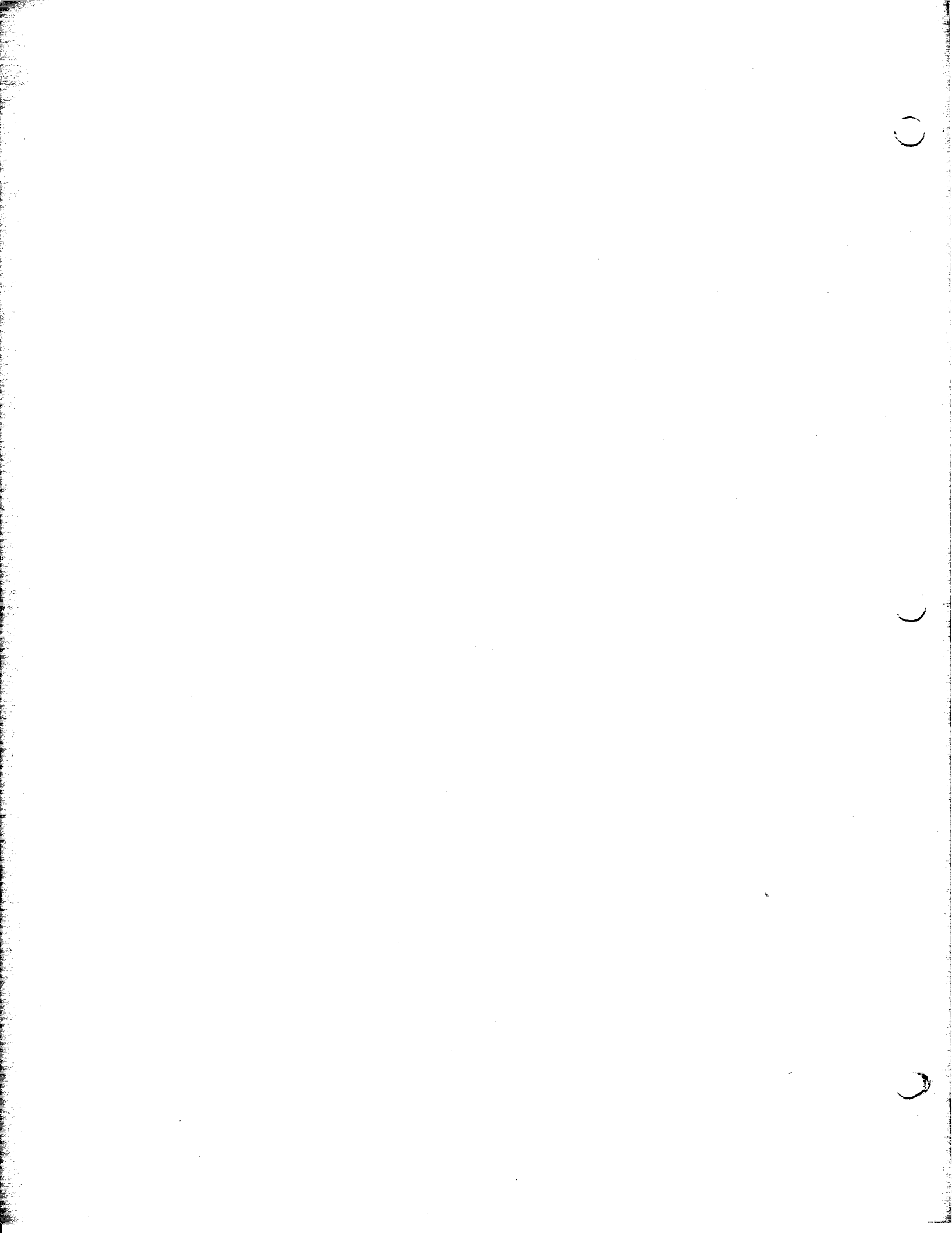


UNIVAC
DATA PROCESSING DIVISION

9200

S Y S T E M

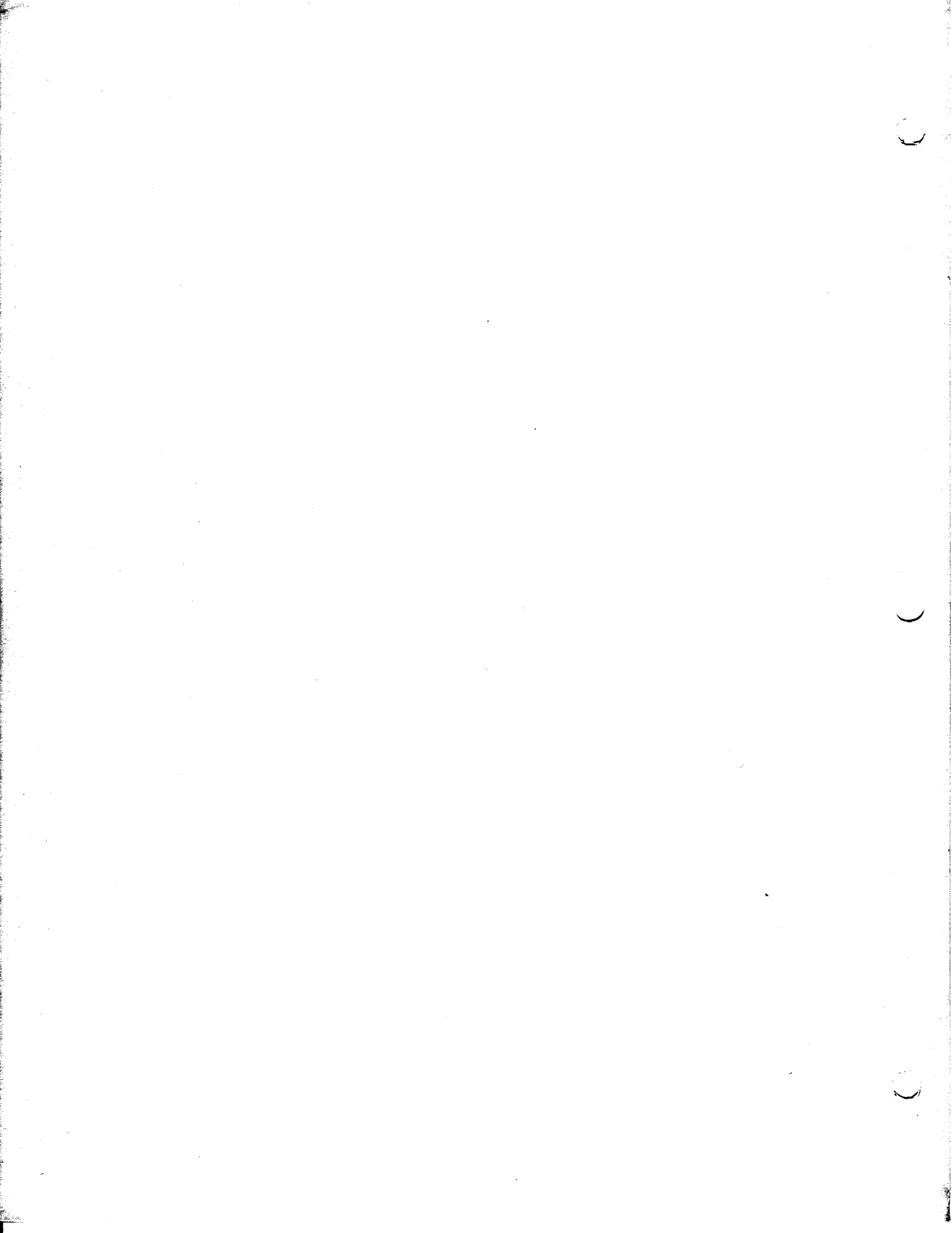
**INSTALLATION
PLANNING
GUIDE**



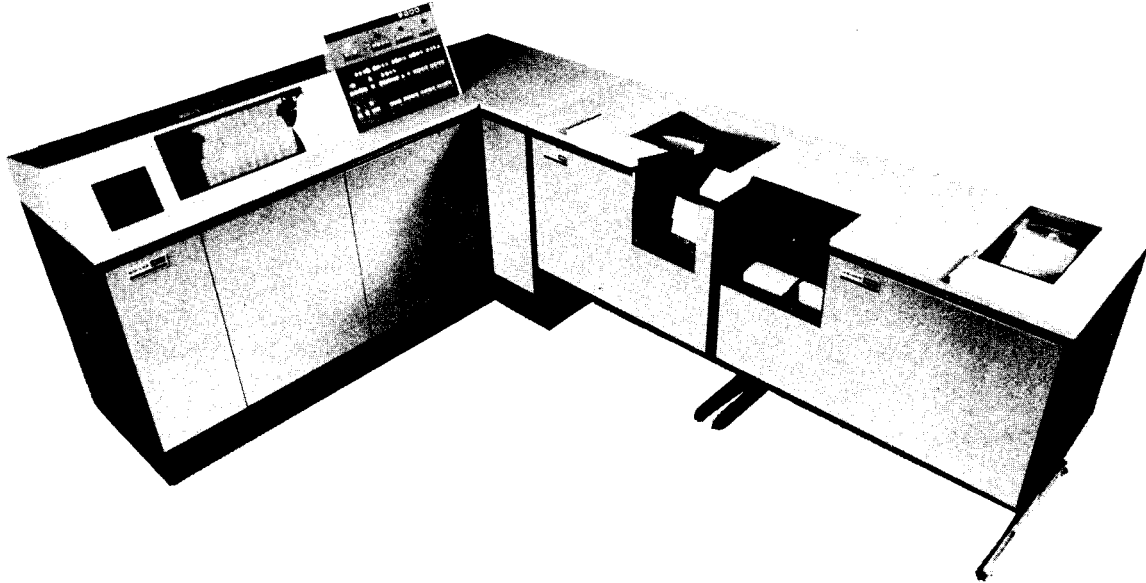
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INTRODUCTION



One of the most substantial tasks associated with EDP operations is that of converting an existing system to a new computer. Few other EDP tasks are as large or as complex, but few others are as important – for the benefits which you will derive from the UNIVAC 9200 System will largely depend on how well the conversion from the old system has been carried out.

For all its size and complexity, the conversion effort can be carried out with a minimum of difficulty if performed in a thorough, logical manner. To aid top management, data processing executives and other supervisory personnel of any organization making the transition to the 9200 computer, Univac has prepared this manual, THE UNIVAC 9200 Installation Planning Guide, which outlines simple, easy-to-use conversion methods. Their implementation is made easier by Univac-devised work charts which relate to each and every conversion step. Use of these forms will enable you to record and analyze pertinent information during each of the five conversion phases described in separate chapters of this manual:

- Installation Scheduling and Control
- Documentation
- Application Development
- Programming
- Record Conversion

Associated with the UNIVAC 9200 Installation Planning Guide is another Univac manual, the “9200/9300 Card Report Program Generator Reference Manual,” UP-4106. This manual describes the nature and use of the Report Program Generator language, a simple tool for the generation of programs for business applications.

I. Installation Scheduling And Control

In preparing for the conversion to a new computer you must first establish a means of controlling the effort and the events that affect the conversion. The purpose of this control is to permit you to determine the progress you are making. You can then make intelligent decisions as to what the future course of action should be. The establishment of a control plan encompasses many areas. You need to identify all the activities that must take place prior to installation. Next, you must determine the amount of work involved in each activity or task. From this you can prepare a schedule of events that becomes the heart of your control plan. You can then compare your actual progress against the schedule and know where you stand. If you are not on schedule you can take whatever corrective action is required. This subject is covered in detail in Chapter I.

II. Documenting The Present System

Documentation involves the systematic gathering of details of the present methods used in accomplishing the goals of the application and documenting them. This includes application flowcharts, card and printer layouts and program logic. The investigation and documentation phase of conversion is fully detailed in Chapter II.

III. Application Development

Application development is the process of preparing the application for programming on the 9200. This is the phase where the documentation of the present (old) system is required. Using the details gathered during the Investigation phase you can develop the new system in an orderly manner. The old system documentation will point out what must be accomplished in the new design, details which might easily be overlooked will have been recorded in the preceding phase. In the Application Development phase you will prepare applications flowcharts and program logic charts for the new system. Application Development is discussed in detail in Chapter III of this manual.

IV. Programming

Programming of the applications is the final phase of the work required to convert to the 9200. It covers everything from coding the programs through testing the programs, and finally, preparing the operator instructions necessary for their utilization. Chapter IV contains a discussion of this phase of conversion.

V. Record Conversion & Planning The Final Cutover

The advent of a new computer will undoubtedly cause some alteration in the output of the EDP department. To insure a smooth transfer of work from the existing system to the new system, a comprehensive and well documented plan must be developed and adhered to. In Chapter V Univac presents guidelines to assist you in developing your plan. Although general in nature, these are the most important to a successful installation.

I. INSTALLATION SCHEDULING AND CONTROL

INTRODUCTION

This first chapter of the UNIVAC 9200 Installation Planning Guide describes the methods and charts developed by Univac to help you establish proper conversion control as soon as the decision is taken to order a UNIVAC 9200. Through this control, you will always be able to quickly evaluate the progress and completeness of your conversion effort and to take prompt remedial action if the need arises. The task of establishing full conversion control involves five basic functions:

- *Preparing the Applications Conversion Plan*
- *Establishing control over other conversion requirements*
- *Developing a master conversion control*
- *Monitoring conversion progress*
- *Planning the final cutover*

PREPARING THE APPLICATIONS CONVERSION PLAN

Planning the conversion of present applications to the UNIVAC 9200 System requires answers to four questions:

- What are the applications to be converted?
- How are they to be converted?
- How much work will it take to convert them?
- When will they be converted?

The four functions which underlie preparation of this Plan, therefore, are:

- Inventory of present runs by application
- Selection of the conversion method
- Workload estimation
- Scheduling

Inventory of Present Runs by Application

The design of conversion control must naturally reflect the number of runs in each individual application, such as payroll or accounts receivable, and the ease with which each run can be programmed. Preparation of the inventory will, therefore, require that the following information be prepared for each run:

- Application identification
- Run listing and evaluation

The Program Inventory List (see Figure I-1) will aid you in these two tasks. It provides a simple medium for systematic recording and analysis of all pertinent information.

Application identification

Before filling out the Program Inventory List, you should group runs according to the applications to which they apply. The name of each application should then be written across the top of a separate List page.

In some cases, there will be runs that are not directly related to any of the applications you have identified. These runs can be either:

- gathered together in a miscellaneous category, or
- included with one or more other applications.

Ease of programming of the run refers to the degree of difficulty known to have been experienced in programming a given run for the machine it presently is on. If there are multiple runs on one control panel, only the difficulty of the one run under consideration should be evaluated. Rating should be simple (S), average (A), or complex (C).

Priority of the runs refers to the desirability of the run's output being included in the new system. Methods for determination of this desirability are described in Chapter III. The following priorities should be assigned:

- (1) if required for the application
- (2) if desirable, but not absolutely necessary
- (3) not needed by delivery date
- (4) not needed

Frequency of the run should be entered as:

- | | |
|---------------|--------------------|
| (D) daily | (SM) semi-monthly |
| (W) weekly | (Q) quarterly |
| (B) bi-weekly | (SA) semi-annually |
| (M) monthly | (A) annually |

In the case of semi-annual and annual reports, the data on which the reports are run should be entered under comments.

The Comments section of the Program Inventory List can be used for entry of any comments for any particular run. The List also contains two columns, headed Documentation and Cross Reference. These columns will be used later in the Documentation and Applications Conversion Planning phases of system conversion, described in Chapters II and III respectively.

Selection of the Conversion Method

Once all runs within each application have been listed and evaluated, a decision can be made as to the manner in which they will be transferred to the UNIVAC 9200. There are two approaches that can be followed. Both are fully described in Chapter III. One approach is conversion of which there are two types - Straight Conversion and Consolidation. The other is System Design. However, the difficulty of new system design and the delays that it can cause are such that use of this method is recommended only for new applications or when a drastic reorganization of the existing system is required for greater efficiency.

Straight Conversion

This method calls for the conversion of each unit record equipment run to an equivalent run on the new system. It permits a prompt conversion within a tight time schedule. However, it tends to result in a greater number of runs than do other methods. This is particularly true for applications involving a large number of calculating runs.

Consolidation

The method involves the combining of several unit record runs into a single 9200 run. This merge is particularly effective in reducing the need for separate calculation runs by marrying them with their associated print runs. Another advantage of consolidation is that it will usually produce a more efficient system than that which was previously in force. Less operator and machine time will be required and card costs will often be reduced as the need for punched card storage of intermediate results is eliminated.

New System Design

Complete redesign of application procedures for the new system is the most difficult and time-consuming method but, in some cases, it yields outstanding results. All application requirements must be analyzed to determine the best method to satisfy them using the new system. This analysis must include the source documents, the management reports, other working reports, necessary processing, history requirements, paper flow both within and outside the data processing department, and all other areas affected by the application. After a particular conversion method has been chosen for a given application, it should be entered at the top of the page of the Program Inventory List.

Workload Estimation

Following the completion of the inventory of applications to be converted and the determination of how they should be converted, you must estimate how much work should be spent on each conversion task. Each application must be analyzed to indicate the scope of each of the three major operations described in Chapters II, III, and IV respectively required for its conversion:

- Documentation
- Application development
- Programming

The workload for the application can then be estimated, using the pertinent Program Inventory List Information. There are many factors involved in estimating the conversion workload. Some apply only to your organization. Others are more common, and have been the subject of extensive study by the Univac systems staff. A Univac systems analyst will assist you in estimating the work required for each task. He will provide suitable work forms and will possess the experience required for accurate evaluation of the total workload and precise determination of how it should be distributed.

Estimating the conversion workload requires the following information:

- The Program Inventory List
- Conversion method selected for each application
- Documentation status of the present system
- Manpower availability

Documentation Status of the Present System

This determination involves two factors: the amount of documentation such as flowcharts and manuals now available, and the knowledge which exists concerning present system programming.

Any available documentation should be reviewed to make certain that it is complete and up to date. The extent of present system programming knowledge can be evaluated through two questions. Are the people who programmed the system still present and do they remember the programs' logic? Could the present system be reprogrammed without any outside assistance?

Manpower Availability

This must be estimated in order to determine the number of man days that can be allocated to each conversion task. Man days represent time that staff members will be able to spend on conversion work between the end of the planning stage and delivery of the new system. Many separate factors, such as cyclical workloads, vacations, training, etc. must be considered in determining personnel availability. Also to be considered are the

secondary effects of other personnel being absent for any reason. A calendar should be used when personnel availability is being computed. The workload estimating process furnishes two important items of information. The first is the time which each conversion task should take if it is to be accomplished before total conversion delivery. The second is the approximate number of man-hours per day required daily for conversion work. This information will underlie subsequent conversion scheduling.

Scheduling

After the conversion tasks have been defined in terms of scope and time requirements, the order in which they are to be done should be determined. Several factors affect scheduling. For instance, the next conversion phase will be Application Documentation, and it is recommended that the first application to be documented be the easiest and shortest (the same recommendation applies to Programming). An easy, gradual introduction to documentation procedures may thus be had. Similarly, the entire system should be documented before the start of the Application Conversion Planning phase. Documentation for all applications must be available so that their interrelationships may be examined.

Each major conversion phase should be completed before the next one begins. This allows a more orderly employee training period. Finally, as the interrelationships between all applications become apparent, the new system can often be simplified. In this way, you can avoid subsequent reprogramming work to eliminate inefficiencies that should have been remedied during conversion.

The Workload Scheduling Chart

This chart (see Figure I-2) has been designed by Univac to permit a graphic representation of the schedule. Use of the chart will enable you to control the progress of conversion and to spot any developing conditions that require corrective action.

The chart is divided into two portions: for written information and for graphic representation. To fill in the first portion, you should:

- (1) Indicate the application in the Application column.
- (2) In the Task column, list all tasks in the sequence in which they will be converted.
- (3) Fill in the name of the person responsible for conversion of this task in the Personnel column.
- (4) Fill in the number of man-days required to complete each task in the Required Days column.
- (5) In the Start Date and End Date columns, show the starting and completion dates for each task. This should be done using a calendar after all tasks have been listed. These dates must reflect the availability of the person assigned to the task.

To fill out the graphic portion of the chart:

- (1) *Fill each of the top row Date boxes with dates for Fridays two weeks apart.*
- (2) *Draw a horizontal bar through the ESTIM. (for "estimated") row extending through the time period allocated for completion of the task.*
- (3) *As tasks are being completed, draw a horizontal bar every two weeks through the ACTUAL row to indicate the actual time that work in progress for this task is taking.*
- (4) *As tasks are completed, the completion date should be inserted in the Date of Completion column.*

At the bottom of the Chart is a bar graph labelled "Estimated Days Completed." This graph should be scaled to represent manpower availability as a man-day total. As each task is completed, the number of estimated man-days assigned to the task should be marked off on the bar graph. This will show how much of the total conversion work has been completed to date, and how much remains to be done.

Program Check List

Besides the Program Inventory List and the Workload Scheduling Chart a third control form, the Program Check List, has been provided. This form (see Figure I-3) will be used in the application, conversion, and programming phases. Its purpose is to provide a means of controlling the work done on each of the programs for the 9200 System.

During the application planning phase, the runs to be programmed for the 9200 will be determined. The following information should be transferred from the Program Inventory List to the Program Check List (see page 2 of this chapter):

- (1) Run name and number
- (2) Run priority
- (3) Numbers for runs being replaced (to be entered in Cross Reference column).

In assigning priorities, it is recommended that the following designations be made:

- "1" - required by delivery date
- "2" - desired by delivery date
- "3" - not needed by delivery date

As the application planning phase progresses, input, output and logic documentation are prepared for the new program. These runs will be reflected in the proper column for that program.

When the programming phase is begun for each application, the proper program check list should be updated. In this way, control can be maintained over the progress of each of the several programs being worked on at this time.

OTHER CONTROL REQUIREMENTS

Conversion of applications to the Univac 9200 is not the only area that requires thorough planning and control. There are many related installation support tasks that must be done before system installation if it is to go promptly on the air. These tasks include:

- Site preparation
- Education of personnel
- New supplies
- Cancellation of present equipment

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**UNIVAC
9200
SYSTEM**

PROGRAM CHECK LIST

APPLICATION _____ PREPARED BY _____

PAGE _____ OF _____

RUN NO.	RUN NAME	PRIORITY	CROSS REF.	PLANNING			PROGRAMMING							COMMENTS	HOURS CODE TO END		
				INPUT	OUTPUT	LOGIC	START DATE	CODE	K. P.	DESK CHECK	DEBUG	TEST	DOCUM.			END DATE	

Figure I-3. Program Check List

Site Preparation

The most efficient installation layout should be determined, and plans should be made to install new equipment in its final location so that it will not have to be moved. This is a very important planning step, and one in which you will receive the same Univac support as in all other installation phases. Your Univac sales representative will assist you in making an early inspection of your site. He will give you all information necessary to properly prepare for the physical installation of the 9200. This work should be completed well before delivery so that any deficiencies in the modifications can be eliminated.

Education of Personnel

As soon as systems planning is completed all members of your organization should be instructed in the new system's nature, requirements and use. Instruction to be planned and scheduled ranges from operator training and programming courses to executive seminars for management. Instructions should be written to cover every processing step and, if possible, practice runs should be held. With the entire organization thoroughly aware of the UNIVAC 9200 System, the Data Processing Department will enjoy maximum efficiency.

New Supplies

Forms, forms control tapes and new card layouts are among the supplies that may be needed for the 9200. You should also investigate all other possible new filing requirements. This should be done early enough so that needed items can be ordered and delivered well before the computer's delivery. Early delivery will permit you to check the new supplies to make certain that they meet all specifications.

Cancellation of the Present Equipment

It is important that cancellation of equipment to be replaced be planned early enough so that you will not have to pay rentals on idle machines. This withdrawal date must not affect the productivity of the Data Processing Department.

MONITORING

Actual conversion to the UNIVAC 9200 System can begin once conversion control has been established and conversion steps have been scheduled. This schedule must be faithfully followed and the conversion progress should be periodically reviewed. This procedure is known as Monitoring.

Univac has prepared an Installation Pert Chart to assist the user in monitoring the total installation process including all of the above mentioned factors.

This chart shows the relationship of factors involved in the conversion. It can provide the user with the general progress of the conversion at a glance.

As the Data Processing Manager is responsible for the installation of the new computer, he should monitor the progress of conversion. At least once a week he should update the four planning forms provided by Univac:

- Program Inventory List
- Workload Scheduling Chart
- Program Check List
- Installation Pert Chart

After the forms are updated, he should review them to compare the progress of conversion to date with the scheduled progress to date. He will thus be able to spot problem areas before they become critical and, whatever their causes may be, to take corrective action

to bring the work back on schedule. Monitoring will also enable the Data Processing Manager to keep his management regularly informed of the progress of conversion.

If the conversion work is not progressing according to schedule, four types of corrective action can be taken:

- Increase the productivity of the Data Processing Department
- Use outside help
- Temporarily rent additional equipment
- Reschedule the conversion work

Increasing Productivity

The work schedule and working conditions are the two areas that can most effectively be improved to speed conversion work. It is possible that personnel working on the conversion are hindered by other duties. If this is so, their productivity can be raised by assigning their nonconversion duties to other people, if possible. Working conditions should provide sufficient space and quiet to allow personnel to work without distractions or interruptions. If neither the work schedule nor working conditions can be improved, it may become necessary to put personnel on an overtime basis or to use outside help.

If permanent personnel are used on an overtime basis, care should be taken that their over-familiarity does not adversely affect the accuracy of the conversion. The tendency exists for special cases to be carried forward because the operator knows the circumstances and how these exceptions are handled under the old system. In any event, a staff supervisor should be given the responsibility of controlling the conversion.

Use of Outside Help

This can take two forms:

- Temporary personnel
- Conversion by a service bureau

Temporary personnel are often hired for simple card reproduction operations. Their accuracy and their knowledge of how to handle special case cards may not, however, match those of permanent personnel. They will require close supervision and can thus represent an additional supervisory burden.

Conversion by a service bureau will usually be efficient and on schedule. It may, however, present some control problems, and will require the reproduction or temporary release of working files. One of the advantages of this approach is the lesser burden which it places on installation personnel at a time of peak activity.

Rescheduling Conversion Work

If no internal improvements can be made, it will be necessary to reschedule the conversion. Small monthly jobs and others that are not run daily or are not absolutely necessary for successful operation can sometimes be scheduled as last for conversion. They can then be run outside after the new system is installed until they, too, are converted.

If delays in the progress of conversion are such that the Workload Scheduling Chart must be modified, it will usually not be necessary to recreate the entire Chart. Only starting and completion dates on the graphic portion of the Chart need be altered. The dates on the Installation Pert Chart can also be changed, if necessary.

During conversion, higher management should be kept informed of current progress so that it may provide effective support to any area that requires it. In addition, the Univac Sales

Representative will cooperate in meeting difficult problems that may arise. Through the Sales Representative, Univac will be kept constantly aware of your progress and of your needs.

INSTALLATION PERT CHART

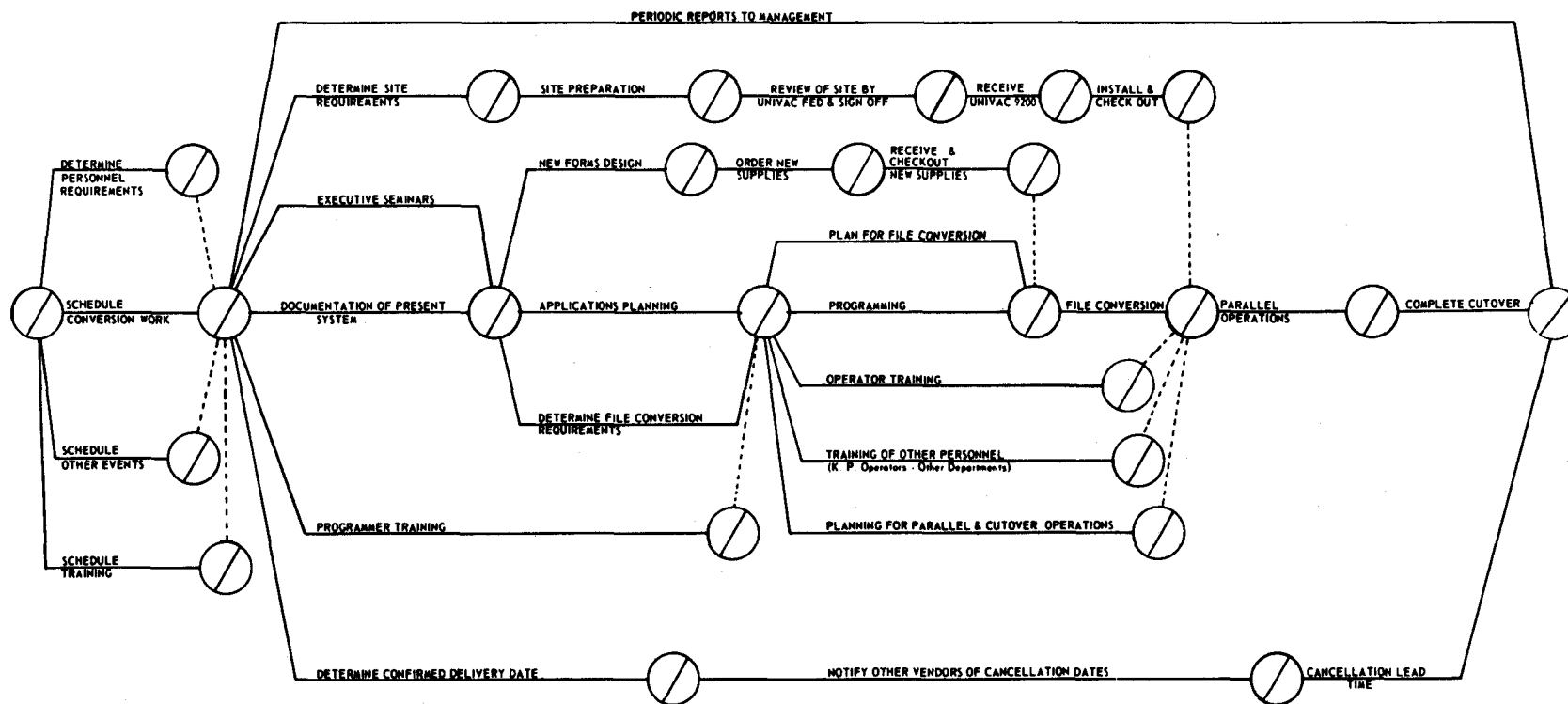


Figure 1-4. Installation Pert Chart

II. DOCUMENTING THE PRESENT SYSTEM

INTRODUCTION

The cutover of existing applications to the UNIVAC 9200 System is no exception to the rule that any kind of accomplishment must be based on thorough knowledge of the work to be done. Before any application system design or programming can begin, it is necessary to prepare complete records of every operation for each application. This documentation task is no less important than actual programming, for its accuracy and completeness will underlie your entire conversion. In addition, the thoroughness with which you can assemble this information will govern the speed and accuracy with which you can convert to the new computer.

To aid you in documenting your present application, Univac has designed an easy-to-use documentation method and related work forms. They are specifically designed to record your existing procedures in such a way as to reveal any changes that must be made for conversion to the 9200. As a result, subsequent programming will be much easier and cutover to the new system will be expedited.

Both the Univac method and associated forms are fully described in this chapter. They will help you perform the four functions that are basic for a successful documentation effort:

- Flowcharting the application
- Documenting operations for each run
- Recording documentation progress
- Final Review

THE UNIVAC METHOD

The Univac Documentation method provides a way to systematically record existing application information with maximum ease and in a simple, standardized action format. This information describes input, output, frequency and volume for each run within an application. It is arranged in a manner that enables you to eliminate the need for intermediate steps and quickly determine runs, input and output that should be eliminated, combined or otherwise modified for optimum use of the UNIVAC 9200. Documentation can best proceed on an application-by-application basis. Recording of one application should be completed before documentation of the next is begun. Information thus assembled is entered on four related work charts. They are:

- Application Chart
- Multiple Card Layout Chart
- Printer Format Chart
- Program Logic Chart

The Application Chart is used to chart individual runs for analysis of functions and data flow. The Multiple Card Layout and Printer Format charts serve to document run inputs and outputs, and the Program Logic Chart is used to record operations occurring within each run. As you use these charts to document successive applications, you should keep a record of your progress. Your documentation should be reviewed after completion to make sure that it covers the requirements of each application. It can then be used to support the subsequent application development and programming phases described in Chapters III and IV.

FLOWCHARTING THE APPLICATION

For effective flowcharting, each application must be portrayed as a whole. All operations, whether machine or clerical must be shown and their inter-relationships easily visualized. Even minor functions must be included as their omission might cause wrong conclusions during the subsequent installation planning phase. Only a complete application chart can be analyzed to reveal time-saving consolidations of operations and procedures.

The Univac designed Application Chart (See Figure II-1) should be used to record application data. It contains a series of American Standards Association flowchart symbols so arranged that they may be connected to portray a function's inputs and outputs and also picture the function itself.

The Chart is divided into two vertical sections, each section holds symbols for charting of four different functions. The three types of symbols used on the form represent:

- Operation or function
- Input or output document
- Input or output card

The operation or function symbol is a rectangular box.

UNIVAC

APPLICATION: NO. _____ NAME _____

APPLICATION CHART

**UNIVAC
9200
SYSTEM**

PAGE _____ OF _____

PREPARED BY _____ DATE _____

UP-4588

VOL.

VOL.

VOL.

RUN	MACHINE	FREQ.

VOL.

VOL.

VOL.

VOL.

RUN	MACHINE	FREQ.

VOL.

VOL.

VOL.

VOL.

RUN	MACHINE	FREQ.

VOL.

VOL.

VOL.

VOL.

RUN	MACHINE	FREQ.

VOL.

Figure II-1. Application Chart

There are spaces within each box in which to enter the operation number, the number of the machine on which it is performed, and a brief description. Additional input or output symbols may be drawn to the left of the operation box if needed.

To portray the operation, lines are drawn to connect its various elements. Blank, unconnected symbols are disregarded. A flowchart can thus be formed by connecting lines between separate operations, with the output of the first becoming input to the next. Symbols for input or output documents and cards should contain a brief description or report name and the average volume of cards or number of document lines. This volume information is an important consideration for proper planning of application revisions. The frequency information noted in the operation box is also important. It can be abbreviated to read "D" for daily, "W" for Weekly, etc. It is important that full information be noted in each operation box.

Connectors designate card files that have come from some previous operation or are to be used in some subsequent operation, not directly in sequence. A connector is a circle containing a number that serves as a reference point. A triangle may be used as a symbol for a file or storage point.

Flowchart Information

Internal information may be available to aid in the preparation of an application flowchart. This information should, however, always be carefully reviewed for errors, omissions and obsolescence by someone familiar with the application, even if it seems complete and up to date.

- *A previous flowchart* of the application provides the most useful documentation. If complete and up to date, it can be used as is. Otherwise, it can serve as a guide for the new chart.
- *An operations manual* is almost as useful as a flowchart. However, even if the manual is complete and up to date, a chart should still be drawn so that the application can be quickly visualized as a whole.
- *An operation-by-operation record* of an application may be made during machine-processing if no adequate documentation is available. The operator should record every operation as he performs it, and even special reports and other operations that are performed only infrequently.

Each flowcharted application and every operation within it must be identified and be listed on the Program Inventory List (see Chapter I). Each application should be assigned a letter designation, usually the initial of its name, such as "P" for Payroll. No more than three letters should be used. Each operation is then assigned a number, indicating its place in the operations sequence. It is recommended that operations be numbered by "tens" to reserve unused numbers for later additions to the application. The first operation would thus be numbered 10, the second 20, and so forth. In this way, every change in an operation can be easily recorded as it occurs. The flowchart will thus reflect current operations at all times, and continue to provide the benefits of good documentation.

An example of how the Application Chart may be used to flowchart an application is provided in Figure II-2. A segment of a typical payroll is to be charted and it is assumed that time cards have been previously gathered, punched extended and the weekly payroll cycle is now being performed. The letter symbols on the chart refer to the following significant aspects of the flowcharting procedures:

- A. A connector from the preceding page of the flowchart binder indicates the source of the input cards. They are briefly described and their volume is entered in the input card form.

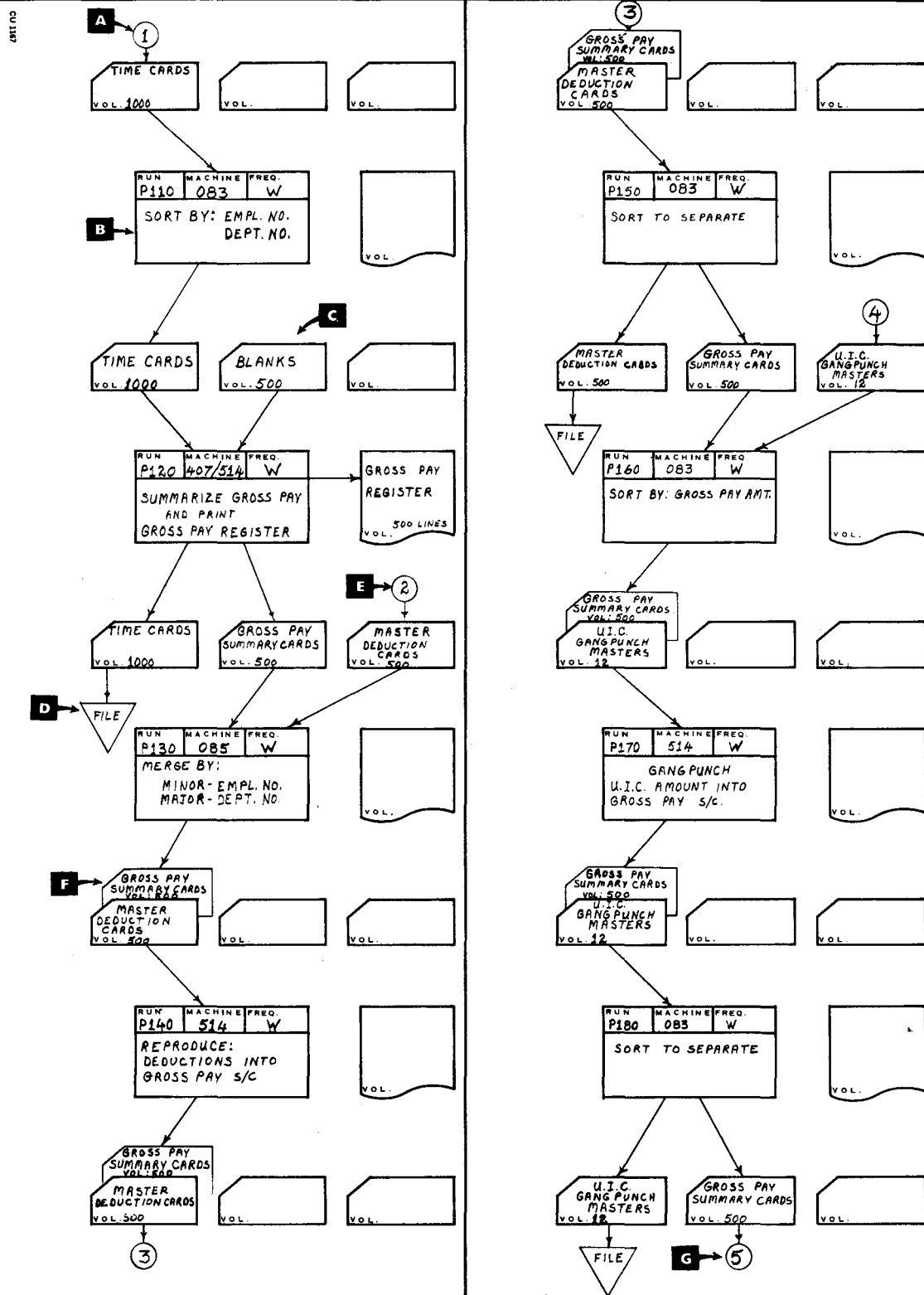


Figure 11-2. Payroll System Flowchart, Sheet 1 of 4

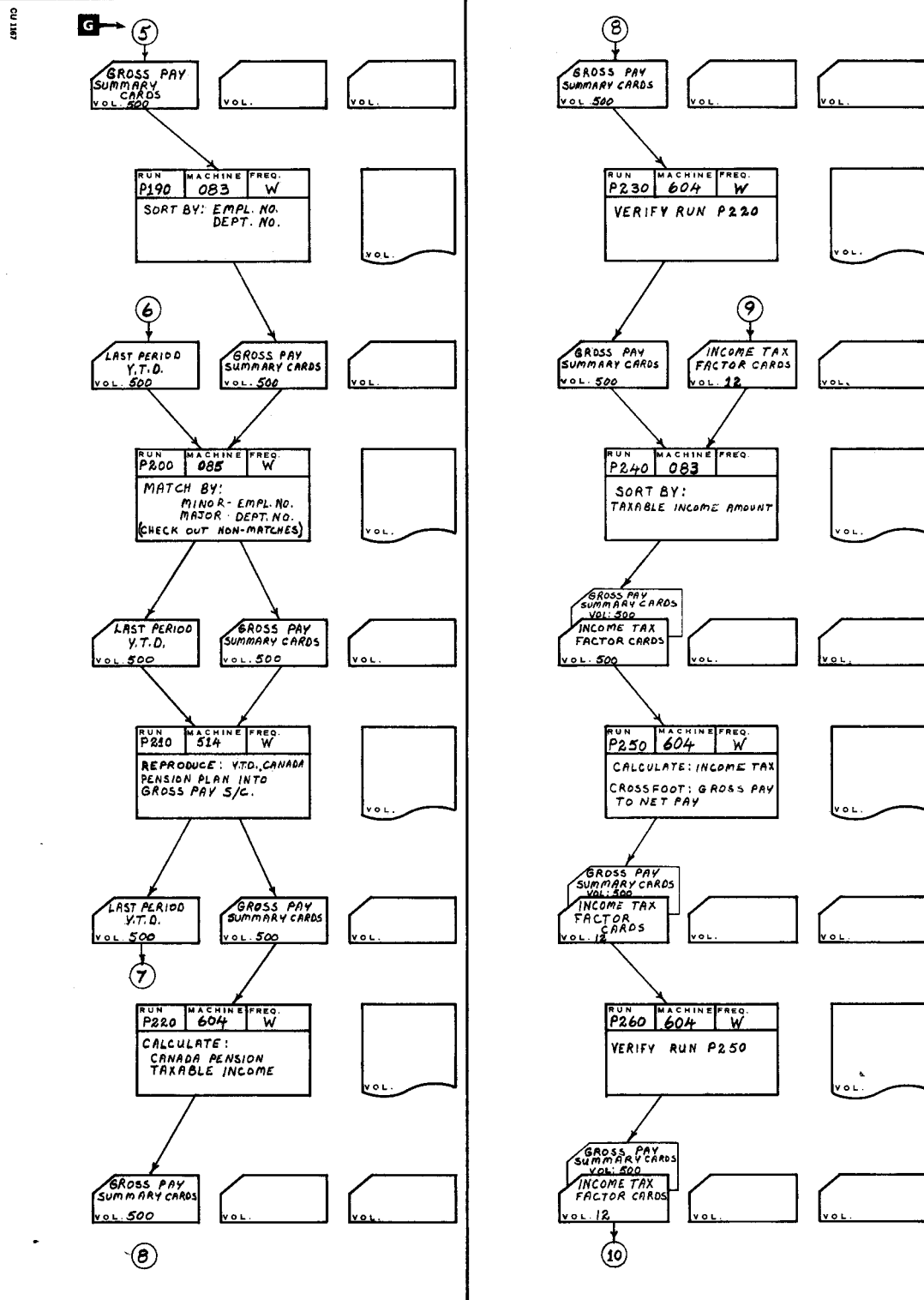


Figure 11-2. Payroll System Flowchart, Sheet 2 of 4

- B. Information entered in the Operation 110 box shows that this is a sort operation on an 083 sorter, that the sort is by employee and department and is performed weekly.
- C. Five hundred blank summary cards are required as input for the next operation.
- D. Processing of detail time cards for this operation has been completed. This is indicated by a "file" symbol drawn after the output card form.
- E. Connector "2" indicates that the "Deduction Master" card file is now entering the application flow.
- F. The second card drawn behind the first indicates that the two different card files have been merged into one.
- G. The gross pay summary cards will re-enter processing flow on the next page of the chart binder. Its origin will be referenced by the connector.

As you chart each application, you are likely to remember inefficient procedures that could not be remedied before, to uncover new ones, and to discover ways in which system operations could be simplified and improved. This information should be carefully recorded for the planning phase that will follow, either on the relevant flowchart or on an attached listing. Deficiencies to be noted include operations that should have been performed in the past, but were left undone due to time or equipment limitations. Also to be noted are the possibilities of simplifying the processing sequence that become evident during flowcharting. These consist largely of duplicate, similar or obsolete report requirements that were "tacked on" to an existing application and create needless additional operations. When operations are reprogrammed for the new system, it will be possible to meet some present requirements through by-products of other operations.

Interrelationships of cards and reports between applications should be set down. In this way, provision will be made for them during the planning phase and conflicts between applications will be avoided.

DOCUMENTING RUNS

Each run within an application must be fully documented to indicate:

- Input and output card formats
- Printer output formats
- Calculation details

The following paragraphs describe the three simple charts provided by Univac to aid you in recording run documentation:

- Multiple Card Layout Chart
- Printer Format Chart
- Program Logic Chart

The Multiple Card Layout Chart (See Figure II-3) has six cards per page on which to record data for individual input or output cards. Card names, control positions and other pertinent data are recorded in the spaces provided at the left of each field. This information will be used later for new system programming.

APPLICATION NO. P NAME PAYROLL

RUN: NO. _____ NAME _____

PREPARED BY B.W. LINN DATE _____

TOTAL LEVEL																																																																																	
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																																																																																	
CARD NAME MASTER NAME CARD		ELECTRO. NO. _____																																																																															
I/O	SEQ	NO. CDS	OPT	DEPT. NO.	EMPL. NO.	SOCIAL INSC. NO.	EMPLOYEE NAME																																																																										
0	0	0						0																																																																									
CONTROL POSITIONS <u>0/80</u>																																																																																	
CARD NAME MASTER RATE CARD		ELECTRO. NO. _____																																																																															
I/O	SEQ	NO. CDS	OPT	DEPT. NO.	EMPL. NO.	RATE	JOB NO.																																																																										
0	0	0						1																																																																									
CONTROL POSITIONS <u>1/80</u>																																																																																	
CARD NAME MASTER DEDUCTION CARD		ELECTRO. NO. _____																																																																															
I/O	SEQ	NO. CDS	OPT	DEPT. NO.	EMPL. NO.	DED. PER TDI	DEDUCT. NO. 1	DEDUCT. NO. 2	DEDUCT. NO. 3	GANGPUNCH CTL. ONLY																																																																							
0	0	0								X	2																																																																						
CONTROL POSITIONS <u>2/80</u>																																																																																	
CARD NAME TIME CARD		ELECTRO. NO. _____																																																																															
I/O	SEQ	NO. CDS	OPT	DEPT. NO.	EMPL. NO.	GROSS PAY	REG. HOURS	O.T. HOURS	RATE	JOB NO.	DATE																																																																						
0	0	1									MM/YY	3																																																																					
CONTROL POSITIONS <u>3/80</u>																																																																																	
CARD NAME GROSS PAY SUMMARY CARD		ELECTRO. NO. _____																																																																															
I/O	SEQ	NO. CDS	OPT	DEPT. NO.	EMPL. NO.	GROSS PAY	REG. HOURS	O.T. HOURS	DED. PER TDI	CANADA PENSION PLAN	Y.T.D. CANADA PENSION PLAN	U.I.C.	DEDUCT. NO. 1	DEDUCT. NO. 2	DEDUCT. NO. 3	TAXABLE INCOME	INCOME TAX	NET PAY	DATE																																																														
0	0	0																		MM/YY	4																																																												
CONTROL POSITIONS <u>4/80</u>																																																																																	
CARD NAME YEAR-TO-DATE SUMMARY CARD		ELECTRO. NO. _____																																																																															
I/O	SEQ	NO. CDS	OPT	DEPT. NO.	EMPL. NO.	Y.T.D. GROSS PAY	DED. PER TDI	Y.T.D. CANADA PENSION PLAN	Y.T.D. OTHER	Y.T.D. INCOME TAX	DATE																																																																						
0	0	0									MM/YY	5																																																																					
CONTROL POSITIONS <u>5/80</u>																																																																																	

Figure II-6. Sequencing of numeric card fields

- Control positions that identify cards and card names should be entered in the space provided for this purpose at the left of the chart (See Figure II-7).
- Total level control fields (See Figure II-8), the card fields that cause automatic total breaks, will vary from run to run. This information must therefore be entered separately for each run. The fields are recorded by extending the vertical separator lines upward into the "total level" tier at the top of the chart. The class of total (major, minor, intermediate) is then entered in the resulting new box.
- Sequencing, number and optional presence (See Figure II-9) information varies from run to run. It is entered in the four boxes at the left of the chart (below "Card Name") under the four following abbreviated headings:
 - I/O
 - SEQ
 - No. Cds.
 - OPT
- I/O column indicates whether a given card type provides input or output in this run. Either "I" or "O" should be marked in the column, or both if the card combines input and output functions; that is, if output data is punched into the same card as was used for input.
- SEQ indicates the sequence in which a particular card type is processed during a run. If the card is the first to be processed, the "1" should be entered in the column, a "2" if it is to be second, and so forth. An "A" is entered if sequence of card types has no significance.
- No. Cds. column shows whether only one or any number of cards of a given type may appear in a control group. Either the "1" or "MUL" should be marked.

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MUL

APPLICATION: NO. P NAME PAYROLL
RUN: NO. _____ NAME _____

TOTAL LEVEL																																									
		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		
CARD NAME		MASTER NAME CARD																																							
1/0	SEQ.	NO. CARDS	OPT.																																						
I	0	1	MUL.																																						
CONTROL POSITIONS				0/80																																					
				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
CARD NAME																																									
1/0	SEQ.	NO. CARDS	OPT.																																						
I	0	1	MUL.																																						

Figure 11-7. Entry of Control Positions of Multiple Card Layout Chart

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MULTIPLE - CARD LAYOUT

APPLICATION: NO. P NAME PAYROLL
RUN: NO. _____ NAME _____

TOTAL LEVEL		MAX MINOR																																								
		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			
CARD NAME		TIME CARD																																								
1/0	SEQ.	NO. CARDS	OPT.	DEPT. NO.	EMPL. NO.	GROSS PAY	REG. HRS.	O.T. HRS.	RATE	JOB NO.																																
0	0	A	1	1	1																																					
CONTROL POSITIONS				3/80																																						
CARD NAME																																										
1/0	SEQ.	NO. CARDS	OPT.																																							
I	0	1	MUL.																																							

Figure 11-8. Multiple Card Layout Chart-total level control fields.

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MULTIPLE - CARD

APPLICATION: NO. P NAME PAYROLL
RUN: NO. _____ NAME _____

TOTAL LEVEL																																										
		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			
CARD NAME		MASTER RATE CARD																																								
1/0	SEQ.	NO. CARDS	OPT.	DEPT. NO.	EMPL. NO.	GROSS PAY	REG. HRS.	O.T. HRS.	RATE	JOB NO.																																
0	0	1	0	1	1																																					
CONTROL POSITIONS				1/80																																						
CARD NAME		TIME CARD																																								
1/0	SEQ.	NO. CARDS	OPT.	DEPT. NO.	EMPL. NO.	GROSS PAY	REG. HRS.	O.T. HRS.	RATE	JOB NO.																																
0	0	2	1	1	1																																					
CONTROL POSITIONS				3/80																																						
CARD NAME																																										
1/0	SEQ.	NO. CARDS	OPT.																																							
I	0	1	MUL.																																							

Figure 11-9. Multiple Card Layout Chart, sequencing, number and optional presence entries.

- *OPT* column contains an "0", to show that a given card type may or may not be present in a control group, that is, its presence is optional.

Any additional data that may help describe a card should also be recorded. If necessary, notes may be attached to the Card Layout Chart.

Printer Format Chart. Printing format information can usually be obtained from a copy of the existing printout. This printout should show output from all individual cards and indicate all special vertical spacing and skipping requirements. Sometimes more than one printout page should be included to show all possible conditions. If no printout is available, however, the Printer Format Chart should be used to record printing data. The top of each chart should carry the application's name, run number and other pertinent data. Within the work space, at least two detail lines can be entered by positioning XXX's, filling out the maximum size of each field (See Figure II-10). Any totals printed, should be entered in the same fashion. To aid later evaluation, page and column headings must be entered in the appropriate spaces, even if they are not shown on existing forms.

The layout must show all editing features. These include:

- special symbols
- check protection
- total and credit indications
- decimal and comma printing

Notes can be entered in the layout to indicate desirable editing characters that cannot now be printed because of current equipment limitations (See Figure II-11).

Chart notations should include all vertical spacing and skipping requirements, including the normal overflow to following pages. Forms that require eight to the inch spacing should have a special note to that effect. The chart should contain a short summary of forms construction, particularly of those forms that have special fastening requirements as spot carbon, snap-out set, etc.

RPG PRINTER FORMAT CHART

APPLICATION <u>PAYROLL</u>																												DATE																																										
RUN NAME <u>GROSS PAY REGISTER</u>														RUN NUMBER <u>P330</u>														PRE																																										
DETAILS RECORD NAME <u>GROSS PAY REGISTER</u>														RECORD NUMBER														APPR																																										
																												DATE																																										
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	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
				UIC				DED 1				DED 2				DED 3				GROSS PAY				INC TAX				CAN PENS																																										
				X.XX				XX.XX				XX.XX				XX.XX				XXX.XX				XX.XX				XX.XX																																										
				X.XX				XX.XX				XX.XX				XX.XX				XXX.XX				XX.XX				XX.XX																																										
																XXXXXXXX.XX				XXXXXX.XX				XXXXXX.XX																																														

Figure 11-10. Printer Format Chart, Payroll Gross Pay Register

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	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
				XXX.XX				XX.XX				XX.XX																												
				XXX.XX				XX.XX				XX.XX																												
				XXXXXXXX.XX				XXXXXX.XX				XXXXXX.XX																												
				↓				↓				↓																												
				SHOULD BE				SHOULD BE				SHOULD BE																												
				↓				↓				↓																												
				XXX,XXX.XX*				XX,XXX.XX*				XX,XXX.XX*																												

Figure 11-11. Printer Format Chart, new system layout modifications.

Program Logic Chart is used to state the logic of a run. This is a "problem statement," not a description of how the present machine actually processes that run. One chart is usually enough for this purpose. The application name, run number and other pertinent data should be shown across the top of each page. Chart statements should be in plain English with the algebraic signs +, >, <, ≠, -, x, :, =, used to describe operations performed. Machine terminology should not be used.

The Program Logic Chart is divided into six main columns:

- *Card Type*
- *Condition and/or Control* column contains control positions that identify cards or special conditions during calculation.
- *Step* column identifies step numbers. There is no requirement that step numbers be continuous or consecutive. They are to be used as reference points.
- *Description of Operation* column contains a series of logical statements, arranged in sequence, defining the problem solution.
- *Branch* column is used when a condition is created by the logic that causes the problem solution to take an alternative path. There are two sub-columns: *Condition* and *To*. The first states the condition that causes the branch, and the second shows the first step in the alternate sequence to be "jumped" to.
- *Comments* column shows the number of positions needed in the result, if this has not been made apparent through previously defined fields and the number of decimal places. Other comments helping to sharpen logic definition should also be entered.

The use of the Program Logic Chart is demonstrated by Figure 11-12. The calculation run illustrated is numbered P220 (calculation of Canada Pension Plan contributions and Taxable Income) on the Application Flowchart. Input for this run is the Gross Pay summary card which contains the following information pertinent to this run:

- Gross Pay
- Deductions per TD1.
- Year-to-Date Canada Pension Plan contributions.

During the run, the Canada Pension Plan contribution for the current period must be calculated and punched into the Gross Pay summary card. The Gross Pay amount is reduced by the Canada Pension Plan Contribution and the calculated weekly equivalent exemption from the employees TD1 form. The resulting Taxable Income amount is punched into the Gross Pay summary card for subsequent use in the determination of income tax to be deducted for the current pay period.

The Gross Pay summary card is described in the Payroll Multiple Card Layout Chart (see Figure 11-13). Other payroll cards not required for run P170 are not included on the copy of the chart for this run.

Significant factors to be considered in developing the Program Logic Chart are indicated by the letter references in Figure 11-12.

- A. The card type describes the card as a Gross Pay summary card.
- B. The control position indicates that the card is identified during a run by a "4" punch in column 80.
- C. In step 1, a test is made to determine if the maximum Canada Pension Plan Amount has been previously deducted. If the maximum has been reached, the remainder of the steps for the Canada Pension Plan routine (steps 2 to 8) are bypassed.
- D. (\$11.54) indicates a constant value. The basis for using this value is indicated in the comments section.

- E. Step 5 indicates that the C.P.P. amount is rounded.
- F. Since the size of the card field does not reflect the true size of the result field and since it is not otherwise apparent, it is noted in the comments section.

The operations that are required to be shown on the Program Logic Chart are those concerned with calculations and with testing numeric values. It is often not necessary to show movements of fields such as name and department number.

An example of print and punch operations is illustrated in Figures 11-14. The purpose of the Program Logic Chart for run P300 (punch new Year-to-Date summary cards and print a Control Register), is to illustrate clearly the accumulation of data for punch and printer output. The Gross Pay summary cards and Year-to-Date summary cards are used as input. Operations to be performed are shown in Figure 11-14. A Multiple Card Layout Chart for run P300 is illustrated in Figure 11-15.

Significant factors to be considered in developing the Program Logic Chart are indicated by the letter references in Figure 11-14.

- A. Steps 1, 2 and 3 accumulate three fields which are to be updated. Fields in the last period Year-to-Date summary card are added to zero to show a clear counter.
- B. Steps 4, 5 and 6 accumulate current period amounts before a new Year-to-Date summary is punched.
- C. Steps 7 through 12 accumulate control totals, both to-date and current period, for each of the three fields.
- D. xxxxxx.xx indicates the maximum possible number of digits to be accumulated.

Only Operations that involve calculations are shown. There is usually no need to describe operations in which data is transferred solely for printing or punching purposes. Their nature should, however, be carefully examined. What may essentially be a punching operation, if your present card equipment does not include a calculator, may be a calculating operation for a computer. As an example, it is possible to multiply without a calculator through the use of a complete deck of master cards containing the extension of every normal calculation. Detail cards are merged behind matching masters and the extensions are matched and gang-punched on a reproducer. A set of run definition charts should always be created for this type of collator-reproducer run, if it is used.

During the creation of the Program Logic Chart, it is extremely important that the number of decimal positions and the maximum size of result fields be specified if they are not readily indicated by previously defined fields. Preferably, they should be entered in the Comments column, as illustrated by Figure II-16. Control totals developed during a run, but not included in the normal output may be "spilled out" in a special operation at the end of the run. A separate card pass is often used to develop these totals which must be thoroughly documented. Any other pertinent data that will aid in describing a given logical operation should be written down and attached to the logic chart. It is most important that all data be committed to writing to insure a complete and accurate conversion.

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UNIT RECORD PROCEDURE
PROGRAM LOGIC CHART

9200 9300

APPLICATION: NO. P NAME PAYROLL PAGE 1 OF 1
 RUN: NO. P300 NAME PUNCH NEW YTD. S/C AND PRINT CTL. REGISTER PREPARED BY A. B. REDDON DATE _____

CARD TYPE	CONDITION AND/OR CONTROL	STEP	DESCRIPTION OF OPERATION	BRANCH		COMMENTS
				COND-ITION	TO STEP	
LAST PERIOD Y.T.D.	5/80	1	Y.T.D. GROSS PAY + Ø = Y.T.D. GROSS PAY			STORE OLD Y.T.D. AMOUNT
		A → 2	Y.T.D. C.P.P. AMT. + Ø = Y.T.D. C.P.P. AMT.			" " " "
		3	Y.T.D. INC. TAX + Ø = Y.T.D. INC. TAX			" " " "
GROSS PAY S/C.	4/80	4	Y.T.D. GROSS PAY + GROSS PAY = NEW Y.T.D. GROSS PAY			ACCUMULATE NEW Y.T.D. S/C
		B → 5	Y.T.D. C.P.P. AMT + C.P.P. AMT = NEW Y.T.D. C.P.P. AMT.			BY EMPLOYEE NO.
		6	Y.T.D. INC. TAX + INC. TAX = NEW Y.T.D. INC. TAX			
		7	S. CURRENT GROSS + GROSS = S. CURRENT GROSS			ACCUMULATE DEPT. TOTALS
		8	S. CURRENT C.P.P. + C.P.P. = S. CURRENT C.P.P.			FOR PRINT
		9	S. CURRENT INC. TAX + INC. TAX = S. CURRENT INC. TAX			XXXXXXXXXX
		G → 10	S. Y.T.D. GROSS + Y.T.D. GROSS = S. Y.T.D. GROSS			XXXXXXXXXX
		11	S. Y.T.D. C.P.P. AMT + Y.T.D. C.P.P. AMT = S. Y.T.D. C.P.P. AMT.			XXXXXXXXXX
		12	S. Y.T.D. INC. TAX + Y.T.D. INC. TAX = S. Y.T.D. INC. TAX			D → XXXXXX.XX

Figure 11-14. Program Logic Chart, Payroll Operation P300.

UNIVAC

UNIT RECORD PROCEDURE
MULTIPLE - CARD LAYOUT CHART

9200 9300

APPLICATION: NO. P NAME PAYROLL
 RUN: NO. P300 NAME PUNCH NEW YTD. S/C. AND PRINT CTL. REGISTER PREPARED BY A. B. REDDON DATE _____

TOTAL LEVEL		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																																																																															
CARD NAME		ELECTRO. NO.																																																																															
10	1	DEPT. NO.	EMPL. NO.	GROSS PAY	REG. HRS.	O.T. HRS.	DED. PER TDI	CANADA PENSION PLAN	Y.T.D. CANADA PENSION PLAN	U.I.C.	DEDUCT. NO. 1	DEDUCT. NO. 2	DEDUCT. NO. 3	TAXABLE INCOME	INCOME TAX	NET PAY	DATE DAY MO YR																																																																
CONTROL POSITIONS		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
CARD NAME		ELECTRO. NO.																																																																															
10	1	DEPT. NO.	EMPL. NO.	Y.T.D. GROSS PAY	DED. PER TDI	Y.T.D. CANADA PENSION PLAN	Y.T.D. OTHER	Y.T.D. INCOME TAX	DATE DAY MO YR																																																																								
CONTROL POSITIONS		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
CARD NAME		ELECTRO. NO.																																																																															

Figure 11-15. Multiple Card Layout Chart, Payroll Operation P300.

					XXXXXX.XX
8	$\$$	CURRENT C.P.P. + C.P.P. =	$\$$	CURRENT C.P.P.	XXXXXX.XX
9	$\$$	CURRENT INC. TAX + INC. TAX =	$\$$	CURRENT INC. TAX	XXXXXX.XX
10	$\$$	Y.T.D. GROSS + Y.T.D. GROSS =	$\$$	Y.T.D. GROSS	XXXXXXXXXX.XX
11	$\$$	Y.T.D. C.P.P. AMT + Y.T.D. C.P.P. AMT =	$\$$	Y.T.D. C.P.P. AMT	XXXXXXXXXX.XX
12	$\$$	Y.T.D. INC. TAX + Y.T.D. INC. TAX =	$\$$	Y.T.D. INC. TAX	XXXXXXXXXX.XX

Figure 11-16. Program Logic Chart, specification of decimal positions and field boundaries.

RECORDING DOCUMENTATION PROGRESS

You should control the progress of your documentation effort to make certain that it is being accomplished thoroughly and according to schedule. For this purpose, you should use two check lists, the Program Inventory List and the Workload Scheduling Chart.

Entries were made on both Univac designed forms before documentation began. The nature and instructions for their posting are thoroughly described in Chapter I.

- *Program Inventory List.* As soon as documentation is completed for a given run, the Input, Output and Logic list columns for that run should be checked.
- *Workload Scheduling Chart.* This list should be checked as soon as documentation for an entire application is completed.

FINAL REVIEW

After all applications and runs within the existing system have been suitably recorded, a final review must be conducted to insure that the documentation is both complete and accurate. This review should preferably be done by individuals familiar with the operations covered.

A detailed review of completed documentation will insure that all periodic application requirements have been met. Records must cover processing on a daily, weekly, monthly, quarterly and annual basis, or for as often as the runs must be performed. Similarly, where one application is linked to another, documentation for both applications must reflect this inter-relationship.

Completed documentation should be filed in a binder by application. Records of the individual runs should be filed by run number within the application. The Application chart should be filed in the front of each application section in the binder. After documentation has been placed in a binder, it should be carefully indexed, and the pages numbered, so that any information desired is easily available for reference. If more than one binder must be used, they should be carefully labelled as to their contents, and this information should be recorded in the index.

III. APPLICATION DEVELOPMENT

INTRODUCTION

This chapter provides the bridge between the documentation of the present system (see Chapter II) and its application to the UNIVAC 9200. It describes the simple conversion techniques and related work forms that will enable you to use the information on the existing system to determine how each application should be run on the 9200, taking fullest advantage of the machine's capabilities. The complete and accurate documentation of the new system that will result will underlie the subsequent preparation of 9200 programs described in Chapter IV.

This phase of the installation of the UNIVAC 9200 probably involves the largest number of decisions, and the Univac Sales Representative and the Univac Systems Analysis staff are ready to assist you. Decisions should be made in the light of your particular requirements, such as the need for new or more detailed reports or the running of additional applications on the 9200. Knowledge of these needs will help you determine which of the two following alternate approaches to the conversion method should be used for each application.

- *Straight conversion*, the carryover of each present equipment run to an equivalent computer run on a one-for-one basis.
- *Consolidation* of several present operations into a single 9200 operation for better throughput and greater efficiency.

Another method of conversion, System Design, is also described in this chapter. The use of this method, which involves the entire redesign of an application, is, however, quite difficult and time-consuming. It is recommended only for new applications or in instances when a clear need exists for the drastic reorganization of an existing system.

STRAIGHT CONVERSION

Even though runs are to be carried over "as is," carryover planning will still require close analysis and, in some cases, documentation changes prior to programming, particularly for the following:

- Printer Format Chart
- Multiple Card Layout Chart
- Program Logic Chart

Printer Format Chart

The chart (described in Chapter II) may have to be revised to reflect changes in printer format, such as conversion to 10 to the inch spacing and possible compression or expansion of data fields that were restricted under the old system.

Multiple Card Layout Charts

You may wish to modify card input and output designs to take advantage of the power of the 9200. Even though existing formats can usually be effectively used for the new system, it is well to review them to determine whether any minor changes might be appropriate under some circumstances. These may include changes in control punching which will have to be extended to related summary cards.

Program Logic Chart

After card inputs and outputs have been analyzed, the Chart (described in Chapter II) should be revised for any minor changes that may be required for the transfer of a run to the new equipment.

CONSOLIDATION PLANNING

Planning the consolidation of present runs involves three basic functions.

- Defining runs to be consolidated
- Analyzing runs to be consolidated
- Updating documentation.

Defining runs to be consolidated

Three types of runs can usually be consolidated. They are:

- Multiple Calculation Runs
- Calculation followed by Print Runs
- Multiple Print Runs

Multiple Calculation Runs. The capacity and speed of the UNIVAC 9200 System permit one-pass operations where two or more would be required on unit record calculators. Figure III-1 portrays unit record processing of a typical invoicing application. A small punched card calculator might require two passes to perform the operations necessary to extend the item cards, take discounts and apply sales tax.

Calculation Followed by Print Runs. The 9200 can simultaneously edit and print reports and perform calculations on input data. This makes it possible to consolidate as one the unit record runs which use the output of a calculating run as immediate accounting machine input for production of a printed report. Figure III-1 also provides such an example. The invoice detail or item cards are extended in one pass through the calculator and an accounting machine then prints and totals the customer invoices. Figure III-2 shows how the 9200 System can perform these several runs in one pass.

Multiple Print Runs. Using unit record equipment, it is often necessary to process a file two or more times to print and total information for a simple report. This is caused by the equipment's lack of sufficient type bars to print through the desired width or counters to create the totals needed. The calculator's limited capacity may also prevent generation of all the results needed for the report. In the last case, as many as two calculations and two print runs may be needed.

Figure III-3 portrays a typical example where the counter capacity of the accounting machine cannot carry the totals required for a report. It then becomes necessary to print a report with two to three levels of totals and also to create summary cards. The latter are then tabulated to generate the additional totals required. Figure III-3 pictures how the UNIVAC 9200 permits these two runs to be combined, and one comprehensive report to be produced instead of two.

Analyzing runs to be consolidated

Several factors must be carefully considered to determine whether a consolidation is feasible:

- Consolidation logic
- Effects on production schedule
- Cycle or frequency of runs

- Complexity of programming
- Equipment capability

Consolidation logic. Two considerations must be examined:

1. Does the present or proposed flow of data allow a given consolidation?
2. Does the output of one run provide immediate input to the next, or are intermediate card-handling operations necessary?

Even if intermediate card-handling is required, runs can sometimes still be consolidated. For instance, if the output of a calculation run requires merging of header cards before printing, the merge can precede the calculation, and a consolidation is thus feasible.

It must be determined whether intermediate outputs can be eliminated through consolidation or whether they are needed for later runs, and also whether card output is needed for visual reference for audit purposes.

Effects on production schedules. Before consolidation, the overall machine room schedule and the preparation of reports must be considered.

Cycle or frequency of runs. Consolidation of two or more operations into one is most rewarding for high-volume runs whose frequency is higher than quarterly.

Complexity of programming. The value of combining two or more runs depends on the complexity of the resulting program. In many cases, this program is simple enough to materially reduce the running time of the consolidated run.

Equipment capability. While some consolidations may be accommodated by the UNIVAC 9200, consideration of peripheral equipment capacities should be reviewed. This could affect machine room scheduling and report timing.

It might for instance, seem logical to produce Summary cards during a summary report preparation run. However, it is possible that 2 passes of the detail cards would provide a faster throughput since the UNIVAC 9200 card reader is faster than the summary punch.

Updating documentation

When two or more programs are consolidated, the pertinent documentation must be revised. Included in this revision will be updating of:

- Input/output forms
- Program Logic Chart

Input/Output forms. As consolidations occur, inputs may have to be modified or combined. Similarly, card output may require redesign to include information from more than one run. Intermediate card and printer outputs may be eliminated when runs are combined, and the final printer format may be changed considerably as multiple print runs are consolidated. To reflect these changes the following documentation forms must be updated:

- Multiple Card Layout Chart
- Printer Format Chart
- Program Logic Chart

The Program Logic Chart. When several programs are consolidated, all run inputs and outputs must be reviewed and the Chart should be re-written to reflect the new single data flow.

UNIT

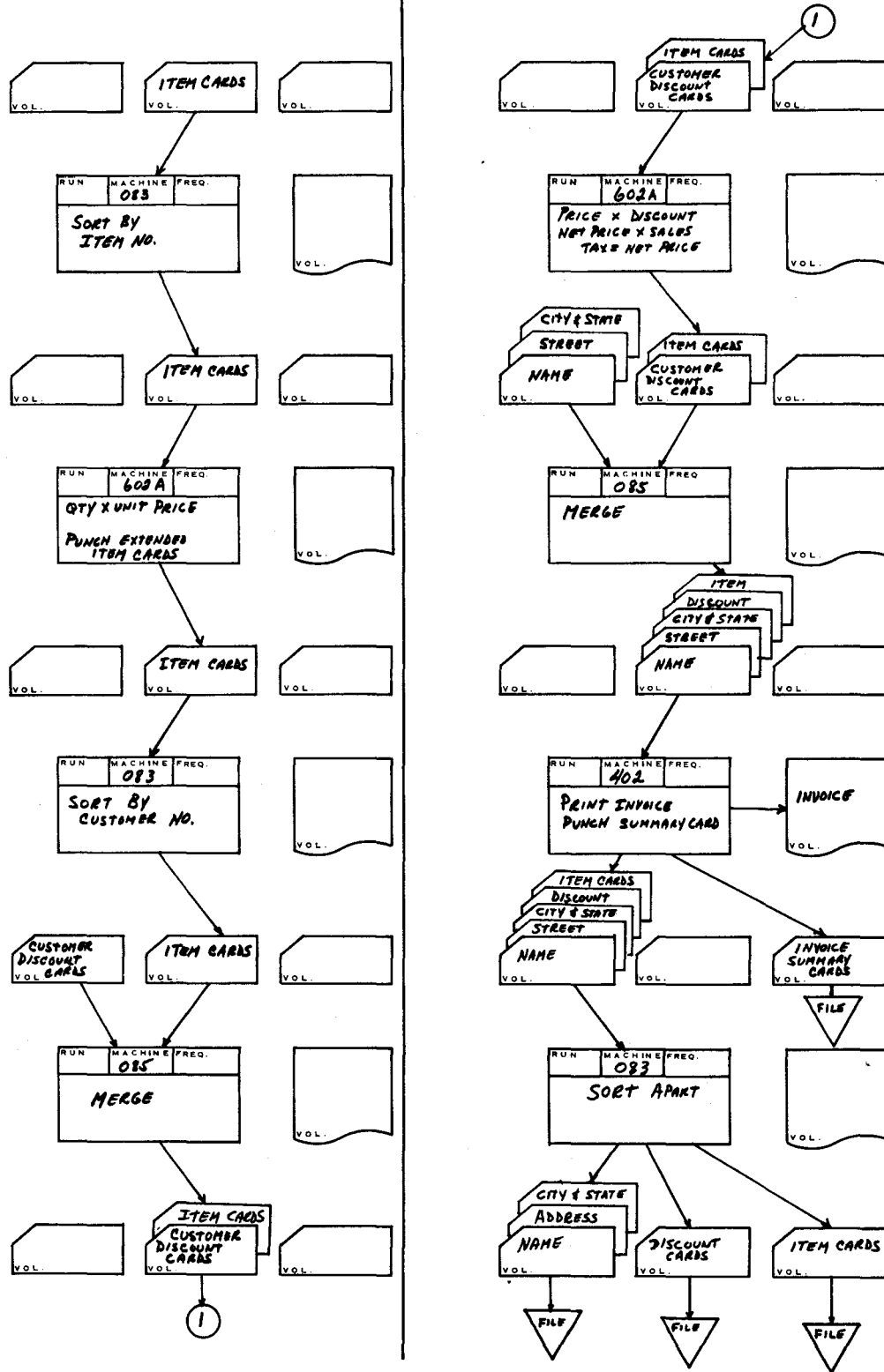


Figure III-1. Billing - Unit Record Procedure

CU 1187

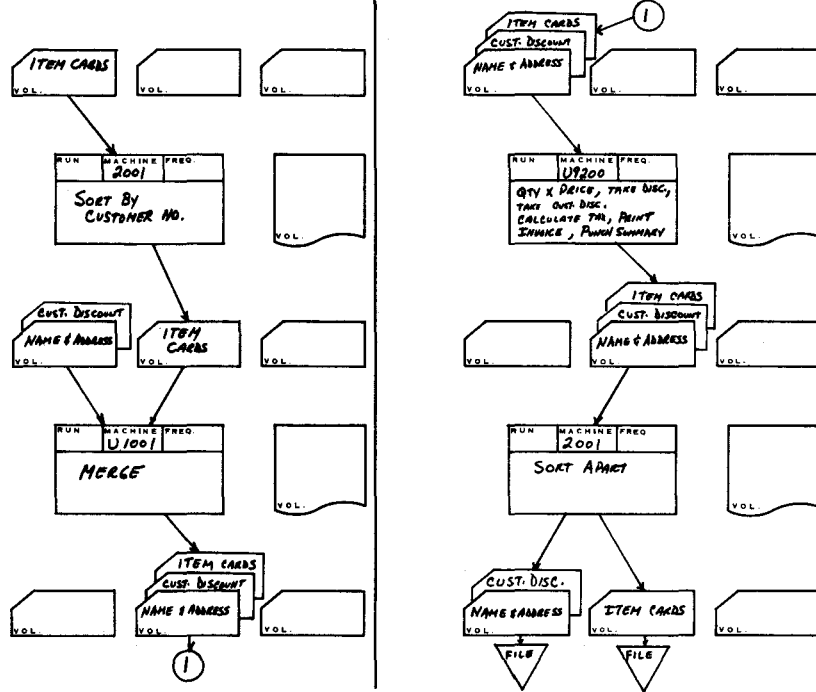


Figure III-2. UNIVAC 9200 Procedure

CU 1187

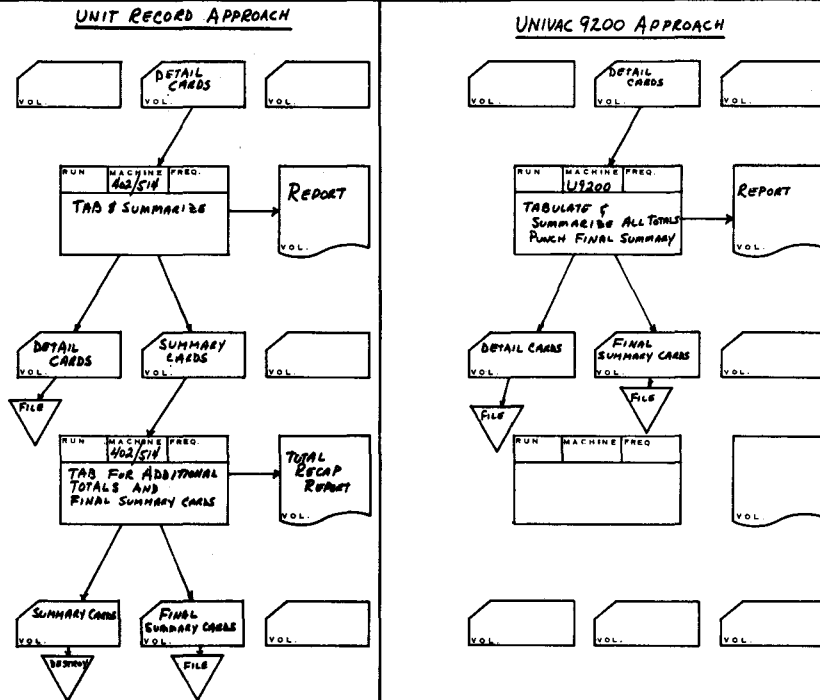


Figure III-3. Tabulate and Summarize

The combined approach

A combination of both the Straight Conversion and the Consolidation approaches will often be used in converting various runs within an application. The flexibility of this approach is extremely useful as it permits simultaneous enjoyment of the simplicity of carryover and the improved efficiency of consolidation. Each conversion approach, however, has its particular requirements, and runs to be converted should be examined in the light of these needs.

SYSTEM DESIGN

Existing applications can usually be easily carried over to the UNIVAC 9200, using either Straight Conversion or the Consolidated approach, or a combination of both. However, the great power and throughput of the 9200 will allow many applications to be run on the computer which it was not practical to put on a machine before. Complete new systems will have to be designed for these applications and a design method recommended by Univac is described in this section. It is designed to aid UNIVAC 9200 users who, having successfully converted previous applications to the new system, now seek to develop additional applications to make fullest use of equipment capabilities.

The design method follows the pattern recommended by Univac for other conversion tasks – the performance of the actual conversion work being preceded by a careful definition of objectives which the new system must meet. The two major system design functions therefore are:

- Investigation
- Development

System design is the study and creation of manual or automated procedures to accomplish specific objectives. Systems can be designed for many reasons, but must always be designed logically. The system's objectives, its effect on other systems and its operating economy must always be kept in mind. Comprehensive and effective system design should be carried out in close liaison with management.

Investigation

Production of output information is the main purpose of any system. Therefore, to determine the objectives which the system must meet, you should define the output information which it must produce. Similarly, the input data and the procedures which will create this information must also be examined. These definitions must be complete in every detail and clearly expressed in a standardized manner that will allow no misinterpretation.

System design information. Comes from two chief sources: existing records and individuals responsible for work which the system will cover. Records include work papers, step-by-step procedures and Data Processing Department material such as flow-charts, input/output records, procedures write-ups, etc.

No one system is quite like any other. However, if you use the following general questionnaire outline, omissions will be kept at a minimum and you should be able to quickly determine how the questionnaire must be modified. Correct and complete answers to the following questions will provide basic data for a successful system design investigation.

- (1) What is the prime application area?
- (2) What are the specific operations involved?
- (3) What is the purpose of the operation?
- (4) Who is responsible for the operation?
- (5) Is it automated or manual?

(6) What documentation is available?

Automated Procedures

- (a) process charts?
- (b) procedure charts?
- (c) source and input media?
- (d) processing functions?
- (e) output formats?

Manual Procedure

- (a) procedures manual?
- (b) job descriptions?
- (c) workpapers?
- (d) tables and charts used?
- (e) forms?
- (f) equipment used?

- (7) Is available documentation up to date?
- (8) What is the volume or workloads?
- (9) What is the processing cycle time?
- (10) What is the processing frequency of the operation?
- (11) What are the exceptions and how are they handled?
- (12) Is the work flow steady or irregular?
- (13) What is the previous operation – the next operation?
- (14) What controls are exercised?
- (15) Are there any legal requirements?

These questions are general in nature and not specifically directed toward analysis of any particular application. Their answers, however, will suggest more specific queries concerning definite applications. The investigation must also cover application work papers, restrictions and controls.

■ *Work papers.* Their functions are varied, but they usually provide management with current information. Work papers can be classified into three groups according to their functions:

- reports
- forms
- records

Each item must be examined to check whether it meets the requirements of the task for which it was designed and is now used.

■ *Restrictions.* Sometimes company policy or legal restrictions cannot be modified, and their effect on the new system must be carefully noted.

■ *Controls.* During the systems investigation, all control for the application must be listed. Their types will vary, depending on the application and your organization's activities, but the following questions must be answered:

- What are the input controls?
- What are the output controls?
- Is there an audit trail?
- Are there excess controls?
- Are there enough controls?

Review. After the investigation is completed, you should perform a step-by-step check of each operation in the sequence in which it occurs to check how well it meets system objectives. Both new and previously existing documentation must also be examined for clarity, accuracy and completeness. This is the time at which you should make any changes in procedures.

After you have completed documentation and review of the entire system, it is recommended that you have your findings checked for accuracy by the various people involved with the system's procedures. You can then resolve all differences of opinion and, if necessary, modify system documentation before submitting your recommendations for management approval.

Some applications can best be handled as manual operations, because of time, cost and low volume. The results of your investigation can, therefore, be summarized into the answer to a single question – "Should the application be automated?" If this answer is "Yes," you can then proceed to actual design of the new application system.

Development. After all necessary information has been collected to document the application, the actual design of the new system can begin. This procedure involves the performance of two basic functions:

- Definition of new system requirements
- New system flowcharting

Definition of new system requirements. Actual system design must begin with a thorough study and re-evaluation of the information assembled during systems investigation. This will enable you to determine the following requirements and considerations for the new system:

- Output
- Data files
- Input
- Procedures
- Workload and timing
- Equipment specifications

These determinations will indicate the approaches to be followed in the subsequent applications flow-charting phase.

- **Determination of required output.** Decisions as to which applications or runs can be eliminated, modified or combined depend largely on such output factors as the needs of various department, company policy and legal requirements. The nature and usefulness of each output item must, therefore, be determined. This determination involves questions such as whether system revision can reduce the number of copies which must be made of a form, or whether this form is small enough to print two-up instead of one original and one carbon copy. As the number of carbons in a form, rather than the size of the paper, influence its price, a run can be made much more economical through the elimination of unnecessary copies.

The following questions can be asked of the people who use a given report in order to justify its production in its present form, and to determine how it can be improved or if it should be eliminated.

1. How many other persons use it?
2. How essential is it to the work of your organization?
3. How often do you use your copy of the report?
4. How much of the information on the report do you not use?

5. Is the data necessary for:
 - a. making action decisions
 - b. keeping you informed of current conditions
 - c. checking accuracy of other information
 - d. maintaining control over operations
6. What would be the effect on your work if:
 - a. you did not get the report at all
 - b. seldom received the report
 - c. the report contained less information
 - d. the report contained more information
7. Do you consider that your use of this report justifies the cost of preparing the report?
8. What other reports, records or forms are prepared from data on this report?
9. Can the data on this report be obtained from any other source?
10. How long do you keep your copy of the report?
11. Is this report easy to use and read?
12. How and where do you file it?
13. How often do you refer to it after its original use?

■ Description of required data files. There are two types of data files:

- Master files
- Transaction files

■ *Master files* contain permanent records concerning an organization or functions of that organization. Examples are name and address files, inventory files, and accounts receivable files.

■ *Transaction files* are data files whose contents are run to update the master files. Examples are files of payment cards, time cards, and item cards. A transaction file may, for instance, be used to update such year-to-date information in a payroll master file as:

- gross pay year-to-date
- total Income Tax year-to-date
- Canada Pension Plan year-to-date
- Total deductions year-to-date

It will not, however, serve to update other master card information such as:

- employee number
- exemptions
- insurance
- bond purchase plan
- union dues

Some types of data files will require little maintenance while others will change with each processing cycle. In any event, the continuity of these records must be insured.

■ *Description of required input.* All types of source documents, such as time cards, invoices, bills of lading, orders and requisitions, must be listed. Their progress from preparation through to the Data Processing Department must be traced to cover:

1. Collection, verification and protection
2. Establishment of batch total and recording
3. Establishment of controls to provide later audit trails

All input cards must be designed for maximum keypunching ease with minimum spacing between fields. In addition, the volume of cards to be handled should be reduced for better computer throughput. This is usually done during the design of the application. This volume may be reduced by consolidating the name and address cards, similarly, special cards should be eliminated as much as possible.

Further throughput speed can be achieved through the elimination of punching some intermediate results as the speed of the 9200 could allow recalculation. In many unit record systems certain input and output card columns are often used for controls and special card codes. These control columns must be carefully analyzed and any non-standard punching codes must be changed to standard codes. The reason for this is that, on the new system, cards are translated from card code to machine code as their data is read. Non-standard codes would, therefore, lose their identity during translation and the resulting code would not permit suitable distinction.

The sign of all arithmetic fields must be in the least significant location (LSL) in the field. In some cards, in carryover from older equipment, the sign positions were located at any point on the card. The sign must appear in the LSL of the field and the cards must be modified to meet this requirement.

■ *Description of required procedures.* The following information must be recorded:

1. Keypunching of source data to create working documents
2. Card-sorting sequence and merges with other data cards
3. Use of cards to update certain files and produce history files

It is recommended that, at this time, you update all block diagrams and make any required changes of procedures. Most changes needed to improve the system have now been revealed.

■ *Description of workload and timing considerations.* When the system is designed, its work flow may be smoothed out to avoid activity highs and lows. Some of the factors to be considered for this purpose are:

- reduction of waiting time
- elimination of bottlenecks
- advancing of cut-off periods
- processing of data before scheduled time
- scheduling mandatory applications first
- scheduling other applications as time allows

Certain applications, such as payroll and cycle billing, which fall on the same dates as, for instance, month-end closing should be watched out for. All other work must be scheduled around these applications, and overtime work may be required unless their processing can be completed during the next business day.

■ *Equipment specifications.* The 9200 System configuration will dictate the system approach to be used. Aspects of equipment specifications which must be considered include:

- What is the size of the storage?
- Is the punch a read-punch?
- Will a UNIVAC 1001 card controller be used on-line?
- Number of print positions?

New system flowcharting. An application flowchart is the layout of the work flow by run within the application. After reviewing the capabilities of the UNIVAC 9200 system, the

user can determine how much work can be accomplished with each computer run. In designing the application, the user should strive to use the UNIVAC 9200 system to its fullest capabilities with the configuration available. Sometimes the configuration may be changed to gain additional benefits from the system.

The following paragraphs portray the tasks required in the investigation and design phases of the creation of a new billing application system. The objectives of the application must first be determined through discussions with the three departments involved:

- Sales Department
- Billing and Accounts Receivable Department
- Credit and Collection Department

For this application, the output requirements of each department will be the following:

- *Sales Department* – Sales Analysis Information by items, customer, territory and vendor.
- *Billing and Accounts Receivable* – Daily Invoice and a Monthly Statement for recording activity of each customer account.
- *Credit and Collection* – Aged Analysis for every account having a balance outstanding.

After the application outputs have been defined, you should perform the following operations:

1. Draw up the actual output forms to cover all possible conditions.
2. Review the forms with the Credit and Collection department and the Billing and Accounts Receivable department.
3. Review Sales Department source data for completeness and flow.

At this point when objectives have been determined, all departments concerned have agreed on the output and the source data has been reviewed, application flowcharting can begin.

Figure III-4 illustrates flowcharting of procedures for *production of daily invoice information*.

1. Data is captured from source documents.
2. Working records must be verified.
3. Item cards are then sorted into customer number sequence.
4. Name and address and routing information cards are merged with item cards.

Printing of daily invoices by the 9200 is portrayed in Figure III-5. By-product invoice summary cards are created and retained for production of month-end statistical reports. After processing of invoices, name and address, routing and item cards are returned to the original files.

Production of monthly statement information is required for the Billing and Accounts Receivable Department. Run procedures are indicated in Figure III-6.

1. Invoice summary cards produced daily are sorted into customer number sequence.
2. Sorted invoice summary cards are merged with cards from the Accounts Receivable file, showing the balance outstanding as a total, and broken down by periods.
3. Cards containing payment, credit and adjustment information are merged with invoice summary and accounts receivable cards to offset old balances outstanding.
4. Customer name and address cards are merged with the file thus created.

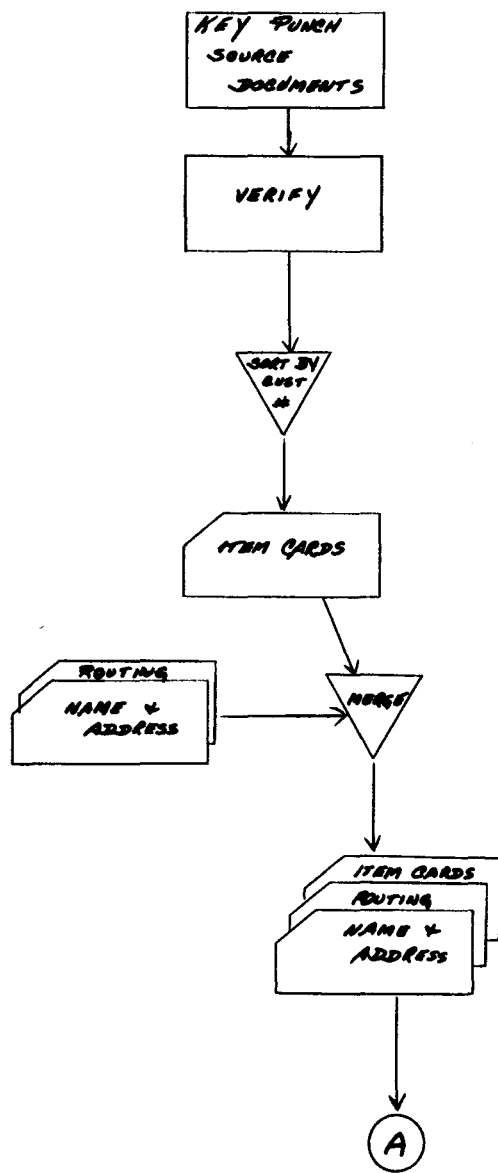


Figure III-4. Production of Daily Invoice Information

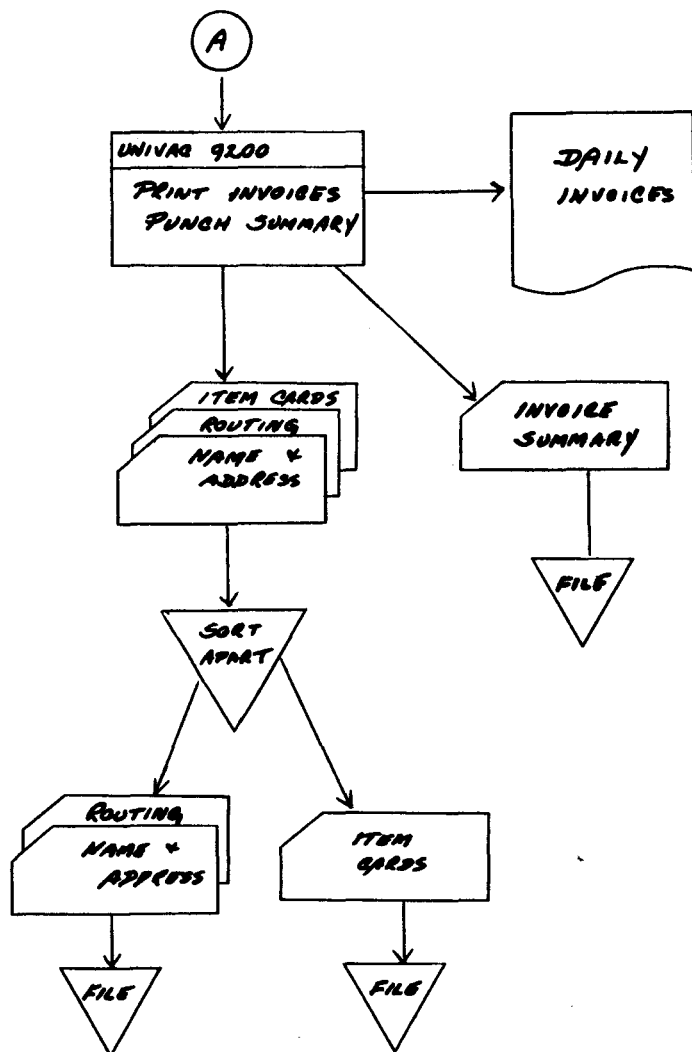


Figure III-5. Printing of Daily Invoices

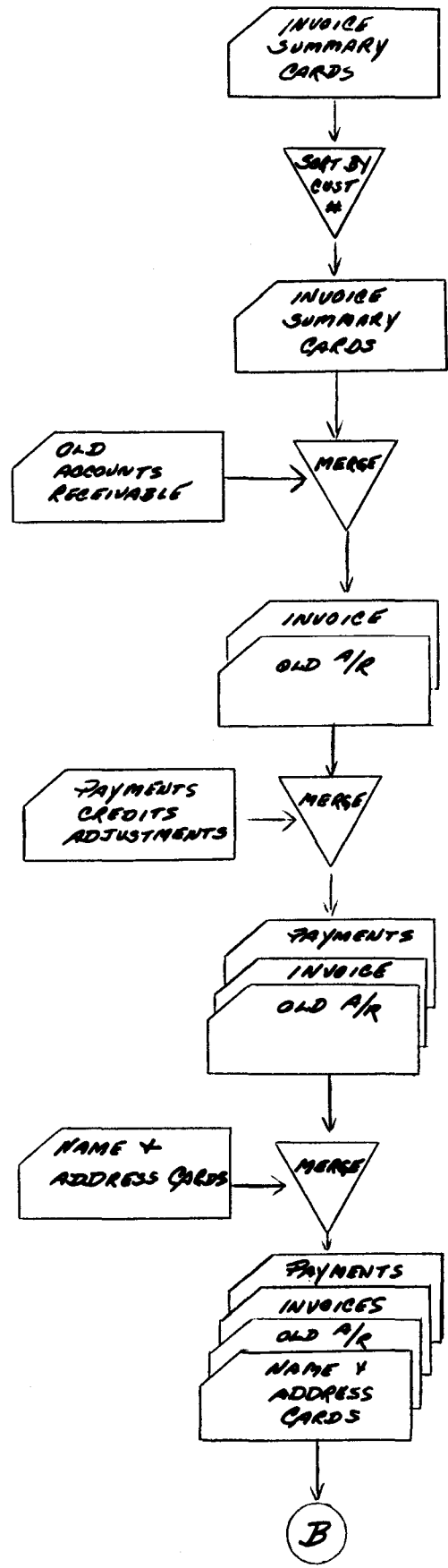


Figure III-6. Production of Monthly Statement Information

Printing of monthly statements and aged analysis report are portrayed in Figure III-7.

1. New updated accounts receivable cards are created as by-products of statement printing.
2. Input card file for statement printing is sorted and:
 - a. Payment, invoice summary and old accounts receivable cards are returned to files.
 - b. Name and address cards are merged with new accounts receivable cards to provide input for printing of aged analysis report.
3. Aged analysis report is printed.
4. New accounts receivable and name & address cards are sorted apart and returned to files.

If the Credit and Collection Department issues memos for accounts with credit balances, the accounts receivable cards must be modified to reflect these transactions.

Monthly sales analysis reports must be printed for the Sales Department, breaking down sales by item, customer, territory, salesman, and vendor. Item cards originally produced from original sales documents provide input for the report. Sorting of the cards and printing of the sales analysis are portrayed in Figure III-8. The item cards are stored afterwards for a short period to provide reference data.

After all runs for the application have been flowcharted, the design of the new system must be reviewed to check that it meets all specified requirements. When the new application system is approved by management, program flowcharting can then take place.

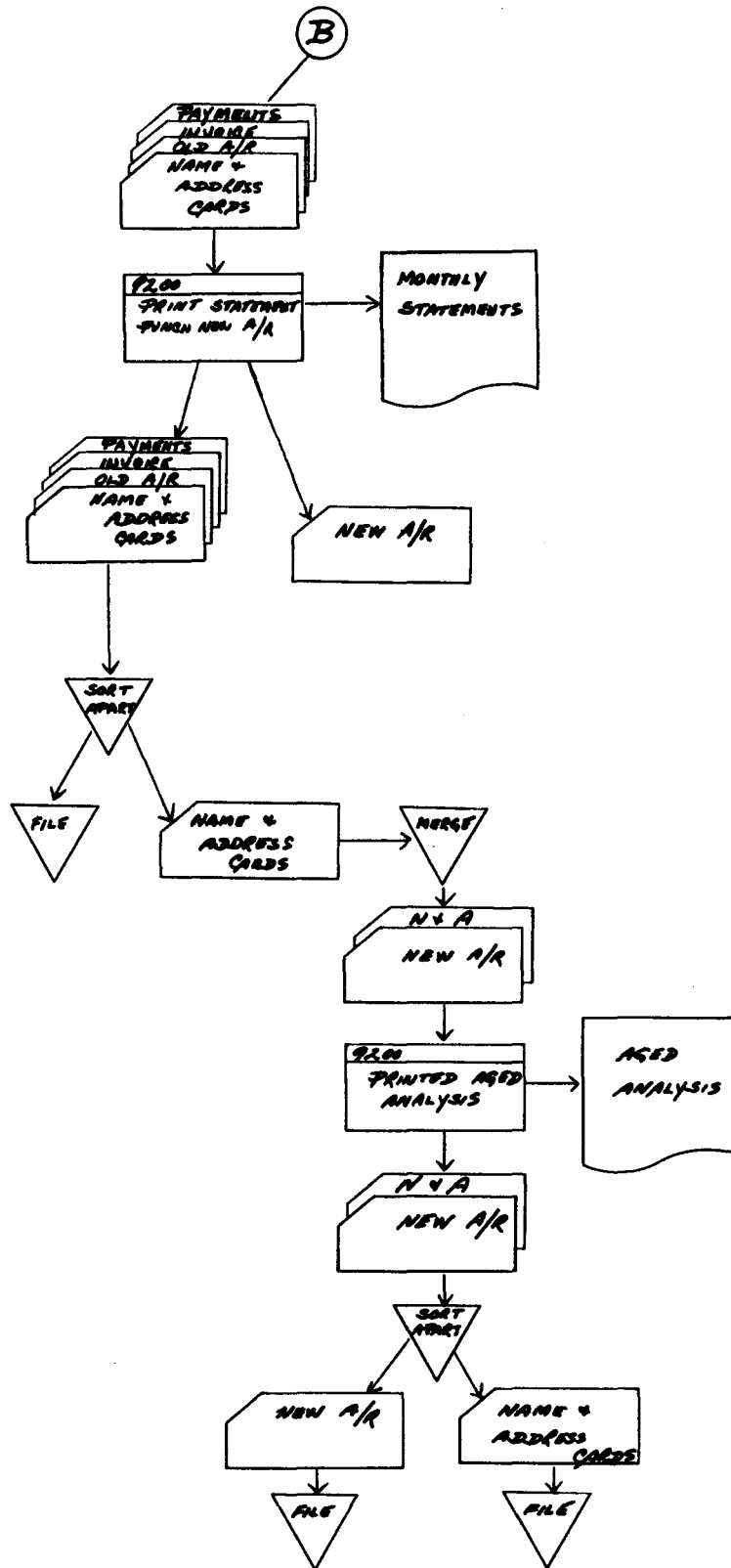


Figure III-7. Printing of Monthly Statements and Aged Analysis Report

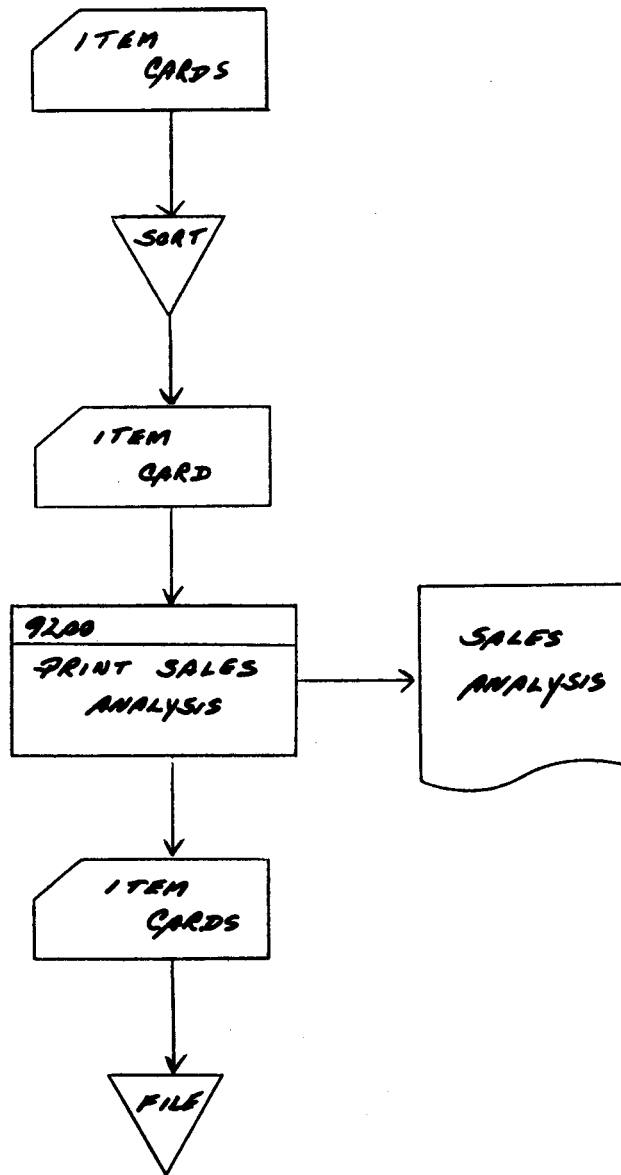


Figure III-8. Monthly Sales Analysis Reports.

EXAMPLE

The following is a sample Payroll Application documented on the forms recommended in this Planning Guide. The example shows this procedure as handled on conventional Tabulating Equipment and the corresponding run procedures using the UNIVAC 9200 approach.

In this example, processing is carried on through the preparation of paychecks and earning statements.

UNIT RECORD PAYROLL RUNS

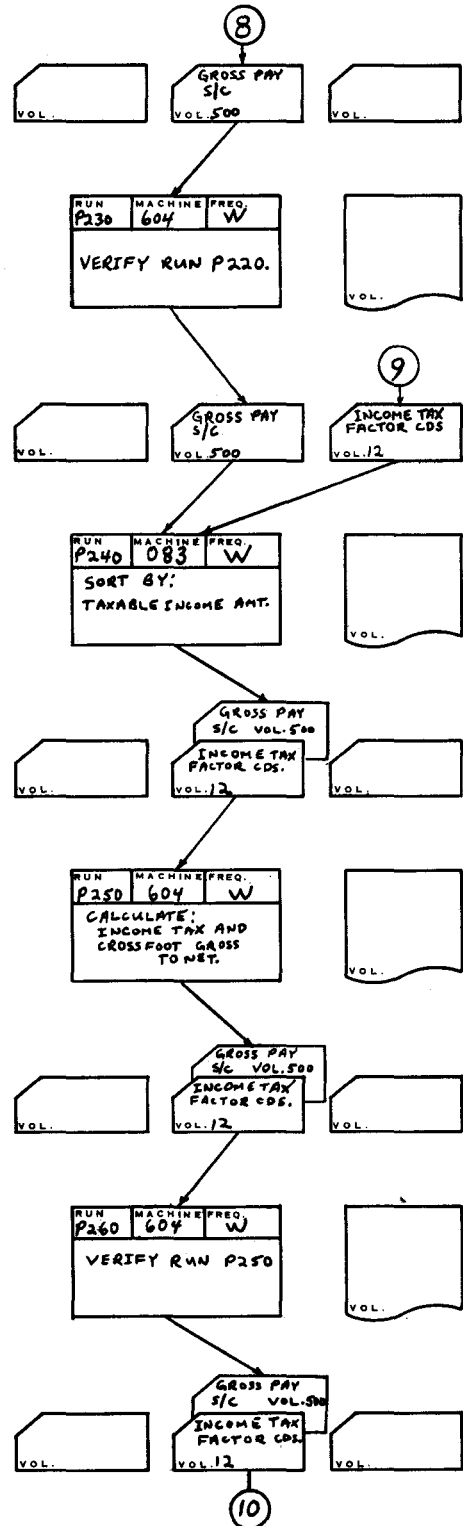
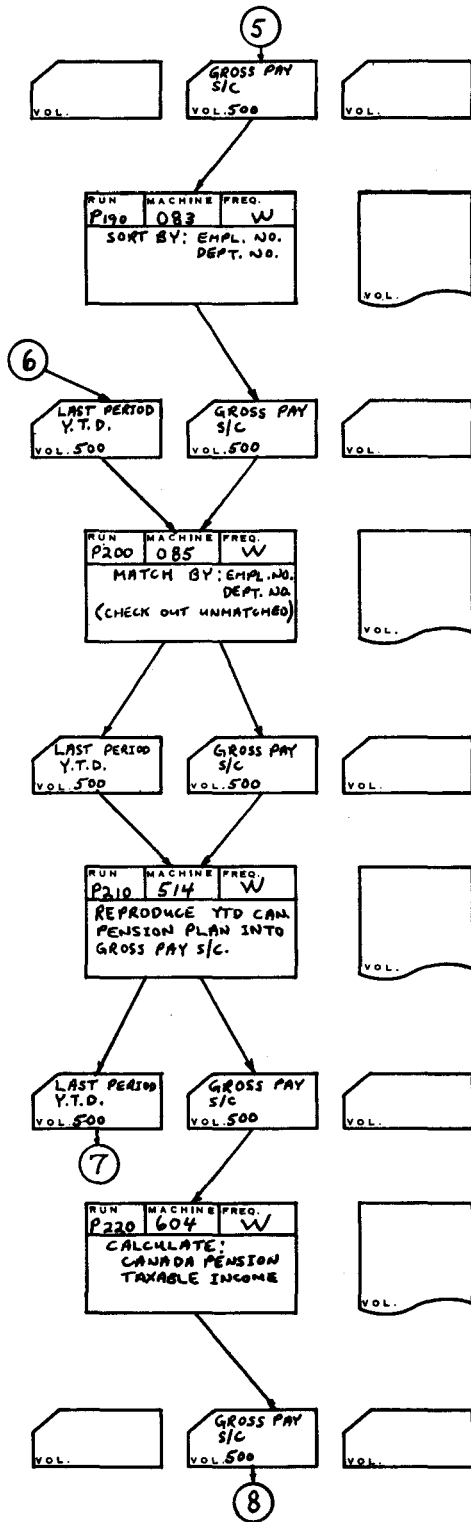
- P110 Time cards, previously punched, rated, extended, and balanced to control, are sorted into Employee Number sequence within Department.
- P120 Time cards are processed through the 407 Tabulator which summarizes the Gross Pay Register showing Department Number, Employee Number, and Gross Earnings. Gross Pay summary cards are punched by the 514 reproducer/summary punch. Time cards are filed for later use in preparing supplementary distribution reports.
- P130 Gross Pay summary cards are merged with Master Miscellaneous Deduction cards.
- P140 The Miscellaneous Deductions are reproduced into the Gross Pay cards.
- P150 Master Miscellaneous Deduction cards and Gross Pay summary cards are separated. The Master Miscellaneous Deduction cards are filed.
- P160 Unemployment Insurance Gangpunch Master cards are sorted with Gross Pay summary cards by Gross Pay amount.
- P170 The 514 reproducer/summary punch is used to gangpunch the Unemployment Insurance Contribution amount into the Gross Pay summary cards.
- P180 Gross Pay summary cards and Unemployment Insurance Gangpunch Masters are separated. Unemployment Insurance Gangpunch Masters are filed.
- P190 Gross Pay summary cards are sorted by Employee Number within Department.
- P200 Last period Year-to-Date summary cards are matched with Gross Pay summary cards to ensure that both files are complete.
- P210 Last period Year-to-Date Canada Pension Plan Contribution amount is reproduced into the Gross Pay summary cards. Last period Year-to-Date summary cards are filed.
- P220 The 604 Calculating Punch is used to calculate current period Canada Pension Plan Contributions and Taxable Income. Results are punched into the Gross Pay summary cards.
- P230 This pass on the 604 verifies the calculation of run P220.
- P240 Income Tax Factor cards and Gross Pay summary cards are sorted by Taxable Income amount.
- P250 The 604 Calculating Punch is used to calculate Income Tax and to develop the Net Pay amount for the current period. Results are punched into the Gross Pay summary cards.
- P260 This pass on the 604 verifies run P250.

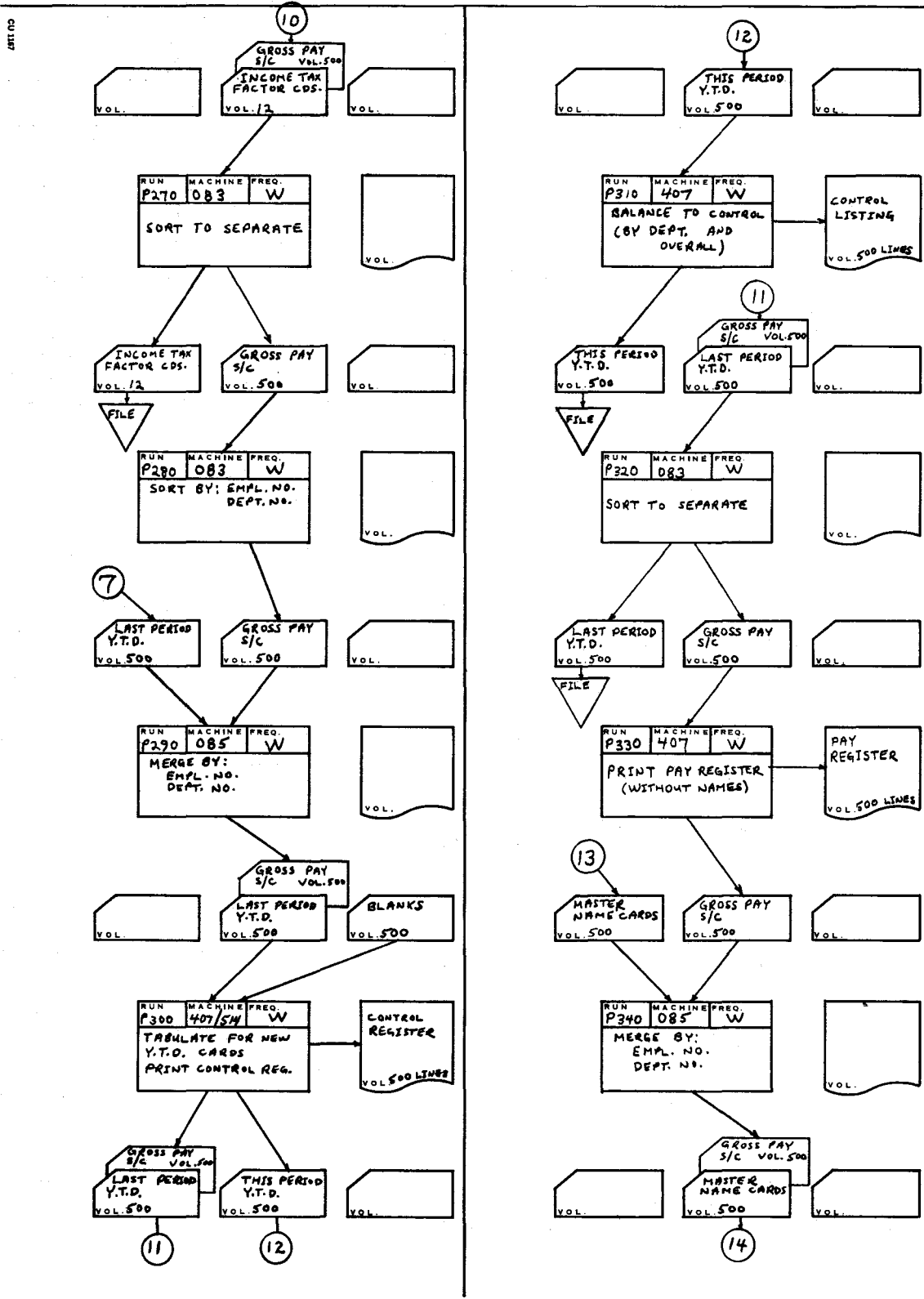
- P270 Gross Pay summary cards and Income Tax Factor cards are separated. Income Tax Factor cards are filed.
- P280 Gross Pay summary cards are sorted by Employee Number within Department.
- P290 Last period Year-to-Date cards are merged with Gross Pay summary cards.
- P300 Last period Year-to-Date cards, and Gross Pay summary cards are processed through the 407. A Control Register is printed. Current period Year-to-Date cards are punched by the 514 Summary Card Punch.
- P310 Current period Year-to-Date cards are tabulated for totals on the 407. Totals are balanced to the Control Register produced by run P300. Current Year-to-Date cards are filed.
- P320 Gross Pay summary cards and last period Year-to-Date summary cards are sorted apart. Last period Year-to-Date cards are filed.
- P330 Gross Pay summary cards are passed through the 407 to produce the Pay Register.
- P340 The Master Name cards and Gross Pay summary cards are merged on the 085 Collator.
- P350 The combined Master Name cards and Gross Pay summary cards are processed through the 407 to prepare Pay Checks and current Earnings Statements.
- P360 Master Name cards and Gross Pay summary cards are separated and filed.

UNIVAC 9200 PAYROLL RUNS

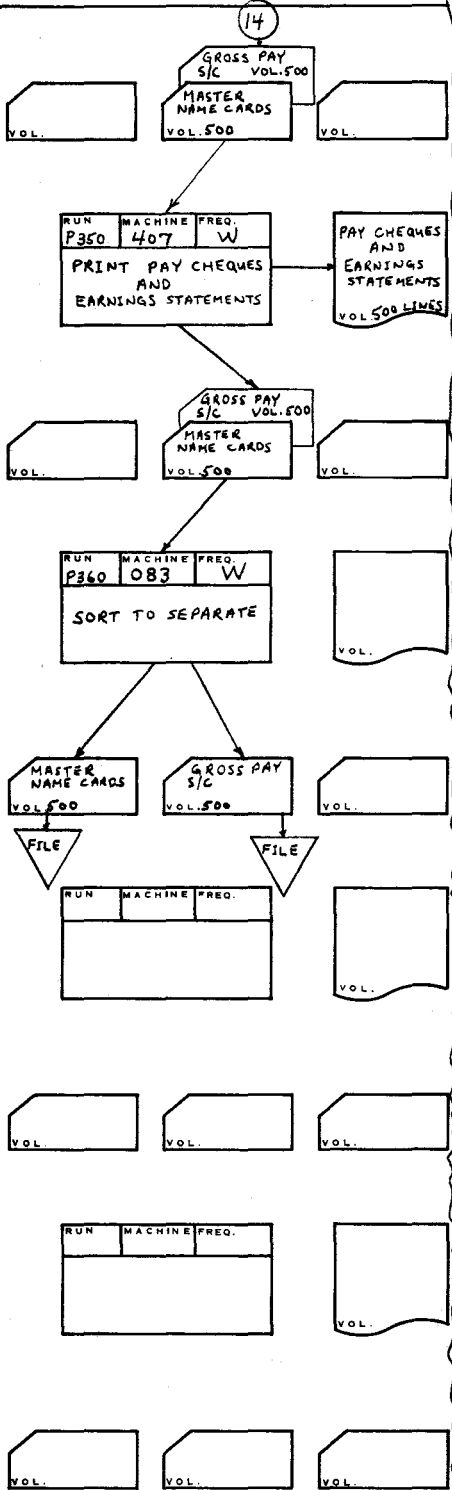
- P10 Time cards, previously punched, rated, and balanced to control, are sorted on the UNIVAC 2001 into Employee Number sequence within Department.
- P20 The Univac 9200 with the Univac 1001 on-line processes Time cards in the U1001 primary feed, combined Master Name and Deduction cards, and last period Earnings and Year-to-Date cards in the U1001 secondary feed. Blank cards are placed in the U9200 Card Punch Unit. Calculations are made to produce Gross Pay, Income Tax, Canada Pension Plan and Unemployment Insurance contribution amounts. Miscellaneous deductions are selected for the current pay period, the next pay amount is developed, and Year-to-Date data is updated. The Payroll Register is printed with department and overall totals for all current period amounts. New current period Earnings and Year-to-Date cards are punched. The U9200 has more than sufficient storage to hold the necessary program instructions, consequently, Unit Record runs P 1 2 0 through P 3 3 0 have been consolidated.
- P30 The Univac 1001 is used to replace the previous Earnings and Year-to-Date cards in the payroll file with those for the current period. The previous Earnings and Year-to-Date cards are filed for later use in periodic reports.
- P40 The second Univac 9200 run prints the Payroll Checks and Earnings Statements for the current period. Control totals are accumulated for balancing to the Payroll Register.

UNIT NO

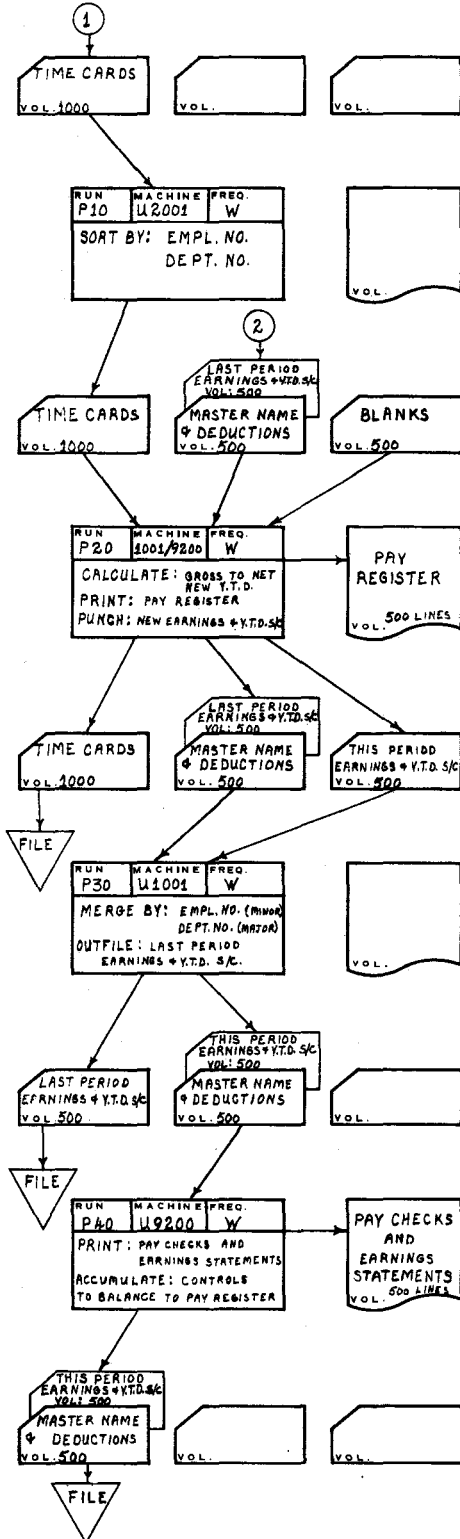




UNIT NO



UNIT NO



APPLICATION: NO. P NAME PAYROLL

PAGE 1 OF 2

RUN: NO. P20 NAME GROSS TO NET, NEW YTD., PRINT PAY REGISTER PREPARED BY D. SRAND DATE _____

CARD TYPE	CONDITION AND/OR CONTROL	STEP	DESCRIPTION OF OPERATION	BRANCH		COMMENTS
				COND-IT ION	TO STEP	
TIME CARD	1/80	1	MOVE DEPT. NO., EMPL. NO., RATE, REG. HOURS, AND O.T. HOURS TO OUTPUT (PUNCH)	DEPT. #	56	DEPT. NO. BREAK
MASTER DEDUCTION	0/80	2	MOVE EXEMPTIONS PER TD1 TO STORE			
		3	MOVE DEDUCTIONS FOR PERIOD TO OUTPUT (PUNCH)			
		4	MOVE EMPLOYEE NAME TO OUTPUT (PRINT)			
		5	COMPARE O.T. HRS. TO ZERO	=	9	
		6	O.T. HRS X 1.5 = EQUIV. REG. HRS. (NR)			XX.XXX
		7	ROUND EQUIV. REG. HRS.			0.005 + XX.XXX = XX.XX
		8	ADD EQUIV. REG. HRS. TO TOTAL HRS.			XXX.XX
		9	ADD REG. HRS. TO TOTAL HRS.			
		10	RATE X TOTAL HRS. = GROSS PAY NR.			XXX.XXX
		11	ROUND GROSS PAY			0.005 + XXX.XXX = XXX.XX
		12	MOVE GROSS PAY TO OUTPUT (PUNCH)			
		13	TABLE LOOK-UP TO FIND U.I.C. DEDUCTION			DETERMINE EMPLOYEES SHARE OF U.I.C. CONTRIBUTION
		14	MOVE U.I.C. DEDUCTION TO OUTPUT (PUNCH)			
LAST PERIOD EARNINGS AND YEAR-TO-DATE	2/80	15	COMPARE YTD. CPP TO 79.20			
		16	GROSS PAY - 11.54 = C.P.P. DEDUCTIBLE AMT.			CALCULATE CANADA PENSION PLAN DEDUCTION
		17	C.P.P. DEDUCTIBLE AMT. X 1.8 = C.P.P. DEDUCTION (N.R.)			
		18	ROUND C.P.P. DEDUCTION			
		19	C.P.P. DEDUCTION + OLD YTD. C.P.P. = NEW YTD. C.P.P.			
		20	COMPARE NEW YTD. C.P.P. TO 79.20	= <	24	
		21	NEW YTD. C.P.P. - 79.20 = OVER DEDUCTION			
		22	C.P.P. DEDUCTION - OVER DEDUCTION = C.P.P. DEDUCTION			
		23	MOVE 79.20 TO NEW YTD. C.P.P.			
		24	MOVE C.P.P. DEDUCTION TO OUTPUT (PUNCH)			
		25	MOVE NEW YTD. C.P.P. TO OUTPUT (PUNCH)			
		26	GROSS + OLD YTD. GROSS = NEW YTD. GROSS			
		27	MOVE NEW YTD. GROSS TO OUTPUT (PUNCH)			
		28	EXEMPTIONS PER TD1 + 52 = WEEKLY TD1 EXEMPT. (NR)			
		29	ROUND WEEKLY TD1 EXEMPTIONS			
		30	CURRENT C.P.P. + WEEKLY TD1 EXEMPTIONS = TOTAL INCOME TAX EXEMPTIONS.			
		31	GROSS PAY - TOTAL INC. TAX. EXEMPT. = TAXABLE INCOME			
		32	TABLE LOOK-UP TO FIND INCOME TAX CONSTANTS			
		33	TAXABLE INCOME - TAX CONSTANT = V1			XXX.XX - XXX.XX = XXX.XX

UNIVAC
DIVISION OF SPERRY RAND CANADA LIMITED
U9200 PROCEDURE
PROGRAM LOGIC CHART
9200 9300

 APPLICATION: NO. P NAME PAYROLL

 PAGE 2 OF 2

 RUN: NO. P20 NAME GROSS TO NET, NEW Y.T.D., PRINT PAY REGISTER PREPARED BY D. SRAND DATE _____

CARD TYPE	CONDITION AND/OR CONTROL	STEP	DESCRIPTION OF OPERATION	BRANCH		COMMENTS
				COND-ITION	TO STEP	
		34	TAX % X V1 = V2			(.XXX)(XXX.XX) = XX.XXX
		35	ROUND V2			0.005 + XX.XXX = XX.XX
		36	V2 + TAX ADJUSTMENT = INCOME TAX AMT.			XX.XX + XX.XX = XX.XX
		37	MOVE INCOME TAX AMT. TO OUTPUT (PUNCH)			
		38	INC. TAX AMT. + OLD Y.T.D. INC. TAX = NEW Y.T.D. INC. TAX			
		39	MOVE NEW Y.T.D. INC. TAX TO OUTPUT (PUNCH)			
		40	CROSS-FOOT ALL CURRENT DEDUCTIONS TO DED. TOTAL			XXX.XX
		41	GROSS PAY - DED. TOTAL = NET PAY			
		42	MOVE NET PAY TO OUTPUT (PUNCH)			
		43	MOVE WEEK NO. AND CARD IDENT. TO OUTPUT (PUNCH)			
		44	EDIT DEPT. NO. AND EMPL. NO. TO OUTPUT (PRINT)			
		45	EDIT CURRENT PAY DATA TO OUTPUT (PRINT)			
		46	ACCUMULATE DEPT. TOTAL FOR REGULAR HOURS			XXXXX.XX
		47	" " " " O.T. HOURS			XXXX.XX
		48	" " " " GROSS PAY			XXXXXX.XX
		49	" " " " INCOME TAX			XXXXX.XX
		50	" " " " CAN. PENSION PLAN			XXXXX.XX
		51	" " " " U.T.C.			XXXX.XX
		52	" " " " DED. 1			XXXXX.XX
		53	" " " " DED. 2			XXXXX.XX
		54	" " " " DED. 3			XXXXX.XX
		55	" " " " NET PAY		1	XXXXXX.XX
		56	ACCUMULATE OVERALL TOTAL FOR REGULAR HOURS			XXXXXX.XX
		57	" " " " O.T. HOURS			XXXX.XX
		58	" " " " GROSS PAY			XXXXXX.XX
		59	" " " " INCOME TAX			XXXXXX.XX
		60	" " " " CAN. PENSION PLAN			XXXXXX.XX
		61	" " " " U.T.C.			XXXX.XX
		62	" " " " DED. 1			XXXXX.XX
		63	" " " " DED. 2			XXXXX.XX
		64	" " " " DED. 3			XXXXX.XX
		65	" " " " NET PAY			XXXXXX.XX
		66	PRINT DEPT TOTAL			
		67	IS IT THE LAST CARD ?	NO	2	
		68	PRINT OVERALL TOTAL LINE		STOP	END OF RUN

UNIVAC

49200 PROCEDURE
MULTIPLE - CARD LAYOUT CHART

9200 9300

APPLICATION: NO. P NAME PAYROLL
RUN: NO. P20 NAME GROSS-TO-NET, NEW Y.T.O. PRINT PAY REGISTER PREPARED BY R. BLACK DATE

TOTAL LEVEL LB LI

CARD NAME MASTER NAME AND DEDUCTION CARD
DEPT. NO. EMP. NO. EXEMPT. PER. TOE DEDUCT. DEDUCT. DEDUCT. DEDUCT. DEDUCT. DEDUCT. SOCIAL INSC. NO. EMPLOYEE NAME

CARD NAME TIME CARD
DEPT. NO. EMP. NO. RATE REG. HOURS O.T. HOURS JOB. NO. DATE DAY MO. YA.

CARD NAME EARNINGS AND YEAR-TO-DATE SUMMARY CARD
DEPT. NO. EMP. NO. RATE REG. HOURS O.T. HOURS GROSS PAY INCOME TAX CANADA PENSION PLAN U.I.C. DED. 1 DED. 2 DED. 3 NET PAY GROSS PAY INCOME TAX CANADA PENSION PLAN OTHER WEEK

CARD NAME

UNIVAC

RPG PRINTER FORMAT CHART

FORM NUMBER APPLICATION PAYROLL DATE
FORM PARTS RUN NAME PAYROLL REGISTER RUN NUMBER P20 PREPARED BY R. R. THIBODEAU
TYPE OF PRINTOUT RECORD NAME RECORD NUMBER APPROVED BY P. G. WOODS
DATE APPROVED

Table with columns for LINE NAME, TYPE, and various data fields (EMP. NO., EMPLOYEE NAME, RATE, REGULAR HOURS, OVERTIME HOURS, GROSS PAY, INCOME TAX, CANADA PENSION PLAN, U.I.C., DED. 1, DED. 2, DED. 3, NET PAY, GROSS PAY, INCOME TAX, CANADA PENSION PLAN, OTHER, WEEK).

UNIVAC

UNIT RECORD PROCEDURE
PROGRAM LOGIC CHART

9200 9300

APPLICATION: NO. P NAME PAYROLL PAGE 1 OF 1
 RUN: NO. P220 NAME CANADA PENSION AND TAXABLE INCOME CALCULATION PREPARED BY W. KENT DATE _____

CARD TYPE	CONDITION AND/OR CONTROL	STEP	DESCRIPTION OF OPERATION	BRANCH		COMMENTS
				COND-IT ION	TO STEP	
GROSS PAY S/C	4/80	1	CAN. PENSION LIMIT *79.20 - Y.T.D. CAN. PENS.	IF 0	9	IF 0, THE MAX. YEARLY C.P.P. HAS BEEN DEDUCTED. YEARLY EXEMPTION OF \$600.00 + 52 C.P.P. RATE IS .018 XX.XX C.P.P. = / < MAXIMUM ALLOWABLE C.P.P. > MAXIMUM ALLOWABLE XXX.XX
		2	STORE DIFFERENCE AS MAX. CURR. C.P.P. DEDUCTION			
		3	GROSS PAY - C.P.P. EXEMPTION (\$11.50) = DEDUCTIBLE AMT			
		4	C.P.P. DEDUCTIBLE AMT X C.P.P. RATE = C.P.P. DEDUCTION			
		5	HALF ADJUST C.P.P. AMOUNT			
		6	MAX. CURRENT C.P.P. - CALCULATED C.P.P. = C.P.P. TEST	IF NEG	8	
		7	CALCULATED C.P.P. DEDUCTION TO C.P.P. OUTPUT AREA		9	
		8	MAX. CURRENT C.P.P. DEDUCTION TO C.P.P. OUTPUT AREA			
		9	DEDUCTIONS PER TAX1 + 52 = WEEKLY DEDUCTIONS PER TAX1			
		10	GROSS PAY - WEEKLY DEDUCTIONS PER TAX1 = TAXABLE INC.			
		11	GROSS PAY - C.P.P. DEDUCTION = TAXABLE INCOME		1	

UNIVAC

UNIT RECORD PROCEDURE
PROGRAM LOGIC CHART

9200 9300

APPLICATION: NO. P NAME PAYROLL PAGE 1 OF 1
 RUN: NO. P250 NAME CALCULATE INCOME TAX AND CROSSFOOT GROSS TO NET PREPARED BY B. BRANNON DATE _____

CARD TYPE	CONDITION AND/OR CONTROL	STEP	DESCRIPTION OF OPERATION	BRANCH		COMMENTS
				COND-IT ION	TO STEP	
INCOME TAX FAC. CD.	X/80	1	STORE TAX RATE AND ADJ. FACTORS 1 + 2			
GROSS PAY S/C	4/80	2	TAX INCOME - ADJ. FACTOR 1 = VALUE 1			CALCULATE CURRENT INC. TAX XXX.XX - XXX.XX = XXX.XX (XXX)(XXX.XX) = XX.XXX XX.XX CROSSFOOT GROSS TO NET XXX.XX
		3	RATE X VALUE 1 = VALUE 2			
		4	ROUND VALUE 2			
		5	VALUE 2 + ADJ. FACTOR 2 = INCOME TAX			
		6	GROSS - INCOME TAX = NET			
		7	NET - CURRENT CAN. PENS. PLAN = NET			
		8	NET - W.I.C. = NET			
		9	NET - DED'N 1 = NET			
		10	NET - DED'N 2 = NET			
		11	NET - DED'N 3 = NET		IF NEG HINT	

UNIVAC

UNIT RECORD PROCEDURE
PROGRAM LOGIC CHART

9200 9300

APPLICATION: NO. P NAME PAYROLL PAGE 1 OF 1
 RUN: NO. P300 NAME PUNCH NEW YTD. S/C AND PRINT CTL. REGISTER PREPARED BY A. B. REDDAN DATE _____

CARD TYPE	CONDITION AND/OR CONTROL	STEP	DESCRIPTION OF OPERATION	BRANCH		COMMENTS
				COND-IT ION	TO STEP	
LAST PERIOD Y.T.D.	5/80	1	Y.T.D. GROSS PAY + 0 = Y.T.D. GROSS PAY			STORE OLD YTD. AMOUNT
		2	Y.T.D. C.P.P. AMT. + 0 = Y.T.D. C.P.P. AMT.			" " " "
		3	Y.T.D. INC. TAX + 0 = Y.T.D. INC. TAX			" " " "
GROSS PAY S/C	4/80	4	Y.T.D. GROSS PAY + GROSS PAY = NEW Y.T.D. GROSS PAY			ACCUMULATE NEW YTD. S/C BY EMPLOYEE NO. ACCUMULATE DEPT. TOTALS FOR PRINT XXXXXX.XX XXXXXX.XX XXXXXX.XX XXXXXX.XX XXXXXX.XX XXXXXX.XX XXXXXX.XX
		5	Y.T.D. C.P.P. AMT + C.P.P. AMT = NEW Y.T.D. C.P.P. AMT.			
		6	Y.T.D. INC. TAX + INC. TAX = NEW Y.T.D. INC. TAX			
		7	\$ CURRENT GROSS + GROSS = \$ CURRENT GROSS			
		8	\$ CURRENT C.P.P. + C.P.P. = \$ CURRENT C.P.P.			
		9	\$ CURRENT INC. TAX + INC. TAX = \$ CURRENT INC. TAX			
		10	\$ Y.T.D. GROSS + Y.T.D. GROSS = \$ Y.T.D. GROSS			
		11	\$ Y.T.D. C.P.P. AMT + Y.T.D. C.P.P. AMT = \$ Y.T.D. C.P.P. AMT.			
		12	\$ Y.T.D. INC. TAX + Y.T.D. INC. TAX = \$ Y.T.D. INC. TAX			

APPLICATION: NO. P NAME PAYROLL

RUN: NO. _____ NAME _____

PREPARED BY B.W. LINN DATE _____

TOTAL LEVEL	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
-------------	---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

CARD NAME		<u>MASTER NAME CARD</u>																												ELECTRO. NO.			
I/O	SEQ.	NO. CARDS	OPT.	DEPT. NO.	EMPL. NO.																									SOCIAL INSC. NO.	EMPLOYEE NAME	0	
0	0	0																															
CONTROL POSITIONS																																	
0/80																																	

CARD NAME		<u>MASTER RATE CARD</u>																												ELECTRO. NO.			
I/O	SEQ.	NO. CARDS	OPT.	DEPT. NO.	EMPL. NO.	RATE	JOB NO.																									1	
0	0	0																															
CONTROL POSITIONS																																	
1/80																																	

CARD NAME		<u>MASTER DEDUCTION CARD</u>																												ELECTRO. NO.			
I/O	SEQ.	NO. CARDS	OPT.	DEPT. NO.	EMPL. NO.	DED. PER TD1	DEDUCT. NO. 1	DEDUCT. NO. 2	DEDUCT. NO. 3	GANG PUNCH CTL. ONLY	2																						
0	0	0																															
CONTROL POSITIONS																																	
2/80																																	

CARD NAME		<u>TIME CARD</u>																												ELECTRO. NO.			
I/O	SEQ.	NO. CARDS	OPT.	DEPT. NO.	EMPL. NO.	GROSS PAY	REG. HOURS	O.T. HOURS	RATE	JOB NO.															DATE	3							
0	0	1																							DAY	MO	YR						
CONTROL POSITIONS																																	
3/80																																	

CARD NAME		<u>GROSS PAY SUMMARY CARD</u>																												ELECTRO. NO.			
I/O	SEQ.	NO. CARDS	OPT.	DEPT. NO.	EMPL. NO.	GROSS PAY	REG. HOURS	O.T. HOURS	DED. PER TD1	CANADA PENSION PLAN	Y.T.D. CANADA PENSION PLAN	U.I.C.	DEDUCT. NO. 1	DEDUCT. NO. 2	DEDUCT. NO. 3	TAXABLE INCOME	INCOME TAX	NET PAY	DATE	4													
0	0	0																	DAY	MO	YR												
CONTROL POSITIONS																																	
4/80																																	

CARD NAME		<u>YEAR-TO-DATE SUMMARY CARD</u>																												ELECTRO. NO.			
I/O	SEQ.	NO. CARDS	OPT.	DEPT. NO.	EMPL. NO.	Y.T.D. GROSS PAY	DED. PER TD1	Y.T.D. CANADA PENSION PLAN	Y.T.D. OTHER	Y.T.D. INCOME TAX	DATE	5																					
0	0	0									DAY	MO	YR																				
CONTROL POSITIONS																																	
5/80																																	

UNIVAC

**UNIT RECORD PROCEDURE
MULTIPLE - CARD LAYOUT CHART**

9200 9300

APPLICATION: NO. P NAME PAYROLL

RUN: NO. _____ NAME _____

PREPARED BY C.L. BRETTON DATE _____

TOTAL
LEVEL ▶

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

CARD NAME ▶ **INCOME TAX FACTOR CARD** ELECTRO. NO. _____

VIC	SEC.	NO. CARDS	OPT.	TAX RATE	ADJUST. FACTOR 1	ADJUST. FACTOR 2	RANGE OF TAXABLE INCOME MIN. MAX.	X
1	0	1	1	X/80				

CARD NAME ▶ **U.I.C. GANGPUNCH MASTER CARD** ELECTRO. NO. _____

VIC	SEC.	NO. CARDS	OPT.	GROSS PAY RANGE	U.I.C. AMT.	X
1	0	1	1	X/79		

CARD NAME ▶ _____ ELECTRO. NO. _____

UNIVAC

**UNIT RECORD PROCEDURE
RPG PRINTER FORMAT CHART**

FORM NUMBER _____ APPLICATION PAYROLL

DATE _____

FORM PARTS _____ RUN NAME GROSS PAY REGISTER RUN NUMBER P330

PREPARED BY W.L. CORBAN

TYPE OF PRINTOUT LIST - TOTALS RECORD NAME GROSS PAY REGISTER RECORD NUMBER _____

APPROVED BY N.A. FIELDING

DATE APPROVED _____

LINE NAME	TYPE	Space	Skip	LINE	NO.	DEPT	EMPL NO	REG	O.T.	NIC	DED 1	DED 2	DED 3	GROSS PAY	INC TAX	CAN PENS
H																
D						XX	XXXX	XX-XX	XX-XX	X-XX	XX-XX	XX-XX	XX-XX	XXX-XX	XX-XX	XX-XX
D						XX	XXXX	XX-XX	XX-XX	X-XX	XX-XX	XX-XX	XX-XX	XXX-XX	XX-XX	XX-XX
T														XXXXXX-XX	XXXXX-XX	XXXXX-XX

IV. PROGRAMMING

INTRODUCTION

All documentation and system design work done so far has been in preparation of the final application conversion task, Programming. Programming is the preparation of programs, a series of related steps or instructions that tell the computer exactly how to handle a complete problem. The phases of programming are:

- *Problem definition*, using a Program Logic Chart or flowchart.
- *Coding* the problem in a form that the computer can use.
- *Testing* the completed program to determine if it will produce the desired results.
- *Documenting* the program for easy reference by all concerned. These phases are described in this chapter and techniques are suggested to make your programming effort easier.

PROBLEM DEFINITION


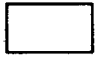


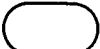
At the point of developing programs for the UNIVAC 9200 System, you will find that use of the present system documentation methods and forms (see Chapter II) has already enabled you to define the separate steps within most problems. This information may also have been updated during the application development phase (see Chapter III), by revising the forms. This documentation will, in most cases be enough to permit programming. The Multiple Card Layout form and Printer Format Chart are all that is needed to define input and output requirements. A review of the Program Logic charts will quickly establish whether they are adequate for determining calculations.

Sometimes, however, the steps outlined in a series of Program Logic charts are difficult to follow, either because they are too numerous, or due to the complex interreactions of various sub-sections of the program. Whatever the reason may be, if any difficulties are experienced in determining calculations from the Program Logic Charts alone, the program should be promptly flowcharted for clear problem definition.

Flowcharting Programs

Program flowcharting differs from application flowcharting (completed during the documentation phase of conversion see Chapter II) in that each computer run charted becomes a complete program. The Program Flowchart portrays all the logical steps involved in different processing procedures. Through its use, a program can be systematically visualized as a whole and its most complex portions can be readily analyzed.

Five basic symbols, standardized throughout the data processing industry, are used in program flowcharting. They are as follows:

1.  *Start symbol*, used to indicate the beginning of a program or a distinct sub-routine of a program.
2.  *Process symbol*, indicates the arithmetic steps within the program.
3.  *Decision symbol*, shows these points in a program where a branch to alternate paths is possible, based on the occurrence of certain conditions.
4.  *Connector*, an entry from, or an exit to another part of the flowchart.
5.  *End symbol*, placed at the end of a program or a distinct sub-routine.

In conjunction with these symbols, the following are used to "build" a flowchart.

1. \rightleftarrows Arrows to indicate direction of data flow or the next step.
2.

= (Equal)	}	symbol used in conjunction with a decision to show conditions which cause a branch.
≠ (Unequal)		
> (Greater)		
< (Less)		
3. : Colon to indicate a comparison of two factors.

The use of standard symbols in a complete flowchart is illustrated in Figure IV-2. This flowchart portrays Payroll operation P220 (shown in Chapter II, Figure II-12) which served to illustrate the use of the Program Logic Chart. Use of the flowchart may provide further clarification of program logic prior to coding.

On the flowchart, the symbol \square containing the card type, indicates the processing that takes place for each card. The year-to-date Canada Pension Plan accumulation is subtracted from the yearly limit (\$79.20). If the result is zero the limit has been reached and the Canada Pension Plan routine is bypassed. It should be noted that **connections** indicate entries to routine branches and re-entry to the "main chain" of coding.

Flowcharting is a skill that requires practice to develop. The first attempt at drawing up a flowchart may be difficult. However, with practice, these initial mechanical difficulties will grow less and the program flow-chart will become a valuable tool with which to portray the total scope of the job and prepare it for coding.

CODING

Coding is that phase of programming in which a program, after having been flowcharted or otherwise defined, is translated into a form which a computer can handle. Coding information is divided into four categories:

- Description of input
- Description of output
- Statements of calculations required
- Input and output devices to be used

Univac has developed the Report Program Generator (RPG), a program generating language for any business application, as a tool for easier conversion of written problem definitions to computer language. RPG statements are prepared with the aid of special specification forms on which information concerning input, output, calculations and I/O units is written in a format acceptable to the UNIVAC 9200 System. The RPG is fully covered in the "UNIVAC 9200/9300 Card Report Program Generator Reference Manual," UP-4106, which describes all RPG forms and specifications.

The simple steps required for generation of a 9200 program, using the RPG, are indicated in the subsequent paragraphs which describe the writing of a program designated as the "worker program." The steps are also portrayed in Figure IV-3.

Step 1 Worker program information is recorded on the RPG specification forms. The data is written in a semi-English form known as *source code*.

UNIVAC

UNIT RECORD PROCEDURE
PROGRAM LOGIC CHART

9200 9300

APPLICATION: NO. P NAME PAYROLL

PAGE 1 OF 1

RUN: NO. P220 NAME CANADA PENSION AND TAXABLE INCOME CALCULATION PREPARED BY W. KENT DATE _____

CARD TYPE	CONDITION AND/OR CONTROL	STEP	DESCRIPTION OF OPERATION	BRANCH		COMMENTS
				COND-ITION	TO STEP	
GROSS PAY S/G	4/80	1	CAN. PENSION LIMIT \$79.20 - Y.T.D. CAN. PENS.	IF 0	9	IF 0, THE MAX. YEARLY C.P.P. HAS BEEN DEDUCTED.
A	B	2	STORE DIFFERENCE AS MAX. CURR. C.P.P. DEDUCTION	C		YEARLY EXEMPTION OF \$600.00 ÷ 52
		3	GROSS PAY - C.P.P. EXEMPTION (\$11.54) = DEDUCTIBLE AMT			C.P.P. RATE IS .018 D
		4	C.P.P. DEDUCTIBLE AMT X C.P.P. RATE = C.P.P. DEDUCTION			XX.XX
		5	HALF ADJUST C.P.P. AMOUNT			
	E	6	MAX. CURRENT C.P.P. - CALCULATED C.P.P. = C.P.P. TEST	IF NEG	8	
		7	CALCULATED C.P.P. DEDUCTION TO C.P.P. OUTPUT AREA		9	C.P.P. ≤ MAXIMUM ALLOWABLE
		8	MAX. CURRENT C.P.P. DEDUCTION TO C.P.P. OUTPUT AREA			C.P.P. > MAXIMUM ALLOWABLE
		9	DEDUCTIONS PER TD1 ÷ 52 = WEEKLY DEDUCTIONS PER TD1			
		10	GROSS PAY - WEEKLY DEDUCTIONS PER TD1 = TAXABLE INC.			
		11	GROSS PAY - C.P.P. DEDUCTION = TAXABLE INCOME		1	XXX.XX F

Figure IV-1. Program Logic Chart, Payroll operation P170.

STANDARD
FLOWCHART
SYMBOLS

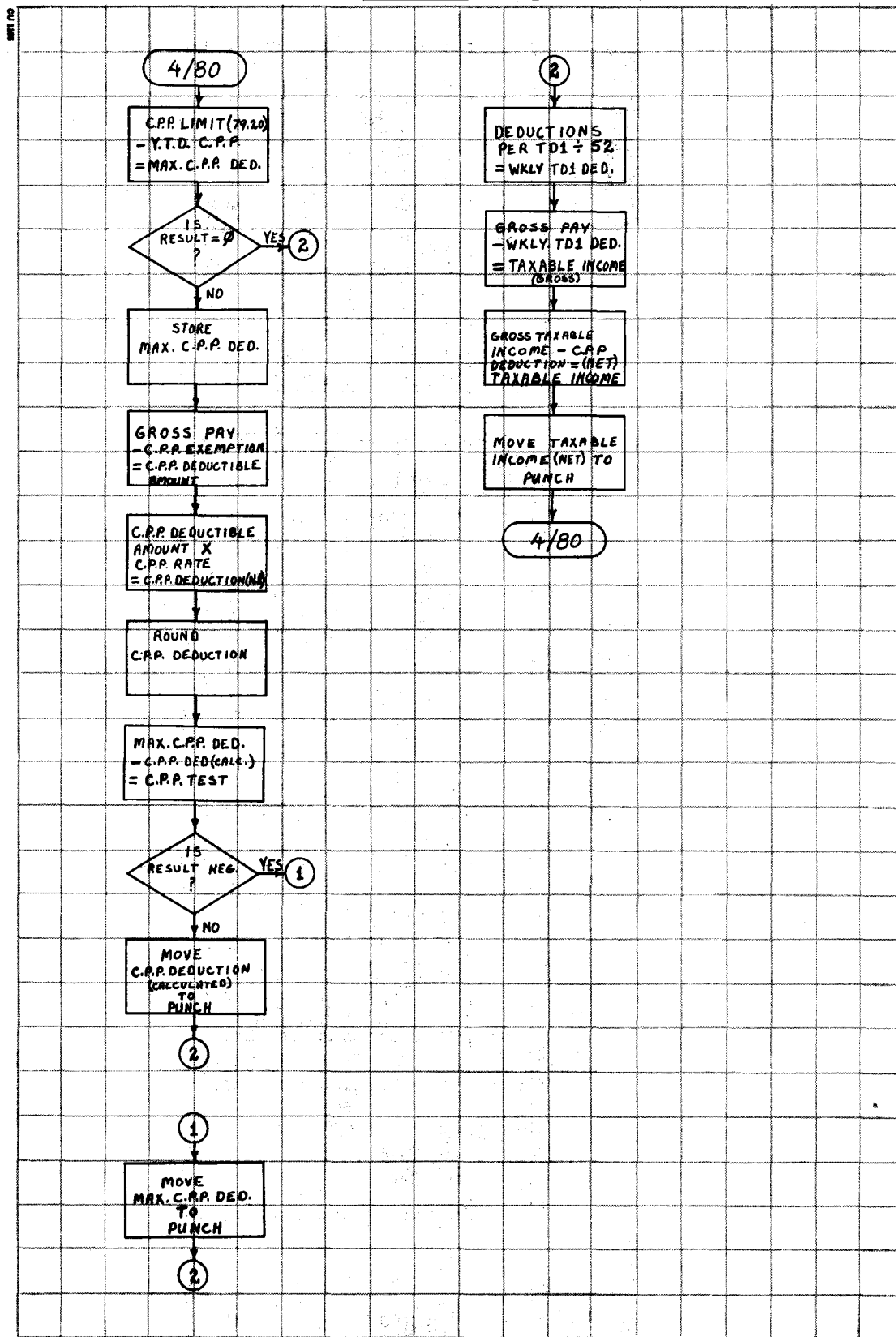
START ROUTINE

PROCESS

CONNECTOR

DECISION

END ROUTINE



UNIVAC
APPLICATION: NO. P
NAME: CALCULATE GROSS PAYROLL AND TAXABLE INCOME
UNIT RECORD PROCEDURE
PROGRAM FLOW CHART

PREPARED BY: W. KENT PAGE 1 OF 1
DATE: _____

Figure IV-2. Flowchart, Payroll Operation P220.

Step 2 The source code specifications are then given to a keypunch operator who punches the worker program into specially designed RPG program input cards.

Step 3 Since the source code definition of the problem is not the "official" language of the computer, but rather a tool to make coding easier, these worker program specification cards are introduced to the RPG program previously stored in computer storage. The Generator program then translates the worker program source code into the true machine language instructions, commonly known as the *object code*.

Step 4 The *problem data* can now be processed, using the object code worker program, to determine if the calculations made produce the desired output from the specified input.

Program steps could be written in the object code, thus eliminating the need for Step 3. This would, however, be far more difficult than using the source code RPG language which allows a problem to be defined in everyday terms. It is a great deal simpler to let the RPG handle the "writing" of the program in machine language.

The object code worker program generated by the RPG is available both in the main storage of the 9200 for immediate processing of the data defined by the worker program and also on punched cards to be used later to load the worker program into the computer. Each program loaded in storage destroys the program previously occupying that area. Having the object program on cards thus eliminates the use of the RPG to regenerate from source code whenever a worker program must be loaded and run. The RPG also provides a printed listing of the worker program on the UNIVAC 9200 printer. This printout shows both the worker program source code and the object code produced by the RPG and will indicate certain types of errors that may have been made in writing source code definitions. The RPG is fully described in the "UNIVAC 9200/9300 Card Report Program Generator Reference Manual," UP-4106, which covers all RPG forms and specifications.

PROGRAM TESTING

After a program has been coded, it must be tested to check that it will produce the desired results. Program testing involves three main functions:

- Desk-checking
- Preparation of test data
- Program testing

Desk-checking

Desk-checking is a very important phase of testing and one that should always be carried out. This procedure will save costly computer time when the program is actually tested. Desk-checking involves three functions:

- Review of program logic
- Validation of programming specification sheets
- Verification of program cards.

Review of program logic. The logic of the program, as represented on a flowchart or a Program Logic Chart, must be checked against the specification forms to make certain that processing requirements are met. This insures that the program has basically been properly coded.

Validation of program specification sheets. In this phase of desk-checking, the RPG specification sheets must be examined for coding errors such as:

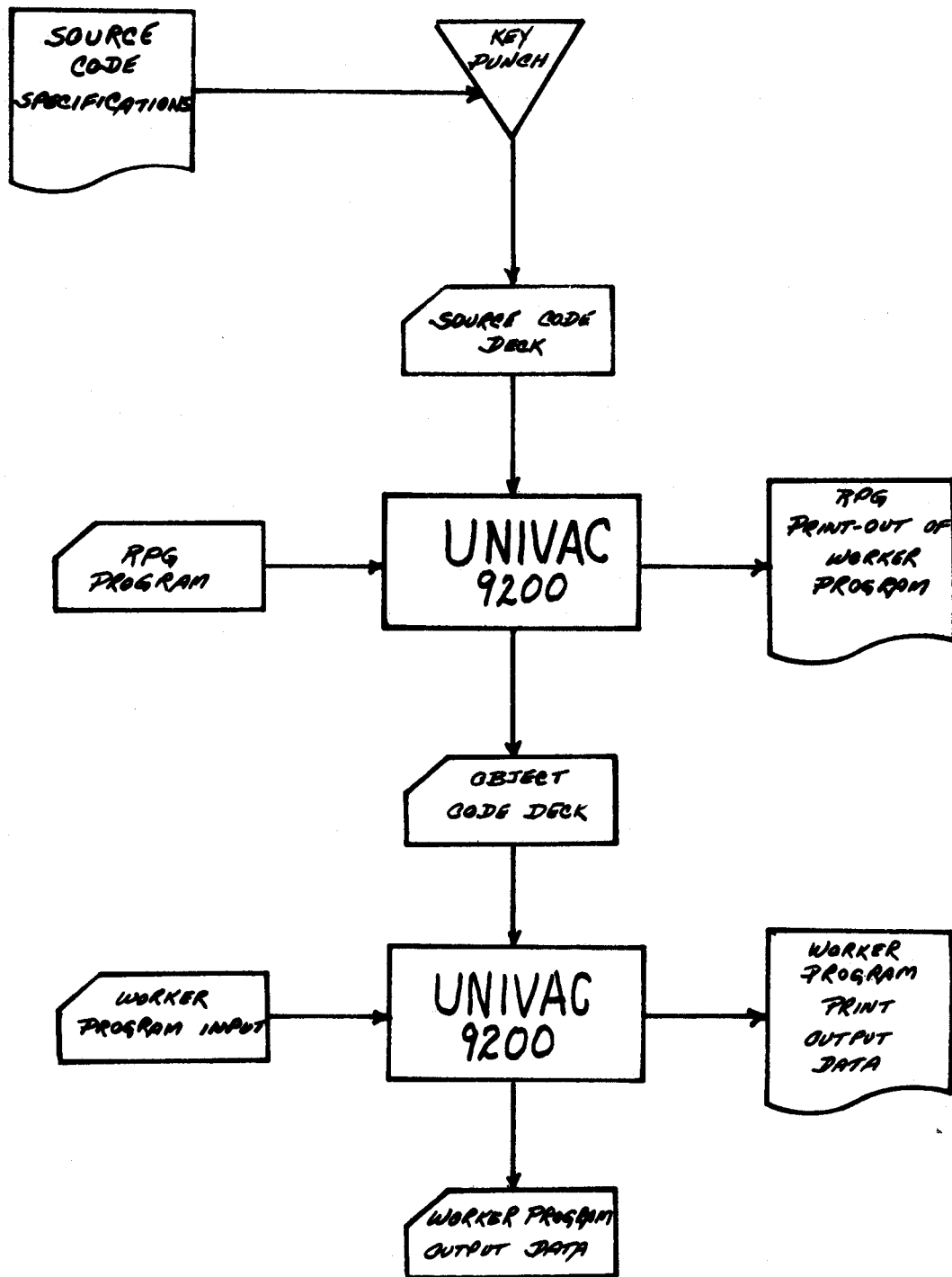


Figure IV-3. Report Program Generator production steps.

- Transposition of characters in labels
- Addition of characters in labels
- Omission of characters in labels
- Use of undefined labels
- Labels off-punched one column

Verification of program cards. The last phase of desk-checking is to verify the accuracy of cards keypunched from the RPG specification. This is done by comparing the specification sheets with:

- The program cards
- A listing of the program cards

Most of the errors on the cards are similar to those on the RPG sheets or consist of zeros and ones punched as alpha 0's and I's, or vice versa.

Preparation of test data

There are three ways to prepare data for program testing. They involve the use of:

- Existing data
- Specially prepared data
- A combination of existing and special data

Test data should cover all branches of the program so as to insure comprehensive testing. It should, therefore, be prepared by the person who is best acquainted with the application. Even though he may not have any programming knowledge or even be on the EDP staff, he will be most aware of exceptions and conditions caused under special circumstances.

After it has been prepared, test data should be thoroughly reviewed both by the person who prepared it and the programmer – to insure its accuracy and to check that it will provide a proper test of the program. The data should be keypunched, verified and listed. Control totals of the test data should be computed either manually or by a run on another machine. After the control totals have been computed, they should be checked for accuracy.

Program Testing

The purpose of machine-testing a program is to provide a final verification of prior desk-checking of the logic and computations of individual runs. To save costly computer time, all preparations for testing should be completed before going to the test location. The following information should be on hand:

- Program specification sheets
- Flowchart and/or Program Logic Chart
- Source code Program Card Deck
- Program test data
- Operator Instructions

The programmer should thoroughly plan the testing session beforehand, establishing the exact testing sequence to be followed for each run, and indicating the purpose of each run and the expected results. Program testing is an important function for the successful completion of a program. A variety of program testing techniques can be used to arrive at the desired results. Some recommended procedures are listed below:

1. A program should not be punched out from RPG regeneration until the RPG printout is completely error-free.

2. The logic of the program should be checked through the RPG printout. If the logic is not correct, the RPG generation must be repeated.
3. A small amount of test data should be used to test the program and produce a visual output. The validity of this output should then be checked.
4. Test data with exceptions should be processed to check that they are handled properly. If the answers are not correct, the flowchart and/or the Program Logic Chart and the RPG printout should be used to determine the sequence of events which causes incorrect results.
5. Test data should be run to balance back to a control total computed before testing of the program.
6. After the above procedures have been completed, the test data should be entered to test the program and insure that it is completely checked out. This test should insure that all aspects of the problem have been considered and resolved.

After all pertinent programs have been checked out, the entire application can be tested. The following procedures should be followed in testing an application:

1. Each program must be tested until it produces the desired results.
2. The interrelationship of programs as they will be processed for the application must be tested. For instance, the output from run A should be processed as the input of run B to follow the actual data flow of the application.
3. A parallel test must be made to determine that a complete application is operational. This is done by processing the same data in the existing system and the new system, if possible. This parallel testing will pinpoint any oversights and will conclude testing of the application.

DOCUMENTATION

Proper program documentation is one of the most important factors in the success of any data processing installation. No organization, nor any department within it, can operate effectively unless it maintains proper and accurate records to prevent the many kinds of misunderstandings that can arise in the normal course of daily activities.

The program documentation recommended for the UNIVAC 9200 is designed to contribute greatly to the effectiveness of the day-to-day activity of the Data Processing Department. It can be prepared as a by-product of this activity with little or no additional effort by the program writer who designs or modifies a program and then includes the necessary information into one or both of the two main documentation sources:

- The Run Book
- The Application Book

The Run Book

The Run Book is a collection of all required documentation pertaining to an individual program. Other information may also be included if it is necessary or if it makes it easier to understand the problem at hand and the approach chosen for its solution. The key to the effectiveness of the Run Book is that persons who are not associated with the creation of the program should experience no difficulties in referring to the Book and find its documentation readily understandable.

The Run Book contains several categories of information which should be filed in the same order that they are listed below:

- Run description
- Input/output file specifications
- RPG specification forms
- RPG printout
- Operator instructions

Each category of information may be one or more pages in length, as the program requires, and may also include additional illustrative and descriptive material.

The Run Description. This is a descriptive document usually requiring only a single page, which identifies a specific program and states its purpose. It indicates data file input, describes how it is to be handled by the program, and specifies the output to be produced. It also stipulates the frequency with which the program is to be run. Each input and output file should be specifically identified by name and form number so that no errors may occur.

The run description should also specify any related special considerations to be incorporated into the program such as the three examples listed below:

- If the sequence of input data is a prime consideration, the field sequence checked should be identified, and a statement of what is to be done with the "out-of-sequence" condition should be included.
- For data field(s) validation, the field(s) should be identified and the nature of the validation should be specified. The disposition of "invalid data" should also be specified.
- If processing requires the presence of certain kinds of processing, a specification must be entered, such as:

"The first card of each STOCK NUMBER group must be a Stock Master; if not, the processing stops with notice of 'missing master' to the operator."

Input/output file specifications. These include the Multiple Card Layout and Printer Layout forms prepared during the earlier stages of programming. Samples of actual input/output cards and printer form samples may be included, if thought useful. These will be followed by the related Program Logic Forms.

This section may also include a flowchart if one has been prepared to aid in filling out the Program Logic Forms.

RPG specification forms. This category is comprised of the Report Program Generator forms prepared during programming. All are fully described in the "UNIVAC 9200/9300 Card Report Program Generator Reference Manual," UP-4106. It is suggested that the documents be listed in the following order:

- File Description Form
- Input Format Specification Form
- Calculation Specification Form
- Output Format Specification Form
- File Extension Specification Form

RPG Printout. This follows the RPG specification forms and provides in printed form the complete detailed references for all preceding program specifications and the resulting object programs.

Operator Instructions. This final category of information in the Run Book includes a copy of the material written by the programmer to inform the operator of any variable conditions which will affect his handling of the program. The information includes the relationships of each input and output file to a specific peripheral device; and the enumeration of each Halt Condition handled by the programmer's own coding, its indication to the operator, and what his response should be.

In order to make the operator's instructions easier to perform, many conditions have been standardized, (such as program load, start and termination, misfeed, output of paper, etc.) and do not have to be mentioned in the Run Book.

The Application Book

The Application Book is prepared when the functions within an application area are divided between two or more individual programs. Its purpose is to present information concerning the application area which was not included in the Run Books for the related program. This information includes a statement of the objectives to be fulfilled and a general description of the work to be accomplished within the area.

The general description should be followed by a list of the specific programs within the application area, and a chart of the associated program series, using the Univac Application Chart form. The check lists for the individual programs should be included, as should any other supporting material which pertains to the area of application rather than solely to individual programs within it.

The Application Book and the individual Run Books can be filed in one of two ways. Either they form separate individual files, or they are combined into individual sections. In the latter case, the Application Book is the first section, and the individual Run Books follow in the order specified on the list of programs provided as part of the Application Book.

V. RECORD CONVERSION

The UNIVAC 9200 installation procedures and the UNIVAC 9200 Report Program Generator language are designed to permit the ready transfer of unit record applications to the computer, with no changes being required in the formats of existing data files. File conversion may, however, prove of great value after the 9200 has become fully operational. The method can then serve in subsequent systems design work to improve present applications and develop new ones. Through it, the 9200 can be used to the limits of its powerful capabilities. The factors to be considered and the procedures to be followed for prompt and easy conversion of existing card files and creation of new files from manual records are outlined in this chapter.

CONVERSION FACTORS

Conversion of card files is usually a simple and well-defined task involving no more than relocating a number of fields and changing card controls or identifiers. Occasionally, obsolete data must be eliminated or new, up-to-date information added.

File conversion permits 9200 System users to conduct operations with clean, accurate files, free of any cards that require special handling, for which solid controls have been established.

A major conversion effort may take several weeks to complete, and may involve several separate conversion jobs. The user will therefore have to consider beforehand the major factors for the determination of conversion methods and timing. Only after the factors listed below have been examined and pertinent questions resolved can a successful conversion begin:

- Need for additional equipment
- File Volume
- File stability

Need for Additional Equipment

Temporary rental of additional equipment may be necessary for conversion, depending on the size of files to be converted and the conversion schedule. The need for more equipment may come up, for instance, if a large file must be converted over a single week-end. Inquiries should be made before conversion concerning local rental rates, delivery lead times, and minimum rental periods.

File Volume

Small, easily managed files can usually be converted as part of the regular work-flow. Larger, more complex files require special methods. One is to break the file down into manageable blocks. Most files have some numeric designation, such as department, product or customer records which will block the file records into fairly equal parts. Occasionally, an arbitrary breakdown, such as an alphabetic designation, must be used. A service bureau may be used to convert a large file within a short period of time without blocking. In any case, the need for close conversion control and supervision will increase in direct relation to the file size and complexity. It is also important that old and new files be clearly identified to prevent improper handling.

File Stability

The amount of updating or use to which a file is subjected will affect the timing of its conversion.

Master files are usually quite stable, even though used in a number of runs. Changes are simple: change of address, new credit limit, number of dependents and so forth. A file of this type should be converted well in advance of the time that it is needed for cutover. Remember, however, that the creation of a second file means duplicate updating. If a new form has been designed to record the changes for keypunching, it should, if possible, be used with both the old and the new files. The early creation of new files provides greater scheduling flexibility and an opportunity to test new procedures and controls.

Files, such as inventory or accounts receivable, that are continually subject to high volume changes can be converted just prior to their use in the new system, since early conversion would place an excessive burden on the staff. Careful planning is needed to schedule this job at the right moment. A business cycle cut-off point, such as month-end statements to customers, is the best time for conversion. A conservative schedule will, however, allow a time margin for a dress rehearsal of the operation and any required recovery and rerun.

CONVERSION PROCEDURES

Conversion of the files can begin after the following necessary steps are scheduled:

- (1) The existing file should be audited and every effort made to clear it of extraneous data. The file must be complete and all records should be returned to it (if necessary, temporary copies of records can be made). Questionable records should be reviewed by the proper personnel and decisions taken as to the proper content of these records.
- (2) Control totals are then tabulated and recorded by the control clerk. If the file has been divided into blocks, each segment will be treated as an independent unit. The control totals for statistical files can be simple and easy to maintain, but files that represent revenue, inventory or costs must be more strictly controlled. The major money or quantity field, as well as a hash total of identification numbers, should be established. The addition of a few more control fields will not reduce the throughput of a new system.
- (3) The cards are then reproduced by whichever method has been chosen.
- (4) Control totals for the new files should be developed, using the same fields as were used with the old files. The two sets of controls must balance before further processing can be undertaken.
- (5) The old files can now be returned to storage and the new records rearranged, if necessary. If the original total groups are disturbed by this manipulation, new control totals must be established and checked out against the first set of controls.
- (6) If the new files have been created in advance of cutover, updating and maintenance must be done on a control basis. All input should be batched, totaled and recorded by the control clerk and the updated run totals verified. Any change in the old records must cause a corresponding change in the new records.
- (7) The same controls should be established if the new files have been created from manual records. The files should be keypunched and key verified in small batches for which adding machine tapes have been compiled. Extra care is needed here since manual files are usually spread throughout a department, and a longer period of audit and clean-up will be required. Tight control will have to be maintained on changes since non-machine oriented personnel seldom appreciate the recovery problems involved. Since control totals attest only to the accuracy of numeric fields totalled, it will be necessary to sight check the indicative information such as names, addresses,

social insurance numbers, etc. The amount of sight checking will depend on the data. In some cases, the entire record will have to be checked. In others, merely reading the data will be sufficient, or spot checks may be all that is required.

The new files can be used as soon as they have been created and proved to be satisfactory. The old files should not be discarded, however, until all wrinkles have been ironed out of the new system and it is self-sustaining.

PLANNING THE FINAL CUTOVER

A smooth and easy cutover to the new system will require answers to three major questions – how applications are to be cutover, what physical controls can be exercised during cutover, and when this cutover is to take place. The determination which must be made for a successful cutover, therefore, are:

- Determination of the cutover method
- Conversion controls
- Conversion scheduling

Determination of the Cutover Method

Every application to be converted to the new system should be treated as a unit, with all associated runs being converted in the same time span. Three cutover approaches can be taken:

- *Parallel*, with both old and new equipment operating side-by-side until final debugging of the new system.
- *Immediate*, with all old equipment being taken out immediately.
- *Gradual*, with new equipment being installed gradually.

Parallel Conversion is recommended when the new system almost duplicates the old with essentially similar output. A satisfactory conversion can be accomplished in two production cycles. The old runs, which still produce usable information, are processed and a printout of all intermediate and final documentation is retained. The new runs are then processed, using the same input data, and the resulting documentation is compared with old-run output. Any discrepancies thus revealed are investigated by the system designer who makes suitable modifications to the program or procedures. Reruns are then made until the results check out. There will be instances where slight differences may be caused by changes in methods of calculation. A programmed payroll tax calculation, for instance, will yield results different from those obtained from a tax table.

When the input of the first parallel run is acceptable, another parallel test will be made on the next production cycle. At least one clean parallel cycle must be produced before the new system can be relied on to produce working output and the old system terminated. This method is particularly recommended for detail-heavy accounting functions such as billing, payroll or inventory control.

Immediate Conversion is used when input or output data bears little resemblance to that of the old system, or when the method of calculation to produce statistical output has changed. The task of modifying live input data and adjusting output from the old system to test the new prevents the adoption of the parallel approach. The old system is therefore terminated and the new one is immediately cut in.

Great care and planning are essential as the immediate conversion technique places the heaviest burden on the data processing staff.

The burden of developing appropriate volume tests before the conversion to ensure its accuracy falls almost entirely on the system designer. Testing should be sufficient to cover all possible suspected combinations of conditions. A change in operating procedures is usually associated with the immediate conversion method. Step-by-step instructions must be developed and tested and operating and clerical personnel adequately trained in their use. Key punch operators should be thoroughly retrained when input content and format have changed.

Gradual Conversion is implemented when the conversion job is too big to handle within a limited period of time. Under this method, the total application can be divided into logical segments, each of which is cut over separately. This approach can be used only if the output of a new system segment is acceptable within the old system. The parallel method should be used in correcting each segment, since there must be a high degree of compatibility between the two systems.

If the application does not lend itself to segment-by-segment cutover, it must be divided in some other way, such as by department or customer number. This technique is similar to the blocking method for file conversion. Here, both systems must be run simultaneously, each producing a portion of the desired output. The people concerned should know that both old and new system output can be used, and a conversion schedule should be kept up-to-date.

Although the gradual approach is necessary in certain cases, it is quite difficult to control, and very careful supervision is needed.

Conversion Controls

Controls for application conversion consist of operation check points and balancing figures developed outside the computer room. Controls used during conversion must be accompanied by specific recovery techniques.

Operation Check Points occur at the stopping places found in any system where completed work can be inspected for accuracy. In a payroll run, for instance, a visual check of the gross-to-net calculation will reveal any amounts outside a predetermined range. A correction at this stage, before any checks are printed, will save unnecessary work later. Some check points will have been built into the system by the designer, for example, the credit limit check in a billing run. Some control totals are developed in the first run of a system and are checked at every subsequent input and output operation. These totals are solely for computer room use and may take the form of hash totals to verify that every record received has been processed. Whatever the check may be, it is designed to prevent an error from being compounded and causing excessive reruns.

Accounting Controls represent the majority of checks normally used by an EDP department. Timekeeper reports are batched, accounts receivable checks are totaled, production figures are verified, general ledger vouchers are keypunched, and so forth. All but statistical reports can usually be balanced back to some control established by the accounting department. The necessary controls are incorporated into the program by the systems designer. The EDP department is responsible for verifying the accuracy of each report before it is released.

Recovery Techniques are the procedures used to correct the errors which the controls reveal. Recovery techniques used during the installation period may differ from those used for normal system operations. The parallel method of conversion provides a complete check on every run, and recovery means continuous adjustment and rerunning until old and new outputs balance out. The immediate method of conversion differs in that normal operating conditions occur right away. If normal recovery techniques fail, the old system can

be put back into operation with only minor consequences, but this is a last resort and should be avoided. The gradual method of conversion presents a more complex problem as normal recovery is used for the portion of the run still under the old system, but new recovery techniques are used for the new system. Any errors in one system must be analyzed to discover what effects they may have on the other systems.

Recovery procedures should be simple enough so that only the affected portion of the run needs to be done over, if possible. An example would be the discovery, after running a large payroll register, that errors were made in the third and sixth of 25 departments. Only the rerunning of these two departments and manual correction of overall run totals should be required. Large jobs should thus be subdivided to permit simple recovery.

Special steps should be taken for those runs where an updated file is produced. The old file should be held for two cycles to facilitate its reconstruction if anything happens to the new files. If possible, the input records that caused the changes should be kept in their original sequence.

Conversion Scheduling

Cutover to the new system should be based on a firm schedule to be drawn up as early as possible. This schedule should show in detail: exactly what must be done – the sequence in which it must be done – and the starting and completion dates for each scheduled conversion activity. It is very important that it be completely realistic, fully reflecting the extent of the conversion job and the speed with which you can accomplish it.

The successful development of a realistic conversion schedule is based on four major considerations:

- Conversion tasks to be done
- The time at which they should be done
- The resulting preliminary schedule
- Firming the conversion schedule

Conversion tasks to be done

All operations to be converted should be identified before any kind of conversion schedule can be drawn up. For this purpose, the following steps should be taken to prepare a detailed list of operations.

- (1) List every application to be converted.
- (2) Breakdown each application into individual runs.
- (3) List all runs in proper sequence.
- (4) Indicate for each run whether it is performed on a daily, weekly, monthly or other periodic basis.
- (5) Use special symbols to indicate:
 - one-time conversion runs.
 - runs that are related to each other.
- (6) List operations or processing runs that do not relate to any one application.

After you have completed the list, you should review it thoroughly to make certain that it is complete and without duplications.

Conversion timing

It is important to know when each application can be cut over to the new system so as to assign it a conversion priority. Conversion must always take place at the start of the processing cycle – either of the entire application or of the next segment to be converted if a very large file has had to be broken down into manageable blocks. Equipment limitations or management decisions may, however, affect the time at which actual processing can begin.

Once the conversion sequence is known, the list of operations to be converted should be rearranged to conform with that order. The list should be carefully checked afterwards to make certain that input/output continuity between runs is preserved. If conversion of a given application must be stretched out, temporary processing measures must be taken to preserve continuity between runs.

The preliminary conversion schedule

After all runs have been itemized and each application has been assigned a priority for conversion, the creation of the preliminary conversion schedule can begin. The first step is to determine the time required for each conversion task – to convert a given file or to complete a certain operation. These time estimates can be made more accurate by checking some testing times for new system runs.

Once that conversion times for each run have been determined, this information is transferred in conversion sequence to a chart or progress board. Applications should be shown across the bottom of either the chart or the board and the sides should be calibrated vertically in time units. This procedure will permit easy visualization of the whole schedule and of each element within it.

Firming the conversion schedule

Before the preliminary schedule can be firmed, you must make certain that it is realistic. If it is not, the schedule must be redrawn or additional support acquired. The factors to be considered include:

- *Current workload.* Is it too great to permit conversion during the time specified in the schedule?
- *Personnel.* Is staff training satisfactory? Is the staff adequate to support both the current workload and the conversion effort? If it is not, should temporary personnel be hired?
- *Equipment.* Is existing equipment adequate for conversion of files within the schedule? If it is not, should additional equipment be rented temporarily?
- *Miscellaneous.* Have adequate provisions been made for additional storage and working space, furniture and operating supplies that may be required?
- *The new system.* When is the new equipment to be delivered, and according to what schedule? What is the progress of site preparation?

Answers to these questions will indicate whether the preliminary "ideal" schedule can be kept or whether it must be modified to fit existing conditions. Once the schedule has been firmed, however, every effort must be made to stick with it.

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