Disk System Introduction

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Preface

This manual is intended for persons who know little or nothing about computers and data processing. It intends to teach the fundamental aspects of data processing and the operating characteristics of the IBM System/3 Disk System.

This manual tells you what a computer is, how information is given to a computer, how you get a computer to do what you want, what you can expect from a computer, and what basic functions the devices of System/3 can perform.

The appendixes to this manual give additional information about System/3 programs, and punched cards. This information has been included primarily for persons with previous data processing experience.

Other System/3 publications referred to in this manual are:

- *IBM System/3 Card and Disk System RPG II Fundamentals Programmer's Guide,* Form C21-7502
- *IBM 5496 Data Recorder Operator's Guide,* Form A21-9086
- *IBM 5486 Card Sorter Operator's Guide,* Form A21-9078
- *IBM System/3 Data Recording and Data Verifying Programs Operator's Guide,* Form C21-7538

First Edition

The illustrations in this manual have a code number in the lower corner. This is a publishing control number and is not related to the subject matter.

Changes are continually made to the specifications herein; any such change will be reported in subsequent revisions.

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What can you expect a computer to do with information? . . . How do you get information into a computer? . . . How does a computer know what to do with your information? . . . What final results can you expect from a computer? These are the basic questions this manual intends to answer. This chapter gives general answers to these questions. Chapters 2, 3, and 4 more fully explain each topic. Chapter 5 summarizes these topics by showing how they are used in an actual data processing job.

Today the computer is doing many jobs, from accounting to predicting election results to guiding spaceships. It is often looked upon as some kind of magical machine, but the computer performs no magic. Everything a computer does is dependent on the people who use it and the instructions they supply. For every job you want a computer to do, you must give a step-by-step procedure—a program—for it to follow. This procedure is then stored inside the computer. The information you want is processed according to the stored instructions.

A computer can do only a few rather simple things, but it does them extremely well. It can retrieve, almost instantly, any item of information stored in it. It can compare any two items of information, and do any arithmetic operations you want—add, subtract, multiply, or divide. It can be instructed to do any combination of these things in any sequence you want them done.

The computer works methodically, doing one thing at a time. When it finishes one step, it goes on to the next, then the next, and the next, according to instructions. But it performs these steps at an almost unbelievable speed until it comes up with the answer you want.

The task performed by a computer is called data processing. Data processing means that information is handled according to a set of rules. Whether you process information by hand or use a computer, the requirements of a job remain about the same. You must have *input,* which is the data you want to do something with; you must *process* the data, which is the act of doing something with data according to instructions; and you must have *output,* which is the result of your processing.

If you are given a problem to solve, such as finding the sum of a list of numbers, and you add the numbers to get an answer, you are doing data processing. The numbers you used were input, the addition you did was processing, and the answer you got was output.

When a computer, such as IBM System/3 Disk System, does a similar job, it also uses input, does processing, and provides output. The minimum disk system includes the following input, output, and processing devices (see Figure 1-1):

- 5410 Processing Unit
- 5424 Multi-Function Card Unit
- 5444 Disk Storage Drive
- 5203 Printer

The Multi-Function Card Unit and Disk Storage Drive are input units that read data into the processing unit. The Multi-Function Card Unit (MFCU) reads data recorded in punched cards. The Disk Storage Drive reads data recorded on magnetic disks. The Processing Unit stores job instructions, performs calculations on input data according to the instructions, and controls operations of the input-output devices. The Printer provides output in the form of printed reports.

The MFCU and the Disk Drive are output as well as input devices. The MFCU can punch data into cards as directed by the processing unit; the disk drive can record data on magnetic disks.

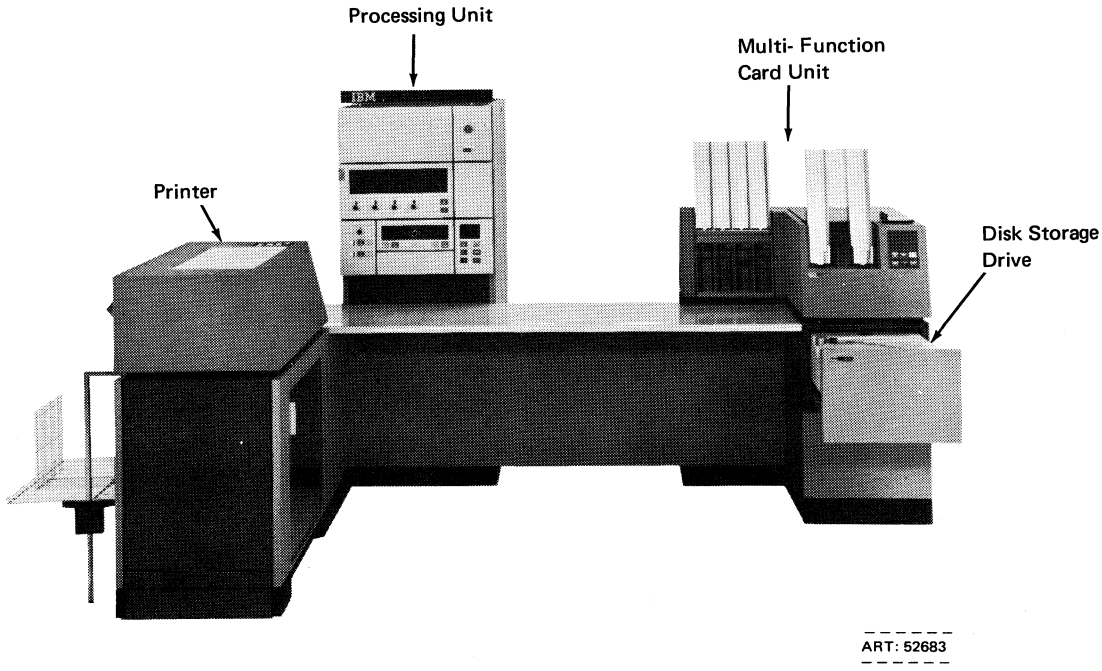

Figure 1-1. IBM System/3 Disk System

System/3 was designed for use in business, and is particularly well-suited to the following business applications:

- Order Writing
- Billing
- Accounts Receivable
- Accounts Payable
- General Ledger
- Inventory Control
- Payroll
- Sales Analysis

To help you understand System/3 and data processing, let's first look at how a clerk might process information for one of the jobs just mentioned—billing. Assume for this job that the clerk works with the following data:

- Customer Orders
- Price Catalogues
- Customer Records
- Accounts Receivable Records
- Inventory Files

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The clerk receives a copy of the customer orders after orders are shipped. He uses these documents to prepare bills which he sends to customers. To prepare the bill, he follows this procedure:

1. Looks up, in a price catalogue, the price of each item on the order.
2. Multiplies price by quantity shipped.
3. Adds total price of items to get total amount of bill.
4. Checks customer records to see if any special discounts apply, and adjusts bills accordingly.
5. Types bill.
6. Adjusts accounts-receivable records to show what customer owes.
7. Updates inventory records to show reduced stock.

For each bill he prepares, the clerk follows this same procedure. In computer terms, this procedure is his *program* for doing the job. The customer order is his *input,* the calculating and file updating he does is *processing,* and the results of processing—the bill and the updated records— are his *output.*

As long as the business remains small, the clerk can handle the whole job. As the business grows, however, more and more clerks would be needed and the chances of errors would increase.

System/3 can speed up a billing operation and reduce costly errors. The MFCU can read input data (order information) at high speeds; disk storage can hold many records that can be quickly referenced and updated (price lists, customer records, accounts-receivable records, and inventory files); the processing unit can store and carry out long and complex job instructions (a program) and perform needed calculations; and the printer can print the bills (see Figure 1-2).

Before you can use System/3 for billing or any other data processing job, input data must be prepared in a certain way. In the next chapter we'll look at how data is represented.

In the succeeding chapters, we'll discuss programs, followed by specific descriptions of the devices of System/3. Finally, we will describe in more detail how System/3 would do a billing job.

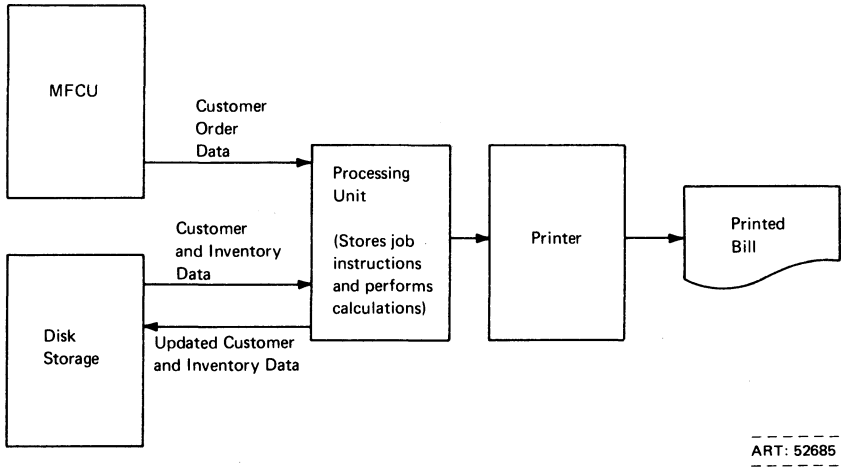

Figure 1-2. Input, Processing, and Output Functions

Data is a collection of facts—numbers, letters, or symbols—that can be processed or produced by a computer. Information on a shipping order, for example, is data, but most computers cannot read data handwritten or printed on documents. Data must be recorded in a form a computer can read. Two forms in which System/3 can read data are punched cards and magnetic disks.

Punched Cards

The card used with System/3 is shown in Figure 2-1. Data can be punched in the lower part of the card and printed on the upper part. The punch area is divided into three parts called *tiers.* Each tier has 32 places where characters of data can be punched. These places are called *card columns.*

The card columns each have six positions in which punches can be placed. Characters are represented by combinations of punches in these positions. Sixty-four different characters can be represented by various punch combinations.

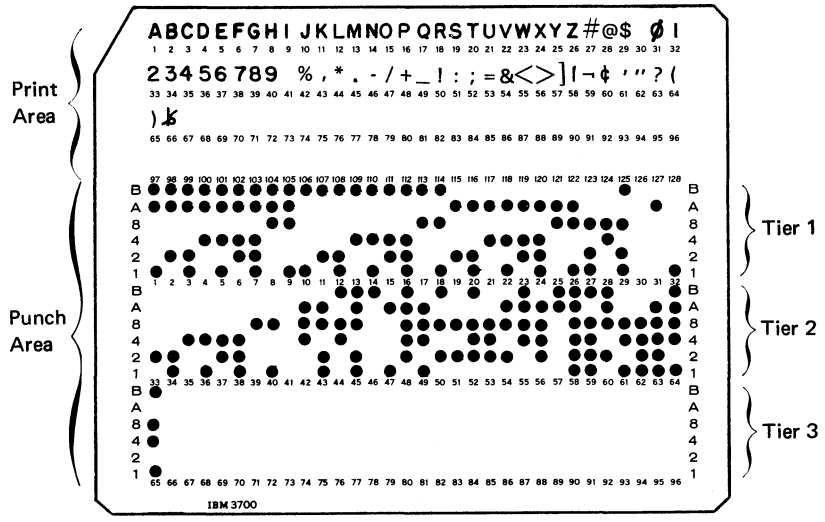

Figure 2-1. 96-Column Card

One card can hold up to 96 characters of data. Figure 2-2 shows how data from a shipping document might look in a punched and printed card.

To punch information, such as this shipping data, into a card, you use the IBM 5496 Data Recorder (Figure 2-3). You sit at the keyboard of the Data Recorder, read the shipping data, then press the appropriate keys, character-by-character. Data recording is similar to typewriting except the result is a punched and printed card. (More information about the Data Recorder is given in Chapter 6.)

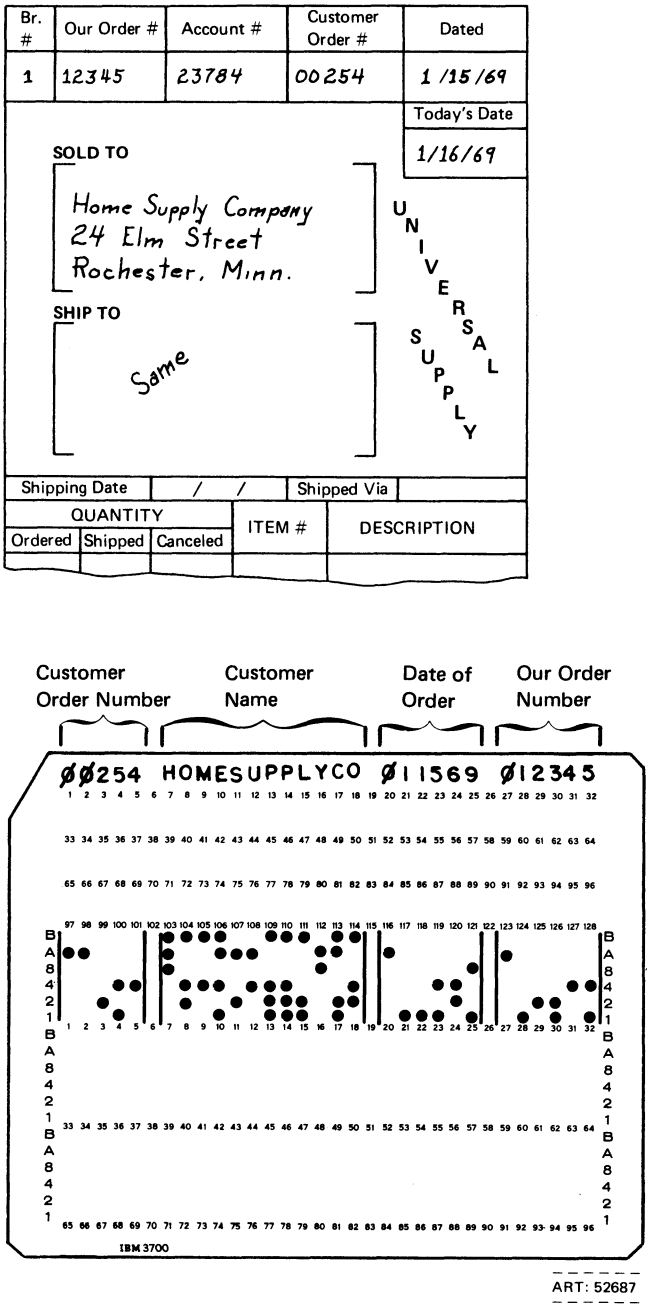

Figure 2-2. Customer Order and Punched Card

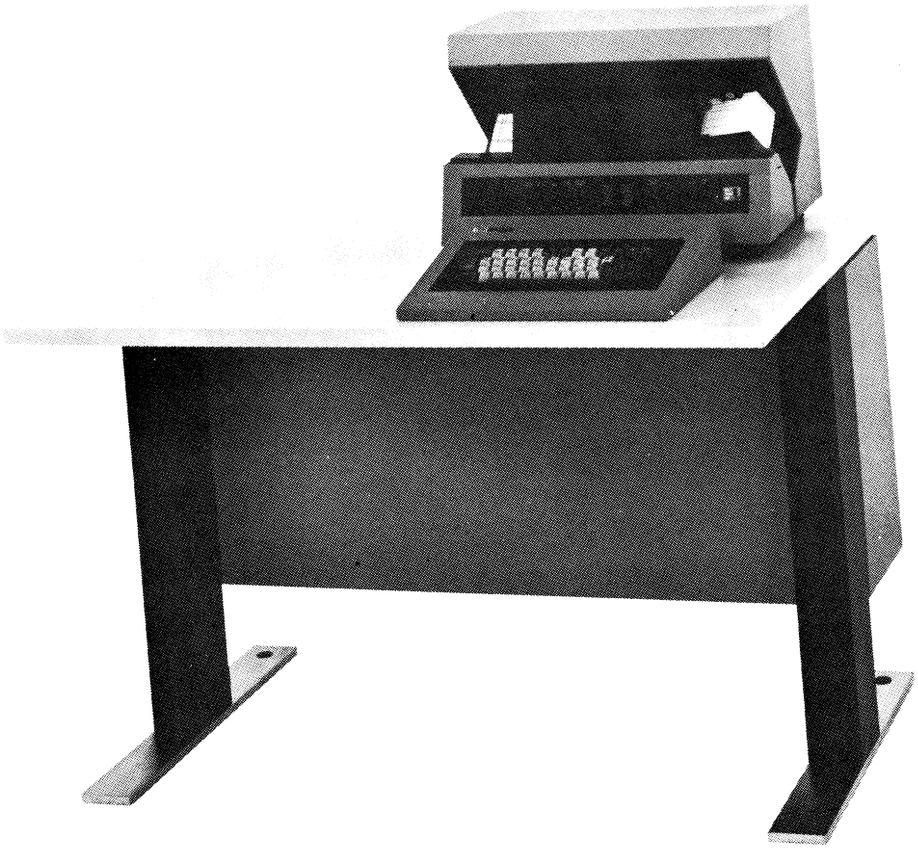

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Figure 2-3. IBM 5496 Data Recorder

Magnetic Disks

A disk is a thin, round metal plate coated with magnetic material. Information can be recorded on both sides of the disk in the form of magnetized spots.

The recording surfaces of the disk are divided into many tracks. Each track is divided into equal parts called sectors. Each sector has its own numbered location (address) on the disk. This enables the system to get any information it needs. For example, if an inventory file were stored on disk and the system needed data about a particular item, it could go directly to that item without reading through all the other items that might be recorded ahead of it. Figure 2-4 shows an example of a sector on a disk containing inventory records.

Data on disks can be used over and over and changed as required.

ORGANIZING DATA

Data stored in cards or on disks must be arranged in an orderly fashion so it can be used efficiently by the system. Like most other business information, computer data is organized into records and files. Records are further organized into fields so the computer can locate specific items of information within each record.

Records

A record is any document that contains data about a particular topic. Since computers must be able to locate individual records, each record must be represented on one or more cards or on one or more sectors of a disk.

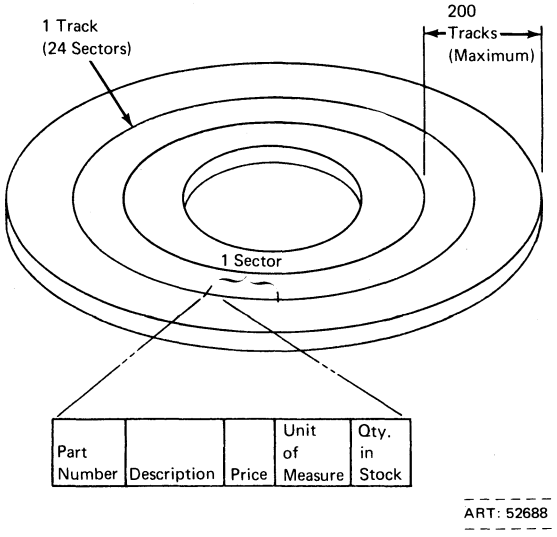


Figure 2-4. Inventory Record on Disk

Fields

Computers must also know where individual items of data are located within a record. An area must be reserved for each item. This area is called a *field.* Figure 2-5 shows fields in a card and a disk record.

A card layout form and a disk layout form are available to help you plan the location of fields in records.

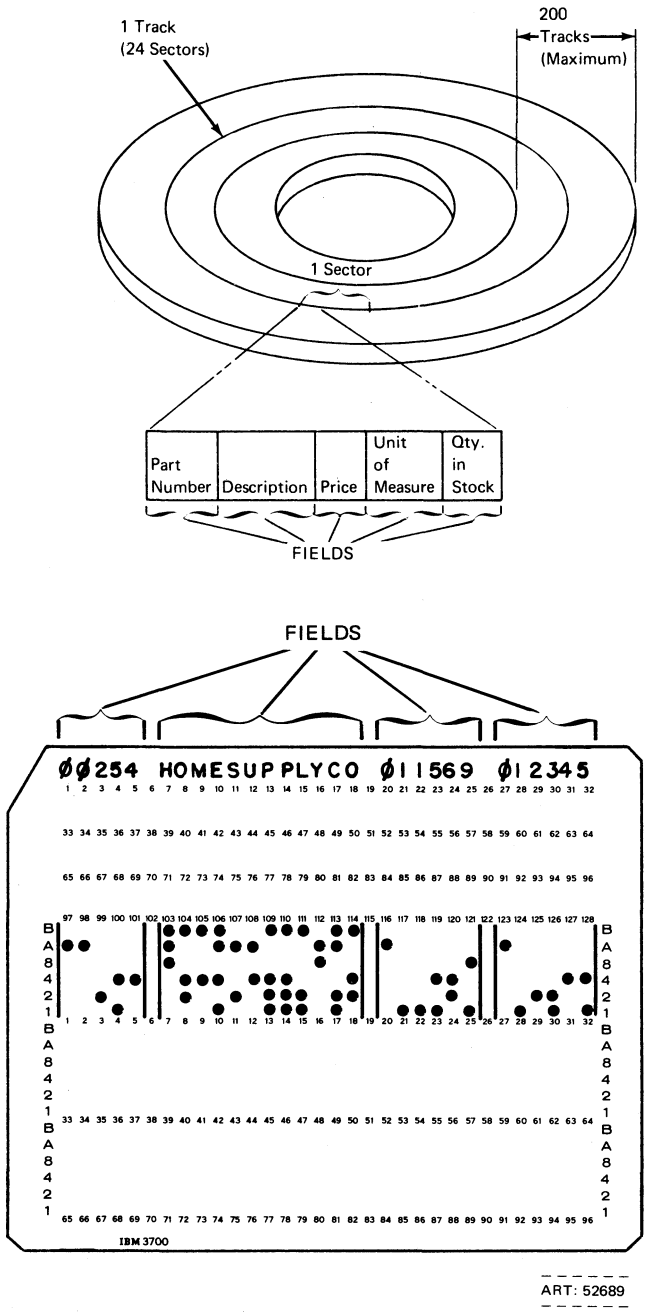


Figure 2-5. Card and Disk Fields

Files

A computer not only works with records and fields, but also with files. Files are groups of related records, such as inventory records, payroll records, or accounts receivable records. In a disk system, files can be kept in cards or on disks. Card files are usually temporary. They contain information that often is used only once.

Disk files contain information that is up-to-date. When changes are made to a disk file they usually affect only some of the records or only certain fields in records.

PROCESSING FILES

In a disk system, files can be processed sequentially or directly. Sequential processing means starting at the beginning of a file and reading each record in order. Direct processing means reading any record that is needed regardless of its location on the disks.

Card files are always processed sequentially. Disk files can be processed sequentially or directly.

As mentioned in Chapter 1, instructions play an important role in computer processing. They are necessary because a computer cannot think for itself. The set of instructions you write for a job is called a *program.* The process of writing a program is called *programming,* and the person who writes programs is called a *programmer.*

When writing a program for System/3, you use a language called RPG II. RPG II is a simple-to-use programming language in which you describe your job to the computer and what you want the job to do. Like any language, RPG II has certain rules you must follow. The *IBM System/3 Card and Disk System RPG II Fundamentals Programmer's Guide* explains the RPG II language and the rules for using it.

DEVELOPING A PROGRAM

Before writing a program, you must first define the problem. To do this, you analyze the input data and determine the output that is desired. You can use the card layout form and a disk layout form, mentioned in Chapter 2, to define the arrangement of fields in your records. A printer spacing chart is also available to help you define how your printed report is to be arranged. Then you determine what processing steps are required to produce the output information from the input data.

WRITING A PROGRAM

Special sheets are available on which you can write, or code, your RPG II instructions. Five different sheets are used (see Figure 3-1). These sheets enable you to concentrate on one part of your program at a time.

Four of the sheets are designed to handle the basic requirements of a job: input, processing, and output. You use the Input sheet to (1) specify the files you want read, (2) to identify the different kinds of records in each file, and (3) to indicate the location of fields in each record. On the Calculations sheet, you specify the operations you want performed. You use the Output-Format sheet to specify the kind of output you want—printed reports, card records, or disk records—and the format of the output. The File Description sheet is used to define all files used in your program.

The fifth sheet, Extension and Line Counter Specifications, is used only under special circumstances as described in the *IBM System/3 Card and Disk System RPG II Fundamentals Programmer's Guide.*

Because of the many different fields on these sheets, coding may appear to be a difficult job. Few programs, however, require all the sheets, and some may require only a few fields and a few lines on a sheet.

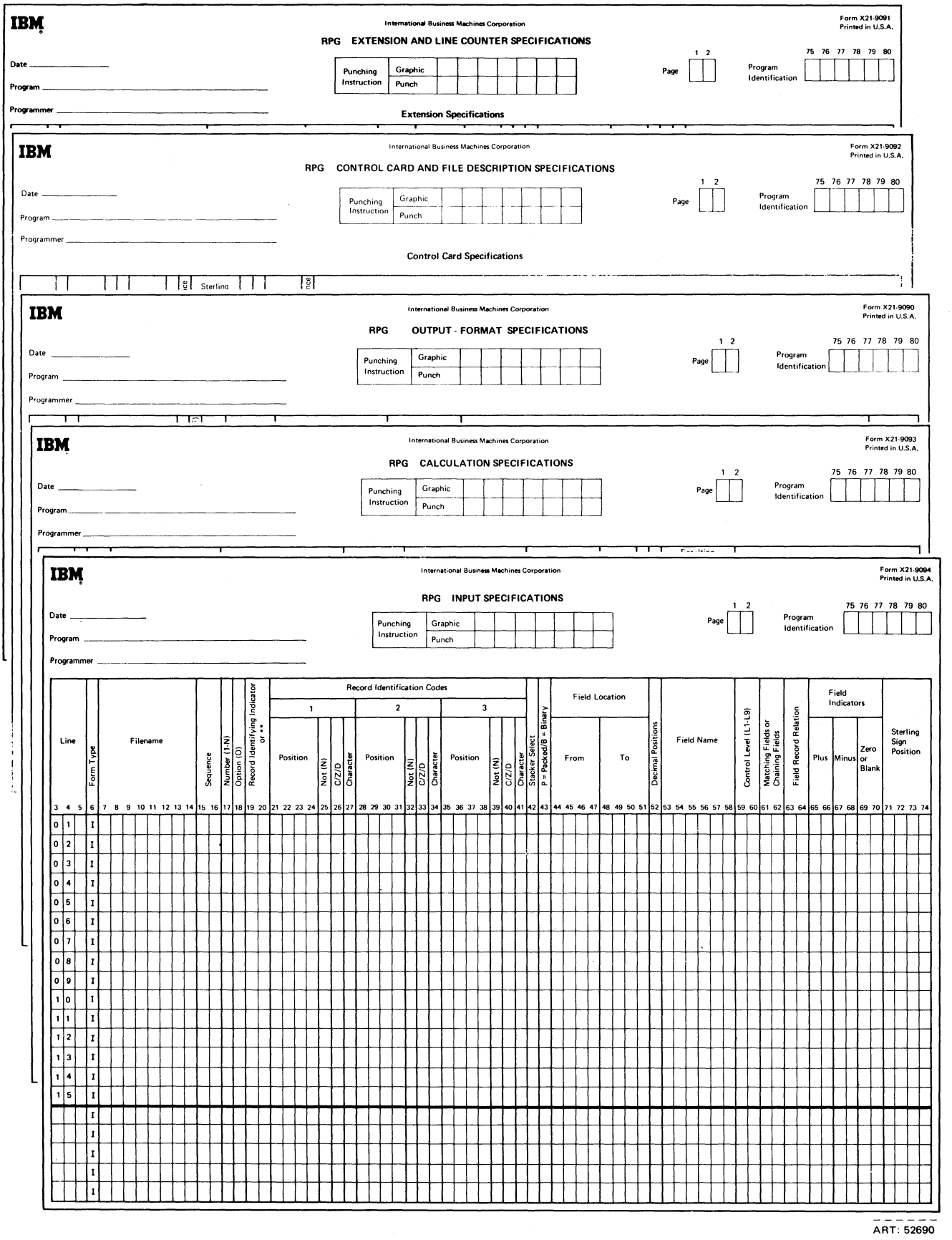


Figure 3-1. RPG Specifications Sheets

COMPILING A PROGRAM

After you have coded the specifications on the sheets, the specifications must be punched into cards. Each line from the sheets is punched into a separate card. The deck of cards that results is called a *source program* deck.

Since the source program is not in the form the computer uses to process a job, it must be translated into a machine-understandable program. The RPG II Compiler is a program that translates your source program into machine instructions and produces a new deck of cards called an *object program.* The object program is in a language the computer can use. It is the object program that is read into storage and used to execute your job (see Figure 3-2).

Besides translating your source program, the compiler does several other things for you:

1. It checks your source program for coding errors and notes the errors on a listing.

2. It assigns storage locations in the processing unit for your data and instructions. (More information about storage and the processing unit is given later in the manual.)

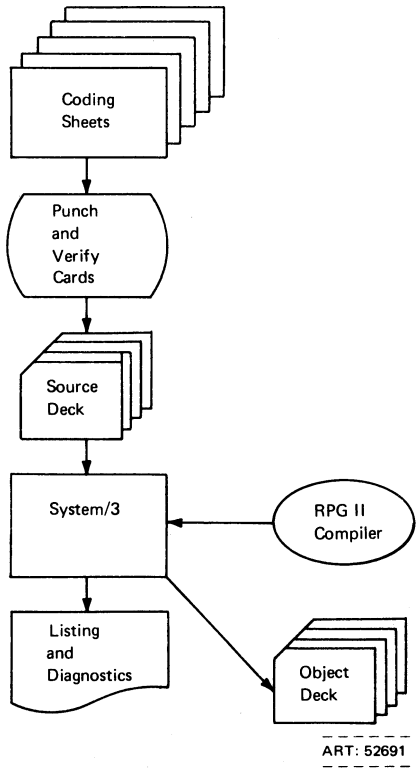


Figure 3-2. Steps in Producing an Object Program

TESTING A PROGRAM

The compiler can check your instructions for coding mistakes (errors in using the RPG II language), but it cannot check for missing instructions or instructions in a wrong sequence. You must do this yourself by testing the program, using sample data. In this way, you can see if your program does, correctly, everything you planned.

RUNNING A PROGRAM

After your object program is tested and corrected, it is ready to be used. All that remains is for you to load the program into storage and process the input data (see Figure 3-3).

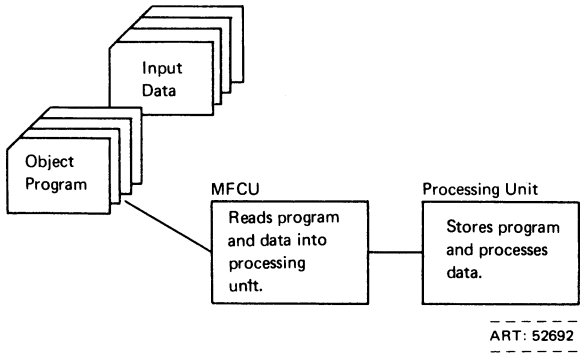


Figure 3-3. Loading a Program and Input Data

IBM System/3, as we said earlier, is composed of several devices. These devices work together to do your data processing. What each device can do and basically how it does it are explained in this chapter.

IBM 5410 PROCESSING UNIT

The IBM 5410 Processing Unit (Figure 4-1) is the main storage and control device for the system. The storage section holds the program instructions for a job and data to be processed during a job. Although information is stored electronically, the idea is similar to a series of numbered mailboxes. Whatever is stored in one of the boxes, or storage positions, can be retrieved by knowing the box number or storage address.

The control section of the processing unit is the decision-maker and the calculator. It carries out the instructions in the storage section. For example, it tells the MFCU to read a card, the Disk Storage Drive to read a record, or the Printer to print a line. If the program calls for calculations—add, subtract, multiply, or divide—they are carried out in the control section.

The control section usually carries out program instructions in the order in which they are stored, beginning with the first instruction. However, instructions do not always have to be executed in sequence. Certain instructions can be placed in the program to cause the control section to carry out a set of instructions located somewhere else in storage, then return to where it left off.

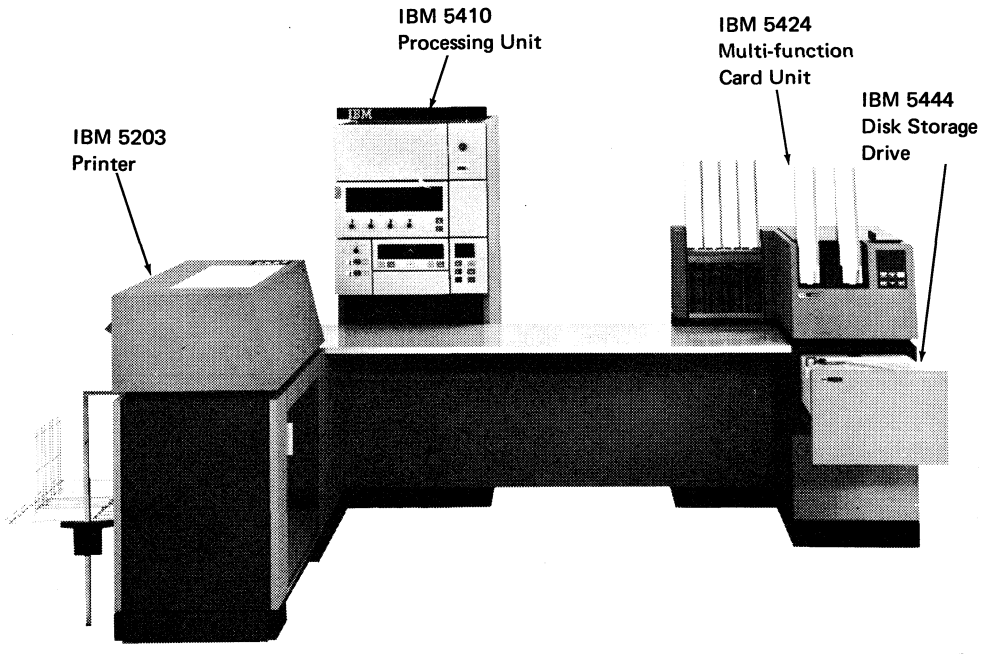


Figure 4-1. IBM System/3 Disk System

Input, output, and processing operations can be done at the same time. For example, while the processing unit is doing calculations for one record, the MFCU can be reading the next record and the printer can be printing the last record processed. This overlapping of functions helps get a job done faster.

The IBM 5410 Processing Unit is available in several capacities: 12,288 storage positions, 16,384 storage positions, 24,576 storage positions, and 32,768 storage positions. The larger the capacity of the processing unit, the more program instructions and data it can store. This can have a significant effect on how fast a job can be done.

IBM 5203 PRINTER

The IBM 5203 Printer (Figure 4-1) provides system output in the form of printed reports. The arrangement of the printed information on the page is controlled by the program in the processing unit.

The printer uses a 48-character print set consisting of 10 numeric, 26 alphabetic, and 12 special characters. The print characters are assembled on a chain (see Figure 4-2).

The chain can be replaced with other chains containing different sets of characters. This permits the operator to choose a set of characters that best suits each job.

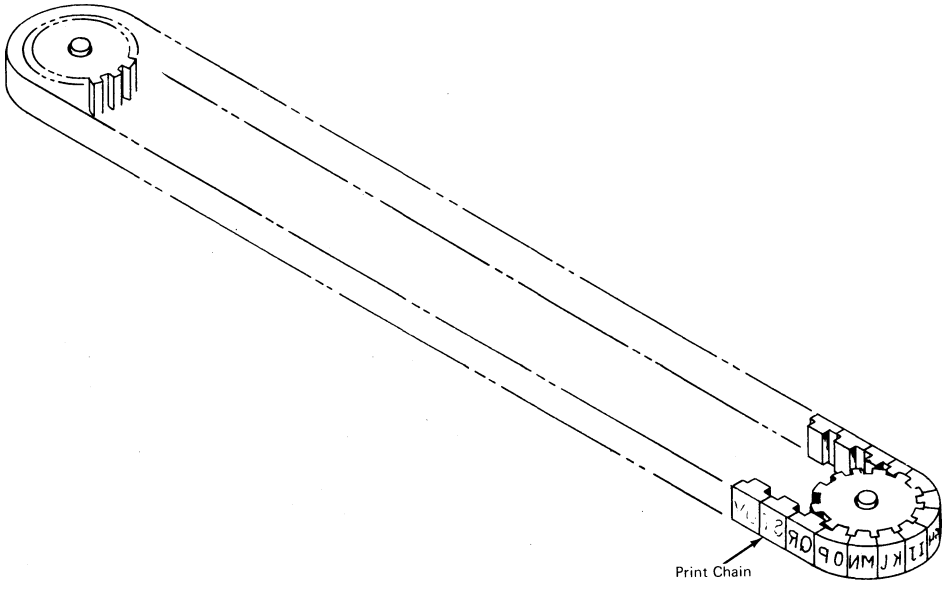


Figure 4-2. Print Chain

The printer can print in 96 positions across a page with a horizontal spacing of ten characters to the inch. Vertical spacing is six or eight lines to the inch as selected by the operator. Spacing between lines and skipping to a predetermined line on a page are controlled by instructions in the program.

The IBM 5203 Printer prints at a speed of 100 or 200 lines a minute, depending upon the model used. It can print an original and multiple carbon copies.

Universal Character Set: Some jobs may require more than a 48-character print set. This optional feature offers character sets ranging from 49 to 120 characters.

Additional Print Positions: This optional feature extends the 96-print positions to 120 or 132.

Dual-Feed Carriage: This optional feature enables the printer to print two, side-by-side forms at the same time. Each form is individually controlled by the program.

IBM 5424 MULTI-FUNCTION CARD UNIT

The IBM 5424 Multi-Function Card Unit (MFCU), shown in Figure 4-1, is both an input and output device. It can read punched-card data into the system and punch output from the system into cards.

In addition to its reading and punching functions, the MFCU has other features that make it unique among card devices. It has two card hoppers, a read station, a punch station, and four stackers (see Figure 4-3). Cards can be fed from either hopper and selected into any stacker according to instructions in the program.

Two separate files can be processed. One can be used as input and the other can be used as output, as in reproducing cards; or both files can be used as input. Data from each file can be combined as necessary during processing.

The MFCU can match records within two files, merge two files, and select records. Sorting can also be done.

Card Reading

The MFCU reads each card serially (three columns at a time, one from each tier). Maximum reading rate is 250 cards a minute or 500 cards a minute, depending upon the MFCU model used.

Reading is accomplished by 18 solar cells. As the card moves through the read station, light passes through the punched holes and is converted into electrical signals by the solar cells.

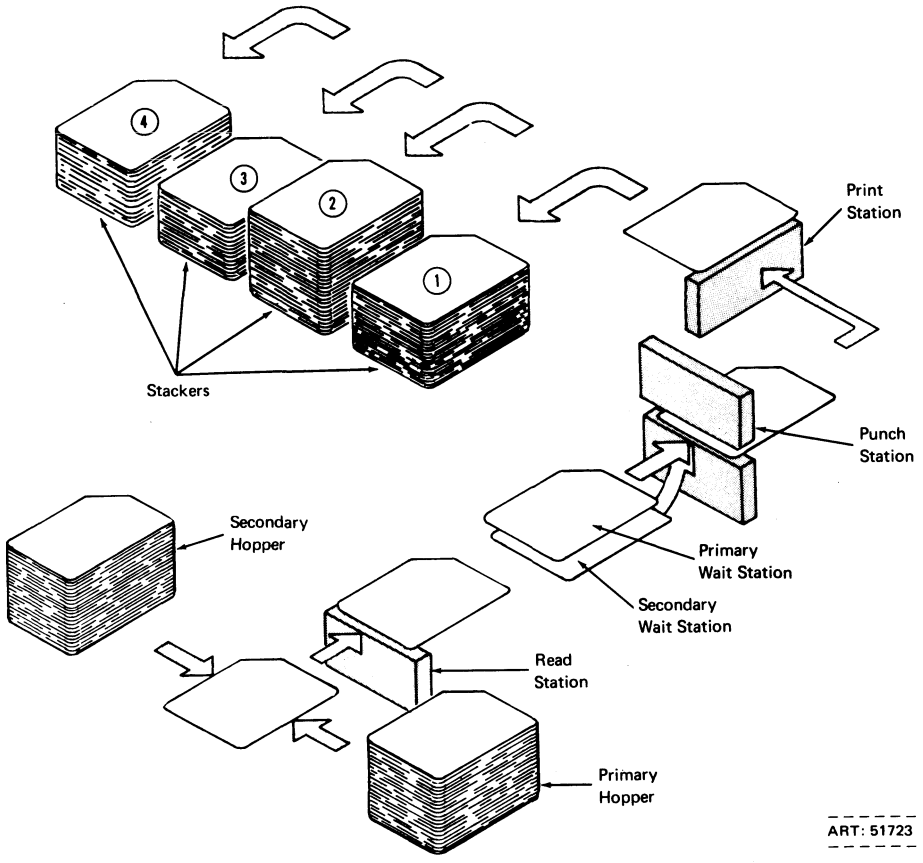


Figure 4-3. MFCU Card Path

Card Punching

The MFCU punches cards serially (three columns at a time, one from each tier). Card punching is done at a maximum rate of 60 cards a minute or 120 cards a minute, depending upon the MFCU model used. As a card moves through the punch station, the stored program activates appropriate punch magnets, causing data to be punched.

Card Printing

At the print station, data can be printed at the top of the card. Up to four lines can be printed, under program control. Each line has 32 print positions.

Maximum printing rate, for up to three rows of printing (top three rows), is 60 cards a minute or 120 cards a minute, depending upon the MFCU model used. The fourth row of printing is also done under program control, but with a reduction in printing speed.

MFCU Control Panel

A control panel at the right of the primary hopper provides the lights and switches necessary for operator control of start, stop, and card runout.

IBM 5444 DISK STORAGE DRIVE

The IBM 5444 Disk Storage Drive is in a drawer under the MFCU. The basic unit consists of one drive, two disks, and an access mechanism (see Figure 4-4).

The lower disk is mounted permanently on the drive. The upper disk is removable and can be replaced with other disks. To protect the disk surfaces from damage, the upper disk is completely enclosed in a cartridge. This also makes it easy to handle and store.

The access mechanism on the disk drive has four read/write head, one for each surface of the two disks. When activated, the access mechanism moves the heads back and forth across the surfaces of the disks to any designated position. The heads move together. When one is positioned at a certain place on one disk surface, the others are positioned at the same relative positions on the other three disk surfaces.

Depending upon the model, the IBM 5444 can record data on 100 or 200 cylinders on each disk. (Corresponding tracks from each side of the same disk are called cylinders.)

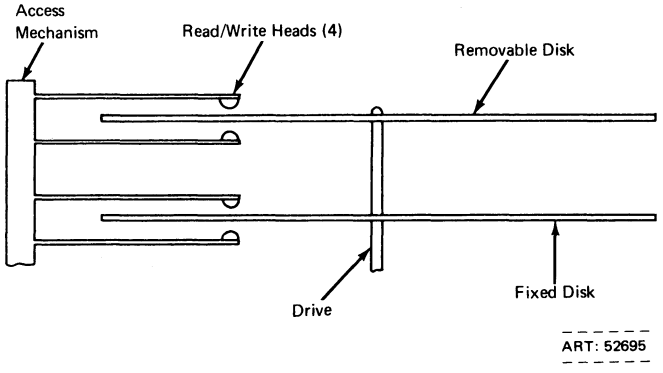


Figure 4-4. Disk Storage Drive

Tracks are divided into 24 equal parts called *sectors*. Each sector of a track has its own unique address. Two-hundred fifty-six characters of data can be stored in each sector (see Figure 4-5).

Disk storage is available in four different configurations:

- Configuration 1: Contains one drive and two disks. Uses 100 cylinders on each disk. Total storage capacity is 2,457,600 characters.
- Configuration 2: Contains one drive and two disks. Uses 200 cylinders on each disk. Total storage capacity is 4,915,200 characters.
- Configuration 3: Contains two drives and three disks. Uses 200 cylinders on each disk on drive 1; on drive 2, uses 200 cylinders on removable disk only. Total storage capacity is 7,372,800 characters.
- Configuration 4: Contains two drives and four disks. Uses 200 cylinders on both disks on both drives. Total storage capacity is 9,830,400 characters.

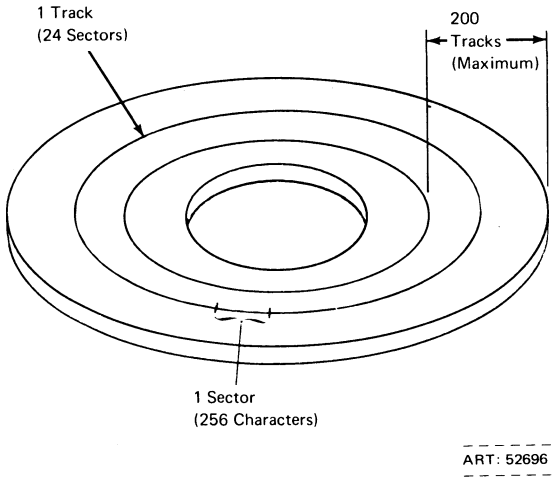


Figure 4-5. Tracks and Sectors on a Disk

To show how System/3 performs data processing let's assume that a company called the Universal Supply Company uses System/3 to do its billing. This company has a central warehouse and several branch locations. It stocks and sells 12,000 different items. All the company's billing is done at the central location.

The billing process involves order writing, preparation of a bill, and several related applications: accounts receivable, inventory control, and sales analysis.

ORDER WRITING

For every order received, whether by phone or letter, a clerk writes the information on a standard order form (see Figure 5-1). After he writes the order, he forwards it to a shipping clerk.

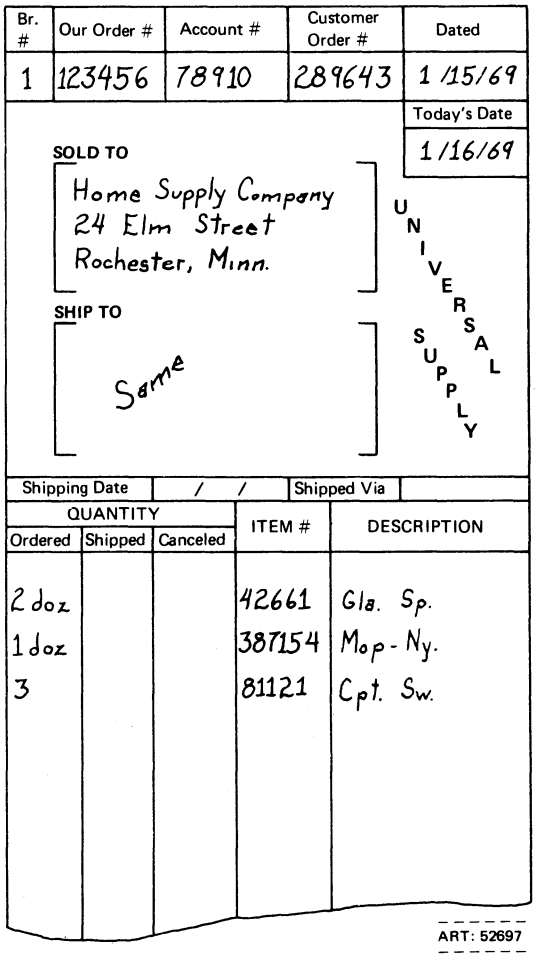


Figure 5-1. Order Form

As the shipping clerk fills each item on the order, he writes in the quantity shipped. If he cannot fill the full quantity, the remainder is either cancelled or placed on back order. A check (✓) in the cancelled column means cancel. If the cancelled column is left blank, any unfilled quantity is placed on back order. The system calculates back-order quantities during the billing operation.

After the clerk has filled all items on the order, he writes in the date and method of shipment (Figure 5-2). He encloses a copy of the order with the shipment, and forwards the billing copy of the order to the central warehouse.

INPUT

Input for this billing job comes from three sources: billing copies of customer orders, customer files, and inventory files.

Br. #	Our Order #	Account #	Customer Order #	Dated
1	123456	78910	289643	1/15/69

Today's Date: 1/16/69

SOLD TO

Home Supply Company
24 Elm Street
Rochester, Minn.

SHIP TO

Same

UNIVERSAL SUPPLY

Shipping Date	1/17/69	Shipped Via	Acme F.F.

QUANTITY			ITEM #	DESCRIPTION
Ordered	Shipped	Canceled		
2 doz	2 doz		42661	Cla. Sp.
1 doz	8	✓	387154	Mop - Ny.
3	2		81121	Cpt. Sw.

ART: 52698

Figure 5-2. Billing Copy of Order Form

Billing Copy of Customer Order

The billing copy of the customer order (Figure 5-2) contains the basic information used in preparing the bill.

Customer File

The customer file contains such items as customer account number, name and address, accounts receivable, and sales information. The customer file is kept on disk. Figure 5-3 shows the type of data contained in the customer records.

Inventory File

The inventory file on disk contains such data as part numbers and descriptions, information about vendors from whom the items are purchased, stock on hand in each warehouse, and price. Figure 5-4 shows the arrangement of the inventory records.

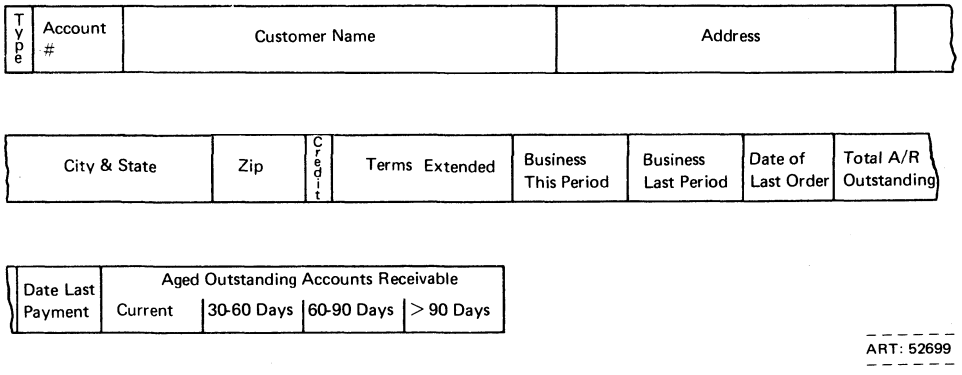


Figure 5-3. Layout of Customer Records on Disk

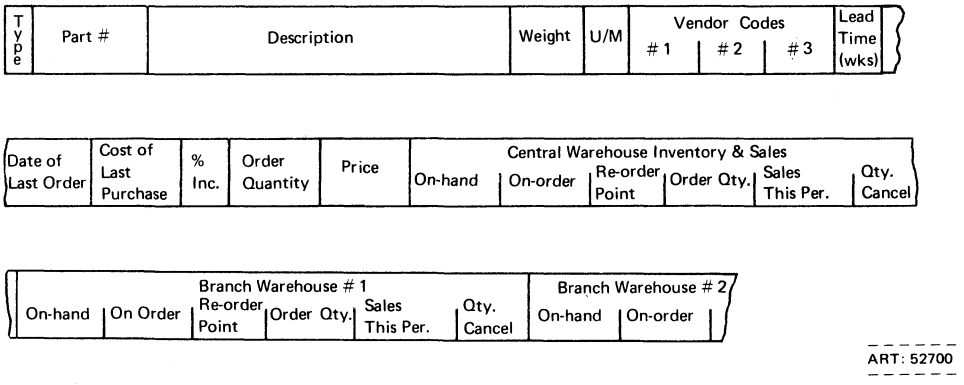


Figure 5-4. Layout of Inventory Records on Disk

JOB STEPS

The steps involved in this job are shown in Figure 5-5. When the filled orders are received in the billing department, a clerk logs them in. He keeps a record of the number of orders received, and perhaps the number of items in each order. This is a control to ensure accuracy throughout the billing process. The number of invoices produced is checked against the number of orders received for billing.

After the orders are logged in, a clerk records the information into cards. Using the IBM 5496 Data Recorder, he creates one card (header card) with general information about the order and one or more cards (item cards) with information about the items ordered (see Figure 5-6). The Data Recorder is also used to verify the correctness of the punching.

At this point, the clerk is ready to process the information. He first loads the object program, written in the RPG II language, as described in Chapter 3. System/3 is now ready to read the input cards and disk files according to the program instructions.

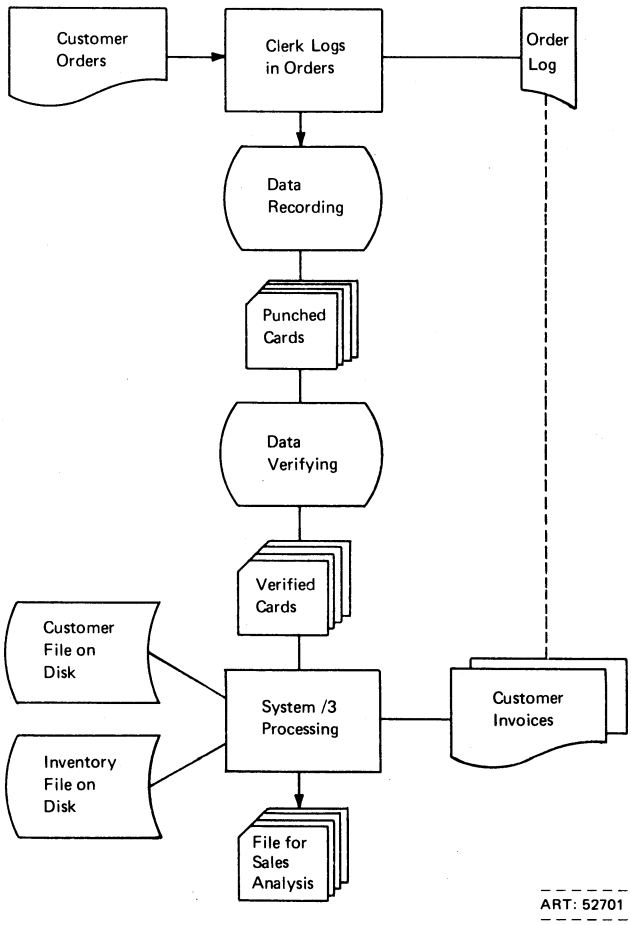
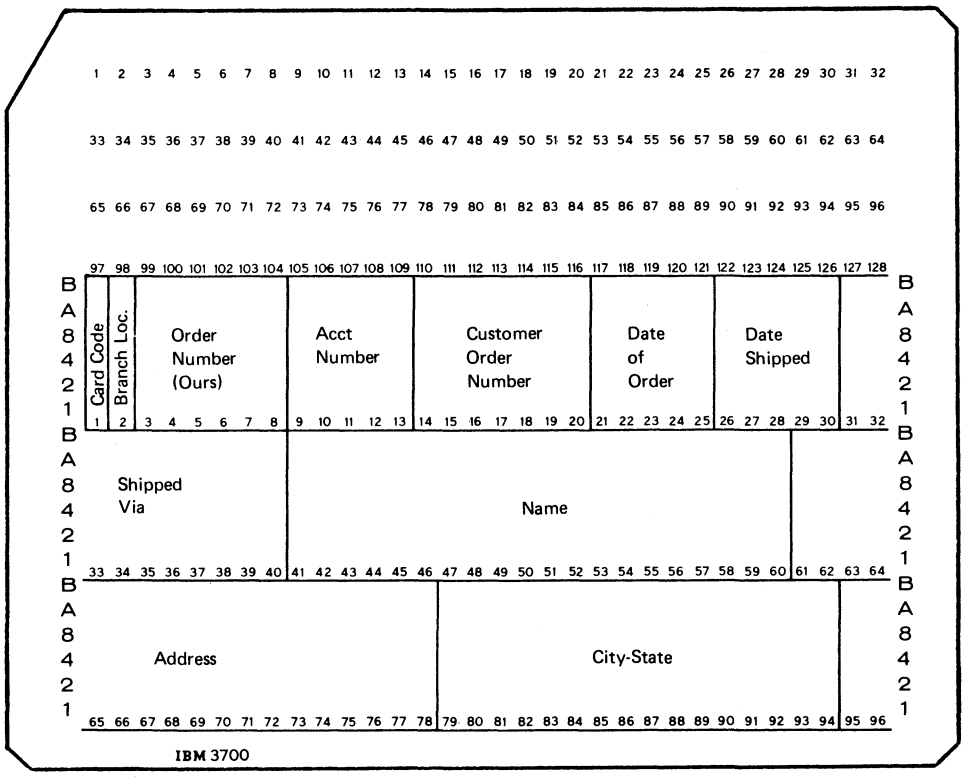


Figure 5-5. Job Steps: Billing Application



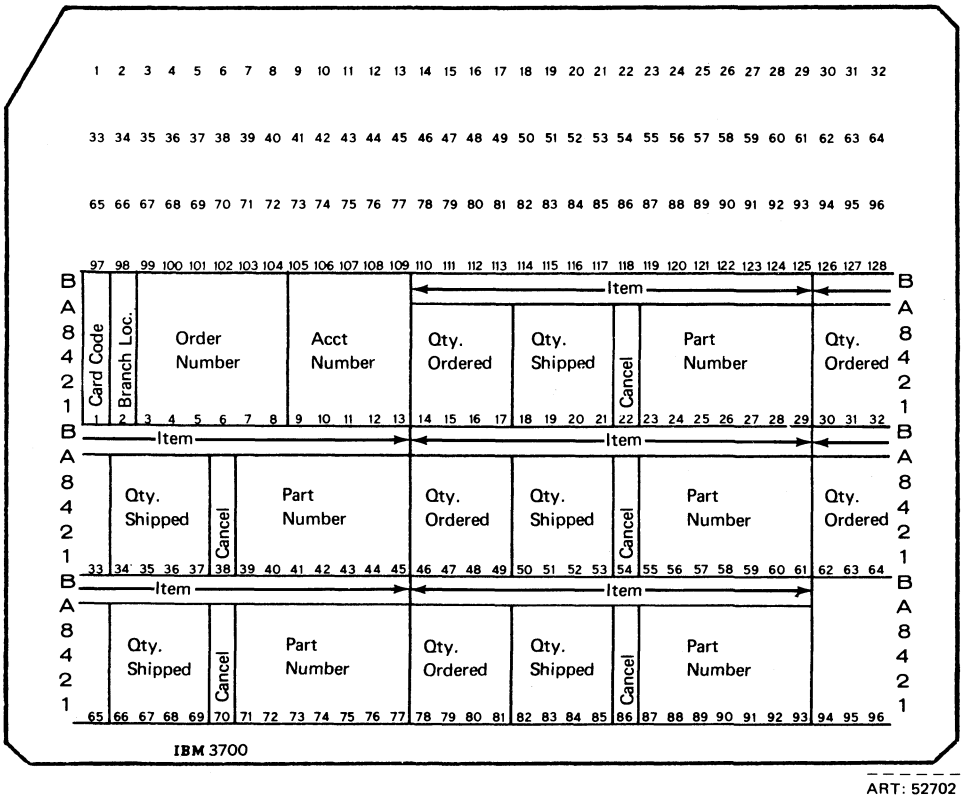


Figure 5-6. Fields in Header and Item Cards

PROCESSING

To print each invoice and update the customer and inventory records, the following processing steps are performed by the system under control of the program:

1. Read header card.
2. Get customer record from disk.
3. Print heading information on invoice.
4. Read item from item card.
5. Get item record from inventory file on disk.
6. Calculate item price.
7. Print item and price on invoice.
8. Update inventory record on disk.
9. Repeat steps 4 through 8 for each item on item cards.
10. Compute tax and total for all items.
11. Print tax and total on invoice.
12. Update accounts receivable and sales records on disk.

OUTPUT

Output from the system is a printed invoice (Figure 5-7) and updated customer and inventory records.

After invoicing has been completed and customer and inventory records updated, other reports can be printed using the order cards and disk records:

- Stock Status
- Daily Sales
- Sales Analysis by Item and Customer

Account # 78910	Terms: 10 NET 30	Invoice Date 02/20/69	Invoice # 14638

UNIVERSAL INDUSTRIAL SUPPLY

SOLD TO:	SHIPPED TO:
HOME SUPPLY COMPANY 24 ELM STREET ROCHESTER MINN 55901	SAME

Your Order # 289643	Dated 01/15/69	Was Shipped 01/17/69	Shipped Via ACME F.F.

Ordered	Shipped	B/O or Cancel *	Item #	Description	U/M	Price	Extension
24	24		42661	GLASS SPRAY	EA	55	13 20
12	8	4*	387154	NYLON MOP	EA	2 50	20 00
3	2	1	81121	CARPET SWEEPER	EA	11 20	22 40
				TOTAL			55 60

ART: 52703

Figure 5-7. Printed Invoice

SUMMARY

The disk storage capabilities of the system make it possible to do a billing job and all its related functions at one time. You can process rush orders as they are received or accumulate orders and process them all at once.

Because of the high speed at which the system operates, a large volume of orders can be processed quickly. Inventory records can be updated as each order is processed, making inventory easier to control. Timely and accurate reports on sales and profits can be easily and quickly obtained.

This chapter describes additional devices available for use with the IBM System/3 Disk System. These devices expand the basic capabilities of the system.

IBM 5471 PRINTER-KEYBOARD

The IBM 5471 Printer-Keyboard can be installed on the system (see Figure 6-1). It consists of an IBM SELECTRIC® Typewriter connected to the system processing unit. With the printer-keyboard, the operator can:

1. Request information from a disk file on the Disk Storage Drive.
2. Print out requested information.
3. Enter data directly into the system.
4. Use the printer-keyboard as a second printer for low-volume output.

ART: 52704

Figure 6-1. IBM 5471 Printer-Keyboard

The 5471 Printer-Keyboard has a 44-character print element. It can print lines up to 125 characters long at an approximate rate of 15 characters a second. Multiple copies can be printed.

IBM 5475 DATA ENTRY KEYBOARD

The IBM 5475 Data Entry Keyboard (Figure 6-2) provides program-controlled data recording, online (under direct control of the processing unit). By means of the keyboard and the IBM Data Recording and Data Verifying programs (described in Appendix A), the MFCU can be used to punch and verify cards.

Online data recording uses a buffered input technique. This means that the entire contents of a card is keyed into system storage before any punching is done. This gives the operator a chance to correct mistakes by erasing and rekeying the data.

Program control cards can be used to control automatic functions, such as skipping or duplicating, on a card-field basis. Two program levels are available for storing information from two different control cards. More information on control cards is given in the *IBM System/3 Data Recording and Data Verifying Programs Operator's Guide.*

Figure 6-2. IBM 5475 Data Entry Keyboard

ART: 51733

IBM 5496 DATA RECORDER

The IBM 5496 Data Recorder (Figure 6-3), provides operator-controlled card punching, printing, and verifying. The data recorder has a 64-character keyboard, a card hopper, a punch station, a read station, a print station, and a stacker. Reading, punching, and printing rates are 60 columns per second.

The data recorder features a buffered input-output area; that is, data is collected in a key-entry storage area and is not punched until all data for a card has been keyed. This allows the operator to erase and rekey any data he wishes. One character, one field, or a whole card record can be erased and rekeyed.

Overlapping of punching and keying functions increases the rate at which data can be recorded. While one card is being punched, data for the next card can be keyed.

ART: 51802

Figure 6-3. IBM 5496 Data Recorder

Prepunched program cards can be read into storage at the start of a job to control automatic functions, such as skipping or duplicating, on a card-field basis. Up to four program cards can be stored. The operator can select any of the four program levels while punching.

The data recorder can also be used as a card verifier. This permits immediate error correction when verifying cards. For additional information, refer to the *IBM 5496 Data Recorder Operator's Guide.*

IBM 5486 CARD SORTER

The IBM 5486 Card Sorter (Figure 6-4) arranges cards in alphabetic or numeric sequence. The sorter has a hopper, a read station, and six stackers. Speeds of 1000 or 1500 cards per minute are available. For additional information about the card sorter, refer to the *IBM 5486 Card Sorter Operator's Guide.*

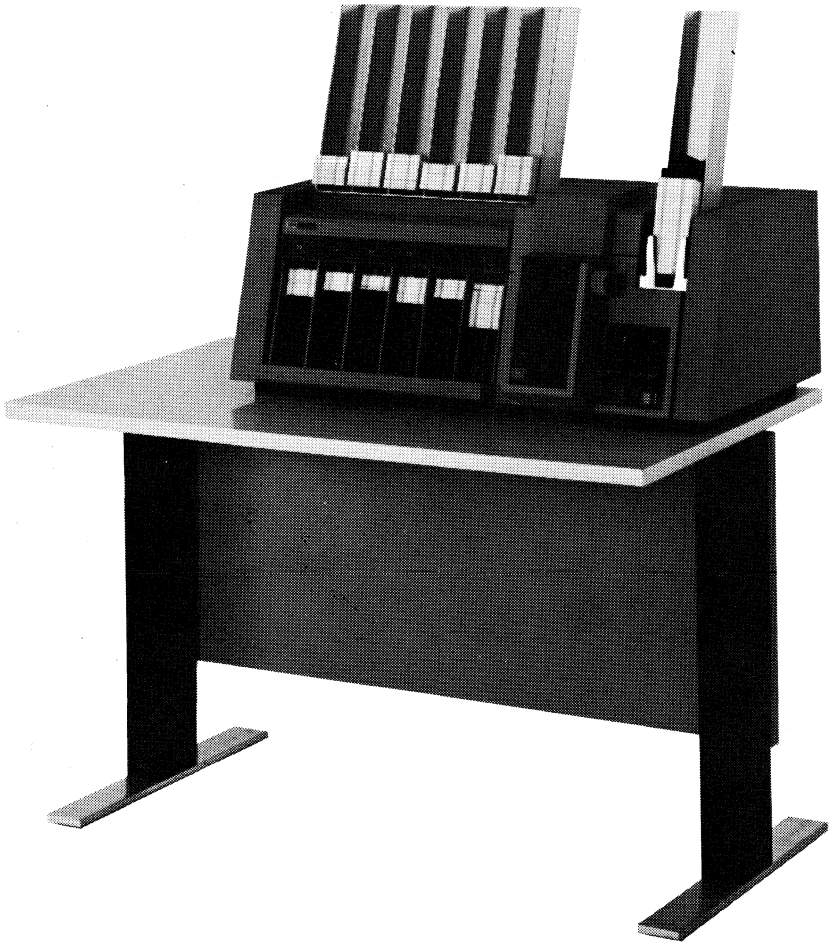


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Figure 6-4. IBM 5486 Card Sorter

This section briefly describes the programs available for use with IBM System/3. It has been included for persons already familiar with computers and programming. Additional information about these programs is contained in *IBM System/3 Disk System Reference Manual,* Form C21-7512.

System/3 programs can be divided into three groups: processing programs, service programs, and control programs.

PROCESSING PROGRAMS

RPG II Compiler

The RPG II Compiler program translates source programs, written in the RPG II language, and produces object programs in machine language. It also produces source program listings that are used for checking the accuracy of source program coding.

Sort

Two sort programs are available: Disk Sort and MFCU Sort/Collate.

Disk Sort: Arranges disk records in any desired order.

MFCU Sort/Collate: Arranges cards in any order, combines two card files, compares two card files for matching records, and selects cards from a file.

Utilities

Utility programs perform standard input/output functions, such as copying files. They also provide maintenance of alternate tracks and initialization of disks.

Alternate Track Assignment: Relocates the contents of an entire track to an alternate track if a track becomes defective.

Alternate Track Rebuild: Permits the operator to correct erroneous data that cannot be transferred from a defective track to an alternate track by the Alternate Track Assignment program.

96-Column Reproduce and Interpret: Reproduces decks of punched cards or interprets (prints) data on previously-punched cards. Four options are provided in the program:

1. Reproduce only
2. Reproduce and interpret
3. Reformat and interpret
4. Reformat, reproduce, and interpret

96-Column List: Prints data, column-by-column, from 96-column cards.

SERVICE PROGRAMS

Library Maintenance

The Library Maintenance program is used to store and update programs on a disk. Each program is identified so that it can be retrieved when needed. The area on a disk in which programs are stored is called a *library.*

File Delete

The File Delete program removes disk files that are no longer used or needed, making the area available for new files.

File and Volume Display

The File and Volume Display program enables the user to print the Volume Table of Contents (VTOC). VTOC is an index describing each file on a disk. This program can also print out identification for any one of the files on a disk.

CONTROL PROGRAMS

Supervisor

The Supervisor loads programs that are to be executed and starts and stops the execution of programs according to the user's requirements.

Initial Program Loader

The Initial Program Loader (IPL) transfers the Supervisor program into storage to begin system operation.

Scheduler

The Scheduler program provides job-to-job transition. It causes the Supervisor to load the next program and identifies the disk data files to be used.

DATA RECORDING PROGRAM

The System/3 Data Recording Program, used with the Data Entry Keyboard feature, provides fully-controlled card punching, online. Using the Keyboard, Multi-Function Card Unit, and Processing Unit, this program simulates most of the functions of the IBM 5496 Data Recorder. The Data Recording Program uses, as input, program control cards similar to those used in the IBM 5496.

DATA VERIFYING PROGRAM

The System/3 Data Verifying Program, used with the Data Entry Keyboard feature, controls all functions necessary for verifying punched cards and for repunching incorrect cards. Using the Keyboard, Multi-Function Card Unit, and Processing Unit, this program simulates all the functions of the IBM 5496 Data Recorder.

CHARACTER STRUCTURE

Each column is composed of six punch positions labeled B, A, 8, 4, 2, and 1, from the top to the bottom of the column (see Figure B-1). The B and A punch positions are the *zone* portion of a character. The 8, 4, 2, and 1 positions are the *digit* portion.

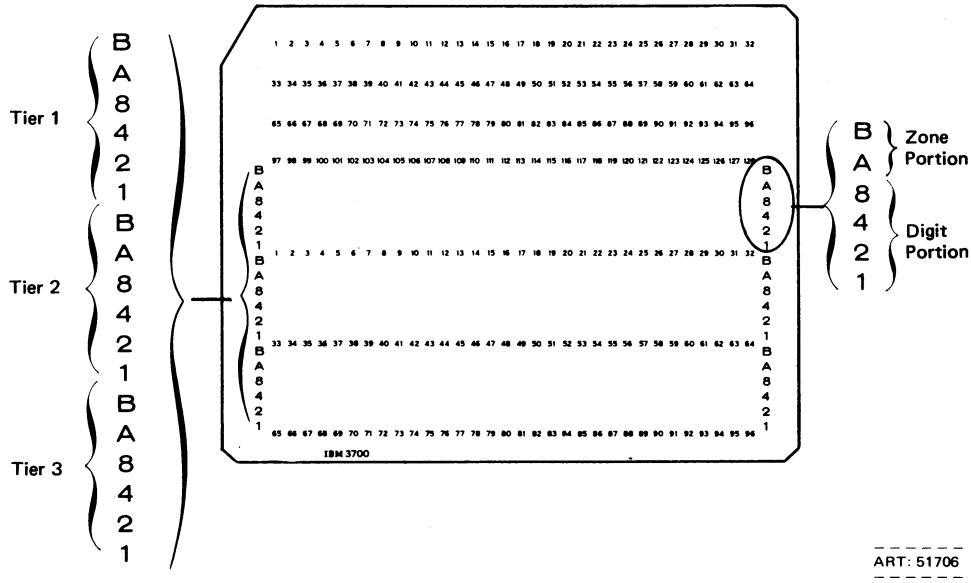

Figure B-1. Punch Positions in a Card

Numbers are usually represented by one or more holes in the digit portion of a column (Figure B-2). The number 1 consists of a hole in the 1-punch position. Likewise, a hole in the 2-punch position would represent a 2. Since there is no 3-punch position, a 3 is represented by both a 1 and a 2 punch. The number 0 is represented by a single punch in the A position. This is the one exception when a digit is represented by a zone, not a digit punch.

Alphabetic characters are represented by a combination of digit and zone punches. Special characters are represented by combinations of digit and/or zone punches.

CHARACTER SET

For every character keyed, a particular combination of holes is punched. Using the six punch positions of a column, it is possible to form 64 different punch combinations. The computer distinguishes one character from another by the different punch combinations. Since 64 different punch combinations can be formed, it is possible to represent 64 different characters: A through Z, 0 through 9, and 28 special characters; such as, the comma, dollar sign, period, and blank. Figure B-3 shows the punch combinations for these 64 characters.

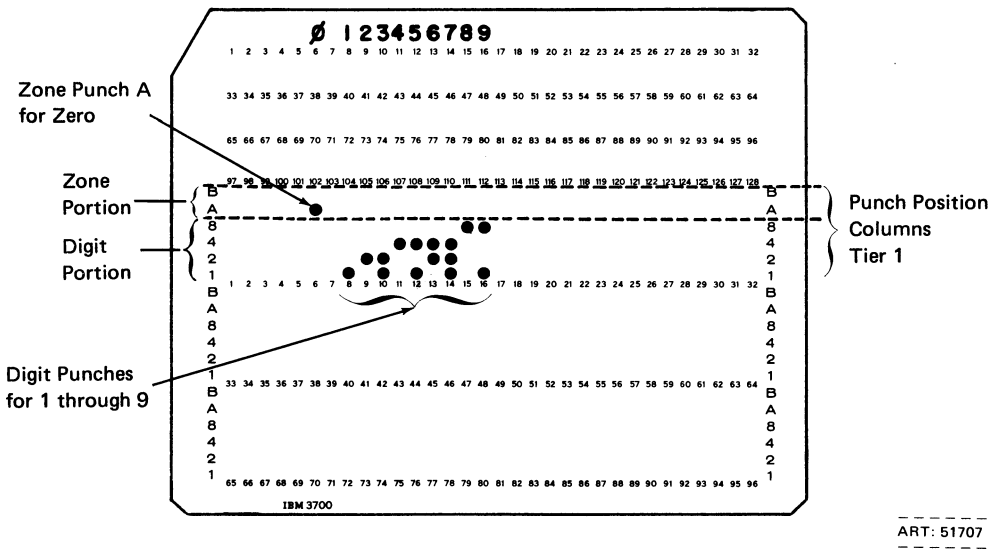

Figure B-2. Numeric Punches in a Card

Punch Positions			Numeric Characters									
			0	1	2	3	4	5	6	7	8	9
	Zone	B										
		A	A									
	Digit	8									8	8
		4					4	4	4	4		
		2			2	2			2	2		
		1		1		1		1		1		1

Punch Positions			Alphabetic Characters																										
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
	Zone	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B									
		A	A	A	A	A	A	A	A	A	A										A	A	A	A	A	A	A	A	
	Digit	8								8	8								8	8							8	8	
		4				4	4	4	4					4	4	4	4						4	4	4	4			
		2		2	2			2	2				2	2			2	2			2	2			2	2			
		1	1		1		1		1		1	1		1		1		1		1		1		1		1		1	

Punch Positions			Special Characters																											
			}	¢	.	<	(	+	|	!	$	*	)	;	¬	-	/	&	,	%	_	>	?	:	#	@	'	=	"	ø
	Zone	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B													
		A	A	A	A	A	A	A	A									A	A	A	A	A	A	A						
	Digit	8		8	8	8	8	8	8	8	8	8	8	8	8			8	8	8	8	8	8	8	8	8	8	8	8	
		4				4	4	4	4			4	4	4	4					4	4	4	4			4	4	4	4	
		2		2	2			2	2	2	2			2	2			2	2			2	2	2	2			2	2	
		1			1		1		1		1		1		1		1		1		1		1		1		1		1	

ART: 51708

Figure B-3. Punch Combinations

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