

IBM

Data Processing Techniques

Form and Card Design

Design

This manual is divided in two sections—the first devoted to form design and the second to card design.

Its use presupposes a knowledge of IBM data processing equipment. It can be used as a guide for individual study or a text for class study.

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Introduction

To insure efficient processing, cards and forms should be designed specifically for the application in which they are to be used. In doing this, it is necessary to:

- Know thoroughly the procedure and the machines to be used.
- Understand the reports to be prepared and know the use to which each will be put.
- Know the rules of good card and form design.

The application of these must be accompanied by ingenuity, common sense and experience.

This manual is divided into two sections -- the first devoted to form design and the second to card design. Each is intended to serve as a guide and in no way replaces the valuable assistance that is available through your local IBM representative.

The design of efficient, economical forms requires a certain amount of preparatory evaluation and analysis. Bear in mind that the major objectives are (1) forms which are legible, simple and economical, and (2) forms which can be prepared efficiently. Local IBM representatives should be consulted early; their guidance and reference materials will help insure against costly mistakes.

Steps to be Taken

First, the necessity of designing a particular new form should be established. There may be existing forms which are similar to the proposed one and which, with minor changes, will satisfy the new requirements.

Next, study the machine to be used for printing. In so doing, use the reference manual for this machine; most manuals have at least one section devoted to the tape-controlled carriage and/or form design. These sections contain valuable information about forms specifications as well as different printer characteristics and operation.

Thirdly, list all types of information to be recorded and the number of positions which will be allotted for printing each. In doing this, past and present statistics should be assembled and studied; these can be evaluated in light of future plans and then used as an indication of probable needs. One of the greatest weaknesses in form design is the tendency to burden a form with unessential information. Since entire data processing procedures may be geared to the preparation of a certain report, unnecessary information is extremely costly.

As a fourth step, lay out the form on a spacing chart. (Note: A 1403 spacing chart is illustrated in Figure 1. Spacing charts for each IBM printer are available through your local IBM representative.) In so doing, the following tips will be helpful, some of which will be discussed in greater detail later:

- Use bold type to make special information or headings stand out.
- In columns for figures allow sufficient space for the largest amount.
- Place filing information near the top of the form.
- Title the form.
- Include form number and date.
- Keep headings small, to allow sufficient room for written data.
- Consider headings at the bottom of the form.

- For multiple copies, use colors as an aid in routing each copy.
- Use double-ruled lines to set off sections.
- Avoid horizontal rulings as much as possible to eliminate adjusting.
- Consider guide marks for names, addresses and folding.
- Use some type of check protection for payroll, accounts payable and other checks.
- If possible, choose a form width that is standard.
- Make certain that the form length is compatible with the spacing to be used.
- Include a guide for forms alignment in the printer.

The final step in form design should be a test in which a copy of the proposed form is used. In making the test, examine the report carefully to make certain that zeros are printing properly and that amount fields are large enough. Make certain that all possible conditions that can arise during processing are tested.

Design Considerations

During the design of a form the designer should understand and keep in mind the following:

Form Width

The overall width of a form is important in determining printing space. Although the IBM form-feeding devices available will handle a great variety of document sizes, certain practical aspects should be observed.

Form costs can be reduced by confining form widths to the standard sizes of paper stock used by business forms companies. These standard sizes can be obtained from the forms company; reference to the individual machine manual will indicate which are acceptable.

In addition, standardization permits (1) purchase of report binding and filing supplies in fewer sizes and greater quantities at reduced cost, (2) more convenient forms handling and (3) a reduction in the setup time of form-feeding devices.

Form Length

The total number of body lines which a form contains (regardless whether six- or eight-lines-per-inch spacing is employed) can be any whole number in the case of single spacing, should be evenly divisible by two in the case of double spacing, and should be evenly divisible by three in the case of triple spacing.

Horizontal Spacing

For ten-characters-per-inch spacing, vertical lines separating fields, and periods of numbers should be drawn so that each splits a printing position. If they are drawn between adjacent positions, paper shrinkage, variations in form insertion and alignment, as well as other variables, may prevent satisfactory registration during printing.

For 402-3 spacing, the lines can be drawn between printing positions.

Vertical Spacing

On many printers the vertical spacing is under operator control and can be set for six or eight lines per inch. The importance of this is that double spacing at eight lines per inch permits 25% more lines to be listed on a page than double spacing at six lines per inch. While it is true that six lines per inch at single spacing gives more items than eight lines per inch at double spacing, the advantage of the latter is the double-spaced legibility (see Figure 2).

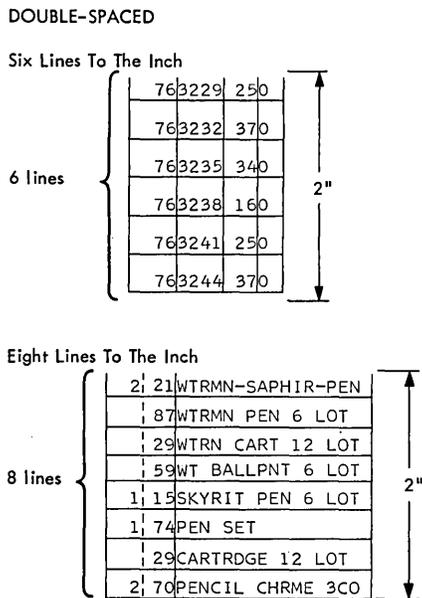


Figure 2.

Before designing forms for single spacing at eight lines per inch, it should be made certain that the lines of print will not overlap. Machine and type style determine this.

Principles of Operation Bulletin 94 (form 224-6156) describes preparation of carriage tapes for eight-lines-per-inch spacing.

Form Skipping

Forms should be such that carriage skipping from one area to another, or from one form to another, requires little or no extra processing time. Since the maximum

distance which can be skipped without losing a machine cycle is not the same for all printers, the individual machine or systems reference manual should be read. It is also advisable to study very carefully and determine the number of body lines which will occur most frequently. If the form provides for more or less than this number, valuable machine time may be lost in long skips or frequent overflows.

Availability of Characters for Each Printing Position

On most printers, alphabetic, numerical and special characters can be printed in every print position. However, for the 402 and 403 it should be made certain that reports requiring the printing of alphabetic information are designed so that the machine can print from the alphameric type bars.

On the 402, 403 and 419 asterisks are printed from odd-numbered numerical type bars while the CR symbols are printed from even-numbered ones. In some cases it is difficult to arrange reports so that these characters print for odd and even type bars respectively. Therefore, by special request, the asterisks can be replaced by credit symbols and vice versa. If it is desirable to have special characters other than those available, demountable type bars must be used.

Form Alignment Guide

If possible, a guide for form alignment should be determined and preprinted on each form to facilitate machine setup operations. For the 402 and 403 accounting machines this is accomplished by printing a ribbon guide (see Figure 3). For other printers it can be accomplished by a short line or mark in the margin or heading of the form; this line or mark should be used in conjunction with a stationary object such as a print line indicator.

For forms that are prenumbered and must be accounted for, a clear plastic facsimile of the form can be made. This facsimile, when clipped to the top of the first form, should provide the means for form alignment and restoring the control tape in the carriage.

It is important that a description of the form alignment guide and its use be included in the manuals of procedure. A delay in machine setup will create an unavoidable delay in processing.

Numerical Amounts

In determining the number of print positions needed for numerical fields, it is the size of the total which must be provided for rather than the size of the detail amounts. If marks of punctuation are to be machine-printed, the size of the field should be checked to make certain that printing positions have been allotted.

If offset total printing is used on a form, the total and the individually listed amounts should be positioned so

SUMMARY OF PURCHASES					RIBBON GUIDES	
DATE 3 / 31 / 6						
ACCOUNT NAME	ACCOUNT		SUB ACCOUNT TOTAL	GENL. ACCOUNT TOTAL		
	GENL.	SUB				
RAW MATERIALS						
BRASS	123	301	14	971	50	
CASTINGS	123	305	24	607	53	
BLANKED PARTS	123	320		180	75	
GEARS	123	325		100	45	
GLASSWARE	123	335				

DEPARTMENTAL PURCHASES					
DATE 3 / 31 / 6					
DEPT.	MATERIAL CLASS	YEAR-TO-DATE THIS YEAR		YEAR-TO-DATE LAST YEAR	
14	10	12	253	96	31 220 97
14	11	9	732	10	7 354 78
14	12		139	12	

SUMMARY OF EXPENSES		
DATE 3 / 31 / 6		
ACCOUNT NAME	ACCOUNT NO.	ACCOUNT TOTAL
SALARIES EXE		
SALARIES SUP		

STOCK STATUS SUMMARY									
DATE 12 / 31 / 6									
MATRL. CLASS	STOCK NUMBER	DESCRIPTION	OPENING BALANCE	ACTUAL TRANSACTIONS			PLANNED TRANSACTIONS		
				RECEIVED	ISSUED	ON HAND	ON ORDER	REQUIRED	AVAILABLE
174	146301	MOTOR 1 HP 60 CYC	49	7	16	33	50	36	47
								2	5

ACCOUNTING	<input type="checkbox"/>
ENGINEERING	<input type="checkbox"/>
PURCHASING	<input checked="" type="checkbox"/>
PRODUCTION	<input type="checkbox"/>
SALES	<input type="checkbox"/>

Figure 3.

that zero and special symbol printing control in one field does not interfere with that in the other (see Figure 4). The same is true of other numerical fields, particularly those that appear in the heading of the form.

Check Protection

Since the amount field on a payroll, accounts payable, or other check may be larger than the amount printed in it, a positive method of preventing fraudulent alteration is needed. One way is to allow zeros to print to the left of the high-order digit.

Another common means of check protection is the use of asterisks. For some printers, this is a routine operation; for others it requires a special device.

Marginal Perforations

Most forms have a vertical perforation $\frac{1}{2}$ " from each side. Sometimes, however, forms are designed with dissimilar margin widths. For example, a form with an overall width of $9\frac{7}{8}$ " may be perforated $\frac{1}{2}$ " on the left and $\frac{7}{8}$ " on the right, to leave an $8\frac{1}{2}$ " x 11" letter-size report after the marginal strips are removed. Many such variations in margin size are used. At least one unused printing position should be left between a machine-printed character and a perforation.

Since some report binders utilize the form-feeding holes for binding, many reports are set up with no perforation on the binding side.

The practice of eliminating perforations and letting the form-feeding holes remain on both sides of the fin-

ished reports is being followed more and more, particularly with internal reports.

Binding

In most cases, it is desirable to keep the binding space at a minimum to reduce form cost. Therefore, information that is not likely to be referred to should be placed nearest the margin, since it becomes increasingly more difficult to read information near the binder posts when many sheets are placed in a binder.

Because of the amount of space required for headings, many forms can be bound at the top, with no sacrifice in readability. If it is desirable to bind continuous forms without bursting them or binding them on the side, binding holes can be punched in both the top and bottom of the forms.

Carbon Copies

Substantial savings can be realized by keeping the number of carbon copies to a minimum. Some techniques that are effective in reducing the number of carbon copies are:

1. Side-by-side duplicate reports.
2. Consolidation of reports for multiple use.
3. Sequence-routing of reports to different departments, instead of simultaneous distribution.
4. Mechanical or photographic reproduction.

Any report that is subject to constant usage, such as a weekly time sheet, should be prepared on a durable grade of paper. For most multiple-copy work, the first,

POLICY NUMBER		NAME OF INSURED	AMOUNT OF INSURANCE
9 1 8 4 6 7 0 2		EVELYN SMITH	1 5 0 0
6 0 9 4 2 3 0 1		DOROTHY GREEN	2 5 0 0
6 6 4 5 0 3 9 8		ANDREW HERRON	5 0 0 0
1 3 8 1 4 9 2 7 5		DONALD CREW	2 0 0 0
POLICIES	TRANSFERS	TOTAL AMOUNT INSUR.	REVIVALS
		1 1 0 0 0	

↑
OFFSET TOTAL

Figure 4.

or original, copy and the last copy are heavier in weight than the intermediate copies. Lighter weights of paper have less cushioning effect on the printing impact, and therefore permit more legible printing on multiple copies. The paper must not be so stiff that it will buckle away from the platen. On the other hand, it must be of sufficient weight and strength to prevent tearing while feeding or ejecting forms.

Platen hardness requirements vary with the number of parts in each form. Printing payroll checks without carbons, for example, necessitates a medium platen, while an invoicing operation with six parts to be recorded necessitates a hard platen.

In addition to this, the distance between the type bars and the platen is adjustable (for a varying number of copies) by the use of the machine's form thickness adjustment device. Many printers also have an adjustable device which permits the operator to vary the print density. It is also valuable for stencil cutting or preparation of spirit duplicator master sheets if the machine is used for other work.

When feeding forms of eight parts or more, or exceptionally heavy forms, the use of an undercut platen should be considered to avoid improper registration and smearing.

The carbon paper used should produce the required number of legible copies without excessive smudging. Various carbon forms are in use. They include:

1. One-time carbon. This is used once and discarded.
2. Carbon-backing paper. The carbon surface is on all or part of the reverse side of the original.
3. Chemical-coated paper. The chemical coating on the back of one sheet reacts with the coating on the face of the next, under the impact of the type bar.

The type style is also an important consideration for multiple carbon copies. Standard type will give maxi-

imum legibility. A type style with a smaller area tends to fill in when printed through several sheets of paper, and type with a bolder face spreads the force of the hammer blow and decreases the sharpness and density.

The legibility of some special-purpose type is limited. Since it is fixed in size, the more characters that are crowded within the area, the smaller each character becomes. Therefore, as the number of carbon copies increases, the definitive lines of each character seem to become broader. The result is a character that is difficult to read.

In some cases carbon paper is narrower than the form. It may be held in place by a fastening technique at the horizontal perforations between forms, or by some other method such as stitching, gluing, or paper perforations in the margins.

The recommended maximum distances between fastenings are:

<i>Form Length</i>	<i>Maximum Distance Between Fastenings</i>
1 to 5 inches	5 inches
5½ to 11 inches	11 inches
11 to 14 inches	7 inches
14 to 17 inches	8½ inches

For forms more than 17" in length, the maximum distance between staples should be determined by actual test.

If staples are used, these conditions must be satisfied:

- Staples must be located out of the printing area.
- Staples must be properly crimped so they won't catch on guides, edges or staples in succeeding forms.
- Staples must not cause excessive bulging during feeding, particularly at the out-fold.

Form Types

Depending upon its purpose and destination, the form on which a report is printed may range from the least expensive blank stock to the more expensive custom design.

Reports printed on blank stock will probably be vague to outsiders, such as auditors, as well as to many insiders, unless the printer itself can be used to print column headings during report preparation. Imprinted stock forms are standard-size forms which are stocked in large quantities and upon which lines, headings, markings and some designs are printed as desired. Custom forms are those which are designed to fill special needs of size, complexity and design. Although more expensive, they can be used advantageously to "sell" the company.

Stock forms, both blank and imprinted, are generally used for infrequent or low-volume reports and, in particular, for those reports which are sent to insiders.

Card Design

Generally speaking, cards can be categorized by the manner in which they are prepared:

Transcript cards are punched from information previously recorded on other documents. Examples include the customer order cards punched from orders, accounts receivable cards punched from invoices, voucher cards punched from accounting vouchers.

Dual cards are punched from information previously written on the cards themselves. Thus they serve a dual purpose as both source document and processing medium. Examples include (1) inventory counting and recording cards, which have the physical count written on them in the warehouse, and which are then sent to the data processing installation for punching of the handwritten data, and later used in printing the inventory report, (2) payroll change cards, which have the change written on them, and which are then signed by the employee, punched, and automatically machine-processed to effect the change, and (3) certain requisition and personnel cards.

Mark-sensed cards are automatically punched from electrographic pencil marks that are recorded in mark-sensing positions on the face of the cards. Certain weekly attendance and meter reading cards are of this type. They are marked by an employee on the job, sent to the machine room where the mark-sense data is machine-read and punched into the same or a different card for processing.

Output cards are automatically machine-created as a result of processing disk storage records, tape records or other IBM cards. Examples include summary, balance forward, updated file, exception and certain detail cards. Some of these undergo additional processing for report preparation, while others replace the corresponding but outdated cards in a file.

Special cards are used with the IBM PORT-A-PUNCH® to enable on-the-spot punching of data. Punching positions of those columns that are to be used for recording data are prescored; the holes are created by punching out the prescored chips with a special instrument.

Regardless of the manner in which it is prepared, in no case should a card be imposed upon a procedure; instead it should be designed for the particular use to which it will be put. This is the only way to achieve maximum effectiveness and efficiency.

Determining Card Data

The first step in card design requires a study of the final report that is to be printed from the card and a listing of data needed for it. Next, the procedure is studied and any data needed for processing that is not also needed for the report is added to the same listing. Every item except that which comes from a table, master card and/or storage is extracted and recorded on a form similar to the one illustrated in Figure 5. Provision must be made for recording in the card all data that is listed, unless it is calculated, emitted or summarized.

A check should be made that the necessary reference data is included on the listing. Reference data should be sufficient to (1) identify the transaction with the original source document from which it was created, (2) indicate the date on which the transaction occurred, and, in some cases, (3) designate a person, place or item responsible for or involved in the transaction. Examples of reference data include date, invoice number, batch number, account number, salesman number, etc.

The amount of reference data that is necessary is determined by the use to which the cards will be put and the reports which will be written from them. Care should be taken to avoid duplicate or unnecessary reference data.

Determining Field Size

The number of columns required to record each type of information should be determined and added to the list in Figure 5. For codes, dates, invoice number, account number, etc., this is determined by the largest single number to be recorded. Thus, four columns are reserved for invoice number if the number series is to be repeated after 9,999, and two for branch if there are no more than 99 branches.

With quantity and amount fields, the problem becomes more difficult. In the first place, the space needed to record the largest amount may not be known; in the second place, if the largest amount is known, its chances of occurring may be rare.

It is therefore a good plan to provide for all except those rare cases, and to handle them by punching extra cards or by using class selection. If, for example, the seven-digit amount \$67,265.80 is a rare case, it may be recorded in a six-column field by punching six cards of \$9,999.99 and one card for \$7,265.86 (or any combination of six-digit numbers totalling \$67,265.80). In designing summary and balance-forward cards, however,

CARD DESIGN WORK SHEET

CARD NAME: *Patient Card*

DESIGNER: *H.E. Norcross*

INFORMATION REQUIRED FOR PROCESSING AND REPORT PREPARATION	FIELD SIZE				LOCATION IN OTHER CARDS	SEQUENCE ON SOURCE DOCUMENT	REMARKS
	TRIAL	TRIAL	TRIAL	FINAL			
<i>Type Room</i>	1	1	1	1	13	2	
<i>Admission Date</i>	6	6	5	5		8	
<i>Insurance Plan 1</i>	4	4	4	4	19-22	4	
<i>Name</i>	20	20	20	20		6	
<i>M. I.</i>	1	1	1	1		12	
<i>Sex</i>	1	1	1	1		10	
<i>F. C.</i>	1	1	1	1		16	
<i>Charity Code</i>	4	4	4	4		17	
<i>State Code</i>	2	2	2	2		18	
<i>W. C. Code</i>	3	3	3	3		15	
<i>Room Rate</i>	4	4	4	4		7	
<i>Age</i>	2	2	2	2		9	
<i>Class</i>	3	3	3	3		14	
<i>Attending Physician</i>	4	4	4	4		13	
<i>Admission Number</i>	8	8	6	6	7-12	1	
<i>Card Code</i>	1	1	1	1			
<i>Storage Address</i>	5	5	5	5			<i>Should be in card columns 1-5.</i>
<i>Room Number</i>	6	6	5	5		3	
<i>Insurance Plan 2</i>	4	4	4	4	23-26	5	
<i>Religion</i>	1	1	1	1		11	
<i>Responsible Party Name</i>	20						<i>Place in another card</i>
<i>Street Address</i>	18						<i>Place in another card</i>
<i>City</i>	16						<i>Place in another card</i>
<i>State</i>	4						<i>Place in another card</i>
	139	81	77	77			

Figure 5.

the amount fields must be made large enough to accommodate the summary totals.

For punching names, 20 columns are generally sufficient; this should be carefully checked, however, on each individual job. A study of the number of columns required for recording names and addresses reveals that 95% of names of individuals can be recorded in 18 columns or less; that 95% of names of companies require 20 columns or less; that 90% of street addresses require 18 columns or less; and that 99% of cities and states (abbreviated) require 20 columns or less.

The total of the columns required for all fields will indicate whether the capacity of the card has been exceeded. When the number of columns exceeds 80 but does not go over 100, the decision must be made whether to use two cards or to reduce the number to 80. If the total number reaches 100 or more, it is evident that an additional card is needed.

If it is decided to reduce the number of columns to 80, the following techniques may be used:

1. Reduce the size of reference fields by repeating the numbering series more frequently; for example, invoice numbers may start with 1 each month instead of each quarter.

2. Reduce the size of control fields by having certain ones serve as subclassifications of others.

3. Reduce the size of reference or control fields by recoding. It is often possible to eliminate several digits.

4. Reduce the number of columns required for recording reference or control fields by ignoring one or more digits which may not be essential. Thus, it may be possible to punch only four digits of a six-digit invoice number and preserve positive identification.

5. Reduce the size of amount fields in those cases where the number of digits in the amount seldom exceeds the capacity of the field.

6. Record in the 11th and 12th punching positions information which is never used for printing. These positions can be easily used in columns that are set aside for multiple punching; however, they should not be used in control or alphabetic fields.

7. Use a single card column for recording several one-digit codes. If an applicant is categorized male (11 punch) or female (12 punch) and by age group (for example, a zero punch for age 15-20, a 1 punch for 21-23, a 2 punch for 24-26 . . . and a 9 punch for 65 and above), then both codes can be punched in the same column. Since this is multiple punching, caution should be exercised and the user should make certain that the different combinations are machine-readable.

8. Investigate the use of the group-sorting device if master and detail cards are sorted together. Its use may make it possible to eliminate from the detail cards a sorting field or fields.

9. Avoid unnecessary data; for example, the use of both an order number and an invoice number is unnecessary if one will provide adequate reference.

10. Use one field instead of two when alternative information is to be recorded. An example is an accounts receivable transaction card that is to be used to record either an invoice or a credit memorandum. The use of two fields—one titled "Invoice No." and the other "Cr. Memo. No."—will suffice if an X or digit punch is also punched in some specified card column as identification of the credit memo.

11. For cards that are to be used for statistical analysis, combine several classes of statistical data into a single column. This technique is especially applicable in the case of yes-no responses.

If it is necessary to use more than one card, the data is separated or classified to determine which should be placed in each card. Such a division may be based upon any one of several schemes:

1. Place the repetitive or recurring information in one card and temporary or non-repeating information in a second card, as in the case of master cards and detail cards.

2. If more than one source document is involved, design a different card for each and use card codes.

3. In cases where one transaction affects two different accounts, design two cards—each with a different degree of detail. Examples are accounts payable and payables distribution cards, accounts receivable and sales cards, payroll and labor distribution cards.

4. For printing invoices, orders, etc., design a card for each section of the form. For example, a job may include for each customer (1) heading cards, (2) a miscellaneous data card and (3) detail commodity cards. Such an arrangement is simple and effective; the heading and miscellaneous data cards may also be used for other jobs, such as printing credit memorandums and packing slips.

Determining Data Sequence

There are four major considerations in determining a card's data sequence. In the order of importance, these are (1) the location of identical data in other cards with which the new one will be processed, (2) the sequence of data on the source document from which the card will be punched, (3) the machines and/or programs to be used during processing and (4) the manual operations in which the card will be used.

Specific areas have been made available on the Card Design Work Sheet (Figure 5) for recording the location of data in other cards as well as the sequence of data on the source document. The effect upon sequence of machines and/or programs as well as manual operations and the location of interpreted information can be

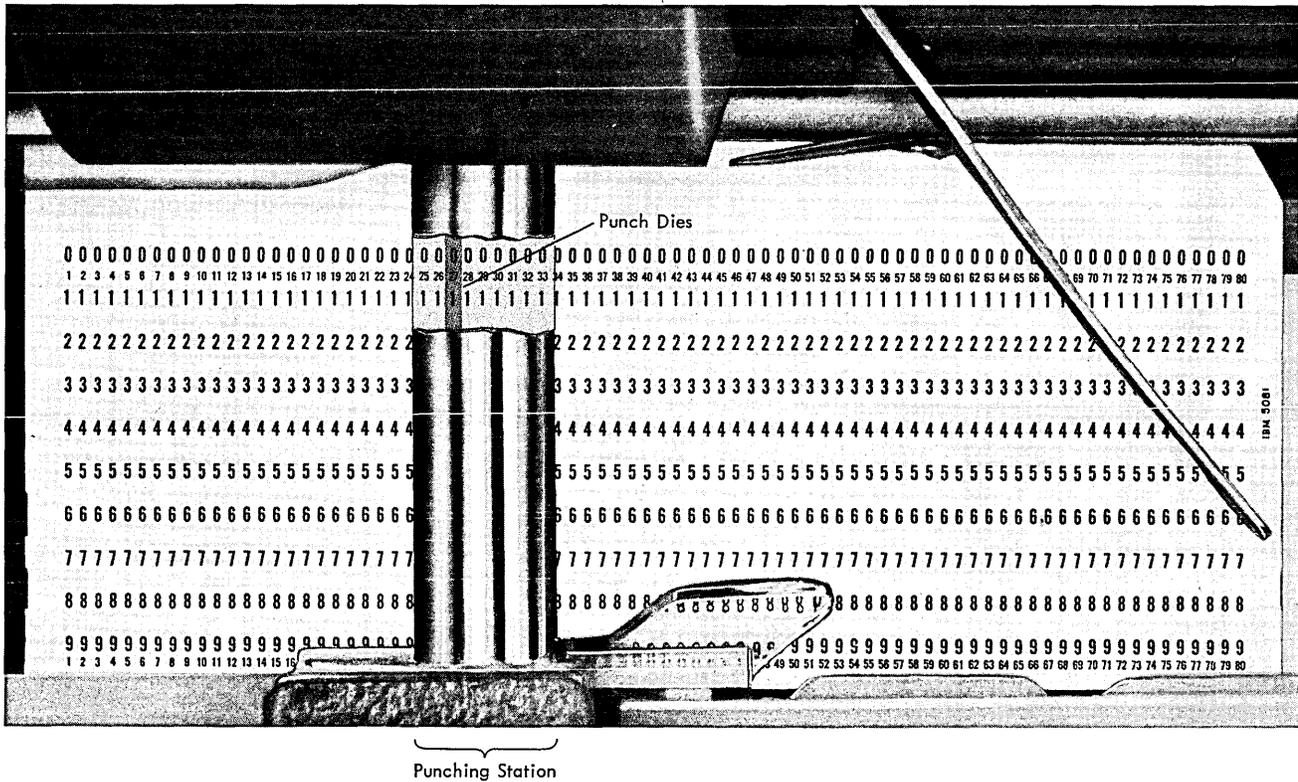


Figure 7.

Sorters. For sorting operations in which cards are being sequenced by several codes (e.g., minor, intermediate and major), operator control is simplified if the fields are located adjacent to each other with the minor code on the right and each progressively higher one to the left. Thus, the column selector is turned once for each pass and always in the same direction.

If the multiple column selection device is used to select cards on the basis of punching in two or more small fields, the fields should be adjacent so that all will pass under the brushes.

Automatic Punches. For those machines which punch serially (e.g., 602, 534, 536, 524, 526), the card should be designed so that the data sequence does not conflict with the sequence in which results will be supplied and punched into the card by the machine. Such a conflict can be avoided by a study of the particular machine and the processing to be done by it.

Computers. Computer characteristics should be investigated to determine whether the card's design will affect processing speed. For example, with the 1400 series, field sequence, size and grouping will determine whether instruction chaining can be used. With many computers the ability to move and process blocks of data without rearrangement will facilitate

programming and increase processing speed.

Control Panel Wiring. In installations where control panels are not permanently wired, the accuracy and speed of frequent wiring operations is improved if the input card's data sequence is similar to that for reading, punching and printing.

Manual Card Handling. If data is to be punched and printed on the 26 Printing Card Punch, any information to be checked visually should be placed near the right or left end of the card. This makes it easier to fan and check a group of cards. If data will be read from cards that are sitting in a file, make certain that the reference data is positioned so that it can be easily seen.

Card Layout Forms

Once field size and data sequence have been determined, the card's design can be created. Several types of card layout forms available for this are illustrated in Figure 8. To make design easier, these forms are considerably larger than the standard-size IBM card, which measures $7\frac{3}{8}$ " x $3\frac{1}{4}$ ". Through the use of photography and reduction techniques, the forms can be reduced to the proper size for making printing plates.

On the transcript card layout form in Figure 8 all guides and scales are numbered to correspond with paragraphs in the text below, which describes them. Most scales appear in duplicate; this permits the use of a straight edge in locating and laying off specific areas.

1. Type-spacing scales appear at both the top and the bottom of the design working area; the individual scales are labeled in the set at the bottom. The two groups are alike and should be used to locate, horizontally, a particular printing position or group of positions.

2. These two guides indicate the location of lines 1 and 2 for standard end printing.

3. This spacing guide appears only on the left end of the form. It indicates spacing for standard end printing. There are eight possible positions on both lines 1 and 2.

4. These two guides—one at the top, one at the bottom, and both near the right end of the design area—represent the location of lines 1 and 2 for right-hand

end printing.

5. This guide appears on the right-hand side of the form and indicates spacing for right-hand end printing.

6. These two scales appear near the top on both the left and the right ends of the form; they indicate the location of printing lines for the 26 Printing Card Punch as well as the 548, 550, 551 and 552 interpreters. The digits 1 to 5 that appear in the scale on the left end of the form designate printing lines; the symbol appearing between printing lines indicates the location of punching positions. The numbers 45 and/or 60 indicate which interpreters make use of each line. The number 80 and the short horizontal broken line in the first box of the scale indicate the line of printing for the 26 Printing Card Punch.

7. This is a six-line-per-inch scale that appears on both the left and right ends of the form; together they are used to lay off printing lines for continuous-form

The figure displays three IBM card layout forms. The top form is 'IBM CARD LAYOUT FORM - DUAL' (FORM X74-4555-10) with a grid of punch positions and a 'DESIGN WORKING AREA' in the center. Below it is 'IBM CARD LAYOUT FORM' (FORM X74-4049-12) with a similar grid and design area. To the left is 'IBM TYPE SPACING' (FORM X74-6259-0) with various scales and guides. The forms include sections for 'COMPLETE THESE SECTIONS FOR ALL LAYOUTS' and 'COMPLETE THESE SECTIONS WHEN APPLICABLE', with handwritten annotations and checkboxes.

Figure 8.

card stock and bill-feed cards. Note that some of the printing lines overlap punching positions; avoid the use of these in areas of the card where there will be a lot of punching.

8. These scales locate printing lines for the 557 interpreter. There is one at each end of the form.

9. This guide shows the location of each of the twelve rows of punching.

10. In addition to indicating the location of punching positions, this guide shows the location of each of the twelve rows of mark sensing. Note that they do not overlap punching positions.

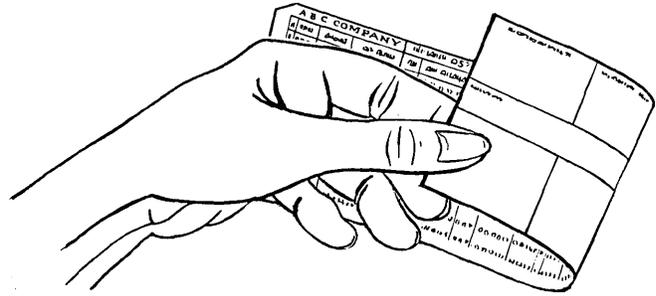
11. This guide indicates the location of mark-sensing columns. Each overlaps three card columns and always ends over a card column whose number is divisible by three.

12. These numbers can be cut out and used for numbering areas on the card as well as for numbering card columns. In addition to being used for cutouts, the top row is also used as index for the Short Card Column Guide.

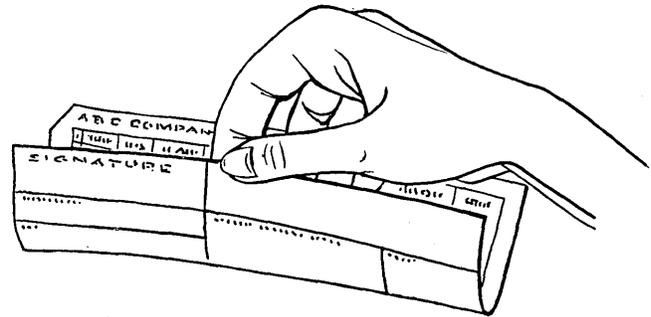
13. The Short Card Column Guide is in two sections, each containing the numbers 22 through 66. It is used in laying out a stub or short card that is to come from the midsection of an 80-column card. (A short card is any card having between 22 and 60 columns.) The guide is used to indicate the beginning and ending card columns. Assume that a 51-column card is being designed; the number 51 is located and circled in both sections of the guide. The column number in which the short card will begin is 15; it is the number which appears in the index below 51 in the left-hand section of the guide. The column in which the short card will end is number 65; it appears in the index below 51 in the right-hand section of the guide. (Note: A short card may come from one end rather than from the center of the standard card; if it does, the guide is not used.)

14. This section is near the bottom and extends the full width of the form. For each layout it should be read to make certain that appropriate areas are completed. There are certain areas to which attention should be called. Reading from left to right, in both the third and fourth boxes, at least one condition should be checked. (Note: If a lower right corner cut is specified for an IBM 24-26 card punch having the self-checking number feature, then a C-3 corner cut is recommended; for tumble cards it should be remembered that an upper left corner cut becomes a lower right corner cut when the card is turned.)

At the bottom of the fifth box one of two conditions, Book or Tumble, should be checked if the card is to be printed on both sides. "Book" is checked if the card will be turned right to left when the reverse side is read:



"Tumble" is checked if the card is turned bottom to top when the reverse side is read:



If mark sensing is used, its style should be indicated in the sixth box. It makes no difference which style is pasted on the layout itself; it is the one which is checked off in this box which determines the style that will be printed on the card.

Drawing the Layout

In drawing the card layout, there are a number of points to be considered. The value of each should be determined by the card being designed and the application in which it will be used. These points will be discussed in the following text. Figure 9 shows the layout for a material accounting card; much of the discussion which follows can be related to it.

All field and box headings should be explicit, and ambiguous abbreviations avoided. Headings for written information should be such that they force writing into the desired location. Make certain that adequate space has been allowed for this writing.

If a dual card is being designed, the right-hand side of each area or box containing handwritten data should be at least five card columns to the left of the field in which it is to be punched. This prevents the data from being obscured when it is time to punch it. Figure 7 shows the position of the punch dies and the number of card columns to the right and left of them which are

so that sorting and control panel wiring will be easier. The first column of a 22-column card will be read by brush 30, and the 22nd column will be read by brush 51. Cards designed for a 51-column operation are read by brushes 15 through 65. If the whole card is to be processed before the stubs are detached, it may also be desirable to show column numbers for the standard 80-column card as well as those for the short card.

Designing PORT-A-PUNCH® Cards

A PORT-A-PUNCH card is illustrated in Figure 10. A maximum of 40 columns may be punched; however, the punching positions must be prescored to permit use of the PORT-A-PUNCH. The scoring is limited to consecutive, even-numbered columns.

In considering the card design, it must be remembered that normal machine punching cannot be accomplished in columns adjacent to PORT-A-PUNCH columns. In some cases it may be necessary to reproduce the PORT-A-PUNCH card into another card in order to provide additional space for calculated results or other data to be added.

Tumble and Sectional Cards

In cases such as merchandise control for retailing and freight car accounting for transportation, where 40 or fewer card columns are required for a transaction, a sectional or tumble card is frequently designed and

used. This cuts card costs in half; with the sectional card they may be cut even more. Figure 10 illustrates both types. Their nature is such that it does not easily permit their use as a permanent record card.

Testing Card Design

After the design of a card has been established, it should be tested. An effective way of doing this is to lay out the design on several cards (IBM cards with form numbers 5081 or 1001 are satisfactory) and use them in the procedure. Any serious drawback to the design should become apparent.

The IBM Charting and Diagramming Template is helpful in preparing for the test. Its height and its length up to the notch that appears on the bottom edge are the exact dimensions of a standard IBM card. On the face of the template are shown (1) along the bottom edge, the location of card and mark-sense columns, (2) along the left edge, the location of punching and end-printing positions and (3) along the top edge, alphabetic interpreter type spacing.

Whenever conflicts arise in the design of cards that are processed together, the cards and their uses should be studied to determine which one should have priority. In so doing, consider for each type (1) its volume, (2) the number of manual operations in which it is used, (3) the nature of each manual operation and (4) its effect upon such things as board wiring and programming.



International Business Machines Corporation
Data Processing Division
112 East Post Road, White Plains, N.Y. 10601
[USA Only]

IBM World Trade Corporation
821 United Nations Plaza, New York, New York 10017
[International]