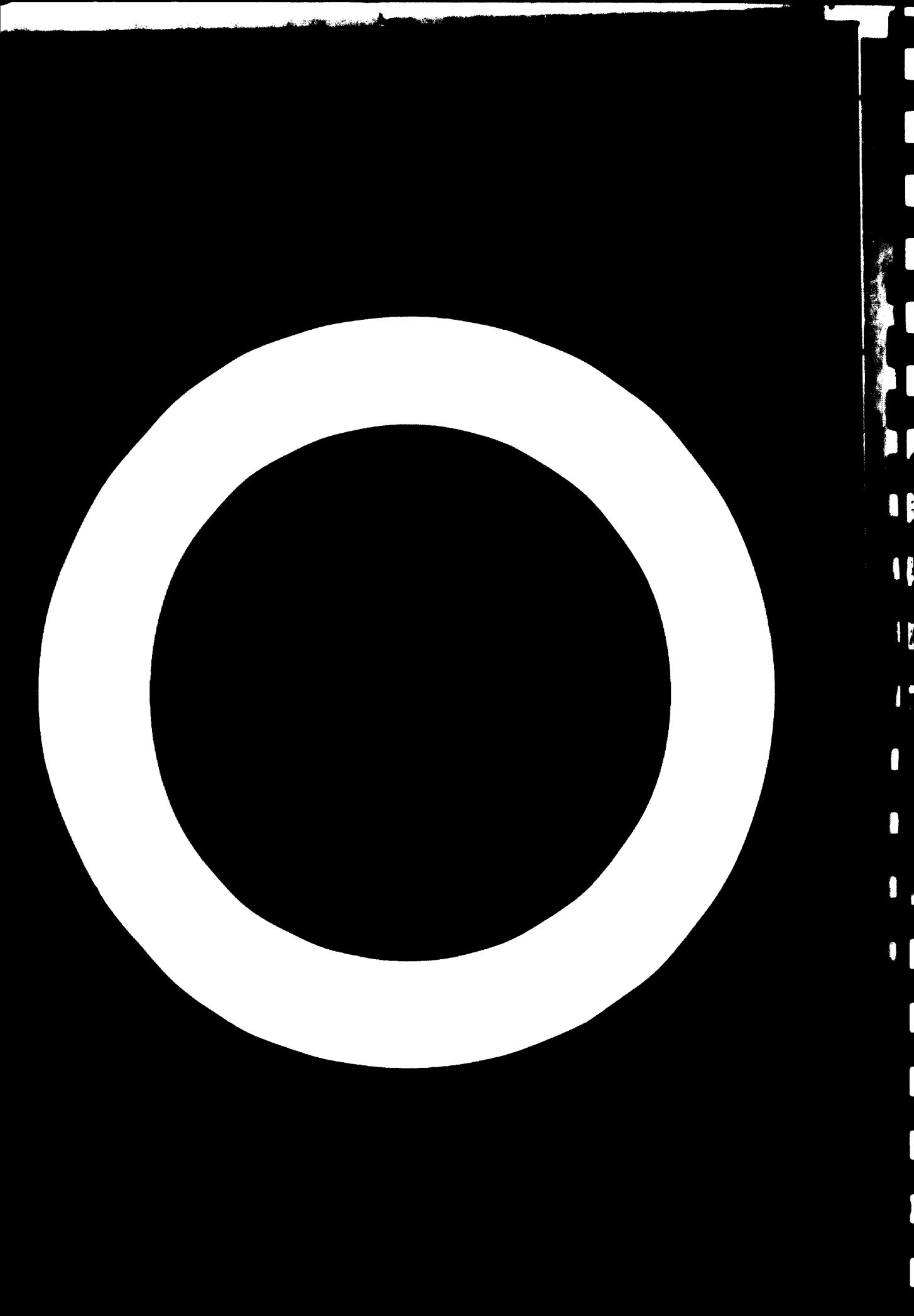
(p) Badge/card remove slot. After the badge or the card has been read, it is deposited in this slot.

3. See the flow chart for normal operation and error correction sequence of the input data station (figure XII).

4. EVIC's management should keep in mind that this kind of system needs a CPU to gather the correct data, perform edit checks, formate the data and put the data on to a magnetic file tape that, in turn, is used as the feedback input to the third generation computer for the integrated management information system. The task of the CPU in this feedback gathering system could probably be realised with the [illegible] minicomputer. It is therefore advisable that a team of hardware and software experts be formed to study the feasibility of the proposed feedback system in EVIC's environment. After that the management should make a decision on the feedback system itself.

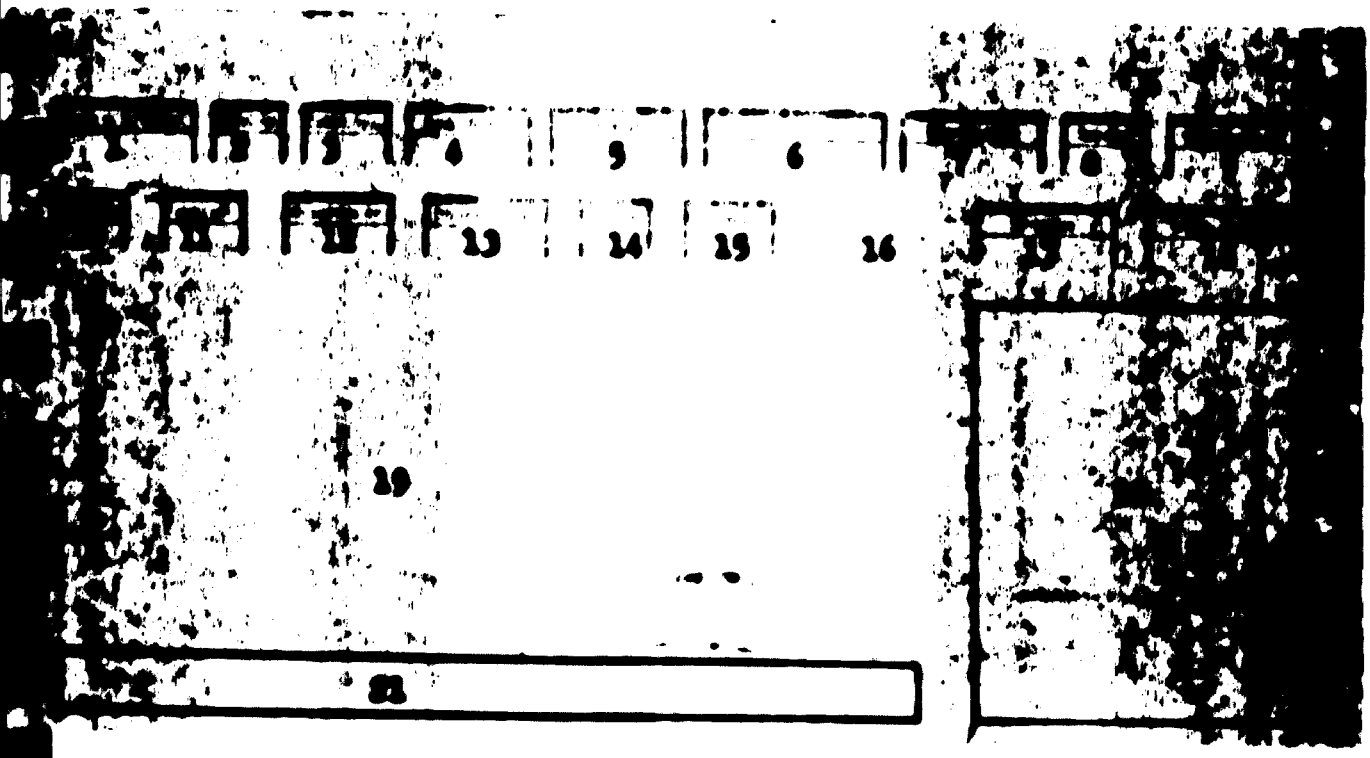
Figure XIX. Normal operation and error correction sequence of the input data station





Annex I

INSTRUCTIONS FOR FILLING OUT THE T-SHEETS FOR THE MATERIAL ISSUE OR WORK ORDER a/



a/ This annex is a literal translation from Hungarian of EVIG's instructions and is reproduced without formal editing.

MATERIAL ISSUE or WORK ORDER

General rules:

In the process of T-sheet creation the technologist should fill out fields 1 - 2 - 3 - 4 - 6 - 10 - 11-12 - 15 and 19.

Field 1: filled by (a) member of Organization Department
(b) Production Preparation Section (PPS)
- in case of '0' T-sheet

13-14: filled by norms technologist

7-8-9-17: filled by computer or PPS

20-21: workshop, warehouse, Materials Section, Wages Section

Write / symbols correctly otherwise it can be taken as a 1.
Write readable numerics and letters when filling it. Write the following symbols in words: triangle, square, star, parallels, dash. In case of eventual change in drawing numbers indicated by lower case letters do it as follows:

> The drawing number on the drawing is 856784 a II B, write it on the T-sheet like this 856784 lower case A II B. There is a difference between T-sheets of components (semi-finished) and for assemblies (productive) - data should be loaded in the fields by following different rules in the above cases. As there is one type of document for both material issue and work order, besides the data itself it is the field number 2 which indicates its function.
>
> Additionally, in case of material write "Material" in the lower left corner of field 19.

It is a work order from 01 to 19 and a material issue from 20 to 99. Operation number 00 means 'take it to the warehouse'. In the process of T-sheet creation the first document is the material issue. This is followed by routing sheets and a warehouse bill. In cases of sub-assemblies or assembly T-sheets - in certain cases - material issue and generally warehouse bill are not required.

Detailed instructions

Field 1

Drawing number or T-sheet number of bill of material number. 8 positions. Write the number of T-sheet created by the technologists - 8 digits.

If it is a so-called zero T-sheet prepared by PPS for assemblies, this 8 digit number is identical to the T-sheet number.

Field 2

Operation number. 2 digits. This is the field where the numbers of material issues have to be written in ascending order from 20 up to 99, depending on the number of kinds of materials or details required for manufacturing a component or assembly. If it is a work order, the operation number ranges from 19 to 09. The first operation gets a number which is equal to the number of operations required in the manufacturing process (of that detail or assembly). The last number is 01. So this is a descending order. Operation 01 is followed by 00 that means warehouse receipt.

Field 3

5 positions. Write "1" in this field in every case because in EDP the number of pieces required for one product comes from the bills of material. There is an exception: when the 'assembly T-sheet' of an assembly - fan for instance - includes material issues, too. In this case write 1 in this field of the work order, but the quantity in the material issue documents amounts to the demand of one assembly - fan for instance. Another exception is the "0" T-sheet made in PPS. If it is an "0" T-sheet, write the quantity required for one product into this field (quantity is taken from bill of mat.).

Field 4 Demand/unit

8 positions: xxxx,xxx

the decimal part of the number always consists of three digits.

Examples: 1,000 - 11,000 - 111,000 - 1111,000 - 1,020 (one position is reserved for comma)

Write the weight of the detail into this field if the document is material issue (the total weight of all components for different products). Write 1,000 when it is a material issue for components to make an assembly, or in case of 0 T-sheet created by PPS. Also write 1,000 if it is a work order.

Field 5 Field of assigned material number.

8 positions. Technology leaves it blank. If it is an 0 T-sheet created by PPS write T-sheet number in this field with changing 1 (the first digit of T-sheet number) to 8.

For example: T-sheet number 1126-0006, so write

1126-0006 in this field

The number must be written without dash, of course, because there is no position saved for it. If an O T-sheet has data of purchased items, write eight zeros in this field.

Field 6 Size. Ten positions.

Write casting form number if the item is casting; write cut size if the item is steel sheet or other kind of rolled material. Write ten zeros in every other case.

Field 7 Work number. Eight positions.

Filled by computer or PPS. Write only the number of one order out of the "ORMIG" orders bearing identical production data numbers in a production plan period - if it is an assembly (productive) document. In case of components (semi-finished) write a "semi-finished number" assigned in accordance of the rules of the Organization Department. Assign this number by the following rules:

10553320, where

105 means Gyömrői Street

5 means the year (1975)

3320 are the digits taken from the T-sheet number (2nd to 5th positions)

for example: 10553320 - work number

13320695 T-sheet number

20553320, here

205 means Klapka Street.

Field 8 Month of production plan.

For example: January = 101, November = 111.

Filled by computer or PPS.

Field 9 Production quantity. Six positions.

Write the quantity of the item referred to in field one; to be manufactured in the month referred to in field eight. Filled by computer or PPS.

Field 10 Cost Center. Three positions.

Find Cost Center numbers in "Instruction for Factory Managers" number 24-10-29.

According to the basic rule the Cost Center number linked to the first operation must be written on the material issue whereas the Cost Center number linked to the last operation must be written on OO marked material issues.

The material issues record the Cost Center number linked to the last operation.

The material issues included in O T-sheets created by PPS must have the Cost Center numbers of the users. As the output of EDP (reports, sort of documents) is distributed according to Cost Center numbers, this number has to be written with special care. False numbers make difficulties for production control.

Field 11 Work Center. Four positions.

A list produced by the Organization Department contains the prescribed Work Center numbers. Write four zeros on material issues.

Field 12 Tool number. Six positions.

Write tool number in this field. In case of more than one tool required, write all the other tool numbers in field 19. If no tool is required or the document is a material issue, write six zeros.

Field 13 Run time per 100 pieces. Six positions.

Data are recorded here by norms technologists with two decimals. If the operation is payed by hours, write 0,00.

Field 14 Setup time. Three positions.

Norms technologists write setup time here with one decimal. If there is no setup time assigned, write 0,0.

Field 15 Next Work Center. Four positions.

Write number of next Work Center. In case of material issue write the Work Center number linked to the first operation.

Field 16 Leave it blank.

This field is not used in the new documents.

Field 17 Sequential number. Eight positions.

Filled by computer or PPS. Write production data number on assembly (productive) document. Write eight zeros on component (semi-finished) document.

Field 18 Prescribed quantity. Eight positions.

Filled by computer or PPS. If it is work order, divide values in fields 9 and 13 and write here.

Field 19 Narrative.

Drawing number

Coil data sheet number

Description of item

If it is material issue, write size, name, quality and standard material numbers, and "Material" in the left corner.

If the document serves for component issue, write "semi-finished product, machined". If it serves for work order, describe the operations (in sequence) accurately, so that the worker could be able to accomplish the work assigned to him using the drawing (or coiling data sheet) and this document.

Annex II

Key-punch instructions for time norming punched tapes[a/]

1. Each punched tape roll can contain all key combinations only. This means that blank tapes or tapes with eight punched holes cannot be created.

2. At the beginning of each tape a correction code (length: 70-80 cm) for tape leadway should be punched. Then key-punch WS code.

3. At the end of each roll a correction code should be punched (length: 70-80 cm) after the last meaningful code.

4. Description of the first heading line:

(a) Line spacing as necessary for the setup of the document (it usually does not exist);

(b) Upper case letters - lower case letters; switch code punching;

(c) Key-punch identification code number one;

(d) Key-punch T-sheet numbers - nine position characters:

XXXX-XXXX or XXX-XXXXX

This field must exist in any case;

(e) Key-punch tab code;

(f) Operation number (2 positions). This field must exist in any case;

(g) Key-punch tab code;

(h) Demand/product (5 positions, integer). This field must exist in any case;

(i) Key-punch tab code;

(j) Demand/unit; 7 positions: XXX,XXX or XXXX,XX;

(k) Key-punch tab code;

(l) Prescribed material number (eight positions);

(m) Key-punch tab code;

(n) Size (10 positions);

(o) Key-punch STOP code;

(p) Key-punch WS code (end of line);

(q) Carriage return.

Note: (i) Alphanumeric codes can be in the "Size" field only, all the others should contain pure numeric information;

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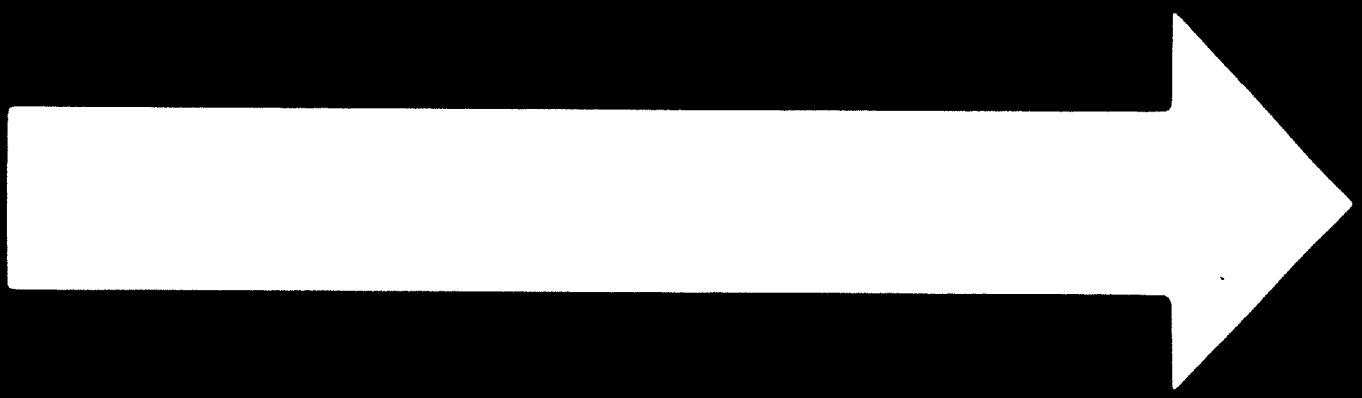

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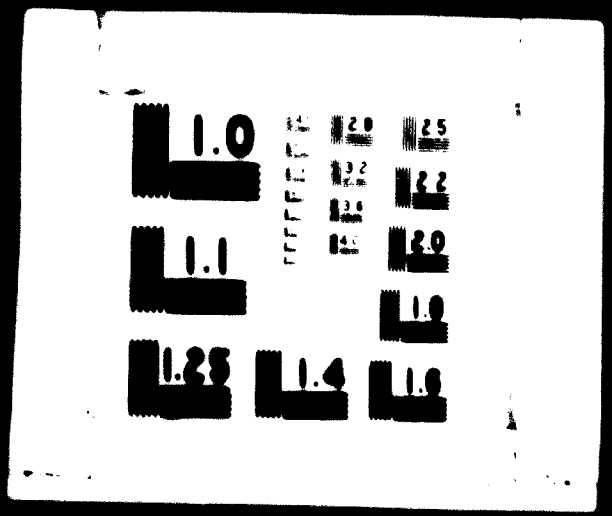

Field 18 Prescribed quantity. Eight positions.

Filled by computer or PPS. If it is work order, divide values in fields 9 and 13 and write here.

Field 19 Narrative.

Drawing number

Coil data sheet number

Description of item

If it is material issue, write size, name, quality and standard material numbers, and "Material" in the left corner.

If the document serves for component issue, write "semi-finished product, machined". If it serves for work order, describe the operations (in sequence) accurately, so that the worker could be able to accomplish the work assigned to him using the drawing (or coiling data sheet) and this document.

Annex II

Key-punch instructions for time norming punched tapes[a/]

1. Each punched tape roll can contain odd key combinations only. This means that blank tapes or tapes with eight punched holes cannot be created.

2. At the beginning of each tape a correction code (length: 70-80 cm) for tape leadway should be punched. Then key-punch WS code.

3. At the end of each roll a correction code should be punched (length: 70-80 cm) after the last meaningful code.

4. Description of the first heading line:

(a) Line spacing as necessary for the setup of the document (it usually does not exist);

(b) Upper case letters - lower case letters; switch code punching;

(c) Key-punch identification code number one;

(d) Key-punch T-sheet numbers - nine position characters:

XXXX-XXXX or XXX-XXXXX

This field must exist in any case;

(e) Key-punch tab code;

(f) Operation number (2 positions). This field must exist in any case;

(g) Key-punch tab code;

(h) Demand/product (5 positions, integer). This field must exist in any case;

(i) Key-punch tab code;

(j) Demand/unit; 7 positions: XXX,XXX or XXXX,XX;

(k) Key-punch tab code;

(l) Prescribed material number (eight positions);

(m) Key-punch tab code;

(n) Size (10 positions);

(o) Key-punch STOP code;

(p) Key-punch WS code (end of line);

(q) Carriage return.

Note: (i) Alphanumeric codes can be in the "Size" field only, all the others should contain pure numeric information;

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(ii) If a field is not filled out, there must be a tabulating code instead;

(iii) After the last field ST and MS fields can be key-punched immediately, then do "carriage return";

(iv) Maximal record length: 50 characters with functional flags, 41 letters + 9 functional flags;

(v) If the length is shorter than the abovementioned, don't write zeros.

5. Specification of the second heading line:

(a) Necessary line spacings;

(b) Key-punch program code 2;

(c) Cost Center (xxx). This field has to be filled in any case. If it is Cost Center only, key-punch two tab codes then ST, MS and carriage return codes;

(d) Tab code;

(e) Work Center (xxxx);

(f) Key-punch tab code;

(g) Key-punch tool number (xxxxx);

(h) Key-punch tab code;

(i) Run time/100 pieces xxx,xx or xxxx,x;

(j) Key-punch tab code;

(k) Setup time x,x;

(l) Key-punch tab code;

(m) Next Work Center (4 positions);

(n) Key-punch tab code;

(o) Quantity issued, if any (8 positions);

(p) Key-punch ST code;

(r) Key-punch MS code;

(s) Carriage return, line space.

Note: (i) It can contain numeric data only;

(ii) It is identical to points (ii) to (v) of the 'Note' part of the first heading line;

6. Description of the narrative lines:

(a) Necessary line spaces;

(b) Key-punch program code;

(c) Narrative max. 46 positions; key-punch MS at line-ends then carriage return code.

Note: (i) If there is no narrative line, key-punch the next heading line number one in line with the description;

(ii) If there are several narrative lines, see and do as in point 7;

(iii) There should be no more than 10 narrative lines.

Annex II

INSTRUCTIONS FOR CORRECTING THE MASTER PUNCHED TAPE FILE[1]

[illegible] punched tapes in the [illegible] ways:

[illegible] by the organization department [illegible] the card [illegible] to be corrected.

[illegible] ways:

[illegible] T-sheet is written [illegible] the narrative, the whole T-sheet [illegible] written and handled correctly. At the same time, extract "[illegible]" by and check this T-sheet number. Please [illegible] by [illegible] the attached tape.

[illegible] is not [illegible] the narrative [illegible] the T-sheet is written. In this case [illegible] and [illegible]. Place the attached [illegible] and [illegible] to [illegible] tape again. If [illegible] a T-sheet number exist, [illegible] in this case to [illegible] by a new one. These new points must [illegible] if the [illegible] part of the narrative in the whole [illegible]. If [illegible] the first three [illegible] should be made by [illegible].

(a) Correct first line - [illegible] the first heading line. The correct data [illegible] must be key-punched according to the card-layout. If this [illegible] key-punched, it has to be underlined with red pencil in the card.

(b) Correct second line - [illegible] second heading line. The correct data [illegible] must be key-punched into the card according to the existing card-layout. Underline with red pencil.

(c) Correct third line. It is the first narrative line which is corrected by punched card because of its frequency. Key-punch the data of the third line according to the proper card-layout. Underline with green pencil. The blank positions in the narrative field must be spaced.

It is required to make all corrections accurately. In the cards write zeros in all blank fields (not in narrative fields).

Change line only where T-sheet number and operation number do not change, otherwise the machine can not find the document in question.

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[1] This annex is a literal translation from a Hungarian of UNIDO's instructions and is reproduced without formal editing.

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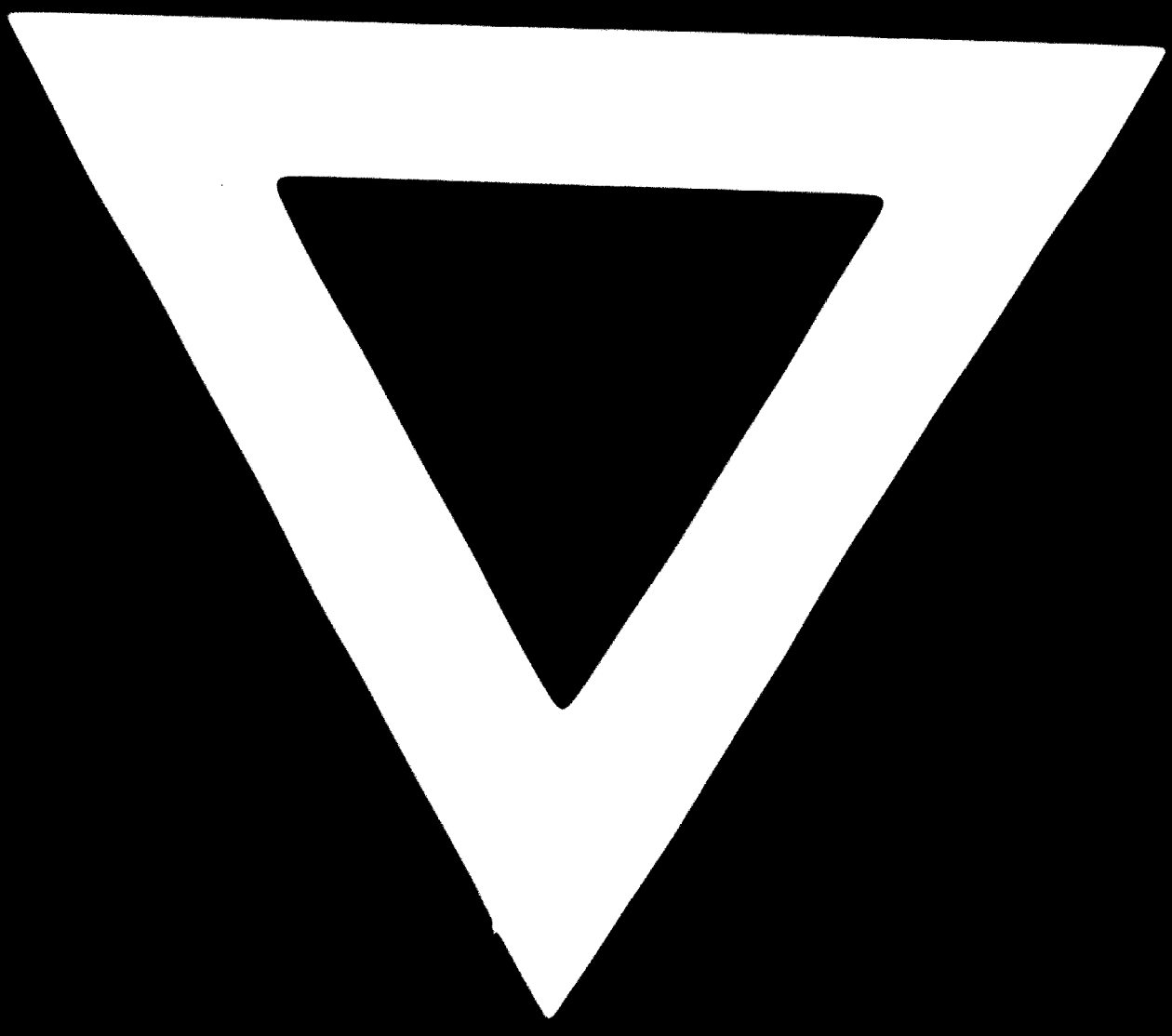

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