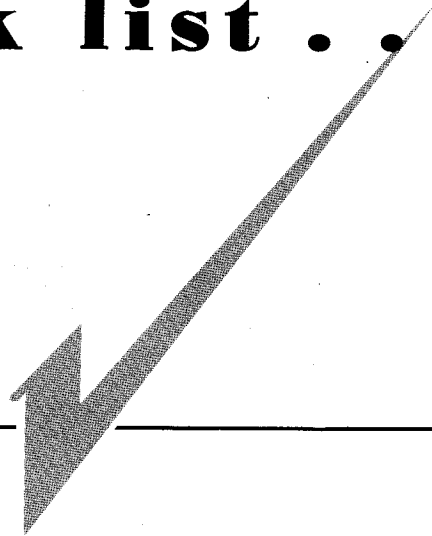# IBM® Data Processing

Customer Executive Program

Installation Management

check list . . .

. . . FOR PLANNING AN INSTALLATION OF

IBM ACCOUNTING MACHINES AND MAJOR

APPLICATIONS

Days before
Scheduled
Machine Delivery

PROCEDURES

PLANNING: PROCEDURE MANUAL

over 150	150	120	90	
x				Document and report design
x				Codes
x				Card design
x				Chart of operational steps
x				Controls
		x		Wiring diagrams
		x		Operator instruction sheets
		x		Operation test cards
x				Machine load requirements
		x		Work schedules

CARDS

over 150	150	120	90	
				Specifications
	x			Tab index
	x			Prepunching
	x			Prenumbering
	x			Stub
	x			Printing (special)
	x			Padded
	x			Re-inforcements or stringing or wiring
	x			Creasing
	x			Corner cuts (check for machine limitations)
	x			Colors
	x			Stripes
	x			Design service for checks
	x			Special packing
	x			IBM cards in continuous form
	x			IBM post card stock
		x		Shipping schedule
		x		Proofs approved

DOCUMENTS AND REPORT FORMS

over 150	150	120	90	
	x			Ordered
		x		Shipping schedule
		x		Proofs
		x		Continuous form stock paper
		x		Carbon paper
		x		Multiple part stock forms
		x		Roll paper
	x			Special requirements on continuous form document reports
			x	Prepunched files
			x	Master code cards
		x		Use of Service Bureau (planned)
			x	Set up master files
	x			Special operations pending delivery of machines
			x	Peak loads

MACHINE SPECIFICATIONS

CAPACITIES

over 150	150	120	90	
x				Sorters
x				Accounting Machines
x				Calculating Punches
x				Reproducers; Gang Punches
x				Cardatypes
x				Statistical Machines
x				Summary Punches
x				Interpreters

SPECIAL DEVICES--PUNCHES

over 150	150	120	90	
x				Additional crossfooting device
x				Additional selectors and distributors--043, 044, 063, 064
x				Alphabetic indication storage device--528
x				Alternate program device--024, 026
x				Auxiliary duplication--024, 026
x				Auxiliary verification
x				Card counter auxiliary
x				Card insertion device
x				Card reversing device
x				Card reverse feeding device--043, 044
x				Class selection device
x				Column indicating device
x				Column split device
x				Consecutive-number gangpunched and checking
x				Copy racks, punches, verifiers
x				Count-controlled punching and serial number printings
x				Counter read-back device--528
x				Decimal accumulating device
x				Digit selector--528
x				Double punch and blank column detection device
x				Emitter
x				Extended space key--031
x				Folded stub card feeding device--513, 514, 519
x				Gangpunching emitter
x				Group control (additional)--528
x				Interchangeable Feeds (51-80 cols.)
x				Interchangeable stub card read feed--513, 514, 519
x				Interspersed gangpunch device
x				Marking device
x				Mark sensing device (punch feed)
x				Mark sensing device (read feed) 513, 514, 519
x				Offset stacking device
x				Program device--528
x				Program drum (additional)--024, 026, 526
x				Program positions
x				Reading board (large)
x				Reading light and record holder
x				Self-checking numbering device
x				Selectors, additional
x				Special skip key
x				Split column device
x				Summary punch devices
x				Summary punch cable, extra length
x				X-control of gangpunching
x				X-controlled group summation

SPECIAL DEVICES--SORTERS

over 150	150	120	90	
x				Alphabetical sorting device
x				Auxiliary card counter
x				Card matching device
x				Folded stub card feeding device
x				Group sorting device
x				Multiple column selector
x				Sorting suppression device

SPECIAL DEVICES--ACCOUNTING MACHINES

over 150	150	120	90	
x				Alphabetical summary punching device
x				Asterisk protection device
x				Automatic carriage
x				Automatic control stops
x				Automatic start device--858
x				Auxiliary card counter
x				Bill Feed
x				Folded-form feeding device
x				Comparing device
x				Carbon ribbon feed device
x		x		Card feed stop
x				Card cycle total transfer device
x				Check device--858
x				Class selection device

SPECIAL DEVICES--ACCT'G. MACHS. (continued)

over 150	150	120	90	
x				Color control device--858
x				Column split device
x				Complement reconversion device--402, 403, 417
x				Consecutive number control device
x				Continuous form feed, manual
x				Controlled hammer trip device--402, 403
x				Counter reset to pre-determined significant digit
x				Demountable typebars
x				Digit selector--402, 403, 416, 407, 417
x				Distributors, additional--858
x				Formfeed device
x				Fractions
x				Hammer spring tension device
x				Interchangeable feeds (51-80 cols.)
x				Intermediate control
x				Line finding insert device
x				Line selection device--923
x				Line spacing devices
x				List-tabulate control, automatic
x				Matched card indication device
x				Program device (special)--402, 403
x				Program steps, additional--858
x				Progressive totals
x				Reread device--858
x				Reset device--triple
x				Semi-fixed control panel
x				Single card total suppression device
x				Single column month listing and summary punching
x				Skip stops (additional) 402, 403, with tape carriage
x				Split column device
x				Split counters and print banks
x				Storage, additional--858
x				Summary punch elimination device
x				X-Distributors (additional)
x				X-Eliminator
x				Up-stroke space suppression device
x				Zone control device

SPECIAL DEVICES--AUXILIARY MACHINES

over 150	150	120	90	
x				Alphabetical collating device
x				Auxiliary card counter
x				Card counter
x				Check protection--557
x				Class selection device
x				Collator counting device
x				Column distributors (additional)--101
x				Cycle delay unit
x				Emitters--550, 551, 552 ,557
x				Pre-sensing--557
x				Print control device--854
x				Print entry--557
x				Proof--557
x				Recode relays (additional)--101
x				Repetitive print--557
x				Sample selection device--101
x				Special characters--557
x				Split column device
x				Units-tens device--101
x				51-column feed--557

AUXILIARY SUPPLIES AND REQUIREMENTS

over 150	150	120	90	
x				Voltage requirements
x				Current requirements
x				Motor generator
				Additional control panels
		x		Manual
		x		Fixed
x				Control panels with self-contacting wires--519, 602A
		x		Control panel templates
				Additional wires
	x			Single
	x			Multiple

AUXILIARY SUPPLIES AND REQTS. (continued)

over 150	150	120	90	
		x		Skip bars (hardened bars cut to specifications)
			x	Plastic skip bars
		x		Tabular inserts (printing punch)
			x	Ribbons
			x	Facsimile posting fluid
x				Card gauge
x				Sorting needles
x				Machine covers
		x		Sorting trays
		x		Mark sense pencils
			x	IBM glue
x				Platen sectors
			x	Transmittal tapes (additional)--043, 044, 063, 064, 854
			x	Program tapes (additional)--854, 856, 922, 923
			x	Combinational tape punch (additional)--854, 922, 923
			x	Transmittal tape gauge (additional)

MISCELLANEOUS EQUIPMENT

over 150	150	120	90	
	x			Card files
x				Forms stand--924
	x			Storage cabinets and racks (cards and forms)
	x			Control panel racks
	x			Keypunch chairs
	x			Working tables
	x			Desks
	x			Time Stamp (documents)
	x			Facsimile typewriter (special headings)

MACHINE ROOM LAYOUT

over 150	150	120	90	
	x			Weight requirements (floor load)
	x			Elevator capacity
	x			Door widths
		x		Electrical outlets
		x		Lighting
		x		Sound proofing
x				Floor plan layout
		x		Grounding EAM equipment
x				Finish--EAM equipment
x				Air conditioning

PERSONNEL AND TRAINING

DETERMINE PERSONNEL REQUIREMENTS

over 150	150	120	90	
	x			Clerical
	x			Machine operators
x				Supervisor

OPERATING PERSONNEL TRAINING

over 150	150	120	90	
			x	Card punch aptitude test
			x	Local machine schools
			x	Machine operator aptitude test
			x	Procedure training in department

SUPERVISOR TRAINING

over 150	150	120	90	
x				Local machine schools
x				Endicott Management class
		x		Visits to other installations
x				On procedures with IBM salesman

EDUCATIONAL LITERATURE

over 150	150	120	90
		x	

EXTENSION PROGRAM PLANS

over 150	150	120	90
		x	

IBM

Procedure Development

IBM

data processing
MANAGEMENT

PROCEDURE DEVELOPMENT

IN PLANNING the activities of an IBM accounting department it is essential for the manager to be satisfied that the fastest, most accurate, and most economical procedures will be used, for plans and operations in his department will hinge upon the procedure. When a new job is being set up or existing procedures are being reviewed for their adequacy, certain important principles must be kept in mind.

Whether the manager has the assistance of a systems or methods man within the organization or must do the work alone, a certain amount of creative ability should be developed in the direction of building procedures. All persons exercising supervisory control over record keeping activities should be able to:

1. Secure sufficient knowledge of all the business to recognize its accounting and managerial requirements.

2. Obtain all of the necessary facts for developing procedures which will produce the required accounting and managerial reports.

3. Establish the procedures by examining critically all the possible methods of doing the job, and by taking into consideration the essential factors of cost, time, personnel, equipment, and control.

Since the purpose and function of a machine accounting department is to transform source document information into final reports and documents, it is evident that the first consideration of the manager is the *procedure* to be used to effect the transition—the job steps which are necessary to change raw factual information into finished reports. Any number of procedures can be designed to accomplish a given job; however, only one procedure will be the most efficient, and it can be found only by logical and methodical means. It is the purpose of this booklet to assist the manager in developing such punched card procedures.

OBJECTIVES

PROCEDURES do not exist for their own sake. The periodic activities demanded by a given procedure are performed not because such work has always been done or because people must be kept busy, or even because the desired results *can* be produced that way. Procedures are adopted to produce, with the greatest economy of money and time, a given set of results which are valuable to the organization.

Before a procedure is built, it is necessary to know what is to be produced — the ultimate objectives must be determined. It is usually necessary for the manager to confer with management or other persons who will use the reports to ascertain the adequacy of such reports for the use intended. The manager must determine:

1. What information is needed on the reports?
2. In what classification should the report be prepared?
3. Are multiple classifications desired?
4. What form should the report take?
5. How detailed is the information needed? Should the report be detail or group-printed?
6. Who will receive and use the report?
7. When is it to be presented?
8. What priority is assigned to the report compared to the other necessary reports?
9. What is the value of the report to the organization?

Most of this information can be answered by preparing a sample report on the accounting machine, by typing it, or even by making a sketch of it. When all of the reports to be produced in the department are listed with their due dates and other data, and when samples are available the objectives for procedure development are known. The schedule of reports and the sample reports or results are ready for inclusion in the general manual of procedure.

SOURCE DOCUMENTS

ONCE THE objectives have been established, the next step is to examine the raw material with which to begin the procedures. Information which is to appear on the final reports must be included in source documents. Basic information is not usually originated within the accounting department but is copied from the source document, rearranged, and summarized so that it appears in a more usable form — the final report.

The first question to ask is: "Are the documents available which contain the information required on the reports?" The documents must not only contain the necessary information but must be available in the proper form, in the necessary detail, and when needed. Certain clerical functions may be needed to prepare the source documents for most effective use in key punching or other processing: assigning the proper codes to the documents; transcribing the information to an apron or a stamped form to improve its legibility or to arrange it in the most desirable sequence for key punching; underlining or circling the information to be key punched. Such a preparation of source documents is usually made to improve the production and accuracy if the key punching operation.

For ease in handling and control, source documents are frequently batched and transmitted with control tapes or item counts. The size of batches should not be completely arbitrary but should be established after taking into consideration the prevailing percentage of errors, which must be located by batch. It is evident that as cards are punched and listed or balanced against predetermined batch totals to prove the inclusion of all documents and the punching of all cards correctly, errors which may be detected must be isolated and corrected — first by batch, and then by item within the batch. The size of batch should be small enough so that most batches will balance out and contain no errors. This, of course, eliminates much detail checking within the batch. As the number of errors decreases, more items may be included in each batch. The physical size of documents, their availability, the distance between points of operation, or other special grouping requirements may modify the ideal size of a batch as determined by the percentage of errors expected.

USE OF CARDS IN PROCEDURES

THE VARIOUS card forms used in a specific accounting procedure should be designed simultaneously with the development of the procedure. The information to be punched in cards is the information needed for the final reports, plus certain information which may be recorded for control purposes. For each item of information, the number of columns must be determined. When the total number of columns required exceeds or even approaches the capacity of one card, the use of a second card should be considered. In using a second card, however, care must be exercised in deciding what information is to appear in each card. The allocation of information to either card may be based on any one of several plans, depending upon the methods used for securing source data, processing the cards, or writing the reports.

One of the more common plans for classifying information is according to the degree of repetitiveness with which the information is used. Information which is used repeatedly or which does not change for every transaction is assigned to one card called a *master card*. Such repetitive information is utilized at the time of a transaction by reproducing or gang punching from the predetermined master card into transaction cards. The transaction or detail card, on the other hand, is usually prepared by key punching or mark sensing the variable or unpredictable information which cannot be assigned to the master card.

An alternate method of using repetitive or predictable information is to prepare a reservoir of prepunched cards. For each transaction involving a particular set of prepunched information, a card is withdrawn from the prepunched file and variable or specific information is added by key punching or mark sensing. When the supply of a particular set of prepunched cards becomes depleted, the file is replenished by gang punching additional cards.

Master cards are used extensively as employee master cards in payroll procedures. By contrast, prepunched files are used frequently in billing procedures where cards are prepunched for all possible commodities and for all regular customers. For writing a bill or invoice it is necessary only to pull the pertinent cards which apply to a given transaction. In this way the key-driven job is practically eliminated.

The use of master cards or a prepunched reservoir file generally provides a very econocimal procedure (by reducing the punching function), and this should be done when repetitive information is encountered.

In some situations, classification of information into separate cards is accomplished most advantageously on the basis of the source of information. When the data required for a given report must come from a variety of sources, it may be more practical to punch a separate card from each source document — or for each transaction — and combine or associate these data in the sorter so that consolidation and summarization may be performed by the accounting machine. Material or stock accounting frequently makes use of this method, because the stock status report must reflect the result of a variety of transactions. If a separate card is punched for each receipt, issue, transfer, adjustment, order, etc., and all pertinent cards are sorted together by stock number, the net result of all transactions, when summarized, will be reflected in the stock status report. An additional advantage of this procedure is the possibility of running separate analytical reports for any desired phase of the transaction by using only the detail cards for that particular classification.

Many procedures require the classification of information according to the degree of detail required in the use of the information. For instance, in an accounts payable procedure, certain information pertaining to the vendor and the total amount due him is needed for payment, but, in addition, detailed information pertaining to items purchased —amounts, purposes, etc., — must be available so that the correct accounts may be charged. In this case, one card is punched for accounts payable pur-

poses, and a second set of cards — one for each item on the invoices — is punched for payables distribution.

The same plan may be used for accounts receivable and sales analysis or for payroll and labor distribution. It is not always necessary to key punch all of the cards in this type of procedure. The distribution cards may be key punched and the accounting card summary punched from them, or, a portion of the distribution card may be key punched and the remaining information gang punched from the accounting card. In other procedures, both sets of cards are punched independently and then balanced or reconciled to prove the accuracy of the source records or the punching operations.

The design of the final report to be run may dictate the distribution of information to the various card forms involved. For instance, in a billing procedure, the form of the bill to be written may require customer name and address, shipping instructions, miscellaneous data, commodity, freight, and control data—all represented by different cards. The simple requirement is that information to be printed first on the form must pass through the accounting machine first. Such sequence may determine what information is assigned to the separate cards.

The type of information recorded may be the best basis for designing the cards to be used. For instance, when it is desirable to carry item descriptions, customer names, or other alphabetical information requiring a large number of columns, a distinct advantage is gained by having such information in a separate card along with its numerical code. Such a set of cards is, in reality, a code file which may have many uses. Code books and catalogues may be prepared automatically, automatic coding may be accomplished, automatic decoding becomes possible as reports are run, and volume jobs can be run more efficiently because burdensome alphabetical descriptive information is not included in detail cards.

Although various plans are used for allocating the required information to several cards, it is evident that due consideration must be given to the procedures in which the cards are to be used.

It is for this reason that the design of cards and the design of the procedure must go hand in hand.

It is not the purpose of this booklet to discuss the techniques and detailed factors affecting the design of IBM cards, for this can be found in other literature. However, several important principles should be remembered in designing cards which will be the best suited to the particular procedure. These principles may be summarized into the following steps for designing IBM cards:

1. List all information desired on the final reports.

2. Add to this list any information needed for control or reference in the procedures.

3. If other cards have already been designed, indicate the card columns opposite any item of information already in IBM cards. Similar information should be in the same columns on all cards.

4. Indicate the method of punching for each item of information. All information punched in the same way should be adjacent on the card. Take maximum advantage of automatic punching methods.

5. The sequence of key punched information should be the same as that on the source records. Reading should proceed from left to right and from top to bottom on the source document.

6. Determine the number of columns required for each item of information. Quantitative data require the greatest amount of research.

7. If for the total number of columns exceeds or even approaches the card capacity, consider the use of two or more cards. Classify the information properly as discussed in the preceding paragraphs. Allow room for expansion on each card.

8. Determine what information is to be interpreted and in what order it should be placed on the card. Check the number of type bars needed for interpretation.

9. Design the card, using a skeleton card layout form.

10. Check the card designed with the procedure and the reports to see if all requirements have been met.

Cards as Source Documents

Before constructing the procedure, it is necessary to determine the effective and economical point at which to convert to punched cards. Frequently, it is not desirable to start the automatic procedure upon receipt of the source document into the organization. Certain auditing, checking, matching, or classifying functions requiring judgment may be necessary before the accounting functions can be performed. Such work does not lend itself to mechanization. At some point during the processing of these documents, however, the work usually becomes standardized and routine. This is where mechanization is economically introduced.

When documents and the information contained on them originate within the organization, and before accepting the existing source documents as the starting point for the punched card procedure, the possibility of actually originating the document itself as a punched card should be examined. In other words, the punched card procedure may start with the origination of the document. This may be done economically where the information to be recorded can be placed on an IBM card.

At the point of origin most documents contain certain recorded data extracted from present records to indicate their purpose. With punched cards, such data can be applied to the document automatically by either punching or printing. By reproducing, gang punching or even key punching, cards may be prepunched to reduce the punching load upon receipt of the document. They may be printed with basic data on the Document-Originating Machine (IBM 519), the Alphabetical Interpreter (IBM 552), the Bill Feed on the Accounting Machine, or the Facsimile Posting Machine (IBM 954).

Certain advantages which increase efficiency and lower the cost are found when cards are used as source documents:

1. Ease and flexibility of recording the data on the document.

2. Automatic verification.

3. Ease in auditing and checking.

4. Automatic coding and decoding, through the use of coding or decoding cards.

5. Ease in handling because of convenient, uniform size.

6. Lower cost of the card as compared with other forms.

The use of cards as documents is best adapted to internal record keeping functions such as time tickets, attendance cards, personnel cards, production control cards, etc. With the development of mark sensing, the use of cards as documents is being further extended because the essential elements of the transaction or event are easily and effectively recorded in a card for subsequent automatic handling. In addition, the use of IBM cards as checks, remittance statements, bills and invoices is being extended daily.

CONSTRUCTING THE PROCEDURE

IN DEVELOPING a procedure for an accounting application to be performed on IBM machines, the basic accounting steps should be kept clearly in mind. The procedure involves:

1. Punching the cards.
2. Arranging or classifying the cards.
3. Special processing steps.
4. Preparing the finished report or document.

The rules governing the accounting functions to be performed must still be applied; mechanization of the accounting job does not in any way limit or affect the necessity of applying good accounting practices to the accounting job, for the machines are merely units which perform the basic operations required in all accounting procedures. These operations — reading, writing, calculating, arranging, sorting and filing — should be applied to the proper machine when constructing the procedure. In some situations insufficient volume, the nature of the job, special precautions, variations found in the standard method, or other similar conditions prevent the application to the

operation of machines which are best from a mechanical point of view.

In working out procedure with mechanization in the picture, the practical aspects should always be kept in mind. Machines have been built to perform the more simple and repetitive types of accounting jobs. By doing this, personnel may be utilized more effectively in the more variable aspects of the procedure where analysis and good judgment are necessary. The procedure should be developed as follows:

1. Determine the job steps necessary to bridge the gap between the source documents and the final report or document.

2. Analyze the job steps and determine which can be performed mechanically.

3. Determine which machine operations and clerical functions will be applied to the various steps.

In determining job steps in the procedure, the following check list may be found useful.

Check List of Functions in IBM Accounting Procedures

I. RECORDING

  A. Receipt and preparation of source documents
    1. Due-in dates
    2. Batching
    3. Predetermining control totals
    4. Document control
    5. Auditing for correctness
    6. Editing for arrangement or completeness
    7. Coding
    8. Transcribing for punching
  B. Punching (IBM 10, 24, 26, 514, 519)
    1. Card design principles
    2. Key punching new or nonrepetitive information
    3. Automatic punching of repetitive information
      (a) Reproduce from master cards
      (b) Gang punch from prepunched files
    4. Mark sensed punching

C. Verifying

   1. Key verify (IBM 56)

   2. Visual verifying
      (a) List and read back
      (b) Interpret and read back
      (c) Read or needle check punched holes

   3. Automatic verifying
      (a) Compare on IBM 77, 89, 402, 407, 514, 519
      (b) Double punch, blank column detection

D. Writing register (IBM 402, 403, 407)

   1. Listing every item of information in detail
   2. Verifying and proofing
   3. Accumulating control totals
   4. Posting totals to control sheet

II. AUXILIARY PROCESSING

  A. Calculating (IBM 602A, 604)

  B. Reproducing (IBM 514, 519)

  C. Selecting (IBM 77, 80, 82, 83, 89)

  D. Interpreting (IBM 522)

  E. Comparing and checking (IBM 77, 402, 403, 407, 514, 519)

III. CLASSIFYING

  A. Use of classification codes

  B. Sorting (IBM 80, 82, 83)
   1. Alphabetic
   2. Normal numerical
   3. Block sorting

  C. Filing and arranging
   1. Manual
   2. Merging (IBM 77, 89)

IV. SUMMARIZING

  A. Writing reports (IBM 402, 403, 407, 954)
   1. Designing reports
   2. Posting requirements
   3. Classifying totals
   4. Horizontal distribution
   5. Comparative figures
   6. Item or group counts
   7. Due-out dates

  B. Summary Punching (IBM 514, 523, 518, 519, 526)
   1. Carrying balance-forward figures
   2. Reducing card volume

FLOW CHARTS

ONCE THE PROCEDURE is conceived and developed, it is important to put it on paper so that it may be examined, revised, or explained. Since a procedure is a series of related job steps which must occur in a given sequence to complete the finished reports, these job steps can be indicated on a flow chart to give a picture of the entire procedure. This picture serves to show the job steps involved, indicates their sequence, and points out the main elements of the procedure. It is always an aid to constructive thinking to make a picture which will show the main factors involved and their relation to each other. The act of making the flow chart will provide a clearer understanding of the procedure.

One of the best methods of teaching is the use of illustrations. The flow chart is the picture used to illustrate the procedure graphically to supervisors or operators. The purpose of the flow chart is not just to have a pretty picture, but to bring out forcibly and visibly salient facts which assist in clarifying thinking and in conveying the facts clearly to others. The leading facts should stand out clearly; they should be simple, obvious, and easily grasped by anyone. To realize these objectives, certain points should be kept in mind:

   1. Any work which can be performed can be charted.

   2. The flow chart should show in a clear, simple picture the flow of work into the department and the flow of work within the department.

   3. The wording on the flow chart should be as brief and clear as possible.

   4. The type of work performed at each job step must be clear.

   5. The chart must not be cluttered with details so that the over-all picture is lost.

   6. If the procedure is too long or too complicated to be pictured on one chart, break it down into logical subprocedures and draw several flow charts depicting different phases of the work. The relationship between different phases of the work should be clearly explained, possibly
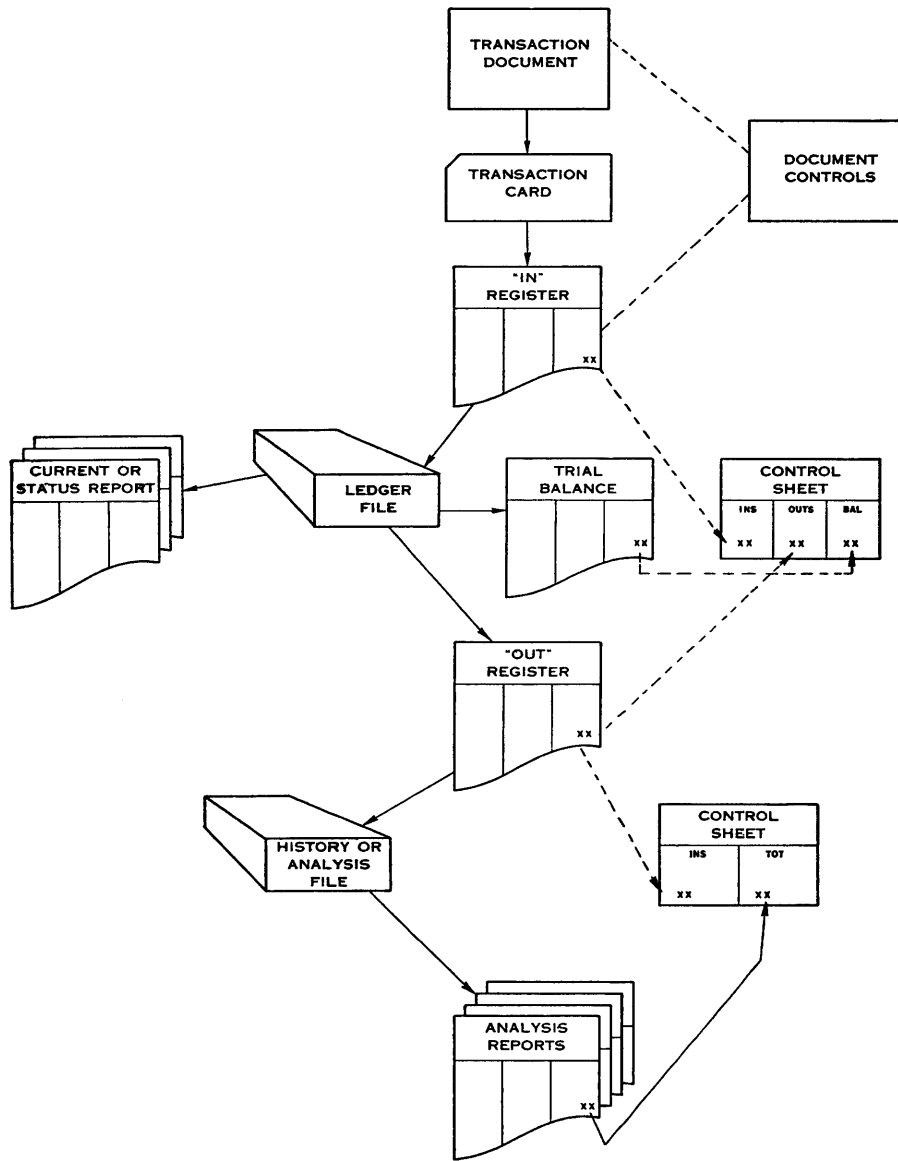
FIGURE 1. GENERAL FLOW CHART

in a general flow chart showing the more important steps in the procedure.

7. The source of more detailed information concerning each job step should be indicated by keyed numbers or letters.

Flow charts are usually of two types:

1. The *general flow chart* is a pictorial representation of the general method by which source document information is converted to final reports and documents. These flow charts serve to give a picture of the accounting job which the procedure accomplishes. It emphasizes the source documents, the cards and card files used in the machine accounting procedure, and the final reports and documents. Such a flow chart is illustrated in Figure 1. These general flow charts have value in depicting the overall procedure to management or to the person or persons receiving the final reports. The source of the information is readily seen, the cards used in the accounting procedure are evident, and the various reports relating to the job are shown.

CLERICAL FUNCTION

SORT OR COLLATE

ACCOUNTING MACHINE

KEY PUNCH OR KEY VERIFY

AUXILIARY MACHINE
(INTERPRETER, REPRODUCER, CALCULATOR, ETC.)
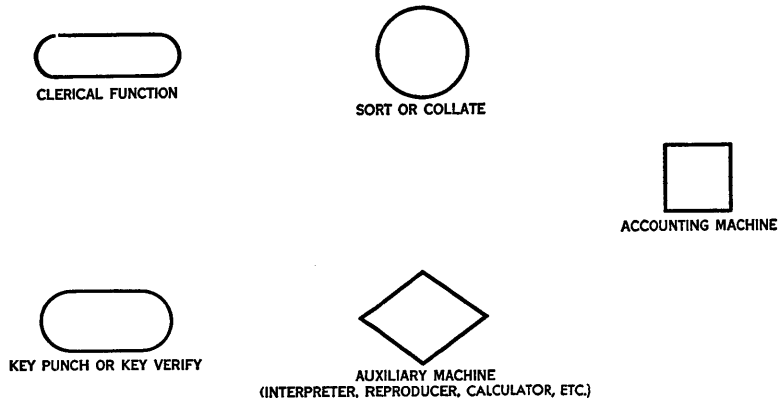
FIGURE 2.   FLOW CHART OPERATIONAL SYMBOLS

2. The *operational flow chart* is a pictorial representation of the specific job steps necessary to arrive at the end product. These flow charts point out the machine or clerical operations in their proper sequence and the movement of cards or documents from one operation to another. Since operational flow charts contain more detailed information than general flow charts, they should be drawn for each job to depict a portion of the entire accounting procedure. The operational flow chart is used by the manager of the IBM installation as a nucleus around which he builds his plans, schedules, controls, and operations. It is desirable, therefore, that elements common to all accounting machine procedures be symbolized and standardized so that they may be quickly drawn and recognized.

If many types of procedures are examined, certain common job steps and processes may be found. In an IBM installation, machine operations and clerical operations are found; cards move from job to job and documents move from step to step. Most operations are performed within the machine installation, but some may be performed in outside departments.

To indicate the various machine and clerical operations on flow charts, the symbols illustrated in Figure 2 have been assigned to the respective operations. A word or two indicating the type of operation the machine is performing can be included beside or within each symbol.

Symbols that can be used to represent source documents, final reports, cards, and card files are illustrated in Figure 3.

SOURCE DOCUMENT

CARDS

OR

REPORT

FILES

OR
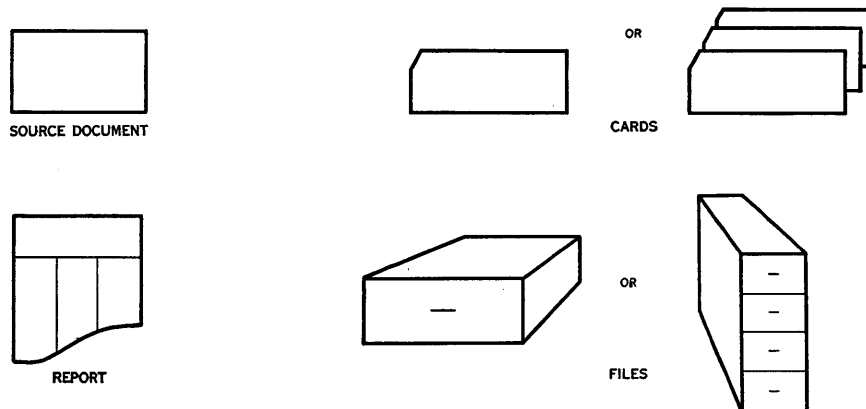
FIGURE 3.   FLOW CHART SYMBOLS

The movements of cards from one job step to another job step may be represented by a solid arrow. Documents moving through the procedure may be represented by dotted arrows. Note that the card symbol and the report symbol in Figure 4 have no arrows leading to them, but the arrows appear to go behind them. This is advisable to prevent confusion which may result if these particular symbols are interpreted as job steps rather than identification symbols. The card symbol and the report and documents symbols are not job steps and should have no arrows leading into them.

When a job step or operation is performed outside the IBM department, these functions should be made to stand out distinctly on the flow chart by some notation or device such as drawing them in red, and any element of the flow chart which is related to outside activities should be drawn in red. If the use of color is not practical, the outside function should be clearly designated as such.
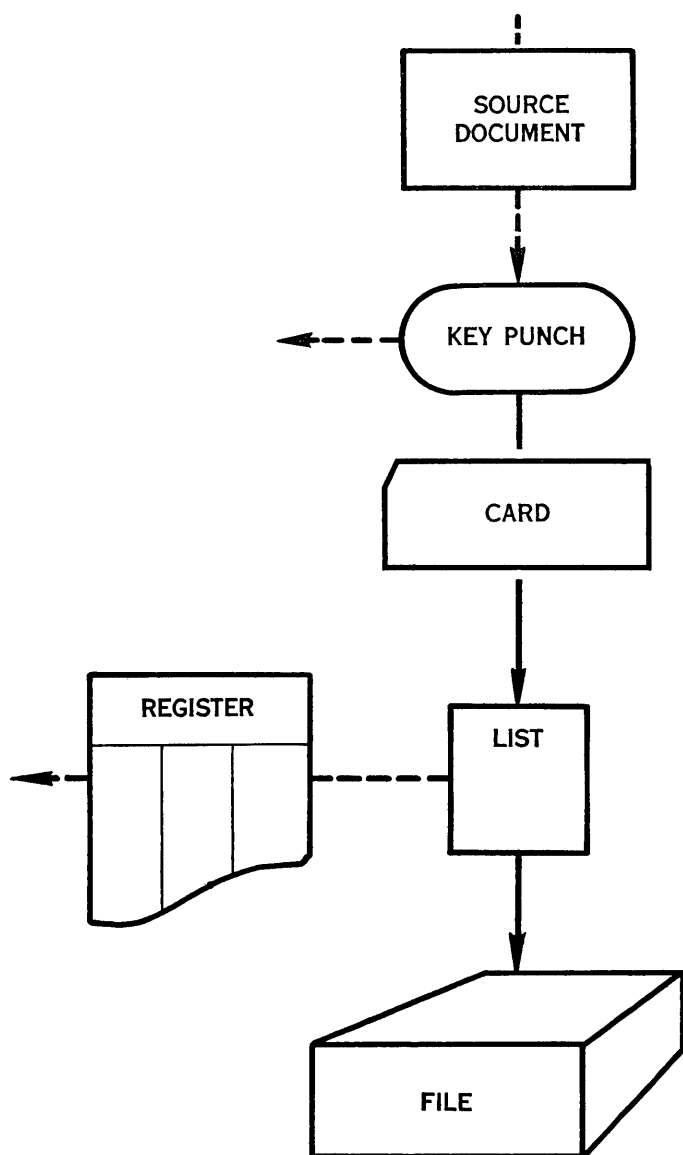
FIGURE 4. FLOW CHART DEVELOPMENT
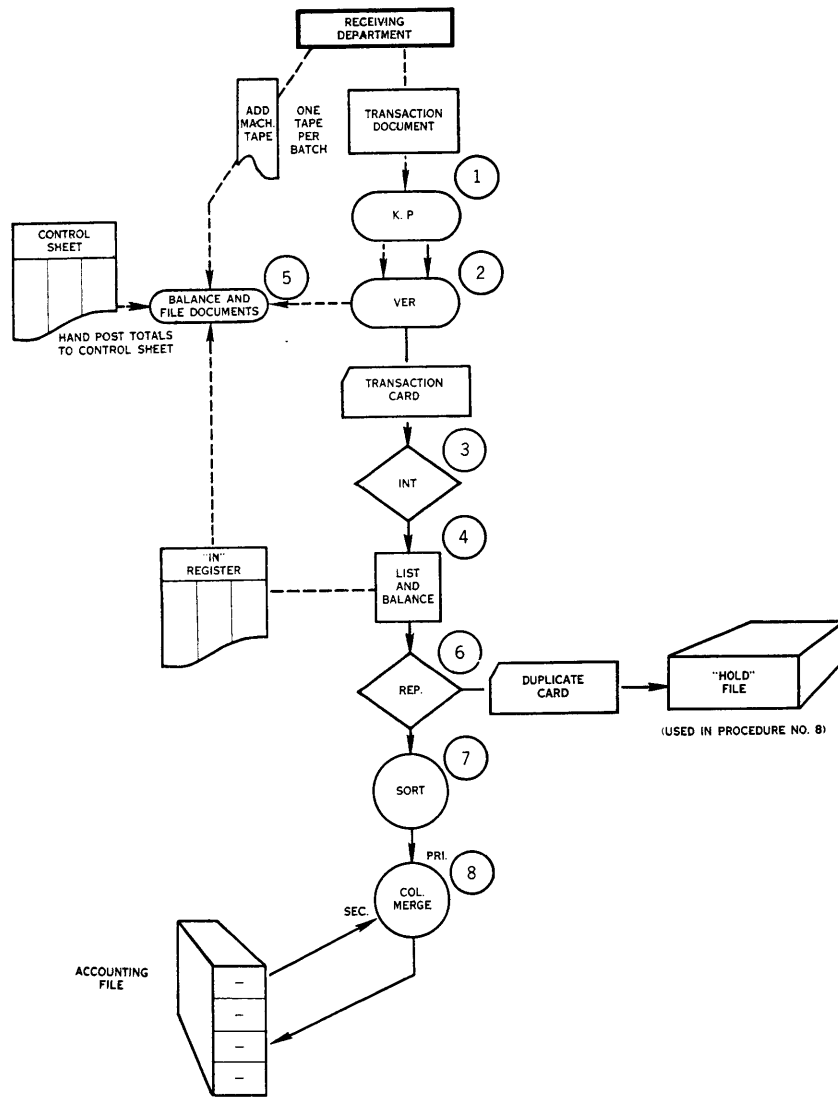
FIGURE 5.   OPERATIONAL FLOW CHART

Special symbols may be devised and used for job processes and for special documents which are unique to a given procedure. It is important to remember, however, that any special symbol which is not standard should be clearly indicated so that no opportunity for misinterpretation will arise. By using these standardized symbols and principles, the general flow chart shown in Figure 1 may be transformed into an operational flow chart. The operational flow chart for one job depicts the operations necessary for punching the cards, preparing the IN register, and inserting the cards into the current working file (Figure 5).

Note that the main line procedure in Figure 5 is down the center of the page. Subsidiary or parallel jobs are drawn to the side. Cards selected from one procedure to be used in another procedure are indicated, but additional information regarding the second procedure is reserved for the flow chart for that procedure. The material with which the procedure starts, whether it be documents or cards, should be at the top of the page, and the final results, whether they be reports or cards, should be at the bottom of the page. The flow chart will then show the main line job steps which link the source documents to the final report.
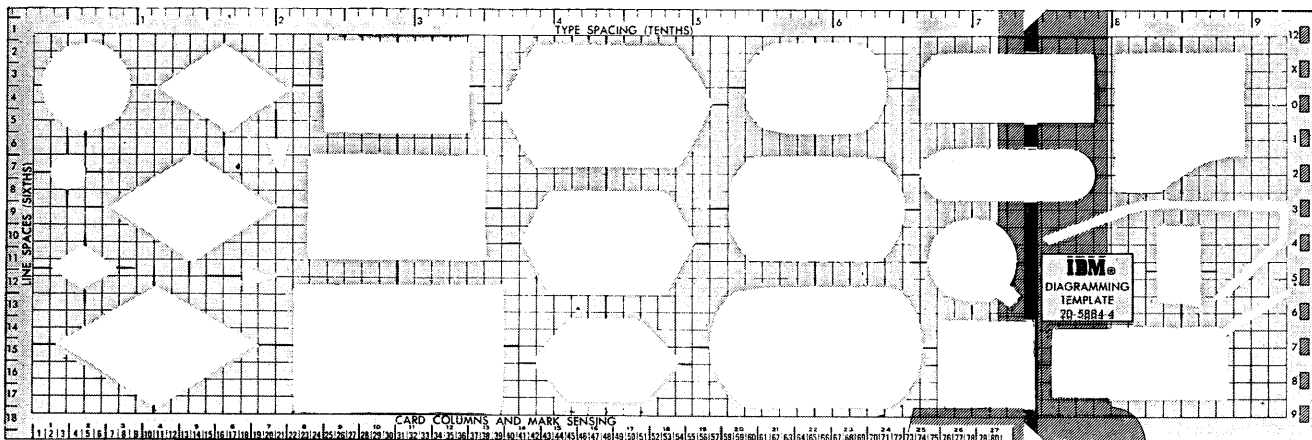
FIGURE 6. FLOW CHART TEMPLATE

Flow Aid Charts

To facilitate the drawing of these various standardized symbols a template has been designed and is available for use in constructing flow charts (Figure 6).

In addition to the punched card symbols, the above template also contains cutouts for many component systems operations such as those accomplished on the 650 and 700 series machines.

Figure 7 shows suggested uses for the various symbols.

This template, in addition to the symbol cutouts, contains various scales and spacing guides.

FRONT

> TOP—Accurate scale of tenths-of-inches; 407 printing positions
>
> LEFT—Standard line spacing; six line per inch

RIGHT—Punching positions; locates 552 interpreter stations and 557 between-the-line-printing

BOTTOM—Accurate measurement of actual card columns and mark-sense positions

NOTES: 1. Notches at top and bottom edges are for positioning actual cards. The template is card size; in width, from top to bottom; in length, left edge to notch.

2. Shadowed portion is silhouette of the housing over the punching station of the 24-26 card punches. When the dark-shadowed area is placed on any given column, the light-shadowed area represents that portion of the card that *cannot* be seen.

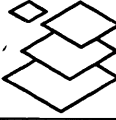BACK

> TOP—402-403 typebar spacing
>
> LEFT—Card volume scale
>
> RIGHT—Optional line spacing; 8 lines per inch
>
> BOTTOM—Accurate measurement of interpreter printing positions
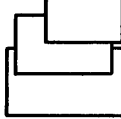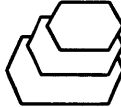
SUGGESTED USE OF SYMBOLS

AND DESCRIPTION OF FEATURES OF IBM DIAGRAMMING TEMPLATE (FORM 20-5884-4)

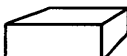| Symbol	700 Series	650 Systems	305 Ramac ⊛	Punched Card
(large circle)	CONTROL INSTRUCTIONS	CONTROL TABLE LOOKUP		SORT, COLLATE
(small circle)	CONNECTOR, or STEP IDENTIFICATION			
(diamonds)	DECISIONS, SWITCHES, BRANCHES		PROGRAM EXIT	AUXILIARY MACHINES
(arrows)	DIRECTION OF DATA FLOW, NEXT STEP IN PROCEDURE			
(rectangles)	OPERATIONS or STORED PROGRAM STEP — Depth may be decreased to conserve space:			SOURCE INFORMATION or ORIGINAL DOCUMENT General Utility Blocks
(hexagons)	MODIFICATIONS		CONTROL-PANEL FUNCTION	
(rounded shapes)	INPUT/OUTPUT READ/WRITE	May be used for DRUM STORAGE	May be used for DISK FILE	KEY-DRIVEN OPERATIONS: Punch Verify Cardatype Facsimile-Post etc.
(card symbol)	IBM CARD; Any Card-Coded Data			
(oval)	EXCEPTIONS; ERROR HALT; END OF JOB			CLERICAL or Manual Operations
(tape symbol)	MAGNETIC TAPE			PUNCHED or MAGNETIC TAPE
(square)	CONSOLE			ACCOUNTING MACHINE
(document)	DOCUMENT PRINTED BY THE MACHINE			
(narrow tape)	TRANSMITTAL TAPE (Adding Machine)			
(file cabinet)	FILE CABINET (Drawn by combining two patterns)			

Accurate measurement of actual card columns and mark-sense positions.
Other side: Accurate measurement of interpreter printing positions.

Accurate positioning of all punching positions   Locates 552 interpreter stations and 557 between-the-line printing.
Other side: Card-volume scale.

Accurate scale of tenths-of-inches   407 Printing positions.
Other side: Scale of 402-403-404-405-416 Printing positions.

Standard line spacing: 6 lines per inch
Other side: Optional line spacing: 8 lines per inch

Notches for positioning actual cards   The template is exactly card size; in width, edge-to-edge; in length, left-edge-to-notch

Shadowed portion is silhouette of the housing over the punching station of the 24-26 card punches. When the dark-shadowed area is placed on any given column, the light shadowed area represents that portion of the card that can NOT be seen.

FIGURE 7

14

IBM
®

The Design of
IBM Cards

IBM
data processing
MANAGEMENT

THE DESIGN OF IBM CARDS

THE APPLICATION of IBM Accounting, and especially the design of the IBM cards around which the principle has been developed, afford a wide range for the use of ingenuity. The various accounting and statistical records which are compiled by means of the IBM Accounting principle reach into practically every phase of modern business and governmental activity. The cards themselves reflect this wide variety of business applications, and rarely are two identical card forms used by different companies, regardless of the similarity of their jobs.

In order to be able to design the most effective card for a particular procedure, it is essential:

> To have a complete knowledge and understanding of the accounting and managerial reports to be made from the card and the use that is to be made of each.
>
> To understand that the card is a tool in the hands of operators and clerks who will produce the desired reports.
>
> To have a thorough knowledge of the procedure and machines through which the card is to be processed.
>
> To know the rules and principles of good card design.

Although there are many basic principles governing the designing of card forms, it must always be remembered that common sense and practical experience will contribute much to the selection of the one best way to do the work.

DETERMINATION OF CARD DATA

THE FIRST step in card design is to determine the data which will be needed from the card in order to meet the requirements of the contemplated procedure. In order to accomplish this, all of the following factors must be considered, in the order presented.

Report Requirements

Of all the factors affecting card design the most important are the requirements of the finished reports that are to be prepared. These reports should be kept in mind constantly so that all necessary information may be included in the card and arranged to facilitate their final preparation. The factors so determined may be considered as the desired or ideal card requirements. Certain modifications may then be required to conform with any of the limiting conditions discussed later.

Availability of Data

The factors next in importance are determined by the sources of the original information. These must be studied to see whether all the desired data are available on the original documents to be used in punching. If not, or if too much labor is required to get them on these documents, it will be necessary to revise the list of card data, or substitute other data which will accomplish a similar purpose. A study of the source cards will also determine whether a dual card can be used advantageously to replace these records. It will further show whether certain available data can be conveniently included in the card and a new use devised which was not originally planned, or which may be needed in the future. At this point, also, a study of reference punching should be made so that the card may be identified with the original record from which it is punched, if this is necessary. Dual cards will frequently need no reference punching because they are also the original records.

Summarizing Card Data

After the above studies have been completed, the final results should be prepared in list form. This list will serve in assigning the proper number of columns to each field.

CARD DESIGN AID

TYPE OF CARD: CARD NAME: SOURCE DOCUMENT:

Information Available and Required for Reports	Columns in other Cards	Sequence on Source Documents	Method of Punching	R-Reference C-Classification Q-Quantitative	Card Field Size		Final Design		Interpretation		
					Trial	Final	Field	Sequence	Field	Size	Sequence
			TOTALS →								

FIGURE 1. A WORKSHEET FOR CARD DESIGN

PRELIMINARY WORK FOR CARD DESIGN

A WORK sheet similiar to the Card Design Aid illustrated in Figure 1 should be used to list the information which must be placed on the card and to record the results or decisions made in the preliminary work of designing cards.

Information Available and Required for Reports

This list of information is made by studying the reports and documents. Information which is to appear on the reports (except calculated, emitted, and summarized data) must be punched in the card. The sequence of this listing is of minor importance at this point.

Columns in Other Cards

One of the most important factors to be decided in assigning card fields to the information is the alignment principle. A given item of information in the new card should be placed in the same columns previously assigned to it in other cards.

An IBM card designed to be used in various IBM accounting machine operations with other types of cards (such as a customer name card used with accounts receivable cards to list a Statement of Account, a daily time ticket used with labor distribution cards to obtain zero balance, or a labor distribution card with material distribution cards for cost analysis) must be aligned with these cards in the common control fields, and any other common types of information in the several cards should be placed in corresponding columns. This assures that fields for sorting and controlling will be placed in the same columns on all cards to be used together. Control panel wiring is facilitated when quantative fields are placed in the same columns on all cards used together.

Figure 2 is a convenient layout form for planning several cards so that the alignment principle can be followed. After the major outlines of the card design have been planned, a separate form should be used for designing each card form in detail.

MULTIPLE LAYOUT FORM

FOR ELECTRIC ACCOUNTING MACHINE CARDS

INTERPRETER SPACING

FORM 12-4823-3 500 PADS 2-47-END.

BRANCH OFFICE NO._____

DATE_____

1. ELECTRO NUMBER

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

2. ELECTRO NUMBER

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

3 ELECTRO NUMBER

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

4. ELECTRO NUMBER

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

5. ELECTRO NUMBER

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

6. ELECTRO NUMBER

9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

CUSTOMER'S NAME & NO._____

ADDRESS_____

FIGURE 2. MULTIPLE CARD LAYOUT FORM

Sequence on Source Documents

The fields of the card to be manually written or key punched should be arranged so that information can be read from left to right or from top to bottom on the original document. The key punch operator's task is greatly speeded if the information to be punched into the card is in the same order in which it appears on the source document.

Method of Punching

Assign to each field the method by which it will be punched, i.e., key punched, duplicated, summary punched, gang punched, or calculated. All like punching operations should be grouped together to simplify wiring, and to eliminate interspersed skipping on the key punch.

Types of Information

All information will be one of these three types:

Reference—to identify the original source (date, invoice number, batch number).

Classification—to cross index and classify the transaction to produce the desired summaries (state, department, part number).

Quantitative—To be added, subtracted, multiplied or divided (quantity on hand, unit price, sales amount).

After each item of information is so classified, consideration may be given to the following arrangement: reference information should be placed to the left of the card; classification information should be placed in the center of the card; quantitative information should be placed to the right of the card.

These four important considerations have been discussed in the order of their importance in determining the position of information on cards. It is evident that frequently there will be conflicts among these requirements, and when such conflicts arise, it is necessary to use good judgment in resolving them on a priority basis. To summarize, the usual priority is as follows:

1. Columns in other cards
2. Sequence on source documents
3. Method of punching
4. Type of information

Size of Fields

The number of columns required to record each type of information should be added to the memorandum list previously mentioned. For reference and controlling fields, this is determined by the largest single number to be recorded, as indicated by the codes which have been devised for the machine application. Thus, two columns might be left for month (twelve being the largest number), two for day, four for invoice number if the number series is repeated after 9,999 is reached, and two for branch if there are 99 branches or less.

With the quantitative fields, the problem becomes more difficult. In the first place, the space needed to record the largest amount may not be known, and in the second place, this amount may be very unusual. It is a good plan to provide columns enough to take care of all except the unusual cases, and to handle these by punching extra cards or by using the class selection device. For example, the amount $67,265.80 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 totaling $67,265.80).

Attention should be given at this time to the possibility of consolidating certain fields on the card. The original list may include several types of information which can be carried in a single field if they do not occur simultaneously. Successive cards may be used where a spread of the data fields is not desired. This applies more particularly to quantity and amount fields.

The total of the columns assigned to all fields will indicate whether the data are within the capacity of the card, or exceed it. When the columns total less than about 100 columns, the decision must be made whether to use two cards or to reduce the number of columns to 80. If the total num-

ber of columns reaches 100 or more, it is evident that more than one card is needed. This requires separating or classifying the desired information to determine what information is to be placed in which cards. Such a division may be based upon any one of several schemes:

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

2. Use different cards for different source documents, or make one of the new cards a dual card to be used as a source document.

3. Use different cards for different degrees of detail, or as "double entry" cards each of which affects two different accounts. Examples are accounts payable and payables distribution cards, accounts receivable and sales cards, payroll and labor distribution cards.

4. Use separate cards to produce the desired form of report. A billing job may contain heading cards, miscellaneous data card, and detail commodity cards, for the reason that such arrangement gives the simplest procedure and the best form of invoice.

In those cases where the preliminary draft of column requirements shows a need for a few columns more than the capacity of a card, some of the following expedients may be used to bring the requirements within the range of the card capacity without dropping any fields.

1. Reducing the size of reference or controlling fields by having these fields serve as subclassifications of other fields. Thus, invoice numbers may start with "1" each month instead of being numbered separately; or a separate series of salesmen's numbers may be used for each branch, instead of one series for all branches.

2. Reducing the size of reference or controlling fields by recoding to eliminate one or more digits.

3. Reducing the size of reference or controlling 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.

4. Reducing the size of quantitative fields where amounts seldom exceed the capacity of the reduced field.

5. Recording in the 11th and 12th positions information which is never used for printing. This can best be used where the information to be punched is the same for large groups of cards.

6. Using multiple-punching in certain columns to reduce the number of columns required. This practice should be avoided where fields are to be listed or added, but may be very desirable in fields which are to be sorted only.

7. Using the class selector to distribute a carry-over amount which has been punched as a second card. Thus, a card punched 7,265.80 and one punched 000006 can be selected to produce 67,265.80 as the desired result, saving one column in the amount field.

8. The group sorting device may be used to eliminate common information from detail cards.

Interpretation

Determine the fields to be interpreted. Arrange them according to the method of filing the cards, with the most important information in a prominent location for easy reference.

If the total of the fields to be interpreted exceeds 60 characters, eliminate unnecessary fields to be interpreted; or, interpret the remainder on the second line.

MACHINE CONSIDERATIONS IN CARD DESIGN

A FEW basic restrictions must be observed in designing cards if all the advantages of IBM ac-

counting are to be obtained. Actually, the rules are not limitations of the accounting routine, but they are standards that have been generally accepted so that uniform machines could be designed to perform the task of accounting more automatically.

Card design rules which are based upon machine specifications are grouped under the names of the machines to which they apply.

Key Punches

1. When less than the full number of columns of a card are to be punched on machines in which cards are manually fed, the punched fields should be placed at the right-hand end of the card.

2. Card visibility is also an important factor to consider. The degree of visibility in Card Punches, Types 24-26, is illustrated in Figures 3 and 4.

3. Fields to be duplicated should be grouped together and placed at the left end of the card.

4. Manually punched fields should not be interspersed among duplicated, gang punched, reproduced, or summary punched fields.

5. Fields that are always skipped, or X-skipped, should be as uniformly placed on various card forms as conditions will allow.

6. As a general rule the left side of a tumble card should be inverted when using manually fed punches; the right side should be inverted when using automatically fed punches.

7. On printing punches, the printing appears at the top of each column and requires $\frac{3}{16}''$ from the top edge of the card.

8. On alphabetic punches, locate numerical fields together so that operator need not change from one keyboard to another more than once during the punching of the card.

The key punching operation is the only step in the IBM machine method of accounting which is not fully automatic. It is, therefore, the only

phase in which the rate of production is subject to variation. Anything which can be done to simplify the work of the operator will tend to increase the rate of punching and consequently reduce the time required for the preparation of management reports.

The value of early reports makes it necessary to take every precaution in the design of cards to avoid any factors which will retard punching speed. Careful consideration should be given to these factors:

Provide for the use of the duplicating punch and master code cards, or other automatic punches, whenever possible.

The sequence of punched fields should be the same as that of the data to be punched from the original document.

Eliminate the punching of unnecessary zeros by keeping the size of fields down to the number of columns that are absolutely essential for efficient handling of the majority of transactions.

Do not have fewer columns in the field than are required to handle most of the transactions.

Proper use of indicating cards and group-sorting cards will frequently eliminate the necessity for providing for some of the punched fields on detail cards.

Provide for most legible records, especially in the design of dual cards.

Give consideration to the use of prepunched cards.

Sorters

1. Whenever a card is to be used for statistical analysis, it is advisable to combine several classes of statistical data in a single column. This is especially true of alternative responses on questionnaires.
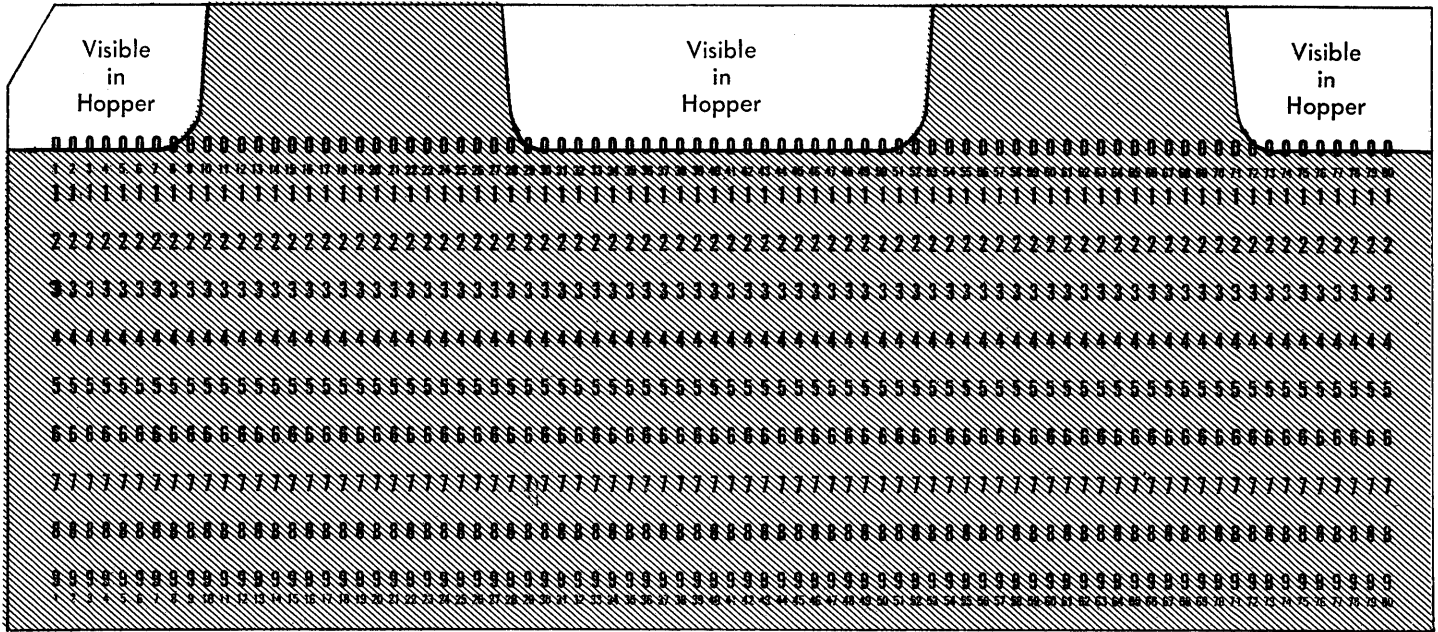
FIGURE 3. CARD VISIBILITY IN THE HOPPER, CARD PUNCHES, TYPE 24-26
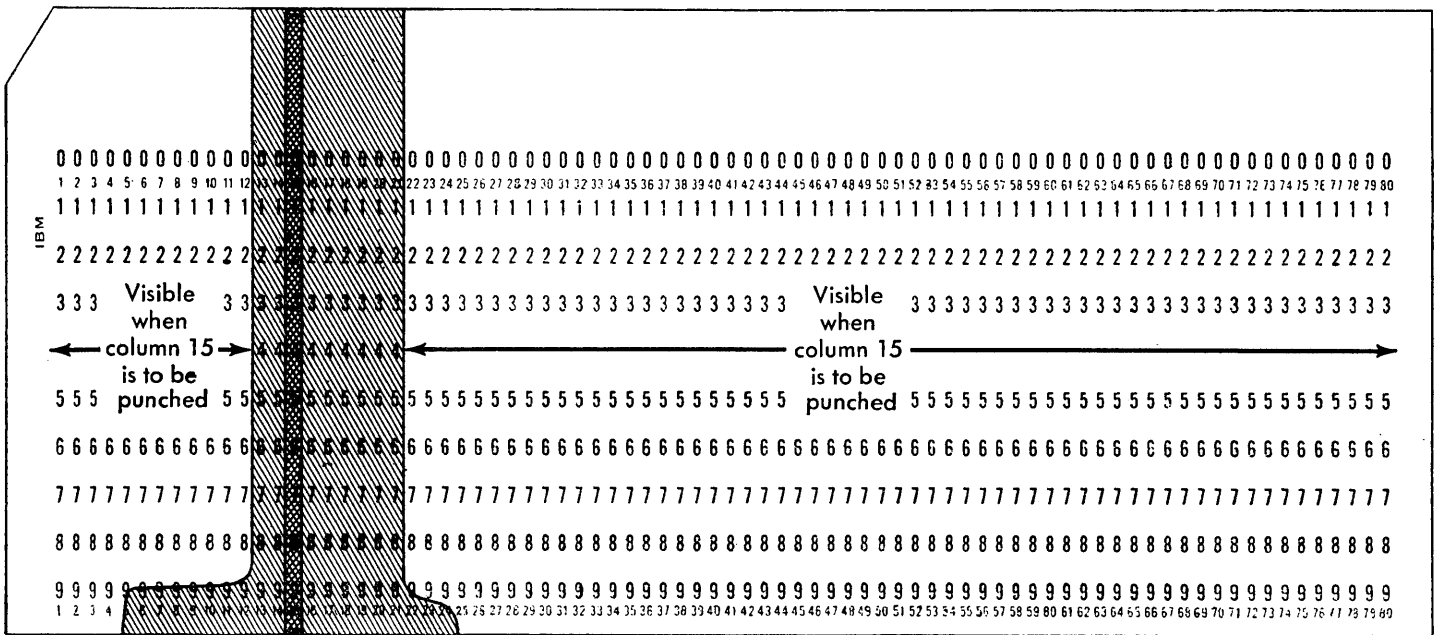

FIGURE 4. CARD VISIBILITY AT THE PUNCHING STATION, CARD PUNCHES, TYPE 24-26

The whole card is visible before it is registered, and at least 71 columns are visible after punching has started

2. The eleventh and twelfth punching positions can be utilized for recording reference data to be sorted but never printed.

3. If the multiple column selection device is to be used to select simultaneously a group of cards from two or more small fields, they should be adjacent in order that they will appear under the ten adjacent brushes.

Accounting Machines

1. Control fields must not be skipped. Zeros must be punched in columns if other digits do not appear.

2. The eleventh position (X) punching which governs class selection or subtraction should never be placed over fields used for automatic control or alphabetic printing.

Auxiliary Machines — Interpreter

If there are several changes of machine setups in the interpretation of 80-column cards, the changes in setups will be simplified by indicating the type bar numbers in the printing spaces.

Calculating Punch

1. Fields for the products of multiplications or results of other calculating operations should be placed as near to the right-hand end of the card as possible.

2. Constant factors may be eliminated entirely from detail cards and read either from master cards or emitted from the machine.

3. The factors to be calculated may appear in any columns of the card.

Summary Punch

1. Fields to be duplicated, pre-indicated, or manually punched in cards that are being summary punched should appear to the left of the columns reserved for counter totals.

2. Fields to be punched from counter totals should be as near the right-hand end of the card as possible.

BASIC TYPES OF CARDS

THE CHOICE of the type of card to be designed frequently can be made only after making the preliminary study of reports, procedures, and machine operations discussed in the previous sections. IBM cards are generally of four basic types:

> *Transcript Cards* are punched from information previously recorded on another document.
>
> *Dual Cards* are punched from information recorded on the card itself, that is the card serves a dual purpose as source document and card.
>
> *Mark Sensed Cards* are automatically punched from pencil marks recorded in significant positions on the face of the card.
>
> *Summary Cards* are automatically punched with totals resulting from accumulated results in the Accounting Machine or Calculating Punch.

Transcript Cards

The following pointers apply specially to the design of transcript cards:

1. Perhaps the most important rule of transcript card design is the one governing the sequence of punched fields. It is absolutely essential to place punched fields in the same sequence as the data being transcribed from the original document. This facilitates key punching and, consequently, speeds up the entire procedure.

2. All single column fields should have decoding abbreviations placed above each corresponding punching position.

3. Wherever letter type codes are used, the corresponding numerical symbols on the card should be replaced by the alphabetic characters. These should be placed slightly above the punching positions so that they will not be obliterated.

4. Whenever complement fields are used, the digits 1 to 8 should be omitted in the first column at the left of that field.

5. Whenever fraction wheels are placed on the Accounting Machine, the card columns reserved for use in recording fractions should contain only the digits corresponding to the denominator of the fraction less one. For example, if a fourths wheel is used, the column would contain only the numbers 1, 2, 3; if an eighths wheel is used, the column would contain the numbers 1, 2, 3, 4, 5, 6, 7.

6. Field headings should usually be placed along the top of the card, between the zeros and the edge, unless interpretation is provided for.

7. Field headings should be as explicit as possible. Avoid the use of obscure abbreviations.

8. Every transcript card should carry a field for reference punching which will positively identify the punched card with the original document from which it was prepared. A sales card, for example, will usually have the invoice number punched on it, or invoice date and customer may sometimes be used when card capacity is limited; in other cases the date and the last two digits of invoice number may be sufficient.

9. Avoid unnecessary duplication of reference data, such as the use of both order number and invoice number when one would provide adequate reference.

10. Whenever alternative information is to be recorded, one field should be used instead of two. For example, sales reference punching would serve to identify either an invoice or a credit memorandum; therefore a single field heading "Invoice or Cr. Memo. No." would suffice. The use of two fields — one headed "Invoice No." and the other "Cr. Memo. No." would be a waste of valuable card capacity since only one reference number would ever be punched on any one card.

11. Since no written information appears on the card, any color or striping of cards may be used.

12. Purely reference information which is never to be printed by the machine may be placed in the 11 and 12 positions of a column, or in columns set aside for multiple-punching.

13. Vertical lines used to separate fields should be drawn midway between the columns of numbers and should not reach beyond the line of column numbers at the bottom on the card.

14. Whenever five or more columns appear in a single field, dotted lines should be drawn to mark off the position of the decimal point, where it is involved, and other periods of numbers in groups of three columns.

15. It is absolutely essential that punched classifying information which is to be used for purposes of automatic control on the accounting machines be placed in the same columns on all cards that are to be jointly processed.

16. Alignment of fields which contain data to be accumulated simplifies machine wiring for joint runs.

17. Fields for results of calculations and summary punched totals should be placed at the right-hand end of the card for maximum machine efficiency.

18. Whenever several different card forms are to be processed together, the card form with the greatest volume should be designed for maximum efficiency. The other cards may then be made to conform with the limitations of the card with the greatest volume.

19. Twenty columns for the alphabetic punching of names is sufficient for most work. This should be carefully checked, however, on each individual job. A recent study of the columns required for recording names and addresses re-

FIGURE 5. TRANSCRIPT CARD LAYOUT FORM

veals 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 (abbreviations) require 20 columns or less.

20. Be sure that the column capacity of each field is sufficient to take care of all recording except the very unusual items.

21. When designing tumble or sectional cards, be sure that the two types of work have approximately the same card volume. For instance, it would be impractical to combine sales analysis and voucher distribution on a tumble card if there were 200,000 sales items and 30,000 voucher items each month. Under such conditions 170,000 cards a month would be unused on the tumble section.

22. The nature of tumble and sectional cards ordinarily does not permit their use as dual or permanent record cards.

23. Every card form should carry the IBM industry classification code of the user. The code number is printed on the bottom center or along the end, depending upon the method of card printing.

Figure 5 is a convenient form for the layout work of designing transcript cards.

Dual Cards

Dual cards incorporate all of the principles involved in the design of transcript punched cards, as well as some additional distinctive features to facilitate their use. The design of dual cards is especially important because of their use in departments other than that in which the accounting machines are actually used. They may be found as requisitions, payroll tickets, and miscellaneous shop records throughout the plant, and therefore simplicity of design becomes one of the most important factors.

Dual cards have attained a rather wide use not only because of the part they play in the actuation of the accounting machines to prepare final reports automatically, but also because of the fact that original records may be automatically sorted in any desired sequence. In this manner the actual original document can be analyzed for any specific detail without the necessity of preparing a complete report. The dual IBM card presents the only automatic means of sorting original documents.

A dual card, as an original record, must satisfy accounting requirements. To do this it must contain all the data relative to a given transaction so that pertinent facts may be reconstructed without the aid of memory. Because of the limitations of the size of the card, care must be exercised to provide ample room to meet this requirement and still not permit the possible obliteration of the data in subsequent punching operations.

One of the factors most frequently overlooked in the designing of dual cards is the incorporation of radical changes in what is to be the new original document. If the maximum efficiency of all clerical departments using the record is to be attained, the form of the IBM cards should resemble as closely as possible the original form which it is about to displace. Only in those instances where definite operating advantages are going to be obtained should the design be varied from the accustomed form.

The following pointers apply to the design of dual cards:

1. Generally the written information should be placed on the left end of the card to obtain visibility of recorded data while punching. This degree of visibility is discussed and illustrated under *Key Punches*, pages 8 and 9.

2. Punched fields should be placed at least 14 columns on an 80 column card to the right of the written data to be punched. This is also modified by the visibility factor mentioned above.

3. Dual cards, generally, should not be designed as multiple-use cards.

4. Written descriptive information should be placed in the portion of the card reserved for punched fields. This information may be readily reconstructed even though part of it may be obliterated by punching.

5. Horizontal lines should be drawn through the mid-points of the regularly printed digits. This will cause the writing to be located in such a position that it will not be obliterated by punching.

6. The card may serve multiple uses. One form may serve for several related records.

7. Retain as many as possible of the column digits which show the positions of punching. This facilitates the reading of the punched holes whereever it may be necessary.

8. Filing information should be placed across the top or end of the card, depending upon the method of filing to be used.

9. Field headings for dual cards may be placed at either top or bottom of card.

10. Follow as closely as possible the appearance and arrangement of previously used forms to reduce to a minimum confusion in record-keeping due to changes.

11. The design of the section of the card reserved for punching should follow the rules for transcript cards.

12. Printed headings of spaces for written information should be placed so that the writing will be forced into the desired location.

13. Information to be checked visually should be placed at the left end for convenience in fanning.

14. Related information should be grouped for efficiency in recording, and ease in performing any manual calculations.

15. Adequate space should be allowed for writing. Leave ample space for remarks and descrip-

tions. Horizontal lines for descriptive writing may be drawn in the section of the card later keypunched. Provide space for authorizations or auditing information.

16. Provide for automatic printing when possible by means of addressing plates or time stamps. Measure the spacing accurately.

Figure 6 illustrates the layout form that facilitates the design of dual cards. IBM checks, which are a special kind of dual card, have special requirements for effective design. These requirements are explained in a special aid, the IBM Check Layout Form, Form Number 12-3867-2, available at all IBM branch offices.

Mark Sensed Cards

The increasing use of cards as source documents has caused mark sensing to be used to an increasing extent. Whenever clerks or other employees can be trained to mark cards properly, key punching can be reduced or eliminated. It is well to bear the following pointers in mind in designing mark sensed cards:

1. Place marking fields on the right side of the card. This allows the operator to hold the card conveniently while marking it.

2. A marking position is three-columns wide, starting with columns 1-3, 4-6, 7-9 for 27 three-column fields ending with 79-81. The marking fields must be designed over the correct card columns; the right-hand column of any mark sensing field will always be divisible by three. Each marking position is located immediately above the punching positions so that punched holes will not obliterate the marks.

3. Arrange marking fields in sequence for easy marking.

4. The marking field may be designed over punched fields.

5. The marked information may be punched in any columns on the card.

FIGURE 6. DUAL CARD LAYOUT FORM

LAYOUT FORM - IBM CARD (MARK SENSE)

FORM 12-4815-6
PRINTED IN U.S.A.

INTERPRETER SPACING

END PRINTING SPACING

INTERPRETER SPACING

END PRINTING SPACING

SHORT CARD LAYOUT INSTRUCTIONS

1) DETERMINE SHORT CARD COLUMN NUMBERS BY REFERRING TO GUIDE AND COLUMNS PRINTED BELOW USABLE COLUMN RANGE IS ESTABLISHED BY THE CAPACITY LOCATION ON EACH SIDE OF GUIDE EXAMPLE: ON A 30-COLUMN CARD USABLE COLUMNS ARE 26-55

2) CUT OUT THE STRIP OF COLUMN NUMBERS
3) PASTE THE STRIP ON THE LAYOUT FORM IN DESIRED LOCATION FOR THE SHORT CARD
4) RULE ENDS OF SHORT CARD 2 1/2 COLUMNS BEYOND THE STRIP OF COLUMN NUMBERS

5) DETERMINE MARK SENSE POSITIONS, IF ANY, BY ASSOCIATING STRIP NUMBERS WITH CARD LAYOUT POSITIONS EXAMPLE ON 30 - COLUMN CARD M S POSITIONS 9-18 ARE USABLE

IMPORTANT — CHECK THE FOLLOWING:

Is this a revision of form in use? YES☐ NO☐	
What is present form number?	
May we scrap old electro? YES☐ NO☐	
Indicate corners LEFT RIGHT UPPER☐ ☐	
to be cut. LOWER☐ ☐	

REQUIREMENTS

Stub
Consecutive prepunching
Repetitive prepunching
Prenumbering
Padding
Proofs required
If card is to be printed on both sides, check style. BOOK☐ TUMBLE☐

INTERPRETATION

45- Numerical
60- Alphabetical
80- Printing punch
Bill Feed five lines per inch ☐ six lines per inch ☐
End Printing LEFT ☐ RIGHT ☐
Typewriter spacing

519 END- PRINTING
1st POSITION / 2nd POSITION

519 END- PRINTING
2nd POSITION / 1st POSITION

IF CARD IS TO HAVE MARK SENSING, CHECK STYLE.

SCALE APPROXIMATELY DOUBLE SIZE; ACTUAL CARD SIZE 3-¼" X 7-¾"

BRANCH OFFICE NAME
DATE
BR OFF NO.
CUSTOMER NAME
CUST PUR ORDER NO
MAIL PROOFS TO

SHORT CARD COLUMN GUIDE
CARD CAPACITY (COLUMNS)

CUT-OUTS FOR PASTING

IBM

FIGURE 7.   MARK SENSED CARD FORM LAYOUT

6. Include headings for all marked fields.

7. Indicate cents, decimals and commas by broken or hair lines.

8. Signatures and other writing should be placed as far from the marking fields as possible.

Figure 7 illustrates a convenient layout form for designing the mark sensed portion of a card. Sections of this layout are usually cut out and pasted on a layout form for dual cards or transcript cards.

Summary Cards

It is frequently necessary to design separate summary cards to allow for the larger quantitative figures which will appear as summary totals. It is often necessary to add other information such as year-to-date figures, balance-forward, and certain indicative information. The quantitative fields should align as nearly as possible with similar fields in the detail cards so as to simplify procedures and machine operations.

DRAWING THE DESIGN

IN PROCESSING newly designed cards, a great many delays and misunderstandings may be avoided if the card drafting on the layout form is done in a clear and concise manner.

A primary principle to remember as a guide in designing the card is to keep in mind who will read the printed information on the card. Machines cannot read the printing on cards. Such printing is provided as a convenience to the machine operators and clerks who will be handling the cards.

General Pointers

The following general pointers will be helpful to the designer of IBM cards, in drafting the final layout form.

1. The name of the company should appear on all of its record forms, and its trademark should be printed on all documents which reach outside organizations or individuals.

2. All essential reference information should be placed at or near the top of unbound forms to facilitate the filing and locating of permanent records.

3. Headings or titles of spaces for written information should be placed so that the actual writing will be forced into the desired position.

In Figure 8 one of the cards shows how a violation of this rule results in inconvenience. The other, a more desirable arrangement, forces the writing closer to the top. When block headings are printed at the top of a space, reference information is forced down below the point of ready visibility.

4. Information to be checked visually should be placed near the right or left margin of the card for convenience in fanning.

5. All related information should be grouped and placed in the position which will promote efficiency in recording. For example, on a job time record, hours should be in position for convenient notation after subtraction of start and stop time. All data recorded by shop clerks or workers should be placed together for convenience. Time registration at margin should be in sequence to facilitate visual subtraction. Rate should be located between hours and pieces to facilitate either calculation.

6. Adequate space should be provided for large writing where records are to be made by workers and not by regular shop clerks. The average machine worker is not a skilled penman and may frequently use a thick lead pencil which will necessitate provision for two or three times the minimum amount of space required by a regular clerk.

7. Ample space should be furnished for recording additional miscellaneous remarks and descrip-

FIGURE 8. DESIGN OF BLOCK HEADINGS

tions. Several lines may frequently be required, and therefore a large portion of the unused space may be devoted to this purpose.

8. Essential written information should be reduced to a minimum of manual recording by providing for automatic printing (such as time stamps, addressing plates, etc.) and by marking preprinted descriptions whenever practical.

9. Company slogans should appear on record forms which have wide circulation in several departments. Safety warnings to factory workers are most common.

10. Titles or descriptive headings should always be the same for like items whether they appear on various documents or at different places on the same document.

11. All duplication of items which must be recorded manually or semi-automatically should be eliminated.

12. The limitations of mechanical recording equipment such as typewriter spacing, clock registration, serial numbering machines, addressing machines, stamps, etc., should be checked carefully, in order to provide the proper position and ample room for printing.

13. When large numbers are to be written, make provision for guide lines or dots to designate the position of digits or periods of numbers. This corresponds in principle to the pen-ruling of amount fields on journal and ledger sheets.

14. The color for paper stock upon which the

form is to be printed should be one that will not interfere with the utility of the record. Plain white or yellow is satisfactory and economical, but if colored paper is used to facilitate the segregation of various kinds of documents, the light colors should be used to increase the legibility of written information.

15. Care should be taken to place essential permanent information in such a position that it will not be obliterated or destroyed by stamps or punches, or torn off with detachable stubs.

16. The possibility of multiple uses should be considered. Make one document serve as a standard form for as many related records as possible. For example, a material requisition can usually be designed to provide for recording returns to stock.

17. New documents which are to replace others should be as similar to the old document as possible in order to reduce clerical confusion.

18. In procedures where cards are handled by clerks and operators performing clerical functions, it is advisable to provide distinguishing features on each type of card. For instance, it is common practice to distinguish heading cards from body cards by opposite corner cuts. Colored stripes on cards are particularly useful in distinguishing between similar cards of different use or routing.

19. When the document is completely drawn up it should have a good symmetrical appearance.

20. A color stripe can be used to emphasize special instructions printed in that space.

Drawing the Design

Drawing the design of a given card may require the use of several layout forms: A basic transcript card form, with a section of the dual card form pasted on, and also a section of the mark sensed layout form. Using the necessary layout forms, draw the lines and write in the headings in accordance with the preliminary work sheet or card design aid. In drawing the design, the following details should be kept in mind.

1. Indicate accurate start and stop points for each line by lines (horizontal as well as vertical) that terminate at an even distance from the edge of the card. Neatness is obtained by eliminating unnecessary lines around the edges of cards.

2. Indicate heavy or light lines as desired.

3. Indicate dotted or broken lines as desired. Amount fields should indicate the decimal point between dollars and cents by means of a dotted line or a very thin line drawn vertically between columns. Large fields should indicate the comma positions between hundreds and thousands.

4. In printing the desired headings, use correct spelling and abbreviations. Avoid obscure abbreviations. Headings should be similar to like items as they appear on other documents.

5. Indicate the correct position of printed words, printing horizontally when space permits. Avoid hyphens if possible. Avoid vertical printing, one letter underneath the other.

6. Indicate relative size of printed headings.

7. Indicate punctuation if needed.

8. Include decoding information for one-column code fields if possible. Letters or abbreviations may be printed directly above the punching positions and the number may be omitted.

9. Use headings across the body of the card to specify the type of punching required: duplicating, gang punching, key punching, etc.

10. Consider placing many headings on the same card for multiple use of a single card form. Be sure the heading to be used for a given purpose is clearly identified, preferably by a digit punch opposite the desired headings.

11. Print the name of the card and the name of the company across the end of the card. Trademarks or slogans may be included.

12. Give the design a symmetrical appearance.

13. For a card used with the printing punch, continue the vertical lines that divide punching fields to the top edge of the card in order to facilitate reading of interpretation.

14. In interpretation blocks, print decimal points in "amount" fields and commas where large numbers are to be read.

15. Design the card for the interpretation of only the essential fields.

16. Place the most important reference number at the upper left corner of the card for ease in filing and locating the card.

17. Place interpreting field headings across the top of the card just beneath the printed interpretations and the punched field headings across the bottom of the card.

18. Print interpreter type-bar numbers beneath interpreting field to indicate first and last type-bar for each field.

Upon completion of the new design, answer all questions at the bottom of the layout form.

TYPICAL DESIGN OF A CARD

IT HAS BEEN determined that the information necessary for labor distribution reports, which can be obtained from the daily time ticket (Figure 9) is as follows:

Order Number
Employee Number (Department and Clock No.)
Regular Rate
Overtime Rate
Part or Account Number
Pieces
Operation Number
Machine Group
Department Charged
Kind of Labor
Amount
Hours
Date (Month and Day)

FIGURE 9. DAILY TIME TICKET

This information is listed in the left column of the Card Design Aid (Figure 10).

From the daily time ticket, it is found that certain items in this list of information are punched in the time ticket card. These columns are recorded in the next column headed "Columns in Other Cards."

The information to be key punched in the distribution card is as follows:

> Order Number
> Employee Number
> Part or Account Number
> Pieces
> Operation Number
> Machine Group
> Department Charged
> Hours

The sequence in which this information appears on the time ticket in printed or written form is indicated in the next column headed "Sequence on Source Documents."

From the proposed procedure it has been determined that the following information can be gang punched:

> Date
> Kind of Labor
> Regular Rate
> Overtime Rate

"Amount" is to be punched on the Calculating Punch. The remaining information must be key punched. This information is recorded in the next column headed "Method of Punching."

To classify information, indication is made in the next column as to whether each item is reference, classification, or quantitative information.

A study of the coding system used for classification information and experience with the number of digits needed to record quantitative information determines the card field size. This totals 47 columns, which is well within the capacity of one card, and no consideration need be given to the use of a second card. The same numbers are therefore repeated in the "final" column.

The *final design* columns indicating the correct number of columns in each field and the correct sequence of these fields can now be completed.

From past experience and from the proposed procedure, it is believed that visual reference will possibly be made to the cards in connection with the following items of information:

> Order Number
> Part or Account Number
> Operation
> Machine Group

Department Charged
Pieces
Date
Hours
Amount
Kind of Labor
Employee Number

These items, therefore, are checked in the next column headed "Interpretation." The number of type bars needed is the same as the number of columns for punching, and is so indicated in the next column headed "Size." These 40 columns may be interpreted on one line.

The "Sequence of Interpretation" is next determined and recorded. Since the cards are to be filed by "Order Number" this is placed first in order so that it will be in the upper-left corner of the card. Because "Employee No." is also referred to frequently it is placed last so that it will appear in the upper right-hand corner.

With this preliminary study and work sheet, the card can now be designed using the field definition (card columns) and the field sequence shown in the final design columns. This final card design can be determined in the following manner:

Using the transcript card layout form (Figure 5) the fields are assigned. Since interpretation will be provided for, punched field headings will be near the lower edge of the card.

First the items which have "columns in other cards" are assigned (Figure 11).

In the assignment of the key punched fields according to the sequence on the source document,

CARD DESIGN AID

Form 22-6214-1
Printed in U.S.A.

TYPE OF CARD: CARD NAME: SOURCE DOCUMENT:

Information Available and Required for Reports	Columns in other Cards	Sequence on Source Documents	Method of Punching	R-Reference C-Classification Q-Quantitative	Card Field Size		Final Design		Interpretation		
					Trial	Final	Field	Sequence	Field	Size	Sequence
Order No.		6	KP	C	6	6	54-59	8	✓	6	1
Employee No.	64-68	1	KP	C	5	5	64-68	11	✓	5	11
Dept. No.	64-65		KP	C	(2)	(2)	64-65				
Clock No.	66-68		KP	C	(3)	(3)	66-68				
Regular Rate	35-37		GP	C	3	3	35-37	3			
Overtime Rate	38-41		GP	C	4	4	38-41	4			
Part or Account No.		4	KP	C	5	5	47-51	6	✓	5	2
Pieces		3	KP	Q	5	5	42-46	5	✓	5	6
Operation No.		5	KP	C	2	2	52-53	7	✓	2	3
Machine Group		7	KP	C	2	2	60-61	9	✓	2	4
Department Charged		8	KP	C	2	2	62-63	10	✓	2	5
Kind of Labor	33-34		GP	C	2	2	33-34	2	✓	2	10
Amount	72-75		Calc P	Q	4	4	72-75	13	✓	4	9
Hours	69-71	2	KP	Q	3	3	69-71	12	✓	3	8
Date	29-32		GP	R	4	4	29-32	1	✓	4	7
Month	29-30		GP	R	(2)	(2)	29-30				
Day	31-32		GP	R	(2)	(2)	31-32				
				TOTALS →	47	47				40	

FIGURE 10. USE OF CARD DESIGN AID

two items, Employee No. and Hours, have already been assigned for the sake of column alignment. At this point there are several choices:

1. Re-assign these fields according to sequence.

2. Re-design the daily time ticket card for alignment with the re-assigned sequence.

3. Compromise for the sake of alignment.

If the last one is chosen, the fields are assigned in sequence (with the exception of the two items) as shown in Figure 12.

Upon checking the method of punching it is found that the gang punched fields are located together, key punched fields are together, and the calculating punch field is at the right where it belongs. The method of punching should be so indicated on the card.

Referring to the interpretation data on the work sheet, interpretation headings and blocks are drawn in, using the scales and guides on the layout form to determine the location of the blocks. Dividing lines between blocks are drawn to split a type bar for more legible interpretation; periods and commas are inserted as desired; first and last type

bar numbers are shown; card columns from which the information is read are indicated if desired.

With the addition of card names and trademark symbols, the design of the card is completed (Figure 13). When the questions at the bottom of the layout form have been answered, the design is ready to submit for a proof to be made.

SHORT CARD FORM DESIGN

INSTRUCTIONS for designing short cards are contained in the lower section of IBM Card Layout Forms.

A short card is any card designed for 22 to 60 columns of punching. Cards of 51-column capacity may be processed through Types 77, 80, 82, 402, 403, 419, 514, 519, or 523, provided they are equipped with interchangeable feeds. All other short cards can be processed only through Types 514, and 519 equipped with interchangeable short-card read feed devices.

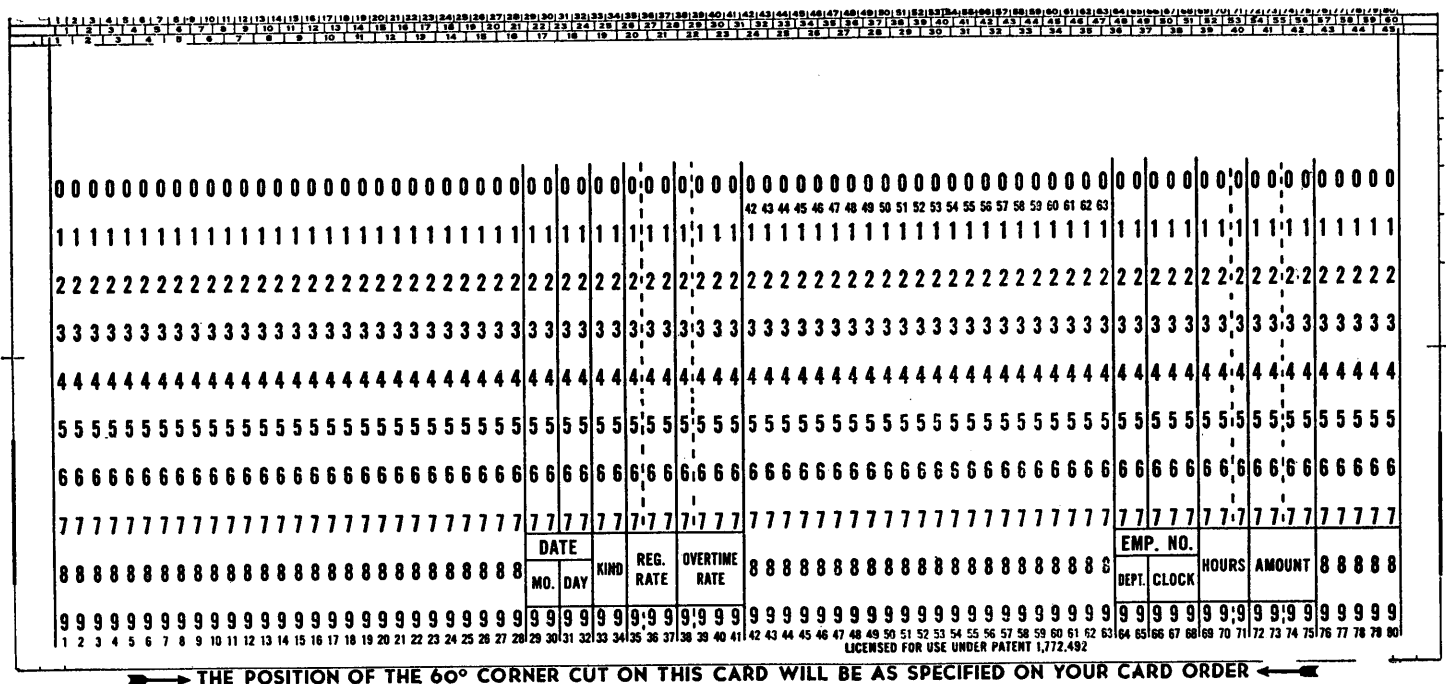Since the position of the cards in the hopper is predetermined, it is advisable in designing short

FIGURE 11. HEADINGS OF INFORMATION PUNCHED IN DAILY TIME TICKET

LICENSED FOR USE UNDER PATENT 1,772,492

►► THE POSITION OF THE 60° CORNER CUT ON THIS CARD WILL BE AS SPECIFIED ON YOUR CARD ORDER ◄◄

FIGURE 12. FIELDS OF ALL PUNCHED INFORMATION ASSIGNED

LICENSED FOR USE UNDER PATENT 1,772,492

►► THE POSITION OF THE 60° CORNER CUT ON THIS CARD WILL BE AS SPECIFIED ON YOUR CARD ORDER ◄◄

FIGURE 13. COMPLETED DESIGN FOR LABOR DISTRIBUTION CARD

cards that the column numbers on the card coincide with the brushes to be used to read the punched information. For example, the first column punched in a 22-column card will be read by brush 30, and the 22nd column will be read by brush 51. Cards designed for 51-column operation are read by brushes 15 through 65.

If the columns of short cards are numbered to agree with brush readings, sorting operations and control panel wiring will be greatly facilitated. If the whole card is to be processed through machines before the stubs are detached, it may also be desirable to show the standard 80-column numbers, as well as those determined by the short card layout.

Figure 14, page 25, shows a 28-column short card on the left, a 30-column short card on the right, and a stub in between. The first 28 columns are numbered 27 to 54; the last 30 columns are numbered 26 to 55. Thus, when wiring control panels for either short card, the column numbers preprinted on the bottom of the form correspond to the brushes that must be used.

The example shown is for demonstration purposes only and does not imply that both a 30-column and a 28-column short card can be handled by the same card read feed device.

Two short card sections in an 80-column card must be separated by a stub at least one-half inch wide.

When short cards are designed for mark sensing, it is important to remember that three card columns are required for each mark sensed position, and that the units card column for each mark sensed position is divisible by 3. For example, a mark sensed position that is to be read by mark sense brush 12 must cover card columns 34 to 36.

LAYOUT FORM — IBM CARD

FORM 12-4049-9
PRINTED IN U.S.A.

MFG. NO. | STYLE | DEPT | CLASS | FABRIC | COLOR | SEAS | W'HSE

MFG NO. | STYLE NO | DEPT NO

MFG. NO. | STYLE | DEPT | CLASS | FABRIC | COLOR | SEAS | W'HSE

SIZE | SEASON | CL | PRICE

Customer's Merchandise Identification Ticket

6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

SIZE · PRICE

SALES TICKET

Tear Off When Sale is Made

Style — Quality — Value

Styled By _____ Representative Store _____ City _____ State

SHIPPING TICKET

Tear Off Before Shipping

DEPT | STYLE | MFG NO. | SIZE | PRICE | CL | FAB | COL | SEAS
27 28 29 30 | 31 32 33 34 | 35 36 37 38 | 39 40 41 42 | 43 44 45 46 | 47 48 | 49 50 | 51 52 | 53 54

DEPT | STYLE | MFG NO | SIZE | PRICE | CL | FAB | COL. | SEAS | CODE
26 | 27 28 29 30 | 31 32 33 34 | 35 36 37 38 | 39 40 41 42 | 43 44 45 46 | 47 48 | 49 50 | 51 52 | 53 54 | 55

IMPORTANT — CHECK THE FOLLOWING:

1st POSITION | 2nd POSITION
519 END-PRINTING

DATE

BRANCH OFFICE NAME

BR OFF. NO

CUSTOMER NAME

CUST PUR ORDER NO.

Is this a revision of form in use? YES ☐ NO ☐
What is present form number? _____
May we scrap old electro? YES ☐ NO ☐
Indicate corners UPPER LEFT ☐ RIGHT ☐
to be cut. LOWER ☐ ☐

REQUIREMENTS
Stub ☐
Consecutive prepunching ☐
Repetitive prepunching ☐
Prenumbering ☐
Padding ☐
Proofs required ☐
If card is to be printed on both sides, check style BOOK ☐ TUMBLE ☐

INTERPRETATION
45-Numerical ☐
60-Alphabetical ☐
80-Printing punch ☐
Bill Feed five lines per inch ☐ six lines per inch ☐
End Printing LEFT ☐ RIGHT ☐
Typewriter spacing ☐

2nd POSITION | 1st POSITION
519 END-PRINTING

IF CARD IS TO HAVE MARK SENSING
CHECK STYLE.

SHORT CARD LAYOUT INSTRUCTIONS

1) DETERMINE SHORT CARD COLUMN NUMBERS BY REFERRING TO GUIDE AND COLUMNS PRINTED BELOW. USABLE COLUMN RANGE IS ESTABLISHED BY THE CAPACITY LOCATION ON EACH SIDE OF GUIDE. EXAMPLE: ON A 30-COLUMN CARD, USABLE COLUMNS ARE 26-55

2) CUT OUT THE STRIP OF COLUMN NUMBERS
3) PASTE THE STRIP ON THE LAYOUT FORM IN DESIRED LOCATION FOR THE SHORT CARD
4) RULE ENDS OF SHORT CARD 2 1/2 COLUMNS BEYOND THE STRIP OF COLUMN NUMBERS

5) DETERMINE MARK SENSE POSITIONS, IF ANY, BY ASSOCIATING STRIP NUMBERS WITH CARD LAYOUT POSITIONS. EXAMPLE: ON 30-COLUMN CARD, M S POSITIONS 9-18 ARE USABLE.

SCALE APPROXIMATELY DOUBLE
SIZE, ACTUAL CARD SIZE 3-1/4" X 7-3/8"

SHORT CARD COLUMN GUIDE
CARD CAPACITY (COLUMNS)

CUT-OUTS FOR 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
PASTING 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

IBM

FIGURE 14. SHORT CARD FORM DESIGN

IBM

FORM DESIGN CHART

PREREQUISITES TO FORM DESIGN

1. Determine if the form is necessary in order to accomplish the purpose.
2. Determine if there are any other forms in use similar to proposed form. Minor changes in other forms may satisfy requirements.
3. Determine cost of preparing form in equipment, clerical work, storage, etc.

NEW FORM QUESTIONNAIRE

1. What form(s) if any will it replace? (Give form number and attach sample.)
2. Is proposed form a consolidation of existing forms? (Give form numbers and attach samples.)
3. Can existing forms be revised to include required information?
4. How was this information previously supplied?
5. Frequency of form (weekly, monthly).
6. Number of copies at each writing.
7. Will it be permanent?
8. For pen, pencil, for typing, listing, etc.
9. For local or general use.
10. For internal or external use.
11. Minimum usable size of form and quality of paper. (Paper on which form is printed will be supplied unless otherwise specified.)
12. Is form to be:
    a. Loose, padded, bound.
    b. Punched, numbered, perforated, interleaved, folded or gummed.
    c. Book—number of leaves.
    d. Punched—size and position of holes.
    e. Numbered—consecutively, duplicate.
    f. Interleaved—number of sheets.
    g. Folded—number of folds.
    h. Gummed—position and extent of gumming.
13. Reason for any special operation.
14. State fully any other reasons for the establishment or the revision of this form.
15. Value of stock to be scrapped.
16. Value of plates to be scrapped.
17. Disposition of present stock:
    a. On hand.
    b. On order.
18. Initial supply required.
19. Subsequent annual consumption.

FACTORS AFFECTING FORM DESIGN

1. Legibility.
2. Simplicity.
3. All information required for immediate understanding of the intent and purpose of the report.
4. Make-up for form must be straightforward and in accordance with accepted accounting practice.
5. Reports must be so prepared that they may be easily reproduced and so that legible, usable, multiple copies can be prepared.
6. If the report is lengthy and detailed, a summary or condensed report should be attached.
7. They should be in the proper sequence for use.

RULES FOR FORM DESIGN

1. Make a record of all information that is to be recorded:
    a. Designate required information.
    b. Eliminate unnecessary information.
    The greatest weakness in form designing is that the form is burdened with unessential information.
2. Determine source of information to be recorded.
    a. Is the information available in the manner requested on the form?
    b. Is the information to be recopied from another form?
    c. Must information be developed for first time?
3. Design the form so that a minimum of recording and recopying is required. If the form precedes a subsequent form, or is dependent upon another form, follow the same general sequence and arrangement, so that recopying and recording can easily be accomplished.
4. Determine in what manner the various entries on the form are to be made. Will these entries be made by hand or machine? If by machine, what kind?
5. Determine if the form design is sufficiently clear to be understood. See that all necessary instructions are contained therein. Routine instructions can be given in letter; pertinent instructions should be printed on form, especially copies.
6. Determine possibility of form becoming basis for additional forms.
7. Determine grade of paper:
    a. Will form be handled much?
    b. Will form be permanent or temporary?
    c. Will form be mailed?
    d. Does the form go to the public, or will it be used within the company only?

8. Determine size of form. Check:
    a. Filing
    b. Binders
    c. Envelopes
    d. Mechanical equipment
9. Determine best and most economical method of reproducing form.

OTHER FACTORS FOR GOOD DESIGN

1. Use bold type to make certain information is outstanding.
2. In columns for money, provide sufficient space for largest amount.
3. In fill-ins, use dotted lines to trace to fill-ins.
4. If writing is near binding edge, make sure it can be seen.
5. Filing information should be near top of form or where it is accessible.
6. Every form should have a title.
7. Make sure complete information is shown for printer.
8. Each form, before reprint, should be submitted for approval to some responsible individual.
9. Have forms packaged by printer in small groups and have him label packages.
10. Use of form numbers, date, and quantity.
11. Use of "Printed in U. S. A."
12. Eliminate use of company name on interoffice forms; use trademark.
13. Keep headings as small as possible, so as to get sufficient room for written data.
14. Consider headings at bottom of form.
15. Always get samples of paper and carbon on multiple forms.
16. Use colors for departments.
17. Appearance of printing makes form attractive.
18. Use double rules to set off sections.
19. Neat forms encourage neatness by users.
20. Eliminate horizontal rulings as much as possible to cut down adjusting.
21. Guide marks for name and addresses, folding, etc.
22. Sequence of form which requires filing legibility.
23. Arrange sequence of information to follow form from which it is copied.
24. Keep information on one side of form.
25. Consider numbering columns and print instructions by this number.
26. Keep folder for each form and put in changes.

COMMONLY USED SIZES OF ACCOUNTING FORMS WHICH CAN BE CUT WITHOUT WASTE FROM STANDARD FLAT PAPERS

Size of Form	Standard Sheet Size	Number of Forms from One Sheet	Number of Forms from One Ream
2¾ x 4¼	17 x 22	32	16M
8½	17 x 22	16	8M
3½ x 4¼		32	16M
8½	17 x 28	16	8M
17		8	4M
4¼ x 5½	17 x 22	16	8M
7	17 x 28	16	8M
11	17 x 22	8	4M
14	17 x 28	8	4M
28	17 x 28	4	2M
5½ x 8½	17 x 22	8	4M
17	17 x 22	4	2M
7 x 8½	17 x 28	8	4M
17	17 x 28	4	2M
8½ x 11	17 x 22	4	2M
14	17 x 28	4	2M
22	17 x 22	2	1M
28	17 x 28	2	1M
11 x 17	17 x 22	2	1M
14 x 17	17 x 28	2	1M

Work Loads

IBM
data processing
MANAGEMENT

WORK LOADS

IN PLANNING the work to be done in an IBM department, the supervisor finds it necessary to attain successfully three objectives:

Specify the work to be done. Develop procedures and jobs, and record them in the manual of procedure.

Determine regular work loads. Assign volume and time factors to all operations.

Schedule all jobs and operations. Co-ordinate jobs, machines, and operators in the department to obtain maximum advantage of the integrated activities.

This booklet discusses the second of these three planning objectives. The remaining two are covered in other booklets of the IBM *Accounting Management* series.

Accurate machine and personnel work loads are necessary to the IBM department for several reasons:

1. Scheduling. To schedule work through the IBM department, it is first necessary to know the machine and personnel time required on each step.

2. Standards. If performance time factors are to be set up for particular applications, job steps, or functions such as keypunching, it is necessary to have accurate time factors.

3. Cost Figures. When departments using the facilities of the IBM department are charged for the work performed, it is necessary to have accurate machine and personnel time factors.

MEASURING VOLUME OF WORK

INFORMATION about the volume of work is a prerequisite to the assignment of time factors to each of the operations in all regular jobs. It is necessary to have an accurate knowledge of:

1. number of source documents received,
2. number of cards punched and processed,
3. number of reports produced.

Many scheduling deficiencies in the IBM department stem from an insufficient knowledge of these facts, and many supervisors complain of scheduling difficulties as the result of fluctuating volume or unexpected work loads. Such situations indicate the necessity for a close analysis of work loads.

Information about the number of source documents received may be obtained from the control clerk who maintains document control over the procedures. Frequently, item counts and number of batches are recorded as part of the document control routine. In other cases document counts may be made. The person making this count should be certain to obtain a good sample period. It is also important to know what the expected maximum and minimum volumes will be and when they will occur. Where the number of docu-

ments per weight unit (oz., lb., etc.) can be determined, the source documents can be weighed in batches and the volume computed. In some cases the number of documents is calculated by dividing the number of cards punched by the average number of cards per document. The greatest value of such information about source documents is in the conversion of volume to time for scheduling purposes, and the reduction of cost-per-job data to cost-per-document data for purposes of evaluation.

Records of card quantities are perhaps the most important figures to compile and use. The time required for most operations will depend upon the number of cards, because most operations in an IBM department involve running cards through a machine. In most cases, card counts are obtained by card-counting devices on the sorter or the accounting machine. In some instances, card counts are obtained from the punched-card section, where accurate production records should be kept. In other cases, card volume is computed by multiplying the number of source documents by the average number of cards punched per document.
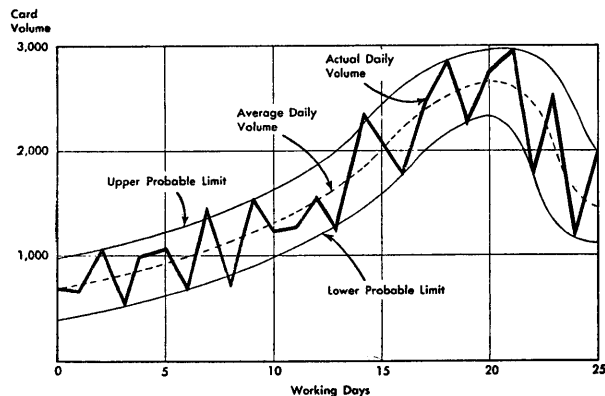
FIGURE 1

Card volume should either be recorded on a form designed for this purpose or plotted on a chart or graph. The reasons for recording card volume are, first, that volume figures provide a means of determining the time for each operation and hence for the jobs; and second, that fluctuations in the work load must be known for effective scheduling.

For an example of the effect of fluctuations on scheduling, consider the results of a particular job volume study shown in Figure 1. The following important facts may be deduced from this chart:

1. The card volume varies from about 500 cards to about 3,000 cards a day. This indicates that time factors for the operational steps should be calculated on a time-per-thousand basis.

2. The maximum work load occurs about the 22nd working day of the month. This is the period that will require closest scheduling with other jobs.

3. The dotted line represents the average volume that may be expected on any day of the month. The figures for these days will become the basis for determining time factors for the operations in this job.

4. The upper and lower probable limits indicate the possible variations allowed for in scheduling. When this possible fluctuation becomes relatively great from day to day, low machine utilization will be found in

the same period with more overtime, thus reducing the over-all effectiveness of the operation.

It is advisable to keep separate records of cards punched in the card-punch section. Usually the volume of cards processed through the machines is much greater than the volume of cards originating in the card-punch section. This results from the multiple use made of punched cards.

Another group of volume figures significant in an IBM department indicates the net output of the department. How many reports are being produced? How many checks are being prepared per week? How many invoices are produced each day? How many pages of reports are run each month? Such figures can be obtained automatically from the accounting machine while the reports are being run. Departmental output figures are useful in calculating unit costs of each type of report or result produced. Such volume figures will also be needed to calculate accounting-machine time and to evaluate accounting-machine performance.

Figure 2 illustrates a method of recording the volume of documents, cards, and reports on one chart. This makes many studies of relationships between various factors possible. It is advisable to make separate volume studies for each major job handled by the department — or, at least, for each major procedure or application.
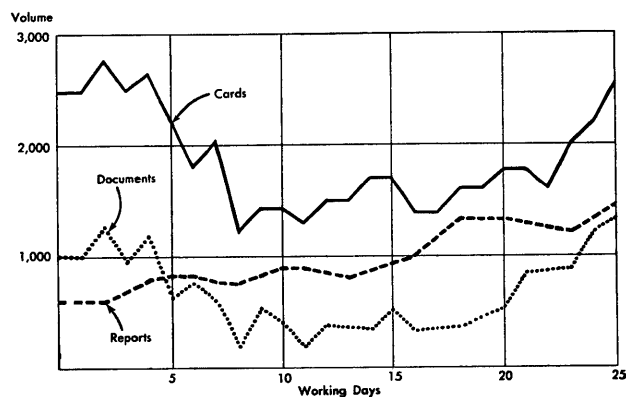

FIGURE 2

WITH THE evolution and development of office practices during the past hundred years, three distinct methods of accomplishing the functions of the office routine have appeared:

Manual operations. Ever since the earliest days of history, when men and groups began to transact business that required some form of accounting or record-keeping, manual methods have been used to keep such records. This method usually involved such work as writing data with a pen or pencil, hand-posting, handling of papers, and mental comparing and checking.

Key-driven operations. When the typewriter was invented, and later at the turn of the 20th century with the development of key-driven adding machines, calculators, and other such equipment, the office transferred many manual operations to key-driven functions. This method usually involves reading data by an operator and striking keys to enter the data into the machine, or to control the various functions of the machine.

Automatic operations. With the invention of the first punched-card machine in 1890 and the development and use of such motor-driven equipment since that time — particularly during the nineteen-thirties — many office functions have been transferred from manual or key-driven functions to the automatic motor-driven functions. This method applies mechanization, long an integral part of factory operations, to the office routine. It requires the conversion of data to punched cards, and the automatic processing of such data through machines that are set up by the operator and that continue to handle thousands of detailed transactions as the cards are fed through. The operator's duties are reduced to those of setup, feeding cards, and control of the machine.

COMPUTING TIME: MANUAL OPERATIONS

EVEN IN punched-card procedures where most functions have been mechanized, a few manual operations have been mechanized, a few manual operations may be found that cannot be mechanized economically. Such manual operations generally require the human functions of control, analysis, judgment, decision, evaluation, and thinking.

Human variables enter into manual operations to a great extent, and such operations are extremely difficult to plan or schedule. One basis for determining clerical speeds is by reference to statistical analysis and efficiency records pertaining to standard clerical functions performed in the department. If such production data are not available in planning a new job, a time study can be made for this manual function on a sample of the actual work. In some cases where a similar manual operation is being done, time factors from this operation can be used. However, it should be understood that a manual job closely paralleling the one being studied must be used, because there is a wide variation of time factors in manual functions.

The errors usually encountered when estimating production, and the human variables to be expected in clerical work explain why manual operations are commonly tried out before any definite plans or schedules are prepared. Even with production experience, many supervisors feel that manual operations vary as much as 40% from the predicted time. In other words, a clerical function planned for ten hours may take as much as fourteen hours or as little as six hours. This explains the administrative difficulties found in planning and scheduling procedures that are completely manual.

COMPUTING TIME: KEY-DRIVEN OPERATIONS

WHEN KEY-DRIVEN equipment was introduced into office procedures, the functions became more productive and more accurate. In addition to the increased productivity, better administrative planning became possible, and production records became more accurate and reliable; therefore, better schedules could be developed.

In punched-card procedures, card punching and verifying are key-driven functions commonly found at some point in the office routine. Many different factors affect efficiency and accuracy of work. All of them should be given careful consideration:

Design of source documents and cards

Legibility of source documents

Number of columns to be punched (or duplicated) and proportion of alphabetic to numerical columns

Skill and experience of operator

Type of equipment used

Type of instruction

Volume of transactions

Flow of work

Duties other than keypunching (auditing, coding or checking)

Working conditions

Each of these factors should be given careful consideration by the supervisor in evaluating work being done, in planning new procedures, or improving procedures already in effect.

Design of Source Documents and Cards

An important factor in speed and accuracy of keypunching is the design of the source documents and of the card form. Because the card moves automatically through the keypunch as each column is punched, the operator must read the data from the document in the same sequence in which they are to be punched. The best design of both document and card, therefore, will provide for exactly the same arrangement of the items on both. Usually the card is designed to conform to the arrangement of an existing source document.

In those cases where information must be added to the source record before punching, such as customer number, account number, and so on, it is often desirable and economical to attach an apron or use a rubber stamp on the source document. All of the information, or that part which is added, is transcribed to the apron for the keypunching (Figure 3). The information on the apron should be arranged in punching sequence. This method is sometimes used when information on the source document and the card are not in the same sequence, thus re-arranging it on the apron for ease and speed in keypunching. However, in the latter case, every attempt should be made to redesign the source document or the cards so that transcription to the apron is not necessary.

The ideal source document for keypunching shows all information to be punched in one card on one line, so that it may be read from left to right. It is for this reason that transcription forms or alignment sheets are designed for use in many jobs for which the source information arises within the company. These transcription sheets are ruled into grids, with 80 (or fewer) squares horizontally in which the data to be recorded in one card are recorded, and 25 or 50 lines vertically to receive the data for that many cards. Such sheets may be used to good advantage when the information must be collected from many sources before it is punched, when there are coding or editing functions to be performed, or when the source document is so poorly designed or illegible that the keypunch operation would be inefficient without special forms.

The design of the card with respect to duplicated, punched, and skipped fields further affects card-punching speed and efficiency. Best operation is achieved when duplicated information appears at the left of the card, and when all fields to be keypunched are grouped together so that the punching need not be interrupted by skipping.

Legibility of Source Documents

The degree of legibility of the source data is one of the more important factors that affect production in keypunching. For this reason, original copies—rather than the sixth or twelfth carbon copy—should be routed to the keypunch operation whenever possible. A source document that contains manually written data should be designed so that enough space is allowed for large, legible characters to be handwritten, especially when this writing is to be done by someone other than a clerk.

Number of Columns Punched

The number of cards punched per hour is directly dependent on the number of columns to be punched per card. To evaluate production of keypunch operators, it is customary to express production in terms of columns punched per hour, or key depressions per hour. This is obtained by multiplying the number of cards punched per hour by the average number of columns punched in each card.

NIXON GLASS

NIXON, VIRGINIA

SOLD TO

ODIN CHEMICAL CO
BROCKTON
PENNSYLVANIA

SHIPPED TO

SAME

DATE

3-17-55

VIA   THOMAS MOTOR FREIGHT

TERMS		FOB NIXON	CUST. ORDER NO.	OUR ORDER NO.			INVOICE NO.
2-10 NET 30			11472	45981			24027
QUANTITY	ITEM NO.	DESCRIPTION			UNIT	UNIT COST	AMOUNT
144	18716	DEMIJOHN FRAMED			E	1.18	$ 169.92
6	9497	FLASK 5 GAL FIREGLASS			E	8.43	50.58
10,000	55843	JAR 1 QT. FLINTGLASS			M	26.37	263.70

TRANS. CODE	VENDOR NAME	*Nixon Glass Co.*
1		*Nixon, Virginia*

VENDOR NUMBER	INVOICE	DATE	INVOICE NUMBER
1179		3-17-55	24027

VOUCHER NUMBER	DUE	DATE	GENERAL ACCOUNT
643		3-27-55	1 2 3

$ 484.20*

APPROVED BY:

DRJ

INVOICE AMOUNT	484 20
DISCOUNT	9 68
NET AMOUNT	474 52

ACCOUNT NO.	SUB-CODE	AMOUNT
123	160	169 92
123	115	50 58
123	210	263 70

OP-38366 5M 3-52   ACCOUNTS PAYABLE VOUCHER

FIGURE 3

Whenever it is possible, information common to groups of cards will be punched automatically by using the duplicating feature of the machine. Duplication not only saves actual punching time, but also increases the accuracy of the job and simplifies verification.

Skill and Experience of Operators

In evaluating the work of keypunch operators, it is important to consider their training and experience.

For new operators, the number of cards punched per hour or the number of errors being made are not so important as how much *improvement* is being made from week to week. This trend is the best indication of the type of production that can be expected in the development of each operator. Only after the operator has reached a level rate of production should her proficiency be given an absolute evaluation.

It is of paramount importance that the supervisor of a card punch and verifier section keep accurate and
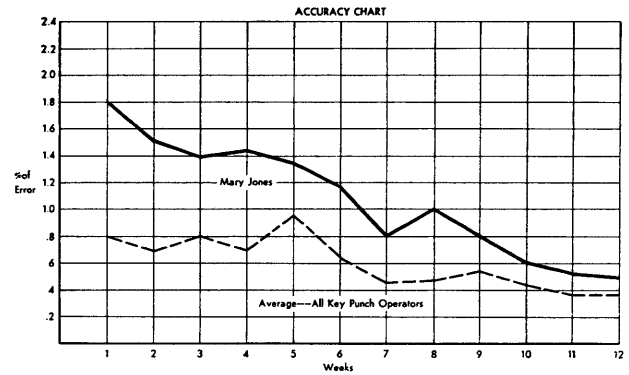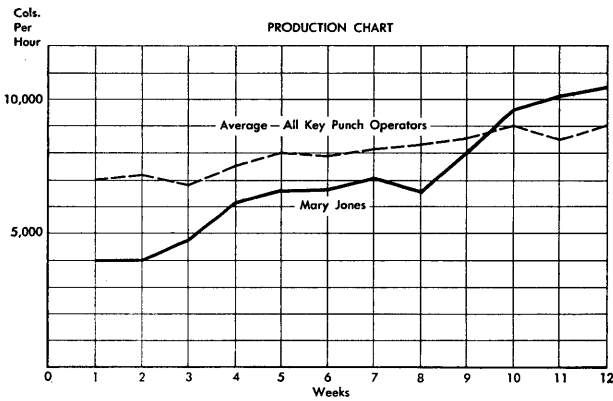
FIGURE 4

up-to-date speed and accuracy records for each operator. Speed is usually measured in key strokes per hour. One effective method of keeping such records and making studies of key-driven production of each or all operators is illustrated in Figure 4.

Such records are valuable in calculating time factors for punching operations; they are also useful in evaluating the progress of the card punch and verifier operators. The prevailing percentage of error will have an important bearing upon the kind and amount of verification which will be built into the procedures.

Type of Equipment Used

New machines are constantly being developed that incorporate more effective mechanisms for the reduction of the fatigue which, to a greater or lesser degree, is associated with all recording operations. The advantages of the newer machines should be carefully studied by the supervisor with the object of continually improving equipment and performance. The special features of each should be used to simplify the keypunching job and increase production. For example, if two types of cards are keypunched from the same source document requiring two separate program controls, the use of the alternate program device should be considered to determine whether both cards could be keypunched without handling the source documents twice.

Operating routines change for some types of equipment, and should be studied to be sure that they are changed along with a change from one machine to another.

Type of Instructions Given Operators

The supervisor can do much to raise the production and reduce the errors of keypunch operators. Com-

plete and clear instructions are extremely important. Oral directions should preferably be summarized in written form.

If directions are given verbally, and in a rather hurried manner, as is so often the case, the speed and accuracy with which the work is done will be low. These conditions can be completely eliminated by carefully writing all instructions necessary for performing all jobs. It is even more important that one-time jobs or infrequent jobs have written instructions, because the operators will have little or no experience to use as a guide for these jobs. *All* jobs should have written instructions for the operator and become part of the operator's manual of procedure (Figure 5).

Volume of Transactions

It might be expected that keypunch operators would produce more per hour when they are working on jobs of large volume, in which there is no change in setup of the machine or in the documents and cards. It is true that production increases as the operators become more familiar with the job, as in any standardized operation. The element of fatigue may, however, offset the greater production resulting from familiarity with the job. The two factors may even exactly balance each other, so that the same rate of production is obtained by an operator, regardless of the volume of the job. The effect of the size of the job on production, then, is dependent entirely upon the operator. Operators who like routine work will have a higher rate of production when the size of the job increases. Those who desire change and novelty will become fatigued quickly on such jobs. This element of fatigue in relation to the size of the job should be given consideration in planning work, so that it may be reduced to a minimum.

CARD PUNCHING OR VERIFYING INSTRUCTIONS   **IBM**

JOB NAME		JOB NO.	CONTROL PANEL NO.	OPERATION NAME	OP CODE	MACH. TYPE
SALES ACCOUNTING		630	-----	Card Punching	31	24

FREQUENCY		DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME
☒ Daily ☐ Monthly		TIME	DATE	TIME	DATE		HOURS TENTHS
☐ Weekly ☐ Quarterly							
☐ Bi-Weekly ☐ Annual							
☐ Semi-Monthly ☐ Other		8:00	Daily	3:00	Daily	1,000	4 5

PROGRAM CARD OR SKIP BAR NO	SPECIAL FEATURES USED
14	☐ ALTERNATE PROGRAM ☐ CARD REVERSING
	☐ AUXILIARY DUPLICATE ☐ SELF CHECKING NO.
	☐ ☐

24-26-56		SWITCH SETTINGS		31	
ON	OFF	SWITCH	OFF	ON	SWITCH
x		PROGRAM UNIT			RELEASE KEY EJECT
x		AUTO FEED			AUTO EJECT
x		AUTO SKIP—AUTO DUPL.			Turn Auto Skip and Duplicate switch off for first card punched for each invoice.
	x	PRINT			
	x	SELF CHECKING NO.			

CARD FIELD	COLUMNS FROM	COLUMNS TO	FUNCTION*	REMARKS
1. Invoice date	30	33	P	
2. Invoice number	34	38	P	
3. Customer number	39	43	D	Duplicate from
4. Location	44	48	D	first card
5. Trade class	49	51	D	punched for
6. Branch	52	53	D	each invoice
7. Salesman number	54	56	D	
8. Quantity	57	61	P	
9. Commodity number	62	66	P	
10. Net amount	67	73	P	
11. Invoice amount	74	80	P	
12.				
13. Columns 1-12				Will be gangpunched
14. Columns 13-29				Will be calculated
15.				
16.				

	FUNCTION*	SYMBOL
	DUPLICATE	D
	PUNCH	P
	SKIP	S
	X-SKIP	XS
	VERIFY	V
	SELF NO. CK	CK

TOTAL KEY STROKES PER CARD—	33 PUNCHED	18 DUPLICATED	9,400 KS/HR

Date: Feb. 27,   Section 2   Page: 7

FIGURE 5

Flow of Work

The most efficient production cannot be reached when the operator is being interrupted continually to perform special jobs, when a job is shifted from one operator to another, or when work is done piece-meal as documents become available. When more than one operator is required for a job, there should be an equitable distribution of work to the several operators, commensurate with their productive capacities. Furthermore, each operator should have a backlog of documents—not so large as to create a pile of idle material, nor so small that the operator's work will be interrupted. This requires careful planning and scheduling on the part of the supervisor.

The flow of work should be such that the operators do not have to leave their place of work. If the operators transfer work from one station to another, they should be located so that they do not have to leave their desks to do so. Otherwise, they will be doing a double job—keypunching and messenger service.

Duties Other than Keypunching

Keypunch operators are frequently called upon to do other kinds of jobs, such as coding, auditing, selecting, comparing, and checking, while they are keypunching. Keypunch production is inevitably lowered in such a case, and these factors should be taken into consideration in evaluating the production. It is sometimes a better plan to have persons other than the keypunch operator to do the auditing, checking, coding, and messenger work. However, for morale purposes, it may be more desirable to introduce the varied duties.

Working Conditions and Morale

The conditions under which keypunch operators perform their duties, and the morale of operators, are intangible factors to be dealt with by the supervisor. Because they are intangible and immeasurable, morale factors are too frequently overlooked. It is now generally recognized by supervisors that efforts exerted to improve morale of operators can go further than those in any other single area, to increase production and improve the working relations of all personnel in the department.

A room of proper temperature, humidity, and ventilation is usually the first consideration for comfort. Disturbing noises and sounds should be kept at a minimum. Rest periods should be provided at proper intervals and every possible effort should be made to reduce fatigue for the keypunch operator. A change in routine is also a good morale builder. Above all, good morale from the supervisor's qualities as a leader is important.

CALCULATING KEY-DRIVEN TIME

Although many human variables enter the key-driven operations, the simplification of key-driven procedures and the accumulation of accurate production-rate figures for each operator make possible a remarkable degree of precision in determining the time requirements for a given operation. By the use of suf-

ficiently accurate production records, supervisors are able to estimate card-punching schedules from which actual production varies by no more than 10%. Once rates of production are established, it is possible to determine quickly the time requirements for a card-punching or verifying operation according to the formula:

$$\text{Hours} = \frac{\text{number of cards} \times \text{columns per card}}{\text{key strokes per hour}}$$

To facilitate this calculation, a scale has been set up on the machine-load computer for card punches and verifiers with a range of 5 to 80 columns punched or verified per card and from 3,000 to 18,000 key strokes per hour. Tables may be set up that convey this same information figure. The use of the computer and tables is explained later in this booklet.

Computing Time: Machine Operations

To understand the process of determining the time requirements of a given operation on an automatic machine, it is well to examine the factors affecting every automatic operation.

The first element of operation time is *setup time*. Before a card can be passed through the machine, the operator must place the correct control panel in the machine, bring the cards to the machine, make other necessary settings and adjustments, perhaps receive instructions pertaining to the operation to be performed, and run a few test cards through the machine to prove the adequacy of the setup. All such operational details, performed once for each operation, contribute to setup time.

The second, and usually the major element of time, is *machine time*. This is determined from the volume of cards and the speed of the machine by a calculation that converts a given volume of cards into corresponding machine time. Many methods are available to facilitate the calculation. Some supervisors prefer to use the arithmetical method of dividing volume of cards by the speed of the machine according to the following formula:

$$\text{Machine hours} = \frac{\text{number of cards}}{\text{cards per hour}}$$

However, most supervisors prefer the faster methods, employing graphs, tables, or computers. The use of the machine-load computer for determining the time requirements for various card volumes on all IBM machines is shown in Figures 10 through 24. The instructions for the use of the computer are included with each illustration. A table used in determining machine times is also shown in Figure 25 with instructions for its use.

The third element of time to apply to an automatic operation is *handling time*. After the operation begins, it is normal to expect short interruptions in the operation of the machine. These interruptions may be caused by such operational details as placing more cards in the machine, spot-checking the results of machine operation, operating a second or third machine simultaneously, checking or balancing results, minor adjustments of the machine, and many other details which the operator must handle. These functions represent the control which a good operator will continually exercise over the operation. The longer an operation lasts, the more handling time will accumulate, and for this reason handling time is expressed as a percentage of total time.

Computation of total machine time may be illustrated by an operation that involves reproducing 24,000 cards. From experience the supervisor has determined that reproducing operations require a setup time of about five minutes. From machine time graphs or tables (Figure 30), he determines that the machine time will be four hours. Evaluations of previous runs

(A). Reproduce 24,000 Cards

Setup Time — Machine Time — Handling Time
5 min. — 4 hours — 1 hour

(B). Reproduce 12,000 Cards

Setup Time — Machine Time — Handling Time
5 min. — 2 hours — 30 min.
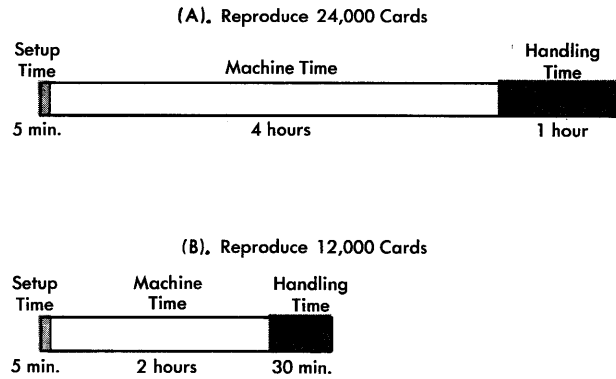
FIGURE 6

of the job indicate that about 25% of the total time is required for handling, or one hour for handling time for this job. These three factors are shown diagramatically in Figure 6A. The second bar, Figure 6B, shows the time for 12,000 cards.

A complete machine time chart (Figure 7) shows the relationship of these factors for all numbers of cards.

A study of this chart will assist in understanding the following principles:

1. In operations with large batches of cards (more than 2,000), setup time is insignificant, but machine time and handling time are important.

2. In operations with small quantities of cards (less than 2,000), setup time and machine time are significant, but handling time becomes relatively unimportant.
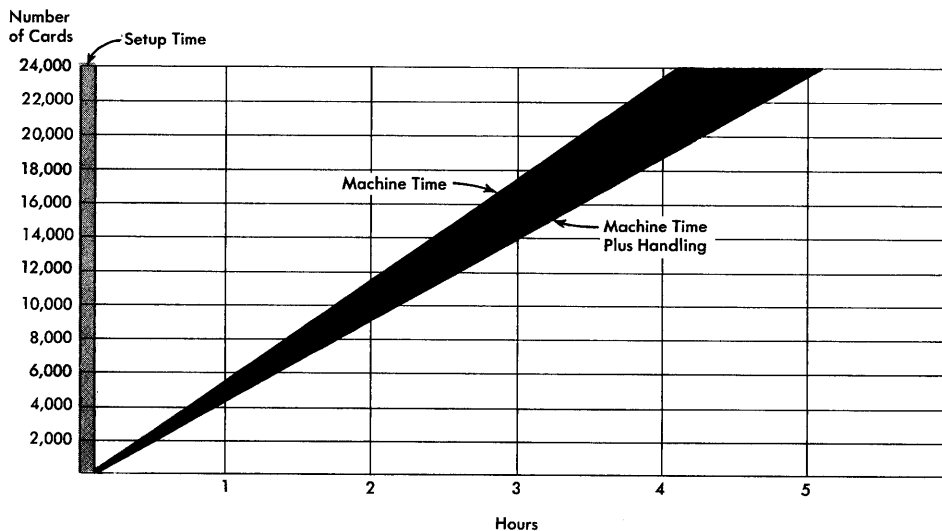
FIGURE 7

3. Because handling time increases with volume, a percentage should be used when expressing or applying this factor.

4. Because setup time is constant, regardless of volume, it should always be expressed or applied as a fixed number of minutes or fractions of hours.

The preceding principles emphasize the importance of constant study of operations so the supervisor will have an accurate knowledge of the necessary setup time and handling time to use in scheduling. Whether the study will be concentrated most on setup or handling time will depend upon the average number of cards per job or operation, because batch size determines the relative importance of the two factors in the over-all operation.

Computing Handling Time

To compute handling time from machine time, a supervisor must be sure that the method for applying this factor conforms to his particular definition of "percentage for handling." There are two common methods of expressing the percentage of handling time: as a percentage of *machine time,* or of the *total time* (except setup) for the job. Both may be illustrated for a job in which the machine time (excluding setup) is 4 hours, and the handling time has been estimated as 20%.

HANDLING TIME EXPRESSED AS A PERCENTAGE OF MACHINE TIME

If percentage for handling is defined as a percentage of the *machine time* to be *added* to machine time to obtain total time, the calculation is as follows:

$$\text{Total time} = \text{machine time} + (\text{percentage for handling} \times \text{machine time})$$

For example, assume that the machine time is 4 hours, and the handling time is 20%. The total time is:

$$4 + (.20 \times 4) = 4.8 \text{ hours}$$

HANDLING EXPRESSED AS A PERCENTAGE OF TOTAL TIME

If percentage of handling is defined as a percentage of the *total time,* then handling is related to the machine time according to the following calculation:

$$\text{Total time} = \frac{\text{machine time}}{(1 - \text{percentage for handling})}$$

$$= \frac{4}{(1 - .20)} = \frac{4}{.80}$$

$$= 5 \text{ hours}$$

To simplify this calculation many supervisors use only one factor: the remainder after subtracting percentage of handling time from one hundred per cent, or the divisor (.80) in the preceding problem. This factor is called *operational effectiveness.* In this case, the final result is the same, for 20% of the handling time is equivalent to 80% operational effectiveness. Therefore,

$$\text{Total time} = \frac{\text{machine time}}{\text{operational effectiveness}}$$

$$= \frac{4}{.80}$$

$$= 5 \text{ hours}$$

The machine-load computer can be used to assist in determining the handling time percentage for each machine job. When card volumes and the time to run the job are known, the computer can be set for the known card volume and the per cent of handling read opposite the time factor (Figure 21). If setup time is included in the total running time, it should first be subtracted from the running time to give an accurate handling time percentage.

WORK LOADS---USING PRESENT MACHINE TIME

IN MANY accounting machine departments, machine time is kept by posting running time by machine for each job. If these figures are accurately posted, and the time recorded reflects the machine time by type of machine, they can be used as the work loads for those jobs. It should be noted, however, that these figures must be checked to make certain of the accuracy by the machine operators in posting these figures. This machine information can be recorded in a number of different ways.

Several card forms used in collecting machine information are shown in Figure 8. Figure 9 shows a form in which the entire day's operation by machine can be collected.

JOB TICKET

JOB DESCRIPTION *Sales Analysis*

JOB NO. *14*	BOX *1* OF *4*

STARTED	APPROX. NO. CARDS
10/20 DATE : *9 A.M.* TIME	*12,000*

	JOB STEP	MACH. NO.	TIME REQ'D.	OPERATOR'S INITIALS
1	Sort	3	2.5	J.R.P
2	Gang Punch	7	3.3	J.C.
3	Sort Select	3	.5	S.K.
4	Group Print Sum.	5	3.3	P.K.
5	Merge	6	3.0	J.M.

TIME REQUIRED

DAILY MACHINE OPERATION RECORD

MACHINE NO. *403-1*	DATE *Oct. 25*	

NAME OF OPERATION	JOB NO.	APPROX. NO OF CARDS	TIME REQUIRED	OPERATOR'S INITIALS	REMARKS
Payroll Register	420	7,000	2.1	J.M.	
Aged Trial Balance	536	18,000	3.0	P.C.	
Sales By State	211	15,000	2.5	J.M.	
			7.6 TOTAL TIME		

FIGURE 8

13

This sheet is in the form of a graph; each section represents a tenth of an hour. The first line starts with 8:00 o'clock, the start of the day. The last line ends with 5:00 o'clock, the end of the day. On the reverse side of the sheet, entries are made in a similar manner for overtime or the second shift. The second column, opposite the clock time, is the conversion to tenths of hours.

The recording operates as follows: The operator looks at the clock when he starts the job. He records the following information on the line for the corresponding clock time: job, volume, and his initials or number. That is all that the operator must record—he does *not* have to write machine number, his name, shift, date, start time, or stop time, or to compute elapsed time and convert it to tenths of hours.

When the operator finishes the job, he again looks at the clock, and draws a line from his original entry to the line with the proper clock time. The amount of operator time spent making the record is negligible.

This method presents the data to the user in a most effective way. The result is a graph of the usage of the machine in tenths of hours for the entire day. It is easy to see not only when the machine is being used, but also when the machine is available during the day.

Regardless of the method of getting this information the data need for each operation are: (1) job identification, (2) machine used, (3) operator, (4) card volume, and (5) start-and-stop time or elapsed time. The machine information, collected in this manner, would then be accumulated by machine number to give machine usage by job.

Work loads, determined from present operations should usually be used as a starting point upon which a standard can be built. Although these figures can be used for the original schedule, they may reflect inefficiencies, such as re-runs or mishandling of cards. Therefore, improved machine times, eliminating these operating inefficiencies, should be the goal and a basis for a true schedule.

IBM   ANALYSIS OF EAM EQUIPMENT UTILIZATION

Plant No.   Dept.   Date *Nov. 10, 195*   Machine No. *514*

PLEASE RECORD EACH USE OF EAM EQUIPMENT ON THIS FORM. WRITE APPLICATION CODE NUMBER, CARD VOLUME, AND EMPLOYEE NUMBER ON LINE OPPOSITE YOUR STARTING TIME. WHEN OPERATION IS COMPLETE CONNECT ASTERISK ON START LINE WITH ASTERISK ON STOP LINE.

Example   } Start Time / Stop Time

TIME		APPLICATION	NO of CARDS	EMPL.NO.	TIME		APPLICATION	NO of CARDS	EMPL.NO
8:00	00.0*	PAYROLL	4,517	RH	12:30	04.5*			
8:06	00.1*				12:36	04.5*			
8:12	00.2*				12:42	04.5*			
8:18	00.3*				12:48	04.5*			
8:24	00.4*				12:54	04.5*			
8:30	00.5*				1:00	04.5*			
8:36	00.6*				1:06	04.5*			
8:42	00.7*				1:12	04.5*			
8:48	00.8*				1:18	04.5*			
8:54	00.9*				1:24	04.5*			
9:00	01.0*				1:30	04.5*	GEN. LEDG.	10,450	JH
9:06	01.1*				1:36	04.6*			
9:12	01.2*				1:42	04.7*			
9:18	01.3*				1:48	04.8*			
9:24	01.4*	SALES	217	RH	1:54	04.9*			
9:30	01.5*				2:00	05.0*			
9:36	01.6*				2:06	05.1*			
9:42	01.7*				2:12	05.2*			
9:48	01.8*				2:18	05.3*			
9:54	01.9*				2:24	05.4*			
10:00	02.0*				2:30	05.5*			
10:06	02.1*				2:36	05.6*			
10:12	02.2*				2:42	05.7*			
10:18	02.3*				2:48	05.8*			
10:24	02.4*	SALES MONTHLY	6,317	JH	2:54	05.9*			
10:30	02.5*				3:00	06.0*			
10:36	02.6*				3:06	06.1*			
10:42	02.7*				3:12	06.2*			
10:48	02.8*				3:18	06.3*			
10:54	02.9*				3:24	06.4*			
11:00	03.0*				3:30	06.5*			
11:06	03.1*				3:36	06.6*			
11:12	03.2*				3:42	06.7*			
11:18	03.3*				3:48	06.8*			
11:24	03.4*				3:54	06.9*			
11:30	03.5*				4:00	07.0*			
11:36	03.6*				4:06	07.1*			
11:42	03.7*				4:12	07.2*			
11:48	03.8*				4:18	07.3*			
11:54	03.9*				4:24	07.4*			
12:00	04.0*				4:30	07.5*			
12:06	04.1*				4:36	07.6*			
12:12	04.2*				4:42	07.7*			
12:18	04.3*				4:48	07.8*			
12:24	04.4*				4:54	07.9*			
12:30	04.5*				5:00	08.0*			

NOTE: IF WORK IS DONE DURING LUNCH HOUR PLEASE INDICATE HERE.

FIGURE 9

Computing Machine Loads

Calculating operation time for many different operations, according to any one of the formulas given, is a time-consuming task. The use of the machine-load computer or a table will make the results readily available for use in any operation. The comp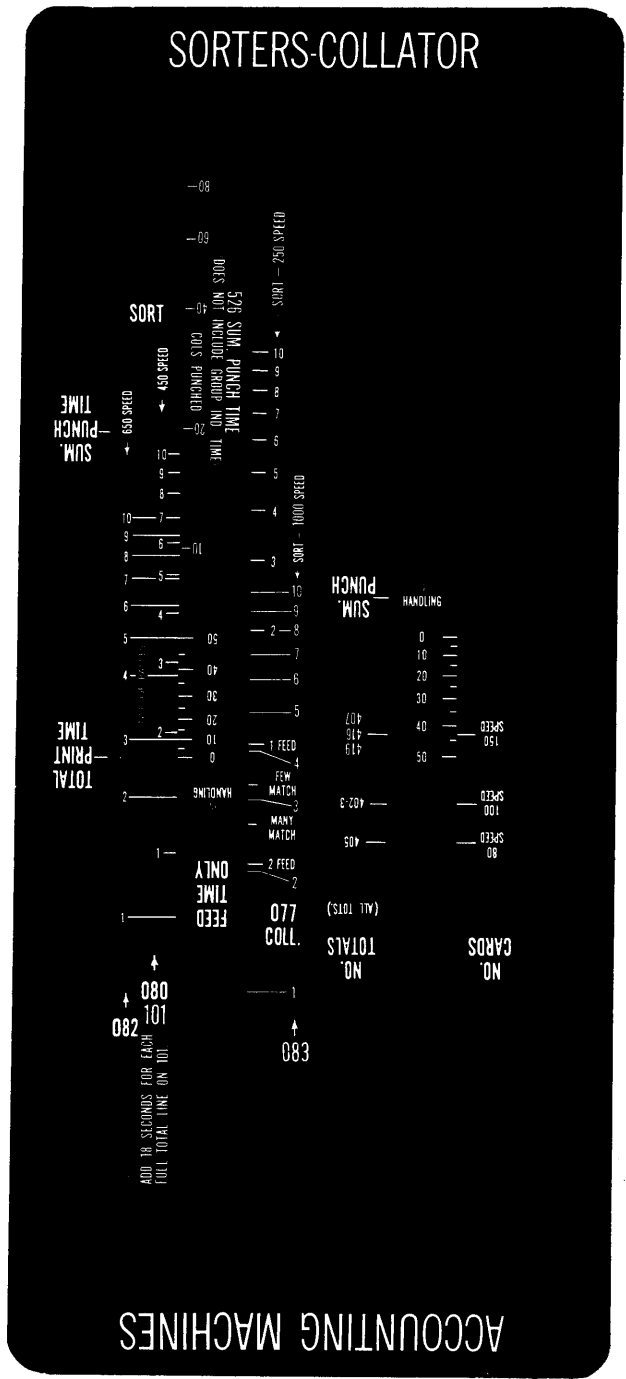uter offers a convenient method of determining the number of hours required to process a given number of cards on various IBM accounting machines.

Machine-Load Computer. The computer is composed of two plastic parts, the sleeve and the slide (Figure 10).

Each part has a black side and a white side. When the slide is inserted into the sleeve, the colors must
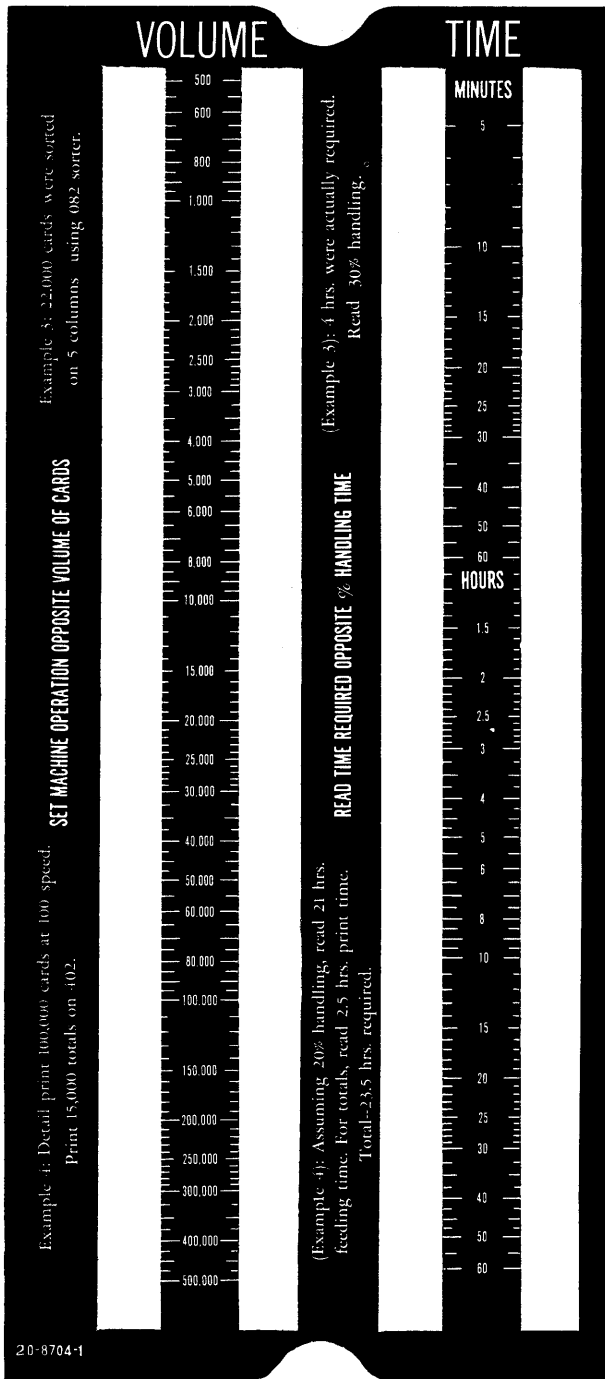
SLEEVE   SLIDE

FIGURE 10

correspond; that is, black must be on black and white on white.

The sleeve has two graduated scales on each side: a volume scale and a time scale.

Black volume scale — from 500 to 500,000 cards
Black time scale — from 5 minutes to 60 hours
White volume scale — from 50 to 50,000 cards
White time scale — from 5 minutes to 60 hours

On both time scales, the figures for more than 60 minutes represent hours and tenths of hours.

On the two sides of the slide are scales representing the various machine operations.

Sorters and Collators   — Black
Accounting Machines   — Black
Auxiliary Machines   — White
Card Punches and Verifiers   — White

The use of the scales for different machine operations is described in the examples on the following pages. Handling time can be included in the total time by using the per cent handling scale as indicated. Setup time, however, must be added to the time that is developed on the computer.

Operation

Turn the slide so that the selected machine operation scale is at the top and faces you; hold the sleeve so that the volume and time headings on the scales can be read as it is held. Insert the slide into the sleeve as shown in Figure 11.

FIGURE 11

AUXILIARY MACHINES

602A
CALC.
PUNCH

VOLUME   TIME

MINUTES

CALC.
PUNCH
607

604
CALC.
PUNCH

THINK

HOURS

International Business Machines Corp.
590 Madison Ave. New York 22, N.Y.
Patent Applied For

IBM

Example 2, Required to punch 50 columns in 1600 cards per day.

SET MACHINE OPERATION OPPOSITE VOLUME OF CARDS

Example 1: Reproduce 2000 cards.

(Example 2): Opposite 8 hours, read 10,000 columns per hour punching rate necessary.

READ TIME REQUIRED OPPOSITE % HANDLING TIME (OR PUNCHING RATE)

(Example 1): Assuming 20% handling, read 25 minutes required.

Problem: Reproduce 2,000 cards; 20% handling time. Set the index line 514-519 REP opposite the volume, 2,000. Opposite 20% handling time on the time scale, read the required time, 25 minutes (Figure 12).

The Type 528 has two feed units. The read unit operates at a maximum speed of two hundred cards per minute and the punch feed, at one hundred cards per minute. For total punch applications the total time will be the sum of the read-feed time and the punch-feed time.

Problem: Summarize 10,000 cards in 528 read feed 30% handling time; average 10 cards per summary group, therefore 1,000 cards will be punched. Set index 528 Read opposite 10,000 cards. Read 1.2 hours opposite 30% handling. Set index 528 Punch opposite 1,000 cards and read 14 minutes (.2 hours) opposite 30% handling. The total running time is 1.4 hours (Figures 13 and 14).

In performing selective reproducing the punch and read feeds operate at 100 cards per minute whenever a card is reproduced. Operation time may be calculated by taking 1/200 of a minute for every card passing through the read feed plus 1/200 of a minute for every card passing through a punch feed. Therefore, to calculate the total time, the cards passing through the read feed and the punch feed are computed at 200 cards per minute, and the two results are added together.
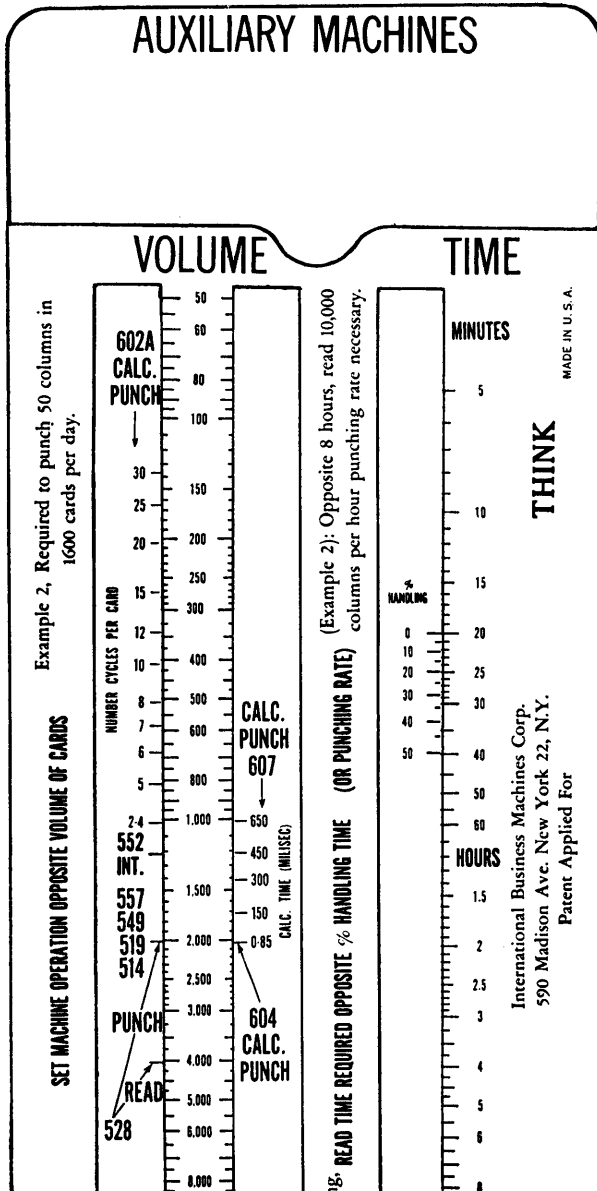
FIGURE 12
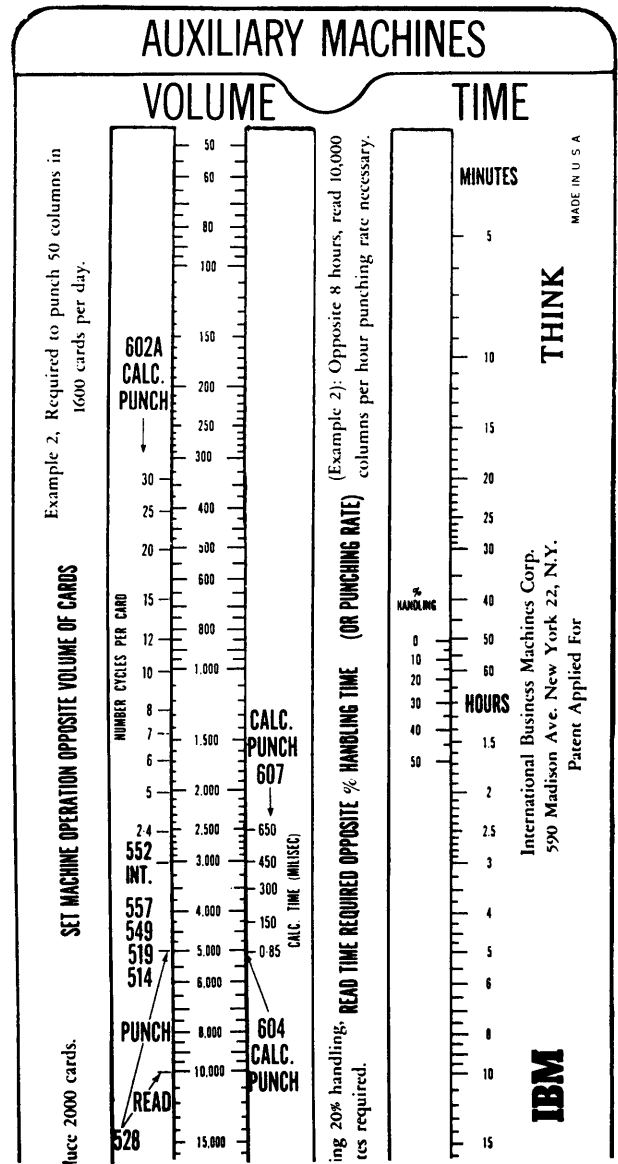
FIGURE 13
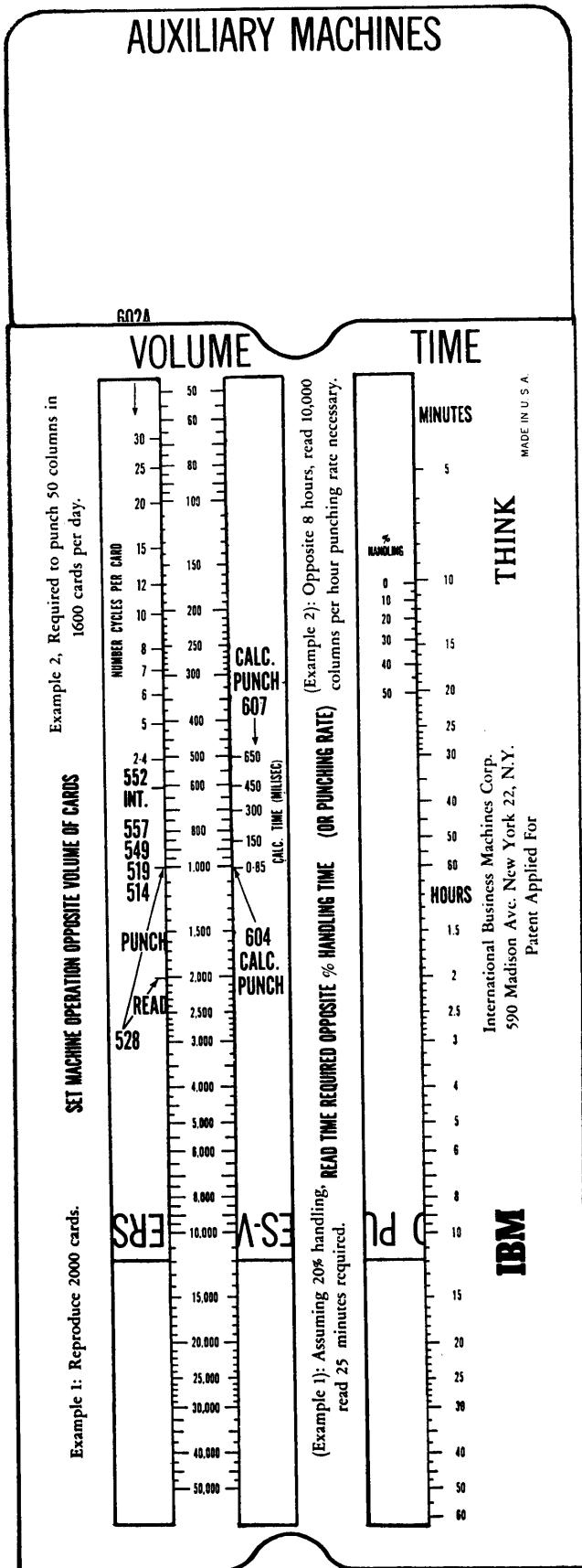
Problem: Interpret 2,000 cards; 5% handling time. Set 552 INT. opposite the volume, 2,000. From the time scale, opposite 5% handling time, read 36 minutes, the required time (Figure 15).
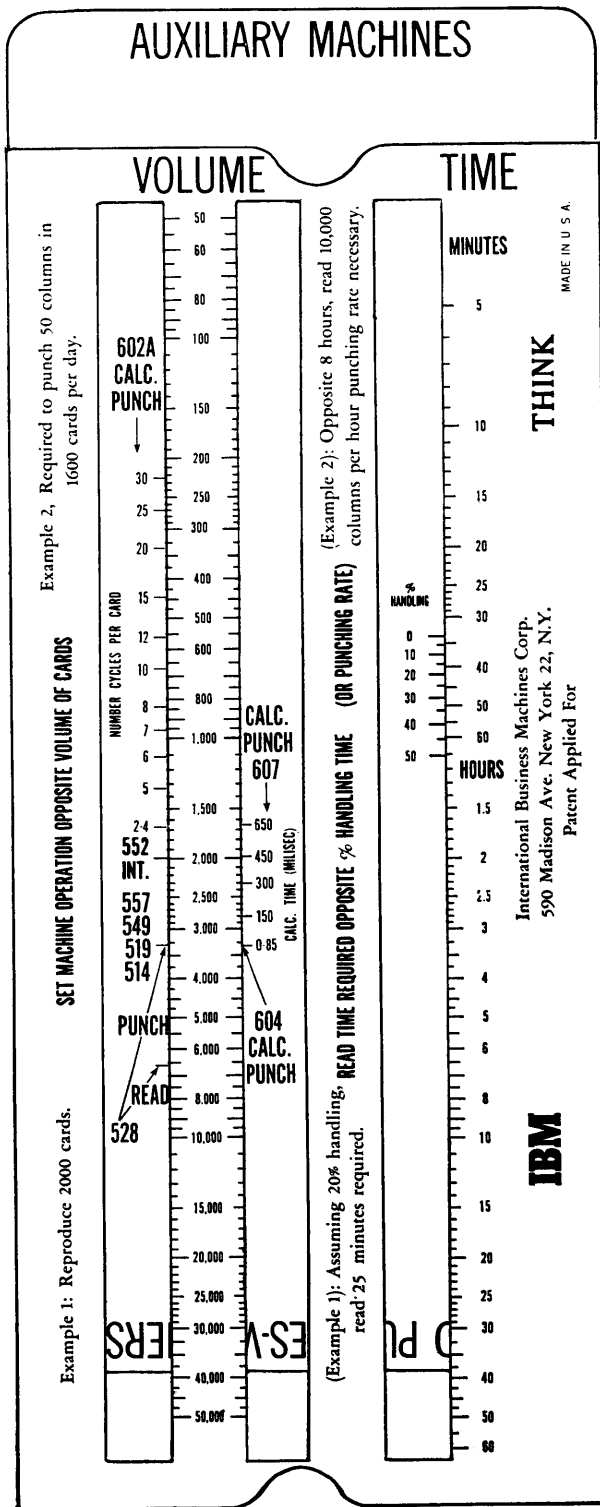
FIGURE 14

FIGURE 15

Time on the Type 602A is figured on the basis of 12,000 machine cycles per hour. From the planning chart developed in setting up the control panel the average number of cycles per card can be determined. Each step in a 602A problem except multiply and divide will be counted as one cycle. The total number of cycles can be determined by referring to the 602A Priniples of Operation Manual. The total number of cycles is the speed to be used on the 602A scale.

Problem: Calculate 2,000 cards, 10 cycles per card; 25% handling time.

Set the index for 602A CALC. PUNCH — 10 cycles per card opposite 2,000 on the volume scale. Oppo-

site 25% handling time on the time scale, read 2.2 hours required (Figure 16).

Problem: Punch 2,500 cards, average of 30 columns per card, 8,000 key strokes per hour.

It is necessary to know from production records, estimating, or a test operation the number of key strokes per hour produced by an operator.

Set the index for 30 average columns per card opposite the volume, 2,500. From the time scale, read opposite 8,000 key strokes per hour the time required — 9.5 hours (Figure 17).
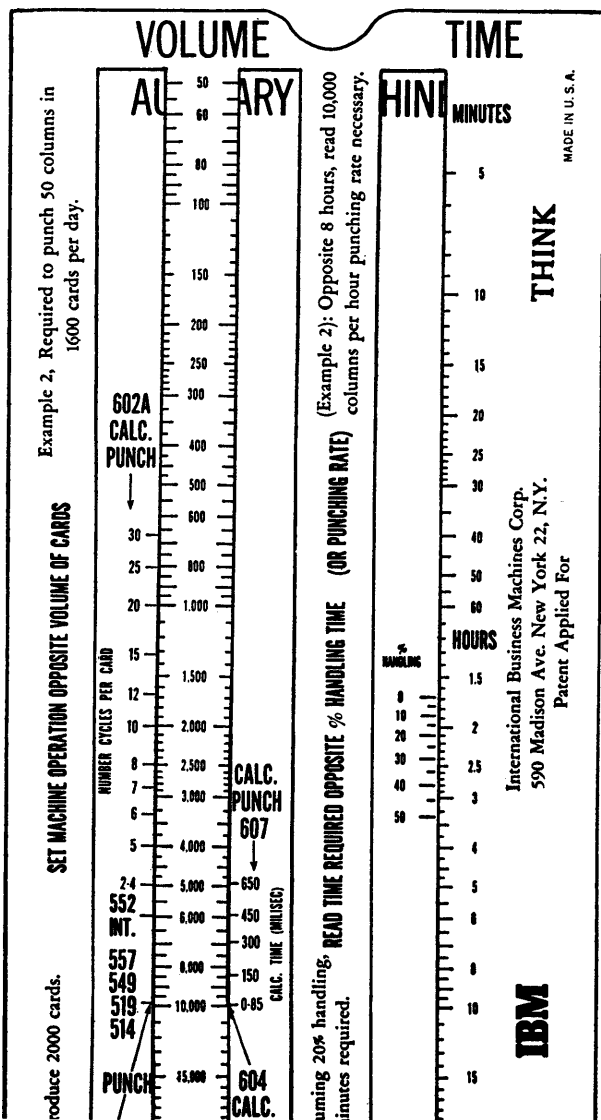
FIGURE 16
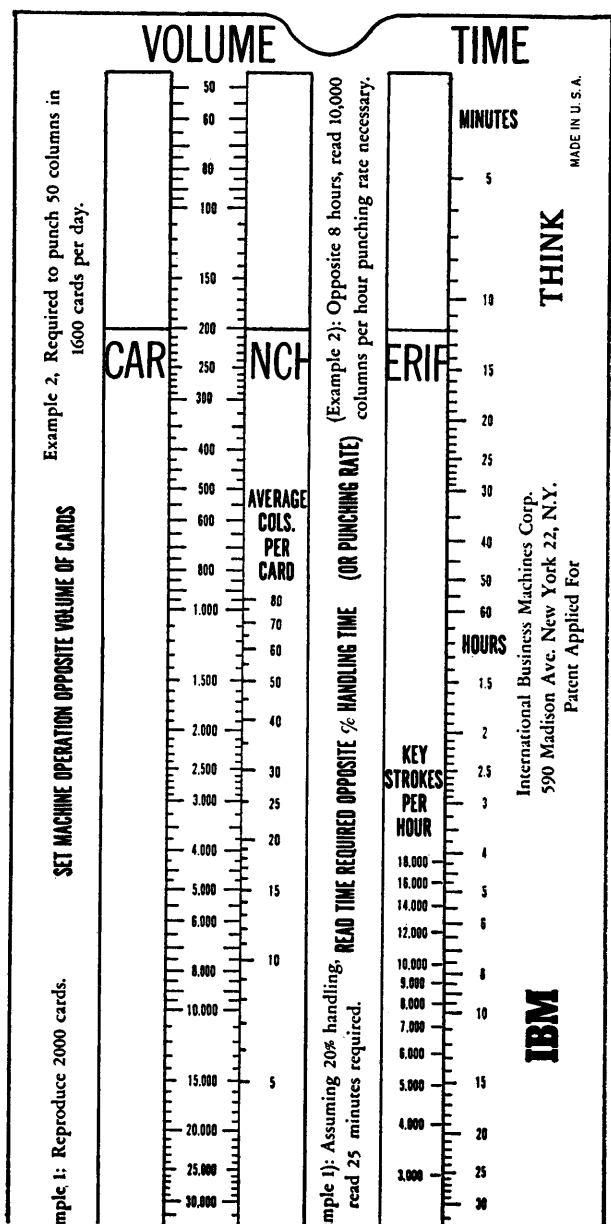
FIGURE 17

Problem: To determine an operator's key strokes per hour from actual time and volume. In 8 hours, the operator punched 2,800 cards, with an average of 40 columns per card.

Set the index for 40 average columns per hour opposite the volume, 2,800. Opposite 8 hours on the time scale, read 14,000 key strokes per hour (Figure 18).
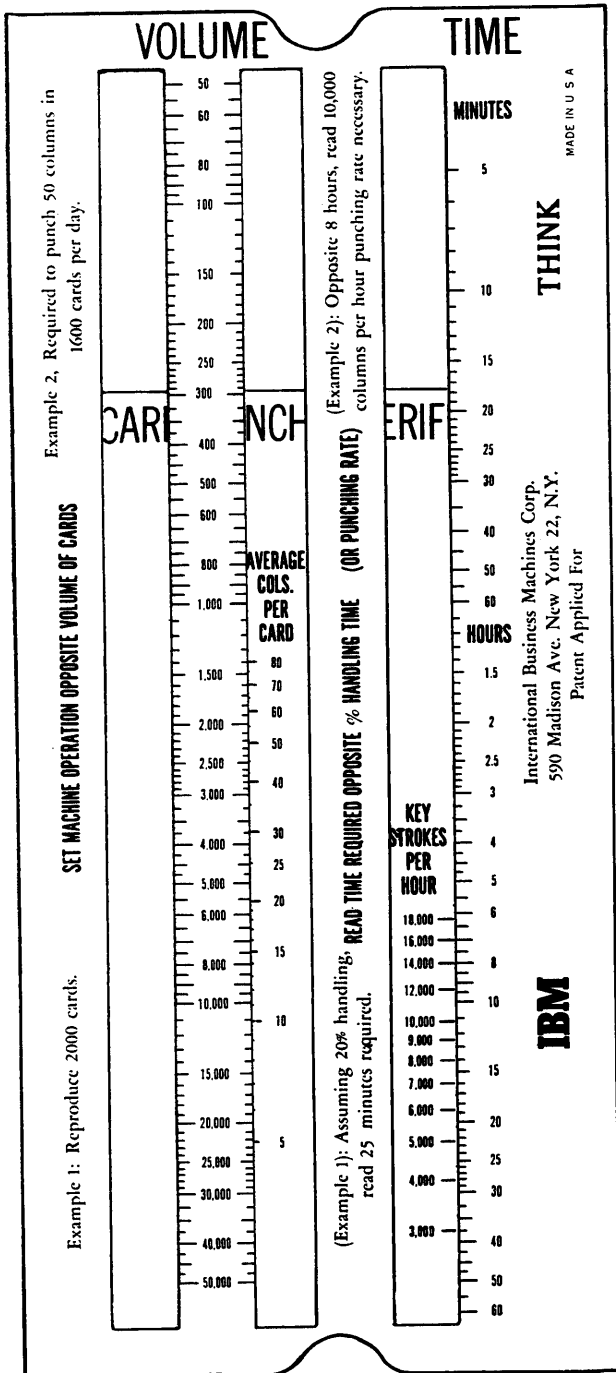
Note that there are separate scales for Sorters, Types 83, 82 and 80: Type 83 at 1,000 cards per minute, Type 82 at 650 cards per minute, and Type 80 at 450 or 250 cards per minute.

Problem: Sort 15,000 cards on 5 columns; 30% handling time. Set the index 082 (650 speed), 5 columns opposite the volume 15,000. Opposite 30% handling time, read 2.7 hours required (Figure 19).
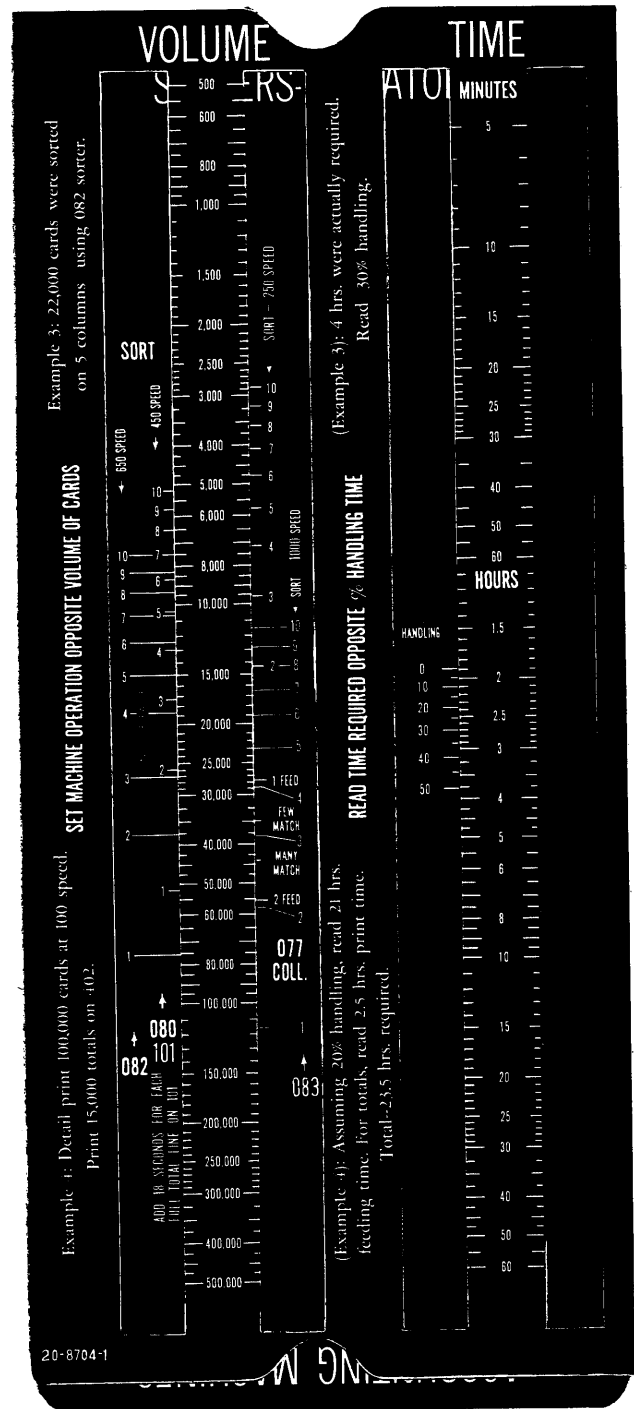
FIGURE 18

FIGURE 19

For the Type 101 use the 450 speed scale. Print time must be added to this. It requires 18 seconds to print a complete line on one or both carriages (on the 101 model having two carriages, both print simultaneously). If stops are positioned so that less than a complete line is printed, the print time is directly proportional to the number of times the typebars rise, i.e., if half a line is printed, it requires 9 seconds.

Since the collator has two card feeds, the number of cards per hour varies with the type of job. For jobs requiring only one feed, the index 1 feed should be used. For jobs in which both feeds operate continuously; i.e., all cards in both feeds match, the number 2 feed should be used. For merging or matching operations in which the two feeds operate separately at some times and together at other times, machine speed will depend upon the MS&S switch setting and the grouping of cards. Use the index which most nearly describes the actual operation. This will be somewhere between 2 feed and 1 feed. In all cases, the total number of cards (primaries plus secondaries) should be used.

Problem: Merge 2,000 cards (primary) with 1,000 cards (secondary); single card groups, many match conditions; 30% handling time. Set the machine operations index MANY MATCH opposite the volume, 3,000. From the time scale, opposite 30% handling time, read 11 minutes (Figure 20).
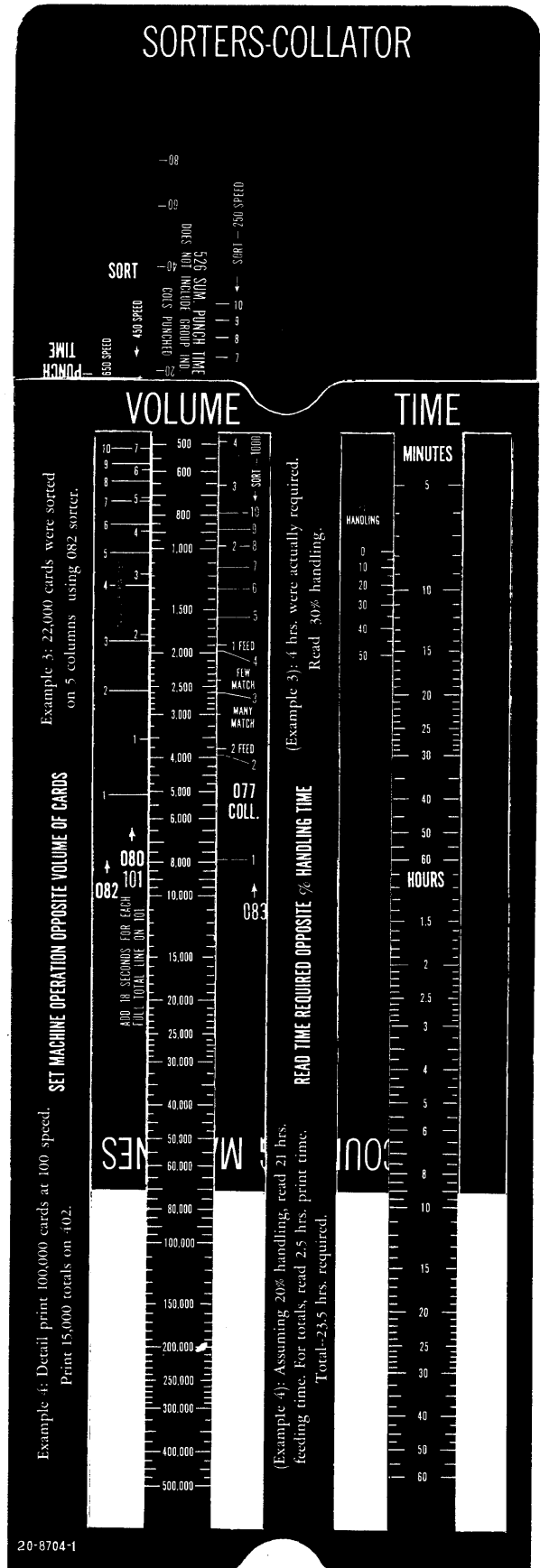
FIGURE 20

To calculate the total time on the accounting machines for any given run, the job should be broken into component parts: card feed time, total time and summary punch time.

Problem: Detail print 30,000 cards, 5,000 totals and punch 5,000 summary cards; 20% handling time. Set the 100 speed opposite the volume, 30,000. Read opposite 20% handling time, 6.2 hours required for feeding (Figure 21). Set the index no. totals 402-3 opposite the volume 5,000. Read total print time of 50 minutes (.8 hours) (Figure 22). Set the summary-punch index opposite the volume 5,000; read summary-punch time as 1.7 hours (Figure 23). The time required for the complete job is therefore 8.7 hours.
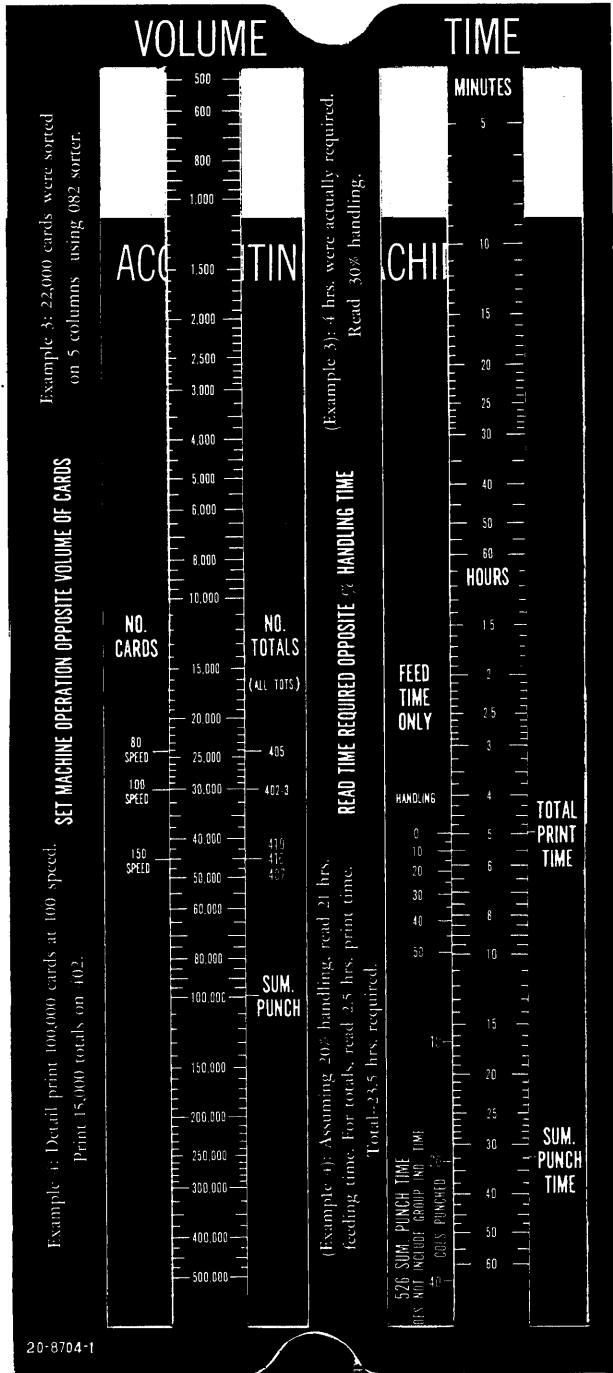
FIGURE 21
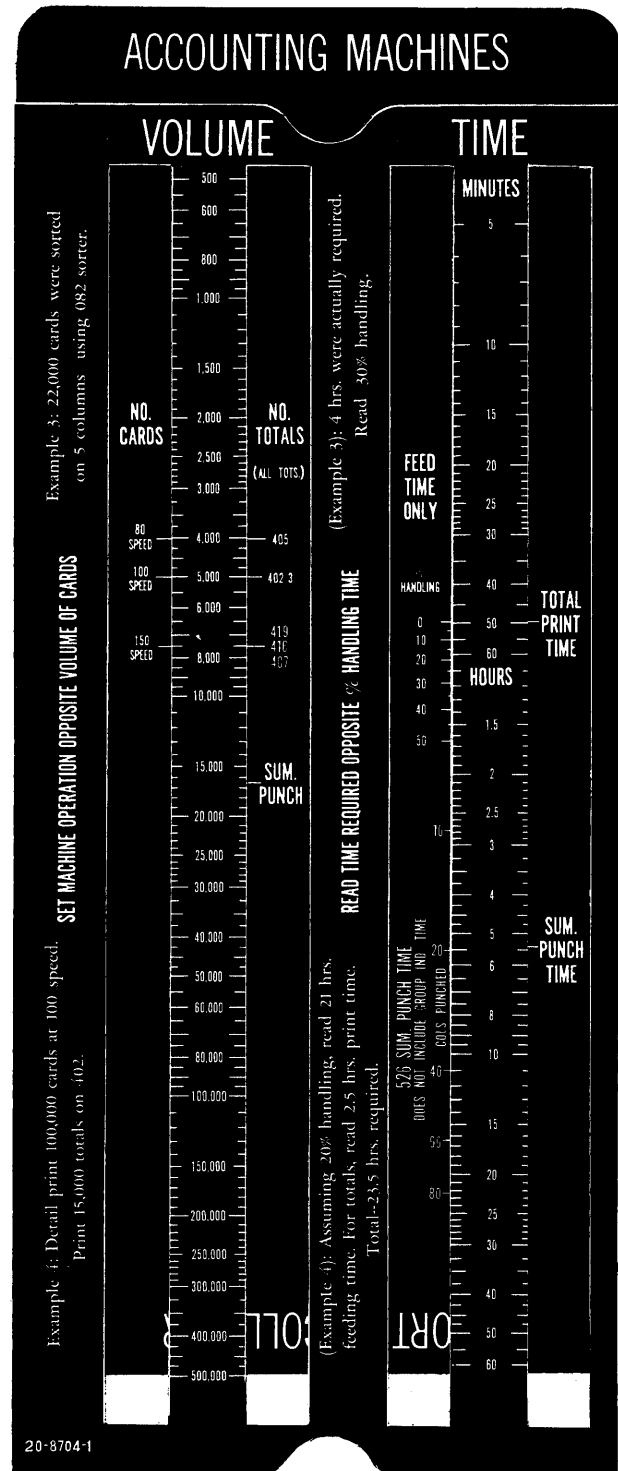
FIGURE 22

When the volume of cards and the total running time are known, the machine-load computer can be used to compute handling time.

Problem: If 10,000 cards were reproduced on the Type 519 and the total time, less setup time, was 2.4 hours, what would be the per cent handling time?

Set the 519 index opposite 10,000 cards and read opposite 2.4 hours on the time scale—30% handling time (Figure 24).
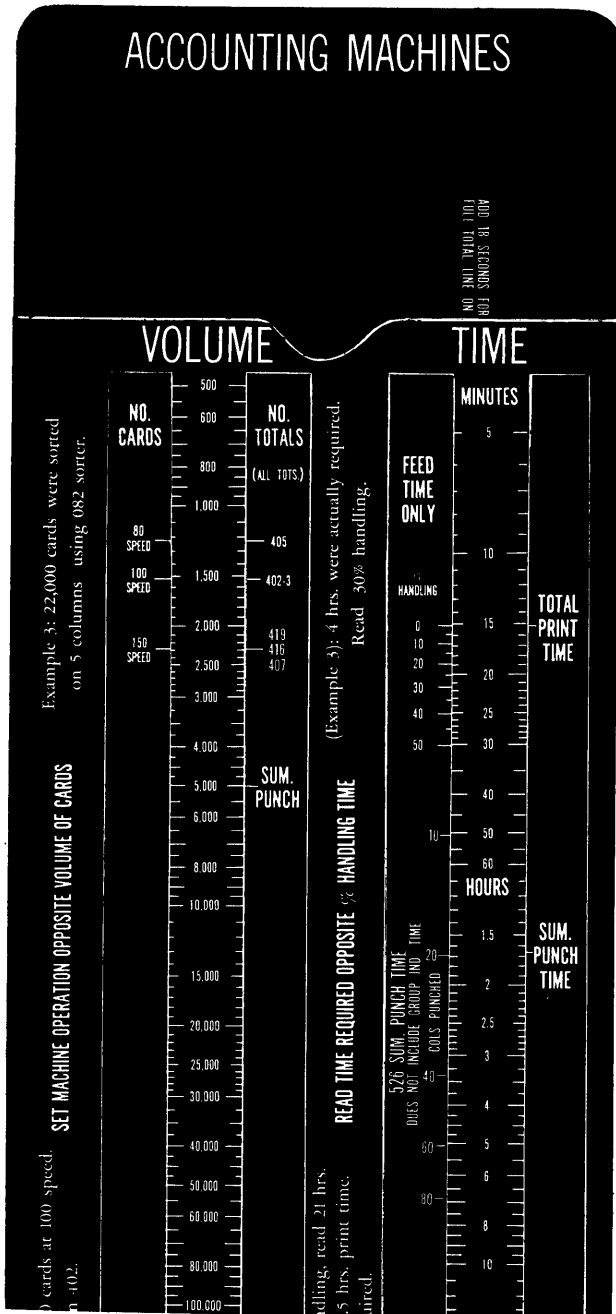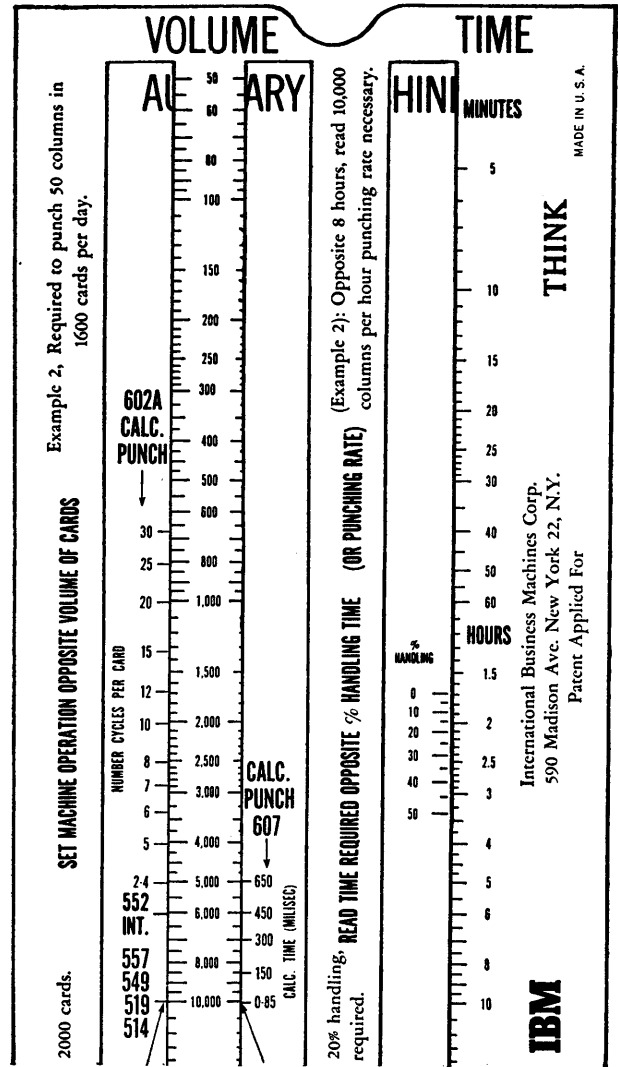

FIGURE 23

FIGURE 24

Machine Load Tables

Machine time tables are also used to give this same information. A consolidated machine time table is shown in Figure 25. When these tables are used for scheduling specific jobs, they must be revised to include the setup and handling time required. Or, if more desirable, a setup and handling time factor may be applied to results obtained from the table. To use the machine time table, locate the volume of cards to be processed in the left or right column of the table. In the column corresponding to the nature of the operation, read the time required. Figure 25 will give further explanation of the use of this chart.

CARD VOLUME	77 COLLATOR TWO FEED	SMALL	LARGE	ONE FEED	82 SORTER 1	2	3	4	5	6	7	8	402-403 GROUP PRINT FEED TIME ONLY	MA. & INT. TOTAL PRINT	MI. TOT PRINT & G.I.	SUM. PUNCH	DETAIL PRINT	514 & 519 REPR. 604 CALC. 557 INT.	552 INT'R	602-A 2	4	6	8	10	15	20	25	KEY PUNCH 20	40	60	80	CARD VOLUME
50	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.3	0.5	0.7	1.0	0.5	0.5	0.8	1.0	1.3	1.5	2.0	2.5	3.8	5.0	6.0	6.0	12.0	18.0	24.0	50
100	0.2	0.3	0.3	0.4	0.1	0.3	0.5	0.6	0.8	0.9	1.1	1.2	0.7	1.0	1.3	2.0	1.0	1.0	1.7	2.0	2.5	3.0	4.0	5.0	7.5	10.0	12.0	12.0	24.0	36.0	48.0	100
150	0.3	0.4	0.5	0.6	0.2	0.5	0.7	0.9	1.2	1.4	1.6	1.8	1.0	1.5	2.0	3.0	1.5	1.5	2.5	3.0	3.8	5.0	6.0	7.5	11.0	15.0	18.0	18.0	36.0	54.0	1.2	150
200	0.4	0.5	0.6	0.8	0.3	0.6	0.9	1.2	1.5	1.8	2.2	2.5	1.3	2.0	2.7	4.0	2.0	2.0	3.3	4.0	5.0	6.0	8.0	10.0	15.0	20.0	24.0	24.0	48.0	1.2	1.6	200
250	0.5	0.6	0.8	1.0	0.4	0.8	1.2	1.5	1.9	2.3	2.7	3.1	1.7	2.5	3.3	5.0	2.5	2.5	4.2	5.0	6.3	7.5	10.0	13.0	19.0	25.0	30.0	30.0	1.0	1.5	2.0	250
300	0.6	0.8	0.9	1.3	0.5	0.9	1.4	1.8	2.3	2.8	3.2	3.7	2.0	3.0	4.0	6.0	3.0	3.0	5.0	6.0	7.5	9.0	12.0	15.0	23.0	30.0	36.0	36.0	1.2	1.8	2.4	300
400	0.8	1.0	1.3	1.7	0.6	1.2	1.8	2.5	3.1	3.7	4.3	4.9	2.7	4.0	5.3	8.0	4.0	4.0	6.7	8.0	10.0	12.0	16.0	20.0	30.0	40.0	48.0	48.0	1.6	2.4	3.2	400
500	1.0	1.3	1.6	2.1	0.8	1.5	2.3	3.1	3.8	4.6	5.4	6.1	3.3	5.0	6.7	10.0	5.0	5.0	8.3	10.0	13.0	15.0	20.0	25.0	38.0	50.0	1.0	1.0	2.0	3.0	4.0	500
600	1.3	1.5	1.9	2.5	0.9	1.8	2.8	3.7	4.6	5.5	6.5	7.4	4.0	6.0	8.0	12.0	6.0	6.0	10.0	12.0	15.0	18.0	24.0	30.0	45.0	1.0	1.2	1.2	2.4	3.6	4.8	600
800	1.7	2.0	2.5	3.3	1.2	2.5	3.7	4.9	6.2	7.4	8.6	9.8	5.3	8.0	10.7	16.0	8.0	8.0	13.0	16.0	20.0	24.0	32.0	40.0	1.0	1.3	1.6	1.6	3.2	4.8	6.4	800
1,000	2.1	2.5	3.1	4.2	1.5	3.1	4.6	6.2	7.7	9.2	10.8	12.3	6.7	10.0	13.3	20.0	10.0	10.0	17.0	20.0	25.0	30.0	35.0	50.0	1.3	1.7	2.0	2.0	4.0	6.0	8.0	1,000
1,500	3.1	3.7	4.7	6.3	2.3	4.6	6.9	9.3	11.5	13.8	16.1	18.6	10.0	15.0	20.0	30.0	15.0	15.0	25.0	30.0	38.0	46.0	54.0	1.3	1.9	2.5	3.0	3.0	6.0	9.0	12.0	1,500
2,000	4.2	5.0	6.3	8.4	3.1	6.2	9.2	12.3	15.4	18.5	21.5	24.6	13.3	20.0	26.6	40.0	20.0	20.0	33.0	40.0	50.0	1.0	1.3	1.7	2.5	3.3	4.0	4.0	8.0	12.8	16.0	2,000
2,500	5.2	6.2	7.8	10.0	3.8	7.7	11.5	15.4	19.2	23.1	26.9	30.8	16.6	25.0	33.3	50.0	25.0	25.0	42.0	50.0	1.0	1.3	1.7	2.1	3.1	4.2	5.0	5.0	10.0	15.0	20.0	2,500
3,000	6.2	7.5	9.4	13.0	4.6	9.2	13.8	18.5	23.1	27.7	32.3	36.9	20.0	30.0	40.0	1.0	30.0	30.0	50.0	1.0	1.3	1.5	2.0	2.5	3.8	5.0	6.0	6.0	12.0	18.0	24.0	3,000
4,000	8.3	10.0	13.0	17.0	6.2	12.3	18.5	24.6	30.8	36.9	43.1	49.3	26.6	40.0	53.3	1.3	40.0	40.0	1.1	1.3	1.7	2.0	2.7	3.3	5.0	6.7	8.0	8.0	16.0	24.0	32.0	4,000
5,000	10.0	13.0	16.0	21.0	7.7	15.4	23.1	30.8	38.4	46.2	53.8	1.0	33.3	50.0	1.0	1.7	50.0	50.0	1.4	1.7	2.1	2.5	3.3	4.2	6.3	8.3	10.0	10.0	20.0	30.0	40.0	5,000
6,000	13.0	15.0	19.0	25.0	9.2	18.4	27.7	36.9	46.2	55.4	1.1	1.2	40.0	1.0	1.3	2.0	1.0	1.0	1.7	2.0	2.5	3.0	4.0	5.0	7.5	10.0	12.0	12.0	24.0	36.0	48.0	6,000
8,000	17.0	20.0	25.0	33.0	12.3	24.6	36.9	49.2	1.0	1.2	1.4	1.6	53.3	1.3	1.8	2.7	1.3	1.3	2.2	2.7	3.3	4.0	5.3	6.7	10.0	13.0	16.0	16.0	32.0	48.0	64.0	8,000
10,000	21.0	25.0	31.0	42.0	15.4	30.8	46.2	1.0	1.3	1.5	1.8	2.1	1.1	1.7	2.2	3.3	1.7	1.7	2.8	3.3	4.2	5.0	6.7	8.3	13.0	17.0	20.0	20.0	40.0	60.0	80.0	10,000
15,000	31.0	38.0	47.0	1.0	23.1	46.2	1.1	1.5	1.9	2.3	2.7	3.1	1.7	2.5	3.3	5.0	2.5	2.5	4.2	5.0	6.3	7.5	10.0	13.0	19.0	25.0	30.0	30.0	60.0	90.0	120.0	15,000
20,000	42.0	50.0	1.0	1.4	30.8	1.0	1.5	2.1	2.6	3.1	3.6	4.1	2.2	3.3	4.5	6.7	3.3	3.3	5.6	6.7	8.3	10.0	13.0	17.0	25.0	33.0	40.0	40.0	80.0	120.0	160.0	20,000
25,000	52.0	1.0	1.3	1.7	38.5	1.3	1.9	2.6	3.5	3.8	4.3	5.1	2.8	4.2	5.5	8.3	4.2	4.2	7.0	8.3	10.0	13.0	17.0	21.0	31.0	42.0	50.0	50.0	100.0	150.0	200.0	25,000
30,000	1.0	1.3	1.6	2.1	46.2	1.5	2.3	3.1	3.8	4.6	5.4	6.1	3.3	5.0	6.7	10.0	5.0	5.0	8.3	10.0	13.0	15.0	20.0	25.0	38.0	50.0	60.0	60.0	120.0	180.0	240.0	30,000
40,000	1.4	1.7	2.1	2.8	1.0	2.1	3.1	4.1	5.1	6.2	7.2	8.2	4.5	6.7	8.9	13.3	6.7	6.7	11.0	13.0	17.0	20.0	27.0	33.0	50.0	67.0	80.0	80.0	160.0	240.0	320.0	40,000
50,000	1.7	2.1	2.6	3.5	1.3	2.6	3.8	5.1	6.4	7.7	8.9	10.2	5.6	8.3	11.1	16.6	8.3	8.3	14.0	17.0	21.0	25.0	33.0	42.0	63.0	83.0	100.0	100.0	200.0	300.0	400.0	50,000
60,000	2.1	2.5	3.1	4.2	1.5	3.1	4.6	6.2	7.7	9.3	10.7	12.3	6.7	10.0	13.3	20.0	10.0	10.0	17.0	20.0	25.0	30.0	40.0	50.0	75.0	100.0	120.0	120.0	240.0	360.0	480.0	60,000
80,000	2.8	3.3	4.2	5.6	2.1	4.1	6.1	8.2	10.3	12.3	14.3	16.4	8.9	13.3	17.6	26.6	13.3	13.3	22.0	27.0	33.0	40.0	53.0	67.0	100.0	134.0	160.0	160.0	320.0	480.0	640.0	80,000
100,000	3.5	4.2	5.2	6.9	2.6	5.1	7.7	10.3	12.8	15.3	17.9	20.5	11.1	16.6	22.2	33.3	16.6	17.0	28.0	33.0	42.0	50.0	67.0	83.0	125.0	167.0	200.0	200.0	400.0	600.0	800.0	100,000
150,000	5.2	6.3	7.8	10.0	3.9	7.7	11.6	15.4	19.2	23.0	26.8	31.0	16.6	25.0	33.3	50.0	25.0	25.0	42.0	50.0	63.0	75.0	100.0	130.0	190.0	250.0	300.0	300.0	600.0	900.0		150,000
200,000	7.0	8.3	10.0	14.0	5.1	10.2	15.4	20.5	25.7	30.9	35.0	41.0	22.1	33.3	44.5	66.6	33.3	33.0	56.0	67.0	83.0	100.0	130.0	170.0	250.0	330.0	400.0	400.0	800.0			200,000
250,000	8.7	10.0	13.0	17.0	6.1	12.8	19.2	25.7	35.0	38.5	43.2	51.4	27.8	41.6	55.5	83.3	41.6	42.0	70.0	83.0	100.0	130.0	170.0	210.0	310.0	420.0	500.0	500.0				250,000
300,000	10.0	13.0	16.0	21.0	7.7	15.4	23.0	30.8	38.5	46.2	53.8	61.5	33.3	50.0	66.6	100.0	50.0	50.0	83.0	100.0	130.0	150.0	200.0	250.0	380.0	500.0	600.0	600.0				300,000

CARDS	MA. & INT. TOTALS	MINOR TOTALS	SUM. CARDS	CARDS & TOTAL PROG.

FIGURE 25

Figures above the heavy line are *minutes;* those below the heavy line are *hours.* All figures are accurate to two significant digits, rounded to tenths of minutes or hours.

To use the table, follow horizontally from the known card volume to the column which represents the operation and read the machine hours. For the Types 402-403 Accounting Machines, the figures in the card column are to be used for five different factors shown at the bottom of the Types 402-403 operations column. The run should be broken down into its component parts corresponding to the factors on the table. When the times for the different phases have been found, they are added together to give the total time. For the Type 77 Collator, on jobs requiring only one feed, the one-feed column should be used. In merging and matching operations, the feeds operate separately or in unison, depending on the grouping of the cards. The speed used should be the one best descriptive of the job. In all cases on the Type 77 Collator, the total number of cards should be used (primaries and secondaries).

RECORDING AND USING TIME FACTORS

REGARDLESS of the method used to calculate time factors for specific operations, it is necessary to record these results in a fashion that permits their best utilization.

If job schedules are to be developed, the most convenient place to record time factors is on the operational flow chart (Figure 26). Time figures may be recorded beside the various operations symbolized on the flow chart, and volume figures may be recorded on or beside the card and card file symbols.
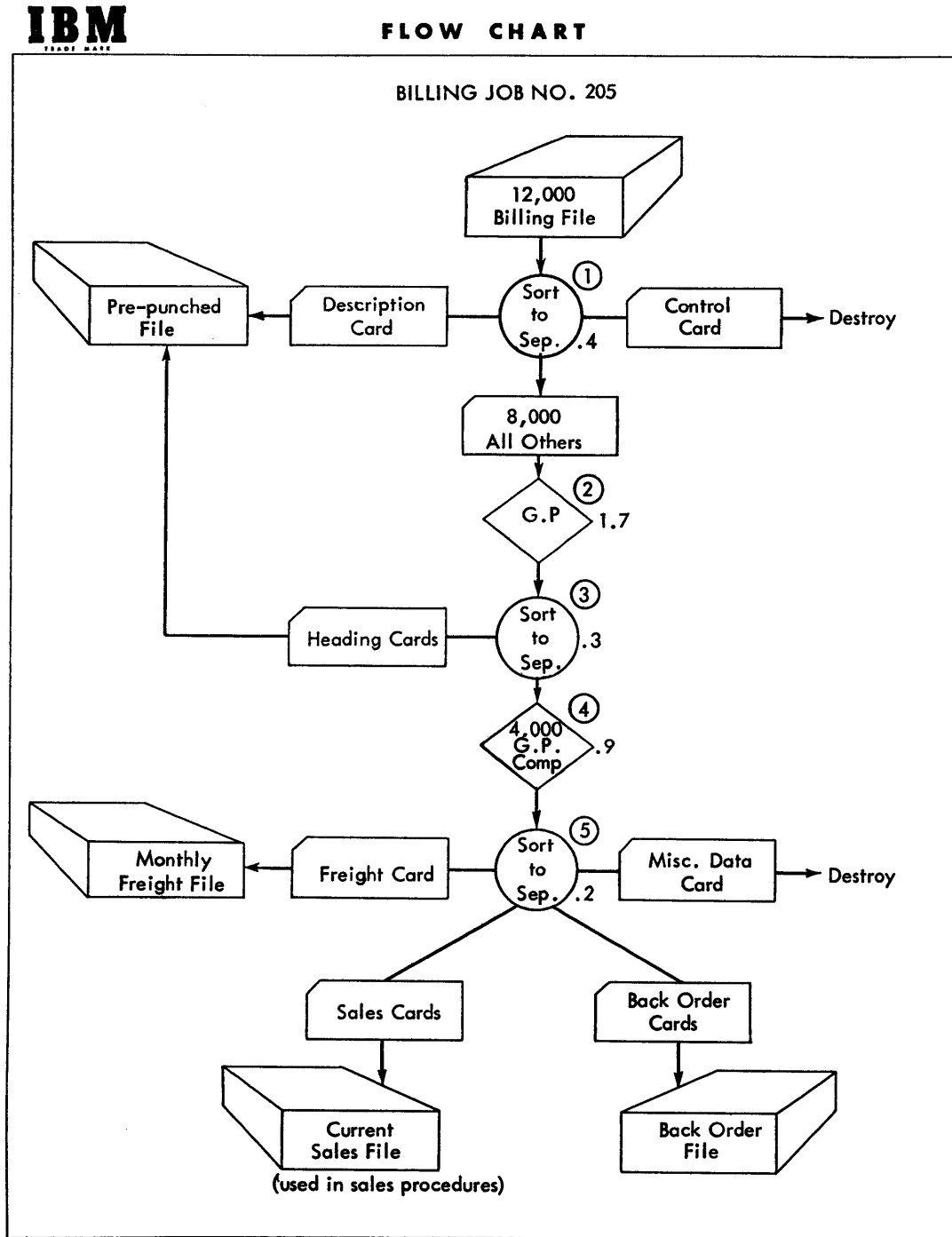
IBM   **FLOW CHART**

BILLING JOB NO. 205

12,000
Billing File

Pre-punched
File

Description
Card

Sort to Sep. ① .4

Control
Card

→ Destroy

8,000
All Others

G.P ② 1.7

Heading Cards

Sort to Sep. ③ .3

4,000
G.P.
Comp ④ .9

Monthly
Freight File

Freight Card

Sort to Sep. ⑤ .2

Misc. Data
Card

→ Destroy

Sales Cards

Back Order
Cards

Current
Sales File
(used in sales procedures)

Back Order
File

FIGURE 26

Some supervisors prefer to record time factors on a work sheet similar to Figure 27. This is merely a list of operations performed in a given job, and the data necessary for calculating time factors. Time may be recorded on a per-thousand basis or on the basis of a known volume load.

To provide operators with information pertaining to scheduled time, the detailed job instruction sheets may be used for recording time factors (Figure 28).

No.	Mach.	Operating Data for Machine Time	No. of Cards	Time
		Daily Job No. 205		
1	Sort	1 column Separation	12,000	.4
2	G. P.		8,000	1.7
3	Sort	1 column Separation	8,000	.3
4	G. P.		4,000	.9
5	Sort	1 column Separation	4,000	.2

FIGURE 27

JOB INSTRUCTIONS   IBM

JOB NAME				JOB NO.	FREQUENCY		DUE IN		DUE OUT	
					☒ Daily ☐ Monthly ☐ Weekly ☐ Quarterly ☐ Bi-Weekly ☐ Annual ☐ Semi-Monthly ☐ Other		TIME	DATE	TIME	DATE
BILLING				205			8:00	Daily	1:00	Daily

OPER. NO.	MACH. TYPE	ESTIMATED VOLUME	ESTIMATED TIME	DESCRIPTION
1	82	12,000	.4	Sort cards on column 80 to pull out Miscellaneous Description and Control cards. All commutator switches except switches No. 6 and No. 8 should be pushed to center.
				Cards falling pocket 8 are Control cards. Destroy.
				Cards falling pocket 6 are Miscellaneous Description cards. Return to Tub file.
				Remaining cards (reject pocket) to Operation 2.
2	514	8,000	1.7	Gangpunch Branch, Customer Number, Salesman Number, Invoice Date and Invoice Number into all Commodity cards.
				NOTE: Branch and Customer Number are punched from the Heading cards. Salesman Number, Invoice Number, Invoice Date, are punched from the Miscellaneous Data card.
				Set PX Brush 1 on column 5.
				Set PX Brush 6 on column 73.
3	82	8,000	.3	Sort cards on "X" in column 5.
				1. Cards falling in "X" pocket are heading cards. Return to Tub files for further use.
				2. Cards in reject pocket continue to Operation 4.

Date: __Oct. 4, 19__   Section ____1____   Page: __23__

FIGURE 28

Figure 29

This method is well adapted to departments which have many standard jobs and work loads; an operator can see the amount of time each operation should normally require.

In a department where many jobs are performed, time factors may be more advantageously recorded in punched cards similar to the one shown in Figure 29. This card includes start and finish, day of the month, job number, operation number, machine type, total hours scheduled for the month, and a breakdown by work days of the daily machine load. If it is not necessary to break down the machine time by operation, the operation number can be elminated, and machine time will be punched only by machine type. Such a form facilitates the calculation of total time by type of machine and by day to control the assignment of jobs to the various operating sections within the department. A report similar to the one in Figure 30 can be prepared from these cards, and it is actually a machine schedule for the month.

As stated earlier in this booklet, work loads in the accounting machine department have several uses:

1. Scheduling
2. Standards
3. Cost figures

The most important of these three, as far as the efficiency of operating the department is concerned, is

scheduling. Work loads themselves are of little value until properly used in planning work through the department. It is up to the supervisor of the machine-accounting function to construct a workable schedule from these time factors. It is also necessary that actual time figures be kept to make comparisons against scheduled machine times. The preparation and utilization of schedules is discussed in the *Scheduling* manual.

Time factors that have been calculated and recorded provide the necessary transition from job specifications to schedules, which provide a basis for operation. Scheduled or standard time is an essential part of the data used in the evaluation of operations such as performance, setup, and handling time. When such evaluations are made continuously, they provide a performance standard. These standards form the basis upon which the total time for similar work in the future can be scheduled with confidence. The scheduling, therefore, is simplified. It is essential, however, to continue evaluating performance to determine the relative amount of setup and handling time compared to machine time, as well as to idle time and overtime.

It should be remembered that information about a job is not complete until it includes *how much time*, computed from *how many cards*, and an estimate of the accuracy with which these figures have been determined.

MONTHLY SCHEDULE OF OPERATIONS

MONTH_____

Type of Oper.	Job No.	Op. No.	Total Est. Hrs.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
															WORK	DAYS	OF	MONTH							
077	030	10	1													1									
077	130	93	1																	1					
077	031	16	3														1	1						1	
077	432	51	3									1	1												
077	439	51	7						7																
077	439	81	3									3													
077	370	84	34					15	15	4															
077	071	05	2						2																
077	372	38	12				3																		
077	478	11	3					3																	
077	479	02	5																		5				
077	079	30	31	1	12			4				6		7											
077	479	64	396	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
077	479	69	20													8	8	4							
			521	19	30	18	21	40	42	22	18	31	19	25	18	27	30	23	18	19	23	21	18	19	20
HRS	AVAIL		704	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32

This report shows the estimated usage for a particular machine by job and working day. A total machine usage by day is shown on the next-to-the-bottom line. The last line is the amount of daily machine time, available (32 hours), and a total for the 22 days (22 × 32 = 704).

FIGURE 30

IBM ®

Card Punching
and Verifying

IBM
data processing
MANAGEMENT

IBM ACCOUNTING

MANAGEMENT

CARD PUNCHING AND VERIFYING

MODERN BUSINESS OPERATIONS involve the use of many kinds of source records or original documents bearing voluminous data. The transcription of such data into the form of punched holes in IBM cards is the first step in an IBM Accounting procedure. This can be done by an operator on high-speed equipment, can be performed automatically from other cards already in existence, or can be done by mark sensing—that is, holes are punched automatically into the card by a machine which senses pencil marks electronically.

Once the initial data have been recorded as holes in the cards, IBM machines automatically read these holes and perform a wide variety of operations to prepare finished reports.

The high degree of accuracy maintained throughout IBM Accounting procedures is dependent upon accuracy in the initial punching of data into the cards. As basically important steps in the over-all accounting procedure, card punching and verifying operations deserve careful study and close analysis. This booklet offers general suggestions for the efficient supervision of card punching and verifying operations and includes specific recommendations for the improvement of accuracy.

CARD PUNCHING

WHILE this section is limited to a discussion of card punching, efficient supervision and planning for recording information includes the use of more automatic methods wherever possible. The first job of the supervisor in relation to card punching, therefore, is to decide whether the information is to be punched by means of a card punch, or whether one of the more automatic methods could be used. This means the investigation of each new job to determine how the data can best be punched, in consideration of all the possibilities:

1. Card punch.
2. Duplicate part of the data from a master card and card punch the rest.
3. Automatically reproduce the data from a set of cards already punched with the same data (although perhaps in different order).

4. Gang punch automatically information common to a group of cards from a master card sorted ahead of them in a file.

5. Have the data pencil-marked on the card, for automatic transcription into punched holes by the mark-sensing feature of the Reproducing Punch or Document-Originating Machine.

6. Punch automatically a summary card with the totals and indicative data accumulated for a report prepared on the Accounting Machine.

7. Set up a prepunched file for information which is used repetitively, such as that used in billing. Gang punch a supply of cards for each item, so that each time it is to be recorded, its prepunched card can be pulled from the file.

8. Use the results of a calculation punched in a card by one of the Calculating Punches.

9. Use an emitter (on the Reproducer, Document-Originating Machine or Calculating Punch) to punch information such as ENTRY DATE which is common to a group of cards being processed.

Two, three, or more of these basic methods can be combined for any one job, depending on its specifications. The selection of the method by which a job should be done requires a knowledge of all these methods and of how they may best be used. Each new job (or an old one being studied) should be analyzed to determine whether any of the information to be punched already exists in punched form so that it can be copied automatically, or whether some items might better be punched by mark-sensing or some other method.

For all these methods except card punching (and duplicating), however, machine operation does not differ greatly from that used for other automatic functions. In the case of card punching, many different factors affect efficiency and accuracy of work. All of them should be given careful consideration:

Design of source documents and cards
Legibility of source documents
Number of columns to be punched (or duplicated) and proportion of alphabetic to numerical columns.
Skill and experience of operator
Type of equipment used
Type of instruction
Volume of transactions
Flow of work
Duties other than card punching (auditing, coding or checking)
Working conditions

Each of these factors should be given careful consideration by the supervisor, in evaluating work being done, in planning new procedures or improving procedures already in effect.

Design of Source Documents and Cards

An important factor in speed and accuracy of card punching is the design of the source documents and of the card form. Because the card moves automatically through the card punch as each column is punched, the operator must read the data from the document in the same sequence in which they are to be punched. The best design of both document and card, therefore, will provide for exactly the same arrangement of the items on both. Usually the card is designed to conform to the arrangement of an existing source document.

If the card and source document are not arranged alike, it is often desirable and economical to attach an apron or use a rubber stamp on the document (Figure 1). The information to be punched can then be manually transcribed to the apron so that the card punch operator may read it in the right sequence. This procedure is especially desirable when coding or other necessary information is added to the document before it is punched.

The ideal source document for card punching shows all information to be punched in one card on one line, so that it may be read from left to right. It is for this reason that transcription forms or alignment sheets are designed for use in many jobs for which the source information arises within the company. These transcription sheets are ruled into grids, with 80 (or fewer) squares horizontally in which the data to be recorded in one card are recorded, and 25 or 50 lines vertically to receive the data for that many cards. Such sheets may be used to good advantage when the information must be collected from many sources before it is punched, when there are coding or editing functions to be performed, or when the source document is so poorly designed or illegible that the card punch operation would be inefficient without special forms.

The design of the card with respect to duplicated, punched, and skipped fields further affects card punching speed and efficiency. Best operation is achieved when duplicated information appears at the left of the card, and when all fields to be card punched are grouped together so that the punching need not be interrupted by skipping.

Alphabetic information affects speed and accuracy of card punching when it is interspersed with numerical data in the same card. Speed is lessened when the operator has to change from numerical punching to alphabetic punching for a certain field, and then back to numerical. Here again, careful design of the source document and card form will reduce to a minimum the necessity for shifting from one to the other.

ABBOT BRASS COMPANY
117 WATER STREET
ERIE, PENNSYLVANIA

SOLD TO
GENERAL MANUFACTURING CO
ENDICOTT
NEW YORK

DATE
1 2 | 2 1 | YR.
MO. | DAY |

SHIPPED TO
ABOVE

VIA FREIGHT ERIE

TERMS 2 10 NET 30	F.O.B. ERIE	CUST. ORD. NO 6542	OUR ORD. NO. 1 1 1 3 7		INVOICE NO. 2 4 0 2 7
QUANTITY	ITEM No.	DESCRIPTION			AMOUNT
1 8	2 0 4 0 0	SOFT BRASS ROD			3 2 9 7
3 5	1 0 3 0 0	BRASS ROD			2 8 6 0
3 9 5 0	2 0 0 2 3	BRASS CASTING			9 7 2 1
					1 5 8 7 8 *

INVOICE DATE *12 /21*	VENDOR No. *1179*	OUR INVOICE *12/20*	RECEIVED	APPROVED BY:
ENTRY *30*	ORDER No.	DUE DATE *12/31*	DEPT. USING	INSPECTED

PURCHASING AGENT

ACCOUNT		DEPT. CHARGED	MATERIAL	QUANTITY	UNIT	AMOUNT
GEN.	SUB.					
123	*360*		*20 400*	*18*		*32 97*
123	*350*		*10 300*	*35*		*28.60*
124	*420*		*200 23*	*3950*		*97.21*

APPROVED BY:

ACCOUNTING

INVOICE AMOUNT	*158.78*
DISCOUNT	*3.18*
NET	*155.60*

FIGURE 1. USE OF STANDARDIZED APRON FORM TO FACILITATE CARD PUNCHING

Legibility of Source Documents

The degree of legibility of the source data is one of the more important factors which affect production in card punching. For this reason, original copies—rather than the sixth or twelfth carbon copy—should be routed to the card punch operation whenever possible. A source document which contains manually written data should be designed so that enough space is allowed for large, legible characters to be hand written, especially when this writing is to be done by someone other than a clerk.
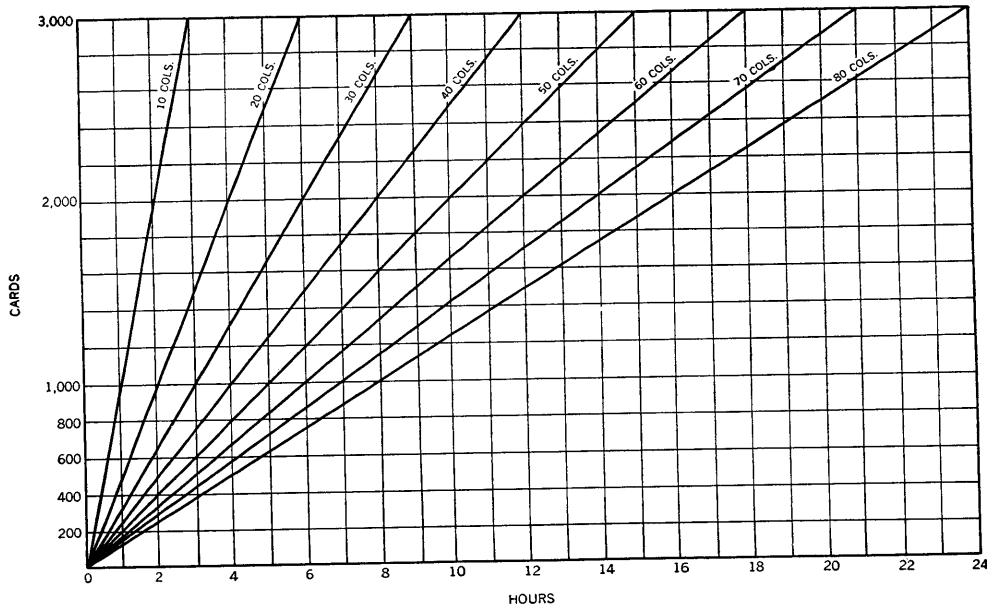
FIGURE 2. CHART FOR DETERMINING CARD PUNCHING TIME

(BASED ON PRODUCTION RATE OF 10,000 COLUMNS PER HOUR)

Number of Columns Punched

The number of cards punched per hour is directly dependent on the number of columns to be punched per card. To evaluate production of card punch operators, it is customary to express production in terms of columns punched per hour, or key depressions per hour. This is obtained by multiplying the number of cards punched per hour by the average number of columns punched in each card. Charts similar to Figure 2 are frequently used to schedule card punching jobs.

Whenever it is possible, information common to groups of cards will be punched automatically by using the duplicating feature of the machine. Duplication not only saves actual punching time, but also increases the accuracy of the job and simplifies verification.

Skill and Experience of Operators

In evaluating the work of card punch operators, it is important to consider their training and experience. For new operators, the number of cards punched per hour or the number of errors being made are not so important as how much *improvement* is being made from week to week. This trend is the best indication of the type of production that can be expected in the development of each operator. Only after the

7
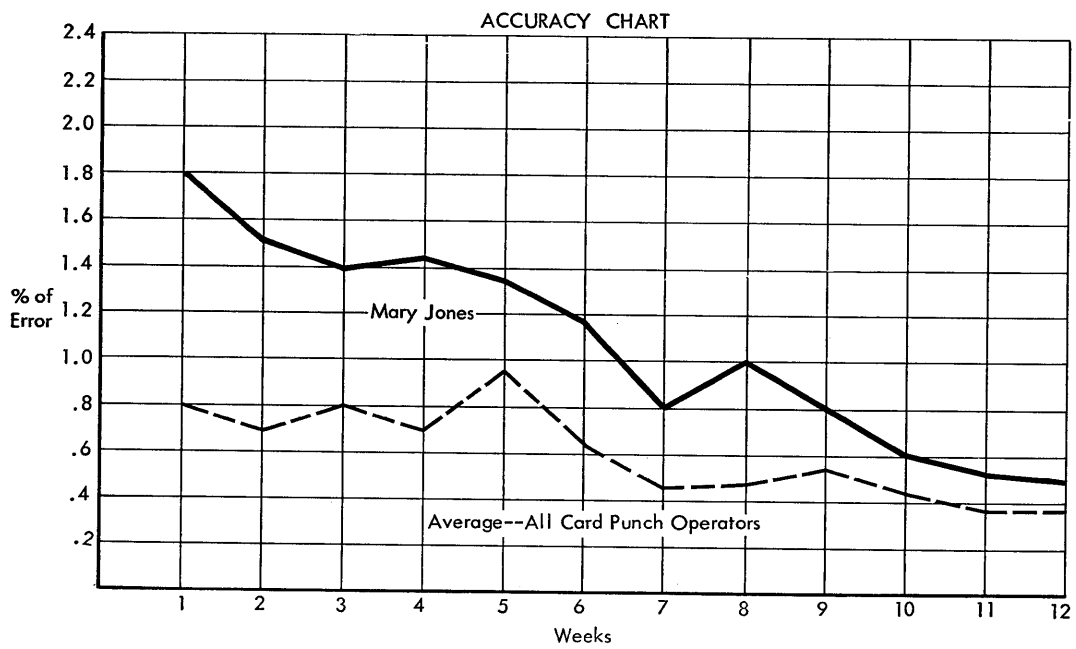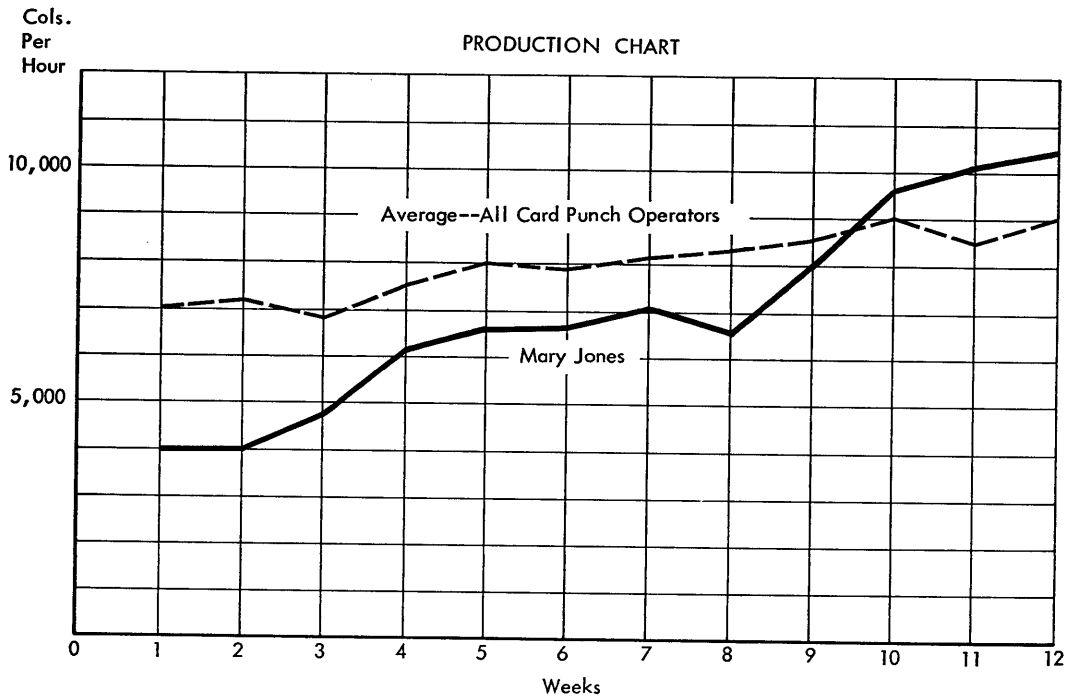
FIGURE 3. CHARTS OF CARD PRODUCTION AND ACCURACY

8

operator has reached a level rate of production should her proficiency be given an absolute evaluation.

It is advisable to keep a record of the production and percentage of errors for each operator, and a comparison with the group average, such as shown in Figure 3. This production record is essential information for the supervisor as he makes plans for scheduling work through the card punching section. The prevailing percentage of error will have an important bearing upon the kind and amount of verification which will be built into the procedures.

Type of Equipment Used

New machines and devices are constantly being developed which incorporate more effective mechanisms for the reduction of the fatigue which, to a greater or lesser degree, is associated with all recording operations. The advantages of the newer machines and devices should be carefully studied by the supervisor with the object of continually improving equipment and performance. The special features of each should be used to simplify the card punching job and increase production. Such devices include alternate programming, auxiliary duplication, and the card insertion device.

Type of Instructions Given Operators

There is much that the supervisor can do to raise the production and reduce the errors of card punch operators. It is extremely important that he give complete, clear, understandable instructions. It is preferable that the oral directions be summarized in written form.

If directions are given verbally, and in a rather hurried manner, as is so often the case, the speed and accuracy with which the work is done will be low. The operator may not have understood at the time, or may forget certain details of the directions; he may ask others (who probably do not know) or may have to go back to the supervisor for a second set of instructions; or he may perform the whole job wrong, so that it has to be done over. These conditions can be completely eliminated by carefully writing all instructions necessary for performing all jobs. It is even more important that one-time jobs or infrequent jobs have written instructions, because the operators will have little or no experience to

CARD PUNCHING OR VERIFYING INSTRUCTIONS   **IBM**

JOB NAME		JOB NO.	CONTROL PANEL NO.	OPERATION NAME	OP.CODE	MACH. TYPE
Accounts Payable		*832*		*Punch*	*30*	*026*

FREQUENCY		DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME
☑ Daily ☐ Weekly ☐ Bi-Weekly ☐ Semi-Monthly	☐ Monthly ☐ Quarterly ☐ Annual ☐ Other	TIME *10⁰⁰*	DATE *Daily*	TIME *1⁰⁰*	DATE *Daily*	*200*	HOURS TENTHS *1 3*

PROGRAM CARD OR SKIP BAR NO.	SPECIAL FEATURES USED		
38 Accounts Payable	☐ ALTERNATE PROGRAM ☐ AUXILIARY DUPLICATE ☐		☐ CARD REVERSING ☐ SELF CHECKING NO. ☐

SWITCH SETTINGS

24-26-56   31

ON	OFF	SWITCH	OFF	ON	SWITCH
✓		PROGRAM UNIT			RELEASE KEY EJECT
✓		AUTO FEED			AUTO EJECT
✓		AUTO SKIP—AUTO DUPL.			
✓		PRINT			
	✓	SELF CHECKING NO.			

CARD FIELD	COLUMNS FROM	TO	FUNCTION*	REMARKS
1. *Entry Date*	*1*	*3*	*D*	
2. *Invoice Date*	*4*	*6*	*P*	
3. *Vendor No.*	*7*	*11*	*P*	
4. *Vendor Abbreviation*	*12*	*22*	*P*	
5. *Vendor Invoice No.*	*23*	*28*	*P*	
6. *Our Invoice No.*	*29*	*33*	*P*	
7. *Date Paid*	*50*	*52*	*S*	*Not punched*
8. *Due Date*	*53*	*55*	*P*	
9. *Discount*	*56*	*60*	*P*	
10. *Invoice Amount*	*63*	*69*	*P*	
11. *Amount to Pay*	*70*	*76*	*P*	
12.				
13.				
14.				
15.				
16.				

	FUNCTION*	SYMBOL
DUPLICATE		D
PUNCH		P
SKIP		S
X SKIP		XS
VERIFY		V
SELF NO CK		CK

TOTAL KEY STROKES PER CARD— *55*

Date: _____   Section____ ____ Page _____

FIGURE 4. JOB STEP INSTRUCTION SHEET FOR CARD PUNCHING

use as a guide for these jobs. *All* jobs should have written instructions for the operator, and become part of the operators' manual of procedure (Figure 4).

Volume of Transactions

It might be expected that card punch operators would produce more per hour when they are working on jobs of large volume, in which there

is no change in set-up of the machine or in the documents and cards. It is true that production increases as the operators become more familiar with the job, as in any standardized operation. The element of fatigue may, however, offset the greater production resulting from familiarity with the job. The two factors may even exactly balance each other, so that the same rate of production is obtained by an operator, regardless of the volume of the job. The effect of the size of the job on production, then, is dependent entirely upon the operator. Operators who like routine work will have a higher rate of production when the size of the job increases. Those who desire change and novelty will become fatigued quickly on such jobs. This element of fatigue in relation to the size of a job should be given consideration in the planning of work, so that it may be reduced to a minimum.

Flow of Work

The most efficient production cannot be reached when the operator is being interrupted continually to perform special jobs, when a job is shifted from one operator to another, or when work is done piece-meal as documents become available. When more than one operator is required for a job, there should be an equitable distribution of work to the several operators, commensurate with their productive capacities. Furthermore, each operator should have a backlog of documents—not so large as to create a pile of idle material, nor so small that the operator's work will be interrupted, This requires careful planning and scheduling on the part of the supervisor.

The flow of work should be such that the operators do not have to leave their place of work. If the operators transfer work from one station to another, they should be located so that they do not have to leave their desks to do so. Otherwise, they will be doing a double job—card punching and messenger service.

Duties Other than Card Punching

Card punch operators are frequently called upon to do other kinds of jobs, such as coding, auditing, selecting, comparing and checking, while they are card punching. Card punch production is inevitably lowered in such a case, and these factors should be taken into consideration in evaluating the production. It is sometimes a better plan to have persons other than the card punch operator doing the auditing, checking, coding, and messenger work. However, for morale purposes, it may be more desirable to introduce the varied duties.

11

Working Conditions and Morale

The conditions under which card punch operators perform their duties, and the morale of operators, are the most intangible factors to be dealt with by the supervisor. Because they are intangible and immeasurable, morale factors are too frequently overlooked. It is now generally recognized by the best supervisors that efforts exerted to improve morale of operators can go further than those in any other single area to increase production and improve the general working relations of all personnel in the department.

The operator works best when the work is enjoyed. Although few jobs are completely enjoyable, there is much that can be done to keep the job from being completely disliked.

A room of the proper temperature, humidity, and ventilation is usually a first consideration for comfort. The card punch operator, more than the operators of any other IBM machines, requires good illumination of the source documents for maximum efficiency. A minimum 25 candle-power illumination is considered necessary for such work. The machine is usually located near the window, preferably with a northern exposure, and positioned so that daylight will be to the operator's left.

Disturbing noises and sounds should be kept at a minimum. It is not the continuous sounds of fans running, machines operating, or keys striking that are so disturbing, but the noises that are not continuous, such as the ringing of telephones, opening and shutting of doors, or other unusual disturbances which increase fatigue. Even more distracting are movements of things and people which take place in the area of vision of the operator and divert the attention from work. Other machine operations, or any other activity involving motion, should be removed from in front of the card punch operator. When several card punch operators are in the same room, they should be placed one behind the other in order to minimize distractions.

Rest periods should be provided at proper intervals. Studies have indicated that long periods of work, such as from morning until noon, should be broken by a rest period about mid-morning and a second rest period at about the three-quarter point. For example, if the hours are from 8:00 to 12:00 noon, there should be a rest period at 10:00 and another at 11:00. If only one rest period is allowed, it should be about two-thirds of the way through the work period.

Every possible effort should be made to reduce fatigue for the card punch operator. Proper instruction in the use of the touch system of card punch operation during an adequate period of training, proper working posture, knowledge of motion economy principles, and adequate and up-to-date machinery all contribute to reduction of fatigue.

12

There are social aspects of good morale, in addition to the physical conditions described. Operators appreciate a certain amount of attention. They like to have their supervisor say "Good morning" to them, call them by name, and chat with them from time to time. They like to be given an opportunity for a periodic interview with their supervisors so that they may know what progress they are making. They want good work to be recognized. They like to be part of a team, to know the part their jobs play in the larger job of the department and the company.

A change in routine is also a morale-builder, and the stimulus of rivalry can add interest to the job. With the operators divided into two sections, contests can be set up on production and accuracy. By changing the groups from time to time, the rivalry can be kept high. Any change in routine, such as an improvement in method, a change of job, or a shift in location, can be stimulating.

Above all, good morale can result from the supervisor's qualities as leader. A supervisor who works with the operators, seeks to assist them wherever possible, and exhibits fair-dealing in all operations, is in a position to maintain high morale among those under his supervision.

VERIFICATION

IN THE IBM Accounting method, it is necessary to verify the accuracy of a fact recorded in punched hole form only once—immediately after the information has been punched. This is in contrast with verification requirements in manual procedures, where it is necessary that each recording of the same fact be verified by repeating the process, by visual checking, or by some other method. It is frequently discovered in manual procedures that as much as half of the office clerical staff is concerned with checking and verifying operations.

The term "verification" in this booklet refers to the checking or testing of punched information for conformity with the source information. Verification may be by use of a card verifying machine, and consist essentially of repeating the motions of the card punching operation. On the other hand there are many methods of verification in addition to manual card verification. For information punched automatically (as in reproducing, gang punching, or summary punching) automatic verification methods are usually used. These automatic methods may in some cases be used also for verifying the accuracy of manually punched information. As in the punching of information, the supervisor's first responsi-

bility is to determine which verification methods will be most effective for each type of information punched—or whether, in some cases, verification should be omitted entirely.

There are many checking methods and routines which are closely related to verification, and while they are not a part of this booklet, they should be kept in mind. These are the routines set up for document or accounting control, as in the use of control totals with each batch of source documents. Comparison of totals accumulated from the punched cards with the predetermined control total proves not only for the presence of all documents, but also for the accuracy of the information included in the control total.

All verification methods may be classified as one of three types: card verification, visual verification, or automatic verification.

Card Verification

The most direct method of verifying card punched information is by use of a key-driven verifying machine. These machines are operated in a manner practically identical to the card punching operation. The verifier operator reads the same information from the source document, and depresses keys, as in the original punching. Key depressions are compared by the machine with the holes already in the card, and if there is a discrepancy, the machine signals to the operator the fact that two recordings are not identical.

Card verification is usually the most effective way of verifying card punched *numerical* information. When a small amount of alphabetic information is found with the numerical data, an Alphabetic Verifier (Type 056) may be used for verifying both numerical and alphabetic data. When there is a large amount of descriptive alphabetic information, however, one of the visual verification methods may be more effective.

The greatest problem in card verification is to be sure that each card has been verified. This can be solved by proper supervision. In addition, the Type 056 Verifier automatically cuts a small notch on the end of the card to indicate that all columns have been verified.

The supervision of card verifying operations involves the same considerations as in card punching, and usually the two operations are located together. It may be advisable to exchange the card punch and verifier operators periodically, as most operators prefer such changes from time to time. Here, as in so many areas of supervision, the individual operator's preferences are most important.

Figure 5 illustrates a typical use of card verification.

14

GENERAL MANUFACTURING COMPANY
ENDICOTT, N. Y.

CUSTOMER'S ORDER No. 311   INVOICE DATE 12/31   INVOICE No. 12349

SOLD TO

New Mexico Company
216 Wysor Building
Houston, Texas

SHIP TO   Above   *Make all checks payable to*   SALESMAN Macy-67

GENERAL MANUFACTURING COMPANY
Endicott, N. Y.

SHIPPED VIA   Truck Prepaid

TERMS   2% 10 Days Net 30

QUANTITY	COMMODITY No.	DESCRIPTION	PRICE	AMOUNT
40	11202	Casters Sq. Shank Swivel	.83	33.20

SALES ACCOUNTING

FIGURE 5. CARD VERIFICATION

PUNCHED DATA VERIFIED FROM ORIGINAL DOCUMENT

15

HOUSTON TEXAS 13 59751

CODE

| | BR. | CUST. NO. | SALES-MAN NO. | | CARD CODE |

NAME AND ADDRESS

216 WYSOR BUILDING 13 59751

CODE

NAME AND ADDRESS

| | BR. | CUST. NO. | SALES-MAN NO. | | CARD CODE |

NEW MEXICO CO 13 59751

CODE

NAME AND ADDRESS

| | BR. | CUST. NO. | SALES-MAN NO. | | CARD CODE |

HEADING CARD — GENERAL MFG. CO.

```
0 0 0 0 0 0 0 0
1 1 1 1 1 1 1 1
2 2 2 2 2 2 2 2
3 3 3 3 3 3 3 3
4 4 4 4 4 4 4 4
5 5 5 5 5 5 5 5
6 6 6 6 6 6 6 6
7 7 7 7 7 7 7 7
8 8 8 8 8 8 8 8
9 9 9 9 9 9 9 9
1 2 3 4 5 6 7 8
      IBM
```

ORDER

GENERAL MANUFACTURING COMPANY

ENDICOTT, N. Y.

OFFICE USE ONLY

CREDIT DEPT. OK_____

SOLD TO _New Mexico Company_
216 Wysor Building
Houston, Texas

SHIP TO _Above_

13
59751

DATE TO BE SHIPPED _Jan 2_

DATE _12/29_ CUSTOMER ORDER No. _311_ SALESMAN _Mary_ SALESMAN No. _67_ INV. No. **12349**

PLEASE SHOW COMMODITY NUMBER

QUANTITY	DESCRIPTION	COMMODITY NUMBER	PRICE	
40	Sq. Shank Swivel	11202		
75	Flat Top Rigid	13102		
5	Ext. Shank with B.R.K.	17203		
2	Bolt + Nut Shank	32105		
4	Rnd. Spr. Ring Stem	44104		
40	Bolt + Nut Shank	62110		
166		179826		

FIGURE 6. VISUAL VERIFICATION

READING PRINTED INTERPRETATION ON CARDS AND COMPARING WITH SOURCE
DOCUMENT

16

Visual Verification

When extensive alphabetic information is punched, as in name and address cards, or when for any reason it does not seem feasible to use card verifying, the punching may be verified by interpreting the punched holes and visually comparing this printed record with the source document. With the Alphabetic Printing Punch, Type 026, the information is printed as it is punched, and the cards are immediately ready for visual checking with the source document (Figure 6). Listing on the Accounting Machine furnishes still another method of recording the punched information in a form which can be read back to the source documents. In most procedures, a register is prepared immediately after the cards are punched, and the register itself may be used to read the information back to the source document.

By crossfooting the totals of certain quantitative fields of information, detailed checking can be reduced. For instance, by totalling Gross, Discount, and Net, and by subtracting total Gross, the total Net is proved. Many controls of this type can serve to eliminate much detailed verification.

When dual cards are used, it may be advantageous to use the "fanning" method of verification. After the cards are punched, they are sorted on one field and then manually fanned so that the block containing the written information will progress in numerical sequence and can be checked by the eye quite rapidly. Additional sorting and fanning must be performed for each block of information verified (Figure 7).
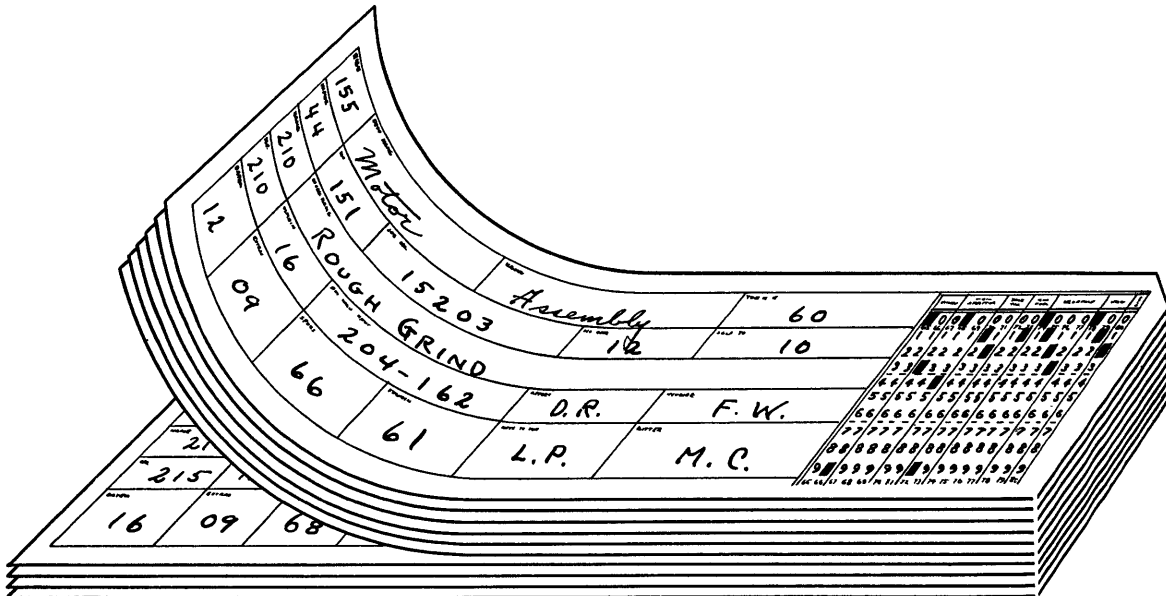
FIGURE 7. VISUAL VERIFICATION

SORTING AND FANNING CARDS FOR VERIFICATION OF PUNCHING

DUPLICATE CARDS
MATCHED

SIGHT OR NEEDLE CHECK

FIGURE 8. VISUAL VERIFICATION

READING OR CHECKING THE HOLES

Small fields of coded information or dates may be checked by reading the holes, sight checking, or needle checking (Figure 8).

Automatic Verification

Automatic verification for certain information can be accomplished by use of the comparing features of machines such as the Reproducer and Collator, which have two sets of brushes for reading two punched records of the same information. In the Type 514 Reproducer and the Type 519 Document-Originating Machine, automatic verification occurs simultaneously with the automatic punching operation.

When two sets of cards are card punched, any identical information on the two sets may be matched or compared automatically on the Collator, Reproducer, or Accounting Machine. This plan might be very useful in installations where verification is normally accomplished by means other than card verifying. For example, if card verification were desirable for special jobs, or in a procedure that could utilize a

18

FIGURE 9. AUTOMATIC VERIFICATION METHODS

1. INFORMATION REPRODUCED FROM MASTER CARD AND COMPARED AUTOMATICALLY.

2. INFORMATION GANG PUNCHED AND COMPARED AUTOMATICALLY.

3. INFORMATION MARK SENSE PUNCHED AND CHECKED WITH DOUBLE PUNCH AND BLANK COLUMN DETECTION.

4. INFORMATION PUNCHED BY CALCULATING PUNCH AND CHECKED BY REVERSE CALCULATION AND COMPARING.

verifier for short periods only, the equivalent of card verification could be performed with the card punch, by having two operators punch two sets of cards with the same data, and comparing the cards on the Accounting Machine, Reproducer, or Collator to prove that two sets are identical.

In jobs where several related cards are card punched with common information, such as an accounts payable card and the associated payables distribution cards, the control unit of the Accounting Machine will indicate if there is any error in the punching of the control field and other common fields by showing breaks in control in the first register prepared.

The punching of results computed by the Calculating Punches is checked by re-runs through the machine and by making use of the checking features on the machine, or by group extension on the Accounting Machine.

19

Summary punched information is automatically proved by running the summary cards through the Accounting Machine and comparing the total with the total obtained from the detail cards. Where summary cards are being produced on a periodic basis, accuracy of the indicative or classification data being summary punched can be checked by placing the summary cards for the previous period in the reading side of the summary punch and comparing indicative data as the new summary cards are punched.

The double punch and blank column detection device on the Reproducer is useful in checking the accuracy of mark sensed punching (as well as other punched information) to detect the presence of more than one hole in a column or the omission of holes in any column. Figure 9 illustrates the use of several methods of automatic verification.

Unverified Data

The cost of complete verification of all punched data must always be given attention, as verification in detail requires a repetition of the work previously performed. If verification is not essential, its elimination will result in accounting economies. A decision with regard to the extent of verification should be based on an analysis of subsequent uses of the cards, and the nature of the documents and reports to be prepared from them.

It is often unnecessary to verify cards that will be used in the preparation of purely statistical analyses. This is not because of an indifference toward accuracy, but because the cost of verification can seldom be compensated for by the value of the increased accuracy. It must be remembered in this connection that the errors which occur in punching are far less numerous than the errors which may have occurred in the preparation of the original information. Many of the errors may be due to illegible records, improper classification, omission of data, and other causes, which could not be detected by verifying the punching.

When punching is not verified in detail, a relatively high degree of accuracy may be obtained by balancing to predetermined totals and checking the final report for the reasonableness of amounts for each classification.

Verification of the punching of cards is not always essential when:
Possible errors in the preparation of the document have not been checked.
The cost of verifying will not be offset by the value of the results obtained.
Subsequent spot-checking will furnish sufficiently accurate reports.

Supervision of Verifying

It is important that the supervisor examine all possible methods of verification before he decides how each field of information is to be verified. Once this decision is made and the method is incorporated as part of the procedure, he should keep in mind the following basic principles so that he may exercise the proper degree of supervision:

1. Proof that all entries have been verified should be set up to furnish assurance that every entry has actually been proved. Otherwise, there is a tendency to neglect part of the verifying routine during the peak-load periods, nullifying the effective checking that has been done up to that time.

2. Any errors should be revealed in one checking operation; it should not be necessary to recheck.

3. The sequence of source documents and punched cards should not be disturbed until verification is completed.

4. Adequate provision must be made to insure accuracy in the making of corrections. Any changes in the card should be carefully made, taking care to destroy or tear the erroneous card so that it cannot be processed.

5. Provision must be made for correcting any registers or reports which have been run before an error in punching is detected. It is not always necessary to rerun registers after cards are corrected. Many prefer to make the change by ruling out the erroneous information and writing in the correct data.

6. The entire operating routine should be so organized that responsibility for errors may be located and analyzed.

7. A record should be kept of all card punch and machine operator errors to be used for job evaluations and efficiency ratings. These records of accuracy may be continuous, or may be made at special intervals.

8. Operators should be informed of the types of errors being detected, so that improvement can be made.

IBM®

Scheduling

IBM
data processing
MANAGEMENT

MAJOR REVISION

This edition, **Form 225-3430-5** obsoletes Form 22-3430-4 and all earlier editions. Significant changes have been made throughout the manual, and this new edition should be reviewed in its entirety.

CONTENTS

SCHEDULING

THE effectiveness of an IBM accounting machine department is determined by the coordination of machines, operators and work. This is scheduling. While scheduling may take many forms, the broad objective as it applies to machine accounting is to produce, on time, the desired reports with a minimum number of machines and operators. Too many machines and too many operators for the amount of work may make scheduling unnecessary—but in that case the installation may be economically inefficient.

Specifically, scheduling lets you accomplish the following:

1. Establish the time that a report will be available to management, with assurance that it will be out as promised.

2. Anticipate requirements of machines and operators, in advance of starting new jobs.

3. Reduce conflicts, such as several jobs waiting for one machine, resulting in report delays or overtime.

4. Control overtime by determining and planning for late arrival of source documents.

5. Construct an historical record of actual receipt and delivery of reports so that corrective action, when required, can be based on facts.

6. Keep equipment and personnel to a minimum by reducing peaks resulting from machine conflicts.

The form that scheduling will take depends on the size of the installation and the type of work performed. Obviously, a large installation with many jobs in process will have different problems than a smaller one with fewer jobs. Some form of scheduling, of coordination, is necessary in both cases. Also, a dynamic department that is taking on new work and making changes or improvements in existing operations will have a different problem than a static department. Because of this multiplicity of basic conditions, the schedule must be tailor-made to the job, and will require original thinking on the part of the supervisor.

Scheduling is a difficult job, too often not solved at all, or solved by having too much equipment. If there is any general rule pertaining to scheduling it is this: the larger the installation, the greater the number of reports, the greater the number of changes, the greater the fluctuation in volume, and the less opportunity for controlling the source documents, then the greater is the need for scheduling. In other words, the more difficult it is to schedule, the more important it is to do so.

SCHEDULING FOR A NEW INSTALLATION

Purpose

In new installations it is essential that a schedule of machines and jobs be constructed in order to
1. establish sound due-out times for each report.
2. anticipate and eliminate the possibility of two jobs requiring the same machine at the same time.
3. determine adequate equipment and personal requirements.

Constructing the Schedule

To construct a schedule of any type, the procedure must first be developed and recorded either in writing or by flow charting. A flow chart is preferable; it must show every operation, machine or manual, to be performed. The time required to perform each step or operation must be computed or estimated. The schedule is constructed on this information and on a knowledge of the due-in time of the source documents and the due-out time of the finished reports. The schedule will consist of the time for each job step plotted in graph form, usually in the form of a Gantt chart or bar graph.

To plot the schedule of a given procedure, the job steps shown on the operational flow chart are indicated in the proper time-square by use of machine abbreviations or, if the job steps are given key numbers in the procedure, such numbers may be indicated on the schedule. A simple schedule of a single procedure might be drawn as shown in Figure 1.

Job or Procedure	Number of Cards	Monday 1 2 3 4 5 6 7 8	Tuesday 1 2
Proc. A		KP → KV → Sort →	List →
		(Start)	(Finish)

Abbreviations: KP-Key Punch, KV-Key Verify
S-Sort   L-List

FIGURE 1

This schedule might be bettered by allowing job steps to overlap in some cases, so that two operations might proceed simultaneously. The schedule would then appear as shown in Figure 2.

It is important to remember, when consideration is being given to overlapping, that the schedule must show what *will* happen in the actual operation, and not what one might wish to occur. A conservative, practical approach rather than optimistic, wishful thinking should underly the preparation of all schedules.

Job or Procedure	Number of Cards	Monday 1 2 3 4 5 6 7 8	Tuesday 1 2
Proc. A		KP → Sort → / VER → List →	
		(Start)	(Finish)

FIGURE 2

Types of Schedules

The two types of schedules illustrated will be based on the information in the flow chart on which the job-step time has been computed (Figure 3) and the machine load work sheet (Figure 4) showing job steps and time. These also indicate the scale or unit of time (day, hour, quarter or tenths of hour) for the schedule chart.

The bar chart shown in Figure 5 consists of two parts. The job schedule shows the start, process and completion times for each job. The machine schedule shows the planned usage of each machine by type.

The entire week can be shown on one sheet. However, there must be a sheet for each week during the month so that month-end or other periodic reports can be scheduled properly.

The bar graph (Figure 6) combines the machine and job schedule. Generally one sheet will be set aside for each day of the month. The job number and job step are noted within the bar—i. e., 1-1 represents job 1, step or operation 1. In certain cases it will be possible to indicate various jobs with different colored pencils. In other cases the start of a job may be indicated in blue, the end in red.

Either method of charting is satisfactory; the nature of the job, the number of machines and the individual

DAILY SALES REPORT - PROCEDURE #1

	Flow		
	Invoices	Tape	
3.0	K. P.	①	
3.0	K. V.	②	
	Sales Card		
1.0	Bal.	③	Control
0.3	G. P.	④	
0.9	Calc.	⑤	
1.0	Calc. Ck.	⑥	
0.2	Sort	⑦	
0.4	List	⑧	Sales Register
	File		
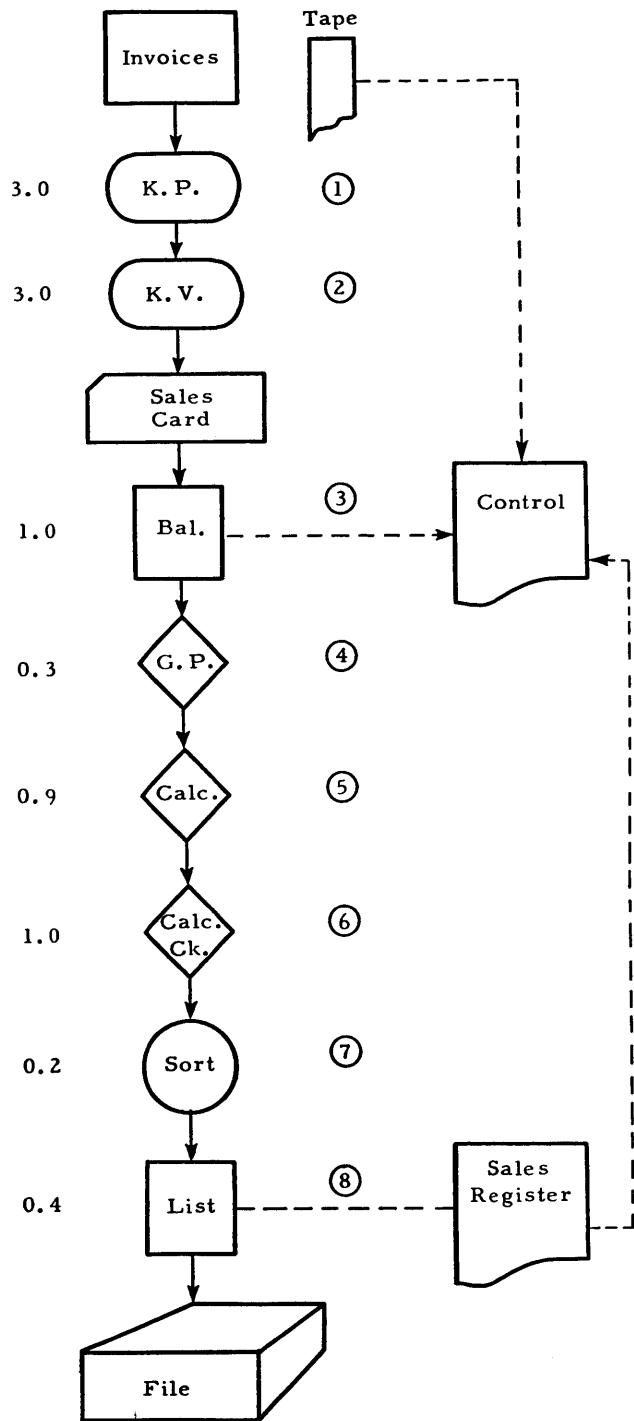
FIGURE 3

preference of the supervisor will determine which type of chart to use.

MACHINE LOAD WORK SHEET

Daily Sales Report   _Procedure 1_

NO.	MACH.	OPERATING DATA FOR MACHINE LOADS	NO. CARDS	TIME
1	026	KP	1200	3.0
2	056	KEY VERIFIER	1200	3.0
3	402	BALANCE	1200	1.0
4	514	GANG PUNCH CODES	1200	0.3
5	602A	CALC. SALES, COST & COM AMT.	1200	0.9
6	602A	CALC. CHECK ABOVE	1200	1.0
7	082	SORT INV. NO. - 4 COL.	1200	0.2
8	402	LIST SALES REGISTER	1200	0.4

FIGURE 4

I. JOB SCHEDULE
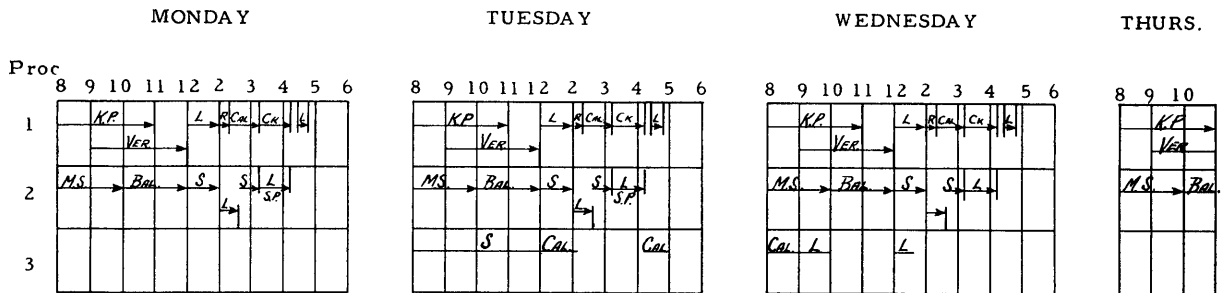
II. MACHINE SCHEDULE

FIGURE 5

HOURS MONDAY

FIGURE 6

Use of Schedules for Procedure Improvement

Frequently, development of a schedule from a previously-designed procedure reveals that the procedures are impractical because of machine conflicts or peak loads requiring overtime work. It is frequently necessary, therefore, to revise the procedure in order to obtain better schedules.

The following pointers indicate methods of altering a procedure to give better schedules:

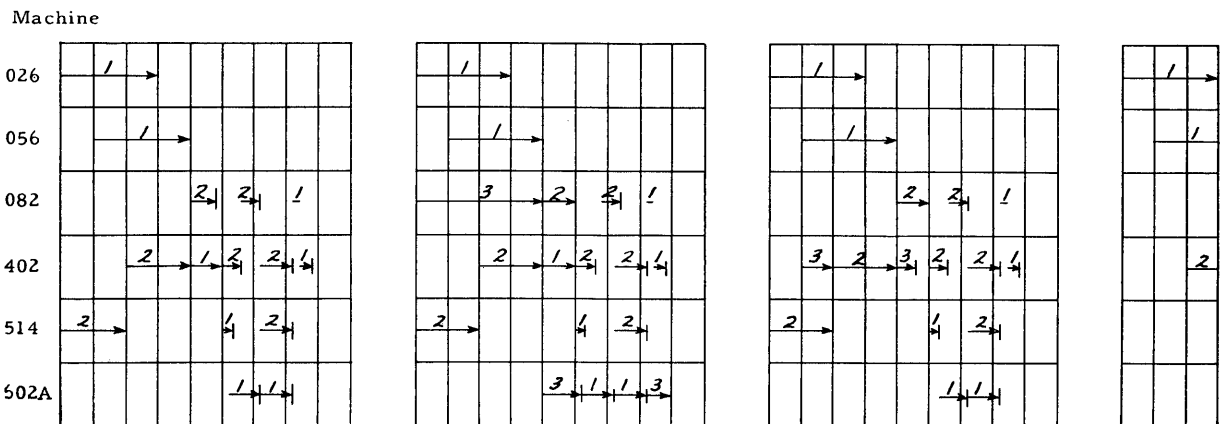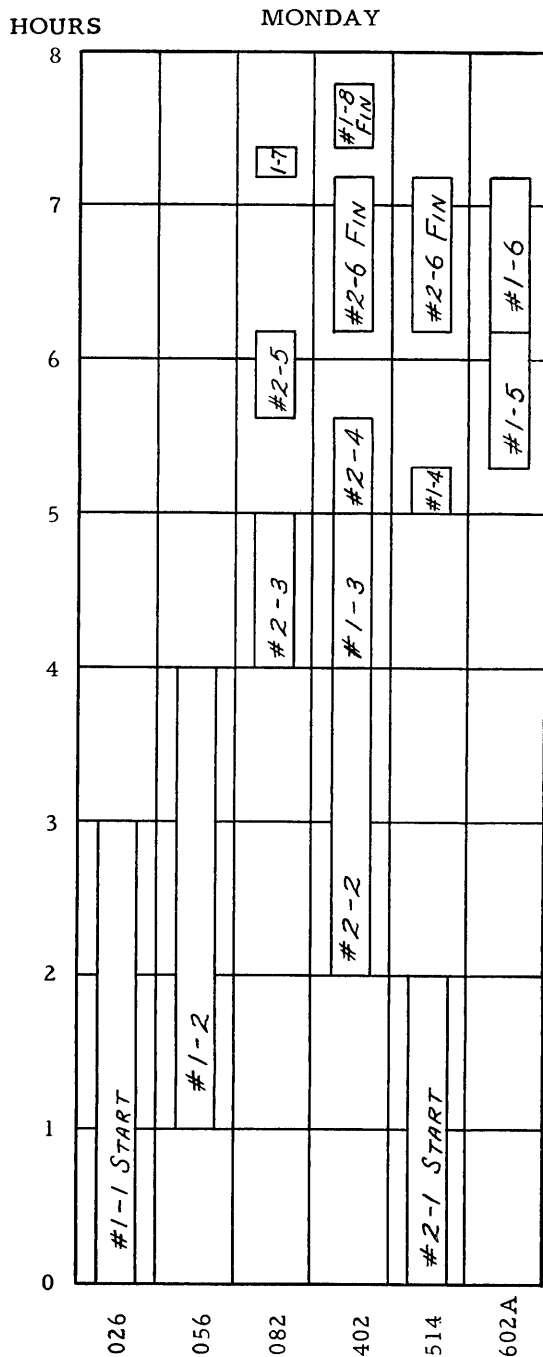1. Use several machines for a single job step if they are available.
2. Perform two jobs steps simultaneously:
   a. Block sort.
   b. Gang punch, reproduce, mark-sense punch, and summary punch simultaneously in one run.
   c. Reproduce all cards and use the second deck for another portion of the procedure so that two identical decks are processed simultaneously.
3. To reduce card volume, summarize periodically and use summary cards. This will reduce peak loads.
4. Change the sorting sequence in the procedure to use a previous major classification for a new minor classification.
5. Use pre-sorting.
6. Interpret cards at another point in the procedure.
7. Perform collating jobs on the sorter.
8. As a substitute for certain types of multiplying jobs on the caluculating punch, use digiting on the accounting machine or the gang-punch extension method.
9. Establish cut-off dates.
10. Perform work in batches of the proper size.
11. Keep a backlog of work to insure continuity of flow.
12. Use special machine devices.
13. Combine information on several reports into one report.
14. Standardize report forms to simplify procedures.

Analysis of a Schedule

Scheduling methods described in this section are for planning purposes so that the supervisor may plan for operations before they happen. Nevertheless, the schedules used for planning have value to the supervisor after they have served their purpose as a medium of planning, and after the operations planned have been completed.

A budget, whether of time or money, has little meaning unless actual performance is measured against it; it is necessary to determine how well the scheduling has been performed. The first few times a procedure is carried through, a close check must be kept of all actual running time so that schedules may be revised on the basis of new efficiency figures. The actual performance may be plotted on the schedule chart, if the chart (as in Figure 7) was designed to provide for this further information.

MASTER MACHINE SCHEDULE AND PERFORMANCE RECORD

FOR WEEK STARTING ___April 1___

FIGURE 7

The performance chart may be used as a convenient and accurate source of information for a statistical analysis of machine running time, machine efficiency, equipment requirements, personnel requirements, processing time and other valuable information for the supervisor and management.

After it has been analyzed, the schedule and performance chart becomes an historical record of all operations.

SCHEDULING FOR A GOING INSTALLATION

A SCHEDULE consists of three elements: due-in time for source documents, processing time, and due-out time for the final reports. The importance of maintaining a record of due-in and due-out time will be discussed under *Report Schedules*. The question at this point pertains to process scheduling, and the timing of the flow of work

step by step and machine by machine through the machine room. Just how necessary is a formalized process schedule? How detailed must it be? When is it required? What form will it take? Such are the questions that may well be asked once the machine room is operating.

It is evident that such a schedule should be available whenever a new job (of some significance) is being considered for machine handling. Whether the installation is large or small, a schedule is necessary. The schedule will show that:

1. the new job will be integrated into the present operation without conflict with present jobs; or
2. a conflict will occur that will require additional equipment, additional people, a change in the due-in or due-out time of the new job, a change in the due-in or due-out time of some existing job, or overtime.

The able supervisor will know, before he takes on the new job, whether or not the new job will cause a conflict. He will know this only by developing a schedule and combining the schedule of his present operations with the schedule of the proposed procedure.

The schedule of the proposed application can be developed and superimposed on one for existing operations by either the Gantt chart of bar-graph technique. Questions to be answered then are: "What are the existing conditions? When are machines and operators busy? When are they idle? When they are busy, specifically what are they doing?" Facts are required. The availability and the accuracy of these facts will determine the effectiveness of the schedule.

Where do we find the facts about operations going on in a machine room—in the operators' head, in the supervisor's head, or on paper?

Facts kept in mind only are readily available, but are seldom accurate. Rare indeed is the individual who remembers exactly what took place during the last four Tuesdays, let alone when during the day it took place. In a small, static installation the facts in the supervisor's head might prove accurate as well as available. However, even a small installation, if it is progressive, should have the facts on paper. In a large installation the facts must be on paper. The methods of collecting these facts are discussed in another booklet. Here we are concerned with the use of these facts, for without them it is impossible to develop an effective schedule.

Scheduling in a Small Installation

A schedule for a small installation is determined by the availability of facts as to when the various machines are busy, what they are doing, and when they are idle. Utilization figures generally are valueless; it does us no good to know that the machines are used 50% of the time. What we must know is *when during each day* they are busy or idle.

Under certain circumstances, schedules will have to be built on unwritten information available from the supervisors or operators. Then, after the procedure has been developed and time factors are determined for each step of the new or planned procedure, the schedule can be constructed. The Gantt chart or bar-graph technique is used to chart the new job step by step. At each step the supervisor will recall from memory whether or not the necessary machine time is available or whether a conflict occurs. The process schedule will be plotted, and either the due-in or due-out time will be determined. This should, if his memory is accurate, result in his learning where his conflicts will occur. He

can discuss with management the various possible solutions that are open, i. e., more equipment, change in schedule, etc. Although we are relying to a great extent on the memory of individuals for the accuracy of our results, it is much better than guessing or hoping that the job can be done without conflicts. Certainly it will eliminate any obvious conflicts.

A much better basis for scheduling, even in a small installation, is to have facts on paper. If facts are to be gathered, it is essential that the method be simple and easy to operate. If it is not, the operators will tire of the reporting, and the user of the facts will find them too cumbersome to manipulate. One of the best methods of gathering data—one that is simple and easy to use and is particularly well adapted to scheduling— is illustrated in Figure 8. A sheet of paper is placed on each machine daily. This sheet is in the form of a graph; each section represents a tenth of an hour. The first line starts with 8:00 o'clock, the start of the day. The last line ends with the 5:00 o'clock, the end of the day. On the reverse side of the sheet, entries are made in a similar manner for overtime or the second shift. The second column—opposite the clock time—is the conversion to tenths of hours.

The recording operates as follows: The operator looks at the clock when he starts the job. He records the following information on the line for the corresponding clock time: job, volume, and his initials or number. That is all that the operator must record—he does *not* have to write machine number, his name, shift, date, start time, or stop time, or to compute elapsed time and convert it to tenths of hours.

When the operator finishes the job he again looks at the clock, and draws a line from his original entry to the line with the proper clock time. The amount of operator time spent making the record is negligible.

This method presents the data to the user in a most effective way. The result is a graph of the usage of the machine in tenths of hours for the entire day. Not only can we see when the machine is being used, but we can also see when during the day the machine is available.

Other than collecting and properly filing these sheets daily, no further work need be done on them. They are available whenever needed, which is most important. All future elapsed-time calculations can be made mentally from the hour and tenths column. Whenever the need arises, the supervisor can pull the required sheets and readily compute the time to perform a particular job or operation. From this he can secure the job cost. Likewise, he can compare this time with the original schedule or estimate to see if his operations are going

IBM ANALYSIS OF EAM EQUIPMENT UTILIZATION

Plant No.   Dept.   Date *Nov. 10, 195*   Machine No. *514*

PLEASE RECORD EACH USE OF EAM EQUIPMENT ON THIS FORM. WRITE APPLICATION CODE NUMBER, CARD VOLUME, AND EMPLOYEE NUMBER ON LINE OPPOSITE YOUR STARTING TIME. WHEN OPERATION IS COMPLETE CONNECT ASTERISK ON START LINE WITH ASTERISK ON STOP LINE.

Example   ) Start Time   Stop Time

TIME		APPLICATION	NO of CARDS	EMPL.NO.	TIME		APPLICATION	NO of CARDS	EMPL.NO
8:00	00.0*	*PAYROLL*	*4,517*	*RW*	12:30	04.5*			
8:06	00.1*				12:36	04.5*			
8:12	00.2*				12:42	04.5*			
8:18	00.3*				12:48	04.5*			
8:24	00.4*				12:54	04.5*			
8:30	00.5*				1:00	04.5*			
8:36	00.6*				1:06	04.5*			
8:42	00.7*				1:12	04.5*			
8:48	00.8*				1:18	04.5*			
8:54	00.9*				1:24	04.5*			
9:00	01.0*				1:30	04.5*	*GEN. LEDG.*	*10,450*	*JW*
9:06	01.1*				1:36	04.6*			
9:12	01.2*				1:42	04.7*			
9:18	01.3*				1:48	04.8*			
9:24	01.4*	*SALES*	*217*	*RW*	1:54	04.9*			
9:30	01.5*				2:00	05.0*			
9:36	01.6*				2:06	05.1*			
9:42	01.7*				2:12	05.2*			
9:48	01.8*				2:18	05.3*			
9:54	01.9*				2:24	05.4*			
10:00	02.0*				2:30	05.5*			
10:06	02.1*				2:36	05.6*			
10:12	02.2*				2:42	05.7*			
10:18	02.3*				2:48	05.8*			
10:24	02.4*	*SALES MONTHLY*	*6,317*	*JW*	2:54	05.9*			
10:30	02.5*				3:00	06.0*			
10:36	02.6*				3:06	06.1*			
10:42	02.7*				3:12	06.2*			
10:48	02.8*				3:18	06.3*			
10:54	02.9*				3:24	06.4*			
11:00	03.0*				3:30	06.5*			
11:06	03.1*				3:36	06.6*			
11:12	03.2*				3:42	06.7*			
11:18	03.3*				3:48	06.8*			
11:24	03.4*				3:54	06.9*			
11:30	03.5*				4:00	07.0*			
11:36	03.6*				4:06	07.1*			
11:42	03.7*				4:12	07.2*			
11:48	03.8*				4:18	07.3*			
11:54	03.9*				4:24	07.4*			
12:00	04.0*				4:30	07.5*			
12:06	04.1*				4:36	07.6*			
12:12	04.2*				4:42	07.7*			
12:18	04.3*				4:48	07.8*			
12:24	04.4*				4:54	07.9*			
12:30	04.5*				5:00	08.0*			

NOTE: IF WORK IS DONE DURING LUNCH HOUR PLEASE INDICATE HERE.

FIGURE 8

as planned. Because both time and volume are available for each machine step, he can compute the machine handling time or the machine efficiency. This, of course, is of great value in estimating job time on new jobs. Should the supervisor consider releasing a machine because of a drop in volume, he again has all the information necessary to make a factual decision. The sheets for the machine in question can be selected and put side by side. A visual comparison will quickly show where conflicts will arise. Further, he will have the names of the jobs that will be in conflict—enabling him to reschedule operations properly. In addition to all of these uses, these sheets will give him the facts that he needs for the scheduling of a new job.

In scheduling, the important thing to know is *not* the amount of machine utilization—but *when during each day* the machine is either free or in use. This information is given to him graphically by these sheets. The supervisor will develop his procedure and apply the necessary time estimates to each step. Then he can select the machine data sheets for the machine and time in question. With these sheets and the load data, he can prepare a typical bar graph as described earlier. Wherever there is a conflict he can determine what job it is, and decide with management whether or not that job should be rescheduled. When he completes the schedule in this manner, he can present his recommendations to management, knowing that the decisions are based on fact and can be substantiated in writing. He can show management what jobs will have to be changed,

why overtime or additional equipment may be required before the job starts. Thus, both the supervisor and management will know in advance what effect the new job will have on the machine room. Sound due-out times can be established and, being soundly established, will be met.

Scheduling in a Large Installation

A large installation requires more formalized procedures and, unlike smaller installations, may require continuing daily process schedules. Scheduling becomes one of the major supervisory functions. Just as the production department must have the work load on each type of machine available, the machine room supervisor must know the load on his various machines. Various techniques have been developed to meet the needs of the particular installations. They are presented here as examples of different techniques that have been successfully used.

Example I: A large operation producing about 700 standard recurring monthly reports and about 800 special non-recurring reports.

Source documents come in from all parts of the world and, therefore, due-in schedules cannot always be met. The scheduling problem is one of determining the work load by machine type, permitting rescheduling of lower priority jobs when required, anticipating overtime requirements in advance, and determining that the required reports will be out at the promised time.

FIGURE 9

MONTHLY SCHEDULE OF OPERATIONS

MACHINE MONTHLY DAILY			
100% UTIL.			
% UTIL.			

MONTH _____

Hours Avail	Type of Oper.	Job Number	Total Est Hrs.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Work Days of Month
	077	103010	1													1											
	077	013093	1																	1							
	077	103116	3														1	1						1			
	077	143251	3									1	1														
	077	343951	7						7																			
	077	343981	3									3																
	077	037084	34					15	15	4																		
	077	107105	2						2																			
	077	037238	12				3					3					3				3							
	077	747811	3					3																				
	077	347902	5																		5							
	077	107930	31	1	12			4				6		7														
	077	347964	396	18	16	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	
	077	347969	20														8	8	4							
			521	19	30	18	21	40	42	22	18	31	19	25	18	27	30	23	19	19	23	21	18	19	20	
32			704	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	

FIGURE 10

Each job is flow-charted, and estimated machine loads for each operation are computed to produce a result similar to the machine load sheet (Figure 4). This information is key punched into schedule cards (Figure 9). Note that the card contains, in addition to the normal information, a spread of the work load by working day.

Each month, new cards are put into the file for new jobs, and cards are pulled for cancelled jobs. The cards are used to produce, monthly, a report schedule showing the planned jobs by name and number, the start and finish time, priority, machine to be used, operations and time for each operation, and the spread of the work day in which the time of the operation will be used.

The cards are further sorted by machine type. A report is prepared showing the daily load for each machine type (Figure 10). Past experience shows that they can schedule work on the various machine types up to 80% of capacity without incurring overtime. When new jobs come in which require more than this available time, overtime will be called for on that particular equipment, or lower priority jobs will have to be rescheduled.

The work load is maintained in total and not by individual job. A form for each machine type, similar to Figure 11, is manually posted on a daily basis. The scheduled time is taken from the schedule (Figure 10) and posted under the "scheduled" column. It also includes all special and rescheduled jobs. Actual time is compiled daily by machine type and posted under "actual." Should the actual hours exceed the schedule hours, there is no carry-over. Should the actual hours be less than those scheduled, there will be a carry-over, which is so recorded. The following day the new schedule will include the schedule for the day and the carry-over from the previous day (Figure 11).

The above information (the work load for each machine type) is then posted to a flexible graph which is in the supervisor's office. This enables the supervisor not only to keep at his fingertips the load status of his department, but also to determine rapidly when new non-scheduled jobs can be worked in and to schedule operators for overtime when required.

At the end of the month the machine utilization cards, which have been punched showing the actual time by machine for each job, are used to produce a report showing actual hours. This report is compared with the report for estimated load. Discrepancies in schedules are thus located, and the schedule cards are adjusted accordingly. Thus, at all times the schedule cards are maintained in a current condition.

							MACH TYPE *077*		QTY *4*	DAILY AVAIL		HRS *32*			
CALENDAR DAYS	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
MONTH																
WORK DAYS	*1*	*2*	*3*	*4*	*5*			*6*	*7*							
SCHEDULE	*19*	*30*	*18*													
NEW SCHEDULE	—	*30*	*23*													
ACTUAL	*20*	*25*	*24*													
CARRY OVER	—	*5*	—													
UNOBLIGATED	*13*	*2*	*9*													

FIGURE 11

Example II: A large operation, producing about 130 recurring reports and approximately 60 non-recurring special reports per month.

In this case the work load is maintained, not by machine type alone, but by job as well—in effect, a work-in-process inventory of jobs in the machine room.

Procedures are developed and work loads established for each step in the procedure. One card is punched for each step in the procedure showing the estimated time, job, operation and type of machine.

When the job is put on the floor, these cards are reproduced. As work progresses, cards are marked by schedule clerks (Figure 12). These cards are combined with the schedule cards and reduce the back log or work ahead. All processing is done on the night shift,

and the new backlog report (Figure 13) is available the following morning. The supervisor then has available, each morning, the position of each job on the floor. He knows how much work ahead there is and, knowing when the job is due out, can schedule overtime and reschedule jobs as required. At all times he has an up-to-date record of what has been done, by job, and what lies ahead. Such a technique gives excellent control over a large operation, but does require machine and clerical time to produce it. It is felt, in this operation, that the control secured is well worth the cost.

Example III: A medium-sized installation producing approximately 300 standard monthly reports and some 20 special requested reports per month.

FIGURE 12

DAILY BACK LOG REPORT						
APPLIC. NO.	OPER. NO.	JOB ORDER NO.	MACH.	START DATE	NET BACK LOG	
3487	080	221		8 13	20 CR	
3487	090	221	513		5 CR	
3487	100	221	552		5 CR	
3487	110	221	552		5 CR	
3487	111	221	514		5 CR	
3487	112	221	552		5 CR	
3487	113	221	000		20 CR	
3487	150	221	552		5 CR	
						70
3487	080	222		8 14	20 CR	
3487	090	222	513		7	
3487	100	222	552		5 CR	
3487	110	222	552		5 CR	
3487	111	222	514		5 CR	
3487	112	222	552		5 CR	
3487	113	222	000		20 CR	
3487	150	222	552		5 CR	
						65
3487	110	223	552	8 15	5 CR	
						5

FIGURE 13

A file of cards is maintained for each report for each job (Figure 14). The card contains the description of the report, the work day and hour it is due out, and a breakdown of the minutes by machine type. In Figure 14, note that the job requires sorting shown as 2.0005 — meaning 5 minutes of sorting — and that the job is of such a nature that the operator can run *two* sorters. In the field labeled "section" is recorded the estimated inches and tenths of inches of cards; thus, this job amounts to 2.5 inches.

Each month these cards (approximately 1000) are listed for the monthly schedule (Figure 15). This report serves both as a report schedule and a process schedule.

The master schedule cards are reproduced into routing cards (same as Figure 14). The supervisor schedules the work by selecting the cards from the files, attaching the routing card to them and placing them on the work ahead table. The machine room is organized by machine type; each machine section under a section super-

FIGURE 14

Job	Work Day	Hour Due Out	Job Chart Number	Est. Inches of Cards	Estimated Minutes			
					080	402 416	513	077
BAL SUM CARDS FROM BREAK UPS	06	445	1B	150		20	20	10
BREAK UP CNTRL TAB SECTION	06	200	1C	20	10	15		
AUTH PREL SORT COLLATOR	06	915	560	80	25			20
AUTHORIZATION 1ST SUM	06	1145	570	350	125	55		
AUTH ATRECO 4 COPIES	06		57					
AUTHORIZATION CUMULATIVE	06	445	57B	800		100		50
BALANCING OFFICE PLANS	06	445	650			35		
AUTHORIZATIONS 01 SORT ONLY	06	1030	157		5			
C O D TANK & PUMP MECH 1ST	06	445	1700	550	210	115	115	
AUTO TURNOVER TJ 1103	06	1145	2310	80	15	35	30	20
AUTO TURNOVER TJ 1108	06	1145	2310	20	5	5	5	
AUTO TURNOVER TJ 1107	06	445	2310	200	50	55	50	20
AUTO TURNOVER TJ 1101	06	1145	231	20	5	10	10	15
AUTO TURNOVER TJ 1105	06	445	231B	550	105	190	170	50
AUTO COST BALANCING	06	445	2400	200		30		
DAILY BREAKUP GENERAL	06	445	4000	10	185	5		
WORK ORDERS DAILY	06	445	400A	25	5	10		
DAILY BREAKUP AUTHORIZATIONS	06	445	400B	110	15	20	20	
DAILY BREAKUP CAR NUMBERS	06	445	400C	118		20	20	
DAILY BREAKUP 2ND POS DEPTS	06	445	400D	480	65	65	65	35
DAILY BREAKUP A R CO	06	445	400E	30	10	5		
DAILY BREAKUP 3RD POS DEPT	06	445	400F	340	155	135	135	65
LEDGERS DAILY BREAK UP	06	445	400G	70	30	25	25	
C O D LEDGERS DAILY BREAKUPS	06	445	400H	100	35	25	25	
DISCOUNT ON STORES MATERIAL	06	1145	4300	250	50	35		
BALANCING CURRENT WORK	06	445	4400			240		
SOCIAL SECURITY BALANCING	06	445	2015	200		100		
					*1105	1350	690	285
AVAILABLE					1440	1440	960	480

FIGURE 15

visor. Each supervisor has a copy of the monthly schedule. He uses this schedule to see which jobs should be run first so that the due-out time will be met. They can always work ahead on jobs, providing that all jobs currently due out are on schedule. The supervisor also has a copy of the schedule and checks off jobs that are done. At all times they can readily see what is ahead, and where the department stands.

This furnishes a very effective control and can be operated with a minimum amount of effort.

REPORT SCHEDULES

EVERY installation, regardless of its size or nature, should maintain a register of reports or a report schedule. The nature and size of the installation will determine the form and makeup of this schedule, but it will contain the following:

1. Report name (number)
2. Due-in time of source documents
3. Due-out time of final reports
4. Actual-in time of source documents
5. Actual-out time of final reports.

Such a register or schedule, when properly constructed and used, becomes a very effective supervisory tool. It establishes the goals. All concerned know when the final reports are due out of the machine room. In all installations there is a tendency for time goals, over a period of time, to change. Gradually source documents come in later and later, until a day has been lost. Gradually reports get later and later, until a new and later schedule is established. A written record will reveal such conditions.

A report schedule fixes responsibility. When a report comes out late it may be due to a number of causes. The source documents coming in late, improper scheduling in the machine room, re-runs for various reasons, etc., all can result in not meeting a schedule. If an accurate record of the time documents come into the department and the time reports leave is maintained, it can be determined readily whether the cause lies within or outside the machine room.

A report schedule permits corrective action. Once the cause of the delay has been positively determined, corrective action can be taken promptly. If the trouble lies within the machine room, it may call for a review of the methods of estimating time of new jobs. It may be found that operator instructions, machine maintenance, operator training, or any number of things are required.

The form such a record takes may vary in many ways. It may be nothing more than a pencil list maintained by the supervisor or his key punch operator. It may be an elaborate board. It may be one list that is used for the entire year; or it may be a list prepared at the beginning of each month. Various examples are illustrated

below; from them the supervisor can select an approach that comes closest to meeting his particular requirements.

It is important, in setting up such a schedule of reports, that consideration be given to accounting periods, work days, calendar days, so many days before and after closing, etc. In some cases the schedule can be converted from calendar days to work days, or vice versa. In other cases the schedule will have to show the various conditions.

Example I: Figure 16 shows a monthly schedule. A similar form is used for weekly and daily jobs. Such a schedule can be adapted to either calendar day, work day, days after closing, or all combined. This form lends itself well to trend analysis. Because it is arranged in date due-in (or due-out) sequence, the supervisor can follow up immediately with outside departments if the necessary documents are not in on time.

REPORT SCHEDULE

Monthly	195			Work Day							
Report No.	Report Name			Due	Jan	Feb	Mar	A	v	Dec
1142	PAYABLES DISTRIBUTION	IN OUT		9AM 3 5PM 3	8AM 3 2PM 3	10AM 4 4PM 3				
1144	PAYABLES ANALYSIS	IN OUT		9AM 3 1PM 4	12AM 3 5PM 4	8AM 3 5PM 3				
2152	PAYROLL DIRECT SUMMARY	IN OUT		1PM 4 11AM 5	1PM 5 12AM 6	1PM 4 10AM 5				
2253	PAYROLL INDIRECT SUMMARY	IN OUT		1PM 4 5PM 5	1PM 4 5PM 5	2PM 4 4PM 5				

FIGURE 16

Example II: When the jobs change frequently, it may be advisable to have a report register prepared each period. Figure 17 shows a schedule combined with a machine utilization analysis.

Example III: When the volume of jobs is large and when there is considerable change in jobs, it may be advisable to punch a card for each job. Changes can be made easily.

The cards described in Figure 9 are used for this purpose. Figure 14 is another example of such a card. In this case, Figure 15 serves as a report schedule and is further used as a process schedule.

Figure 18 illustrates a progress report listed from cards punched for each job. One copy goes to the section head, another to the supervisor. Each morning each section head brings his report to the supervisor, who pulls the cards for completed work. He enters on the card the date completed (an asterisk denotes late report) which is later key punched. Next month, the new progress report will show the past performance.

Example IV: Another company builds a new schedule each month, depending on the closing date. A conference of all department heads is held; the new schedule is developed, and copies are reproduced for all concerned. Figure 19 shows one of ten pages of this schedule.

Example V: Other concerns, for the psychological effect on the department, like a visible schedule. Various visible-board approaches are used, of which Figure 20 is an example. In this case, a strip showing the proper work day is inserted each month. Various shaped pegs represent due-in, due-out, actual in, and actual out. As the jobs come in and out, the control clerk enters the pegs as required. Everyone can immediately see how the department progresses. At the end of the month a picture of the board is taken for historical and trend analysis.

CONCLUSION

One thing should be constantly in mind whenever consideration is given to managerial controls — the value of the controls must exceed their cost. The simplest and easiest method that will furnish the needed controls is the best method. Therefore, in starting any such method, start simply. Slowly add controls until the desired requirements are met. This is a much more satisfactory approach than starting with complete detailed control and later find that it is too complicated and costly. Too often the latter approach is taken, and then all controls discontinued. Start simply. Partial control is better than no control at all.

MONTHLY SCHEDULE FOR TABULATING ROOM

Operation	Operator	Date Completed	Machine Hours Utilized					
			552	082	077	402	514	602A
1ST WORKING DAY								
Rejected Paper_____								
Accounts Payable (to be completed on 2nd Working Day)_____								
2ND WORKING DAY								
Accounts Payable_____								
Composition:								
Job Work_____								
Plate Corrections_____								

FIGURE 17

IBM   WHQ MACHINE ACCOUNTING DEPARTMENT
PROGRESS REPORT

REFERENCE	DESCRIPTION	DUE DATE	COMPLETED DATES											
			JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC.
A	T E COMM JOURNALS	1	1	1	4*	1	1						
A	E T COMM JOURNALS	1	1	1	4*	1	2 X						
A	EAM COMM JOURNALS	1	1	1	2*	1	1						
A	COM COMM JOURNALS	1	1	1	4*	3*	1						
A	EAM COMM SERVICE BUR JOURNAL	1	1	1	2*	1	1						
A	COMMISSION SCHEDULE	1	6 *	7*	1	3*	2 X						
A	E T OPEN ORDERS RECONCILIATION	1	1	1	22*	1	1						
A	T E OPEN ORDERS RECONCILIATION	1	1	1	22*	1	1						
A	PROGRESS REPORT	2	7 *	3*	3*	3*	2						
A	WHQ WTC FIELD & FACTORY LABELS	2	2	1	2	2	2						
A	QUOTA CHART LISTING	6		7*	6	6	6						
A	SALESMENS EARNINGS	7	13 *	7	8*	7	7						
A	MFET ON MACH USED BY IBM LIST	7	5	9*	7	7	8 X						
A	E T OPEN ORDERS BY SLMN	8	12 *	11*	10*	8	8						
A	EAM UNINSTALLED EQUIP REPORT	8	8	8	8	8	8						
A	TELEPHONE TOLL CALLS ANALYSIS	8	9 *	9*	5	11*	9						
A	T E OPEN ORDERS BY SLMN	9	12 *	9	10*	8							
A	T E SALES REPS TRIAL BALANCE	10	13 *	13*	10	11*							
A	E T SALES REPS TRIAL BALANCE	10	13 *	12*	10	11*							
A	EAM SALES REPS TRIAL BALANCE	11	15 *	12*	12*	12*							
A	COM SALES REPS TRIAL BALANCE	11	15 *	13*	10	11							
A	EAM UNINSTALLED ORDERS	13	15 *	13	14*	13							
A	WHQ WTC FIELD & FACTORY LABELS	13	13	14*	14*	13							

FIGURE 18

month   year

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
WORKING DAY	1	2	-	-	3	4	5	6	7	-	-	8	9	10	11	12	-	-	13	14	15	-	16	-	-	17	18	19	20	21
CALENDAR DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
WEEK DAY	Th	F	Sa	S	M	T	W	Th	F	Sa	S	M	T	W	Th	F	Sa	S	M	T	W	Th	F	Sa	S	M	T	W	Th	F
BILLING AND COST																														
Monthly Cut-off							3																							
Reports																														
Invoice Error Comp.																				5										
Audit of Master Rec.																						5								
Reconcil. (thru Oct. 30)																														
Acct. 137.5 Stopover																													5	
Acct. 160.6 inv. adj. acct.																													5	
MACHINE ACCOUNTING																														
Monthly Cut-off							3																							
Misc. Volume stat.																														
Final Trans. Reg.							8½																							
Mfg. Plant Sales								12																						
Cost of Sales Sum.													3																	
Weekly Sales Anal.		8½							8½							8½					8½									8½
Weekly Cost of Sales		8½							8½							8½					8½									8½
Tire-battery Refunds																					5									
Monthly Vol. Stat.																														
Comp. Reports - Sept.																														
#5 area-terr-comm.	5																													
Report #313.1					5																									
Report #313.2					5																									
Com. Reports - Oct.																														
#8 - area-terr-patron																5														
#7 - dept.-area-terr-patr.																				5										
#5 - area-terr-comm.																				5										
Report #313.1																					5									
Report #313.2																					5									
Non-Com. Stat.																														
#1 - com. source														10																
#2 - area-terr-patron														3																
#3 - area-terr. comm.																			3											

FIGURE 19

JOB DESCRIPTION AND NUMBER	MONTHLY WORKING DAYS / CALENDAR DAYS OF MONTH	
	MONTHLY WORKING DAYS: 1 2 3 4 5 - - 6 7 8 9 10 - - 11 12 13 14 15 - - 16 17 18 19 20 - - 21 22 23	
	CALENDAR DAYS OF MONTH: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	
Cost of Sales-Baler Parts 455		Schedule / Actual
Plant Shipment from Whse 761 8 (to)		Schedule / Actual
Collections Sales, Comp. 462		Schedule / Actual
Payroll Job Card Control 414		Schedule / Actual
Payroll Checks-Register 401		Schedule / Actual
Personnel Report 301		Schedule / Actual
Labor Dist. by Orgn. 414		Schedule / Actual
Material Req. 425		Schedule / Actual
Receiving Records-Exp 430		Schedule / Actual

LEGEND

Scheduled In ▮   Actual In ▰
Scheduled Out ●   Actual Out ◗
Prior Report Still Due Out or In ▲

FIGURE 20

IBM

Manuals of Procedure

IBM

data processing
MANAGEMENT

MANUALS OF PROCEDURE

FACTS left unrecorded often cease to be facts. Folklore, passing from generation to generation by word of mouth, accumulates fantasy and loses accuracy. Similarly, the everyday facts, procedures, and organizational details of modern business may be distorted unless they are set down for the record.

Every job prepared for machines must be planned. This must be done on paper prior to the start of a job. From this source, it is a simple matter to transfer these facts into forms suitable for use as *operators'*, *manager's* or *general* manuals of procedure. Facts recorded in this way are lasting, dependable tools that are a requisite for sound operation.

Manuals are written to fulfill the following objectives:

1. To enable operators to set up their machines and to complete a job without supervisory assistance.

2. To provide a permanent record of job requirements in the event of illness, vacations, and operator turnover.

3. To provide assembled facts for simplifying corrections and improvements of procedures.

4. To facilitate the duties of managing the personnel, machines and work of an IBM installation.

5. To allow for executive understanding and control of the department.

The logical time for writing instruction manuals is when the procedure is established. In those operating installations that do not have adequate written instructions, it might prove to be a difficult and long task for the manager to construct operator's manuals personally. When properly instructed, individual operators should be well qualified to complete this assignment, with final review being made by the manager. Experience has shown that this approach will actually produce improvement in the procedures, because, as the operators record what they are now doing, they, in effect, critically appraise their work and make procedural improvements. Further, the manager is relieved of detail work, and tasks can be quickly completed by spreading the work.

AFTER a procedure has been developed and job steps have been determined, it is necessary to record the operational details and machine setup information in a form suitable for operators to use.

There are two fundamental plans for writing instructions of this kind: narrative and job-step.

Narrative Instructions

The narrative approach covers several job steps on one page. Each step should be fully described in sufficient detail to enable an operator with little training to perform a job completely with no outside guidance. While it is difficult to write instructions that will accomplish this goal the first time, this information should be added as questions arise.

Under most circumstances, operational flow charts that are used to develop a procedure, or used by the supervisor, do not contain sufficient detail to enable a machine operator to set up machines and carry a job through to completion. Flow charts may be included, however, to supplement written instructions.

The narrative job-instruction form has been designed with the reverse side to be used for drawing in flow charts. If the first page of the instruction sheet is left blank, the reverse side can be used for the flow chart of steps to be outlined on the following page. In this manner the flow chart and job-step instructions will appear on pages facing each other, as shown in Figure 1. This first page may be used to record information of a special nature. Instructions of this type might include such items as where source information is obtained and the disposition of cards and reports.

On the instruction sheet the heading blocks are provided for recording the job name and number. The frequency of report preparation should be checked

as applicable. In the space provided for due-in time and date, record the time that the source information is due in the department. The date in most cases will be the day of the week or the working day of the month, rather than a chronological date. The due-out time is reserved for recording time for report completion.

Vertical columns are provided for recording the operational sequence number of each step of the procedure, the machine type to be used for processing, the estimated card volume, and the estimated time required for the step. The area set aside for description should be used for recording machine setup information and detail to enable the operator to perform the job.

The narrative form is sometimes favored because several steps may be described on one page. However, it has this disadvantage: Information that should be included for the operator may be forgotten and not recorded. Furthermore, when changes are required, it is often necessary to rewrite the entire form.

Job-Step Instructions

When job-step instruction sheets are used, a separate page is used for each step of the procedure. A special sheet is designed and preprinted for each machine type. These forms contain spaces in which machine setup information should be recorded, as well as other information pertinent to that phase of the procedure.

Spaces are provided at the bottom of each of the forms to record the date the procedure step was written or revised. The procedure manual is sectionalized by major functions, and page numbers are assigned within the section.

FLOW CHART

IBM

JOB INSTRUCTIONS

IBM

JOB NAME			JOB NO.	FREQUENCY		DUE IN		DUE OUT	
				☒ Daily ☐ Monthly		TIME	DATE	TIME	DATE
SALES ACCOUNTING			830	☐ Weekly ☐ Quarterly ☐ Bi-Weekly ☐ Annual ☐ Semi-Monthly ☐ Other		8:00	Daily	11:30	Daily

OPER. NO.	MACH. TYPE	ESTIMATED VOLUME	ESTIMATED TIME	DESCRIPTION
1	82	6,500	.2	Sort cards on column 80 to pull out freight and control cards. All commutator switches except 6 and 8 should be pushed to center. Cards falling into pocket 6 are freight cards; hold for shipping report. The control cards in pocket 8 are destroyed. Remaining cards (reject pocket) to operation 2.
2	514	5,500	1.0	Gangpunch branch, customer number, salesman number, invoice date and invoice number into all commodity cards. NOTE: Branch and customer number are punched from the name and address cards. Salesman number, invoice number, invoice date are punched from the miscellaneous data card. Set PX brush 1 on column 5 Set PX brush 6 on column 73
3	82	5,500	.2	Sort cards on X in column 5. 1. Cards falling in X pocket are name and address cards. Re-file in the billing tub file. 2. Cards in reject pocket continue to operation 4.

Date: 2/10/5

Section 3 Page: 1

FIGURE 1. NARRATIVE JOB INSTRUCTIONS AND FLOW CHART

JOB NAME			JOB NO.	CONTROL PANEL NO.	OPERATION NAME	OP. CODE	MACH. TYPE
STOCK CONTROL			825	18	MERGE	53	77

FREQUENCY		DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME
☒ Daily ☐ Monthly ☐ Weekly ☐ Quarterly ☐ Bi-Weekly ☐ Annual ☐ Semi-Monthly ☐ Other		TIME	DATE	TIME	DATE	11,000 Bal. 3,000 Detail	HOURS TENTHS
		9:00	Daily	11:00	Daily		1 1 ▲
CARDS USED:				DISPOSITION OF CARDS:			
RECEIVED FROM:							

FIGURE 2.   HEADING FOR INSTRUCTION SHEET

For the most part, heading information for all machines has been standardized to include the data as shown in Figure 2.

An operation code has been included, because some large organizations collect operational data on a refined basis, which includes an analysis of the operation to the extent of machine capacity required to do the job. This is more evident in clerical functions where such items as balancing, coding, posting, and typing, may be identified by different codes even though the over-all scope is considered clerical. The following is a typical code that might be used for this purpose:

The body section of job-step instruction sheets are designed to accommodate specific setup data for each machine type.

In some cases the reverse side of the form is imprinted with a wiring diagram form, which, when filled in, enables the operator to wire simple control panels or make modifications to them when required. Standard wiring diagram forms may be included as a supplement to the instructions for those machines where printing is not shown on the back of the form. Job-step instruction sheets and a typical wiring diagram are illustrated in Figures 3 through 10.

OPERATION CODES

Operation Code No.	Operation Name	Operation Code No.	Operation Name
10	Messenger service	41	Interpreting
11	Preparatory (at machine)	51	Sorting
12	Coding	53	Collating
13	Decoding	54	Dividing
14	Checking — Reports	60	Waiting time — chargeable
15	Calculating — Adding machines, etc.	71	Balancing with accounting machine
16	Typing headings, etc.	72	Proving with accounting machine (Mult., etc.)
17	Card pulling and refiling		
18	Clerical — chargeable	73	Group printing
19	Control figure work	74	Detail printing
20	Facsimile posting operations		*Non-Billable Operations*
21	Wiring (not at machine)	80	Clerical — chargeable
23	Job instruction	81	Awaiting machines
25	Planning — Special	82	Awaiting assignment
29	Mark-Sense punching	83	Procedure planning
30	Operating Proof Machine	84	Receiving training
31	Punching	85	Supervising
32	Verifying	86	Illness or personal reason
34	Visual check — Alphabetic Punching	87	Late
35	Gangpunching	88	Vacation
36	Reproducing	91	Machine repair
37	Multiplying	92	Machine error
38	Crossfooting	93	Instruction error
39	Multiplying for checking	94	Operator error
40	Combined calculating	95	Customer error

IBM

CLERICAL INSTRUCTIONS

JOB NAME	OPERATION NAME		OP CODE
ACCOUNTS PAYABLE	Coding		12

FREQUENCY		DUE IN		DUE OUT		ESTIMATED VOLUME	EST TIME
☒ Daily ☐ Monthly ☐ Weekly ☐ Quarterly ☐ Bi-Weekly ☐ Annual ☐ Semi-Monthly ☐ Other		TIME	DATE	TIME	DATE		HOURS TENTHS
		10:30	Daily	3:00	Daily	200	3 3 ▲

SOURCE DATA				
TYPE OF DOCUMENT	FROM		TO	AVER NO LINES
Vendor's Invoice	Mail Room		Keypunch	3

DETAILED INSTRUCTIONS

The following factors are to be coded or written on the voucher apron attached

to each vendor's invoice:

INVOICE DATE: This is the date written on the invoice being processed.

VENDOR NUMBER: This 5 digit numerical code should be looked up in the vendor's

code book which is arranged alphabetically.

OUR INVOICE NUMBER: Each invoice should be stamped with a consecutive

number stamp.

DUE DATE: Calculate the date which payment is required to be made, based upon

the terms quoted for discount.

INVOICE AMOUNT: Write in the face amount of invoice. This factor may or may

not include freight data.

Distribution Data

ACCOUNT NUMBER: Assign the account code to be charged for merchandise

purchased. In the event two or more distributions are required on one invoice,

a second line of the apron should be used.

DEPARTMENT USED: Identify the department to be charged with material or

services.

QUANTITY: Fill in number of items received of each item to be distributed.

UNIT OF MEASURE: Code the unit of measure as follows:

01 Each

02 Pound

Date 2/10/5   Section 1   Page 1

FIGURE 3. CLERICAL INSTRUCTION SHEET

IBM   CARD PUNCHING OR VERIFYING INSTRUCTIONS

JOB NAME		JOB NO.	CONTROL PANEL NO.	OPERATION NAME	OP. CODE	MACH. TYPE
SALES ACCOUNTING		630	-----	Card Punching	31	24

FREQUENCY			DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME
☒ Daily ☐ Weekly ☐ Bi-Weekly ☐ Semi-Monthly	☐ Monthly ☐ Quarterly ☐ Annual ☐ Other	TIME 8:00	DATE Daily	TIME 3:00	DATE Daily		1,000	HOURS TENTHS 4 5 ▲

PROGRAM CARD OR SKIP BAR NO. 14	CARD ELECTRO (FORM) NO

24-26-56	SWITCH SETTINGS	31

ON	OFF	SWITCH	OFF	ON	SWITCH
X		PROGRAM UNIT			RELEASE KEY EJECT
X		AUTO FEED			AUTO EJECT
X		AUTO SKIP—AUTO DUPL		SPECIAL FEATURES USED	
	no	PRINT	☐ ALTERNATE PROGRAM		☐ CARD REVERSING
	no	SELF CHECKING NO	☐ AUXILIARY DUPLICATE		☐ SELF CHECKING NO

SOURCE DOCUMENTS USED	DISPOSITION OF CARDS.
Sales Invoices	to verifier station

RECEIVED FROM.	DOCUMENTS
Billing Department	to verifier station

	CARD FIELD	COLUMNS FROM	COLUMNS TO	FUNCTION*	REMARKS
1	Invoice Date	30	33	P	Manually turn auto skip
2	Invoice Number	34	38	P	and dupl. switch off for
3.	Customer Number	39	43	D	first card punched for each
4	Location	44	48	D	invoice
5	Trade Class	49	51	D	Duplicate from first card
6	Branch	52	53	D	punched for each invoice.
7.	Salesman Number	54	56	D	
8	Quantity	57	61	P	
9.	Commodity Number	62	66	P	
10.	Net Amount	67	73	P	
11.	Invoice Amount	74	80	P	
12.					
13	Columns 1-12				Will be gangpunched.
14.	Columns 13-29 Will be calculated.				
15.					
	TOTAL KEY STROKES PER CARD—	33 punched	18 duplicated	9,400 KS/hr	

FUNCTION*	SYMBOL
DUPLICATE	D
PUNCH	P
SKIP	S
X-SKIP	XS
VERIFY	V
SELF NO CK	CK

Date   2/10/5   Section   2   Page   1

FIGURE 4. CARD PUNCHING OR VERIFYING INSTRUCTIONS

IBM — REPRODUCING AND SUMMARY PUNCHING MACHINES

JOB NAME		JOB NO	CONTROL PANEL NO.	OPERATION NAME	OP CODE	MACH TYPE
PAYROLL TIME CARDS		1320	10	Reproduce	36	519

FREQUENCY		DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME
☐ Daily ☐ Monthly		TIME	DATE	TIME	DATE		HOURS TENTHS
☒ Weekly ☐ Quarterly							
☐ Bi-Weekly ☐ Annual		-----	-----	3:00	Friday	3,000	▲8
☐ Semi-Monthly ☐ Other							

CARDS USED: **Payroll Master (178321)**
Weekly Attendance (166212MS)

DISPOSITION OF CARDS.
Master Cards to File
Attendance Cards to Timekeeper

RECEIVED FROM:
Payroll Master File

OPERATION

[x] REPRODUCE	[ ] INTERSPERSED G. P.	[ ] SUMMARY PUNCH	[ ] DPBCD
[x] GANG PUNCH	[x] END PRINT	[ ] M S PUNCH	[x] COMPARE

READ FEED CARDS						X-D CTL	PUNCH FEED CARDS						X-D CTL
Payroll Master						X-21	**Blank Attendance Cards**						

RX BRUSH	1	2	3	4	5	PX BRUSH	1	2	3	4	5	6
CARD COL						CARD COL						

ON	OFF	SWITCHES	COL READ	COLS PUNCH	COMPARE	DPBCD	PRINT
		REPRODUCE	1-5	1-5	X		X
		SEL REP G P COMP	6-30	6-30	X		
D	M	CARD "X"					
		MARK SENSE					
		MASTER CARD PUNCH					
		END PRINTING					
[x] 1st LINE							
[ ] 2nd LINE							
[ ] OFF							
		PRINTING POSITIONS					
		1 2 3 4 5 U					
		L					
1 2 3 4 5 6 7 8							

OPERATING INSTRUCTIONS

Gangpunch payroll period date into each reproduced card, columns 31-35.

Date __2/10/5__   Section __3__   Page __4__

FIGURE 5. REPRODUCING SUMMARY PUNCHING MACHINES

IBM

SORTING INSTRUCTIONS

JOB NAME		JOB NO	CONTROL PANEL NO.	OPERATION NAME	OP CODE	MACH. TYPE
SALES ANALYSIS		1435		Sorter	51	82

FREQUENCY		DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME

FREQUENCY	DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME	
☐ Daily ☒ Monthly	TIME	DATE	TIME	DATE	22,000 detail	HOURS	TENTHS
☐ Weekly ☐ Quarterly		2nd		3rd	1,600 master	5	4
☐ Bi-Weekly ☐ Annual	1:00	W.D.	8:00	W.D.			
☐ Semi-Monthly ☐ Other							

OPERATING INSTRUCTIONS

CARDS USED   Sales Detail (748342)
　　　　　　　 Item Master (153762)

RECEIVED FROM   Monthly Sales File
　　　　　　　　 Item Master File

DISPOSITION OF CARDS
403 Accounting Machine
Operation Step 3

SORTING SEQUENCE

1 FIELD	COLUMNS		ALPHABETIC ☐	CARD ☒ YES
Product Class	FROM 30	TO 29	NUMERICAL ☒	COUNT ☐ NO

2 FIELD	COLUMNS		ALPHABETIC ☐	CARD ☐ YES
Location	FROM 20	TO 16	NUMERICAL ☒	COUNT ☒ NO

Place location master cards in front of file before starting this sort.

3 FIELD	COLUMNS		ALPHABETIC ☐	CARD ☐ YES
	FROM	TO	NUMERICAL ☐	COUNT ☐ NO

4 FIELD	COLUMNS		ALPHABETIC ☐	CARD ☐ YES
	FROM	TO	NUMERICAL ☐	COUNT ☐ NO

Date ___ 2/10/5 ___

Section ___ 5 ___   Page ___ 2 ___

FIGURE 6.   SORTING INSTRUCTIONS

IBM   COLLATOR INSTRUCTIONS

JOB NAME		JOB NO.	CONTROL PANEL NO.	OPERATION NAME	OP. CODE	MACH. TYPE
STOCK CONTROL		825	18	Merge	53	77

FREQUENCY		DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME
☒ Daily ☐ Monthly		TIME	DATE	TIME	DATE	11,000 Bal.	HOURS TENTHS
☐ Weekly ☐ Quarterly							
☐ Bi-Weekly ☐ Annual		9:00	Daily	11:00	Daily	3,000 Detail	1 1
☐ Semi-Monthly ☐ Other							

CARDS USED:	RECEIVED FROM:
Daily Transaction (507831)	Sorter Operation Step 2
Item Balance Cards (773742)	Balance File

OPERATING INSTRUCTIONS: __Merge Daily transaction cards with balance cards for active__
__items.__

TYPE OF CARD: PRIMARY FEED: __Balance Summary Cards__

SECONDARY FEED: __Transaction Cards__

CONTROL SEQUENCE: FIELDS   COLUMNS

Major

Intermediate   __Material Class__   __1-2__

Minor   __Part Number__   __4-7__

POCKETS:

4 SEL. SECONDARDIES	3 SEL. SECONDARDIES	2 MERGED	1 SEL. PRIMARIES
	Unmatched	Active Balance	Unmatched
	Transactions	Transactions	Balance

DISPOSITION:

	Investigate	Accounting Machine	Return to File
		for Transaction	
		Register	

Date: __2/10/5__   Section_____7_____ Page_____3_____

FIGURE 7. COLLATOR INSTRUCTIONS

IBM CALCULATING PUNCH INSTRUCTIONS

JOB NAME	JOB NO.	CONTROL PANEL NO.	OPERATION NAME	OP. CODE	MACH. TYPE
BILLING	**733**	**20**	**Multiply**	**37**	**602A**

FREQUENCY		DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME
☒ Daily ☐ Monthly ☐ Weekly ☐ Quarterly ☐ Bi-Weekly ☐ Annual ☐ Semi-Monthly ☐ Other		TIME **2:30**	DATE **Daily**	TIME **4:45**	DATE **Daily**	**300 name 1200 detail**	HOURS TENTHS **1 2** ▲

CARDS USED:	DISPOSITION OF CARDS:
See Below	**403 Accounting Machine**

RECEIVED FROM:	
Card Punching Operation Step 2	**Operation Step 4**

	CARD TYPES	X-D CONTROL		SORTING SEQUENCE — FIELDS	COLUMNS
1	**Master name card**	**X-40**	1	**Invoice number**	**34-38**
2	**Miscellaneous Data Card**	**X-46**	2.		
3	**Item Detail Card**		3		
4			4		

CONTROL READING BRUSH SETTING									SKIP STOP INSERTS (602A)
NO	**1**	**2**							
COL	**40**	**46**							**67**

FORMULA

Unit price x quantity = Amount

FACTOR	½ ADJ	DECIMAL POSITION	CARD COLUMNS READ	CARD COLUMNS PUNCH
Unit Price		**XX.XXX**	**8-12**	
Quantity		**XXXXX.**	**57-61**	
Amount	**yes**	**XXXXX.XX**		**67-73**
Invoice Number--Gangpunch into				**34-38**
detail cards from X-46				
Miscellaneous Data Card				

Date ___**2/10/5**___   Section___**6**___ Page___**3**___

FIGURE 8.   CALCULATING PUNCH INSTRUCTIONS

IBM 402 403 419
□ ☒ □ **ACCOUNTING MACHINE INSTRUCTIONS**

JOB NAME		JOB NO.	CONTROL PANEL NO.	OPERATION NAME	OP. CODE	MACH. TYPE
ACCOUNTS PAYABLE CHECKS		728	91	Detail Print	74	403

FREQUENCY		DUE IN		DUE OUT		ESTIMATED VOLUME	EST. TIME
		TIME	DATE	TIME	DATE		HOURS TENTHS
□ Daily □ Monthly		11:00	Tue.		Tue.	3,000 detail	
□ Weekly □ Quarterly							
☒ Bi-Weekly □ Annual			Fri.	4:00	Fri.	1,000 MLP	1.4
□ Semi-Monthly □ Other							

CARDS USED: Accounts Payable Detail (632433) Vendor Name and Address (133231)	DISPOSITION OF CARDS:
RECEIVED FROM: Sorter Operation Step 2	Collator Operation Step 4

SORT	FIELD	COLUMNS	PROGRAM	FIELD	COLUMNS
1.	Vendor Number	7-11	MINOR	Vendor Number	7-11
2.			INTERMEDIATE		
3.			MAJOR		
4.			FINAL	X	
5.			SPECIAL		

		ALPHAMERICAL	NUMERICAL	SET UP CHANGE SWITCHES			
				ON	OFF	NO.	REMARKS
HAMMER LOCKS	LONG	37, 38, 39			X	1	
	SHORT						
HAMMER SPLITS (ZEROS)		36	6, 14, 15, 16		X	2	

CARRIAGE TAPE

CHAN.	FUNCTION	CHAN.	FUNCTION
1	FIRST PRINT LINE	7	
2	Check address line	8	
3	First check line	9	
4		10	
5		11	of Remit.
6		12	LAST PRINT LINE State.

	X	3	

X	GANG PUNCH
X	LAST CARD AUTO TOTAL

FORM THICKNESS ADJUSTMENT			TENSION ADJUSTMENT		
	TOP	CENTER	LOWER	HIGH	CENTER	LOW
PAPER BRAKE	☒	□	□	□	☒	□

SUMMARY PUNCH	TYPE	DETAIL PRINT ☒
YES ☒ NO □	519	GROUP PRINT □

FORM NO. 40371   NO. COPIES 1

OPERATING INSTRUCTIONS:

   The check used is an inverted paper form with remittance statement at top
and check as lower portion. When completed checks are to be delivered to the
accounts payable department. Summary-punched cards are used for check
reconciliation.

Date: 2/10/5   Section 4   Page 3

FIGURE 9. IBM 403 ACCOUNTING MACHINE INSTRUCTIONS
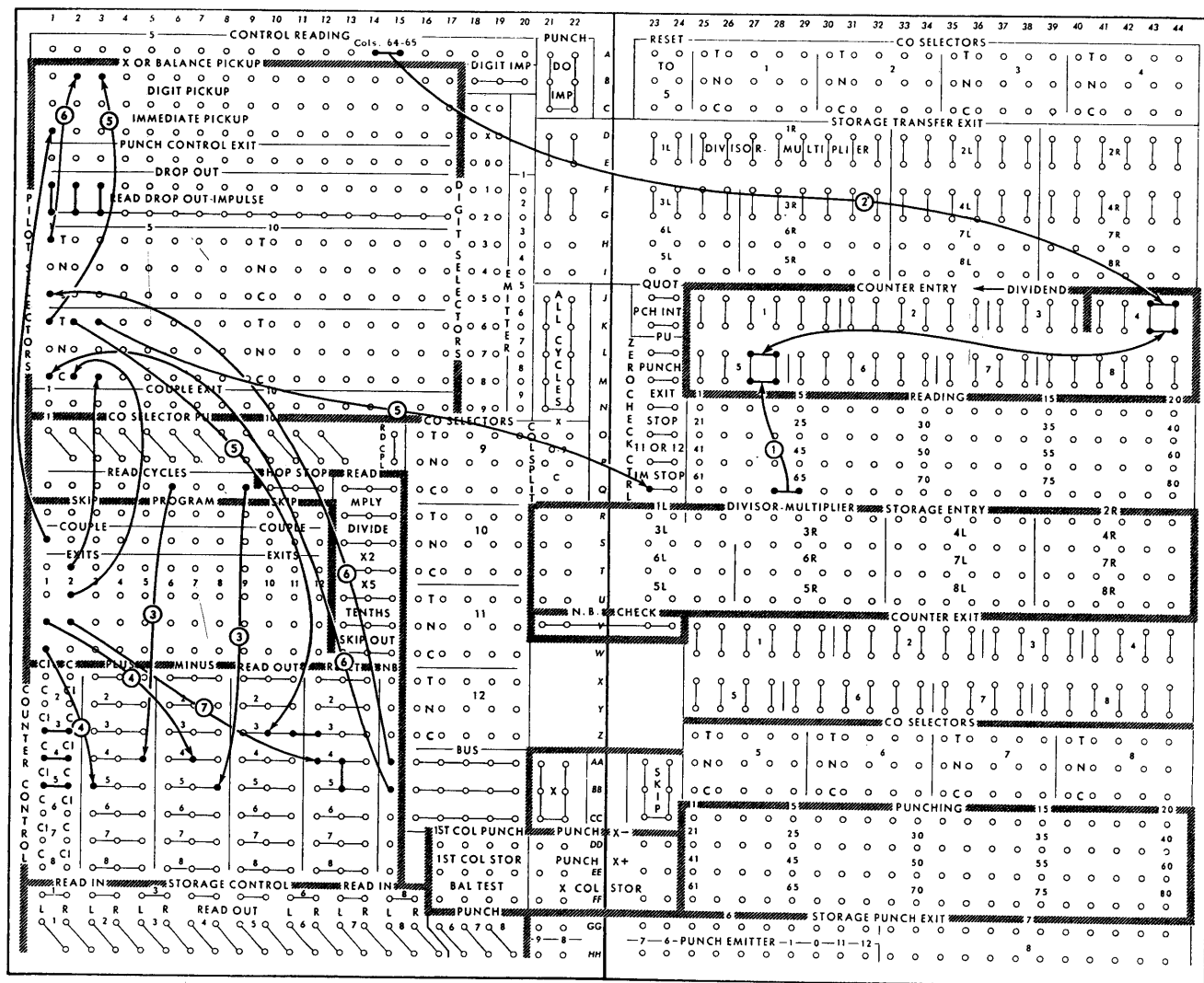
FIGURE 10. TYPICAL WIRING DIAGRAM

Planning Charts

The use of planning charts has grown in importance in recent years. Their usage is perhaps the result of calculating punches that perform one step of a problem at a time, calling for planning on that basis. The reverse side of instruction sheets for the accounting machines has planning charts printed on them.

Figure 11 clearly illustrates how this form is used for the IBM 407 Accounting Machine. In many cases it is better to use a planning chart in preference to a wiring diagram. All basic data needed for control panel wiring may be arranged in table form for convenient reference of the individual who is to wire the panel. If the problem is a complex one, the planning chart may be supplemented by a diagram of the difficult portion of the job.

Even though fixed control panels are used, it is important to maintain written instructions of this type in the event it is later desirable to make changes. In addition, the time required to diagnose service problems can be reduced if this information is available to the customer engineer.

Electronic Data-Processing Machines

Electronic data-processing machines, such as the IBM 650, and the 700 series machines, which are capable of internally storing all instructions for processing an entire accounting function without outside directions, emphasize the importance of sound planning.

Proper analysis of what is required can be best made by dividing the whole problem into small segments and by making block diagrams of the functions and

TYPE 407 PLANNING CHART

REPORT HEADINGS	Employee Number Dept.	Serial	Earnings after Taxes		Deductions		Net Pay		
CARD COLUMNS	14-16	17-21	76-80		76-80		76-80		
EMITTED CHARACTERS			.		.		. *CR		
PRINT ENTRY — TRANSFER									
PRINT ENTRY — NORMAL	11-13	15-19	. 25		. 34		. 41	* 44	CR 45-46
PRINT ENTRY — COUNTER CONTROLLED			22-24	26-27	32-33	35-36	38-40	42-43	
ZERO PRINT CONTROL	Normal	Zeros to the left	.01 100.00		.01 100.00		.01 100.00		
PRINT CONTROL									
PROGRAM CONTROL	MINOR								
COUNTERS 1 MINOR — GROUP			6		14		10		
COUNTERS 1 MINOR — CONTROL			+NX74		+NX74		+NX74 -X74		
COUNTERS 2 INTER. — GROUP									
COUNTERS 2 INTER. — CONTROL									
COUNTERS 3 MAJOR — GROUP									
COUNTERS 3 MAJOR — CONTROL									
COUNTERS 4 FINAL — GROUP									
COUNTERS 4 FINAL — CONTROL									
COUNTERS 5 — GROUP									
COUNTERS 5 — CONTROL									
STORAGE CONTROL — UNIT									
STORAGE CONTROL — IN									
STORAGE CONTROL — OUT									
SUMMARY PUNCH CARD COLUMNS									
SELECTORS	NO. PS1 PUX74	NO. PU	NO. PU	NO. PU	NO. PU	NO. PU	NO. PU	NO. PU	NO. PU / NO. PU
	T +ctr 14	T -ctr 10	T	T	T	T	T	T	T / T
	N +ctr 6	N +ctr 10	N	N	N	N	N	N	N / N
	C card cycles	C card cycles	C	C	C	C	C	C	C / C

FIGURE 11. IBM 407 PLANNING CHART

1042 1045 1047 1049 1055 1059

| b | 1 | 3 | 0 | 0̄ | 1 | 8̇ | 2 | 0̄ | 4 | 2 | 0 | 0 | 0 | 0̄ | 0 | 0 | 0 | 0̄ | b |

CONSTANT   DATA

Read
0200→1001

INPUT TAPE

1001   1006 1007   1013   1019   1023   1028   1031   1035   1040 1041

| b | 1 | 0 | 0 | 3 | 7 | 2̇ | 0̇ | 3 | 5 | 0 | 0 | 0 | 0̄ | 0 | 4 | 3 | 0 | 6 | 1̇ | 2 | 1 | 4 | 2̇ | b | b | b | b | b | b | b | b | b | b | b | b | 1 | 9 | 2 | 7 | 9̇ | ‡ |

Man No.   Tax Cl.   Yr-to-Date Gross   Yr-to-Date W.H. Tax   Qtr-to-Date FICA   Net Pay   OASI   W.H. Tax   Gross Pay

Compute W.H. tax exemption amount

Subt. exempt. amt. from gross pay

W.H. Tax ←

No W.H. Tax

Compute W.H. tax

Store zeros for W.H. tax

Add year-to-date W.H. tax → Subtract yr-to-date gross from $4200.00

Try for FICA tax

Partial ←   Whole Tax →

Compute partial FICA

Compute whole FICA

No Tax

Add mem. and store FICA → Compute net pay ← Add Qtr.-to-date FICA and store

Write
1001→0201

OUTPUT   TAPE

| 1 | 0 | 0 | 3 | 7 | 2̇ | 0̇ | 3 | 6 | 9 | 2 | 7 | 9̇ | 0 | 4 | 5 | 1 | 2 | 7̇ | 2 | 3 | 4 | 2̇ | 1 | 7 | 0 | 1 | 3̇ | 2 | 0 | 0̇ | 2 | 0 | 6 | 6̇ | 1 | 9 | 2 | 7 | 9̇ |

Man No.   Tax Cl.   Yr-to-Date Gross   Yr-to-Date W.H. Tax   Qtr-to-Date FICA   Net Pay   OASI   W.H. Tax   Gross Pay

FIGURE 12.   BLOCK DIAGRAM

decisions the machine must be instructed to make. A typical block diagram is shown in Figure 12. Next, detailed instructions must be prepared in the form of a program. Special forms, such as Figure 13, are available for each of the machines, and should be maintained in the books in the event the job instructions are to be reviewed or changes are required. Procedure review is facilitated by keeping the block diagram and program steps on opposite pages. After planning is completed, these instructions are recorded in cards or tapes for providing actual instructions to the machines.

In the data-processing systems it is possible to program operator instructions into the machine to simplify the job. For example, when a tape reel on the IBM 705 has been exhausted and should be removed, a message can be written on the typewriter to inform the operator.

INSTR. LOCATION	INSTRUCTION OPER.	ADDRESS	ACCUMULATOR A	SIGN	ACCUMULATOR B	SIGN	EXPLANATION
0004	Sel	0200					Select tape unit number 1
0009	Read	1001					Read record into memory
0014	R Add	1007	a6	+			Place tax class in accumulator
0019	Mpy	1045	a07800	+			Tax exemption amount
0024	Add	1040	a11479	+			Add gross = taxable amount
0029	Tr Pls	0049					Taxable
0034	R Add	1059	a0000	+			Not taxable, enter zeros in acc.
0039	Store	1035					Store zeros for no tax
0044	Tr	0074					To FICA
		COMPUTE WITHHOLDING TAX					
0049	Mpy	1047	a0206622	+			Multiply times 18%
0054	Round	0002	a02066	+			
0059	Set L	0004	a2066	+			
0064	Store	1035					Store withholding tax
0069	Add Mem	1019					Add to year-to-date withholding tax
		TRIAL FOR FICA					
0074	R Add	1055	a360000	+			Place FICA limit in accumulator
0079	Sub	1013	a010000	+			Subtract year-to-date earnings
0084	Sub	1040	a009279	–			Subtract gross pay
0089	Tr Pls	0139					Gross pay is taxable
0094	Add	1040	a010000	+			Add gross pay
0099	Tr Pls	0109					Partial earnings taxable
0104	Tr	0149					No earnings taxable
		PARTIAL FICA					
0109	Mpy	1049	a00020000	+			Multiply times 2%
0114	Round	0002	a000200	+			
0119	Set L	0003	a200	+			
0124	Add Mem	1023					Add to qtr. - to-date FICA
0129	Store	1031					Store FICA
0134	Tr	0164					To compute net pay
		WHOLE PAY FICA					
0139	R Add	1040	a19279	+			Place gross pay in accumulator
0144	Tr	0109					To compute FICA
		NO FICA					
0149	R Add	1059	a0000	+			Place zeros in accumulator
0154	Shor	0001					Shorten to 000
0159	Store	1031					Store zeros in FICA field
		COMPUTE NET PAY					
0164	R Add	1040	a19279	+			Gross Pay
0169	Add Mem	1013					Add to year-to-date earnings
0174	Sub	1035	a17213	+			Subtract withholding tax
0179	Sub	1031	a17013	+			Subtract FICA
0184	Store	1028					Store net pay
0189	Sel	0201					Select tape unit number 2
0194	Write	1001					Write record
0199	Tr	0004					Transfer to start

FIGURE 13. IBM 705 PLANNING CHART

The operator of the console, however, must have very complete information of each job available to enable him to prepare the machine for operation by loading instructions or modifying them as required during processing. An instruction sheet for the operator of a console is illustrated in Figure 14.

IBM ELECTRONIC DATA – PROCESSING MACHINE   –   TYPE 702 **OPERATOR'S CHECK SHEET**

FORM 22-6217-0
PRINTED IN U.S.A.

JOB NO. __150__   JOB TITLE __Inventory Control__   WRITTEN 10/15 /54 BY __M & K__   CHECKED 10/15 /55 BY __BA__

PROGRAM NO. __1__   PROGRAM TITLE __702 Assembly Program__   REVISED __-/---/__ BY __----__

OPERATOR'S PANEL   A. CHECK INDICATOR SWITCHES

ADDRESS	AUTOMATIC	PROGRAMMED
0900	x	
0901	x	
0902		x
0903		x
0904	x	
0905	x	

B. ALTERATION SWITCHES

ADDRESS	ON	OFF
0911		x
0912		x
0913	x	
0914	x	

TAPE UNITS: A. READ STATUS

ADDRESS	FILE DESCRIPTION	NO. OF REELS	SOURCE	REMARKS
0202	Prog. Entry Records	1	Prog. Entry Cards	File protection on
				Will require an
				alteration card punched
				0310 05 0202

B. WRITE STATUS

ADDRESS	SIZE OF REEL	NO. OF REELS	REMARKS
0200	1200	1	Prog. Entry Records.
0201	1200	1	Table of addresses.
0203	1200	1	Used instead of punch when 0913 OFF
0204	1200	1	Used instead of printer when 0914 OFF

CARD READERS

ADDRESS	FILE DESCRIPTION	NO. OF CARDS	SOURCE	REMARKS
0100	Assembly Prog. #2	84		Include an alteration
				card to select 0202

CARD PUNCHES

ADDRESS	CARD FORM
0300	5081

DRUM

DRUM NO.	ADDRESSES USED
	Not required

FIGURE 14. OPERATOR'S CHECK SHEET

Test Decks

Each time a machine is set up, it should be tested with a file of test cards to insure that it is functioning properly. There should be a card included in the test for each type of transaction that could exist to insure that all mechanical features of the machine are in proper working order and that the control panel is wired properly. In the event that an X or digit control is used, a card for each possible combination should be included.

Results of tests made on the accounting machine should be compared with a sample copy retained with the procedure instructions.

Test cards for calculating punches may be punched to include both the factors to be calculated and the correct answer as well. When this is done, the precalculated answer should be recorded in a field other than the one into which the answer is to be punched. In addition, it should be interpreted for ease of comparison against the calculation made during the test.

If a stock of cards is maintained for each job to be calculated, it is unnecessary manually to punch and compute an example each time the machine is set up.

Instruction Binders

A loose-leaf notebook is often used for procedure instructions. For best results, books of this type should be sectionalized by the job to be performed. Only in small installations is it good practice to place all operating instructions in one book, because it limits its usage to a single individual.

In most cases it is desirable to maintain altogether instructions, wiring diagrams, planning charts, test decks, sample copies of reports, and accounting machine carriage tapes for a job. The procedure envelope illustrated in Figure 15 has been designed for this purpose. Each logical segment of a job should be contained in a separate envelope and filed in job-number sequence.

FIGURE 15. PROCEDURE ENVELOPE

Setup Cards

While detailed instructions must be written to supplement the instruction manual, slots are provided in covers of fixed control panels to contain setup instructions for the machine. These are often complete enough to be used by experienced operators for repetitive jobs without further reference to other instructions. However, this does not decrease the importance of maintaining detailed written instructions even though they are not required on a day-to-day basis. These cards are available for almost all machine categories and are used as shown in Figure 16.
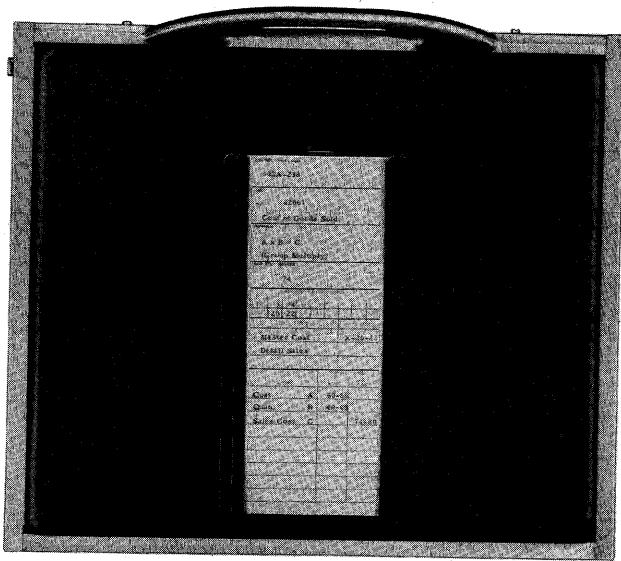
FIGURE 16.   IBM 602A FIXED CONTROL PANEL COVER

Setup Cards for Accounting Machines

On these cards, the section provided for control panel number is used to identify either the regular serial number stamped into each panel, or to show the numerical assignment made by the company or organization using machines. This should include the machine type to avoid possible confusion in storage and use of like-size panels.

Cards for the IBM 407 and 402 and 403 Accounting Machines (Figures 17 and 18) contain three sections for separate instructions in the event more than one job comes from each control panel by use of alteration switches. Only one such section is provided for the IBM 405. The job number, major application, and report title are shown here.

Automatic carriage tapes are frequently kept in

FIGURE 17.   IBM 402-403 SETUP CARD

this slot behind the setup card, or are filed in the envelope containing job sheets. In some cases they are filed separately; consequently, cross reference is made to the tape number or description. Carriage instructions for the IBM 405-416 are filled in at the bottom of that card (Figure 19).

FIGURE 18. IBM 407 SETUP CARD

FIGURE 19. IBM 405-416 SETUP CARD

In order that all machine switches are properly set, space has been provided on the IBM 402 and 407 cards for setup change or alteration switch settings. Because of the greater number of exposed switches on the IBM 405, a large portion of the card has been allocated for this purpose.

Auxiliary Machine Setup Cards

The interpreter setup card (Figure 20) can be used for all current model machines. Heading information is similar to those previously described. The IBM 557 can print in 25 different locations on the card. The bottom of the card identifies each of these positions in

relationship to the card. The printing line dial is set to correspond with the printing location desired. The print entry switch makes it possible to use the same board for a second job. Similar instructions apply to setting the printing position control dial on the IBM 550 and 551. Only upper or lower dial setting need be indicated on the IBM 552.

The collator setup card (Figure 21) provides a block to indicate the function performed. Card types fed into the primary and secondary feeds should be shown. Under *control*, list the fields and card columns used to govern the function performed. Under *card pockets*, list the status of cards directed into each pocket.

FIGURE 20. INTERPRETER SETUP CARD

FIGURE 21. COLLATOR SETUP CARD

On the reproducing and summary punch setup cards (Figure 22), indicate the function performed and types of cards used in each feed of the machine. Control X or digit punches may also be shown here. Blocks are provided to indicate brush settings of both RX and PX brushes if they are used for the job. For reproducing machines with exposed switches, mark in accordance with their desired setting for the job. When using an IBM 519, indicate on the setup card the printing location desired.

Space is reserved on the calculating punch setup card for the formula that applies. When the IBM 602A is used, skip stop inserts should be identified by the columns that apply. Control reading brushes are required to be set on predetermined columns to identify master cards or other factors shown by X or digit punching. An area is provided for this recording. To identify the factors for this formula, use the lower portion of the card and indicate columns to be read or punched as applicable (Figure 23).

CONTROL PANEL NO.

519-124

JOB

3276
Attendance Cards

OPERATION

☒ REPRODUCE   ☒ END PRINT
☒ GANG PUNCH   ☐ SUMMARY PUNCH
☒ COMPARE   ☐ M.S. PUNCH
              ☐ D P B C

READ FEED CARDS

Payroll Master

PUNCH FEED CARDS

Blank Time Cards

RX BRUSH	1	2	3	4	5	
CARD COL.						
PX BRUSH	1	2	3	4	5	6
CARD COL.						

ON	OFF	SWITCHES
X		REPRODUCE
	X	SEL. REP. G.P. COMP.
D	M X	CARD "X"
	X	MARK SENSE
	X	MASTER CARD PUNCH

END PRINTING
☒ 1 ST LINE   ☐ 2 ND LINE   ☐ OFF

BLANK COLUMN SWITCHES

	1	2	3	4	5	6	7	8	9	10
ON										
OFF	X	X	X	X	X	X	X	X	X	X

REPRODUCING AND SUMMARY PUNCH SET-UP CARD

FIGURE 22. REPRODUCING AND SUMMARY PUNCH SETUP CARD

CONTROL PANEL NO.

602A-238

JOB

42061

Cost of Goods Sold

FORMULA

A x B = C
(Group Multiply)

SKIP STOP INSERTS

74

CONTROL READING BRUSHES

NO.	3	4						
COL.	20	22						

CARD TYPES	X-0 CTL.
1. **Master Cost**	**X-20-22**
2. **Detail Sales**	
3.	

FACTORS		CARD COLUMNS	
		READ	PUNCH
Cost	**A**	**50-56**	
Quan.	**B**	**40-45**	
Sales Cost	**C**		**74-80**

CALCULATING PUNCH SET-UP CARD

FIGURE 23. CALCULATING PUNCH SETUP CARD

THE MANAGER'S responsibility is to produce reports and results for management in the most effective and most efficient manner. The management of an IBM installation includes the elements of

Planning — developing procedures, determining work loads, establishing schedules.

Operating — controlling the work flow, exercising

STATIONERY INDEX

CARD INDEX

X AND DIGIT ASSIGNMENT

CODE LISTS

EVALUATION DATA

OPERATIONAL FLOW CHARTS

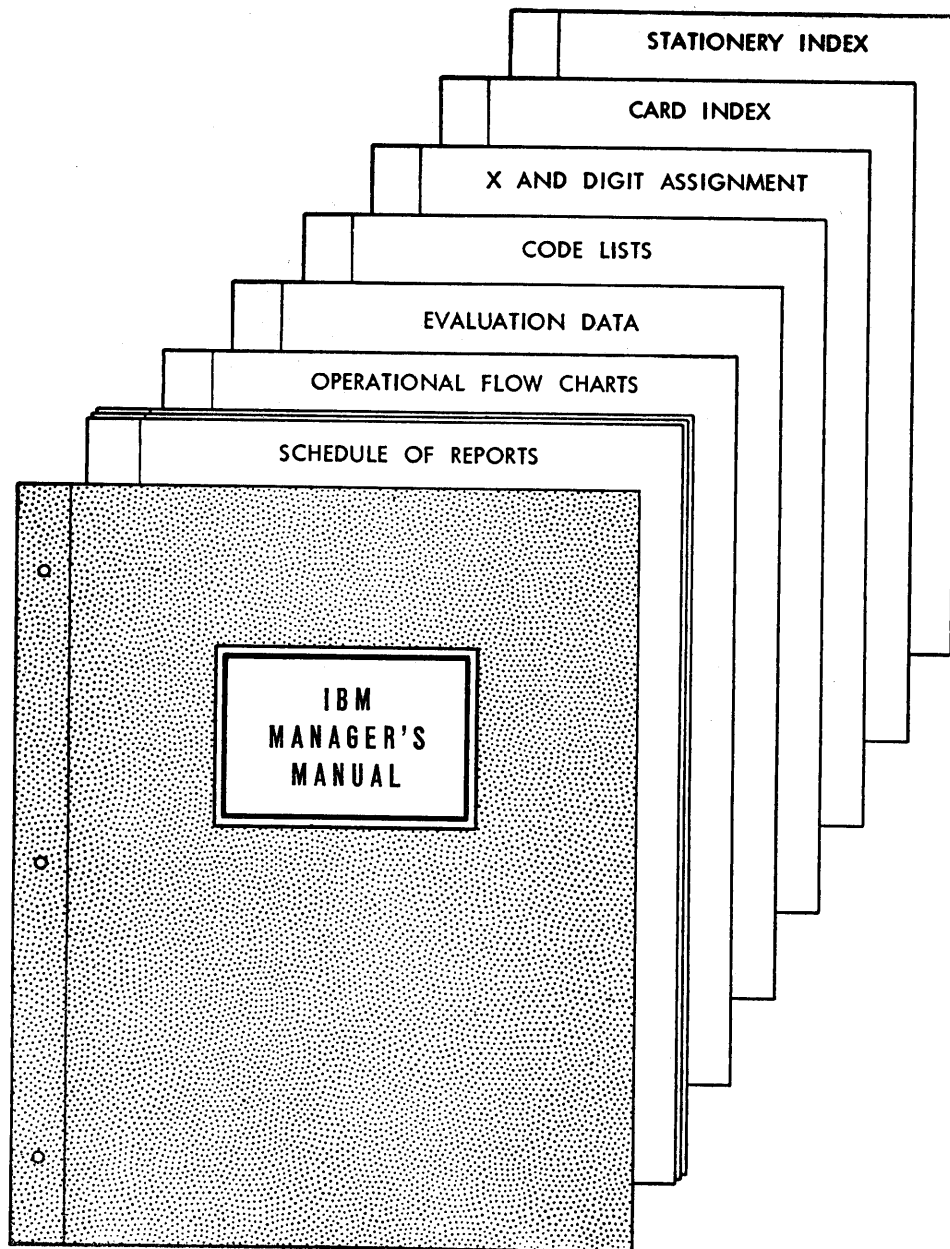SCHEDULE OF REPORTS

IBM
MANAGER'S
MANUAL

FIGURE 24. THE MANAGER'S MANUAL

document and accounting control, and administering personnel.

Evaluating — collecting operating information, analyzing utilization and performance, improving the original plans.

The *Manager's Manual* serves as a basis for all of these plans, controls, and evaluations of the department's operations. As illustrated in Figure 24, this manual should include:

IBM ACCOUNTING MANUAL			GENERAL SECTION		APPLICATION
SCHEDULE OF REPORTS				DATE	
SUBJECT					
	EXHIBIT	DUE IN	FROM	DUE OUT	TO
BILLING					
*Customer Orders	A	DAILY 10 AM	Order Dept.	DAILY 4:30 PM	Order Dept.
Shipping Orders	B			DAILY 4:30 PM	Shipping Dept.
Invoice	C			DAILY 1:00 PM	Customers
Register	D			DAILY 3:00 PM	Supervisor
ACCOUNTS RECEIVABLE					
*Remittance Advice	E	DAILY 2 PM	Cashier	DAILY 10 AM	Cashier
Cash Receipts	F			DAILY 2 PM	Chief Acct.
Aged Trial Balance	G			MONTHLY 1st	
Statements	H			MONTHLY 5th	Mail Room
SALES ANALYSIS					
Cost of Sales	I			MONTHLY 10th	Sales Mgr.
Sales by Customer	J			MONTHLY 15th	Sales Mgr.
Commission Statement	K			MONTHLY 17th	Sales Mgr.
Sales by State	L			MONTHLY 20th	Sales Mgr.
Sales by Salesman	M			MONTHLY 25th	Sales Mgr.
*Source Document					

FIGURE 25

Schedule of Reports (Figure 25) containing complete due-in and due-out information about each job. This information clearly enumerates the objectives of the installation and establishes the time limits within which the results must be accomplished. The schedule of reports is the first step of planning the department's operations. It is the blueprint from which all future jobs are constructed.

Operational Flow Charts (Figure 26) containing the individual, detailed steps for each application. Such flow charts assist the manager in maintaining a better over-all view of the few or the many jobs being processed. If additional detail is required, the step number on the flow chart serves as cross reference to the accompanying written instructions.

Evaluation Data containing the recording and organizing of operating experience. Such information as illustrated in Figure 27 can be utilized for comparison of actual operations with the previously planned activity. Analyses of these facts and figures result in significant graphs or charts like those of Figure 28. This type of evaluation makes possible the improvement with which every IBM accounting department manager should constantly be concerned: improvements in procedures, modification of machine load assignments, revision of schedules, and re-allocation of personnel.

Although the preceding two items constitute the main part of the manager's manual, it is many times convenient to include certain other information and pertinent data as:

Code Lists. These lists include such items as the chart of accounts, detailed expense classifications, customer number, and vendor code listings as well as all other important codes.

X and Digit Assignment Lists. These clearly establish specific designations of each card for each application. This information is necessary to properly revise existing procedures and to adequately plan for new jobs.

Index of Card Forms. This includes an up-to-date sample of each electroplate in use. Changes in card design and correlation of common fields in several applications can be accomplished effectively using these details. It may also be advisable to maintain inventories simultaneously.

Index to Stationery Forms. All existing forms should be included so that the manager can control revisions and improvements.

These items, as well as those previously described, provide the manager with a thorough knowledge of his department and complete control of its operations. The manager's manual then is an absolute requisite for fulfilling the responsibilities of any IBM installation.
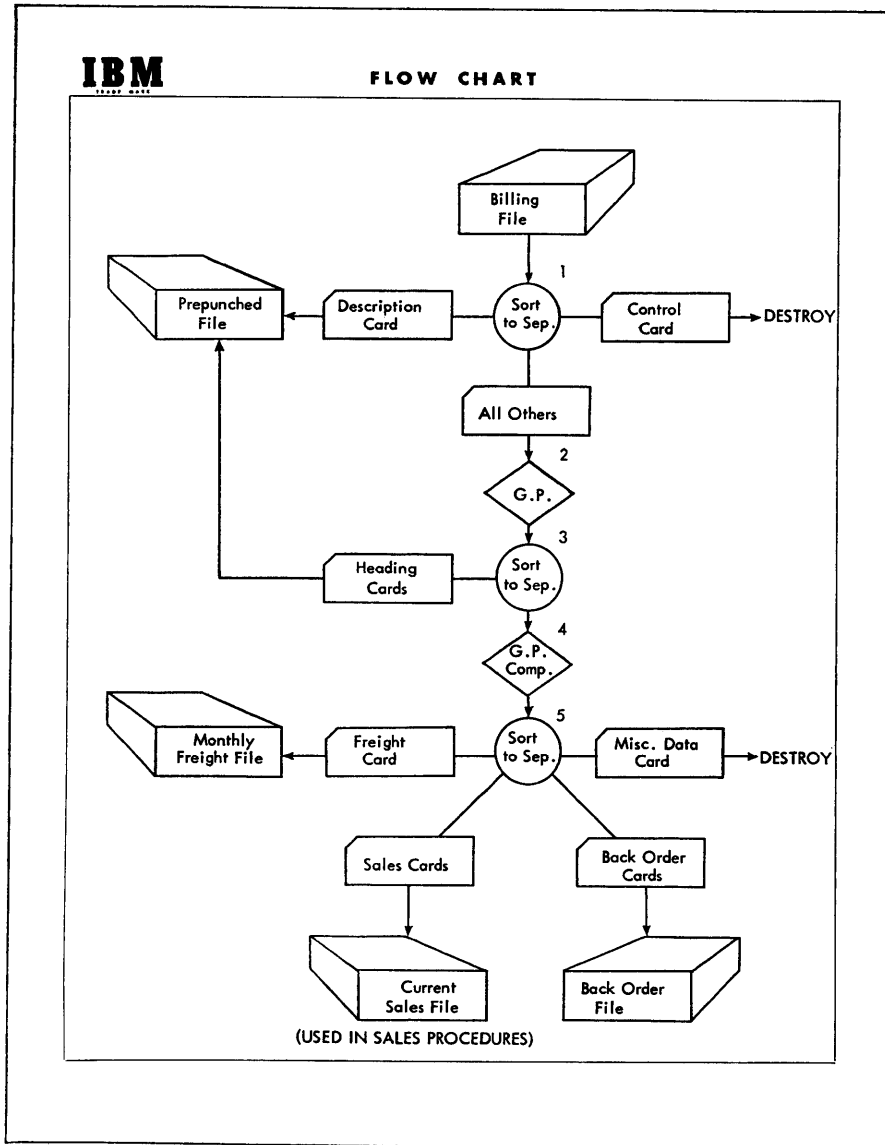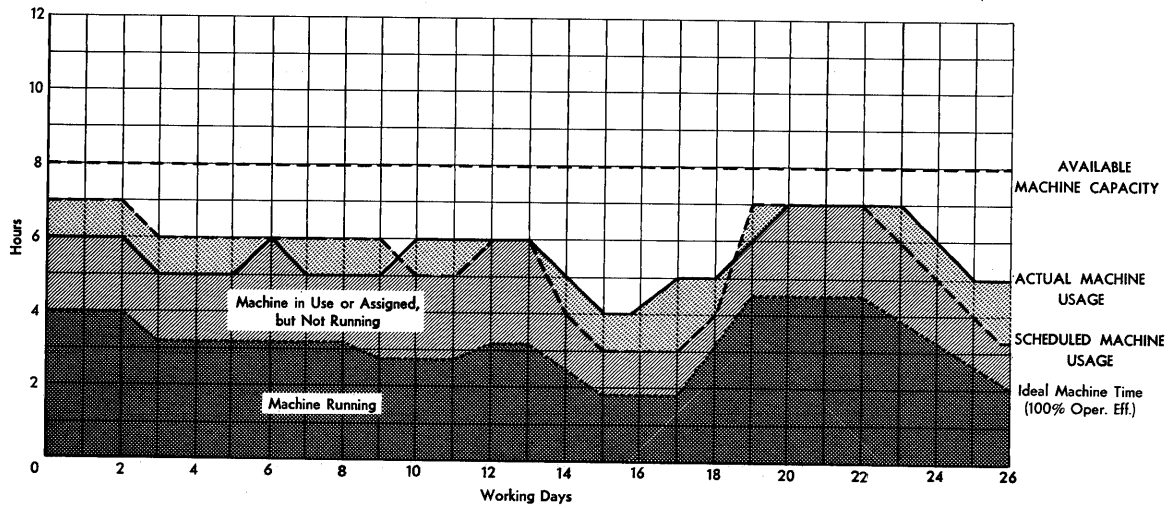
FIGURE 26. OPERATIONAL FLOW CHART

OPERATING DATA SUMMARY
CARD PUNCH PRODUCTION
FOR WEEK ENDING *April 5*

| DATE	NUMBER OF DOCUMENTS RECEIVED	NUMBER OF CARDS		NUMBER OF ERRORS	% OF ERRORS
		KEYPUNCHED	SPOILED		
April 1	1380	3500	65	20	.57
April 2	1465	3850	83	25	.65
April 3	1205	3223	40	15	.47
April 4	1310	3485	45	13	.37
April 5	1325	3415	55	10	.29
WEEKLY TOTALS →	6685	17473	288	83	(2.36)
DAILY AVERAGES →	1340	3500	58	17	.47

OPERATING DATA SUMMARY
MACHINE AND OPERATOR PRODUCTION
FOR MONTH ENDING *April 30*

MACH	MACHINE TIME			NO. OF CARDS PROCESSED	NO. OF DOCUMENTS PRODUCED	OPERATOR TIME			
	ACTUAL USE	UNAVAIL- ABLE	IDLE			NAME	REG	O'TIME	TOTAL
407	180	4	24	720M	120M	John Blaine	208	4	212
82	175	3	30	875M	—	Mary Smith	200	-	200
519	150	0	58	730M	—	Joe Rogers	208	-	208
602A	195	1	13	292M	—				
26A	150	0	58	41M	—				
26B	185	2	23	50M	—				
TOTALS →	1035	10	206	2728M		TOTALS →	616	4	620

OPERATING DATA SUMMARY
COST OF OPERATIONS

| MONTH	TOTAL SALARIES	MACHINE SERVICE CHARGE	SUPPLIES	OVERHEAD	TOTAL
Jan.	850	570	150	75	1645
Feb.	850	570	174	75	1669
Mar.	875	570	130	75	1650
April	885	570	120	75	1650
May	885	570	125	75	1655
June	886	570	135	75	1665
TOTALS →	5230	3420	834	450	9934

FIGURE 27. OPERATING DATA SUMMARY FORMS

MACHINE USE CHART—ACCOUNTING MACHINE, SHOWING JOB ANALYSIS
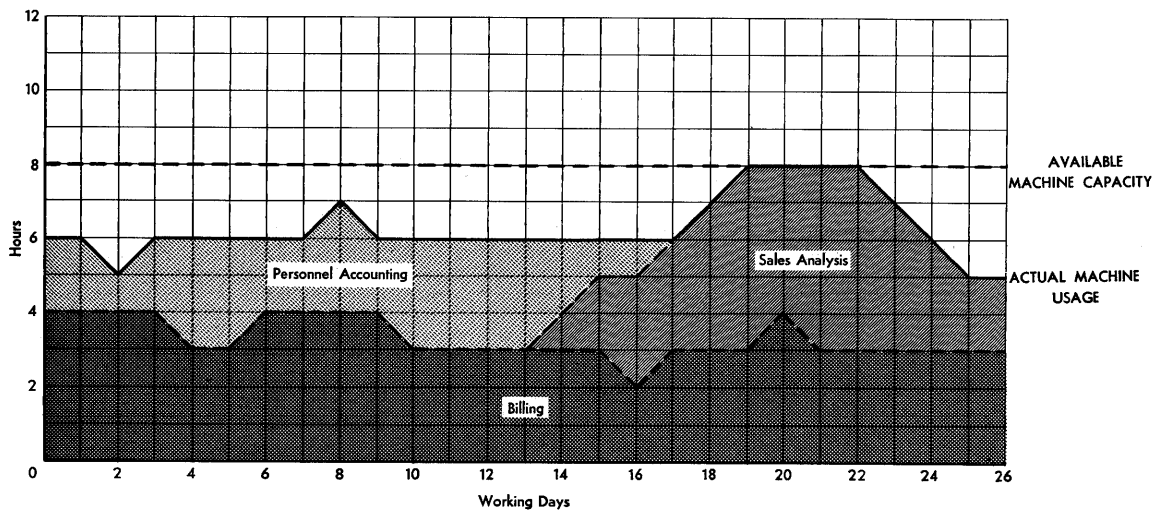
MONTHLY MACHINE USE—ACCOUNTING MACHINE, SHOWING OPERATING ANALYSIS

LONG-RANGE USE CHART—ACCOUNTING MACHINES

FIGURE 28
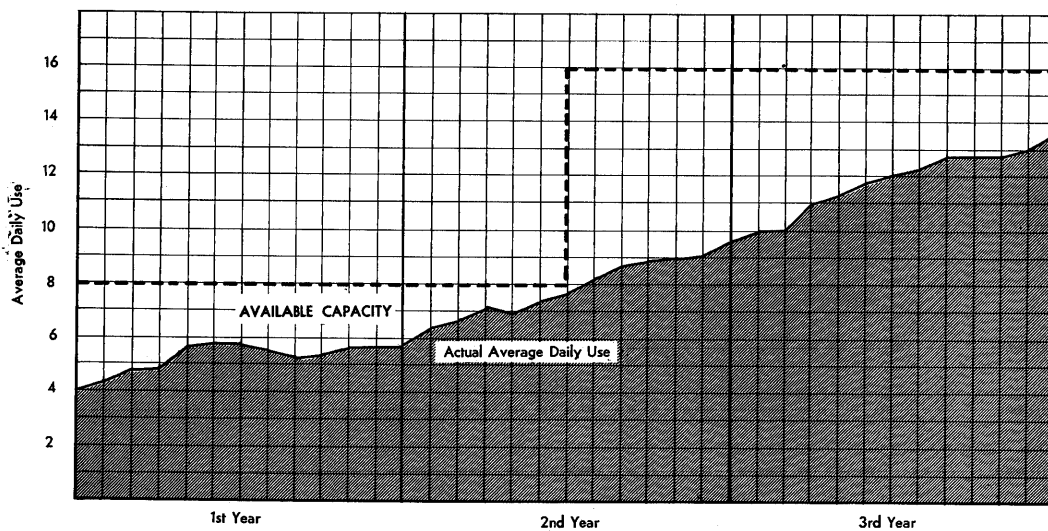
THE GENERAL MANUAL

A MANUAL outlining the broad objectives to be attained by the machine installation and summarizing the department's operations, can be effectively used in many situations. Such a publication essentially has a threefold purpose:

1. To orient company trainees or new machine accounting department employees.
2. To provide, for executives, information which serves as a basis for the common understanding and the mutual control of the department by the executive and the installation manager.
3. To show visitors the nature and the scope of the work performed by the machine accounting department.

As the name implies, this manual should be ot a general nature and should not contain unnecessary detail. Sample copies of reports and source data together with general flow charts of major applications provide a simple but complete appreciation of the results produced and the data handling involved. Pictorial flow charts (Figure 29) often portray a clearer illustration of the operation than do the general flow charts. However, the former are more difficult to prepare, and consideration should be given to the frequency with which they are used.

Again, the schedule of reports defines in capsule form the objectives or results of the installation and the scheduled time for producing these results.

CONCLUSION

EVERY JOB that is performed in a machine accounting installation should be recorded in an Operator's Procedure manual:

1. To enable operators to set up their machines to complete a job without supervisory assistance.

2. To provide a permanent record of job requirements in the event of illness, vacations, and operator turnover.

3. To provide assembled facts for simplifying corrections and improvements of procedures.

Similarly, every installation should be guided by a Manager's manual. This manual should be so constructed to facilitate the planning, operating, and evaluating responsibilities of the department manager.

To insure executive control and to assist in the general administration of the IBM installation, there should exist a General Manual. This book defines the objectives, illustrates the results, and establishes the responsibilities of the installation.

Every job performed on machines must be planned. This planning and the detailed instructions evolving from it must be recorded as a *permanent written record*.

GENERAL MANUFACTURING CO.

ACCOUNTS RECEIVABLE

COMMODITY CARDS USED TO PREPARE INVOICES
ARE COMBINED WITH AUTOMATICALLY PRODUCED
ACCOUNTS RECEIVABLE CARDS TO LIST THE SALES
REGISTER AND PROOF SHEET.

ACCOUNTS PAYABLE CARD

COMMODITY CARDS

SALES ANALYSIS
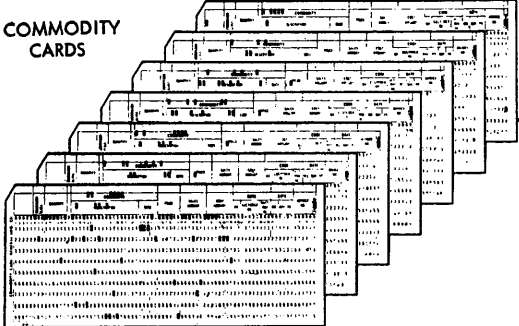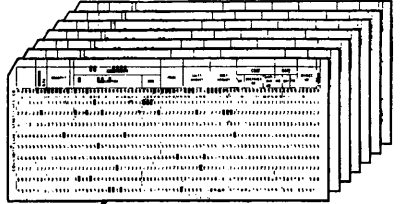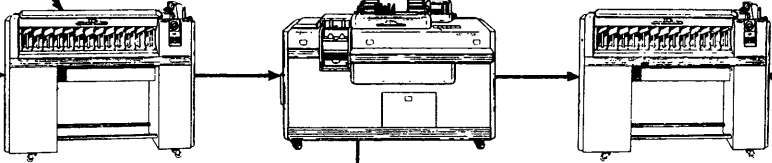
COMMODITY CARDS ARE SEPARATED
AND FILED FOR LATER ANALYSIS.

SALES REGISTER

ACCOUNTS RECEIVABLE
CONTROL SHEET

ACCOUNTS RECEIVABLE CARDS
ARE FILED BY CUSTOMER NUMBER

ACCOUNTS RECEIVABLE

DAILY TOTALS POSTED
TO CONTROL SHEET

FIGURE 29. PICTORIAL FLOW CHART

30

IBM

Document and
Accounting Control

IBM

DOCUMENT AND ACCOUNTING

CONTROL

WHEN RECORD KEEPING is placed on a machine basis, one of the prime considerations should be safeguarding the accuracy of the net results obtained. Just as modern manufacture of goods makes imperative the use of rules, gages, and other instruments of precision measurement, so does modern record keeping require the use of standards of measurement. In earlier times, an error in the choice of a hand tool might have resulted in the scrapping of a few pieces which had been fashioned manually. As machines, running at high speed, began to take on the job of turning out our goods, more and more effort was directed to making certain that the machine set-up was correct, that the right raw material was being used, and that the finished product measured up to standard. An error in one of these calculations might result in the spoilage of a large quantity of goods on a modern factory machine.

In modern record keeping, then, just as in modern manufacturing, a system of checks and balances or standards must be developed to make sure that the correct raw material or facts are being used, that the machine set-ups are correct, and that the results being produced are in accordance with specifications. The faster and more automatic the machine being used, the greater is the necessity for establishing these controls.

Every machine procedure should be built on a foundation of effective controls, by which detail records and reports are balanced against a controlling account and one result must balance the results obtained by another operation. Control over the scheduling of operations and the performance of the operators must be preceded by a positive check on the original document from which accounting results are obtained and control over the mathematical accuracy of those results.

IBM Accounting procedures inherently avoid many of the errors characteristic of other methods of accounting. A single recording in

punched hole form, once verified, need never again be checked as it appears successively in many reports. The punched card is automatically classified and summarized to produce final reports. Special journals, manually-posted ledgers, work sheets, and other forms of intermediate records are eliminated. The accuracy of the final results is not dependent alone, however, on the original accuracy of the transcribed data in punched hole form, but also on the fact that all required transactions have been included in the preparation of each report.

In this booklet, the discussion will be concerned with safeguarding the accuracy of the raw material used and of the final results obtained, under the headings "Document Control" and "Accounting Control," respectively.

DOCUMENT CONTROL

DOCUMENT CONTROL is the system of checks utilized to insure the availability and inclusion of all necessary original documents for report preparation, and to account for the proper distribution and final disposal of original documents. Generally, the necessity for document control increases with the volume of documents processed and the complexity of operations performed. There are several methods used to achieve this control, and the particular plans used in any situation depend upon the individual conditions.

Document Register

Unit control of documents can be maintained most effectively by the preparation of a register, listing each document at its point of receipt or origin. The register should contain either sufficient description to identify each document quickly, or a serial identification number. The serial number not only furnishes positive identification and an effective method for reference to later records containing the document information, but it also can be most easily applied at the point of origin. When each document has been processed through all operations, it is "checked off" or cancelled on the register. The uncancelled numbers thus represent documents which are either in process or mislaid. Intermediate processing operations may also be shown on the register, and each number can be checked as the corresponding document passes that point in the procedure. Figure 1 illustrates a document register for sales orders. This type of register not only discloses a missing or misplaced document (as might be the case with Order No. 12843, which, several days after its receipt, has not yet been billed) but it also indicates clearly delays in processing steps. Order No. 12831 was received and released by the order department on the 14th, but it was not billed until four days later. The delay might have been justified, but in relation to the processing time for the other orders shown, a four days' delay seems too long in this case.

ORDER REGISTER

MONTH *October*

DATE RECEIVED	ORDER NUMBER	DATE AUDITED	DATE BILLED	DATE SHIPPED	REMARKS
10/14	12831	10/14	10/18	10/18	
"	12832	"	10/16	10/16	
"	12833	"	"	"	
"	12834	10/15	10/17	10/18	
"	12835	10/14	10/16	10/17	
"	12836	"	"	"	
"	12837	10/15	10/17	10/19	
"	12838	10/14	"	"	
"	12839	"	10/15	10/17	
"	12840	"	"	"	
"	12841	"	10/16	10/17	
10/15	12842	10/15	10/17	10/18	
"	12843	10/16			*Awaiting spec. instructions*
"	12844	"	10/19	10/19	

FIGURE 1. ORDER REGISTER

Document Number and Sequence Check

Where serial numbers are printed or stamped on each document, rearrangement in serial number order and a check for missing numbers may be performed after processing to insure inclusion of all documents. This plan is particularly adaptable to such end or final documents as checks or drafts, where each document prepared is strictly accounted for. When the document is an IBM card, the serial number may be punched as well as printed or interpreted, and arrangement and check for serial numbers and a count of the documents may be accomplished automatically. The Sorter, equipped for card counting, the Collator, or the Accounting Machine is used for this purpose.

Serial numbers may be assigned to groups or batches as well as to individual documents. The quantity or number of documents in each batch is recorded, together with the batch serial number, either on the first document or on a separate form accompanying the batch. In large

/	4	2	TO: *Receiving Dept.*
BATCH	NO		

10/13/	FROM: *Sales Dept.*
DATE	

	NUMBERED	
37	12355	12391
NO. OF DOCUMENTS	FROM	TO

RECEIVED ATTACHED DOCUMENTS SPECIFIED ABOVE

DATE	SIGNATURE

PLEASE SIGN AND FORWARD THE COPY OF THIS BATCH CONTROL
TICKET TO SENDING DEPT. WITHOUT DELAY.

FIGURE 2. BATCH CONTROL TICKET

volume operations, the number of documents per batch may be a predetermined standard for ease and efficiency in handling.

Figure 2 illustrates the use of a serial document number as well as a batch number for document control. A batch of 37 invoices is being forwarded to another location from the sales department. In this case, the receiving department is asked to check the invoice numbers from 12355 to 12391, sign a copy of the batch control ticket, and return it to the sales department as a receipt. By maintaining a file of the batch control tickets, both the sending and receiving departments can be certain that all documents have been accounted for.

Transmittal and Route Slips

A letter of transmittal describing the contents and quantity of documents in groups or batches is frequently employed to establish control and fix responsibility when documents move from one department or location to another. The transmittal letter is usually a printed form with spaces to indicate the variable information for the batch. When the volume of work or the number of people who may perform any given operation is large, it may be desirable to fix responsibility and account for documents passed from each operation to the next as well as from one department to another. In this case, a route slip is employed, either in addition to or combined with the letter of transmittal.

A typical route slip is illustrated in Figure 3. It can be seen that the route slip is similar to the batch control ticket shown in Figure 2, except that in this case all the departments or operational steps which the accompanying documents pass through are identified, together with an indication of the processing time and the operator or clerk responsible for each job. Responsibility is fixed and the means to affect a degree

4 41	*10/16*	NUMBERED		
		17321	*17385*	*65*
BATCH NO.	DATE	FROM	TO	NO. OF DOCUMENTS
DEPT. TO	DATE FWD.	INITIALS	REMARKS	
Billing	*10/16*	*JCR*		
a/c Rec.	*10\19*	*TLM*		
Order	*10/26*	*a. R.*	*#17349 held for approval*	
EXPLAIN ANY DIFFERENCES IN NO. OF DOCUMENTS FORWARDED AND RETURN TO CONTROL CLERK				

FIGURE 3. ROUTE SLIP

of work control as well as document control have been incorporated into the same form.

Cancellation and Time Stamps

As each document is passed through a given department or control point, it may be "cancelled" by stamping, perforating or other marking to indicate automatically that it has passed a certain stage in its processing. For example, any clerk or operator handling documents after a cancellation point would automatically reject or return for checking any document not bearing the correct cancellation. The use of the time stamp for cancellation affords, in addition to document control, a method of achieving work time or production control, since it furnishes an accurate, unalterable record of elapsed time for handling (Figure 4).

PURCHASE ORDER

NEW MEXICO COMPANY

HOUSTON. TEXAS

SHOW OUR ORDER NO. ON ALL INVOICES.
PACKAGES AND SHIPPING PAPERS.

REQ. 56

DATE 10/12

ORDER No. 311

TO

GENERAL MANUFACTURING COMPANY

MAIL INVOICES IN TRIPLICATE UNLESS
OTHERWISE SPECIFIED.

ENDICOTT, N. Y.

OCT 25 3 04 PM

SHIP TO ABOVE   VIA BEST WAY   F. O. B.

QUANTITY	DESCRIPTION		PRICE
40	SQUARE SHANK SWIVEL	11202	
75	FLAT TOP RIGID	13102	
5	EXT SHANK WITH BRK	17203	
2	BOLT AND NUT SHANK	32105	
4	RND SPR RING STEM	44104	
40	BOLT AND NUT SHANK	62110	

NOTIFY DEPT.	ORD. BY DEPT.	DEL. TO DEPT.	APPROPRIATION	CLASS	CODE	

SUBJECT TO THE TERMS AND CONDITIONS ON THE BACK HEREOF
WHICH ARE INCORPORATED AND MADE A PART HEREOF

W. C. Dawson

PURCHASING AGENT

FIGURE 4. TIME STAMP CANCELLATION

Production Tickets

A production ticket, similar to those used in factory operations, may be used to effect document control in record keeping. The production ticket is usually composed of a series of removable coupons, one for each operation to be performed, containing in preprinted form the job number, operation number, and number of pieces per batch. The ticket accompanies each batch as it is released for processing. As each operation is performed, the corresponding coupon is removed, marked as to operator and time of completion, and forwarded to a control point. This method appears to be most effective when the volume of documents is large and processing steps are relatively consistent for all documents (Figure 5).

FIGURE 5. PRODUCTION TICKET

If the volume is sufficiently large to warrant it, a series of pre-punched and interpreted IBM cards, contained in a jacket or envelope, can be used as the production ticket. Speed and ease in classifying and totaling the returned tickets at the central control point make this method highly effective.

Matching

The reassembly and matching at a predetermined point of duplicate copies of documents which have been processed through different series of operations can be used to effect document control. This plan is particularly adaptable where the copies are prepared simultaneously, as with carbon copies, and the documents are being used as source records. Various copies may be segregated and used to prepare records in different locations. At a predetermined point, all copies are reassembled and matched. The presence of all copies indicates the accuracy of handling to that point. If the documents are punched cards, matching and checking is accomplished automatically by means of the Collator or the Sorter.

Any of the above methods can be used in combination to establish good control, and frequently two methods can be used independently for the same series of documents, in which case one plan checks the effectiveness of the other. Regardless of the techniques used, however, the application of suitable document controls is essential to full realization of the potentialities of the IBM Accounting method.

ACCOUNTING CONTROL

ACCOUNTING CONTROL may be defined as any system of checks or balances that will prove the mathematical accuracy of the results obtained. Since it has been generally conceded that the value of any accounting system can be measured only by the final results, the methods used to insure the accuracy of these results are most important. The development of double entry bookkeeping is tangible evidence of the recognition of the principle. Each transaction is recorded, classified, and summarized more than once, first to a detailed ledger account to which it is charged, and secondly, to a controlling account to which the sum of all the detailed accounts must balance. If the totals balance, it is presumed that mathematical accuracy has been obtained. Modern management, however, has found it necessary in most cases to analyze the events of business beyond those which can be made readily apparent by the totals of the ledger accounts. Many analytical reports are produced in which the same transactions are classified and summarized over and over again. When this work is done manually, it is evident that the details of each transaction must be read and written, classified and totaled by hand or key stroke movements. With each new reading, therefore, the possibility of error is present, and thus it is necessary to do the work twice for each step if accuracy is to be maintained.

IBM Accounting procedures inherently avoid many of the errors characteristic in other methods of accounting, and the function of accounting control is modified. Accuracy is established at the point where the detailed facts of each transaction are transcribed into punched cards. The process of establishing this accuracy is referred to as verification, and the several techniques used to apply it are described in more detail in the manual *Key Punching and Verifying.*

Once it is proved that the punched information is correct, then controls over subsequent records or reports prepared from the cards are established primarily to make certain that all the required cards have been included and that the correct operational steps have been performed for any given result. The problem of insuring the presence of all required data, however, as outlined previously, is somewhat broadened

because the card is a unit record. During the physical handling or moving of groups of cards from one operation to the next, the tendency to misplace or omit a card is increased over that in strictly manual record keeping, where many transactions would normally be contained on one work sheet or form. A secondary objective of accounting controls in IBM procedures is the checking of the accuracy of the machine function itself.

Good control techniques will provide the means to detect any error resulting from a missing or misplaced card quickly, or as near to the point where the error occurred as possible. In addition to locating an error quickly, it is also desirable in most procedures to be able to correct or adjust the error without reference to the original source data. In IBM procedures, the means to correct an error or to recreate a transaction should exist within the punched card procedure itself, since normal use of original or source documents ceases when the information is transcribed to punched cards, except for the purposes of reference or final audit. Once the card is punched, it becomes the means by which the transaction data are arranged and summarized. This is unlike manual procedures where the source document itself is read and reread to ac-cumulate the desired totals. Therefore, accounting control, as it specifically applies to IBM procedures, begins at the point of punching verification, or the point where it is ascertained that the information in punched hole form agrees with the data in written or printed form on the source document, and for most accounting applications it consists of three basic steps:

1. Punching dates of entry into the IBM cards so that they may be associated with correspondingly dated registers.

2. Preparing registers of all transactions affecting the accounts concerned:

       Registers of additions to the account.
       Registers of subtractions from the account.
       Trial balance registers of transactions
          still in the account.

3. Maintaining a control sheet established from the registers to which the trial balance must check.

The original or entry register should be listed by date of entry immediately after the cards have been punched or activated from a suspense or holding file. In some procedures, predetermined data are punched into IBM cards and the cards are placed in reservoir files. When an event occurs which can be recorded by the detailed predetermined information already punched into IBM cards, the necessary card or cards are removed from the holding file, and entry date is then punched into each card together with other information not already in prepunched form. This situation is typical of billing applications where commodity cards are usually punched in advance, held in reservoir files, and selected as the corresponding commodities appear on incoming sales orders.

Frequently the entry register can serve as a verification medium and proof sheet. In this case, the information is read back to the source data from the register. In many procedures, parallel entry cards are prepared, or cards which represent entries to both the controlling and subsidiary ledger accounts. If both types of cards are included on the register, zero balances can be produced, reflecting agreement between the cards and thus proving the accuracy of the punching operation. Specific examples of this type of cards would include payroll and labor distribution cards, accounts payable and payable distribution cards, accounts receivable and sales cards. For example, it can be seen in Figure 6 that the totals on the Sales Register charged to Accounts Receivable balance to the amount credited to Sales, since the IBM Accounting Machine has indicated zero balances for these totals. It should also be noted that all the punched information has been listed on the register, so that if a transaction card has to be recreated at some later time, reference to the source data or sales order will not be necessary.

After the register has been listed, the third step in the maintenance of good accounting controls in an IBM procedure must be attained. Totals from the registers are posted to a control sheet, and the summary of these current totals establishes the final control total to which all cards for the accounting period must balance. The sum of the register total of additions minus the sum of the register total of subtractions must equal the total of the trial balance register or the entries still active in the account. If we interpret the active account as being a file of cards

in a typical procedure, this principle might be expressed as follows: "The totals that entered the file less the totals that left the file must equal the total still in the file."

If the totals do not agree, all the cards for the accounting period, both those still in the active file and those subtracted or removed from the file during the period, are combined and sorted to entry date, summarized and checked against the entry totals on the control sheet. It will be seen, then, that one or more of the totals will not balance. The cards for the daily total that does not balance are relisted and a duplicate of the original or entry register is prepared. A line by line comparison between the duplicate and original entry registers will reveal the error.

Figure 6 illustrates the application of good control techniques in a typical Accounts Receivable application. Controls are not superimposed on a previously established series of operations. Rather, good controls are built into and become an integral part of each procedure. For example, one of the basic requirements of good accounting controls, as has been stated above, is the preparation of lists of all transactions affecting the general accounts concerned. This requirement is incorporated in the regular Accounts Receivable and Cash Receipts registers, which are normally a part of any receivables procedure, by preparing the registers in complete detail rather than by simply preparing registers of accumulated or batch totals. This principle of good built-in control techniques should be followed in every IBM procedure.

Just as mechanical means solved industry's need for greater production in less time than that required under manual methods, so mechanical means have now made possible the automatic production of accounting records in modern commerce and industry. The more machines are relied upon to do the work, however, the more necessary it is to control the results they produce.

GENERAL MANUFACTURING COMPANY

SALES REGISTER

REPORT NO. 1
DATE December 31,

DESCRIPTION	COMMODITY NUMBER	CODE			DATE			INVOICE NUMBER	PRICE	QUANTITY	GROSS SALES	COST OF GOODS	FREIGHT	INVOICE AMOUNT

INCOMING TRANSACTIONS LISTED IN
DETAIL FOR PERMANENT AUDIT
REFERENCE

General Manufacturing Company
ACCOUNTS RECEIVABLE
CONTROL SHEET

Month of December

Date	Invoices Billed DR. A/R	Invoices Paid CR. A/R	=	Cash Received DR.	+	Discount Allowed DR.	+	Returns DR.	+	Allowances DR.

TOTALS ARE POSTED TO
THE CONTROL SHEET
FROM BOTH DAILY REGISTERS

CHECK TO
TRIAL BALANCE

FIGURE 6

16

GENERAL MANUFACTURING COMPANY

AGED TRIAL BALANCE

REPORT No. 1

DATE December 31

CUSTOMER NAME	CUSTOMER NO.	INVOICE DATE	INVOICE NO.	TOTAL	CURRENT	30 DAY	60 DAY	90 DAY
AMERICAN STEEL CO	1281	1123	11666	64031		64031		
	1281	1230	11336	90904	90904			
				154935	90904	64031		
APALACHIN LUMBER CO	2179	915	9852	46920				46920
	2179	1114	11609	25461		25461		
	2179	1230	12335	143930	143930			
				216311	143930	25461		46920
B J E SERVICE CORP	2283	1229	12332	147478	147478			
				147478	147478			
BARRETT MACHINE	3076	1125	11717	58715		58715		
	3076	1231	12347	61023	61023			
				119738	61023	58715		
BENSON MFG CO	4123	1018	10864	758			758	
	4123	114	11452	21749		21749		
	4123	1228	12319	119165	119165			
				141672	119165	21749	758	
BROWN AND WILLIAMS	6195	111	11234	41440		41440		
	6195	1228	12321	194905	194905			
				236345	194905	41440		
CASTLE HARDWARE CO	8062	1230	12338	34043	34043			
				34043	34043			
CENTRAL UNION SUPPLY	8257	1122	11643	13280		13280		
				13280		13280		
CENTRAL VALLEY CORP	10723	1015	10514	62963			62963	
	10723	1110	11603	38925		38925		
				101888		38925	62963	
CHALLIS ALMERS	11905	1018	10901	2763			2763	
	11905	1222	12290	63707	63707			
				66470	63707		2763	
CHANEL WHOLESALE	11234	1228	12324	80208	80208			
	11234	1228	12324	500000	500000			
	11234	1231	12351	26786	26786			
	11234	1214	99588	261170	261170			
WHITE STEEL BENCH CO	86287	1215	12244	32398	32398			
				32398	32398			
WINTERDALE RAILWAY	87652	1213	12228	59895	59895			
				59895	59895			
WISELOMANN INC	88213	1215	12240	90336	90336			
				90336	90336			
				6729099	3798283	1690319	1022632	217865

OPEN TRANSACTIONS BALANCE
TO CONTROL SHEET TOTALS AT
ALL TIMES

CHECK TO
CONTROL SHEET

ACCOUNTS RECEIVABLE

GENERAL MANUFACTURING COMPANY

CASH RECEIPTS BOOK

REPORT No. 2

DATE December 31,

CUSTOMER NAME	CUSTOMER NO.	BR.	SALESMAN	ENTRY	INVOICE NO.	INVOICE DATE MO.	DAY	ACCOUNTS RECEIVABLE CREDIT	CASH DEBIT	DISCOUNT ALLOWED DEBIT
CASTLE HARDWARE CO	8062	25	13	11	11506	11	8	49217	49217	
CENTRAL UNION SUPPLY	8257	34	71	11	12300	12	23	36903	36165	738
CHANEL WHOLESALE	11234	22	79	11	12324	12	28	50000	49000	1000
COVENTRY OIL	19285	19	53	11	12292	12	23	95097	93195	1902
HASKEL IND SUPP CO	36512	1	16	11	12318	12	28	41533	40702	831
KELVINAIRE CORP	45035	10	74	11	11686	11	23	38166	38166	
MAIZE REFINING CO	58091	22	79	11	12285	12	22	25256	24751	505
NEWTON PARK AND CO	61043	4	18	11	11239	11	1	76131	76131	
NEW MEXICO COMPANY	59751	13	67	11	11993	11	30	100000	100000	
N Y GAS AND ELEC CO	61221	22	46	11	12325	12	28	105503	103393	2110
VESTAL STEEL CO	78050	7	69	11	10452	10	8	14661	14661	
WINTERDALE RAILWAY	87652	16	76	11	9562	9	1	65040	65040	
								697507	690421	7086

ACCOUNTING CONTROL.

IBM®

Process Control

IBM
data processing
MANAGEMENT

PROCESS CONTROL

AN ESSENTIAL ELEMENT of good supervision is the follow-up of planned operations to see that they are executed in the proper manner. Elaborate procedures and schedules which have been planned have no value until the operations are actually performed in accordance with those plans. The actual performance of the work can be indicated on a schedule chart in such a manner that the comparison between the scheduled operations and the performance record is obvious (Figure 1).

As work moves out of the planning stage into processing operations, the supervisor must follow up his plans with a system of process control. He must be able to determine at any time the status of work in process, so that he may know the effectiveness with which his plans are being carried out. Furthermore, he must have available recorded facts pertaining to all work which has actually been done in his department. These facts he uses to analyze current operations and as a basis for more intelligent future planning.

To maintain effective control of operations, the supervisor must:

1. See that each batch of work is properly identified to avoid loss or misplacement.

2. Be assured (through a system of procedure control) that each job is expeditiously kept on the right track until it is finished.

3. Obtain factual data on operations actually performed in order to analyze machine, personnel, and job performance.

By maintaining such controls over his work the supervisor has full knowledge of the operations being performed in his department and is not at the mercy of his machines or operators in determining the effectiveness of work for which he is responsible. The necessity for controls becomes increasingly important with larger installations and more complex procedures.

MACHINE SCHEDULE AND PERFORMANCE RECORD

FOR WEEK STARTING _April 1_

MACHINE	SCHEDULE OR ACTUAL	MONDAY 1 2 3 4 5 6 7	TUESDAY 1 2 3 4 5 6 7	WEDNESDAY 1 2 3 4 5 6 7	THURSDAY 1 2 3 4 5 6 7	FRIDAY 1 2 3 4 5 6 7
Card Punch No 1	Sch.					
	Act.					
Card Punch No 2	Sch.					
	Act.					
Verifier No1	Sch.					
	Act.					
Verifier No2	Sch.					
	Act.					
Sorter No1	Sch.					
	Act.		Machine Inspection			
Sorter No2	Sch.					
	Act.					
Reproducer	Sch.					2 HR O.T.
	Act.					3 HR O.T.
Interpreter	Sch.					
	Act.					
Acctg. Mach No 1	Sch.					
	Act.					
Acctg. Mach No 2	Sch.					
	Act.		Machine Inspection			
Clerical	Sch.					
	Act.					1 HR O.T.

FIGURE 1. MASTER MACHINE SCHEDULE AND PERFORMANCE RECORD

Identification

THE PURPOSE of identification of work in process is to insure that each set of cards is maintained as an integral unit and that the cards remain in proper relation to each other. The operator should always know exactly what cards he has to work with. Identification reduces the likelihood of mixing cards from different decks or of misplacing or losing cards. Such identification of work makes it possible for the supervisor to inspect his department and determine the progress on any given job.

One useful expedient for identifying a deck of cards is to write the title of the work and the number of boxes across the edges of the cards as they are stacked in a box or file. A soft pencil should be used to avoid mutilating the edges of the cards. This form of identification may be used within the job step and is particularly useful in identifying a given sequence of the deck, as well as its title. When the sequence of a deck changes, the identification is naturally destroyed. This limits the usefulness of this method of identification, because in many cases the sequence is not retained throughout the procedure.

Decks of cards being processed may be in various forms. Small groups of cards may have no container at all; they may be held intact by a rubber band or a large metallic clip. Larger groups of cards may be kept in file drawers which are moved about the department as the cards are processed. Punched cards are frequently retained in their original cartons when files are not available or when the job is of a temporary nature.

It is evident that the practice of marking the identification directly on the boxes or file drawers will serve to title the work or number the boxes. These boxes will be used again and again, however, and repeated markings of the same boxes soon render them illegible. It is for this reason that the use of work identification cards is advisable. These cards are simply inserted in the front of each file or box containing work in process. They should be of a distinctive color, different from that of all other cards used in the department, so that the identification may be readily spotted. Such identification cards should be conveniently located

for access by the operators. It is advantageous to use a card which is the same size as an IBM card, so that it may be placed on top of a small deck of cards to form a neat and compact deck.

The first box of every batch of work should contain an identification card giving the job or title of the batch of cards and the number of boxes. Each of the other boxes should contain a similar identification card showing the number of the box within the batch, such as Box 3 of 7, indicating the third box of a group of seven boxes. This constitutes the minimum of information to be put on identification cards (Figure 2.)

Any amount of additional information may be included on these cards. Pertinent data such as scheduled time, actual time required, "due out" time, number of cards involved, machines to be used, operators, etc., may be placed on cards to be used for routing slips or job tickets as well as for identification purposes.
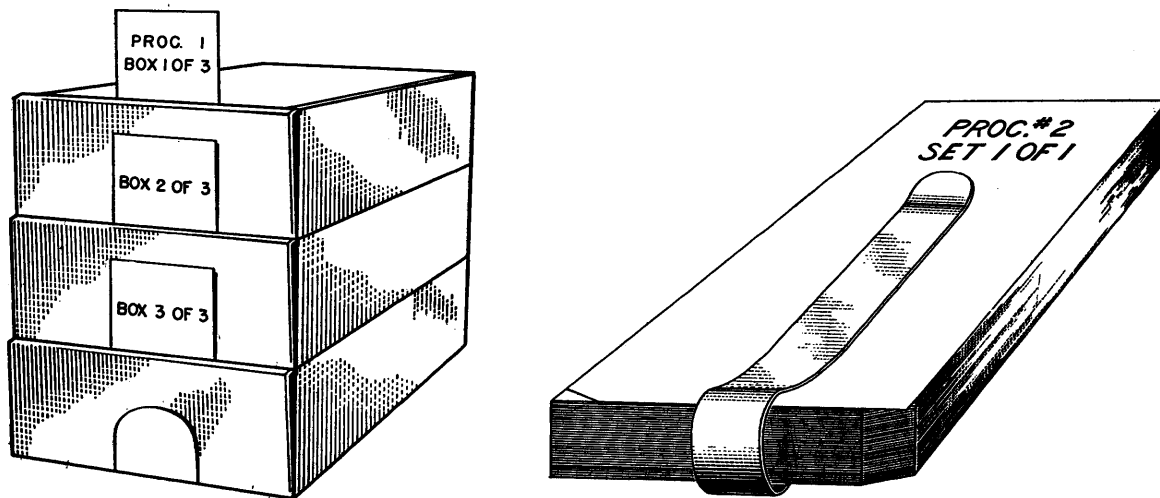
FIGURE 2. CARDS WELL IDENTIFIED

Procedure Control

OPERATIONAL CONTROL over work being processed requires that the supervisor keep close check on the progress of work to be certain that the job being performed is in accordance with the procedure flow chart. He may stay with the work himself or delegate this responsibility to a supervisor or operator. In any case this person must be thoroughly familiar with the entire procedure and exercise personal supervision over the job.

A more automatic method of control is the use of Route Slips or Job Tickets which are filled out by the supervisor and which show the sequence of all job steps necessary to accomplish the job. This form stays with the cards as they move from machine to machine and serve as a guide to the operators in transmitting the work to the next job step. The operators, of course, would have their detailed operation instructions pertaining to the job, and these instructions may be keyed in to job steps on the route slip by name of operation or by number of the job step. The form may further serve as a medium to record information pertaining to actual work performed, for analysis purposes. As the job is performed, the operators would fill in information such as machine used, time required, or any other desired information, and this information would be certified by the operator's initials, indicating that the job step has been performed according to instructions. This gives the supervisor the necessary information concerning the operations of the procedure so that he may intelligently appraise the performance of the job. A sample of such a form is illustrated in Figure 3.

JOB TICKET

JOB: *Job No. 14*

| BOX | *1* | OF | *6.* |

STARTED		APPROX. NO. CARDS
10/20 : *9 A.M.*		*12,000*
DATE TIME		

JOB STEP	MACH. NO.	TIME REQ'D.	OPERATOR'S INITIALS
1 *Sort*	*3*	*2.5*	*J.K.M.*
2 *Gang Punch*	*7*	*2.3*	*T.C.*
3 *Sort Select*	*3*	*.6*	*J.K.*
4 *Group Print Sum.*	*5*	*3.3*	*P.K.*
5 *Merge*	*6*	*3.0*	*L.M.*
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

COMPLETED		
10/21 : *2 P.M.*		*11.6*
DATE TIME		TOTAL TIME REQ'D.

REMARKS

J. Jones

SUPERVISOR'S SIGNATURE

FIGURE 3. ROUTE SLIP OR JOB TICKET

Analysis Data

IF OPERATIONS and procedures are never analyzed critically, they may never be improved upon. Too many procedures are followed year after year for the simple reason that they produce results. The purpose of analysis is to determine *better* methods of producing results.

Before any analysis is possible, sufficient data must be accumulated concerning the various operations so that conclusions will be based upon *facts*, and any changes which may be made will be sound.

Since the job of a supervisor is to use effectively machines, personnel, and time, and to so coordinate these factors through good procedures and schedules that his job is efficient, it is obvious that to analyze the procedures he must have data pertaining to the actual use of machines, of personnel, and of time.

MACHINE NO.	DATE	DAILY MACHINE OPERATION RECORD			
403 -2	Oct. 25				
NAME OF OPERATION		APPROX. NO. OF CARDS	TIME REQUIRED	OPERATOR'S INITIALS	REMARKS
Payroll Register		7,000	2.1	J.M.	
Aged Trial Bal.		18,000	3.0	P.P.	
Sales by State		15,000	2.5	J.M.	
IBM 752528			7.6 TOTAL TIME		

FIGURE 4. DAILY MACHINE OPERATION RECORD

These data may be taken from the completed Route Slip (Figure 3) and summarized by machine or by operator for the desired analysis. Or these same data may be classified by machine in the form of a daily Machine Operation Record (Figure 4.) In this case the form is kept with each machine and each operator enters the record of operations performed on that machine throughout the day.

OPERATOR'S DAILY REPORT

NAME *Pauline hue Cain*

DATE *October 18*

TIME	KIND OF WORK	MACH NO.	APPROX. NO. CARDS
8 9	*Key Punch Daily Sales*	2	510
10 11	*Verify Daily Sales*	4	710
12	*Lunch hour*		
1 2 3 4	*Key Punch Master cards*	2	210

K. Stroke
SUPERVISOR'S SIGNATURE

FIGURE 5. OPERATOR'S DAILY REPORT

A common method of receiving operational data is through the medium of the Operator's Daily Report (Figure 5). This report would be submitted by each operator each day as a report of the day's work. This sample form illustrates the use of a graphic time scale representing the hours of the day. The operator would divide the various jobs performed through the day into their respective time units by horizontal lines drawn at the proper "time" position. This same idea may also be adapted to the Daily Machine Report.

Finally, mention should be made of the unit record method, using punched cards, which may be adaptable to a large installation. In this case a record is made of each operation performed on each machine by each operator (Figure 6). This form illustrates the use of "time started" and "time finished" entries to facilitate the computation of elapsed time. Coding and punching the information makes it possible to analyze and summarize the operation records by automatic machine methods.

FIGURE 6.   UNIT OPERATION REPORT

MACHINE USAGE AND PERFORMANCE

FOR WEEK STARTING _May 15_

MACHINE	ACTUAL TIME (HRS)	AVAILABLE TIME (HRS)	UTILIZATION (%)	SCHEDULED TIME (HRS)	PERFORMANCE % OF STD.	REMARKS
Card Punch #1	34	40	85	32	94	
Card Punch #2	30	40	75	32	107	
Sorter	35	40	88	35	100	
Reproducer	20	40	50	18	90	Machine Inspection (8 hours)
Acctg. Machine	36	40	90	30	83	Re-run on Proc #3 (2 hours)
TOTALS	155	200	78%	147	95%	

FIGURE 7. MACHINE REPORT

USE OF OPERATING DATA

FACTUAL INFORMATION relative to actual operations has value when it is used to analyze the efficiency of operations. When these operational data are accumulated and summarized, valuable information becomes available concerning the installation as a whole. For instance, when the operating records are summarized for each machine used, machine utilization and performance can be computed:

$$\text{Machine utilization} = \frac{\text{Actual time performing useful work}}{\text{Available time}}$$

$$\text{Performance} = \frac{\text{Scheduled or standard time required}}{\text{Actual operating time required}}$$

Figure 7 illustrates a report showing machine evaluations.

When operating information is classified by job, and summarized, the job performance for the procedures in use may be computed.

$$\text{Job performance} = \frac{\text{Scheduled or standard time}}{\text{Actual operating time required}}$$

Figure 8 illustrates a report showing job or procedure performance.

The greatest value of such reports lies in the use of summarized data to locate elements of the operation which have abnormal performance or unusual variations from standards. These would then be analyzed in more detail to determine the cause of such variations, by making use of the Operators' Daily Reports, Machine Daily Operation records, or Job Tickets, if they are already in use, or by initiating the use of such forms for collecting data for some specific analysis. For more detailed information pertaining to the use of such data, refer to the booklet *Evaluation and Improvement*.

JOB PERFORMANCE

FOR WEEK STARTING _July 15_

PROCEDURE	ACTUAL TIME (HRS)	SCHEDULED TIME (HRS)	JOB PERFORMANCE (%)	REMARKS
Proc #1-A	18	15	83	Final report re-run (3-hrs.)
Proc #1-B	10	10	100	
Proc #2	35	33	94	
Proc #3	43	38	89	
Proc #4	15	15	100	
Proc #5-A	30	31	103	
Proc #5-B	4	5	125	
TOTALS	155	147	95%	

FIGURE 8. JOB PERFORMANCE REPORT

When forms have been in use continuously for collecting operating data, the supervisor must make sure that operators do not become careless and perfunctory in filling them out. The data should always be as representative of the actual operations as possible.

Like all records which are gathered for analysis purposes, it is necessary that these records be complete enough to provide an adequate picture of actual operations, but not so numerous as to be cumbersome or without use.

The supervisor must bear in mind at all times the psychological reaction that reports or records may have upon personnel, and forms such as the Operator's Daily Report must be used with caution.

Records are necessary to maintain control of complex operations and their effective use determines the degree of control which a supervisor or manager can exercise over his organization. The following principle must be kept in mind:

Gather all the information you need to maintain adequate control, but do not accumulate more data than you can effectively use. Usable facts are the raw material of good judgment.

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IBM ACCOUNTING
MANAGEMENT

EVALUATION AND IMPROVEMENT

IN AN IBM ACCOUNTING department the supervisor's job involves co-ordination of machines and people in order to produce specified results. This coordination is achieved largely through good supervisory planning, which requires experience and foresight. Experience must be so recorded and organized that it can be utilized for effective planning and operation. This recording, organizing, and use of past experience in relation to a given activity is a process of *evaluation*. It is essential to good planning and execution of plans.

IMPROVEMENT THROUGH EVALUATION

EVALUATION makes possible the improvement with which every IBM Accounting department supervisor should constantly be concerned. The supervisor's objectives are to work within the department to improve *reports, procedures, machine usage* and *operation*. To do this, he must also go outside his department to improve *teamwork* with other departments.

Improvement of Reports

Periodically, the entire set of reports being produced by the IBM Accounting department should be reviewed on these points:

Does a need exist for each report?

Do the reports show the necessary detail consistent with their use?

Is provision made for decoding, if necessary?

Is the form of the report satisfactory to those who must use it?

Supervisors are frequently in a position to suggest additions or modifications which will increase the value of the reports to management. Because figure-facts have most meaning in relation to other figures and facts, reports usually have greater value when comparative figures are placed together on the report. Quotas, standards, and budget figures can be introduced with a small amount of extra effort. For comparisons in time, previously punched cards may be introduced so that "same month last year," "last month," and "year-to-date" figures are shown to indicate trends in the various activities of the organization.

While reports are being prepared, it is frequently possible to have the machine perform additional functions which require no extra time, but which may add value to the report. Comparison may be made automatically to give a net difference or variance from standards. By the addition of a separate calculating process with the Calculating Punch, variances expressed as percentages may be printed on the report. Item counts frequently are useful to management, and consideration should be given to the possibility of setting the machine to count cards, classes of cards, number of totals, number of a particular type of transaction, number of specific types of cards, or almost anything which might be counted, and to print these counts on the report.

In addition to the review of the reports themselves, a careful study should be made of the times when reports are due. Reporting time may be changed in order to alleviate a bad peak-load situation. Priority

considerations affect schedules and machine loads, and management should appreciate general operating conditions, so that the supervisor and representatives of management may work out their mutual problems frankly and cooperatively.

Improvement of Procedures

From periodic reviews of the end results produced by the IBM Accounting department, certain changes will be made in these results so that they may satisfy the changing requirements of management. The fact that the accounting requirements of management do change is largely the reason why a flexible system such as IBM Accounting becomes necessary in a progressive organization where improvements are constantly being made.

The supervisor will find that as changes are made in other departments and activities of the organization, source data may change, or the methods of obtaining source data may be revised. Changes in policies and practices within the organization must become known through the contacts which the supervisor makes with management and with other supervisors. He must be aware, however, that any change in final results or in source documents usually requires changing the procedures also.

It is essential, then, that procedural changes be made within the IBM Accounting department whenever external changes call for new internal adaptations. Sometimes, when the need for particular information or a report no longer exists, the operations continue because of the inherent inertia which exists in all activities. A review of the procedures, after examining the current nature of source documents and final report requirements, will probably disclose that some operations are no longer necessary.

The operational flow chart has great value to the supervisor as he reviews his procedures critically. Changes can be quickly inserted and alternative methods proposed. Such changes, of course, are subject to a detailed study of the relative advantages to be gained by the alternative methods.

As changes in volume of transactions and cards become known, methods and procedures will be altered. A procedure which is adequate for a certain volume of work may be completely inadequate for an increased volume. The general nature of the transactions may also affect the procedure. As transactions become more standardized or of a predictable nature, they lend themselves to mechanized processing

more readily. A given type of transaction may become so variable that mechanization may be discontinued in favor of a manual process. It may be decided that the greatest economy can be obtained by separating the transactions or cards into two sets — standard and variable — and running two parallel procedures, which will accomplish the same results but use different methods.

The number of control functions in a procedure may be increased as the number of operational errors increases; or, as errors decrease, the number of controls may be reduced to a degree consistent with good accounting practice.

Improvement of Machine Usage

One of the first objectives of the supervisor is to obtain maximum utilization of the equipment with which he is charged and whose maintenance requires expenditure. Cost is measured either as a service charge, as in the case of IBM machines; as depreciation cost, as in the case of capital assets such as chairs and desks; or as maintenance cost on material bought but not yet used, such as ribbons, cards, or forms. In each case, the supervisor attempts to evaluate this cost by comparing it with the value being derived or the use to which the equipment is put. Maximum value is derived from IBM machines only when they are used for productive work which has value to the organization. For this reason, it has become customary in the better departments to evaluate machine usage by comparing the actual use of the machines with the available time. A machine used only 4 hours in an 8-hour working day is productive only 50% of the available time. It may be that the four hours' usage accomplishes a given job more economically than any other method would, but it must be recognized that room for improvement still exists, and the supervisor should search for additional work which would raise the value of the machine still further.

Improvement in machine usage may also be made by doing a more effective scheduling job, so that stand-by time is reduced, machine conflicts are avoided, and peak loads are eliminated. The best operating condition exists when the machines are used approximately the same length of time each day. A fluctuating machine load usually reduces the utilization and operation efficiency, and should be avoided if possible.

The alert supervisor will take measures to assure the best performance of his mechanical equipment by proper maintenance and care. Proper maintenance is provided by the IBM Customer Engineer. The assistance of the supervisor is necessary, however, in working out in-

spection schedules, maintaining close control over machine performance, and in securing the cooperation of machine operators so that they will exercise the necessary care in the use of the equipment. A small amount of preventive maintenance on the part of the operator will go a long way toward keeping machines in top condition. Periodic cleaning and dusting of machines, oiling exposed metallic surfaces to prevent rust, and the covering of machines when they are not in use are protective measures taken by all well-trained operators.

Improvement of Operation

When productive tools are placed in the hands of people so that they can do a job better and faster, there is a tendency to forget the job the *person* is doing and direct our attention to the job the *machine* is doing. Although the machine removes many of the most detailed repetitive, and routine aspects of his work, the operator still retains important duties which the machine cannot do. He must still perform the functions of control, analysis, judgment, decision and evaluation. These remain the most important aspects of a given operation. Furthermore, as tools are brought into use for greater productivity, the *thinking* function of the persons using the tools increases in importance. If the operation of the IBM Accounting Machine is observed closely, it will be noted that, during the time necessary to complete an operation, the operator will be performing functions over and above those of the machine. Time is consumed as cards are moved to the machine. Cards are checked to make sure of their identity, joggled, and placed in the machine. Proper forms are selected and positioned in the machine. As the work progresses, certain interruptions arise for checking, minor adjustments, asking questions and receiving instructions. These are variable factors which are present to some degree in all operations, and the extent to which they apply to a given operation is measured by the operation efficiency, which is the ratio between the running time of the machine and the total time for the job. This will vary, depending upon the nature of the job and the training and experience of the operator.

Machine loads are calculated and schedules are projected on the basis of a prevailing standard operation efficiency which the supervisor knows from past performance records. The objective in all improvement is to raise this standard gradually and continually. Operation standards can be raised only by doing a better personnel job, particularly in the selection and placement of operators and in their continuous training on the job. This places the responsibility for improving

the people in a department squarely in the hands of the supervisor. He should conduct a continuous training program for his operators; he should see that adequate manuals of procedure are always available; he should keep morale high by promoting better working conditions, improving his administrative relationships, being fair and impartial, and being a real leader of people. These are the methods of raising operating standards in an IBM Accounting department.

Improvement of Management-Supervisor Teamwork

An understanding relationship between management and the supervisor is the basis for teamwork in sound planning and efficient operation. This teamwork should extend not only up and down the line of authority but laterally, as well, to include the supervisors of other departments.

As the supervisor works outside of his department he comes into contact with supervisors in other departments. In this activity he attempts to coordinate the work of his department to that of other departments in the organization. This coordination becomes necessary when source documents move into and out of the department, or when reports are sent to another department for additional clerical work or processing.

The most satisfactory condition, as far as the IBM Accounting department is concerned, is to carry out the complete procedure, from source document to final report, within the department. This will minimize the number of points in a procedure where inter-departmental coordination and control must be maintained, and serves to fix responsibility for effective work within a single department. Whatever the situation, however, it is imperative that, for every point in the procedure where work crosses departmental boundaries, the supervisor establish the necessary controls with the departments in question. These points of interdepartmental contact require close supervision and complete understanding by supervisors and operators.

In his work with other departments, the supervisor determines as closely as possible the volume of work he may expect and at what times such work becomes available. He needs this information to establish his "due-in" times and machine loads, which become the basis for scheduling operations within his department. Frequently, having once established a "due-out" time for finished reports, the supervisor must consider the processing time in the department to arrive at the "due-in" time for the source documents. In this case the department trans-

mitting these documents should conform to the necessary schedule or else consult management for a revision of the due-date or a change in procedure so that the desired schedule may be met.

Understanding among the supervisor of the IBM Accounting department, management and supervisors in other departments is essential. It is particularly important that the supervisor maintain this understanding in regard to the schedule of reports, adequacy of reports, "due-in" times and "due-out" times. It is the basis for all that he does within his department.

RECORDING OPERATING DATA

IF THE SUPERVISOR desires to make any kind of evaluation, he must first obtain certain factual data about the operations performed in his department, and must see that such data are recorded at the time of the operation. Operating data may be obtained from job tickets, machine operation records, operator reports, and operation tickets. The forms in Figure 1 are typical of the most common types of operation reports in present use. The essential and minimum information to be recorded on any of these forms is:

> Job name or number
> Operator name or number
> Machine name or number
> Actual time of performing operation

With these facts, many evaluations become possible. First, however, the recorded facts must be classified and summarized. The average supervisor will perform this record-keeping job manually, but in many of the larger installations, IBM cards are used effectively. Figure 2 illustrates sample summarizations of such basic operating data.

Just as a business organization keeps an accounting department to give management the facts they need for sound planning, so the supervisor keeps simple records of his departmental activities for sound supervisory planning. The kind of analysis to be made will largely determine the form to be used in getting the data. For instance, if a study of machine time is to be made, a machine operation record for each machine would furnish the data. In the average department, it should take only a few minutes each day to compile these facts from the source data.

There are many other aspects of operations about which the supervisor will want to keep records. These include key punch production, percentage of errors or number of errors per month, operation efficiency, card volume, number of transactions and cost of operation (salaries, machine service charges, supplies and miscellaneous expenses).

JOB TICKET

Job No. 14

| BOX | 1 | OF | 6. |

STARTED		APPROX. NO. CARDS
10/20	9 A.M.	12,000
DATE	TIME	

JOB STEP	MACH. NO.	TIME REQ'D.	OPERATOR'S INITIALS
1 Sort	3	2.5	JRM
2 Gang Punch	7	3.3	J.C.
Sort Select	3	.5	JK
Group Print Sum.	5	3.3	P.K.
Merge	6	3.0	L.M.

17.6

TOTAL TIME REQ'D.

OPERATOR'S DAILY REPORT

NAME	Pauline Mae Cain		MACH. NO.	APPROX. NO. CARDS
DATE	October 18			5
	KIND OF WORK		2	
TIME			4	
8	Key Punch	Daily Sales		
	Verify		Sales	

UNIT OPERATION REPORT

JOB NUMBER	113	MACH NO	6078
TIME FINISHED	AM 11.3		
TIME STARTED	AM 9.4	FINISH	
ELAPSED TIME	01.9	START	
APPROX. NO. CARDS	500		

DATE 10 20 MACH NO 6078

REMARKS

Special job
Key punch 30
cols.

DATE			MACH. NO.	MAN NO.	JOB NO.	HOURS	NO. CARDS
MO.	DA.	YR.					

DAILY MACHINE OPERATION RECORD

MACHINE NO.	DATE				
405-2	Oct. 25				

NAME OF OPERATION	APPROX. NO. OF CARDS	TIME REQUIRED	OPERATOR'S INITIALS	REMARKS
Payroll Register	7,000	2.1	J.M.	
AGED TRIAL BAL.	18,000	3.0	D.P.	
Sales by State	15,000	2.5	J.M.	
		7.6		
		TOTAL TIME		

FIGURE 1.   OPERATION REPORTS

11

MACHINE USAGE AND PERFORMANCE

FOR WEEK STARTING _May 15_

MACHINE	ACTUAL TIME (HRS)	AVAILABLE TIME (HRS)	UTILIZATION EFF. (%)	SCHEDULED TIME (HRS)	PERFORMANCE % OF STD.	REMARKS
Card Punch #1	34	40	85	32	94	
Card Punch #2	30	40	75	32	107	
Sorter	35	40	88	35	100	
Reproducer	20	40	50	18	90	Machine Inspection (8 hours)
Acctg. Machine	36	40	90	30	83	Re-run on Proc #3 (2 hours)
TOTALS	155	200	78%	147	95%	

JOB PERFORMANCE

FOR WEEK STARTING _July 15_

PROCEDURE	ACTUAL TIME (HRS)	SCHEDULED TIME (HRS)	PERFORMANCE % OF STD.	REMARKS
Proc # 1-A	18	15	83	Final report re-run (3-hrs.)
Proc # 1-B	10	10	100	
Proc # 2	35	33	94	
Proc # 3	43	38	89	
Proc # 4	15	15	100	
Proc # 5-A	30	31	103	
Proc # 5-B	4	5	125	
TOTALS	155	147	95%	

FIGURE 2. SUMMARIES OF OPERATING DATA

OPERATING DATA SUMMARY
CARD PUNCH PRODUCTION
FOR WEEK ENDING _April 5_

DATE	NUMBER OF DOCUMENTS RECEIVED	NUMBER OF CARDS		NUMBER OF ERRORS	% OF ERRORS
		KEYPUNCHED	SPOILED		
April 1	1380	3500	65	20	.57
April 2	1465	3850	83	25	.65
April 3	1205	3223	40	15	.47
April 4	1310	3485	45	13	.37
April 5	1325	3415	55	10	.29
WEEKLY TOTALS ➡	6685	17473	288	83	(2.36)
DAILY AVERAGES ➡	1340	3500	58	17	.47

OPERATING DATA SUMMARY
MACHINE AND OPERATOR PRODUCTION
FOR MONTH ENDING _April 30_

MACHINE TIME				NO OF CARDS PROCESSED	NO. OF DOCUMENTS PRODUCED	OPERATOR TIME			
MACH	ACTUAL USE	UNAVAIL-ABLE	IDLE			NAME	REG	O'TIME	TOTAL
407	180	4	24	720M	120M	John Blaine	208	4	212
82	175	3	30	875M	—	Mary Smith	200	-	200
519	150	0	58	750M	—	Joe Rogers	208	-	208
602A	195	1	13	292M	—				
26A	150	0	58	41M	—				
26B	185	2	23	50M	—				
TOTALS ➡	1035	10	206	2728M		TOTALS ➡	616	4	620

OPERATING DATA SUMMARY
COST OF OPERATIONS

MONTH	TOTAL SALARIES	MACHINE SERVICE CHARGE	SUPPLIES	OVERHEAD	TOTAL
Jan.	850	570	150	75	1645
Feb.	850	570	174	75	1669
Mar.	875	570	130	75	1650
April	885	570	120	75	1650
May	885	570	125	75	1655
June	885	570	135	75	1665
TOTALS ➡	5230	3420	834	450	9934

FIGURE 3. OPERATING DATA SUMMARY FORMS

Figure 3 illustrates forms upon which is recorded information of the type needed for useful evaluation. This factual information may be entered daily, weekly, or monthly depending upon the frequency with which studies of departmental activities are made.

In evaluating such information, comparisons with fixed standards or with facts give a basis for judging the efficiency of the job being done

in the IBM department. Number of cards handled, compared to amount of work done, is one important comparison which can be expressed as cards processed per man-hour of work. Other useful comparisons are: number of documents processed per dollar cost, number of cards processed per available machine hour, number of documents handled per employee, percentage of cards spoiled by card punch operators, machine usage at peak load periods, operator overtime hours compared with machine idle time, cards processed per dollar cost, cost per final document produced, and many others.

The elements of factual information must be carefully selected and combined according to the nature of the problems being encountered. Such information must be evaluated so that decision can be made and changes incorporated which will lead to definite improvement in the department. The following list illustrates certain significant comparisons which can be used in most IBM Accounting departments:

Cards handled per machine operator $\dfrac{Number\ cards\ processed}{Number\ of\ machine\ operators}$

Cards punched per operator $\dfrac{Number\ cards\ punched}{Number\ of\ card\ punch\ operators}$

Cards handled per man hour $\dfrac{Number\ of\ cards\ processed}{Total\ man\ hours}$

Cards handled per machine hour $\dfrac{Number\ of\ cards\ processed}{Total\ actual\ machine\ hours}$

Cards processed per dollar cost $\dfrac{Number\ of\ cards\ processed}{Total\ cost}$

Cost per machine hour usage $\dfrac{Total\ cost}{Total\ actual\ machine\ time}$

Cost per document processed $\dfrac{Total\ cost}{Number\ of\ documents\ processed}$

Cost per report or document produced $\dfrac{Total\ cost}{Number\ of\ reports\ produced}$

Cost per 10,000 cards processed $\dfrac{Total\ cost\ \times\ 10,000}{Number\ cards\ processed}$

These formulas show total figures for the department. The best studies can be made, however, when information is prorated by job to show the time or cost of each job. For instance, cost may be prorated on the basis of machine usage applied to each job. In this case, the cost of a given job, number 1, is determined as follows:

$$\text{Cost for Job 1} = \text{Total cost} \times \frac{\textit{Actual machine time on Job 1}}{\textit{Total actual machine time}}$$

For a more complete cost analysis of each job, it would be necessary to determine the actual cost for each kind of expense pertaining to each job, by associating with each job the operator salary, machine service charge, and actual cost of supplies used, together with a possible burden charge prorated to each job on the basis of operator or machine time.

In the same way, costs and other figures can be developed for each type of machine or for each operator, provided the basic operating data can be obtained in the desired classification by operator or by type of machine.

METHODS OF EVALUATION

PROBABLY the information easiest to obtain is the actual operating time of the machines. A machine operation record placed on each machine on which operators record each job and the time required furnishes the information necessary to analyze machine usage. Such analysis may be for each machine unit, for each type of machine, or for all the machine units in the department. Suppose, for example, that at the end of each day the total hourly wage is determined for each type of machine, and that this daily usage is plotted on a chart for one month. The resulting chart is shown in Figure 4. The dotted horizontal line drawn at 8 hours indicates that one accounting machine is available for use in each 8-hour working day. If two such machines were in the department, this line would be drawn at the 16-hour mark to indicate 16 machine hours are available each day for accounting machine operations.

The solid line represents the actual use of the accounting machine on the various working days throughout the month. It is evident that this chart depicts an average machine use of about 30% during the first half of the month, a usage that fluctuates considerably from day to day, and a peak load in the last half of the month requiring overtime work. This chart would indicate at least three possible improvements: eliminating overtime, using idle time more productively, and improving scheduling.
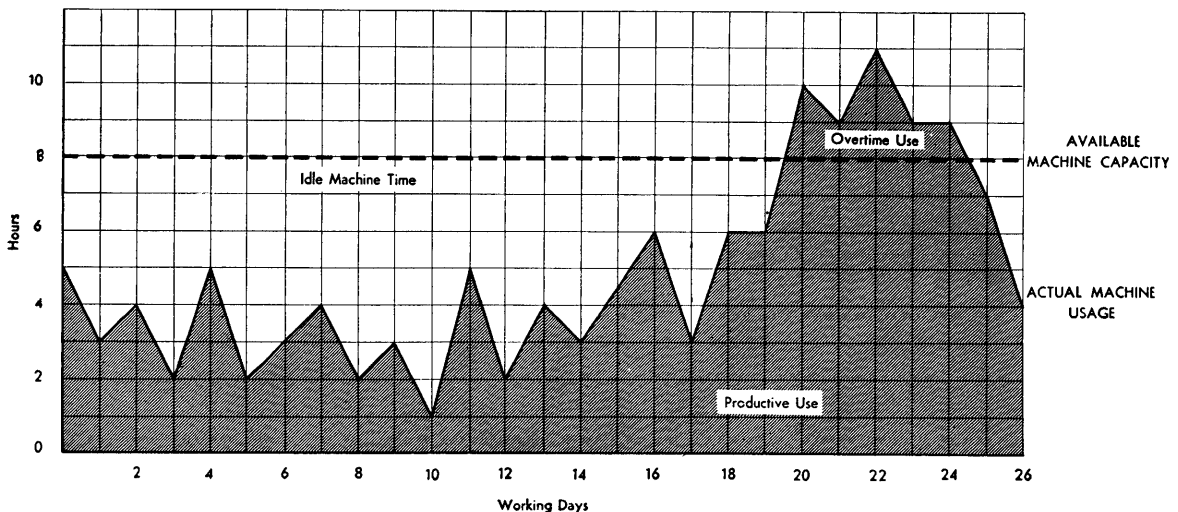
FIGURE 4. MACHINE USE CHART—ACCOUNTING MACHINE

16

Eliminate Overtime

The overtime near the end of the month should be eliminated if at all possible. This may be done in several ways. It is frequently possible, especially with certain types of analytical reports, to alter the "due-out" time. This type of change, of course, usually requires the understanding and cooperation of those who receive the reports. Another method is to change the "due-in" time for the source documents, or stagger the "due-in" schedule so that some of the processing can take place earlier in the month. This type of change usually requires the cooperation of other supervisors and management. When neither the "due-in" or "due-out" times can be changed, it is still possible at times to reduce the peak load by changing the procedures in such a way that machine time earlier in the month can be used to prepare cards for the peak period. For instance, if the peak load is caused by a monthly sales analysis prepared from a large volume of accumulated detail cards, it can be eliminated by punching summary cards at the middle of the month, and combining them with the detail cards for the last half of the month to run reports.

Use Idle Time Productively

The second type of improvement indicated by this chart is to use more of the idle machine time for productive purposes. As indicated above, some of this idle time may be used in resolving the peak load periods. The main way of using this idle time, however, is to provide more information on the existing reports, prepare more reports of an analytic nature, or to add more record-keeping activities to the machines when it is economical to do so.

To improve existing reports, it is only necessary to remember the factors which make a report informative and useful. Reports are used to measure results and they should contain comparison figures so that actual expenditures, or amounts, or hours, may be compared against budget figures, quotas, and standards; or amounts this month can be compared with amounts last month, amounts same month last year, or year-to-date figures. Most of such information is already available in files, and can be brought together with current cards to produce reports which show trends. Advantage should be taken of many other ways of producing better reports: adding name or description cards for decoding purposes, printing variances from standards or quotas, printing item counts or group counts, and even changing the design of the form. Many of these would use more of the available machine time.

17

The preparation of additional reports from the same punched cards always represents a good use of otherwise idle machine time. It must be remembered that classification on any field in the card will produce a report which will have interest or value to someone in the organization. When such possibilities are combined to give major and minor classifications, the types of new reports with possible value become almost unlimited.

Use of idle machine time for new record-keeping activities requires a greater degree of planning and study, for, in this case, it is necessary also to design new cards and report forms, build new procedures, train additional personnel, and revise the schedule. But the economies that can be effected by mechanizing additional parts of the record-keeping activities of an organization may well repay the cost and trouble of making the change. When idle machine time is available for such additional work, the cost may be negligible compared to the results.

Improve Scheduling

The chart in Figure 4 indicates still another possibility for improvement. The fluctuating load from day to day should, if possible, be smoothed out to give a more nearly constant work load. Such fluctuations usually result from poor schedules or a total lack of scheduling. By advance planning, different jobs can be alternated or staggered to use the machine for approximately the same number of hours each day. This would be a more desirable operating situation, with a minimum of machine conflicts. Scheduling is a requisite for this condition.

By putting into effect changes similar to those mentioned above, the monthly machine use chart might look more like Figure 5.

For more detailed analysis of the usage of each type of machine, the time devoted to each job or application can be indicated to show what constitutes the relative bulk of the work and the time of month when it occurs (Figure 6). Furthermore, the portion of the non-productive time alloted to machine maintenance, inspection, and repair can be shown.

For a still more detailed study of operations, the supervisor should make a comparison between his plans or scheduled operating time and the actual operating time as reported by the operators (Figure 7). This chart has great value to the supervisor. It shows how realistic his schedules are, indicates unusual departures between the scheduled time and operating time, and points up inefficient operations whether due to

Chart 1 (top):
- AVAILABLE MACHINE CAPACITY
- ACTUAL MACHINE USAGE
- New Job
- Prepare Cards for Month-End Operations
- More and Better Reports
- Old Job with Better Schedules
- Hours (y-axis): 0, 2, 4, 6, 8, 10, 12
- Working Days (x-axis): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26

Chart 2 (middle):
- AVAILABLE MACHINE CAPACITY
- ACTUAL MACHINE USAGE
- Personnel Accounting
- Sales Analysis
- Billing
- Hours (y-axis): 0, 2, 4, 6, 8, 10, 12
- Working Days (x-axis): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26

Chart 3 (bottom):
- AVAILABLE MACHINE CAPACITY
- ACTUAL MACHINE USAGE
- SCHEDULED MACHINE USAGE
- Ideal Machine Time (100% Oper. Eff.)
- Machine in Use or Assigned, but Not Running
- Machine Running
- Hours (y-axis): 0, 2, 4, 6, 8, 10, 12
- Working Days (x-axis): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26

FIGURE 7.   MONTHLY MACHINE USE—ACCOUNTING MACHINE, SHOWING OPERATING

19

operator, machine, or poor scheduling. The lower line represents the ideal maximum machine time if the work of the operator were eliminated. The difference between this hypothetical time and the actual operating time represents time spent as stand-by time, checking time, set-up and wiring time, or any other non-running time.

The comparison between the actual time and scheduled time indicates how the machine operation efficiency must be revised upward or downward in future machine load and scheduling activities.

Charts of this type for specific studies are rarely prepared regularly, but are used periodically as the need occurs.

THE USE OF EVALUATIONS

IT IS EVIDENT that the possible number of comparisons and evaluation studies that can be made is unlimited. As each additional kind of fact is recorded, a whole array of new comparisons become possible. Since it is impossible to exhaust all of these, it is important that the comparisons to be made be selected carefully in relation to the most urgent and immediate problems. On the other hand, a single efficiency figure or comparison will seldom be sufficient to study adequately the operations of the department. For instance, it is not enough to know that the accounting machine is used 85% of the time. It is possible that much of this usage is being absorbed by re-running reports An operation efficiency figure would disclose such a condition. Consequently, several significant comparisons should be made, and these should change from time to time as new problems present themselves.

Such comparisons will not solve problems. It is only through knowledge of such facts and figures that sound decisions can be made, changes instituted, and problems solved. The only purpose of evaluations is to give the supervisor a basis for making sound and economical improvements. Thus, the supervisor should be able to determine how effective his decisions have been. In other words, the supervisor needs to evaluate the use he has made of evaluation figures. It is by this means that he can answer such questions as:

> Is the cost per document diminishing from month to month or is it on the increase?
>
> Is productive capacity being utilized to an increasing extent?
>
> At what increased volume will additional equipment become necessary?
>
> Is the training program enabling operators to handle more cards per hour than they could last year?
>
> Does the greater number of transactions require that the procedure be changed to keep costs from becoming excessive?

All of these questions are related to trends. The only way such questions can be answered intelligently is to have current evaluation figures and historical records or charts of past performance. In this way, planning is effective for a long-range period, and preparations for future conditions are possible by means of forecasts made from trend curves on long-range improvement charts. Figure 8 illustrates a graph of machine usage plotted over a period of several years. The
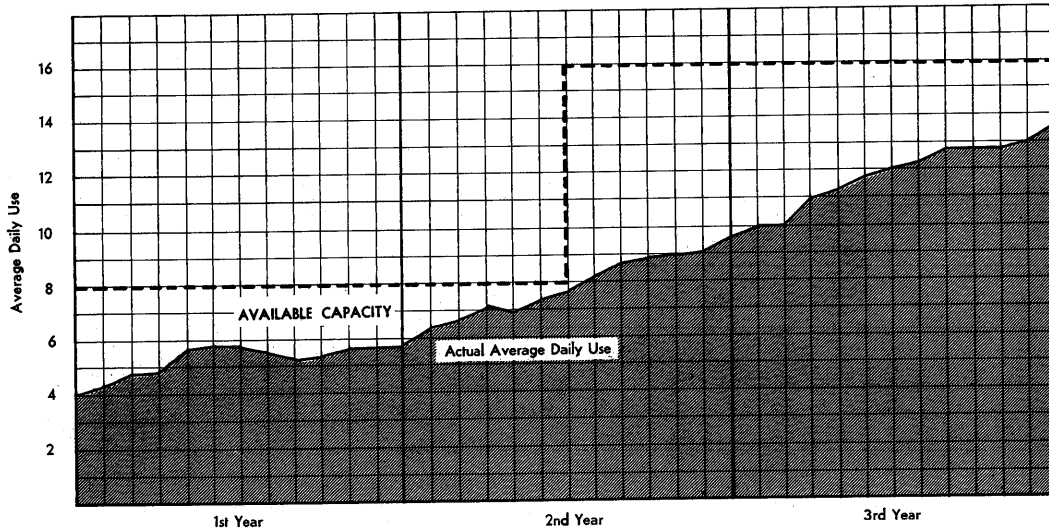
FIGURE 8. LONG-RANGE USE CHART—ACCOUNTING MACHINES

gradually rising line shows that, during the first year of oper-tion, use increased from about 50% to 80%. This may have been due to jobs added in order to improve utilization, or to an increase in business transactions giving a rising volume of cards from month to month. If a larger work volume is responsible, it serves to indicate that around the early part of the second year, an additional machine should be ordered so that when the rising volume of work exceeds the capacity of one machine, the second machine will be installed. Or, perhaps, it may be more desirable to order the additional machine to be installed at the beginning of the third year, and make arrrangements to use the IBM Service Bureau for the intervening six months to take care of the excess work load.

The installation of the new machine doubles the daily available accounting machine time from 8 to 16 machine hours per day. It would also be advisable to search for additional record-keeping work that can be applied to the new machine to use some of the initial available time given by the additional equipment.

In the final analysis, the purpose of all improvement in a department is to raise the value of the results being produced as compared to the cost of the job. This can be done in either of two ways:

1. Increase the value of results by improving existing reports and producing more reports which have value.
2. Reduce the cost by improving methods of operation and raising efficiency.

The supervisor who is interested in raising the value of his department to the organization thinks in terms of the greatest value for a given cost rather than the least cost for a given value. The first is a program of enlargement; the second is a program of contraction.

22

CHECK LIST

No EVALUATION is complete until the entire range of activity of the supervisor is reviewed and continually improved, because improvement in all of the details discussed thus far is dependent upon the capabilities of the supervisor in planning, executing, and evaluating the work over which he has control. He should be continually aware of the possibility for improvement in his net results, manuals of procedure, machine loads and scheduling, controls, evaluation methods and personnel work. For this reason, the following outline is given as a check list so that the entire scope of supervisory activity may be reviewed for consideration of possible areas of improvement in his job.

Reports: Is management receiving from the IBM Accounting department the reports it needs?

1. Do the reports contain valuable information?
2. Is the information being used?
3. Are the reports too detailed?
4. Is there provision for decoding?
5. Can the form of the report be improved?
6. Are quotas, standards, and budgets included in the reports for comparative purposes?
7. Are "same month last year," "last month," and "year to date" figures included for trend purposes?
8. Are variances given for analysis purposes?
9. Are automatic item counts being used to advantage?

General Manual of Procedure: Does the supervisor of the IBM Accounting department know what is expected of him?

1. Has he a list of all reports he is expected to produce, together with scheduled time for submitting these reports?
2. Does he know the relation of his department to other departments in regard to procedures and organization?
3. Does he have a definite schedule of availability of source documents from other departments?
4. Is there a general manual of procedure for the department which contains:
   a. Schedule of reports?
   b. Exhibit of reports and source documents?
   c. General or applicational flow charts?

Has the supervisor built adequate Operating Manuals of Procedure?

1. Has he prepared operation flow charts showing every job step or function within every procedure?

2. Is each function clearly presented to the operators with diagrams, sample cards, sample reports and documents, test cards, or other supporting exhibits?

3. Is the manual of procedure kept up to date through continual revision and adaptation to meet changing requirements and improved operations?

4. Does the manual always reflect methods which are really being followed, or is it just a historical record of what was once being done?

5. Does the supervisor use the manual to analyze his job and methods so that he may make improvements?

Machine Loads: Does the supervisor determine carefully the machine and clerical work loads?

1. Does he keep records of the time required to perform certain clerical functions which are part of his department's work?

2. Does he keep production records of each key punch and verifier operator which show:
   a. Speed in columns per hour?
   b. Accuracy in percentage of errors?

3. Does he take advantage of mechanization in determining processing time from known machine speeds and work loads?
   a. The main variable involved is the operation efficiency. This should be known for each type of machine job, and attempts should be made to raise it.

Scheduling: Does the supervisor schedule all of his expected work?

1. Can he establish definite "due-in" and "due-out" times for each job?

2. Is the processing time sufficient to control adequately his operations and produce results which are accurate?

3. Is a priority for his various jobs established?

4. Does he record his schedules in such a way that he can analyze the schedule and properly adjust it as changing requirements arise?

5. Does he cooperate with other supervisors in coordinating his schedules?

Controls: Does the supervisor have adequate control of his operations?

1. Are all source documents accounted for, while they are in custody of his department, by some visible form of document control sheet?
2. Do the procedures contain sufficient accounting controls and checks to insure accuracy of results? Specifically, do they provide for:
   a. Detecting and isolating possible errors?
   b. Recreating any transaction without the aid of memory?
   c. Establishing audit trails trough control sheets, registers, and reference data?
3. How is the supervisor assured that his plans are being performed as he wishes them to be?
   a. Does he have all work in process identified?
   b. How does he direct the work through the correct series of job steps?
   c. Does he gather operating data from the operators as the work is actually performed?

Good Housekeeping: Is there a place for everything, and is everything in its place?

1. Are machine covers kept in place? Is reasonable care exercised to protect the covers from dents, scrapes, and other defacing marks?
2. Has definite filing, storage, and work space been provided for cards, stationery forms, form feeds, platens, procedure manuals, test decks, control panels, tapes, and wires?
3. Are the items in 2 refiled immediately upon completion of the job?
4. Are processed source documents and finished results dispatched promptly?
5. Are manually wired control panels adequately identified while in use and promptly torn down after use?
6. Is responsibility for all of the above clearly defined?

Card Handling: Is the card treated as a precise, accurate accounting tool?

1. Are cards, when not actually being processed through a machine, kept under pressure in a file or box?
2. Is the use of paper clips on cards discouraged?
3. Are rubber bands placed around cards carefully to avoid damaging the edges? Are the bands removed before placing the cards under pressure in a file?
4. Are operators trained to joggle cards properly before placing them in the feed hopper?
5. When card trays are stacked and otherwise handled, are precautions taken to prevent damaging the card edges?
6. Are throats and card guides in all feed hoppers periodically checked?

Test Decks: Is the accuracy of every detail of job set up completely verified?

1. At full capacity and under all conditions, does the test deck check all features which may be used during the machine operation?
2. Are test decks readily available to the operator?
3. Are test decks used and carefully evaluated before beginning each job step?
4. Are test decks used periodically during the processing of large volume jobs?
5. Are operators fully instructed as to the proper use of the test deck?

Evaluation: Does the supervisor continually evaluate his work by seeking to raise the value of his results compared to a given cost?

1. Does he frequently confer with management to determine ways of making the reports more valuable?
2. Does he raise his efficiency of operation by the use of proper layout, accessories, operator test cards, and good housekeeping?
3. Does he keep records of machine usage efficiency operation efficiency, and improvement?
4. Does he keep equipment in good working order by:
   a. Using machine test cards?
   b. Cooperating with the IBM Customer Engineers?
   c. Setting up inspection schedules?
   d. Instructing operators to clean, cover and use machines properly?

Leadership: Is the supervisor a leader of people?

1. Does he conduct an effective interview?

2. Does he know personally every member of his department?

3. Does he provide a continual training program for all his people?

4. Does he utilize supervisory ability of his people in delegating certain supervisory functions such as:
   a. Research?
   b. Planning?
   c. Personnel?
   d. Control?
   e. Operations?

5. Does he show that he appreciates the value of good morale by:
   a. Gaining respect as a leader?
   b. Providing good working conditions?
   c. Being a fair and impartial supervisor?

6. Is he given a sufficient amount of freedom to do his job the best way he sees fit within the limits of company policy?

IBM®

A SIMPLE METHOD FOR THE COLLECTION AND USE OF MACHINE ROOM DATA

Frequently, users of IBM accounting machines face the need of answering certain questions:

1. Do we need another machine?
2. Can we do without a particular machine?
3. Is there enough time - at the right time - for the installation of another job or application?
4. What does this application cost?
5. How efficiently are we using our machines?

The answers require specific information as to machine usage--both present and past. In installations where continuing records are maintained the answers are generally available. In many instances, however, continuing records are not maintained. This is either because the information is not thought necessary, or because it is considered too troublesome to gather.

Even in the smallest installations such records can prove invaluable, particularly in planning additional work, or in justifying additional equipment. In any but the most static installations memory is a poor guide, and a poor method of proving a point to management. An easy-to-operate, easy-to-control method of securing this machine usage information would remove much of the resistance sometimes encountered.

The method described here offers the following advantages:

1. Easy and simple to operate; easy to supervise.
2. Produces a permanent historical record by machine in daily graph form.
3. Adaptable equally well to large or small installations, and for occasional or continuous analysis of
   a. Time by jobs by machine
   b. Handling time and machine efficiency
   c. Machine utilization - and idle time - as it occurs throughout the day.
   d. Schedules of new or present jobs.

USE IN A SMALL INSTALLATION

A use sheet, similar to that shown in Figures 1 and 2, is placed on each machine prior to the start of the shift.

The operator's job is simple, which is most important. He merely notes three things:- the job(name or number), number of cards, and his number or

initials – on the line for the clock time when he starts the operation. When he completes the job he draws a line from his first entry to the line for his finish time. There is no operator recording of start time, stop time, machine number, shift, or date, no converting of minutes into tenths of hours, and no computing of elapsed time. Figure 3 shows a sheet properly filled out.

The sheets, collected at the end of the day, furnish everything needed for proper machine analysis. The type of analysis required depends on the nature of the installation. In smaller installations a periodic review is all that is required. But even this requires the availability of facts.

A glance at the completed use sheet (Figure 3) will show that the result is a graph - a picture of the use of the machine. This is much more valuable than a figure (say 80% machine utilization), as it shows when during the day the machine is idle and when in use. This graph is a direct result of the operator's reporting - and does not require computing of elapsed time or subsequent plot work.

The sheets may be used periodically to get the answers to the following questions:

Is another machine needed?

Sheets for the machine in question can be selected for as long a period in the past as is desired.

Further selection can be made of sheets where overtime (or known conflicts) occurred. The amount of overtime on the particular machine in question is readily determined. The jobs causing the overtime or conflict are apparent immediately. Thought can be given to rescheduling them, which may in turn result in a study of sheets for other machines, also readily available.

The reasons for the overtime and excessive use can be quickly, accurately, and factually determined. If it is not due to scheduling it will be due either to excessive handling time or increased volume. All the data to determine which is the case are available. The number of cards processed at that time can be compared with the estimated or original volume. Further, the necessary factors for computing the handling percentage are in most cases available on the sheet.

From the above factual evidence, management can readily come to a decision.

Should a machine be removed?

Sheets for the several machines in question are selected and laid side by side for each day (Figure 4).

Comparisons of the used and idle time for the different units can easily be made. Points where conflict would occur with reduced equipment will immediately be seen. The jobs in conflict are also evident, and can be re-scheduled to eliminate the conflicts.

With these facts from past operations, and a knowledge of future plans, a decision can be made with certainty of results.

Is there enough time, AT THE RIGHT TIME, to handle another application?

A new job, properly scheduled, may show a machine need for the 10th and 15th of the month. Select the sheets for that machine for those days for the past five or six months. It can be readily seen from these sheets just how much time is available and when. Furthermore, when time is tight the conflicting jobs are apparent and rescheduling possibilities can be studied.

New jobs can be taken on with assurance that they can be worked in with-out disrupting the present schedule. Additional machine requirements can be discovered before starting the job. Anticipated changes in volume can be properly planned.

What does the application cost?

It is relatively simple to determine, periodically, the cost of the appli-cation or job. The time sheets contain the job start and stop time. Elapsed time, on the particular job under consideration, can easily be computed by entering the hours and tenths column. The time by machine used can be added for the total cost in hours. An average rate can be applied, or if more ac-curacy is required, a machine rate, furnishing job cost.

This analysis is of value in comparing the actual cost or time with that of the original estimate.

How efficiently are we operating?

All the information needed for comparison and evaluation is available. The handling time percentage can easily be determined, as the card volume and the actual time taken for each job on each machine is on the time sheet.

Using the Machine Load Computer, and the above factors, the Machine Operating Efficiency can be determined (100 minus the computed handling time percentage).

This percentage is of value in two ways. First, it offers a sound base for estimating future jobs. Second, it makes possible an analysis of operating efficiencies.

USE IN A LARGE INSTALLATION

A large installation will use the time sheets in a manner similar to those described in so far as scheduling is concerned. In addition, large installations require continuing job costs and machine analysis, made by using key-punched time records. This time sheet serves as the source for punching, in addition to the use in scheduling.

Cards are punched in the detail desired: job number, operation number, machine number, cards, passes or sorts, and operator number. In addition, the hours and tenths for both the start line and the stop line will be punched.

Whenever time is free on the calculator the elapsed time can be calculated. If a close cost analysis is required, and machine rates are available, the cost can be computed for the operation as well.

Each day cards are sorted first by start time and second by employee number. A list is made, similar to Figure 5, from which it is possible to trace path of the operators from machine to machine, job to job, throughout the day. The list will aid in determining that all time is recorded. (It aids but does not eliminate supervision in this respect. The time sheet lends itself well to supervision of reporting as the floor supervisor can easily see, as he passes about the machine room, that a machine in use has the data recorded.) Furthermore, in an installation where the work log is increasing, such a report will aid in determining whether it is more operators or more machines that are needed. If such a condition exists that produces the figures shown in Figure 5, it is obvious that an additional operator, not more equipment, is the solution. It should be noted that one operator in less than 8 hours used 19.5 hours of machine time. This was due, as seen from an analysis of the start and stop time columns, to his running several machines simultaneously.

Weekly the cards can be sorted to machine number and machine type for utilization and performance analysis as shown in Figure 6.

Monthly, the cards can be sorted by job number (and operation or machine number as well) and summarized as in Figure 7. This report will produce job cost data and actual time which can be compared with estimated time. Such comparisons will reveal areas where corrective action may be required.

ADAPTING METHOD TO DIFFERENT REQUIREMENTS

Design of the Sheet

An $8\frac{1}{2}$ x 11 inch sheet can readily be designed to handle an 8-hour work day with a one-hour lunch period on each side. Thus, one sheet can serve for two shifts, or, for one shift and overtime.

Various arrangements for recording data in the columns, or for designing the columns are described as follows:

<u>Column 1</u>. The left-hand time column (1, Figure 3) should begin with the normal start time of the shift. The department in this example starts operations at 8:00 A.M. Time advances in units of 6 minutes (tenths of hours) to 5:00 P.M. at the bottom of the sheet, the end of the normal work day. The other side of the sheet is designed in the same manner, but the start time is the start of overtime or the second shift--in the example, 5:00 P.M.

<u>Column 2</u>. The right-hand time column (2, Figure 3) is the clock time converted to hours and tenths of hours. The beginning of the day is shown by 0.00. Time advances in units of tenths of hours to the bottom of the sheet-- 8.0 hours at the end of the work day. (See discussion in the section following for various methods of handling lunch time.)

<u>Column 3</u>. The application column (3, Figure 3) is used to describe the application or job. In small installations not using job numbers, a short description suffices, as in Figure 4. In larger departments a job number will be used. In still more advanced departments a job and operation number will be required as in Figure 3. The columns may be so headed, or the same thing may be accomplished by a dash. Figure 3 shows "6432-09", meaning job number 6432, step or operation number 9.

<u>Column 4</u>. The number of cards (4, Figure 3) may be determined in various ways and recorded in this column. It is necessary in certain sorting, collating, and accounting machine jobs to show the number of card passes as well. This column can be subdivided to show this, or the card passes can be circled as in Figure 4. The entry "400 (6)" means 400 cards sorted on 6 columns.

<u>Column 5</u>. Employee column (5, Figure 3) may be filled in with either initials, or number of the employee.

<u>Down Time</u>

Down time is recorded by writing "down" or a down code such as 9999 in the application column. The operator should sign his initials or number in the employee number column at the time the machine goes down. When the Customer Engineer repairs the machine he can place his initials in the employee column at the proper line for the time the machine was ready for re-use.

This serves several purposes:
1. It is a record of down time for the machine.
2. It fixes responsibility as to who turned in the call and who repaired the unit.
3. It serves notice to following operators that the machine has been reported down, serving the same purpose as a "down" tag.

In certain cases a machine will have down time carried from one day to the next. The supervisor, or the operator assigned the responsibility of collecting the sheets at the end of the day, will carry the line down from the time reported to the last line of the sheet. He will also record, on the first line of the sheet for the next day (as he places it on the machine), the "down" entry.

Lunch Time

The sheet may be designed to permit the handling of lunch time in several ways.

If work is performed during the lunch hour, column 2 for hours and tenths should continue to advance through that time; this will make the last line show a 9 hour day. This will require that the operator sign off when he stops for lunch, and sign back on the job when he resumes after lunch.

If no work is ever performed during the lunch hour, that hour can be left out, and the last entry in the hours and tenths column will be 8.0. This saves signing on and off for lunch.

If occasional work only is performed during lunch, and the lunch hour is fixed, the form can be as shown in Figure 1, in which the clock hours advance from 12:30 to 1:30, but the hours and tenths column does not. The operators, when they work during the lunch hour, note it on the bottom of the sheet. The only advantage to this is that it eliminates the signing on and off of work interrupted by the lunch hour. It distorts the graphic picture and therefore should rarely be used.

Punching

If cards are to be punched from these sheets and a job is recorded in less than 6 minutes, as in Figure 3 on the line for 4:06, the punch operator should punch 07.1 start and 07.2 stop. If this were not done the calculator would show 0 hours, from the same start and stop time.

Clerical Time

If the true cost of the job is desired it will be necessary to collect clerical time. This can be done by having this reported, as it occurs, on an individual operator's clerical card. In smaller installations, this is not necessary.

Recording Volume

If Veeder counters or accounting machine totals are available, these should be used. If they are not available, cards can be measured. The time

sheet can be designed with a card measuring gauge down the right hand side, or other suitable measuring devices can be employed.

Definite rules should be set up for measuring volume for each machine, and these should be followed both in estimating and in reporting time. Examples for specific machines follow:

Interpreters. Decide whether to show cards and card passes, or just card passes. The number of cards alone may not be sufficient, as some interpretations may require two passes through the machine.

Sorters. Decide whether to use cards and card passes, or card passes alone.

Collators. The card volume should be the total number of cards in both the primary and the secondary. In certain cases many groups will be merged into one file through successive merging operations. The volume should be reported as the number of card passes. If this is not done it will be impossible to determine performance. Group performance or efficiency is rather difficult to determine because of the fluctuating machine speed.

Accounting Machines. It will not be possible to determine performance on a group basis for all jobs because of the variance in the job times. Performance will have to be determined for each individual job. A decision will have to be made as to the method of handling card passes. In many operations cards are re-run for totals, or summary cards are summarized for proof. If the jobs are small it would be well to consider that as one job and ignore card passes. If the jobs are large and the re-runs take considerable time, it would be well to consider each re-run as a separate operation.

Calculating Punches. Performance can be computed on a group or weekly basis for the 604, but with the 602A performance must be computed on an individual job basis. A decision must be made concerning successive calculating runs or subsequent check runs. Again, the rule should be based on the general size of the operations. If they are mostly small runs, they should be recorded as one operation. If there are many large checking runs, they might be considered as a separate operation. Considerable flexibility can be secured by incorporating the various conditions in the Operator's Job Instructions.

In most cases card passes are more important than card volume, particularly in determining group machine efficiency. If cards are to be punched and elapsed time computed on the calculator the card passes could be computed at the same time. If this is not done it would seem advantageous to record volume as "card passes. "

Installing The Method. The method should be installed only after the operators have been thoroughly briefed on the purposes and the reasons for

collecting the data. The simplicity of the method should be pointed out. Written instructions should be handed out to each operator on how to fill out the forms, in a meeting called to discuss verbally what they are to do. It is important that the operators be thoroughly familiar with their part of the job before it is instituted. This pre-supposes that the supervisor has thought out carefully such things as how card volume is to be measured, what is to constitute card passes, what and how clerical time is to be handled, how summary punch time is to be handled, etc.

One person should be assigned the responsibility of collecting and picking up the sheets. The method of filing them should be decided upon.

The critical time will be the first week or two. During this period the supervisor should check frequently to see that the sheets are being filled out every time, and that they are being filled out correctly. No method of collecting data will be successful unless the supervisor really supervises during this period. As time progresses, and the operators learn that management is sincere, they will by habit and as a matter of routine, perform this simple recording. This period, during which the proper habits and routines are being learned, is the critical one for the supervisor.

The above is one of the most significant reasons why the periodic collection of data proves unsuccessful. Not only is the information not available when it is most needed, but it is difficult to secure accurately. Periodic collection of data results in a "Here we go again" attitude on the part of the operators. Continuous collection becomes a habit - and after a few weeks a painless one.

IBM ANALYSIS OF EAM EQUIPMENT UTILIZATION

Form 94-7498-1

Plant No.	Dept.	Date	Machine No.

PLEASE RECORD EACH USE OF EAM EQUIPMENT ON THIS FORM. WRITE APPLICATION CODE NUMBER, CARD VOLUME, AND EMPLOYEE NUMBER ON LINE OPPOSITE YOUR STARTING TIME. WHEN OPERATION IS COMPLETE CONNECT ASTERISK ON START LINE WITH ASTERISK ON STOP LINE.

Example) Start Time : Stop Time

TIME		APPLICATION	NO of CARDS	EMPL.NO.	TIME		APPLICATION	NO of CARDS	EMPL.NO
8:00	00.0*				12:30	04.5*			
8:06	00.1*				12:36	04.5*			
8:12	00.2*				12:42	04.5*			
8:18	00.3*				12:48	04.5*			
8:24	00.4*				12:54	04.5*			
8:30	00.5*				1:00	04.5*			
8:36	00.6*				1:06	04.5*			
8:42	00.7*				1:12	04.5*			
8:48	00.8*				1:18	04.5*			
8:54	00.9*				1:24	04.5*			
9:00	01.0*				1:30	04.5*			
9:06	01.1*				1:36	04.6*			
9:12	01.2*				1:42	04.7*			
9:18	01.3*				1:48	04.8*			
9:24	01.4*				1:54	04.9*			
9:30	01.5*				2:00	05.0*			
9:36	01.6*				2:06	05.1*			
9:42	01.7*				2:12	05.2*			
9:48	01.8*				2:18	05.3*			
9:54	01.9*				2:24	05.4*			
10:00	02.0*				2:30	05.5*			
10:06	02.1*				2:36	05.6*			
10:12	02.2*				2:42	05.7*			
10:18	02.3*				2:48	05.8*			
10:24	02.4*				2:54	05.9*			
10:30	02.5*				3:00	06.0*			
10:36	02.6*				3:06	06.1*			
10:42	02.7*				3:12	06.2*			
10:48	02.8*				3:18	06.3*			
10:54	02.9*				3:24	06.4*			
11:00	03.0*				3:30	06.5*			
11:06	03.1*				3:36	06.6*			
11:12	03.2*				3:42	06.7*			
11:18	03.3*				3:48	06.8*			
11:24	03.4*				3:54	06.9*			
11:30	03.5*				4:00	07.0*			
11:36	03.6*				4:06	07.1*			
11:42	03.7*				4:12	07.2*			
11:48	03.8*				4:18	07.3*			
11:54	03.9*				4:24	07.4*			
12:00	04.0*				4:30	07.5*			
12:06	04.1*				4:36	07.6*			
12:12	04.2*				4:42	07.7*			
12:18	04.3*				4:48	07.8*			
12:24	04.4*				4:54	07.9*			
12:30	04.5*				5:00	08.0*			

NOTE: IF WORK IS DONE DURING LUNCH HOUR PLEASE INDICATE HERE.

Figure 1

Plant No.	Dept.	Date	Machine No.

PLEASE RECORD EACH USE OF EAM EQUIPMENT ON THIS FORM. WRITE APPLICATION
CODE NUMBER, CARD VOLUME, AND EMPLOYEE NUMBER ON LINE OPPOSITE YOUR
STARTING TIME. WHEN OPERATION IS COMPLETE CONNECT ASTERISK ON START
LINE WITH ASTERISK ON STOP LINE.

Example   )   Start Time   Stop Time

TIME		APPLICATION	NO of CARDS	EMPL.NO.	TIME		APPLICATION	NO of CARDS	EMPL.NO.
5:00	08.0*				9:30	12.0*			
5:06	08.1*				9:36	12.0*			
5:12	08.2*				9:42	12.0*			
5:18	08.3*				9:48	12.0*			
5:24	08.4*				9:54	12.1*			
5:30	08.5*				10:00	12.2*			
5:36	08.6*				10:06	12.3*			
5:42	08.7*				10:12	12.4*			
5:48	08.8*				10:18	12.5*			
5:54	08.9*				10:24	12.6*			
6:00	09.0*				10:30	12.7*			
6:06	09.1*				10:36	12.8*			
6:12	09.2*				10:42	12.9*			
6:18	09.3*				10:48	13.0*			
6:24	09.4*				10:54	13.1*			
6:30	09.5*				11:00	13.2*			
6:36	09.6*				11:06	13.3*			
6:42	09.7*				11:12	13.4*			
6:48	09.8*				11:18	13.5*			
6:54	09.9*				11:24	13.6*			
7:00	10.0*				11:30	13.7*			
7:06	10.1*				11:36	13.8*			
7:12	10.2*				11:42	13.9*			
7:18	10.3*				11:48	14.0*			
7:24	10.4*				11:54	14.1*			
7:30	10.5*				12:00	14.2*			
7:36	10.6*				12:06	14.3*			
7:42	10.7*				12:12	14.4*			
7:48	10.8*				12:18	14.5*			
7:54	10.9*				12:24	14.6*			
8:00	11.0*				12:30	14.7*			
8:06	11.1*				12:36	14.8*			
8:12	11.2*				12:42	14.9*			
8:18	11.3*				12:48	15.0*			
8:24	11.4*				12:54	15.1*			
8:30	11.5*				1:00	15.2*			
8:36	11.6*				1:06	15.3*			
8:42	11.7*				1:12	15.4*			
8:48	11.8*				1:18	15.5*			
8:54	11.9*				1:24	15.6*			
9:00	12.0*				1:30	15.7*			
9:06	12.0*				1:36	15.8*			
9:12	12.0*				1:42	15.9*			
9:18	12.0*				1:48	16.0*			
9:24	12.0*								
9:30	12.0*								

NOTE: IF WORK IS DONE DURING LUNCH HOUR PLEASE INDICATE HERE.

IBM ANALYSIS OF EAM EQUIPMENT UTILIZATION

Form 94 7498 1

Plant No.   Dept.   Date *Nov. 1, 1951*   Machine No. *514*

PLEASE RECORD EACH USE OF EAM EQUIPMENT ON THIS FORM. WRITE APPLICATION CODE NUMBER, CARD VOLUME, AND EMPLOYEE NUMBER ON LINE OPPOSITE YOUR STARTING TIME. WHEN OPERATION IS COMPLETE CONNECT ASTERISK ON START LINE WITH ASTERISK ON STOP LINE.

Example   Start Time   Stop Time

(1) TIME (2)	APPLICATION	NO of CARDS	EMPL.NO.	TIME	APPLICATION	NO of CARDS	EMPL. NO
8:00 00.0	6432-09	4.5M	143	12:30 04.5*			
8:06 00.1*				12:36 04.5*			
8:12 00.2*				12:42 04.5*			
8:18 00.3*				12:48 04.5*			
8:24				12:54 04.5*			
8:30				1:00 04.5*			
8:36 00.6*				1:06 04.5*			
8:42 00.7*				1:12 04.5*			
8:48 00.8*				1:18 04.5*			
8:54 00.9*				1:24 04.5*			
9:00 01.0*				1:30 04.5	1143-06	10,450	720
9:06 01.1*				1:36 04.6*			
9:12 01.2*				1:42 04.7*			
9:18 01.3*				1:48 04.8*			
9:24 01.4	DOWN			1:54 04.9*			
9:30 01.5*				2:00 05.0*			
9:36 01.6*				2:06 05.1*			
9:42 01.7*				2:12 05.2*			
9:48 01.8*				2:18 05.3*			
9:54 01.9*				2:24 05.4*			
10:00 02.0*			*JB*	2:30 05.5*			
10:06 02.1*				2:36 05.6*			
10:12 02.2*				2:42 05.7*			
10:18 02.3*				2:48 05.8*			
10:24 02.4	6413-03	6.3M	140	2:54 05.9*			
10:30 02.5*				3:00 06.0*			
10:36 02.6*				3:06 06.1*			
10:42 02.7*				3:12 06.2*			
10:48 02.8*				3:18 06.3*			
10:54 02.9*				3:24 06.4*			
11:00 03.0*				3:30 06.5*			
11:06 03.1*				3:36 06.6*			
11:12 03.2*				3:42 06.7*			
11:18 03.3*				3:48 06.8*			
11:24 03.4*				3:54 06.9*			
11:30 03.5*				4:00 07.0*			
11:36 03.6*				4:06 07.1*	1347-07	50	650
11:42 03.7*				4:12 07.2*			
11:48 03.8*				4:18 07.3*			
11:54 03.9*				4:24 07.4*			
12:00 04.0*				4:30 07.5*			
12:06 04.1*				4:36 07.6*			
12:12 04.2*				4:42 07.7*			
12:18 04.3*				4:48 07.8*			
12:24 04.4*				4:54 07.9*			
12:30 04.5*				5:00 08.0*			

NOTE: IF WORK IS DONE DURING LUNCH HOUR PLEASE INDICATE HERE.

ANALYSIS OF EAM EQUIPMENT UTILIZATION

Date _TUES. JAN. 15_ Machine No. _082-1_

PLEASE RECORD EACH USE OF EAM EQUIPMENT ON THIS FORM. WRITE APPLICATION CODE NUMBER, CARD VOLUME, AND EMPLOYEE NUMBER ON LINE OPPOSITE YOUR STARTING TIME. WHEN OPERATION IS COMPLETE CONNECT ASTERISK ON START LINE WITH ASTERISK ON STOP LINE.

APPLICATION	NO of CARDS	EMPL.NO.	TIME	APPLICATION	NO of CARDS EMPL. NO
			12:30		
SALES-DAILY	400	⑥			

IBM   ANALYSIS OF EAM EQUIPMENT UTILIZATION

Plant No.   Dept.   Date _TUES. JAN. 15_ Machine No. _082-2_

PLEASE RECORD EACH USE OF EAM EQUIPMENT ON THIS FORM. WRITE APPLICATION CODE NUMBER, CARD VOLUME, AND EMPLOYEE NUMBER ON LINE OPPOSITE YOUR STARTING TIME. WHEN OPERATION IS COMPLETE CONNECT ASTERISK ON START LINE WITH ASTERISK ON STOP LINE.

TIME	APPLICATION	NO of CARDS	EMPL.NO.	TIME	APPLICATION	NO of CARDS EMPL. NO.
	PAYROLL	5000	⑤			
					SALES-WEEK	

NOTE: IF WORK IS DONE DURING LUNCH HOUR PLEASE INDICATE HERE.

Figure 4

DAILY MACHINE TIME REGISTER
(by Employee by Start Time)

Start Time	Stop Time	Man No.	Card Volume	Shift	Date Mo Day	Job No.	Mach. Type	Mach. No.	Time Used
0 0 3	0 3 1	2 5 6 4 6	6 2 0 0	1	4 0 6	1 1 0 0	5 1 9	0 3	2 8
0 0 4	0 0 7	2 5 6 4 6	4 0 0 0	1	4 0 6	1 1 0 0	0 8 0	0 1	3
0 2 0	0 3 1	2 5 6 4 6	4 5 0 0	1	4 0 6	1 1 0 0	0 7 7	0 1	1 1
0 2 1	0 2 3	2 5 6 4 6	2 0 0	1	4 0 6	1 1 0 0	5 5 2	0 2	2
0 3 0	0 4 5	2 5 6 4 6	4 1 0 0	1	4 0 6	1 1 0 0	5 5 2	0 2	1 5
0 4 2	0 7 5	2 5 6 4 6	3 6 0 0	1	4 0 6	1 1 0 0	0 8 2	0 1	3 3
0 4 5	0 7 1	2 5 6 4 6	4 0 0 0	1	4 0 6	1 1 0 0	0 8 0	0 1	2 6
0 4 6	0 6 7	2 5 6 4 6	6 0 0 0	1	4 0 6	1 1 0 0	0 7 7	0 1	2 1
0 5 0	0 7 0	2 5 6 4 6	7 0 0 0	1	4 0 6	1 1 0 0	5 1 9	0 2	2 0
0 5 0	0 7 0	2 5 6 4 6	6 5 0 0	1	4 0 6	1 1 0 0	5 1 9	0 3	2 0
0 6 7	0 7 6	2 5 6 4 6	3 0 0 0	1	4 0 6	1 1 0 0	5 5 2	0 2	9
0 6 8	0 7 5	2 5 6 4 6	5 0 0 0	1	4 0 6	1 1 0 0	0 7 7	0 1	7
			5 4 1 0 0						19 5
		2 6 8 3 6	3 3 0	1	4 0 6		0 5 2	0 4	6
		2 6 8 3 6	3 3 0	1	4 0 6		0 1 6	1 2	6 5
		2 6 8 3 6	1 8 5	1	4 0 6		0 5 2	0 4	5
		2 6 8 3 6	1 8 5	1	4 0 6		0 1 6	1 2	6
		2 6 8 3 6	4 7 0	1	4 0 6		0 1 6	1 2	1 8 2
		2 6 8 3 6	4 0	1	4 0 6		0 1 6	1 2	1 1 4
		2 6 8 3 6	4 6 0	1	4 0 6		0 5 1	0 2	1 8
		2 6 8 3 6	4 6 0	1	4 0 6		0 1 6	1 2	8 5
		2 6 8 3 6	5 6 0	1	4 0 6		0 1 1	0 6	8 0
			3 0 2 0						
0 0 0	0 0 6	2 7 4 7 2	7 8 0 0	1	4 0 6	5 0 2	0 8 2	0 8	6
0 0 6	0 2 3	2 7 4 7 2	2 4 0 0 0	1	4 0 6	8 6 5	0 8 2	0 8	1 7
0 0 8	0 1 6	2 7 4 7 2		1	4 0 6	5 0 2	0 7 7	0 6	8
0 1 7	0 3 5	2 7 4 7 2		1	4 0 6	5 0 2	4 1 6	0 1	1 1 8
0 1 7	0 2 7	2 7 4 7 2	5 0	1	4 0 6	5 0 2	5 1 7	0 5	1 0 5
0 2 5	0 3 0	2 7 4 7 2	1 0 0 0	1	4 0 6	8 6 5	5 1 4	0 1	5
0 3 2	0 3 5	2 7 4 7 2	1 0 0 0	1	4 0 6	8 6 5	5 5 2	0 4	3 5
0 3 5	0 8 0	2 7 4 7 2	5 0 0 0	1	4 0 6	5 0 2	0 8 2	0 8	4 5
0 3 5	0 3 9	2 7 4 7 2	2 0 0 0	1	4 0 6	8 6 5	4 1 6	0 1	4
0 4 6	0 7 8	2 7 4 7 2	4 0 0 0	1	4 0 6	5 1 7	4 1 6	0 1	3 2
0 4 9	0 5 3	2 7 4 7 2	2 5 0	1	4 0 6	5 0 7	5 1 4	0 1	4
0 5 8	0 6 1	2 7 4 7 2	6 0 0	1	4 0 6	5 0 2	5 1 4	0 1	3 5
			4 5 7 0 0						1 5 5

Figure 5

MACHINE ANALYSIS

SHIFT	MO DAY	MACHINE TYPE	NO.	PRODUCT'V TIME	DOWN TIME	TOTAL TIME	CARDS	DAILY & WEEKLY TOTALS		
								PROD. TIME	DOWN TIME	TOTAL TIME
1	2 26	519	01	5 8		5 8	8710			
1	2 26	519	02	4 7		4 7	7040			
1	2 26	519	03	4 8		4 8	6850			
							22600 *	15 3		15 3
1	2 27	519	01	2 4		2 4	3600			
1	2 27	519	02	5 9		5 9	9050			
1	2 27	519	03	4 3		4 3	7020			
							19670 *	12 6		12 6
1	2 28	519	01	3 5		3 5	2060			
1	2 28	519	02	4 5		4 5	8040			
1	2 28	519	03	3 7		3 7	7040			
							17140 *	11 7		11 7
1	3 01	519	01	2 4	3 7	6 1	8740			
1	3 01	519	02	4 3		4 3	7090			
1	3 01	519	03	4 7	1 2	5 9	8170			
							24000 *	11 4	4 9	16 3
1	3 02	519	01	2 8		2 8	3310			
1	3 02	519	02	3 6		3 6	6140			
1	3 02	519	03	3 7		3 7	7310			
							17060 *	10 1		10 1
							100470 *	61 1	4 9	66 0 *

PURPOSE OF REPORT

1. Machine utilization

$$\frac{\text{Time used}}{\text{Time Available}} - \frac{66.0}{120} = 55\%$$

2. Machine efficiency

$$\frac{\text{Actual cards}}{\text{Cards/hour}} \quad \text{or} \quad \frac{100470}{6000} = 16.7 \text{ ideal hours}$$

$$\frac{\text{Ideal hours}}{\text{Productive Hours}} \quad \text{or} \quad \frac{16.7}{61.1} = 27\% \text{ efficiency}$$

or 73% handling time

Figure 6

JOB ANALYSIS							
JOB	Job No.	Oper	Mach. Type	Hours	$_{Tns}$	Cards	Card Passes
PAYABLES	14	1	26	10	7	2500	2500
	14	2	56	9	9	2540	2540
	14	3	402	1	0	2500	2500
	14	4	82		6	2500	15000
	14	5	402		8	2500	2500
	14	6	82		4	2500	10000
	14	7	513		7	2500	2500
	14	8	82	1	0	2500	15000
	14	9	402		9	2500	2500
				26	0 ✱		
RECEIVABLES	ETC.						

OR

PAYABLES	14		26	10	7	2500	2500
	14		56	9	9	2540	2540
	14		82	2	0	7500	40000
	14		402	2	7	7500	7500
	14		513		7	2500	2500
				26	0 ✱		

Figure 7

LIST OF OUTLINES FOR TRAINING AND TESTS AVAILABLE

PERSONNEL SELECTION

Aptitude tests to assist in the selection of personnel for Key Punching and Machine Operator jobs have been prepared and are available to those companies interested in using them.

M04- 6762	EDPM Aptitude Exam
M04- 6351	Card Punch Aptitude Exam
M04- 6375	Machine Operator Aptitude Exam

TRAINING

To standardize machine training in each Branch Office and to assist those companies which train their own people on machines, the following Education Guides (Outlines for Customer Training) have been established and are available:

Form No.	Title
R23-1023	IBM 602A Customer Training Outline
R23-1044	IBM 65, 66 Customer Training Outline
R23-1101	IBM 858 Cardatype Customer Training Outline
R23-1141	IBM 884-46-47 Customer Training Outline
R23-1339	IBM 101 Outline for Customer Training
R23-9145	IBM 705 Customer Training Outline
R23-9403	IBM 704 Training Outline
R23-9519	Series 1200 Education Guide
R23-9527	FORTRAN Education Guide
R23-9541	IBM 24-26 Education Guide
R23-9547	IBM 802-803 Education Guide
R25-0753	IBM 402-403 Customer Education Outline
R25-0957	Machine Operator Education Outline
R25-1020	IBM 407 Customer Education Outline
R25-1077	Functional Wiring Principles Outline
R25-1148	IBM 77 Customer Education Outline
R25-1162	IBM 650 Customer Training Outline
R25-1179	IBM 528 Customer Training Outline
R27-3513	IBM RAMAC 305 Outline for Customer Training
R27-1146	IBM 604 Outline for Customer Training

IBM ACCOUNTING

FUNDAMENTALS OF SUPERVISION

A. Determine job and personnel requirements

1. The number of key men - the responsibilities of each. The size of the department and the nature of the job both will influence the number of key personnel required. A job requiring a large number of employees but of a simple nature may require fewer key men than a smaller but more complex job.

2. Job functions which generally require supervisory personnel in the Accounting Machine Dept. are:

    a. Research

    b. Planning

    c. Personnel and Training

    d. Control

    e. Operations

        (1) Procedure or job supervision.

        (2) Machine unit or functional supervision.

        (3) Clerical work and supplies supervision.

Limitations of supervisory personnel may require several functions to be performed by one person.

3. Definite phases of the work should be made the responsibility of each key man. The number of persons by job classification required to do the detail work should then be determined:

    a. This will be determined from the schedule showing volume of work by job steps which was developed in the construction of the procedures.

    b. The personnel should be assigned directly to the key men responsible for each phase of the work.

R25-0950

B. Prepare organization chart

    1. The organization chart should depict:

        a. The line of authority

        b. The job functions being done

        c. The number and type of personnel required

    2. The organization chart should be substantiated by a write up defining the duties and responsibilities of the several job classifications.

    3. All of the personnel should be familiar with the details of the chart. If this is done there should be no question in the mind of any employee as to the nature of his duties, or the extent of his responsibilities.

C. The selection of personnel:

    1. With the possible exception of one or two experienced machine and key punch operators, personnel for the Machine Accounting section should be selected whenever possible from within the organization. In developing a new Machine Accounting Department where no experienced operators are available, it is wise to employ several with experience to form a nucleus around which to build. There are a number of reasons for selecting present employees for the section, several of the most important being as follows:

        a. Employees from within the organization will probably already be familiar with the work to be processed. This factor may be of great importance wherever the use of technical terms and trade language is commonplace.

        b. The Machine Accounting Department will usually get better cooperation from the other departments if it is staffed with people who are known to the employees in the other department. There is not the feeling of "Outsiders" being brought in to run the new job.

        c. Employees who have been with the organization for several years should have a feeling of loyalty which would be lacking in new employees. This factor of loyalty can do much toward making or breaking the job.

        d. Employees who have given satisfactory service in the past are entitled to any new opportunities for which they are qualified. Above all they should not be released and replaced by new employees if they can become competent workers in the new jobs.

2. In selecting personnel to train for key punch and machine operator positions considerable thought should be given to any past experience or training which make them better qualified. For example, typists can often be easily trained as alphabetical key punch operators, key driven calculating machine operators as numerical key punch operators, and employees with a knowledge of accounting can be trained as competent machine operators. No one should be chosen for machine accounting work who is not doing a good job in his present position.

D. Abide by organization lines of authority

The organization chart should depict the lines of authority and the responsibilities of the personnel. For an organization to be operated efficiently the lines of authority should be strictly adhered to, so that all instructions and directions flow through proper channels.

1. Responsibility and the authority for carrying out that responsibility should go together. A supervisor or section head cannot be expected to get the best results from his department when higher officials circumvent him and deal directly with the employees who are supposedly answerable to him. Such practices tend to break down the confidence of the employees in the supervisor, particularly when he has told them to carry out certain steps, and the employees are given contradictory instructions from higher ups.

2. It is impossible to coordinate work properly unless that work is directed through proper channels. Often duplication of effort results from several men working on the same problem, each man working independently of the others.

3. It is most difficult to maintain an orderly flow and proper scheduling of work unless proper organization lines are maintained. In a number of organizations the accounting machine department performs work for several other departments. Unless the supervisor of the accounting machine department has a free hand at scheduling the work in the department, a general state of chaos might develop from the operators in the department trying to please everyone. As a result, no department would get a satisfactory job done. For similar reasons it is just as important for the accounting machine supervisor to see that the proper lines of authority are maintained within his department.

4. If the lines of authority are maintained, each worker will know that he is being held responsible for certain specific jobs, and that if those jobs are not performed properly he will be held responsible by his immediate supervisor. This clear cut responsibility will be a strong incentive for efficiency.

E. Keep statistics on operating efficiency, and put them into use.

1. The supervisor cannot know the progress his organization is making unless he has some record of production over a period of time. As operators become more experienced they should be able to produce more work, make fewer errors, carry heavier responsibilities, and therefore, be of more value to the organization. The supervisor should not only know in his own mind, but he should be able to prove who is next in line for a raise or promotion, or conversely, he should have a definite fact backing up any decision with respect to whether or not an employee is rendering unsatisfactory service.

2. The employees in the department are entitled to know whether or not they are making progress. Some organizations put charts on the bulletin board showing the standings of the employees, and the progress made. In some instances, it has been advisable not to reveal the names of employees. If such be true, average production by shift, average production by team, average production by the department as a whole over a period of time, and other similar methods of showing operating efficiency may be employed.

3. It is important to remember that operating statistics do not tell the whole story. There are certain intangible conditions such as the morale of the employees which may not be reflected in daily production for several weeks, particularly in a department where the work is well organized. If an unhealthy condition exists, however, it will more than likely be reflected in the work sooner or later, therefore, any unaccountable drop in efficiency should be studied carefully.

4. The type of statistics that can be kept depends to a large extent on the job. It is relatively easy to keep records on key punch production, for example, where a number of operators work continuously on a few standard jobs, whereas, in other cases it is extremely difficult to measure one operator as compared with another when their respective jobs are entirely different. All of the following suggested statistics on operating efficiency will not apply to every job, but each example may be applicable and useful at some time.

    a. Key punch production
       1. The number of cards punched per day.
       2. The number of holes punched per day.
       3. The number of correct cards punched per day.
       4. An efficiency rating figure based on the number of holes punched and the number of errors made.

    b. Machine production.
       1. Total volume of cards handled during the day.
       2. Total volume handled per hour of operating time.

c. Production of the department as a whole:
   1. Average time in clearing documents through the department by type of ducument.

   2. Ratio between the number of documents handled and the number of man hours involved.

   3. Ratio between the number of detail cards handled and the number of man hours involved.

F. Prevent unnecessary overtime work.

1. One of the surest ways to destroy employees' morale is for overtime work to become the rule rather than the exception. This is particularly true when the employees believe, whether rightly or wrongly, that overtime is due to poor planning on the part of the supervisor or one of the higher executives. It is unfortunate but true that poor planning happens to be the cause for overtime in a large number of cases, when in haste to get a job done quickly action precedes thought. Most supervisors have at one time or another completed a job only to find that certain vital information was missing due to incorrect steps early in the procedure. On the other hand, overtime work may result from the department being understaffed, or the work not being distributed properly among the employees in the section.

2. Whenever overtime work becomes too prevalent all of the work in the section should be analyzed carefully, and the following should be kept in mind:

   a. Special jobs other than regular routine functions of the department should be carefully planned to be handled as efficiently as possible.

   b. The regular work in the department should be analyzed to see if there are any unnecessary steps or duplication of effort.

   c. In some instances the routine of work may be sound, but it may be so scheduled as to necessitate overtime due to the work reaching critical stages late in the day.

   d. Whenever it is found that the department is understaffed and that no amount of scheduling or planning will relieve the situation, steps should be taken to secure the necessary personnel.

Recognize a job well done. Whenever an employee does an outstanding job, tell him so. Nothing gives a man quite the lift as does the satisfaction of doing an outstanding job, and knowing that the effort is appreciated.

G. Encourage suggestions from employees

1. It is wise to encourage suggestions from employees for two reasons. First, it makes the employee realize that he has an important part in the organization, and that his ideas are thought to be worth while. It tends to make him do a better job. Second, the men who are doing the detail work will naturally have a number of ideas which will greatly improve the job, since they are in a better position to see certain phases of the work. This source of ideas should be used to the greatest extent possible.

2. Following are several methods of stimulating suggestions from employees:

   a. Hold regular meetings devoted to suggestions.

   b. Have suggestion contests.

   c. Place a suggestion box in a prominent place and ask that suggestions be dropped in the box.

   d. See the employees individually and ask them for suggestions.

   e. Do not belittle any suggestions which may be made. Certain suggestions may be impractical, but may start a trend of thought which leads to useful applications. The employee who makes an impractical suggestion, may make others which are valuable, if his first suggestion is not ridiculed.

MANAGEMENT FUNDAMENTALS

Personnel Training programs within the organization:

1.   The basic training program.

(a) All machine operators, card punch operators, and clerical workers should be instructed in the fundamental principles of punched-card accounting. It is important that these fundamental principles precede any formal instruction in the operation of the machines so that the trainee will realize the place of each basic type of machine in the picture of machine accounting. It is much easier for the trainee to learn the operation of a machine if he knows the function of that machine. Learning to punch holes in cards becomes of much greater interest to the student when she realizes that the holes cause other machines to add, subtract, multiply, list names, prepare checks, and perform numerous other job steps necessary to an accounting system. The machines should be visualized as means of performing certain job steps more efficiently than could otherwise be performed.

(b) Each operator should then be fully instructed in the operation of the machine or machines which he is to study. Lectures can be made much clearer by visual aids such as slides, pictures of the machines, control panel diagrams, charts, and the machines themselves.

(c) Next should come a period of actual practice, accompanied by periods of discussion. This period for the card punch operator is particularly important, lasting five or six weeks. The length of time depends, of course, on the progress which the trainee makes.

(d) Machine operators and card punch operators should be instructed in the care of the machines. The machine operator should learn to remove card jams, to keep the machines free from dirt and dust and to make minor adjustments. The card punch operators should be taught to remove cards which become stuck, to keep the machine clean, to test for off punching and other simple steps for getting better production through better machine care.

(e) All machine personnel as well as all clerical personnel should be taught the purpose and scope of the job to be performed and the operating procedures. Each employee should then be taught his particular job and the manner in which his job fits into the over-all procedure. It is more helpful to route samples of the actual work to be performed through the department so that the employees can learn through doing.

2. Continuous training program.

(a) Many organizations have found it advisable to have a permanent training program. It is far better to anticipate personnel requirements as far in advance as possible, and train people to fill those anticipated vacancies, than to wait and be caught short. There is always a certain amount of training necessary due to business expansions, promotions, transfers, and numerous other circumstances. If for no other reason, a training program is important in that personnel with growing capacities and expanding interests can be employed to better advantage both to the individual and to the organization.

(b) Different organizations with varying needs will develop different training programs. In a fast growing organization it may be necessary to have classes one afternoon each week, whereas, in other organizations less frequent classes may work out much better. Some supervisors have found that by having operators change jobs for a period of time they can build up alternates and substitutes for each job in the office. In other instances, particularly when a sudden expansion is anticipated, extra employees are hired to work as apprentices for a time, until the additional jobs develop. The supervisor should study his anticipated personnel needs carefully, and should develop that type of program which will best fit those needs.

3. Outside facilities for training.

(a) The local IBM office will usually develop a training program to meet the needs of the area which it serves. Classes are conducted for training those who are selected to become operators, either card punch or machine, and, who have had little or no previous experience.

(b) The Customer Administrative Schools at Endicott and Poughkeepsie are of great value for the educational services they render to new customers, customers who are taking on new applications and developing new ideas, and to all customers who wish a greater insight into the methods of machine accounting. The classes conducted are:

ENDICOTT
1. IBM Accounting Management
2. IBM Accounting for Executives
3. IBM Accounting Methods
4. IBM Accounting for CPA and Management Consulting Firms
5. Special classes for Manufacturing Control or Special Industries

POUGHKEEPSIE
1. Data Processing for Executives
2. Data Processing for CPA and Management Consulting Firms

GENERAL SUGGESTIONS FOR INSTRUCTION

First, and most essential, plan your work. Know what you are going to teach, how you are going to teach it, and what material and equipment you will need. Prepare your material and arrange for equipment in advance.

Know your subject. Never attempt to teach anything of which you are not sure. This involves constantly keeping up with latest development of applications and equipment. Only by being sure of your knowledge can you inspire the necessary confidence in your teaching. If details come up in class of which you are not certain, never guess at the answer; look it up.

Your personal manner is very important in teaching because the attitude of the class is dependent on your own. Try not to allow yourself to become repetitious or disinterested; the class will soon sense it. You must remember also that tact, patience and understanding are essential attributes of an instructor.

Whenever a lesson is taught for the first time, a lesson plan should be prepared. The preparation of this lesson plan fixes in the mind of the instructor the course of his lesson and insures that all the essentials of a good lesson are included.

There are six steps to every good lesson:

1. Preparation - Plan the lesson; prepare visual aids and problems; obtain blackboards or charts; procure necessary equipment.

2. Presentation - Keep lecture to a minimum; use simple understandable words; use analogies; enunciate clearly; explain new or technical terms.

3. Demonstration - Supplement or follow the presentation with blackboard illustrations, prepared charts, schematics; actually use the equipment or perform the operations being taught.

4. Participation - Let the student take part in discussions, draw diagrams, use the equipment, or perform the operations being taught.

5. Summarization - At the end of the lesson, review the entire lesson emphasizing the key points to be learned.

6. Evaluation - Ask questions covering the key points of the lesson, have written tests, participation tests, etc. to determine the extent of learning by the student and therefore the efficiency of teaching by the instructor.

Teach your subject thoroughly but quickly. This means planning. It also means simplicity and fundamentals. It is not your purpose to teach all operators

everything that you know about punched cards. If they learn the fundamental principles thoroughly, they will be able to work out more complicated problems for themselves. At all times, keep your teaching simple. Avoid the use of technical terms and "tabulating language." If it is necessary for them to learn the latter, make certain that they understand your meaning. Whenever possible, tie up similar functions on the different machines; (class selection, automatic control and comparing units, etc.). This will help the students to fix the principles in their minds.

Stress the purpose and importance of every operation described or performed, and its function within the Data Processing method.

Insist that students make and carry away with them diagrams and reports of the problems given. Insist that they keep in notebooks all the material given them for later reference.

Use visual aids as much as possible. "A picture is worth more than a thousand words." Use blackboards, charts, easels, examples.

Keep the entire class with you at all times. Never pass to a new subject until you are certain that every student understands thoroughly what has been covered. Therefore, you must constantly ask questions and arrange for as much class participation as possible. It is advisable to give as much practice work and as many problems as possible. If it is necessary for students to work together, try to put more advanced students with students of less experience; thus, they help each other.

Teach students to analyze every problem before beginning work on it.

Encourage students to ask questions whenever they do not understand. Discourage irrelevant or too advanced questions. Do not confuse the entire class or waste time with questions which are not of general interest or benefit; if such questions are asked, answer them later, individually.

Encourage students with experience to enlarge on that experience for the benefit of the class.

In general, always try to impress operators with the importance of their jobs. Discuss the future open to them in the data processing equipment field, and encourage them to be ambitious. Advise them to learn as much as possible about the reasons for what they do, and to think.

Keep your eyes open for students with future possibilities for promotion. Keep a record of them in your personnel data.

Finally, encourage all students to consult you on problems which may come up in the future on machine operation. A question asked may save many hours locating and correcting an error.