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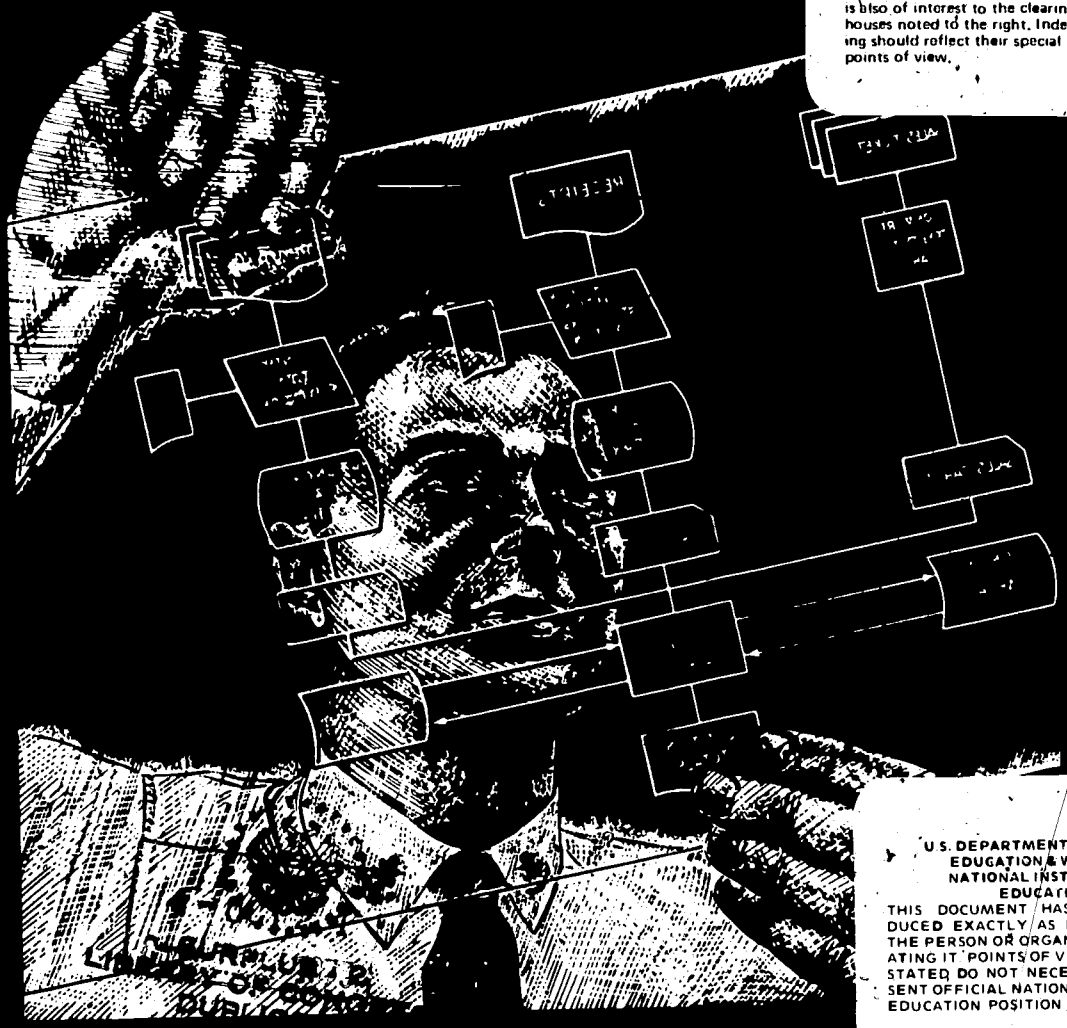
ABSTRACT

This training manual is intended as an individual study aid for Navy personnel who wish to prepare for advancement to the rate of Data Processing Technician First Class or Chief Data Processing Technician. Theoretical knowledge and operational skills are presented along with assignments designed to lead students through the manual. The manual first describes general computer documentation and the use of COBOL in data processing. COBOL in the data division and the procedure division is described and documented with examples. The kinds of systems used by the Navy are explained. Personnel organization and duties for Navy data processing technicians are detailed followed by an analysis of appropriate supervisory personnel requirements, procedures, and attitudes. (CH)





# DATA PROCESSING TECHNICIAN 1&C

NAVAL EDUCATION AND TRAINING COMMAND

RATE TRAINING MANUAL

AND NONRESIDENT CAREER COURSE

NAVEDTRA 10265-C

# PREFACE

This Rate Training Manual and Nonresident Career Course (RTM/NRCC) is intended to serve as an aid for personnel who are seeking to acquire the theoretical knowledge and the operational skills required of candidates for advancement to the rate of Data Processing Technician First Class or Chief Data Processing Technician.

Designed for individual study and not formal classroom instruction, the RTM provides subject matter that relates directly to the occupational qualifications of the Data Processing Technician rating. The NRCC provides the usual way of satisfying the requirements for completing the RTM. The set of assignments in the NRCC includes learning objectives and supporting items designed to lead students through the RTM.

This training manual and nonresident career course was prepared by the Naval Education and Training Program Development Center, Pensacola, FL, for the Chief of Naval Education and Training. Review and technical assistance were provided by the Service School Command, Naval Training Center, San Diego, CA; Aviation Supply Office, Philadelphia, PA; Navy Finance Center, Cleveland, OH; Commander, Training Command, Atlantic, Norfolk, VA; Naval Officer Training Center, Pacific, San Diego, CA; Naval Command System Support Activity, Washington, DC; and by the Chief of Naval Personnel (Pers N).

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# THE UNITED STATES NAVY

## GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

## WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

## THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

# CONTENTS

# CREDITS

Preparation of this manual was aided by the cooperation and courtesy of International Business Machines Corporation and Auerbach Publishers Inc. These companies furnished the technical manuals and aided considerably in the preparation of this text. Permission to use these manuals in assembling the material contained herein is gratefully acknowledged.

Illustrations not listed below are from Navy sources.

| SOURCE | FIGURES |
|---|---|
| IBM | 6-1 |
| Auerbach | 7-1 |

# CHAPTER 1

# ADVANCEMENT

This rate training manual is designed to help you meet the occupational qualifications for advancement to Data Processing Technician First Class and Chief Data Processing Technician. Chapters 2 through 8 of this manual deal with the technical subject matter of the Data Processing Technician rating. This chapter provides introductory information that will help you in working for advancement. It is strongly recommended that you study this chapter carefully before beginning intensive study of the chapters that follow.

## REWARDS AND RESPONSIBILITIES

Advancement brings both increased rewards and increased responsibilities. The time to start looking ahead and considering the rewards and the responsibilities is right now, while you are preparing for advancement to DP1 or DPC.

By this time, you are probably well aware of many of the advantages of advancement—higher pay, greater prestige, more interesting and challenging work, and the satisfaction of getting ahead in your chosen career. By this time, also, you have probably discovered that one of the most enduring rewards of advancement is the personal satisfaction you find in developing your skills and increasing your knowledge.

The Navy also benefits by your advancement. Highly trained personnel are essential to the functioning of the Navy. By each advancement you increase your value to the Navy in two ways. First, you become more valuable as a technical specialist in your own rating. And second, you become more valuable as a person who can supervise, lead, and train others and thus make far reaching and long lasting contributions to the Navy.

In large measure, the extent of your contribution to the Navy depends upon your willingness and ability to accept increasing responsibilities as you advance. When you assumed the duties of a DP3, you began to accept a certain amount of responsibility for the work of others. With each advancement, you accept an increasing responsibility in military matters and in matters relating to the occupational requirements of the Data Processing Technician rating.

You will find that your responsibilities for military leadership are about the same as those of petty officers in other ratings, since every petty officer is a military person as well as a technical specialist. Your responsibilities for technical leadership are special to your rating and are directly related to the nature of your work. Data processing in today's Navy is a job of vital importance. It's a teamwork job and requires a special kind of leadership ability that can only be developed by personnel who have a high degree of technical competence and a deep sense of personal responsibility.

Certain practical details that relate to your responsibilities for personnel administration, supervision, and training are discussed in later chapters of this training course. At this point, let's consider some of the broader aspects of your increasing responsibilities for military and technical leadership.

Your responsibilities will extend both upward and downward. Both officers and enlisted personnel will expect you to translate the general orders given by officers into detailed, practical on-the-job language that can be understood and followed even by relatively inexperienced personnel. In dealing with your juniors, it is up to you to see that they perform their work properly. At the same time, you must be able to explain to officers any important needs or problems of the enlisted men.

You will have regular and continuing responsibilities for training. Even if you are lucky enough to have highly skilled and well trained personnel, you will still find that training is necessary. Also, some of your best workers may be transferred, and inexperienced or poorly trained personnel may be assigned to you. Or a particular job may call for skills that none of your personnel have. These and similar problems

require you to be a training specialist who can conduct formal and informal training programs to qualify personnel for advancement and who can train individuals and groups in the effective execution of assigned tasks.

You will have increasing responsibilities for working with others. As you advance to DP1 and then to DPC, you will find that many of your plans and decisions affect a large number of people, some of whom are not in the division and some of whom are not even in the activity. It becomes increasingly important, therefore, to understand the duties and responsibilities of personnel in other ratings. Every petty officer in the Navy is a technical specialist in his own field. Learn as much as you can about the work of other ratings, and plan your own work so that it will fit in with the overall mission of the organization.

As your responsibilities increase, your ability to communicate clearly and effectively must also increase. The basic requirement for effective communication is a knowledge of your own language. Use correct language in speaking and in writing. Remember that the basic purpose of all communication is understanding. To lead, supervise, and train others, you must be able to speak and write in such a way that others can understand exactly what you mean.

A second requirement for effective communication in the Navy is a sound knowledge of the Navy way of saying things. Some Navy terms have been standardized for the purpose of ensuring efficient communication. When a situation calls for the use of standard Navy terminology, use it.

Still another requirement of effective communication is precision in the use of technical terms. A command of the technical language of the Data Processing Technician rating will enable you to receive and convey information accurately and to exchange ideas with others. A person who does not understand the precise meaning of terms used in connection with the work of his own rating is at a disadvantage when he tries to read official publications relating to his work. He is also at a great disadvantage when he takes the written examinations for advancement. Although it is always important for you to use technical terms correctly, it is particularly important when you are dealing with lower rated men. Sloppiness in the use of technical terms is likely to be very confusing to an inexperienced man.

You will have increased responsibilities for keeping up with new developments. Practically everything in the Navy—policies, procedures, equipment, publications, systems—is subject to change and development. As a DP1, and even more as a DPC, you must keep yourself informed about all changes and new developments that might affect your rating or your work.

Some changes will be called directly to your attention, but others you will have to look for. Try to develop a special kind of alertness for new information. Keep up-to-date on all available sources of technical information. And, above all, keep an open mind on the subject of data processing and associated equipment. New types of data processing equipment are constantly being designed and tested, and existing types of data processing equipment are subject to modification. Computer hardware design has developed from vacuum tube power to solid state logic technology or "third generation" computers in a relatively short time.

It is important that you keep up with the ever-changing, ever-expanding methods and equipment of the DP rating.

## THE DATA PROCESSING TECHNICIAN RATING

Personnel of the Data Processing Technician rating perform a great number of functions associated with data processing support programs through the use of many types of automatic data processing equipment. They gather and process source information, and produce reports and other services in accordance with Navy managerial requirements. They are thoroughly familiar with data processing applications, including applications of general purpose digital computers, programming, systems analysis, participation in designing automatic data processing systems, and administrative and management functions peculiar to data processing offices and installations.

Data Processing Technicians may be ordered to many different types of activities which perform data processing by both electrical and electronic methods. These include ship and shore installations of the operating forces, shore support activities, bureaus, systems commands, and offices of the Navy Department. Generally speaking, the mission of a data processing installation is prescribed by the bureau, office, or systems command exercising command. The data processing systems employed may be broadly grouped as personnel, supply, maintenance material management (3M), fiscal, research, security, communications, and operations control. An installation may perform data processing services under one or more of these systems, and various

other miscellaneous services, depending upon the type of installation and its assigned mission.

A limited number of particularly well-qualified Data Processing Technicians are given assignments to instruct in Navy schools; to assist in making up the servicewide advancement in rating examinations and to assist in the preparation of rate training manuals and other training materials at the Naval Education and Training Program Development Center, Pensacola, Florida. Regardless of location, all Data Processing Technicians are assigned by the Bureau of Naval Personnel, Washington, D.C.

## THE NAVY ENLISTED ADVANCEMENT SYSTEM

Many of the rewards of Navy life are earned through the advancement system. The basic ideas behind the system have remained stable for many years, but specific portions may change rather rapidly. It is important that you know the system and follow changes carefully. BuPers Notices 1418 will normally keep you up-to-date.

The normal system of advancement may be easier to understand if it is broken into two parts:

1. Those requirements that must be met before you may be considered for advancement.
2. Those factors that actually determine whether or not you will be advanced.

## QUALIFYING FOR ADVANCEMENT

In general, to QUALIFY (be considered) for advancement, you must first:

1. Have a certain amount of time in pay grade.

2. Demonstrate knowledge of material in your mandatory rate training manuals by achieving a suitable score on your command's test, by successfully completing the appropriate NRCC's or, in some cases, by successfully completing an appropriate Navy school.

3. Demonstrate the ability to perform all the practical requirements for advancement by completing the Record of Practical Factors, NAVEDTRA 1414/1.

4. Be recommended by your commanding officer.

5. For petty officer third and second candidates ONLY, demonstrate knowledge of military subjects by passing a locally administered MILITARY/LEADERSHIP examination based on the military qualifications for advancement (from NAVPERS 18068 series).

6. Demonstrate knowledge of the technical aspects of your rate by passing a Navy-wide advancement examination based on the occupational qualifications applicable to your rate (from NAVPERS 18068 series, those quals listed at and below your rate level).

If you meet all of the above requirements satisfactorily, you become a member of the group from which advancements will be made.

## WHO WILL BE ADVANCED?

Advancement is not automatic. Meeting all of the requirements makes you eligible but does not guarantee your advancement. Some of the factors that determine which persons, out of all of those QUALIFIED, will actually be advanced in rate are the score made on the advancement examination, the length of time in service, the performance marks earned, and the number of vacancies being filled in a given rate.

If the number of vacancies in a given rate exceeds the number of qualified personnel, then ALL of those qualified will be advanced. More often, the number of qualified people exceeds the vacancies. When this happens, the Navy has devised a procedure for advancing those who are BEST qualified. This procedure is based on combining three personnel evaluation systems:

Merit rating system (Annual evaluation and C.O. recommendation)

Personnel testing system (Advancement examination score, with some credit for passing previous advancement exams)

Longevity (seniority) system (Time in rate and time in service)

Simply, credit is given for how much the individual has achieved in the three areas of performance, knowledge, and seniority. A composite, known as the final multiple score, is generated from these three factors. All of the qualified candidates from a given advancement examination population are then placed on one list, based on this composite figure, the highest achiever first, and so on down to the last qualified person in the population. For candidates for E4, E5, and E6, advancement authorizations are then issued, beginning at the top of the list, for the number of persons needed to fill the existing vacancies.

Candidates for E7 whose final multiple scores are high enough will be designated PASS SELBD ELIG (Pass Selection Board Eligible). This means

that their names will be placed before the Chief Petty Officer Selection Board, a BuPers board charged with considering all so-designated eligible candidates for advancement to CPO. Advancement authorizations for those being advanced to CPO are issued by this board.

Who, then, are the individuals who are advanced? Basically, they are the ones who have achieved the most in preparing for advancement. They are not content to just qualify; they have gone the extra mile in their training, and through that training and their work experience they have developed greater skills, learned more, and accepted more responsibility.

While it cannot guarantee that any one person will be advanced, the advancement system does guarantee that all persons within a particular rate will compete equally for the vacancies that exist.

## SCOPE OF THIS TRAINING MANUAL

What you should gain from your study of this training manual is detailed in the following statements concerning its purpose and scope:

It is designed to give you information on the occupational qualifications for advancement to DP1 and DPC.

It must be satisfactorily completed before you can advance to DP1 or DPC, whether you are in the Regular Navy or in the Naval Reserve.

It is NOT designed to give you information on the military requirements for advancement to PO1 or CPO.

It is NOT designed to give information that is related primarily to the qualifications for advancement to DP3 and DP2. This is given in Data Processing Technician 3 & 2, NAVTRA 10264-C.

The occupational Data Processing Technician qualifications used as a guide in the preparation of this training manual are those promulgated in the Manual of Qualifications for Advancement, NAVPERS 18068-C, change 5. Therefore, changes in the Data Processing Technician qualifications occurring after this change may not be reflected in this training manual. (About July 1975, the Manual of Navy Enlisted Classifications, Addendum for Manual of Navy Enlisted Classifications, and the Manual of Qualifications for Advancement will be combined into one manual entitled Manual of Navy Enlisted Occupational Standards.) Since your major purpose in studying this manual is to meet the qualifications for advancement to DP1 or DPC, it is important for you to obtain and study a set of the most recent Data Processing Technician qualifications.

This training manual includes information that is related to both the KNOWLEDGE FACTORS and the PRACTICAL FACTORS of the qualifications for advancement to DP1 and DPC. However, no training manual can take the place of actual on-the-job experience for developing skill in the practical factors. The manual can help you understand some of the whys and wherefores, but you must combine knowledge with practical experience before you can develop the required skills. The Record of Practical Factors, NAVEDTRA 1414/1, should be utilized in conjunction with this training manual whenever possible.

This training manual deals almost entirely with data processing systems and associated equipment and techniques. It does NOT contain information that is primarily related to a particular system.

Chapters 2 through 8 of this training manual, as already stated, deal with the occupational subject matter of the Data Processing Technician rating. Before studying these chapters, study the table of contents and note the arrangement of information. You will find it helpful to get an overall view of the organization of this training manual before you start to study it.

## TREND OF NAVAL TRAINING

Navy training is changing in several ways; for example, it is becoming more and more individualized, a change brought about by the introduction of scores of programmed instruction courses and a few audio/visual courses. These types of courses permit a student to choose his medium of instruction and to proceed at his own pace (self-paced instruction). All future instructional material must be job related and "system designed"; that is, it must teach the trainee to do a task, and it must follow a specific course including defining the need, planning, developing, and evaluating the course. Thus, all elements required for a complete course will be included in each unit. Training for men and women in many ratings will be planned from the time they enter the Navy until they retire. The objective is to use all the training given and eliminate the "over training" prevalent in the past. Many, if not all, "A" schools will be reduced in length, some other schools will be eliminated. Consequently, more training must be done aboard the ship or station. To expedite onboard training, a great many onboard training packages will be produced. Many of these will be multimedia packages.

# CHAPTER 2

# DOCUMENTATION

Do you ask a lot of questions during a working day? Do you usually ask the same person because he can provide the correct answers? Does that person answer from the "top of his head" or does he refer to a manual and give you an explanation? Chances are that he either looks the information up or he has previously read up on the area in question. If you ever question his responses, do you or he know which manual to go to for proof or clarification of the answer? Do you answer a lot of your own questions by seeking the facts out of reference material? Whichever of the above may fit the case, it is obvious there is no better recourse for answers than written reference material—documentation.

According to definition, documentation is the creating, collecting, organizing, storing, citing, and dissemination of documents or the information recorded in documents. Documents are a medium and the data recorded on them for human use, and by extension, is any record that has permanence and that can be read by man or machine. With the foregoing in mind it is easy to see the importance and relationship of documentation to the data processing world.

The first part of this chapter will discuss in general the required documentation prescribed by SECNAVINST 5233.1 titled Department of the Navy Automated Data Systems Documentation Standards. The discussion will be skeletal in nature but complete enough to acquaint you with the documents that are required for a production ready documentation package. The last part of the chapter will discuss the documentation standards that may be imposed at local command levels.

Remember that you are on your way to becoming a First Class or Chief Petty Officer, and you will be the one who is supposed to answer rather than ask the questions. Your quest for knowledge will now more than ever be directed into the written documentation that surrounds and sometimes seemingly smothers those in supervisory positions.

This smothering effect is dependent on the documentation that is required reference material. If the material is too wordy or confusing in layout, much time is lost and in many cases the material is not utilized to its fullest advantage. The standardization attempt by the Navy through SECNAVINST 5233.1 could do much to help management.

## INTRODUCTION TO COMPUTER PROGRAMMING DOCUMENTATION

Since automated data processing has been adopted by the Navy, a very definite need for documentation has become increasingly apparent. With the use of EAM and first generation computer systems the majority of system information was assembled and remained in the head of the person assigned the task of developing, initiating and running the program or system. Passing on the information was a person to person process, as the man's relief was generally aboard for a learning period of one to three months. With the expansion of data processing in the Navy (personnel and hardware) the contact relief is no longer a luxury available to commands. The passing of information must now be done through factual, detailed and concise documentation.

Many articles have been written discussing the need for and uses of computer program documentation. The following are some of the purposes that documentation serves:

a. Provides managers with documents to review at significant developmental milestones to determine if requirements have been met and if resources should continue to be expended.

b. Records technical information to allow coordination of labor development and use/modification of the computer program.

c. Ensures that authors of documents and managers of project development have a guide to follow in preparing and checking documentation.

d. Provides uniformity of format and content of computer program documentation across command lines.

SECNAVINST 5233.1 has attempted to provide standards of required recorded information for computer programs to ensure that the documentation produced will serve the aforementioned purposes. It is suggested that the following 11 types of computer programming documents be completed for each project:

1. Functional Descriptions (FD)
2. Data Requirements Documents (RD)
3. System/Subsystem Specifications (SS)
4. Program Specifications (PS)
5. Data Base Specifications (DS)
6. Project Manuals (PM)
7. Command/Management Manuals (CM)
8. Computer Operations Manuals (OM)
9. Program Maintenance Manuals (MM)
10. Test and Implementation Plans (PT)
11. Test Analysis Reports (RT)

## DOCUMENT COMPONENTS

Each of the 11 types of documents is a complete work within itself. That is each type is a complete manual or report to explain or support the title of the document. The Functional Description, for example, is the initial definition of a programming project and provides the ultimate user(s) with a clear statement of the operational capability to be developed. This is done by supplying the relevant information called for by the standard outline in SECNAVINST 5233.1, Technical Note 02 (to be discussed later), for each Functional Description. Once the information is supplied to completely fulfill the requirements for a Functional Description, it is then put into manual form as a self standing document.

Within the covers of each of the 11 types of documentation are optional and required components which make up the entirety. Each document is structured from the following components in the sequence listed:

| | |
|---|---|
| a. Front Cover | (Mandatory) |
| b. Title Page | (Mandatory) |
| c. Special Notices | (As required) |
| d. Abstract | (Mandatory in FD, CM, and PM documents) |
| e. Table of Contents | (Mandatory) |
| f. List of Figures | (As required) |
| g. Record of Changes | (As required) |
| h. List of Effective Pages | (As required) |
| i. Text | (Mandatory) |
| j. Appendixes | (As required) |
| (1) Glossary | (As required) |
| (2) Reference | (As required) |
| (3) Bibliography | (As required) |
| (4) Other Appendixes | (As required) |
| k. Index | (Optional) |
| l. Distribution List | (Mandatory) |
| m. Back Cover | (Mandatory) |

Detailed requirements as to the explanation of each component and the required format to be followed can be found in SECNAVINST 5233.1, Technical Note 03.

## DOCUMENT TYPES

The 11 different document types are discussed as to their contents and use in the following.

### FUNCTIONAL DESCRIPTION (FD)

An FD is normally prepared for any system requiring a basis for mutual understanding between the developers and users of a proposed computer program system. It reflects the initial definition of a programming project and provides the ultimate users with a clear statement of the operational capability to be developed. If the scope of the FD is changed at any point during project development, the FD should be updated and receive user concurrence.

The FD is a technical document and a management tool for use by both computer oriented personnel and inexperienced users and should be written as much as possible in noncomputer oriented language, since most elements of the document will be subject to review by staff personnel who do not necessarily have a computer background.

#### Description of Contents

SECNAVINST 5233.1 not only standardizes the document types and components but also provides

a standard outline to be followed for each text component of each document type. These outlines contain the sections, heading and subheadings in a table of contents for each document type. Each heading and subheading is then further defined and the format given for completing each section. The complete description of contents for the Functional Description document will be provided here only as an example of the detail found by SECNAVINST 5233.1.

Figure 2-1 (at the end of this chapter) includes a table of contents and the narrative description of the contents of that document type. Each page shown within the figure is formatted in accordance with the Computer Program Document Preparation Standards. The page numbers given in the table of contents for a particular document are those at the bottom of the figure box.

## DATA REQUIREMENTS DOCUMENT (RD)

The RD is normally prepared when a data collection effort by the user group is required to generate and maintain system files.

The Data Requirements Document is a technical document prepared by both systems and user personnel. It is to be as detailed as possible concerning the definition of inputs required of the user, the procedures to be followed to provide this input to the system, the description of expected output data, the specification of all uses of standard data elements, and the data limitations of the system.

The Data Requirements Document serves as a tool for the development of the data processing system and for the coordination of standard data elements.

A data element is a class, category or basic unit of information that denotes a set of data items. For example, the data items "Pennington, Fairfax and Orange" are members of the set denoted by a data element "county." The names and associated codes of many data elements have been standardized by higher authority in order to facilitate data exchange and commonality of data structures. These standard data elements and data element codes shall be used whenever applicable in all data base files. These include the FIPS (Federal Information Processing Standards) and Department of Defense Standards as listed and defined respectively in the FIPS Publications Series and the SECNAV Instructions pertaining to data element standards.

Automated data element libraries have been developed and are being used by various organizations within the DOD. These data element libraries identify and define the data elements used by that organization, reference the systems and files in which used, and associate these data elements with applicable data element and data code standards. When a data processing system is designed that uses standard data elements or uses data elements that have not yet been standardized, any existing data element libraries should be updated to reflect the new uses.

There are three sections to the RD. These are: General, Data Description and User Support for Data Collection. The detailed outline for the RD sections may be found in SECNAVINST 5233.1.

## SYSTEM/SUBSYSTEM SPECIFICATION (SS)

An SS may be prepared to guide the development of large projects. If the system breaks down readily into subsystems, this document may be used to prepare individual subsystem specifications. A subsystem is herein defined as the logical breakdown of a system into separate areas of responsibility, such as functions, where each breakdown is composed of a program or series of programs. If individual subsystem specifications are prepared, they may at some point be bound together to form a System Specification or a separate System Specification may be written. Many systems, however, may not logically be broken down into smaller components because they are already broken down into the lowest common denominator. In these cases this document outline may be used to write a System Specification.

The System/Subsystem Specification may present modifications from the FD (Functional Description), but it should be noted that any modification to the scope of the system effort should be submitted as changes to the FD.

The System/Subsystem Specification is a technical document prepared for systems personnel. It is to be as detailed as possible concerning the environment and design elements in order to provide maximum guidance to the program design effort. This document also defines system/subsystem interfaces. It is anticipated that the

System/Subsystem Specification will present more detailed data than the FD as a result of the continuing design effort. Subsystem specifications will consider only those segments of the FD that are applicable to the particular subsystem.

There are four sections to the SS. These are: General, Summary of Requirements, Environment and Design Data. The detailed outline for the SS sections may be found in SECNAVINST 5233.1.

PROGRAM SPECIFICATION (PS)

A PS may be written after SS (System/Subsystem Specification) to expand on its requirements or without any SS having been prepared. The PS may present modifications from the FD, but it should be noted that any modification to the scope of the system effort should be submitted as a change to the FD.

The PS is a technical document. The amount of detail to be included is dependent upon the use to be made of the document within the particular project for which it is prepared. The intent of a PS is to guide program development. It is anticipated that the PS will present more detailed data than the FD and related SS as a result of the detailed program design effort. Furthermore, a PS will consider only those segments of an FD or SS that are applicable to the particular program.

There are four sections to the PS. These are: General, Summary of Requirements, Environment and Design Data.

DATA BASE SPECIFICATION (DS)

A DS is generally prepared when many analysts/programmers will be involved in writing programs that will utilize the same data.

The DS is a technical document prepared for programmers. It shall be sufficiently detailed to permit program coding and data base generation by the development group. Since this document is intended to cover all types of systems, it does not make specific data or presentation formats mandatory. Developers of any given system are best qualified to devise the physical formats most useful and comprehensible to project personnel. However, to achieve consistency in documentation the following practices shall apply in all Data Base Specifications:

a. The order of information given by the outline in SECNAVINST 5233.1, TN-02, shall be followed.

b. Each formatted presentation shall be followed by an explanation of the formatted arrangement.

c. Each item of information shown in a formatted presentation shall be consistent with standardized data element names as shown in data element libraries.

There are five sections to the DS. These are: General, Data Base Identification and Description, Data Definitions, Data Base Storage and Common Data Pool.

COMMAND/MANAGEMENT MANUAL (CM)

The primary purpose of the CM is to serve the needs of the user group. Sections 1 and 2 of the CM present general and specific information on a specific computer program system, and are directed toward an organization's general management and staff personnel who have no need for detailed technical information concerning system implementation or operation. Sections 3 and 4 of the CM address staff personnel but are more detailed on how to provide input to the system, respond to requests from the system for information and make use of outputs from the system that may be in the form of hard copy, CRT displays, etc. Instructions for the operation of specific consoles or terminals may be included in appropriate appendixes.

If a Command/Management Manual is the only document produced for a particular computer program, an annotated program listing must be provided.

There are four sections to the CM. These are: General Description, System Summary, Staff Functions Related to Technical Operations, and File Query Procedures.

COMPUTER OPERATION MANUAL (OM)

The OM contains precise and detailed information on the control requirements and operating procedures necessary to successfully initiate, run, and terminate the subject system. It is directed toward supervisory and operator personnel who are responsible for the efficient performance of their organization's computer center. These readers are primarily interested in detailed information on the external characteristics and operating procedures of a computer program. In general, the manual shall be written in a step-by-step fashion as opposed to an expository style

in order to clarify and emphasize the procedures associated with the computer programs. The Computer Operation Manual shall be completely self-contained. Supporting illustrations shall be concerned with the flow of input data and output information but shall not present breakdowns or delineations of the internal logic and flows within a computer program, such as are depicted in a programming flowchart.

There are four sections to the OM. These are: General Description, System Control, Operating Procedures and Nonroutine Operations.

### PROGRAM MAINTENANCE MANUAL (MM)

The MM presents general and specific information on the computer program. It is written for programmer personnel who are responsible for the maintenance of the computer programs. It will describe the computer programs in a detailed, technical presentation to assist the maintenance programmer in his functions.

There are four sections to the MM. These are: General Description, System Description, Input/Output Descriptions and Program Assembling, Loading and Maintenance Procedures.

NOTE: For small projects the Command/Management, Computer Operations, and Program Maintenance Manuals may be combined into one document titled the Project Manual (PM).

### TEST AND IMPLEMENTATION PLAN (PT)

The PT is a tool for directing the program testing, and contains the orderly schedule of events and list of materials necessary to effect delivery of a complete program and to conduct the orientation required for proper use of the programs. Those parts of the document directed toward the staff personnel shall be presented in nontechnical language, and those parts of the document directed toward the operations personnel shall be presented in suitable terminology.

There are six sections to the PT. These are: General, Test Plan, Test Specifications, Test Descriptions, Test Procedures and Test Evaluation.

### TEST ANALYSIS REPORT (RT)

The RT describes the s[illegible]s of the computer program system after test [illegible] provides a presentation of deficiencies for review by staff and management personnel. Therefore, this document should be prepared in nontechnical language.

There are four sections to the RT. These are: General, Test Analysis, System Function Analysis and Summary and Conclusions.

## NEED FOR STANDARD DOCUMENTATION

All of the document types previously discussed may not be needed on a particular project. One of the main determining factors for the number of documents to be provided is the ultimate user. If the user is not computer oriented, it may be beneficial to you and the user to provide all the documentation. This will allow you to explain as much about the system (hardware and software) as possible in a language that the user can understand. The more the user understands about the actual functioning of the system, the better for both parties. Once understanding is developed, communication becomes easier not only in the area of the current project but also for any future dealings.

If the project is large and complex, the maximum amount of documentation should also be provided. Under these circumstances it doesn't matter if the user is computer oriented or not. The better and more complete the documentation is in this case, the better the final product (system) will be. The more documentation produced the less likely it will be that any portion of the system will be left out.

To further help in determining the need for proper documentation, SECNAVINST 5233.1 provides two charts. Figure 2-2 is a chart listing factors and five values assigned to each factor. The more complex, costly or time restricted a factor is, the more value it holds. To utilize the chart for a project, simply put a check mark beside the descriptive block that is most true for each factor. Total the check marks for each column and multiply that times the value for that column. For instance, you may have arrived at a total number of four check marks in column one and a total value for that column of four (4 times 1 equals 4), four check marks in column two for a total value of eight (4 times 2 equals 8), three check marks in column 3 for a total value of nine (3 times 3 equals 9) and no check marks in columns four or five. Each column's value totals are then added together for one total (in this case 21), which is the level of project complexity.

Once a level of project complexity has been established, the types of documentation can then

| FACTORS | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. ORIGINALITY REQUIREO | NONE—REPROGRAM ON OIFFERENT EQUIPMENT. | MINIMUM—MORE STRINGENT REQUIREMENTS. | LIMITEO—MORE ENVIRONMENT. NEW INTERFACES. | CONSIOERABLE—APPLY EXISTING STATE OF ART TO NAVAL ENVIRONMENT. | EXTENSIVE—REQUIRES AOVANCE IN STATE OF THE ART. |
| 2. OEGREE OF GENERALITY | HIGHLY RESTRICTED. SINGLE PURPOSE. | RESTRICTEO—PARAMETERIZEO FOR A RANGE OF CAPACITIES. | LIMITEO FLEXIBILITY—ALLOWS SOME CHANGE IN FORMAT. | MULTI-PURPOSE—FLEXIBLE FORMAT. RANGE OF SUBJECTS. | VERY FLEXIBLE—ABLE TO HANOLE A BROAO RANGE OF SUBJECT MATTER ON OIFFERENT EQUIPMENT. |
| 3. SPAN OF OPERATION | LOCAL OR UTILITY. | COMPONENT COMMAND. | SINGLE COMMAND. | MULTI-COMMANO, NAVY WIOE. | OEFENSE OEPARTMENT. WORLO WIOE. |
| 4. CHANGE IN SCOPE ANO OBJECTIVE. | NONE. | INFREQUENT. | OCCASIONAL. | FREQUENT. | CONTINUOUS. |
| 5. EQUIPMENT COMPLEXITY. | SINGLE MACHINE. ROUTINE. PROCESSING. | SINGLE MACHINE. ROUTINE PROCESSING. EXTENOEO PERIPHERAL SYSTEM. | MULTI-COMPUTER. STANOARO PERIPHERAL SYSTEM. | MULTI-COMPUTER. AOVANCEO PROGRAMMING COMPLEX PERIPHERAL SYSTEM. | MASTER CONTROL SYSTEM. MULTI-COMPUTER AUTO INPUT/OUTPUT ANO OISFLAY EQUIPMENT. |
| 6 PERSONNEL ASSIGNEO | 1-2 | 3-5 | 5-10 | 10-18 | 18 ANO OVER |
| 7. OEVELOPMENTAL COST. | 1-10K | 10-50K | 50-200K | 200-500K | OVER 500K |
| 8. CRITICALITY. | OATA PROCESSING. | ROUTINE OPERATIONS. | PERSONNEL SAFETY. | UNIT SURVIVAL. | NATIONAL OEFENSE. |
| 9. AVERAGE RESPONSE TIME TO PROGRAM CHANGES. | 2 OR MORE WEEKS | 1-2 WEEKS. | 3-7 OAYS. | 1-3 OAYS. | 1-24 HOURS. |
| 10. AVERAGE RESPONSE TIME TO OATA INPUTS. | 2 OR MORE WEEKS. | 1-2 WEEKS. | 1-7 OAYS. | 1-24 HOURS. | 0-60 MINUTES. |
| 11. PROGRAMMING LANGUAGES. | HIGH LEVEL LANGUAGE. | HIGH LEVEL ANO LIMITED ASSEMBLY LANGUAGE. | HIGH LEVEL AND EXTENSIVE ASSEMBLY LANGUAGE. | ASSEMBLY LANGUAGE. | MACHINE LANGUAGE. |
| 12. CONCURRENT SOFTWARE DEVELOPMENT. | NONE. | LIMITED. | MOOERATE. | EXTENSIVE. | EXHAUSTIVE. |
| TOTALS | | | | | |

Figure 2-2.—Level of project complexity.

| COMPLEXITY TOTAL | DOCUMENT TYPES | | | |
|---|---|---|---|---|
| 12 - 15 | | | CM | |
| 12 - 26 | | | PM | PT |
| 24 - 38 | FD | | CM OM MM | PT |
| 36 - 50 | FD | SS | CM OM MM | PT RT |
| 48 - 60 | FD | SS PS | CM OM MM | PT RT |

NOTES: 1. PREPARATION OF RD AND DS IS SITUATIONALLY DEPENDENT.
2. ADDITIONAL DOCUMENT TYPES MAY BE REQUIRED AT LOWER COMPLEXITY TOTALS TO SATISFY LOCAL REQUIREMENTS.

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Figure 2-3.—Document types/project complexity.

be determined. Figure 2-3 is suggested as a method of determining the documentation requirements based on the complexity totals. In the above example the complexity total of 21 would require the writing of a project manual and test and implementation plans.

It must be emphasized that this is a general guide. Situations occur when more or fewer document types may be required, as is indicated in the notes of figure 2-3.

## LOCAL DOCUMENTATION REQUIREMENTS

The Navy has established documentation standards to ensure completeness and uniformity for computer system information between commands and between civilian and Navy organizations. The amount of detail and the time/cost factor of such program documentation for "in-house" use at the local level may be too great. In these instances options are given to the commander/commanding officer providing the resources and/or funds to establish appropriate minimum documentation requirements less than those established in SECNAVINST 5233.1.

Appropriate minimum documentation is usually arrived at by the head of the data processing department/division. This is generally based on experiences of personnel who have been involved in writing, maintaining and analyzing programs/systems, and in training personnel to take the jobs of transferred personnel.

The key to the minimum amount of documentation required by local commands should be the amount that is required for replacement personnel to understand input, processing and output for each program system for which they will be responsible. The following items to be included in documentation at local levels for internal use are recommended as an example of what each data processor should establish as the minimum standards of documentation. These may be expanded or reduced due to the diversity of programming projects and techniques at the many varied commands within the Navy.

## SUGGESTED INFORMATION

Even though local requirements may be much less than those of SECNAVINST 5233.1, terms from the instruction should be utilized rather than individual terms unique to the command/programmer. Basically a combination of several manuals should be utilized and the Technical Note 02 of SECNAVINST 5233.1 consulted as it may help to ensure that a subject being documented is complete.

### Project References

At the beginning of each project a listing should be kept of all references that you have to consult for information or guidance in understanding the system or problem to be programmed. These references and those that you may utilize before completion of the project should be listed and made a part of the permanent documentation for the project.

### Objectives

A narrative statement(s) of the major performance requirements or goals of the computer program system should be included. If the project consists of more than one problem, this should in essence be a problem description of the system. That is, it should be a statement of the problem that may include a description of the method of solution, the solution itself, the relationship of procedures, data, constraints and environment.

In addition, this portion could anticipate changes that may affect the system and explain and identify those areas developed in preparation for the change.

Also, if this project includes more than one program, a separate more detailed objective or problem statement should be made for each program to be developed. If the project is for development of only one program, then the objective should be as detailed as possible to explain the problem to be solved and method of solution.

Input Sources

A listing should be kept of commands, departments and divisions that are directly responsible for providing original (source) data for the system. For each of the input sources, key personnel should also be referenced and the listing kept up to date when personnel are transferred.

Examples of each type of source document might also be included in this area. Notation of the type of action required or generated because of each type of document could be of great benefit. If a source document has multiple uses, a list and explanation of each code is mandatory along with an associated list of the data elements that comprise the complete format for each coded input. If the source documents originate from different sources, make sure the examples are associated with their respective listed origin. This particular section, if completed as suggested, should be duplicated and distributed as a keypuncher's (or key to tape, or key to disk) guide.

Data Base Layouts

The term data base refers to a collection of data, at least as large as a file, as defined by a particular user or system. Basically, this means all of a program's required input may not come from just one file, but it must utilize at least one file. A file is a collection of related records treated as a unit. For example, an inventory file is a collection of invoice records (one invoice record contains all of the inventory control data for one item) which are all related to each other not as like products but by the fact that they are located under one roof (USS FLOATERS Inventory Control File).

The data base for a program could be the "Master Stock Number Listing File," which contains all the stock numbers available through GSA. A program that works with just that file would have a single file data base. If a program were to be constructed that required percentages be established as to the usage of a stock item by class of ship, a multiple file data base would be required. That is, the "Master Stock Number Listing File" would be required as input to insure that all stock numbers are accounted for and that the all Navy usage total for each item is acquired. Then each "Master Usage List File" for each class of ship would be brought into storage, the stock numbers matched and their total usage recorded in storage. When the usage totals for the same stock number from each "Master Usage List File" for each class of ship have been recorded in storage for the respective "Master Stock Number Listing File" stock numbers a logical record has been constructed, and the program may then be executed to calculate the percentages. The system (program) has required that a record be constructed from a data base (collection of data from various files) to create a data base (in this case, one file of collected related records) output.

By definition and example, a file used by itself is always a data base, but a data base is not always a file (collection of related records). Under Data Base Layout then, one would expect to find the layouts of all files related to the program. This would include card, magnetic tape, disk and printer layouts describing in detail data items and elements (fields) that make up a record of each input and output.

Also included should be the lengths of inputs and outputs, including special handling requirements due to variations in length. Security classification of I/O items should be clearly indicated so that no doubt exists on the handling requirements for this project. File tags, titles, labels and full names of all data base files must be given.

Table Definitions

A table is a collection of data in which an item is uniquely identified by a label, by its position relative to the other items, or by some other means. A table is an area of storage reserved by a program and may contain data that is constant, brought in from input, constructed from input or constructed for output. A table is usually made up of related data

elements such as "states" with only the first state, "Alabama" having an unmodified address (and that address would be the address associated with the table label, beginning address). Each state could then have its respective counties within it, and these would be addressed by first addressing the state and then the county within the state. The addressing method itself would depend on the hardware and the language utilized. (The table structure will be explained for COBOL in later chapters.)

The documentation for tables to be used by a system would then be required to contain the following data:

Table tag or label

Brief but concise description of the purpose of the table

Graphic layout of the table showing the number of parts, subparts and the sizes of each (character length or number of words).

The type of data should also be indicated as to whether it is alphabetic, alphanumeric or numeric. An example of the method of addressing each part and subpart (written in the language to be used) should be given.

Control Instructions

Most systems require that control cards precede and trail object programs and input data. These cards give specific information to the software packages to provide proper input, processing and output by your programs. These control cards may be many in number, each one containing specific sequenced parameters. Parameters are variables that are given a constant value for a specific purpose or process.

The number of control cards and the number of parameters will vary depending on the system. Each card will hold a specific number of parameter statements. Each parameter must be filled in with the correct code that applies to this program (i.e., beginning address to load the program for execution). As these parameters must adhere to strict format and are time-consuming to complete, it would be advantageous to provide a listing of each, explanations of the parameters (or reference to a control language manual) and indication of their required placement in an object program or input file.

NOTE: Control cards will not be discussed as to makeup in this manual as there is so much variance with each system and with each language.

Program Logic

The programmer's logic should be depicted in the form of a programming flowchart. This should be neat and completely legible. All standard symbols and flowcharting procedures should be used. Any labels (tags, titles, names or acronyms) used in the flowchart that are not defined elsewhere should be defined when used in the flowchart.

When any modifications are made to any part of the other documentation that affects the logic, labels, I/O layouts, etc., that is depicted in the flowchart, the change should also be reflected in the flowchart. In some instances a data flowchart might also be included.

Program Listing(s)

Once the program has been thoroughly tested for all possible conditions and is error free, the source language program deck should be listed and made a part of the documentation. If the program is a low level language, the various routines should be identified, instructions for decision making should be explained, constants defined, etc.

Backup Procedures

Consideration should be given to the possibility that one of the hardware systems elements may fault or "go down." The biggest determining factor for the detail given to backup procedures is the scheduled priority of the program run. Backup as used here means the alternative operation available in the event the primary system element goes down. For example, a backup technique for a disk output would be a tape output.

In the case of an entire hardware system failure the use of another system or other means to accomplish the system requirements should be indicated. For example, the backup (or in this total aspect, fallback) technique for an automated system might be manual manipulation and recording of the data. In either partial or complete hardware failure the backup procedures may require almost as much documentation as the normal system.

Operator's Manual

Clear, concise instructions must be provided to ensure that the operator will provide the

necessary step-by-step physical operation required for the successful job run. Reference to the Computer Operation Manual in SECNAVINST 5233.1, TN-02, should be made to help preclude the possibility of not including small but needed documentation for the operator.

Management Information

Other information that is required for management purposes, such as scheduling, supply costs, man-hour costs, system costs, etc., should be included. Required form numbers or stock numbers for requisitioning of supplies should be listed. If supplies are not ordered through regular GSA channels, the sources to be ordered from should be listed. Volumes of anticipated cards, paper, and magnetic tape should be included. In short, information for inventory control of associated supplies should be established.

SUMMARY

Documentation is an extremely important facet of the data processing world. Every effort should be made to provide complete packages for each system developed. Research or use of available documentation should also be encouraged by you for all those at your installation.

When a person enters a new field or is transferred to a new duty station, documentation is heavily relied on by the new man to reassure himself that he is performing correctly. After awhile on the job (especially a repetitious one), documentation is not referenced as frequently. This is human nature and is one of the larger single reasons for expensive and time consuming rerun requirements. As a person progresses up the ladder of responsibility, reference to and requirements for documentation become greater. A person being advanced generally finds that eventually he is no longer the person that is in daily contact with the actual job, but he must still be aware of all that occurs within his shop. In this supervisory position it is extremely desirable to have good documentation as a library.

Being in the Navy, a person is always in training to become a leader and a supervisor. Let's make sure that part of that training is in the area of documentation.

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78.139.1

Figure 2-1. — Functional description (1 of 14).

SECTION 1. GENERAL

1.1 Purpose of Functional Description. This paragraph shall describe the purpose of the FD (Functional Description) in the following words, modified when appropriate:

This Functional Description for (Project Name) (Project Number) is written to provide:

a. The system requirements to be satisfied which will serve as a basis for mutual understanding between the user and the developer.

b. Information on performance requirements, preliminary design, and user impacts, including fixed and continuing costs.

c. A basis for the development of system tests.

1.2 Project References. This paragraph shall provide a brief summary of the references applicable to the history and development of the project. The general nature of the computer programs (tactical, inventory control, war gaming, management information, etc.) to be developed shall be specified. The project sponsor, user, and operating center(s) that will run the completed computer programs shall be indicated.

A list of applicable documents[1] shall be included. At least the following shall be specified by author or source, reference number, title, and security classification:

a. Project request, a copy of which must be included as an appendix.

b. Previously developed technical documentation relating to this project.

c. Significant correspondence relating to the project.

d. Documentation concerning related projects.

e. Other manuals or documents that constrain or explain technical factors affecting project development.

f. Standards or reference documentation, such as:

(1) Documentation standards and specifications.

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1 When applicable, specific reference should be made to the provisions of these documents in subsequent sections of the Functional Description.



78.139.2

Figure 2-1.—Functional description (2 of 14).

(2) Programming conventions.

(3) DoD or Federal standards (data elements, programming languages, etc.).

(4) Hardware manuals, support system documentation, etc., if necessary for an understanding of the FD.

2

78.139.3

Figure 2-1.—Functional description (3 of 14).

SECTION 2. SYSTEM SUMMARY

This section shall provide a general description, written in non-ADP terminology, of the proposed computer program system.

2.1 Background. Included within this paragraph, as necessary, will be any information concerning the background of the uses and purposes of the system to orient the reader. Reference must be made to higher order and parallel systems when needed to enhance the general description. The relationships between the project and other capabilities being developed concurrently shall be described.

2.2 Objectives. Statements of the major performance requirements or goals of the computer program system must be included. These statements should be concise and may include examples. When applicable, related events, such as exercises or impending military operations, may be discussed. Any anticipated operational changes that will affect the system and its use shall be identified and the provisions within the system for including them shall be explained.

2.3 Existing Methods and Procedures. This paragraph shall provide a brief description of the current methods and procedures being employed to satisfy the existing information requirements. Both quantitative and qualitative values should be provided for:

a. Organizational/personnel responsibilities

b. Equipment available and equipment required

c. Inputs and outputs (including volume and frequency)

d. Deficiencies (including limitations, such as time delays)

A chart depicting the existing data flow[2] from data acquisition through its processing and eventual output must be provided. This chart may be complemented by an explanation or chart showing the sequence in which operational functions are performed by the user and pointing out the support of these decision making activities that is provided by the present system.

2.4 Proposed Methods and Procedures. A description of the proposed system and its capabilities shall be presented in this and the following paragraphs. When tools, techniques, or procedures from other systems will be utilized with, or will become part of, the proposed system, they shall be referred to in this description.

---

2 A System Information Flowchart may be used.



78.139.4

Figure 2-1.— Functional description (4 of 14).

A chart depicting the proposed data flow[3] should be provided to present an overall view of the planned capabilities.

If the proposed system eliminates or degrades any capabilities in the existing system, these capabilities must also be described as well as the reasons for their elimination or degradation.

When appropriate, alternative methods and procedures that have been considered may be included.

A chart showing the major processing steps[4] and a chart showing the interacting organizations[5] should be included within the following paragraphs wherever they best complement the narrative.

2.4.1 Summary of Improvements. This paragraph shall provide a qualitative and quantitative summary of the benefits to be obtained from the proposed system. A comparison to the deficiencies identified in paragraph 2.3 and the identification of any additional capabilities required, along with appropriate explanations, may be provided.

Explicitly identified will be the required capabilities that will be satisfied by the proposed system. When a required capability is the improvement of existing methods and procedures, the extent of the anticipated improvements must be stated. Also included shall be a comparison of transaction time cycles between the existing and the proposed systems. The discussion shall include:

a. Functional improvements (new capabilities).

b. Improvements of degree (upgrading existing capabilities).

c. Timeliness (decreased response time or processing time).

d. The elimination or reduction of existing capabilities that are no longer needed.

2.4.2 Summary of Impacts. This paragraph shall describe the anticipated impacts and associated costs of the proposed computer programs on the existing equipment, software, organizational, and operational environments. Impacts on the user during the development of the system shall also be noted.

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3 A System Information Flowchart may be used.
4 An Integrated ADP Flowchart may be used.
5 A System Organization Chart may be used.

4

78.139.5

Figure 2-1.—Functional description (5 of 14).

2.4.2.1 Equipment Impacts. Included in this discussion shall be any required additions and modifications to the currently available equipment. Reference shall be made in this paragraph to the specific equipment capabilities outlined in paragraph 4.1 of the Functional Description.

2.4.2.2 Software Impacts. The discussion of software impacts will include any additions or modifications needed to existing applications and support software programs in order to adapt them to the proposed computer program system.

2.4.2.3 Organizational Impacts. Organizational impacts may include the modifications of positional responsibilities and the addition or elimination of responsibilities that will be necessary to implement the new system. Any personnel interactions eliminated will be identified and a discussion provided of the possibilities of retraining. Staff, operator, and program maintenance personnel responsibilities will be discussed. Requirements for the number and skills of additional personnel will be identified.

2.4.2.4 Operational Impacts. Operational impacts will include changes required in both staff and operations center procedures to use the new computer program system. Considered will be impacts on the relationship of the operating center and the user; impacts on the operational procedures of the operating center; operational similarities with other systems; new data sources; quantity, type, and timeliness of data to be provided; data retention and data retrievals; methods of reporting; modes of operation of the user, such as peacetime, alert, and wartime; and results of the suspension of operations of the system by failures not discussed in paragraph 3.5. Also included will be recommended methods for providing input data if those data are not already available. An estimate of the amount of computer time needed for updating, output processing, etc., required by the proposed computer programs will be given.

2.4.2.5 Development Impacts. Development impacts will include a discussion of all user effort that will be required prior to installation of the computer programs, such as manpower required to develop the data base, and operator and computer time necessary for testing. This paragraph will also identify the requirement to develop conversion programs to modify existing data files to be used by the new computer programs. Exceptional levels of manning or computer time required for the parallel operation of the new and existing systems shall be discussed. Any additional activities to be provided by the user to aid development will be included in this paragraph.



78.139.6

Figure 2-1.—Functional description (6 of 14).

2.5 Expected Limitations. Any limitations affecting the desired capability (including the prediction of expected types of errors) and explicit identification of any current or desired capabilities which will not be provided by the proposed computer programs shall be discussed in this paragraph.

6

78.139.7

Figure 2-1.— Functional description (7 of 14).

SECTION 3. DETAILED CHARACTERISTICS

3.1 Specific Performance Requirements. This paragraph shall describe the specific performance requirements to be satisfied by the computer program system. This presentation shall be a delineation of requirements, evolved from the system analysis, on which the system design is to be based.[6] The requirements will be stated in such a manner that system functions discussed in paragraph 3.2 and the system tests necessary for implementation can be related to them. A quantitative presentation of requirements will be included, such as the number of ship plots that must be handled, maximum allowed time from query to display of data, flexibility for adapting to changing requirements, etc.

3.1.1 Accuracy and Validity. This paragraph shall provide a description of the accuracy requirements placed upon the system. The following items must be considered:

a. Accuracy requirements of mathematical calculations.

b. Logical and legal accuracy of alphanumeric data.

c. Accuracy of transmitted data.

3.1.2 Timing. This paragraph shall provide a description of the timing requirements placed on the system, if they are available. The following timing requirements shall be considered:

a. Throughput time.

b. Response time to queries and to updates of data files.

c. Response time of major functions.

d. Sequential relationship of functions.

e. Priorities imposed by types of inputs and changes in modes of operation.

f. Timing requirements for the range of traffic load under varying operating conditions.

g. Interleaving requirements for sequencing and interleaving programs and systems (including the requirements for interrupting the operation of a program without loss of data).

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6 Anticipated deviations from any of the standards specified by the documents listed in the above paragraph 1.2 must be specifically indicated.



78.139.8

Figure 2-1.—Functional description (8 of 14).

3.2 System Functions. This paragraph shall describe the individual functions performed by the proposed computer program system. This description should relate the functions to the performance requirements and to the subsystem or computer programs that will provide the functions and will show how the aggregate of these functions satisfies the specific requirements in paragraph 3.1. If an edit program is required, for example, the fields to be edited and their expected characteristics should be indicated.

3.3 Inputs/Outputs. This paragraph shall explain and show examples of the various data inputs to be used in the computer program system. When available, the medium (disk, cards, magnetic tape, analog originated signals from revolving radar, etc.), format, range of values, accuracy, etc. should be specified.

Also provided shall be examples and explanations of the data outputs of the system, when available, and any quality control outputs that have been identified. Included shall be descriptions and layouts or examples of hard copy reports (routine, situational and exception) as well as graphic or display reports. When an interactive system is being described, these outputs must be related to the system functions described in paragraph 3.2. When possible, these outputs should be related to the programs that will produce them.

3.4 Data Characteristics. This paragraph shall provide a discussion concerning the storage of the data elements to be used by the application. It should include information of specific data elements by name and characters, if known. Also discussed shall be dictionaries, tables, and reference files, if applicable. An estimate of total storage (number of tape files/disk modules and total number of records/cylinders) for the data and related components based on a summation of the requirements should be included.

A description of the expected growth of the data and related components should be provided. Considered must be the number and size of tapes and disks or other media required to store the data.

3.5 Failure Contingencies. This paragraph shall provide a discussion of possible failures of the hardware or software system, the consequences (in terms of system performance) of such failures, and the alternative courses of action that may be taken to satisfy the information requirements. There shall be included as appropriate:

a. Back-up. A discussion shall be provided of the back-up techniques for insuring the continued achievement of system functions given in paragraph 3.2. "Back-up" as used means the redundancy available in the event the primary system element goes down. For example, a back-up technique for a disk output would be a tape output.

8

78.139.9

Figure 2-1.—Functional description (9 of 14).

b. Fallback. An explanation of the fallback techniques for insuring the continued satisfaction of the specific requirements of the system shall be provided. "Fallback" as used indicates the use of another system or other means to accomplish the system requirements. For example, the fallback technique for an automated system might be manual manipulation and recording of data.

c. Restart. A discussion shall be included of the restart capabilities for insuring effective and efficient recovery from a temporary problem within the hardware or software systems. The "restart" capability is a program cabability to resume execution of a program from a point in the program subsequent to which the problem occurred.

9

78.139.10

Figure 2-1.— Functional description (10 of 14).

SECTION 4. ENVIRONMENT

4.1 Equipment Environment. This paragraph shall provide a description of the equipment capabilities required for the operation of the computer program system. This paragraph will present broad descriptions of the equipment presently available and the characteristics of any new equipment necessary based on the discussions in Section 3. A guideline for equipment to be described follows:

a. Processor(s), including number of each on/off-line and size of internal storage.

b. Storage media, including number of disk units, tape units, etc.

c. Output devices, including number of each on/off-line.

d. Input devices, including number of each on/off-line.

e. Communications net, including line speeds.

4.2 Support Software Environment. This paragraph shall provide a description of the support software with which the computer programs to be developed must interact. Included will be both support software, input and equipment simulators, and test software, if needed. The correct nomenclature, level (version), and documentation references of each such software system, subsystem, and program shall be provided. In addition, the language (compiler, assembler, program, query, etc.), the operating system, and any Data Management System to be used will be identified.

4.3 Interfaces. This paragraph shall provide a description of the interfaces with other systems and subsystems. For each interface, the following shall be specified:

a. Description of operational implications of data transfer, including security considerations.

b. General description of data transfer requirements to and from the subject program.

c. Current formats and volume of interchanged data.

d. Type of anticipated interface, such as manual or automatic.

e. Anticipated interface procedures.

4.4 Security. This paragraph shall identify the classified components of the system including computer programs, inputs, outputs, and data bases. Consideration must be given to the fact that the

11

78.139.11

Figure 2-1.— Functional description (11 of 14).

combination of items of one classification may produce a component of a higher classification. This paragraph will specify the level of classification of each component.

12

78.139.12

Figure 2-1.—Functional description (12 of 14).

SECTION 5. COST FACTORS

The purpose of this section is to provide cost factors that may constrain the development, design, and continued operation of the proposed system. While the proposed system responds directly to the project request, other factors may determine the need for this system, such as requirements of higher echelons of command, security considerations, the need to interface with other automated systems, etc.

Discussion of these factors may relate to paragraph 2.4 of the Functional Description. This section should, however, be a collective point of comparison for the conclusions expressed therein. General alternatives that may be discussed include those for system development and system design with consideration being given to equipment, software, organization, operation, etc.

13

78.139.13

Figure 2-1.—Functional description (13 of 14).

SECTION 6. DEVELOPMENTAL PLAN

This section shall discuss the overall management approach to the development and implementation of the proposed computer systems. Included may be a discussion of the documentation to be produced, time frames for the development of the system or the modules of the system, necessary liaison and participation by other organizations to insure successful development, and any other factors that must be known prior to initiating development.

15

78.139.14

Figure 2-1.—Functional description (14 of 14).

# CHAPTER 3

# INTRODUCTION TO COBOL

## HISTORY AND BACKGROUND

On May 28 and 29, 1959, a meeting was called in the Pentagon for the purpose of considering both the desirability and feasibility of establishing a common language for the programming of electronic computers in business data processing. This committee, which was referred to as the Executive Committee of CODASYL (COnference on DAta SYstems Languages), adopted the name COBOL (COmmon Business Oriented Language) as the name to be applied to the target common computer language.

A report of this committee's initial specifications for COBOL was published in April 1960. A maintenance committee composed of user and manufacturer groups was then created, and subcommittees worked until November 1965 when COBOL-Edition 1965 was released by the COBOL committee.

On a parallel, the American Standards Association (ASA) Sectional Committee X3 for Computers and Information Processing was established in 1960 under the sponsorship of the Business Equipment Manufacturer's Association. Many meetings took place between January 1963 and August 1966 when ASA was renamed United States of America Standards Institute (USASI). On August 30, 1966, the content and the format was approved for a proposed USASI standard COBOL.

In 1968 the USASI promulgated what is referred to as USASI X3.23-1968. The Department of Defense (DOD) has adopted these standards, and the Chief of Naval Operations has stated in OPNAVINST 10462.8 of 13 March 1969 that "It is the policy of the Chief of Naval Operations that the programming of all digital computers within the scope of this directive will to the maximum extent feasible be done in an appropriate standard higher-level programming language as set forth herein." This OPNAV policy was in direct line with SECNAVINST 10462.7B of 11 March 1966 that all new computer acquisitions must specify COBOL and FORTRAN (FORmula TRANslator) compilers as a mandatory requirement.

In 1969 USASI again had a name change which resulted in its current title, American National Standards Institute (ANSI). Although the ANSI document (X3.23-1968) goes a long way toward providing a tighter interpretation for the elements of COBOL, and defines several logical modules for common implementation, it does not in itself ensure the development of compatible COBOL compilers. The ANSI COBOL committee realized at the time it started to develop the COBOL Standard that it must provide the user with some means "to validate" a vendor's compliance with the forthcoming Standard. Concurrent with the development of the Standard, the committee undertook to design and develop a set of "audit routines," which were to be so constructed that each element or statement from the Standard could be selected, compiled and executed, giving a "pass" or "fail" indication, as appropriate, for each COBOL feature.

The routines were to accept only one interpretation of a COBOL element or statement, in accordance with the Standard, ensuring that all COBOL programs would yield identical results, regardless of the compiler or computer on which it was to be run. The audit routines were also to provide positive identification of the standard COBOL features that were either present or missing in a given compiler. The committee believed that it would take the combined influences of both the COBOL Standard and the COBOL audit routines to move the business data processing community significantly closer to achieving a means for machine-independent programming. The committee's intention was to make these routines available to the public simultaneously with the publication of the COBOL Standard.

Although the COBOL Standard was published in August 1968, various problems precluded the committee's completing its work on the audit

routines. However, anticipating the ANSI X3.4.4 committee's inability to produce audit routines in a reasonable amount of time, both the Navy and Air Force, being deeply committed to the need for these routines, independently initiated projects in 1967 to undertake and accelerate the development of such routines.

The Navy and Air Force progressed rapidly in the development of their routines. The Navy, for instance, having received the help of several vendors and other users, completed an initial version of the audit routines in January 1968. Continued vendor and user cooperation has enabled the Navy to make significant improvements to its routines in subsequent years. In January 1970, the Navy implemented a version of these routines, requiring all vendors to pass the routines to qualify in procurements involving a COBOL compiler.

Currently, the Navy has been tasked by the Office of the Secretary of Defense (OSD) to consolidate the Air Force and the Navy audit routines into a single set for all DOD use. Upon the Navy's completion of that job, the resultant audit routines will be offered to the ANSI COBOL committee for consideration for adoption.

The ultimate objective of these audit routines is to promote the development of compatible, standard COBOL compilers. However, no single organization can accomplish this alone. The support of every organization interested in these goals is essential. Users must support the ANSI COBOL committee in the expeditious approval and publication of a set of audit routines for the entire COBOL community. They must ensure that all new compilers comply with the ANSI COBOL Standard X3.23-1968. In the interim, a user may do this by requesting from a vendor the latest Navy audit routine results for a specific compiler.

Undoubtedly, the introduction of COBOL in 1960 represents the most significant industry advancement toward the eventual achievement of machine-independent software for the business data processing community. In 1968, with the publication of the ANSI COBOL Standard, another significant milestone was passed in furtherance of this goal.

To ensure that the standards of the COBOL language and the associated compilers are met by contractors, the Chief of Naval Operations (CNO) has authorized the Director, Automatic Data Processing to establish and operate the Central COBOL Compiler Testing Facility (CCCTF). With this action it is hoped that overdue audit routines and their results will become available and, in the future, another victory will have been achieved for machine-independent programming.

## ACKNOWLEDGEMENT

Chapters 3, 4 and 5 of this manual are based on the proposed COBOL standard developed by the American National Standards Institute (ANSI). In response to the Institute's request, the following acknowledgement is reproduced in its entirety:

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## COBOL DIVISIONS

When a program is to be coded in COBOL, it is mandatory that the COBOL program be separated into four separate divisions. The names of the four divisions are as follows: IDENTIFICATION DIVISION, ENVIRONMENT DIVISION, DATA DIVISION, and PROCEDURE DIVISION. The individual divisions may be coded in any sequence that the programmer so desires, but once completely coded and punched into a source deck, the divisions must enter the computer for compilation in the order listed above. The basic purposes of the four divisions are explained in the following paragraphs.

## IDENTIFICATION DIVISION

The purpose of this division is to provide a standard method for identifying the COBOL source programs. This division allows the programmer to provide a program name, the author's (programmer's) name, the date the program was written, a narrative statement regarding the purpose of the program, classification and any other information that would assist others in understanding and working with the program.

## ENVIRONMENT DIVISION

This division describes the computers to be used both for compiling the source program and for running the object program. (Note: It is not infrequent that programs are compiled on one computer and the subsequent object program then executed on another computer.) Memory size, number of tape units, hardware switches, etc., are among the many items that may be mentioned for a particular computer. Problem oriented (programmer originated) names may be assigned to a particular peripheral to allow easier, more identifiable coding in other COBOL divisions. This division is said to be largely computer-dependent as it deals directly with the specifications of the hardware system to be used.

## DATA DIVISION

This division allows the programmer to describe in detail the files required for his program. It is in this division that the PHYSICAL and LOGICAL records are defined and described. The term physical record refers to the number of individual data records or characters that make up a block of data within a file. Blocks of data are restricted in their size only by the amount of storage available for transfer of data to and from an input/output device. The individual data records that make up a physical record are called logical records. As you watch a magnetic tape unit containing input, each time the tape moves, a physical record has been read into the computer. Once the physical record is in memory, a READ statement in the program causes one logical record to be read from the input memory area and moved to an area described by the data division. The logical record is then in an area of memory that is available to the program for execution of the specified instructions of the program. When the last logical record has been called for, another physical record is obtained from the input unit.

In turn, each time a WRITE instruction in the program is executed, a logical record will be read from the area of memory available to the program and delivered to an output memory area. Logical records are accumulated in this area until the specified physical record size is reached. It is at this time that the output tape unit will move, and the physical record will be written.

The characteristics or properties of the data are described in relation to standard data format rather than an equipment oriented format. Therefore, this division is to a large extent computer-independent. So while compatibility among computers cannot, in general, be absolutely assured, careful planning in the data layout will permit the same data descriptions, with minor modification, to apply to more than one computer.

## PROCEDURE DIVISION

It is in this division that the programmer codes in sequence the steps that must be followed to properly solve the problem defined for each logical record and, consequently, each file. This sequence of steps has been depicted in the programming flowchart and should be followed in the procedure division as closely as possible.

This division is essentially computer-independent. That is, any user of COBOL can

understand the information appearing in this division without regard to any particular computer. Furthermore, every COBOL compiler configured to the same level of implementation will interpret this information in the same way.

## COBOL STRUCTURE

A COBOL program is written in terms of meaningful English WORDS, STATEMENTS, SENTENCES and PARAGRAPHS utilizing standard characters.

The characters which are recognizable by the COBOL system may vary depending on the subset of COBOL that is used. For this manual the characters to be used are the alphabetic, numeric and special characters as listed below.

### Characters Used for Words

The first ten decimal numbers are utilized—Ø through 9 (whenever numeric zero is written, it must appear with a slash through it to differentiate it from an alphabetic O). The twenty-six letters of the alphabet are utilized—A through Z. One special character is utilized in construction of words; it is the dash (-).

### Characters Used for Punctuation

There are four characters reserved for punctuation. These characters are the quotation mark, the left and right parentheses, the period, and a space or blank. There are also characters that are used especially for a method called editing. Editing and the associated characters will be discussed in chapter four of this manual.

## WORDS

A COBOL word is composed of a combination of not more than 30 in any combination of the 37 characters available for forming words. Every word is ended by one of the four punctuation characters; there is no exception. There are five types of words used in COBOL. They are: DATA NAMES, PROCEDURE NAMES, LITERALS, FIGURATIVE CONSTANTS and RESERVE WORDS. In this chapter only two of the five types will be discussed as the other three are primarily used in the Data Division and the Procedure Division. The two types to be discussed are data names and reserve words.

### Data Names

A data name is a user created word with at least one alphabetic character. A data name is used to name a data item (field, record, file) most generally appearing in the Data or Procedure Divisions but also in the Environment Division, which is discussed in this chapter.

The following rules apply for forming data names:

1. Data names are composed of not more than 30 of the 37 characters available for forming words.
2. Spaces and special characters are not allowed.
3. Each name must begin with an alphabetic character.
4. Names cannot end with a hyphen.
5. Each data name must be unique (at least one character of each data name must be different from all the rest for a program).

Examples of data names are:

YEARS
Y1975
NUMBER-OF-YEARS (This is one word. Remember hyphens are treated as part of a word by the compiler.)

### Reserve Words

One of the unique characteristics of COBOL is its use of over 200 reserved words. Reserve words are words that are recognized by a COBOL compiler to cause generation of specific machine instructions. These words should never be used by themselves by a programmer as a data name or a procedure name. A complete list of COBOL reserved words is provided in Appendix A of this manual. While all words are not found in all COBOL versions, it is recommended that the programmer avoid using any of these words for data or procedure names.

## CODING SHEET FORMAT

The formatted sheet for coding COBOL programs is fairly standard and is available as a NAVPERS 5230/3 (1/67) form titled COBOL Program Sheet. The coding of a program is also governed by strict rules for placement of the various entries of a COBOL program. Within the areas of this manual that refer to the entries

for each division, placement requirements will be indicated when the entries are explained. The separate portions of the coding sheet are therefore explained and named (where applicable) in the following paragraphs. Refer to figure 3-1 for the following descriptions.

Columns 1-6

These first six columns of the coding sheet are reserved for sequence numbers. The first three columns are for the page number. The next three columns are for the serial or line number for that page. This sequence number when punched in the source deck provides a safety factor. In case the source deck is dropped, individual sections revised or individual cards need to be modified, the source deck can easily be put back in its proper sequence on a sorter or by hand filing.

(Programmer's note: It is good practice not to completely fill a coding sheet as coded lines may need to be added and with available lines on the same page it is easier.)

Column 7

This column is used whenever the last word on a line is not completed and must be continued from the preceding line. A hyphen (-) in this column indicates a continuation of a word with no intervening spaces.

(Programmer's note: It is recommended that such splitting of words be avoided as such action is not compatible to all systems.)

Columns 8-72

All program coding is placed in these columns. Certain entries are required to begin and/or be completely within specific columns of this coding area. These columns are further broken down and related to the terms margin or area. When the various structural units of the language (sentences, paragraphs, section, divisions) are described, their placement will be indicated by use of these terms.

Column 8 is referred to as Margin A.
Column 12 is referred to as Margin B.
Columns 8-11 are referred to as Area A.
Columns 12-72 are referred to as Area B.

Columns 73-80

These columns are used for card deck identification at the discretion of the programmer. Again, if the source deck is disturbed in some manner, the identification punched in these columns will identify the source deck that they belong with, and they may then be resequenced on the sorter or visually (providing the source deck is interpreted). Neither these columns nor columns 1-6 appear in the object program; however, columns 1-6 may have an effect on the compilation operation while columns 73-80 will not. Figure 3-1 shows examples of entries and notations about them.

## SYMBOLS, RULES, AND NOTATIONS USED IN THIS MANUAL

The various language elements that comprise a COBOL program must be written in formats that adhere to fixed and precise rules of presentation. Before discussing these individual formats, it is necessary to understand the various symbols, rules, and notations used in describing them. Each format statement will indicate the following information:

a. The order of presentation
b. Those words that are requisite to the proper functioning of the statement
c. Those words that are optional and included at the discretion of the user
d. That information that must be supplied the user
e. Those elements in the statement that involve a choice by the user
f. Those functions of the particular statement that are optional

In free form, the MULTIPLY statement might appear in the following manner:

> Multiply a data name or a literal by another data name with the result rounded; on size error execute an imperative statement.

This, of course, tells us something about the order of presentation, but very little else about the rest of the format. Let us then establish the first rule of format presentation.

a. All words inherent or built into (reserved) the COBOL language are specified as uppercase.

> MULTIPLY a data name or a literal BY another data name with the result ROUNDED; ON SIZE ERROR execute an imperative statement.

IBM

# COBOL PROGRAM SHEET

Form No. 320-1464-1 U/M.080
Printed in U.S.A.

| System | | Punching Instructions | | Sheet of |
|---|---|---|---|---|
| Program | | Graphic | Card Form# * | Identification SAMPLE01 |
| Programmer | Date | Punch | | 73 80 |

| SEQUENCE (PAGE) 1 3 | (SERIAL) 4 6 | CONT 7 | A 8 | B 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72 |
|---|---|---|---|---|
| 001 | 001 | | | PROCEDURE DIVISION. |
| | 002 | | | WOTE THAT THE ABOVE LINE IS A MARGIN A ENTRY IT ALSO CONTAINS |
| | 003 | | | TWO WORDS AND IS ENDED WITH A PERIOD AND THEN A SPACE AS THIS |
| | 004 | | | ENTRY IS. |
| | 005 | | PART-ONE. | |
| | 006 | | | NOTE THAT LINES 002-004 CONTAIN AN AREA B ENTRY BEGINNING AT |
| | 007 | | | MARGIN B. LINES 003 AND 004 DID NOT HAVE TO START AT MARGIN |
| | 008 | | | B AS THIS LINE DOESN'T BUT IT MAKES A MUCH NEATER APPEARANC |
| | 009 | - | | E. LINE 005 ALSO BEGINS AT MARGIN A AND IS A HYPHENATED WORD. |
| | 010 | | | LINE 005 IN THE PROCEDURE DIVISION WOULD BE KNOWN AS A |
| | 011 | | | PROCEDURE OR PARAGRAPH NAME. MORE THAN ONE SPACE BETWEEN |
| | 012 | | | ENTRIES DOES NOT MATTER. LINE 009 INDICATES THAT A CONTINUATI |
| | 013 | - | | ON OF A WORD IS CONTAINED AS DOES THIS LINE. CONTINUATIONS |
| | 014 | | | ARE NOT GOOD NOR NECESSARY AS LINE 012 COULD HAVE ENDED |
| | 015 | | | WITH THE WORD A AND THE WORD CONTINUATION STARTED ON LINE |
| | 016 | | | 013. |
| | 017 | | | THIS IS STILL PART OF PARAGRAPH PART-ONE REMEMBER MORE |
| | 018 | | | THAN ONE SPACE BETWEEN ENTRIES DOES NOT MATTER. THE PAGE |
| | 019 | | | NUMBER NEED ONLY BE ENTERED ONCE PER PAGE AS THE KEY |
| | 020 | | | PUNCHER SHOULD DUPE IT FOR ALL THESE LINES. |

* A standard card form, IBM electro C61897, is available for punching source statements from this form.

Figure 3-1. — Procedure Division.

b. All uppercase words which are underlined are required or key words. Those uppercase words not underlined are optional and have no effect on the compiler, but may be included at the programmer's discretion to improve readability.

MULTIPLY a data name or a literal BY another data name with the result ROUNDED; ON SIZE ERROR execute an imperative statement.

All uppercase words, whether underlined or not, are a part of the COBOL language and must be spelled exactly as indicated.

c. All lowercase words represent generic terms which must be supplied by the programmer. In the sample statement, there are four such elements to be supplied by the programmer: two data names (which shall be designated data-name-1 and data-name-2 in order of their appearance) or a literal, and an imperative-statement.

d. Elements of a statement involving a choice are surrounded by braces

$$\underline{\text{MULTIPLY}} \left\{ \begin{array}{l} \text{data-name-1} \\ \text{literal} \end{array} \right\} \underline{\text{BY}}$$

data-name-2 ROUNDED;
ON SIZE ERROR imperative-statement.

In some instances, the choice can be made by default. For example, in the statement:

$$\left[ \text{BLOCK CONTAINS integer-1 TO integer-2} \left\{ \begin{array}{l} \underline{\text{RECORDS}} \\ \underline{\text{CHARACTERS}} \end{array} \right\} \right]$$

the programmer must choose either RECORDS or CHARACTERS. If RECORDS is chosen, the word RECORDS must be written because it is a key word (indicated by the underline). However, if CHARACTERS is the choice, CHARACTERS is not a key word and the programmer may or may not write it at his discretion. When the programmer writes a BLOCK CONTAINS entry and neither RECORDS nor CHARACTERS is written, the COBOL compiler assumes that CHARACTERS was chosen and generates machine code based on this assumption.

e. Optional functions which may be included or omitted at the user's discretion are surrounded by brackets [ ].

$$\underline{\text{MULTIPLY}} \left\{ \begin{array}{l} \text{data-name-1} \\ \text{literal} \end{array} \right\} \underline{\text{BY}} \text{ data-name-2}$$

$$[\underline{\text{ROUNDED}}] \quad [; \underline{\text{ON SIZE ERROR}} \text{ imperative-statement,}]$$

f. In some statements, certain portions may be used as many times as needed by the programmer. This repeatability is indicated by the ellipsis ( . . .). Brackets or braces are used as delimiters to indicate the portion of the statement which is repeatable. From the foregoing, the following rule can be formed:

Given an ellipsis ( . . .) in a statement, scan the statement from right to left beginning at the bracket ] or brace } immediately to left of the . . . until the logically matching bracket [ or brace { is found; the . . . applies to the words within the logically matched brackets or braces.

The following two examples illustrate the application of this rule.

Example 1:

$$\underline{\text{ALTER}} \text{ procedure-name-1 } \underline{\text{TO}} [\underline{\text{PROCEED TO}}] \text{ procedure-name-2 } [\text{ procedure-name-3 } \underline{\text{TO}} [\underline{\text{PROCEED TO}}] \text{ procedure-name-4 }] \ldots$$

Scanning this example from right to left, starting at the bracket immediately to the left of the ellipsis, it can be seen that the logically matching bracket is the bracket preceding procedure-name-3. Thus, the second and third lines of the statement can be written as many times as the programmer chooses. The smaller brackets surrounding PROCEED TO in both lines of the statement perform their normal function, i.e., they indicate which portion of the statement is optional.

Example 2:

$$\underline{\text{MOVE}} \left\{ \begin{array}{l} \text{identifier-1} \\ \text{literal} \end{array} \right\} \underline{\text{TO}} \left\{ \text{identifier-2} \right\} \ldots$$

Once again, scanning from right to left, starting at the brace immediately to the left of the ellipsis, the logical matching brace is the brace immediately preceding identifier-2. The

programmer may write as many different identifiers following the word TO as he chooses. The first set of braces in the statement performs its normal function; the programmer must choose either identifier-1 or literal. The following illustrate the acceptable COBOL sentences adhering to the rules established in Example 2:

```
MOVE FIELDONE TO FIELDTWO.
MOVE FIELDONE TO FIELDTWO FIELD3.
MOVE FIELDONE TO FIELDTWO FIELD3
FIELD4 FIELD-5.
```

The preceding illustrate the various elements of a COBOL statement. Certain language elements used in the examples (literal, identifier, imperative-statement) are discussed in later sections.

## IDENTIFICATION DIVISION

In the section called the Identification Division, the information identifying the source program and the output of a compilation is provided. In this division, the user may include such information as the name of the program, date of compilation, programmer's name and so forth. All optional information provided in this division is listed on the printed output of the compilation but has no effect upon the object program.

### ORGANIZATION AND STRUCTURE

In this division and all other divisions of a COBOL program the name of the division must be the first entry. This division name is called a DIVISION HEADER and must begin at Margin A. The fixed paragraph names for entries in the IDENTIFICATION DIVISION identify the type of information that is to appear in the comment-entry. The PROGRAM-ID paragraph is the only other required entry in this division. The other paragraphs are optional and may be specified at the user's discretion in the sequence indicated by the general format that follows:

```
A       |B
8       |12
--------|-------------------------------------
IDENT   |IFICATION DIVISION.
PROG    |RAM-ID. program-name.
[ AUTH  |OR. [ comment-entry ] . . .]
[ INSTA |LLATION. [comment-entry ]. . . ]
[ DATE  |-WRITTEN. [ comment-entry] . . .]
[ DATE  |-COMPILED. [ comment-entry ]. . . ]
[ SECU  |RITY. [ comment-entry]. . . ]
[ REMA  |RKS. [ comment-entry ]. . . ]
```

A comment-entry may be made by any combination of characters from the allowable COBOL character set. The PROGRAM-ID must always appear as the first paragraph following IDENTIFICATION DIVISION. This paragraph must be a single word. It is used to identify the source program and may also identify the resulting object program. The content of the paragraph named DATE-COMPILED will be replaced by the current data and a period. Figure 3-2 is an example of a COBOL identification division.

## ENVIRONMENT DIVISION

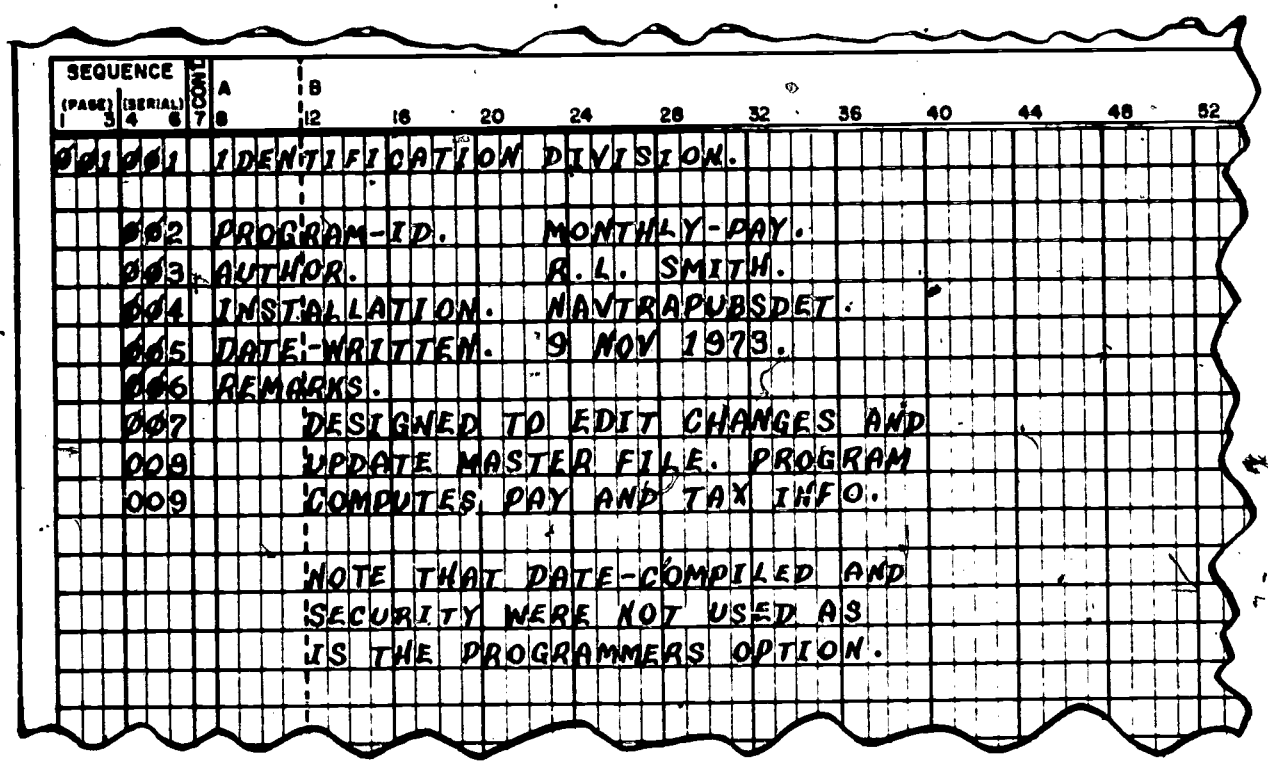
In this division of the COBOL program a relationship is established between the physical requirements of the computing system on which the program will operate and the operations to be performed. That is, the ENVIRONMENT DIVISION describes the computing system on which the object program is to run so that the succeeding divisions of the source program can be translated to an object program for that computing system. This is absolutely necessary as the computer used to compile the object deck may or may not be the same computer in which the object program may be executed. In addition, information relating to input-output control, special hardware characteristics and control techniques can be given.

Each computer system treats this division in a unique manner; therefore, the programmer should always check the system's COBOL manual for the guidelines to follow when writing the ENVIRONMENT DIVISION.

### ORGANIZATION AND STRUCTURE

The following is a general outline of the sections and paragraphs contained in the Environment Division and their order of presentation:

```
A       |B
8       |12
--------|-------------------------------------
ENVI    |RONMENT DIVISION.
CONF    |IGURATION SECTION.
SOUR    |CE-COMPUTER. . . . . .
OBJE    |CT-COMPUTER. . . . . .
SPEC    |IAL-NAMES. . . . . .
INPU    |T-OUTPUT SECTION.
FILE    |-CONTROL. file-control entry
```




78.143

Figure 3-2.— Identification Division.

The discussions that follow are general in nature. Information relating to the specifics of implementation and options peculiar to a system can be found in the programmer's reference manual pertaining to the particular computer.

The first entry in this division is the same as for all other divisions, the division header. ENVIRONMENT DIVISION is a Margin A entry and is required as indicated by the underlined words. This division introduces SECTIONS which are subparts of the division. Each of the sections has a fixed name which identifies it. In this division the section names are CONFIGURATION SECTION and INPUT-OUTPUT SECTION. Each section name must begin in Area A (usually Margin A) and must be followed immediately by a space, the word SECTION, and a period. The section name must be the only entry on that particular coding line.

## CONFIGURATION SECTION

Within the configuration section there are three paragraphs, the SOURCE-COMPUTER, OBJECT-COMPUTER and SPECIAL-NAMES paragraphs. The format for the first paragraph is:

SOURCE-COMPUTER. computer-name.

This paragraph names the computer upon which the source program is to be compiled and provides a means of communicating with the software (executive routine).

The format for the second paragraph is:

OBJECT-COMPUTER. computer-name.

This paragraph describes the computer upon which the object program is to be run.

The computer-name that follows the source and object computer paragraph names describes equipment configuration. These computer-name entries are names fixed by the manufacturer and are recognized by the software (compiler) as designations of memory size and other characteristics of the computer system.

SPECIAL-NAMES

The special-names paragraph allows a programmer to assign a mnemonic of his own to a software reserved word for a special feature of the software control for on-line peripherals, such as a printer. This allows a subroutine to be developed during compilation and included in the object program.

Format:

SPECIAL-NAMES.

[ implementor-name { IS mnemonic-name-1 / IS mnemonic-name-2 } ]

Description

Implementor-name is the reserved word, such as TOP-OF-NEXT-PAGE, assigned to a device to indicate carriage control of an on-line printer. The mnemonic-name is programmer assigned and is to be used in the procedure division. Example:

SPECIAL-NAMES. TOP-OF-NEXT-PAGE IS NEW-PAGE.

In the procedure division when the desired number of lines have been printed, a statement could be written to cause page overflow, such as:

WRITE DET-REC AFTER ADVANCING NEW-PAGE LINES.

```
SEQUENCE  (PAGE) 1 3  (SERIAL) 4 6  CONT 7
A 8   B 12 16 20 24 28 32 36 40 44 48 52
ØØ2ØØ1 ENVIRONMENT DIVISION.
       ØØ2 CONFIGURATION SECTION.
       ØØ3 SOURCE-COMPUTER. IBM-360-40.
       ØØ4 OBJECT-COMPUTER. IBM-360-30.
       ØØ5 INPUT-OUTPUT SECTION.
       ØØ6 FILE CONTROL.
       ØØ7     SELECT DATA-FILE ASSIGN TO SYSIN1.
       ØØ8     SELECT REPORT-FILE ASSIGN TO SYSOU1.

               NOTE DATA-FILE IS THE PROGRAMMER NAME
               DESIGNATING THE INPUT FILE AS EVIDENT
               BY THE ASSIGNMENT SYSIN THE SYSIN1 MAY
               BE THE FIXED IMPLEMENTOR-NAME ASSOCIATED
               WITH A PARTICULAR TAPE DRIVE OR CARD
               READER OR OTHER IMPUT DEVICE.

               NOTE REPORT-FILE IS ASSIGNED AS OUTPUT
               TO A FIXED NAME DEVICE CALLED SYSOU1.
```

78.144

Figure 3-3.— Environment Division.

INPUT-OUTPUT SECTION

This section deals with the definition of the external media and provides information needed for the most efficient transmission of data between the media and the object program. Although this section can contain two paragraphs, only one will be explained.

The format for the FILE-CONTROL paragraph is:

```
FILE-CONTROL. SELECT [OPTIONAL]
file-name ASSIGN TO [integer-1]
implementor-name-1
[, implementor-name-2] ...
```

This paragraph is used to name each file, identify the hardware medium which contains it and permit specific hardware assignments for the program. Each file (input and output) to be utilized by the computer is named once and only once as file-name in a SELECT statement of the FILE-CONTROL paragraph.

The keyword OPTIONAL is required for input files that may or may not be present when the object program is run. (Even though a file is named, there are programming methods which allow a file (or files) to be ignored for specific runs.)

All files employed in the program must be ASSIGNed to a specific input/output hardware device (card reader, tape unit, printer, etc.). The names of these devices are usually abbreviations recognized by the software, and this allows the executive routine during run time to have addresses for input/output channel control. The exact names for these devices (implementor-name-1, . . .) will be covered in the specific programmer's reference manual at your installation.

Integer-1 indicates the number of input-output units assigned to a file-name. If integer-1 is not specified, the compiler determines the number of units (usually one) to be assigned. If this entry is used, more than one implementor-name will be coded as the indication is that a file (e.g., on magnetic tape) consists of more than one reel and that when implementor-name-1 has reached end-of-reel, implementor-name-2 will be automatically addressed, then upon end-of-reel, implementor-name-3, etc. This means that the multireels for a file are mounted on the associated devices at setup time prior to run time.

Figure 3-3 is an example of a coded ENVIRONMENT DIVISION.

# CHAPTER 4

# DATA DIVISION

All data connected with the input/output and all other data created by the programmer required for correct processing must be identified prior to execution of the program. Identification usually consists of supplying the following:

a. Name of the input or output file with which the data is associated
b. Name of the record with which the data is associated
c. Name of the data
d. Length (amount of required storage) of the data
e. Type of data (numeric or alphanumeric)
f. Name, length and type of data in an independent (not associated with a record—programmer created) item

It is in the section of the program entitled DATA DIVISION that this description of all the data and storage areas is found. The DATA DIVISION is comprised of two sections called the FILE SECTION and the WORKING-STORAGE SECTION. The file section contains two types of descriptive entries. They are:

a. File description entries pertaining to each file handled by the program (input and output)
b. Record description entries for each record in a given file

The working-storage section describes all item, record and file areas used as temporary storage areas. Constant data is also described in the working-storage section.

## DATA ORGANIZATION

In the COBOL data division there are terms related to the various entry types. These terms denoting entry types are: item, group item, elementary item, data record, file and independent item. Following are definitions of these terms.

### ITEM

Suppose that a programmer is working on a problem that involves the processing of data on various types of ships. Perhaps one of the pieces of data involved might be the total number of submarines. Another piece of data might be the total number of destroyers, and so forth.

Each of these particular pieces of data is referred to in COBOL as an ITEM. Each can be given a data-name as shown:

| TOTAL-SUBMARINES |
|---|
| TOTAL-DESTROYERS |

GROUP ITEM

Now suppose that the total number of submarines must be processed in terms of fleet assignment. The number of submarines in each fleet would then be a specific item, and each of these pieces of data could be referred to by a data-name, as indicated in the following example.

| TOTAL-SUBMARINES-BY-FLEET | |
|---|---|
| SUBS-6TH-FLEET | SUBS-7TH-FLEET |

Since the item named "TOTAL-SUBMARINES-BY-FLEET" is composed of smaller items, it is referred to as a GROUP ITEM. Group items are beneficial to the programmer when moving data around in storage. If not for group items, each of the smaller items would have to be moved by individual move statements. If the programmer wrote a statement MOVE TOTAL-SUBMARINES-BY-FLEET TO OUT-TOT-SUBS, both the smaller items, SUBS-6TH-FLEET and SUBS-7TH-FLEET, would be moved to an area named OUT-TOT-SUBS.

ELEMENTARY ITEM

In the previous example the two items SUBS-6TH-FLEET and SUBS-7TH-FLEET are referred to as ELEMENTARY ITEMS. Elementary items are those items that are not further subdivided into smaller items. These elementary items are the items utilized for processing steps. A statement written as ADD SUBS-6TH-FLEET TO SUBS-7TH-FLEET would cause the data found in both elementary items to be totaled together.

DATA RECORD

The next unit of data in COBOL is a combination of items—the DATA RECORD. A data record is usually a group item comprised of several related items (group items and/or elementary items). The data record is sometimes referred to as the logical record. In our example of types-of-ships-data, a logical record or data record (SUBMARINE-RECORD) might appear as follows.

| SUBMARINE-RECORD | | |
|---|---|---|
| TOTAL-SUBMARINES | TOTAL-SUBMARINES-BY-FLEET | |
| | SUBS-6TH-FLEET | SUBS-7TH-FLEET |

In this example the Data Record is comprised of one elementary item—TOTAL-SUBMARINES, and one group item—TOTAL-SUBMARINES-BY-FLEET (containing 2 elementary items). In this case if the programmer wrote MOVE SUBMARINE-RECORD TO OUT-SUB-RECORD, all items which are subdivisions of the data record would be moved to OUT-SUB-RECORD.

FILE

If data on all types of ships for the two fleets were together, it would then be a FILE. A file must have a name attached to it. Records are associated with a file, whereas group items and elementary items are associated with a record. A file might appear as shown.

<table>
<tr><td colspan="5">SHIP-FILE</td></tr>
<tr><td colspan="3">SUBMARINE-RECORD</td><td colspan="2">DESTROYER-RECORD</td></tr>
<tr><td>TOTAL-SUBMARINES</td><td colspan="2">TOTAL-SUBMARINES-BY-FLEET</td><td>TOTAL-DESTROYERS</td><td colspan="2">TOTAL-DESTROYERS-BY-FLEET</td></tr>
<tr><td></td><td>SUBS-6TH-FLEET</td><td>SUBS-7TH-FLEET</td><td></td><td>DESTROYERS-6TH-FLEET</td><td>DESTROYERS-7TH-FLEET</td></tr>
</table>

INDEPENDENT ITEM

The final data unit that will be considered is any elementary item that is not a part of a record. Such an item is appropriately referred to as an INDEPENDENT ITEM. Independent items are used to define constants or work areas of the elementary item type.

The COBOL data-units that have been discussed in this section are summarized in the following examples.

FILE—Collection of related data records.
DATA RECORD—Composed of several related items.
GROUP ITEM—Item that is subdivided into smaller items.
ELEMENTARY ITEM—Item that is not composed of smaller items.
INDEPENDENT ITEM—Elementary item that is not a part of any record.

FILE SECTION

The file section is the first section in the data division. It is in this section that the input and output files are described in detail. All specifications of the file must be given first in the file description entry (FD), and then the record (logical) is described.

FILE DESCRIPTION (FD)

A file description is written for each file processed in the program. It generally pertains to the physical aspects of the file. The file description entry, as all entries in the data division, must start with what is referred to as a level indicator. A level indicator is a coding

structure which serves to identify the major items and those items that are subdivisions of major items. The level indicator for the file description entry, which is the major item in the file section, is a mnemonic of FD. All other level indicators will be two numeric digits.

The following discussion of the FD entry is general in nature as the procedures may vary somewhat from system to system. The general form for the FD entry is as follows:

| A | B |
|---|---|
| 8 | 12 |
| FD | file-name [;BLOCK CONTAINS [integer-1 TO] integer-2 {RECORDS / CHARACTERS}] |
| | ;LABEL {RECORDS ARE / RECORD IS} {STANDARD / OMITTED / data-name-1 [, data-name-2]...} |
| | [;DATA {RECORD IS / RECORDS ARE} data-name-5 [, data-name-6]...] |

The mnemonic level indicator FD indicates that everything that follows until the next FD indicator or another section header is encountered belongs with the file that is to be described. Each file that has a SELECT statement in the environment division must be described in the file section with an FD entry (except for the SORT feature; not covered in this text).

The mandatory B Margin first entry of file-name will be the precise name as it appears in the SELECT statement of the environment division. Depending on the system, the name that is entered here is the name that will be provided as a label in the case of an output file.

The BLOCK CONTAINS clause allows enough options to provide for all types of files (fixed-variable, variable-fixed, variable-variable or fixed-fixed). As the programming is more complex when you vary from the fixed-fixed method of reading and writing data and the complexity may be further increased by the individual systems (hardware and software), this text will give examples of control for fixed-fixed file description only.

BLOCK CONTAINS 5 RECORDS

In the statement shown, the blocking length of output for writing or for reading input will be five logical records. Record lengths are defined after the FD entry, so at this point all that is specified is that once five logical records have been sent to the output area, the control software will direct output to a device. For input a controlling factor has been established to allow the software to determine when all records from the input area have been called upon by the program and another physical read from an input device can be accomplished. For either input or output the total length is still to be determined after the record description has been provided. Once the record description is given its total length will be multiplied by the blocking factor to assign the total amount of storage to be reserved for input and output. (If the

blocking factor is 5 and the record length is 80, then the amount of programmer required storage will be 400 characters). When using cards as input or output, this entry may be omitted or written as BLOCK CONTAINS 80 CHARACTERS.

The LABEL RECORD clause allows the programmer to select which type of label checking he requires. This is one method of helping to ensure that the right input has been provided by the operator.

```
LABEL RECORDS ARE STANDARD
LABEL RECORDS STANDARD
LABEL RECORD IS STANDARD
LABEL RECORD STANDARD
```

Any of the preceding statements is correct depending on the input files. The important thing is that specifications have been made that the label checking is to be accomplished by whatever means provided by the system software. If the option of OMITTED is specified, it means that no explicit label(s) exist for the file, and the system software check does not occur.

If the data-name option is specified, other options not shown in this manual's FD entry may be required. Again, systems vary so greatly that if this option is required, local technical manuals should be referenced.

The DATA RECORDS clause allows the programmer to give names to the record or records that make up the file. Each data-name that is supplied in this clause must be described with a level number of 01 following the FD entry. As in all cases when options are given, the proper option must be specified. That is, if only one record type makes up a file, the correct statement would be DATA RECORD . . . or DATA RECORD IS . . . If there is more than one record type in a file, then DATA RECORDS . . . or DATA RECORDS ARE . . . must be used. Also, the optional words may not be wrongly used; a statement would be incorrect if written DATA RECORD ARE . . . or DATA RECORDS IS . . .

The last data-name of the DATA RECORDS clause will be followed by a period and a space. There is no other punctuation in the entire FD entry. Examples of correct FD entries are as follows:

```
003000  DATA DIVISION.
003100  FILE SECTION.
003200  FD  OLD-MASTER-INVENTORY
003210      BLOCK CONTAINS 50 RECORDS
003250      LABEL-RECORDS ARE STANDARD
003300      DATA RECORD IS TAPE-IN.
- - - - - - - - - - - - - - - - -
- - - - - - - - - - - - - - - - -
006120  FD  NEW-MASTER-INVENTORY
006130      BLOCK CONTAINS 10 RECORDS
006140      LABEL RECORD STANDARD
006150      DATA RECORD RPT-TAPE.
```

## RECORD DESCRIPTION ENTRIES

Each of the data-name entries in the DATA RECORDS clause for each FD entry must be described in some manner. It is in the record description entries that the items previously discussed are used: the data record, group item and elementary item. These terms can be related to the record and the fields of the file.

The data record will refer to the programmer assigned name given to a record in the DATA RECORDS clause. This name will be the first entry in the B Margin following the FD entry. The record data-name must have an A Margin level number of 01. This level number is a cue to the software that all that follows, until the next 01 or FD level indicator or the next section name is encountered, relates to the description of one record.

Assigning level numbers to a record description is similar to outlining. The basic format for outlining is as follows:

```
I.
    A.
        1.
            a.
                (1)
                    (a)
                    (b)
II.
    A.
        1.
            a.
            b.
            c.
    B.
        1.
        2.
        3.
            a.
                (1)
                (2)
                (3)
```

In outlining each Roman numeral represents a major subject as does the level number 01 (a logical record). The major subject is then subdivided until sufficiently described. In outlining each different subdivision is identified by a different symbol (capitalized alphabetic letter, arabic number, small case alphabetic letter, etc.). Much the same is done when describing a record, as shown in the following:

```
01
    02
        03
            04
            04
    02
    02
        03
        03
01
    02
    02
    02
```

The only significant difference is that the symbols for the same level subject do not sequentially advance. In outlining the 02 level indicators would appear as A, B and C. In the description of a record in COBOL all 04 indicators are subdivisions of the next higher level indicator (03 in the example); all 03 level indicators (together with their respective 04's) are subdivisions of the preceding 02, etc. It is the furthest subdivision (lowest level indicator) that is the elementary item. All others are group items, except the 01 level indicator, which is the data record.

As an example of how a record description would appear as far as data-names and level numbers are concerned, let's assume that the following record layout is to be utilized in a COBOL program.

| LEAVE-RECORD | | | | | | | |
|---|---|---|---|---|---|---|---|
| DIV-CODE | NAME | | | PAY | LEAVE | | BALANCE |
| | LAST | FIRST | MID-INIT | GRADE | EARNED | TAKEN | |
| | | | | | | | |

The record organization might appear as follows:

```
01  LEAVE-RECORD
    02  DIV-CODE
    02  SAILOR-NAME
        03  LAST
        03  FIRST
        03  MID
    02  PAYGRADE
    02  LEAVE
        05  EARNED
        05  TAKEN
    02  BALANCE
```

Note that the level number 05 is used instead of 03 as a sublevel of the 02 LEAVE group item. This is legitimate as the subdivision is a higher level number and will be interpreted the same as an 03. The only restriction is that no 03 or 04 may then appear for that particular 02. In the file section level numbers 02 through 49 may be used for description of an 01 entry.

## ITEM DESCRIPTION ENTRIES

The next task in COBOL programming to complete the record description entry is to provide item descriptions of all elementary items. These item descriptions provide the length of the elementary items which collectively then provide the length of the record. In addition to providing the length or size, item descriptions are used to denote the class of the item (e.g., numeric, alphanumeric, etc.), the presence or absence of a sign and/or an assumed decimal point in numeric data, and additional information, such as the insertion of

characters such as the dollar sign, comma, etc. This elementary item description is provided in what is termed the PICTURE clause.

The basic format of the item description entry using the picture clause is:

| *level-number* | *data-name* FILLER | PIC PICTURE | IS *character-string* |
|---|---|---|---|

The picture clause details precisely the characteristics of a particular elementary data item. It also specifies any editing that may have to be done to the data. Through this clause, the programmer may specify the class of the data item (alphabetic, numeric, alphanumeric) and its size. He may also add, delete, or alter characters, thereby editing it (by means of a MOVE statement) into a form more useful to his own application. PIC and PICTURE are logically equivalent. PICTURE characters fall into three general categories. They are:

Data Character Symbols.—These characters indicate whether the data item is alphabetic, numeric, or alphanumeric. The characters are A, X and 9.

Operational Symbols.—These characters indicate the operational sign, the assumed decimal position, and the assumed decimal scaling position of a numeric value. These characters are S, V and P.

Editing Symbols.—These characters indicate the editing to be done before printing an elementary item. They are *, Z, O, B, comma (,), period (.), dollar sign ($), plus (+), minus (-), DB (debit) and CR (credit). The characters comprising the editing symbols are of two types, replacement and fixed-insertion.

The replacement symbol specifies that some character in the data item (usually zero) is to be suppressed and replaced by another character (usually the symbol itself). The fixed insertion character is inserted into the data item in addition to those characters already present. All editing will be discussed following the Picture clause discussion.

Data Character Symbols

Each data character symbol that appears in the *character-string* portion of the picture clause represents one character position of storage. Therefore, if an elementary item is three characters long, the entry may appear as follows:

```
02  NAME PICTURE IS AAA.
```

The compiler would then generate at the address associated with the *data-name* NAME a portion of storage three positions in length. Another way of expressing the same size is to write the entry as follows:

```
02  NAME PICTURE IS A(3).
```

An integer enclosed in parentheses can follow all three of the data character symbols (plus the P, Z, *, $, B, O, -, and +). This

integer indicates the number of consecutive occurrences for the symbol that appears. In the last example given (A(3)) more coding (and key-punching) would be required than in the first example (AAA). In those cases where the size of an elementary item is greater than four characters it is most convenient to use the integer enclosed in parentheses. For example, if the *data-name* were 27 characters in length rather than a string of 27 symbols, it could be written as follows:

02 NAME PICTURE IS A(27).

The differences between what the data character symbols represent in storage are described in the following paragraphs.

A represents a character position to be occupied by any of the alphabetic characters (A through Z) and the space character. For example, a five character, alphabetic item would be represented as

AAAAA or A(5)

X represents a character position to be occupied by any character in the character set of the particular system. For example, the alphanumeric item AB1234 could be represented by any of the following:

XXXXXX
AAXXXX
A(2)X(4)
X(6)

9 represents a character position occupied by a numeric character (0 through 9). Thus, a PICTURE of 999 or 9(3) represents a three-digit field that contains a group of three numeric characters.

Operational Symbols

The following symbols may only be used for numeric (9) items:

V The "V" is used to indicate the location of the assumed decimal point and may only appear once in a *character-string*. It does not represent a character position in memory, and, therefore, is not counted in the size of the item. For example, if the input data is a four position numeric field that represents dollars and cents and the data is to be used in calculations, it is necessary that a decimal point be positioned. If the piece of data 4444 is stored as a data item having the PICTURE 99V99, it will be treated in numerical calculation as 44.44. However, the actual contents of the item will be 4444.

If no "V" is used in the *character-string*, then the decimal point is assumed to be to the right of the item being described. Thus, if 4444 is stored as an item described as 9999, then it will be processed as the whole number 4444.

S The letter "S" is used to indicate the presence of an operational sign and, if used, must be written as the left-most character in the PICTURE. The operation sign is a sign associated with a numeric item in storage to designate (if necessary) a positive or a negative

number. The key point is that the operational sign is only effective for calculation purposes; it does not take up an actual character position in memory, and thus will not appear if the non-edited item is printed out. The "S" is not counted in determining the size of the item.

As an example, consider that the PICTURE S9V99 or S9V9(2) represents a three character field which has an operational sign and in which there is an assumed decimal point between the third and second least significant digits. If the data item processed by the object program were -10, it would be treated as -0.10.

P The "P" is used to specify that the location of the assumed decimal point is not within the number that appears in the data item in memory. It is not counted in the size of the item. The "P" symbol can appear as a continuous string of P's (or as a single P) only as the leftmost or rightmost symbols in a PICTURE description. If a "V" does not appear in the string of P's, then the decimal point is assumed to be to the right of P's if they are the rightmost PICTURE symbols and to the left of P's if they are the leftmost PICTURE symbols.

If a data item is four characters in length and the actual data is a positive (or unsigned) 8735, a PICTURE of PPPPS9999 or P(4)S9(4) will provide storage for calculations +.00008735.

If the same data is supplied to a storage area having a PICTURE of S9999PP or S9(4)PP, the data for calculation will appear as +873500. P's cannot appear as both the first and the last characters of a PICTURE. The use of P is redundant if V is already present, but P and V may appear in the same PICTURE.

A programmer familiar with the information presented thus far should be able to code the file descriptions of any input file. The examples that follow will be explained as to what type of storage is generated and why, using the following record layout.

| LEAVE-RECORD | | | | | | | |
|---|---|---|---|---|---|---|---|
| DIV-CODE | NAME | | | PAY GRADE | LEAVE | | BALANCE |
| | LAST | FIRST | MID-INIT | | EARNED | TAKEN | |
| | | | | | | | |

```
FD  MILITARY-LEAVE-FILE
    BLOCK CONTAINS 25 RECORDS
    LABEL RECORDS ARE STANDARD
    DATA RECORD IS LEAVE-RECORD.
01  LEAVE-RECORD.
    02  DIV-CODE PIC IS XXXX.
    02  SAILOR-NAME.
        03  LAST PIC IS A(24).
        03  FIRST PIC IS A(6).
        03  MID PIC IS A.
    02  PAYGRADE PIC IS A9.
    02  LEAVE.
        03  EARNED PIC IS 99.
        03  TAKEN PIC IS 99.
    02  BALANCE PIC IS 99.
```

The length associated with the record in this description is 43 characters. The lengths of each field should appear in the record layout (though not given here) and should be carefully checked once coded in the program to ensure that they agree for each elementary item. The class of the items (PICTURE symbols) would in most cases appear in the record layout and should also be checked carefully against the record description once coded. The elementary item DIV-CODE is described as alphanumeric, as this will take either alphabetic or numeric data. The elementary items comprising SAILOR-NAME are described as strictly alphabetic fields. This can be checked during processing to ensure that only alphabetic characters or the blank are present. PAYGRADE is described as one alphabetic and one numeric character (e.g., E6, E7). The remaining fields are described as numeric and will allow calculations. It should be noted that each entry, whether it is a group or elementary item, is terminated with a period.

```
01  LEAVE-RECORD.
    02  DIV-CODE PICTURE XXXX.
    02  LAST PICTURE A(24).
    02  FILLER PICTURE X(15).
```

For this description of the record it must first be known that the program to be coded is to simply sort the file into last name within division code sequence. In this case the length of the record is still 43 characters (total length of all PICTURE symbols). DIV-CODE is still described as XXXX, as it is a field that must be called on in the program to allow the correct sorting of the file. The data name LAST is no longer associated with a group item. The only reason a group item appears in coding is if the elementary items within the group items are to be individually worked within the execution of a program but still can be collectively moved by referring to the group item when using a MOVE statement. This same record could be described exactly as it appears in the first example, except that it wastes a lot of coding, keypunching and compiling time and is completely unnecessary for the job that is to be done.

The last entry in this record description does not use a data-name but rather uses the option of the reserved word FILLER. Whenever there is data within a record that is not going to be specifically called on by the program, the FILLER option may be used. Remember that the entire length of a record must be accounted for. FILLER not only acts as an ending or filling data-name but also as a spacer, as follows:

```
01  LEAVE-RECORD.
    02  FILLER PIC X(35).
    02  PAYGRADE-ALPHA PIC A.
    02  FILLER PIC XXX.
    02  TAKEN-LEAVE PIC 99.
    02  FILLER PIC XX.
```

For this example the program may only have been to find out how much total leave has been taken by officers (O in PAYGRADE-ALPHA) and by enlisted (E in PAYGRADE-ALPHA). It is apparent from this that the programmer need only provide data-names for those fields that will be called individually and that he need not be restricted by the record layouts.

## EDITING

The output files may also be described by the data character symbols, but these are not sufficient when an element is called for, such as check protection. In check protection floating dollar signs and asterisks are required: these are provided for by use of the editing symbols. Other required outputs may also call for these editing symbols such as billing statements or supply accounting when credits and debits are to be indicated. These edit symbols are to be used in the file description for the output related to a printer when certain of the item characters in storage are to be suppressed or replaced, or other characters are to be inserted. The symbols and their editing functions are explained in the following paragraphs.

Z specifies that before the data item is printed, as many leading zeros as there are Z's are to be suppressed (replaced by a blank or space). Thus,

| PICTURE | DATA ITEM | PRINTED |
|---|---|---|
| ZZZZ | 0000 | |
| ZZZZ | 8730 | 8730 |
| ZZZZ | 0087 | 87 |
| ZZZZ | 8736 | 8736 |
| ZZZ9 | 0087 | 87 |
| ZZ99 | 0087 | 87 |
| Z999 | 0087 | 087 |

* specifies that before a data item is printed, asterisks should replace leading zeros as dictated by the PICTURE clause. For example:

| PICTURE | DATA ITEM | EDITED ITEM |
|---|---|---|
| **** | 0000 | **** |
| **** | 8730 | 8730 |
| **** | 0087 | **87 |
| **** | 8736 | 8736 |
| ***9 | 0087 | **87 |
| **99 | 0087 | **87 |
| *999 | 0087 | *087 |

An asterisk may only be preceded by a B, a zero, a currency sign, a plus sign, a minus sign, a decimal point or a comma. It can never appear in a PICTURE with Z, A, X, or S or more than one currency, minus, or plus sign.

$ may be used as either a fixed insertion character or as a replacement character. If only one $ is used in a PICTURE, then it is a fixed insertion character and will occur in the specified position within the data item when that item is printed. For example:

| PICTURE | DATA ITEM | EDITED ITEM |
|---|---|---|
| $9999 | 1234 | $1234 |
| $ZZZ9 | 0000 | $ 0 |
| $ZZZZ | 0000 | |

If more than one consecutive currency sign is used in the high-order end of a PICTURE, the currency sign becomes a replacement symbol. It suppresses all leading zeros as dictated by the PICTURE and inserts $ in place of the rightmost zero suppressed. However, if the value of the data is zero, then the edited item will contain spaces. For example:

| PICTURE | DATA ITEM | EDITED ITEM |
|---|---|---|
| $$$9999 | 001234 | $1234 |
| $$$ | 000 | |
| $$$$$ | 0008 | $8 |
| $$99 | 123 | $123 |

The currency sign may never appear in a PICTURE with A, X, or more than one plus or minus sign.

+ or - may be used as either fixed insertion or replacement characters. If the plus or minus sign is written as an insertion character in either the first character or last character of a PICTURE, a displayed sign (as opposed to an operational sign) is inserted into the indicated position.

When the minus sign is inserted, a minus sign will appear if the item is negative; a blank will appear in the specified position if the item is positive or unsigned. When the plus sign is used, a plus sign appears if the item is positive; a minus sign appears if the item is negative. Unsigned items are considered positive. For example:

| DATA ITEM | PICTURE | EDITED ITEM |
|---|---|---|
| +33 | -99 | 33 |
| -33 | 99- | 33- |
| -33 | -99 | -33 |
| 00 | -99 | 00 |
| +22 | +99 | +22 |
| -22 | +99 | -22 |
| 20 | 99+ | 20+ |

If either the minus or plus sign is used as a replacement symbol, it will suppress leading zeros as dictated by the PICTURE. The rightmost zero suppressed is replaced according to the following rules:

(1) If a floating minus sign is used and the data item is negative, then a minus sign will replace the rightmost zero suppressed. If the item is positive or zero, a blank will replace it. For example:

| PICTURE | DATA ITEM | EDITED ITEM |
|---|---|---|
| --99 | 123 | 123 |
| ---99 | 012 | -12 |
| ---- | 000 | |

(2) If a floating plus sign is used and the data item is positive, then a plus sign will replace the rightmost zero suppressed.

If the item is negative, then a minus sign will replace it. For example:

| PICTURE | DATA ITEM | EDITED ITEM |
|---|---|---|
| ++99 | 012 | +12 |
| +++9 | 006 | -6 |
| ++++ | 000 | |
| ++99 | 123 | +123 |

0 specifies that a zero is to be inserted in the item in the character position corresponding to that of the 0 in the PICTURE.

| PICTURE | DATA ITEM | PRINTED |
|---|---|---|
| 990099 | 8936 | 890036 |
| $999.00 | 0736 | $736.00 |

B specifies that a blank or space is to be inserted in the item in the character position corresponding to that of the B in the PICTURE.

| PICTURE | DATA ITEM | PRINTED |
|---|---|---|
| 99B9B9 | 8736 | 87 3 6 |
| 9BB999 | 8736 | 8 736 |

, specifies a character position into which a comma is to be inserted unless the preceding character has been suppressed. A comma cannot occur in a PICTURE containing any A or X characters.

| PICTURE | DATA ITEM | PRINTED |
|---|---|---|
| 99,999 | 87362 | 87,362 |
| | 87000 | 87,000 |
| ZZ,ZZZ | 00873 | 873 |
| | 20000 | 20,000 |

. specifies a character position into which a decimal point is to be inserted unless the succeeding character positions have been suppressed. It cannot be used in a PICTURE containing any A, X, P or V characters.

| PICTURE | DATA ITEM | PRINTED |
|---|---|---|
| $$$999.99 | 0087640 (defined LEFT 2 PLACES) | $876.40 |

CR specifies that two character positions of the item are to contain the characters CR if the value of the data item is negative. CR can only occur as the last characters (except for P) of a PICTURE. CR cannot be used in a PICTURE containing A, X, -, +, S or DB characters.

DB specifies that two character positions of the item are to contain the characters DB if the value of the data item is negative. DB can only occur as the last characters (except for P) of a PICTURE. DB cannot be used in a PICTURE containing A, X, -, +, S or CR characters.

| PICTURE | DATA ITEM | PRINTED |
|---|---|---|
| $$$$.99 CR | 24567 | $245.67 |
| $$$$.99 CR | 00138 | $1.38 CR |

Summarizing, the five categories of data described by a PICTURE clause are: alphabetic, numeric, alphanumeric, alphanumeric edited, and numeric edited. There may be restrictions or special rules for using the edit symbols on any particular system. Once assigned to a system, a programmer should refer to the system's programming manual.

## WORKING-STORAGE SECTION

The working-storage section is the second section of the COBOL data division. It is in this section that areas of storage are assigned to hold the intermediate results of processing. The data will come from an input device to the record description described for the FD entry for input and be processed. Output will be provided to an output device through the record description described for the FD entry for output.

The working-storage section may have three types of entries. These are independent items, record items and conditional items. The independent and record items may be described with a PICTURE clause the same as the entries in the file section. Record items or descriptions are done in exactly the same way as in the file section and use the same level indicators. Independent items in the working-storage section are elementary items unrelated to any other data.

### RECORD ITEMS

As an example of using record descriptions in the working-storage section, assume that a program requires two (or more) header lines be printed at the beginning of a report, a single column header for each page and the regular report text for all other printing. The FD and record description entry for the output in the file section could appear as follows:

```
FD PRINTER-OUT
    BLOCK CONTAINS 132 CHARACTERS
    LABEL RECORD IS OMITTED
    DATA RECORD IS PRINT-IT.
01  PRINT-IT.
    08 FILLER PICTURE IS X(5).
    08 STK-NUMBER-PRINT PICTURE IS X(6).
    08 FILLER PICTURE IS X(5).
    08 NO-MFR PICTURE IS 9(3).
    08 FILLER PICTURE IS X(7).
    08 FLAG-NEW-STOCK PICTURE IS A.
    08 FILLER PICTURE IS X(7).
```

```
        08 MFR-ORDER-NUMBER PICTURE IS X(10).
        08 FILLER PICTURE IS X(7).
        08 ITEM-DESCRIPTION PICTURE IS X(30).
        08 FILLER PICTURE IS X(5).
        08 UNITS-ON-HAND PICTURE IS ZZZ9.
        08 FILLER PICTURE IS X(5).
        08 EMERGENCY-REORDER-FLAG PICTURE IS X(3).
        08 FILLER PICTURE IS X(5).
        08 MIN-UNITS PICTURE IS ZZZ9.
        08 FILLER PICTURE IS X(5).
        08 UNIT-COST PICTURE IS $$$$Z.99.
        08 FILLER PICTURE IS X(12).
```

This record description would be the one for the regular report text. The other lines (records) to be printed are for the headers and must contain constant (or in a sense emitted) data that is not brought in through the input device. A method of assigning data in the WORKING-STORAGE SECTION uses a VALUE clause. This VALUE clause (with one exception discussed under conditional items) cannot appear in the FILE SECTION and thus forces the setting up of headers (records) in the WORKING-STORAGE SECTION. Following the last FD entry of the file section, a Margin A entry would be required of WORKING-STORAGE SECTION. This section entry would be followed by any independent items required; then, record description entries could be constructed. To construct the record descriptions for the headers the entries may appear as follows:

```
WORKING-STORAGE SECTION
     (Independent Items)

01 REPORT-HEADER-ONE.
   02 FILLER PICTURE IS X(56) VALUE IS SPACES.
   02 CENTERED PICTURE IS X(21) VALUE IS 'MONTHLY SUPPLY REPORT'.
   02 FILLER PICTURE IS X(55) VALUE IS SPACES.
01 REPORT-HEADER-TWO.
   02 FILLER PICTURE IS X(51) VALUE IS SPACES.
   02 CENTERS PICTURE IS X(29) VALUE IS
      'PARTS LISTING FOR ELECTRONICS'.
   02 FILLER PICTURE IS X(52) VALUE IS SPACES.
01 PAGE-HEADING-FOR-ALL.
   02 FILLER PICTURE IS X(5) VALUE IS SPACES.
   02 1-NO PICTURE IS X(10) VALUE IS 'STK-NUMBERS'.
   02 FILLER PICTURE IS X VALUE IS SPACE.
   02 2-NO PICTURE IS XXXX VALUE IS 'MFG#'.
   02 3-NO PICTURE IS X(14) VALUE IS '  FNSTK    '.
   02 4-NO PICTURE IS X(17) VALUE IS 'MFG  ORD  NO  '.
   02 5-NO  PICTURE  IS X(16)  VALUE  IS 'ITEM DESCRIPTION'.
   02 FILLER PICTURE IS X(25) VALUE IS SPACES.
   02 6-NO PICTURE IS X(9) VALUE IS 'UOH    '.
   02 7-NO PICTURE IS X(8) VALUE IS 'EM-RO   '.
   02 8-NO PICTURE IS X(9) VALUE IS 'MUNITS   '.
   02 9-NO PICTURE IS X(14) VALUE IS 'UNIT COST   '.
```

As can be seen from the examples, the VALUE clause allows the programmer to insert the actual data that is to appear in the output.

By using these entries in a program together with the FD for the regular output, four different formats of output are accounted for (note: all record descriptions are the same length as the FD.) At the beginning of a report, REPORT-HEADER-ONE would be moved to PRINT-IT and printed by the printer. Next, REPORT-HEADER-TWO would be moved to PRINT-IT and printed. Next, an instruction would be executed to blank out the area of PRINT-IT, and one or two lines of blanks (spaces) would be printed. After this, PAGE-HEADING-FOR ALL would be moved to PRINT-IT and printed, followed again by an instruction to clear (blank out) PRINT-IT. This clearing must be done after the headers to ensure that the areas of PRINT-IT with the data-name of FILLER will be blank rather than retaining data that was moved to it from one of the header record descriptions. (NOTE: Even though it appears as if the edit pictures originally given in the PRINT-IT descriptions may be cleared out, this isn't so, as the edit pictures are stored in separate areas and brought in to perform editing when data is moved to those specific areas).

The format for the VALUE clause is as follows:

$$\left\{\begin{matrix}\underline{\text{VALUE}}\ \text{IS} \\ \underline{\text{VALUES}}\ \text{ARE}\end{matrix}\right\}\ \textit{literal-1}\ [\underline{\text{THRU}}\ \textit{literal-2}]\ \left[,\textit{literal-3}\ [\underline{\text{THRU}}\ \textit{literal-4}]\right]\ \ldots$$

The *literal* to appear in the VALUE clause can be of three types—numeric, nonnumeric or a figurative constant. When the literal is nonnumeric, it must be enclosed in quotation marks as shown in the example. By enclosing the literal in quotation marks, the data is set up in storage in what is called display form. Display form is a form that is ready to print. If a value were assigned as follows:

. . . VALUE IS '9876543'.

it would be set up in storage in a coded structure that would allow printing but NOT allow arithmetic or editing functions. If the same data were entered as

. . . VALUE IS 9876543.

it would be set up in storage as a numeric item in a coded structure that would allow computations to be performed and could be edited.

All data entered in the VALUE clause must conform to the associated PICTURE clause. If the PICTURE is X or A, then the data must be enclosed in quotation marks and consist of only the characters allowed for the X or A. If the PICTURE is 9(s), the data is not enclosed in quotation marks, and the data must be of the numeric character set only.

Figurative Constants

As mentioned earlier, the literal to be entered in the VALUE clause can also be a figurative constant. Figurative constants unlike actual literals are not actual values but rather reserved words which name values. Figurative constants, like numeric literals, are not enclosed

in quotations. The figurative constants in the COBOL language most commonly found in the WORKING-STORAGE SECTION are as follows:

| FIGURATIVE CONSTANT | REPRESENTS |
|---|---|
| ZERO<br>ZEROS<br>ZEROES | Represents the value 0, or a sequence of one or more 0's depending on the context of the statement. |
| SPACE<br>SPACES | Represents a sequence of one or more blank characters or spaces depending on the context of the statement. |
| HIGH-VALUE<br>HIGH-VALUES | Represents one or more of the characters that has the highest value in the computer's collating sequence. |
| LOW-VALUE<br>LOW-VALUES | Represents one or more of the characters that has the lowest value in the computer's collating sequence. |
| QUOTE<br>QUOTES | Represents a sequence of quotation marks. |
| ALL (any literal) | Calls for a sequence of the specified literal. The length of the sequence is limited by the receiving field. |

The singular and plural forms of the constants are equivalent and may be used interchangeably.

INDEPENDENT ITEMS

Independent items are those items appearing in working-storage which are not subdivided and are not themselves subdivisions of some other item. They are, therefore, elementary items and must contain the PICTURE clause. They are always assigned the level number of 77. Examples of independent items are as follows:

```
77 COUNTER-ONE PICTURE 9(6) VALUE IS ZEROS.
```

This would set up an area of storage six characters in length with an initial value of 000000 which could be used for arithmetic functions.

```
77 BLANK-OUT PICTURE X(132) VALUE IS SPACES.
```

This could set up an area of storage 132 characters in length with an initial value of all spaces which could be used in a statement such as MOVE BLANK-OUT TO PRINT-IT. This statement would cause all 132 space characters to be moved to the area PRINT-IT.

```
77 ADD-ERROR PICTURE IS X(20)
     VALUE IS 'ERROR AT ADD ROUTINE'.
```

This would set up an area of storage 20 characters in length with an initial value of a nonnumeric ERROR AT ADD ROUTINE. A statement then could be written such as DISPLAY ADD-ERROR. This statement (when encountered in the PROCEDURE DIVISION) would cause the literal at ADD-ERROR to be printed out for operator intervention.

All independent items required for a program must precede any record descriptions in the WORKING-STORAGE SECTION.

CONDITION-NAME CONDITION

A condition-name is a name assigned in the data division to one of the values a conditional variable may assume. The best way to understand this is to carefully follow the explanations of the following examples.

```
FD EXAMPLE-ONE
   BLOCK CONTAINS 25 RECORDS
   LABEL RECORD IS STANDARD
   DATA RECORD IS SAMPLE-ONE.
01 SAMPLE-ONE.
   02 FILLER PIC X(25).
   02 MARITAL-STATUS PIC 9.
      88 SINGLE VALUE IS 1.
      88 MARRIED VALUE IS 2.
      88 DIVORCED VALUE IS 3.
      88 WIDOWED VALUE IS 4.
   02 MAN-NAME PIC X(16).
   02 FILLER PIC X(38).
```

As is shown, a condition-name can appear in the FILE SECTION and is always identified by an 88 level number. Even though there are four condition-names coded, there is only one character of storage set aside as is indicated by the immediately preceding PICTURE clause. If the data is to be moved, the statement that would provide the move is MOVE MARITAL-STATUS TO data-name. The programming advantage of using condition-names is that in the procedure division only one statement is required to determine if the marital status is of a certain value. Once the input is delivered to SAMPLE-ONE, a test to determine if the individual is married would be written as IF MARRIED..... This saves the programmer from having to write a statement as follows:

IF MARITAL-STATUS IS EQUAL TO 2 .....

By simply coding IF MARRIED ..... an internal compare is made by the computer to determine if the contents of MARITAL-STATUS is or is not equal to a factor of 2.

A condition-name may also be used in the WORKING-STORAGE SECTION with either an independent item (77) or a record description (01-10, the same as it is done in the FILE SECTION).

```
WORKING-STORAGE SECTION.
77 CARDS-PER-RECORD PICTURE IS 9.
   88 1-REC VALUE IS 1.
   88 2-REC VALUE IS 2.
   88 3-REC VALUE IS 3.
```

In this example CARDS-PER-RECORD can be used as a counter to count the number of input cards associated with an individual's record (records may be more than one card in length). Once that individual's record has been processed, a statement could appear such as IF 3-REC ..... rather than IF CARDS-PER-RECORD EQUAL 3 ....

## SUMMARY

The DATA DIVISION is comprised of the FILE SECTION and the WORKING-STORAGE SECTION. These sections are comprised of entries which depict all records and working areas that are required for use by the program. This text is only an introduction to the COBOL language. Once assigned as a programmer to a particular system, it will be of great benefit to procure a COBOL programmer's manual for that system.

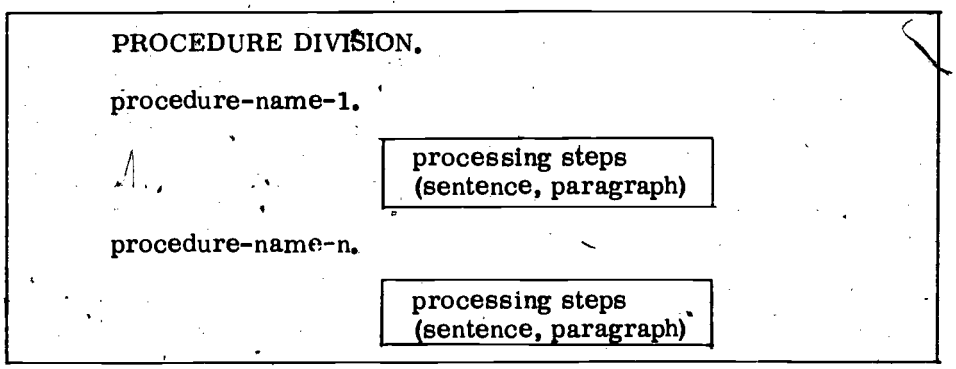
# CHAPTER 5

# THE PROCEDURE DIVISION

## GENERAL

The PROCEDURE DIVISION is made up of all the processing steps needed to solve a particular problem. These processing steps are nothing more than COBOL sentences which are constructed in accordance with specific formats, using various COBOL verbs. These verbs are words from the COBOL reserved word list that indicate various actions to be taken, such as ADD, MOVE, PERFORM, GO TO, etc.

A typical Procedure Division might be structured in the format shown below:




The basic unit of the Procedure Division comprising the processing steps is the sentence. The sentence consists of one or more statements and/or expressions. A procedure is a paragraph, a group of successive paragraphs, or a section within the Procedure Division.

## PROCEDURE PARAGRAPHS

Procedures are formed by combining one or more sentences into a paragraph. Essentially, a paragraph expresses a single procedure (routine) to be carried through in the main program. Each program contains many such paragraphs. Each paragraph must be preceded by a procedure-name since reference may only be made to an entire paragraph and not to the individual sentences that make up the paragraph. If one sentence is to be referenced in the program, that sentence must be a complete paragraph and be preceded by a procedure-name.

A procedure-name may be comprised of either numeric, alphabetic or alphanumeric characters. If numeric, leading zeros are significant

(i.e., 23 is not the same as 023). All procedure-names must start at Margin A on the programing form, be no more than 30 characters in length, and be followed by a period.

## PROCEDURAL VERBS

As in the English language, verbs specify actions to be performed. In COBOL, each verb built into the system causes a specific series of events to occur at object time. Each verb operates within the context of one or more fixed-format statements. The formats indicate the arrangement of verb and operand and the particular category of procedure statement. The various verbs inherent in the COBOL language are categorized in the following description.

Input/Output—OPEN, CLOSE, READ, WRITE, ACCEPT, DISPLAY, NOTE
Arithmetic—ADD, SUBTRACT, MULTIPLY, DIVIDE
Data Movement—MOVE
Sequence Control—GO TO, PERFORM, STOP

A discussion of conditional expressions (relational tests) will precede the section of this chapter dealing with sequence control verbs.

## INPUT/OUTPUT VERBS

In any data processing application, quantities of data pass between the central storage facilities of the computer and external media such as card and tape devices. Control and coordination of the main flow of data is achieved by four input/output verbs—OPEN, CLOSE, READ, and WRITE. These verbs enable the programmer to obtain records for processing and then send the processed record to some external medium. The two verbs—ACCEPT and DISPLAY—permit small quantities of data to be either accepted from or produced upon some external input/output device. The formats and uses of each of these verbs are explained in the following. (The verb NOTE is discussed separately.)

### OPEN

Format:

```
OPEN     [INPUT   {file-name}...]
         [OUTPUT  {file-name}...]
```

Description:

The function of this verb is to initiate the processing of both input and output files. Any file description entry (FD) in the Data Division must be OPENed prior to the first READ or WRITE instruction directed to that particular file. This applies to the printer, card reader, and card punch as well as tape files.

The key word INPUT must be included for all input files, and the key word OUTPUT must be stated for all output files. If INPUT has been specified, the execution of an OPEN statement causes the checking of the label record if a label record has been defined in the FD entry;

similarly, if OUTPUT has been specified, the OPEN statement causes the writing of the label record upon the output file.

At least one option must be specified; however, there must be no more than one instance of each option. For example, the following is permissible:

```
OPEN INPUT OLD-INVENTORY, DETAIL-TRANS-FILE.
OPEN INPUT OLD-INVENTORY, OUTPUT REORDER LIST.
```

The following is illegal:

```
OPEN INPUT OLD-INVENTORY, INPUT DETAIL-TRANS-FILE.
```

The programmer has the facility to OPEN all input files at once or all output files at once, or to OPEN them individually as the need arises. In either case, care must be taken so that a file is not OPENed more than once unless an intervening CLOSE has been directed to the specified file.

A file may be repeatedly OPENed and CLOSEd, both for INPUT and OUTPUT, in the same program.

The OPEN does not obtain or release the first data record. A READ or WRITE, respectively, must be executed to obtain or release the first data record.

READ

Format:

READ *file-name* RECORD [INTO *identifier*]

; AT END *imperative-statement*

Description:

This verb makes available the next record from an input file and allows the execution or a specified imperative-statement when the end-of-file is detected. File-name must have an FD in the Data Division.

An OPEN statement for a file must be executed before the first READ command is given. The OPEN checks the label and positions the first data record for a READ. Upon execution of the first READ, the first block is moved into the allocated area of memory and the first logical record in the file-name becomes accessible in the defined (DATA DIVISION) input area. Subsequent READ instructions advance the next logical record. For example, if MASTER has been defined as having twenty records per block, then a READ directed to MASTER will cause a record advance (positioning of the logical record) to occur twenty times for each physical movement (READ) of the tape.

When a file consists of more than one type of record, a READ delivers the next record regardless of type; stated differently, all records of a given file share the memory area. Thus, if there is more than one 01 entry in a given FD, it is the programmer's responsibility to determine which record is present at any particular instant. As an illustration, assume that HEADER and DETAIL are record descriptions of MASTER, as follows:

```
01 HEADER
   02 IDENTITY PICTURE IS 9.
   02 DESCRIPTION PICTURE IS X(34).
      .
      .
      .
01 DETAIL.
   02 IDENTITY PICTURE IS 9.
   02 PART-CODE PICTURE IS 9(6).
   02 PART-COST PICTURE IS 9(3)V99.
      .
      .
      .
```

Since READ MASTER makes available the next record of MASTER, the IDENTITY must be interrogated to determine whether the record is a HEADER or DETAIL item. Control is then directed to a procedure that will reference only the data-name of the record type that is available. If this is not done, then a command directed to PART-CODE will, whenever a HEADER has been delivered, reference the first six positions of DESCRIPTION in HEADER instead of PART-CODE in DETAIL as intended.

When the INTO identifier option is used, the current record is read and then moved to identifier. The names of identifier and the record cannot be the same. In this instance, moving occurs according to the rules specified for the MOVE verb without the CORRESPONDING option. Under this option, "file-name RECORD" is available in the input record area as well as in the INTO area.

It is illegal to use the INTO option of the READ verb if the file that is READ has more than one record description.

Upon recognition of an end-of-reel condition, the READ causes the following operations:

1. If labels are present (as defined in the FD), the standard end-of-reel label subroutine is performed.
2. A tape swap occurs. If only one tape is ASSIGNed, the program will have to wait on rewind.
3. If labels are present, the standard beginning reel label subroutine is executed.
4. The next logical record of the file is made available.

When the logical end-of-file is reached and an attempt is made to READ the file, the imperative-statement of the AT END phrase is executed. After the imperative-statement is executed, an attempt to READ without first CLOSEing and then OPENing the file will cause an error at object time.

It is illegal to substitute any other statement for the AT END phrase.

If the file-name has been specified as OPTIONAL in the Environment Division and is not present at the object time, the imperative-statement

in the AT END phrase is executed whenever a READ for that file is encountered.

WRITE

Format:

WRITE *record-name* [FROM *identifier-1*]

[{BEFORE / AFTER} ADVANCING {*identifier-2* LINES / *integer* LINES / *mnemonic-name*}]

Description:

The WRITE verb releases a unit record to an output file, and allows vertical positioning if the output medium is an online printer.

The area to be written (record-name) must be defined in the Data Division at the 01 level. The file associated with record-name must also be defined by an FD entry in the Data Division. The file must be OPENed prior to the execution of the first WRITE for that file.

When the WRITE is executed, record-name is released for the output file, and thus, is no longer available.

The FROM identifier-1 option is similar to the INTO data name option of the READ verb. Use of this option, in essence, converts the WRITE to a MOVE and WRITE. If the format of identifier-1 differs from that of record-name, the data is moved in accordance with the rules for the MOVE verb without the CORRESPONDING option. While the information in record-name is no longer available, the data in identifier-1 continues to be accessible. The names of identifier-1 and record-name cannot be the same.

The ADVANCING option allows control of the vertical positioning of each record on the printed page. The following rules are pertinent to the option:

1. When identifier-2 is used, it must have a positive integral value. The compiler inserts a mechanism into the object program which positions the printer page according to the current value of identifier-2.

Example: WRITE DET-REC AFTER ADVANCING CLUB LINES, when CLUB has been defined in WORKING-STORAGE as a one position numeric item.

2. When integer is used, it must be a positive integral literal. The compiler inserts a mechanism into the object program which advances the printer page *integer* lines.

3. When mnemonic-name is used, it is associated with a particular feature specified by the user and it must be defined in the SPECIAL-NAME paragraph of the Environment Division.

4. If mnemonic-name is specified, the printer is advanced according to the rules specified by the user.

Example: WRITE DET-REC AFTER ADVANCING NEW-PAGE LINES. When NEW-PAGE has been specified in the SPECIAL-NAME paragraph, this statement will provide page overflow.

5. BEFORE and AFTER ADVANCING can result in over printing. A matrix of the print-space operation follows:

| | Present Write | | |
|---|---|---|---|
| Previous Write | W | WAA n | WBA |
| W | LINE-SPACING THEN PRINT | SPACE n THEN PRINT | OVER PRINT |
| WAA | LINE-SPACING THEN PRINT | SPACE n THEN PRINT | OVER PRINT |
| WBA m | SPACE THEN PRINT | SPACE m + n THEN PRINT | SPACE THEN PRINT |

LEGEND:

W = WRITE
WAA = WRITE AFTER ADVANCING
WBA = WRITE BEFORE ADVANCING
m = Space information of data-name-2 or integer
n = Same as m

After recognition of end-of-reel, the WRITE performs the following operations:

1. The standard end-of-reel label subroutine if labels are specified in the FD of the file.

2. The standard beginning-of-reel subroutine if labels are specified in the FD of the file.

CLOSE

Format:

```
CLOSE  file-name-1 [REEL]    [ WITH  { NO REWIND }  ]
                             [       { LOCK      }  ]
   [ , file-name-2 [REEL]    [ WITH  { NO REWIND }  ] ]...
                             [       { LOCK      }  ]
```

Description:

The CLOSE verb terminates the processing of one or more input or one or more output files or reels and provides optional rewinding and/or locking. Each file-name refers to an FD in the Data Division and an OPEN statement must be executed prior to the CLOSE statement.

The CLOSE file-name option, as applied to the entire file rather than to individual reels, initiates the final closing conventions for the file and releases the data area. A file may be CLOSEd once, but not more than once, for each time the file is OPENed.

For an output file, the final closing conventions such as block, padding, etc., for the file are performed and the data area is released. Furthermore, for either an input or an output file:

1. If neither LOCK nor NO REWIND is specified, the current reel of the file is rewound and all other reels belonging to the file are rewound. However, this rule does not apply to those reels controlled by a prior CLOSE REEL entry.
2. If the no rewind option is specified, the current reel of the file remains in whatever position it is in at the time the CLOSE is given.
3. The REEL, NO REWIND, and LOCK options are only applicable to magnetic tape files and they are meaningless when operating with card or printer files.
4. If the LOCK option is specified, all reels belonging to the file are rewound with interlock except for those reels controlled by a prior CLOSE REEL.

The CLOSE file-name REEL option may be used for input or output files. The LOCK option may be used and the current reel will be rewound with interlock. The necessary processing is performed.

When a CLOSE REEL is given, the locking and rewinding options of CLOSE REEL, if used, take precedence for the current reel and only the current reel, regardless of the options associated with a CLOSE of file. When a CLOSE file-name is given, its options are executed wherever possible, for all mounted reels of the file except for those reels which may have been closed by a CLOSE REEL whose locking and rewinding options differ from those of the CLOSE file-name.

For multiple reel files, the opening and closing of individual reels is automatic. However, the programmer must close the file when processing is to be terminated. A CLOSE file-name-1 should be executed for each file that was OPENed.

The following example illustrates the use of the LOCK option in terminating a run.

```
CLOSE EDITED-SHIPMENTS WITH LOCK, COST-OF-SALES-RATES
WITH LOCK, COSTED-SHIPMENTS WITH LOCK, NOT-COSTED
ITEMS WITH LOCK, LOSS-ITEMS WITH LOCK, ERROR-LISTING
WITH LOCK.
```

ACCEPT

Format:

ACCEPT *identifier* [FROM *mnemonic-name*]

Description:

This verb is used to read low-volume data from the specified hardware device. The hardware device associated with a mnemonic-name must be specified in the SPECIAL NAMES paragraph of the Environment Division when the FROM option is employed.

In many cases, a standard hardware device is used for a particular implementation of COBOL, thereby making the FROM clause unnecessary. Also, a maximum size for the data represented by identifier

will be set. The individual supplement manuals for a particular computer system should be consulted for this information. If the data ACCEPTed is less than the maximum size for the particular system, it appears in the leftmost positions of the input area with zero fill if the data is numeric and space fill if alphabetic or alphanumeric.

For example:

```
DISPLAY "FURNISH DATE" UPON CONSOLE.
ACCEPT PRESENT-DATE FROM CONSOLE.
```

Previously, the console typewriter was designated as CONSOLE in the SPECIAL-NAMES paragraph of the Environment Division. When the DISPLAY statement is executed, FURNISH DATE appears on the console typewriter. Control passes to the ACCEPT statement and the program waits for the operator to type in the current date, after which the data accepted is stored in location PRESENT-DATE. Control then passes to the statement following the ACCEPT statement.

DISPLAY

Format:

```
DISPLAY    { literal-1    } [ , { literal-2    } ] ...
           { identifier-1 }     { identifier-2 }

[UPON mnemonic-name]
```

Description:

This verb displays low-volume data on an output device.

The hardware device associated with a mnemonic-name must be specified in the SPECIAL-NAMES paragraph of the Environment Division when the UPON option is employed.

A specific peripheral unit may be designated as the standard display device, thereby making the UPON clause unnecessary. Maximum length for DISPLAYed data is set by the implementor. Rules for positioning are the same as for the ACCEPT verb.

Literals and identifiers may be used in combination in a DISPLAY statement. Any figurative constants, except ALL, may be used.

For example:

```
DISPLAY "TOTAL AMOUNT IS" TOTAL-AMOUNT
```

Assume TOTAL-AMOUNT has a value of 4800 at the time the DISPLAY statement is executed. The information that appears on the display device is as follows:

```
TOTAL AMOUNT IS 4800.
```

Since "TOTAL AMOUNT IS" is a nonnumeric literal, it is displayed as is.

NOTE

Format:

NOTE *character-string.*

Description:

This verb permits the programmer to insert comments in his source program for reference purposes. These comments are printed out during compilation but have no effect on the object program.

If a NOTE sentence is the first sentence of a paragraph (i.e., immediately following a procedure-name), the entire paragraph is considered as commentary. If a NOTE sentence appears as other than the first sentence of a paragraph, the commentary ends with the appearance of a period.

Any characters from the COBOL character set may be used, excluding the period which is used to terminate the comment.

ARITHMETIC VERBS

The arithmetic verbs permit basic calculations to be performed on the data. Four verbs are provided in COBOL corresponding to the four basic arithmetic operations: ADD, SUBTRACT, MULTIPLY, and DIVIDE.

The following general rules pertain to the arithmetic verbs:

1. All identifiers used in arithmetic statements must represent numeric data defined in the Data Division. The results are unpredictable if the identifiers contain other than numeric data at object time.
2. All literals used in arithmetic statements must be numeric.
3. The maximum size of any operand (identifier or literal), intermediate result, or receiving item is 18 digits.
4. The formats (PICTURE) of multiple operands in an arithmetic statement may differ from each other. Decimal point alignment is supplied automatically throughout computations.
5. The format of any data item involved in computations (e.g., addends, subtrahends, multipliers, etc.) cannot contain editing symbols. The compiler will indicate an error by an appropriate message when the fields involved are defined in such a way that they would contain editing symbols. Operational signs and implied decimal points are not considered editing symbols. The identifiers in the GIVING option represent data items which must not enter into computations if they contain editing symbols.
6. If the number of fractional places in a computed result (sum, difference, product, or quotient) exceeds the number of fractional places in the format of the identifier associated with the result (i.e., the identifier that is to take on the value of the result), truncation occurs unless the ROUNDED option has been used.

Truncation is the dropping of excess digits; it is always determined by the PICTURE of the identifier associated with the result. When ROUNDED is specified, however, the least significant digit specified by the format of the result is increased by 1 whenever the most significant digit of the excess is greater than or equal to 5. For example, with a receiving item PICTURE of 9(4)V9, the value

8250V96 becomes 8251V0 if the ROUNDED option is specified, and 8250V9 when ROUNDED is not used.

7. Whenever the number of integral places (i.e., those to the left of the decimal point) in the calculated result exceeds the number of the integral places associated with the resultant identifier, a size error condition arises. In the event of a size error condition, one or two possibilities will occur, depending on whether or not the ON SIZE ERROR option has been specified.

Use of ON SIZE ERROR must be carefully controlled. This clause does not substitute for proper investigation and record design.

a. The testing for the size error condition occurs only when the ON SIZE ERROR option is specified in the verb format. In the event that ON SIZE ERROR is not specified, and a size error condition arises, the results are unpredictable.

b. If the ON SIZE ERROR option has been specified, and a size error condition arises, then the value of the resultant identifier is not altered. The imperative-statement associated with the ON SIZE ERROR option is executed after the last resultant identifier is considered.

These options will become clearer when further exemplified in the following discussions.

ADD

Format:

*Option 1:*

```
ADD {identifier-1} [, {identifier-2} ] ...
    {literal-1   }    {literal-2   }

TO identifier-m [ROUNDED] [, identifier-n [ROUNDED]] ...

[; ON SIZE ERROR imperative-statement]
```

*Option 2:*

```
ADD {identifier-1} , {identifier-2} [, {identifier-3} ] ...
    {literal-1   }   {literal-2   }    {literal-3   }

GIVING identifier-m [ROUNDED]

[; ON SIZE ERROR imperative-statement]
```

Description:

This verb permits the addition of two or more data items, storing the result in the last specified data item of the statement. This last data item must not be a literal.

When the TO option is used, the values of the data-names and literals to the left of the word TO are added; the resulting sum is then added to the data-name to the right of the word TO. The results of the addition are stored in the identifier(s) that follows the word TO. For example, ADD A, B, C, TO A is equivalent to ADD A, B, C GIVING TEMP: ADD TEMP TO A.

When the GIVING option is used, the sum of the values of the identifiers or literals preceding the word GIVING is placed in identifier-m. Since identifier-m is a receiving item, it may be an edited item.

Examples:

| Statement | Result Field PICTURE IS: | Calculation |
|---|---|---|
| ADD A, B TO C. | 9999 | A + B + C stored in C as xxxx |
| ADD A, B, C TO D. | $9999.99 | Error—operand may not contain editing symbols except with GIVING option. |
| ADD A, B, C TO D. | S9999V99 | A + B + C + D stored in D as + xxxxVxx |
| ADD A, B, C GIVING D. | $9999.99 | A + B + C stored in D as $xxxx.xx |
| ADD 1, 5, C TO 7. | | Error—result cannot be stored in literal. |
| ADD A, 14 TO C ROUNDED. | 99999 | A+14+C stored in C as $x_1x_2x_3x_4x_5$; rounded if $x_6 \geq 5$ |
| ADD A, B, 43.6 GIVING D ON SIZE ERROR GO TO O-FLOW. | 99V99 | A+B+43.6 stored in D; if integer result is greater than 2 digits, SIZE ERROR occurs. |

*NOTE: x's show result format.*

SUBTRACT

Format:

*Option 1:*

SUBTRACT $\left\{\begin{matrix} literal\text{-}1 \\ identifier\text{-}1 \end{matrix}\right\} \left[, \left\{\begin{matrix} literal\text{-}2 \\ identifier\text{-}2 \end{matrix}\right\}\right] \ldots$

FROM *identifier-m* [ROUNDED] [, *identifier-n* [ROUNDED]]...

[; ON SIZE ERROR *imperative-statement*].

*Option 2:*

SUBTRACT $\left\{\begin{matrix} literal\text{-}1 \\ identifier\text{-}1 \end{matrix}\right\} \left[, \left\{\begin{matrix} literal\text{-}2 \\ identifier\text{-}2 \end{matrix}\right\}\right] \ldots$ FROM $\left\{\begin{matrix} literal\text{-}m \\ identifier\text{-}m \end{matrix}\right\}$

GIVING *identifier-n* [ROUNDED]

[; ON SIZE ERROR *imperative-statement*]

Description:

This verb causes one numeric data item or the sum of two or more numeric data items, to be subtracted from a specified numeric data item. The result is stored in the last specified data item of the statement. This last item must not be a literal.

All previously stated rules regarding the ON SIZE ERROR option, the ROUNDED option, the GIVING option, truncation, and the editing of results apply to the SUBTRACT verb.

Examples:

| Statement | Result Field PICTURE IS: | Calculation |
|---|---|---|
| SUBTRACT 16, A, B FROM D. | 999 | D = (16 + A + B) stored in D as xxx. |
| SUBTRACT A, B FROM D. | $$99.99 | Error—operand may not contain edit symbols unless GIVING option is used. |
| SUBTRACT A, B FROM 126. | | Error—result cannot be stored in literal. |
| SUBTRACT A, B FROM 126 GIVING C. | 999 | 126 - (A + B) stored in C as xxx. |

*NOTE: x's show result format.*

MULTIPLY

Format:

*Option 1:*

MULTIPLY { *identifier-1* / *literal* } BY *identifier-2* [ROUNDED]

[; ON SIZE ERROR *imperative-statement*]

*Option 2:*

MULTIPLY { *identifier-1* / *literal-1* } BY { *identifier-2* / *literal-2* }

GIVING *identifier-3* [ROUNDED]

[; ON SIZE ERROR *imperative-statement*]

Description:

This verb multiplies two numeric data items and stores the resulting product in the last data item specified in the statement.

When Option 1 is used, the value of identifier-1 or literal is multiplied by the value of identifier-2. The value of identifier-2 is replaced by the product of the multiplication.

When Option 2 is used, identifier-3 contains the product of the multiplication.

All previously stated rules regarding the ON SIZE ERROR option, the ROUNDED option, the GIVING option, truncation, and the editing of the results apply to the MULTIPLY verb. For MULTIPLY, the ON SIZE ERROR option rules apply to the intermediate results as well as the final results of the operation.

Examples:

| Statement | Result Field PICTURE IS: | Calculation |
|---|---|---|
| MULTIPLY A BY B. | 999 | A x B stored in B as xxx. |
| MULTIPLY HOURS BY 100. | | Error—result cannot be stored in literal. |
| MULTIPLY HOURS BY 100 GIVING GROSS. | 9999 | HOURS x 100 stored in GROSS as xxxx. |
| MULTIPLY 12 BY B. | $$9.99 | Error—no editing without GIVING option. |

*NOTE: x's show result format.*

DIVIDE

Format:

*Option 1:*

DIVIDE { *identifier-1* / *literal* } INTO *identifier-2* [ROUNDED]

[; ON SIZE ERROR *imperative-statement*]

*Option 2:*

DIVIDE { *identifier-1* / *literal-1* } INTO { *identifier-2* / *literal-2* } GIVING *identifier-3*

[ROUNDED] [; ON SIZE ERROR *imperative-statement*]

*Option 3:*

DIVIDE { *identifier-1* / *literal-1* } BY { *identifier-2* / *literal-2* } GIVING *identifier-3*

[ROUNDED] [; ON SIZE ERROR *imperative-statement*]

*Option 4:*

DIVIDE { *identifier-1* / *literal-1* } INTO { *identifier-2* / *literal-2* } GIVING *identifier-3*

[ROUNDED] REMAINDER *identifier-4*

[; ON SIZE ERROR *imperative-statement*]

*Option 5:*

DIVIDE { *identifier-1* / *literal-1* } BY { *identifier-2* / *literal-2* } GIVING *identifier-3*

[ROUNDED] REMAINDER *identifier-4*

[; ON SIZE ERROR *imperative-statement*]

Description:

This verb divides one numeric data item by another and stores the resulting quotient in the last data item specified in the statement.

In Option 1, identifier-1 is the divisor and identifier-2 the dividend. The value of identifier-2 is replaced by the value of the quotient.

In Option 2, identifier-1 is the divisor, and identifier-2 is the dividend. The quotient resulting from the division is identifier-3. This data name may be an edited item.

In Option 3, identifier-2 is the divisor, and identifier-1 is the dividend. The quotient is placed in identifier-3. This data may be an edited item.

Options 4 and 5 are used when a remainder from the division operation is desired, namely identifier-4. A remainder in COBOL is defined as a result of subtracting the product of the quotient and the division from the dividend. If the ROUNDED option is specified, the quotient is rounded after the remainder is determined.

The identifiers used must reference numeric elementary items whose descriptions appear in the Data Division of the program.

All previously stated rules regarding the ON SIZE ERROR option, the ROUNDED option, the GIVING option, truncation, and the editing of results, apply to the DIVIDE verb. For DIVIDE, the ON SIZE ERROR option rules apply to the intermediate results as well as the final results of the operation.

An error is indicated at compilation time if the data description for either identifier-1 or identifier-2 specifies the presence of editing symbols. Division by zero results in a size error.

Examples:

| Statement | Result Field PICTURE IS: | Calculation |
|---|---|---|
| DIVIDE A INTO B. | 9(4)V9(2) | B ÷ A stored in B as xxxx.xx |
| DIVIDE A INTO B. | $$99.99 | Error—editing not permitted except with GIVING option. |
| DIVIDE A INTO B GIVING C. | S999V99 | B ÷ A stored in C as +xxxVxx |
| DIVIDE A BY B GIVING C. | 9(5) | A ÷ B stored in C as xxxxx |

*NOTE: x's show result format.*

## DATA MOVEMENT VERB

Several COBOL verbs have the ability to move or manipulate data in some manner. However, this aspect is of secondary importance and only incidental to the specific objective of the verb. For example, the arithmetic verbs may involve some data movement and/or manipulation. This, however, is secondary to their main function of effecting an arithmetic calculation. The COBOL verb MOVE is for the specific purpose of moving data. The primary purpose of the MOVE verb is to transmit data from one area of computer storage to another.

MOVE

Format:

*Option 1:*

MOVE $\left\{\begin{matrix} identifier\text{-}1 \\ literal \end{matrix}\right\}$ TO $\{identifier\text{-}2\}\ldots$

Description:

The MOVE verb transfers information from one data area in memory to one or more areas within the computer, in accordance with the rules of editing.

A simple MOVE causes the data represented by identifier-1, or the specified literal, to be moved to identifier-2. The data is also moved to identifier-3, identifier-4, etc., if these areas are specified.

The use of this verb does not destroy the contents of the source area (identifier-1 or literal), but the receiving area (identifier-2, identifier-3, etc.) is replaced by the data of the source area.

It is illegal to MOVE a group item whose format is such that editing would be required on the elementary items in separate operations. If such a MOVE is desired, each elementary item must be MOVEd and edited, individually.

When moving group items, the move is from left to right. If the item PICTURE is not identical, a diagnostic message is given. Truncation of low-order positions from the source item occurs if the receiving area is smaller. Space fill of low-order positions of the receiving area occurs if the source item is smaller.

When both the receiving and source areas are elementary items, editing, as specified in the receiving area, is automatically performed for each MOVE command. The rules governing this are:

For Numeric Elementary Items

1. If the source area is larger than the receiving area, truncation occurs. If the receiving area is larger than the source area, the unfilled positions are zero filled. Data from the source area is aligned with respect to the implied or actual decimal point in the receiving area, with truncation or zero fill occurring to either side of the decimal point as illustrated below.

| SOURCE AREA | | RECEIVING AREA | |
|---|---|---|---|
| Picture | Value | Picture | Value after Moving |
| 9V9 | 12 | 99V99 | 0120 |
| 9V999 | 8765 | V99 | 76 |

2. Insertion of a currency sign, a decimal point, commas, etc., with proper alignment, is accomplished in accordance with the PICTURE of the receiving area. If these latter characters are in a source area, the field(s) will be nonnumeric and, thus, MOVEment must conform to the nonnumeric rules.

3. If no decimal point has been specified, either assumed or actual, data is right justified in the receiving area.

4. A numeric edited, alphanumeric edited, or alphabetic data item must not be MOVEd to a numeric or numeric edited data item.

5. A numeric or numeric edited data item must not be MOVEd to an alphabetic item.

6. A numeric item whose assumed decimal point is not to the extreme right must not be MOVEd to an alphanumeric or alphanumeric edited data item.

For Nonnumeric Elementary Items

1. Data from the source area is placed in the receiving area filling from left to right unless specified otherwise (e.g., JUSTIFIED RIGHT).

2. If the receiving area is larger than the source area; the unfilled low-order positions are replaced with blanks (spaces).

3. If the source area is greater in length than the receiving area, the MOVE terminates when the receiving area is filled. A warning is given at compilation time indicating this situation.

Examples:

MOVE A-FIELD TO COSTED-A-FIELD.

The contents of COSTED-A-FIELD are entirely replaced with the contents of A-FIELD.

MOVE 128 TO CTR.

The numeric literal, 128, is moved to the field named CTR.

MOVE SPACE TO SIZE-CODE-SIGN.

The field named SIZE-CODE-SIGN is entirely filled with spaces. Further examples of the MOVE verb are given in the following examples.

| SOURCE AREA | | RECEIVING AREA | |
|---|---|---|---|
| Picture | Data in source area | Picture | Data in receiving area |
| 9999V99 | 567891 | 9999V99 | 567891 |
| 9999V99 | 567891 | 9999V9 | 56789 |
| 9V9 | 78 | 999V99 | 00780 |
| XXX | M8N | XXXXX | M8N |
| 99V99 | 6789 | 999.99 | 067.89 |
| AAAAAA | WARREN | AAA | WAR |
| 99V99 | 6789 | $$$99.99 | $67.89 |

## CONDITIONAL EXPRESSIONS

Conditional expressions are used in situations where the outcome of a test will determine the next logical steps to be performed. Like the arithmetic expression which reduces to a single numeric value, the conditional expression may be thought of as also reducing to a single

value—in this case, "true" or "false." In general, truth or falsity is determined by a relational test either between a data-name and a literal, or among several data-names. For example, the expression

FICA-TO-DATE IS EQUAL TO 277.20

may or may not be true, depending upon the amount of FICA-TO-DATE accumulated by a particular employee. The outcome of this test will determine the next program steps to be executed.

Since the outcome of a relational test is used in a conditional expression to determine a course of action, and since this test is based on a comparison of characters, it is significant to discuss, at this point, just how this comparison or evaluation occurs.

## RULES OF COMPARISON

Characters are compared and evaluated on the basis of a computer collating sequence in which the characters have a specified order of magnitude. This order is "built into" the machine, and every character meaningful to the computer has its position in this ordering. The result of a comparison depends on the relative position of each character in the machine's collating sequence.

### Comparison of Numeric Items

The comparison of numeric items is based on the respective values of the items considered purely as algebraic values. The item length, in terms of the number of digits, is not itself significant. Zero represents a unique value regardless of the length, sign, or implied decimal point location of an item.

For example, a comparison of a data-item which has a value of +000003 with a data-item which has a value of +03 will result in an "equal" condition. Similarly, the value of 000000 is equal to the value of +0000. Following the rules of algebra, +01 is greater than -155.

### Comparison of Nonnumeric Items

For two nonnumeric items, or one numeric and one nonnumeric item, a comparison results in the determination that one of the items is LESS THAN, EQUAL TO, or GREATER THAN the other with respect to the ordered character set. If a signed, computational item is compared with a nonnumeric item, the sign is ignored. There are two cases to consider: equal length items, and unequal length items. In a comparison of two nonnumeric items, the character in an item is compared with the corresponding character of the other item. The comparison begins with the high-order (leftmost) character of each item. If these two characters are equal, the next two are compared and so on. As soon as the unequal condition is noted, the comparison stops and the result is recorded.

1. Items of Equal Length

   If the items are of equal length, comparison proceeds by comparing characters in corresponding character positions starting from the high-order end and continuing until either a pair of unequal characters is encountered or the low-order low end of the item is reached. The items are determined to be EQUAL

when the low-order end is reached, and no unequal pair of characters is detected.

The first encountered pair of unequal characters is compared for relative location in the ordered character set. The item which contains the character which is positioned higher in the ordered sequence is determined to be the GREATER item.

2. Items of Unequal Length

If the items are of unequal length, comparison proceeds as described above. If this process exhausts the characters of the shorter item without detection of a difference, then the shorter item is LESS THAN the longer item unless the remainder of the longer item consists solely of spaces.

## THE SIMPLE CONDITIONAL EXPRESSION

A simple condition reducing to the value true or false may be expressed by any of the following:

a relation
a condition-name
a sign condition
a class condition
a switch-status condition.

Any of the above may be used in a decision-making operation to select different paths of control in a program.

### The Relational Condition

A relational condition causes a comparison of magnitude between two quantities (or operands). Each quantity may be either an identifier, a literal, or an arithmetic expression. The general form of the relational expression is as follows:

$$\left\{\begin{array}{l}identifier\text{-}1\\literal\text{-}1\\arithmetic\text{-}expression\text{-}1\end{array}\right\} \text{ operator } \left\{\begin{array}{l}identifier\text{-}2\\literal\text{-}2\\arithmetic\text{-}expression\text{-}2\end{array}\right\}$$

The first quantity is called the subject of the condition. The second is referred to as the object. The subject and object in a relational expression may not both be literals.

The relational operators specify the type of comparison to be made between the two quantities. A relational operator must be preceded and followed by a space. The following is a list of the relational operators:

IS [NOT] GREATER THAN
IS [NOT] >
IS [NOT] LESS THAN
IS [NOT] <
IS [NOT] EQUAL TO
IS [NOT] =

A relational expression may appear in the following manner:

AGE IS GREATER THAN 21
AGE IS NOT GREATER THAN 21
FICA-TO-DATE IS LESS THAN 277.20
REORDER-POINT IS EQUAL TO 450
GROSS IS = NET

The word NOT is provided to make the relational operator specify the exact opposite of what it would normally specify. For example:

AGE IS GREATER THAN 21
AGE IS NOT GREATER THAN 21

are exact opposites of each other. The words IS and THAN are optional and may be specified at the user's discretion without altering the meaning of the expression. For example:

FICA-TO-DATE LESS 277.20

is equivalent to

FICA-TO-DATE IS LESS THAN 277.20

or to either of the following:

FICA-TO-DATE IS LESS 277.20
FICA-TO-DATE LESS THAN 277.20

Sign Condition

This condition determines whether a numeric quantity is less than, equal to, or greater than zero. The general format of this conditional expression is as follows:

$$\left\{\begin{matrix}identifier\\arithmetic\text{-}expression\end{matrix}\right\} \quad \text{IS} \quad [\underline{\text{NOT}}] \quad \left\{\begin{matrix}\underline{\text{POSITIVE}}\\\underline{\text{NEGATIVE}}\\\underline{\text{ZERO}}\end{matrix}\right\}$$

The identifier in a numeric status test must always represent a numeric value. For example:

SCALE IS POSITIVE

where SCALE is identified in the Data Division and contains numeric data.

Use of the arithmetic-expression as a subject will not be discussed as arithmetic operators are required.

Class Condition

The class condition test determines whether a quantity is purely numeric or purely alphabetic. The general format of this conditional expression is as follows:

*identifier* IS [NOT] { NUMERIC / ALPHABETIC }

The test must be consistent with the data description of the item being tested. That is, the NUMERIC test may only be used for data which has been described as numeric and the ALPHABETIC test may be only used for data which has been described as alphabetic. Either may be used for data described as being *alphanumeric*. The usage of identifier must be defined, either explicitly or implicitly, as DISPLAY.

CONDITIONAL STATEMENT

Conditional statements and sentences are vital to any data processing problem. In effect, they specify alternative courses of action depending upon the outcome of a test or comparison.

The format of a conditional statement is as follows:

IF *condition*; { *statement-1* / NEXT SENTENCE } ; ELSE { *statement-2* / NEXT SENTENCE }

Here, a conditional expression is evaluated and determined to be either true or false. If the condition is true, then statement-1 is executed and control is transferred to the next sentence. If it is false, then statement-2 is executed and control is passed to the next sentence. If NEXT SENTENCE is specified instead of statement-1, control passes to the next sentence if the statement is true.

Examples:

```
IF AGE IS GREATER 32 SUBTRACT 32
FROM AGE ELSE SUBTRACT AGE
FROM 32 GIVING DIFF GO TO READ-ROUT.
```

In this example if AGE is greater than 32, the condition is true and statement-1, SUBTRACT 32 FROM AGE, will occur. The rest of the sentence to the period will be ignored. If the condition is false (AGE equal to or less than 32), statement-1 will be ignored and the word ELSE will be searched for. If the sentence contains an ELSE, then the statement that follows will be executed.

The same functions will occur if it is written, as follows.

```
IF AGE IS GREATER 32 NEXT SENTENCE
ELSE SUBTRACT AGE FROM 32 GIVING
DIFF GO TO READ-ROUT. SUBTRACT
32 FROM AGE.
```

In this case when the condition is found to be true, control passes to the next sentence directing subtraction.

## SEQUENCE CONTROL VERBS

Normally, each statement in the Procedure Division is executed consecutively in order of its appearance. This is also true of the execution of each paragraph and section. However, it is often necessary to alter this normal sequence of operations and jump to a different point in the program to execute a number of lines of coding before the next statement in sequence can logically be operated upon. Two verbs, GO TO and PERFORM, are used to fulfill this function.

GO TO

Format:

*Option 1:*

GO TO [*procedure-name*]

Description:

This verb permits a departure from the normal sequence of procedures by specifying a transfer of control to another point in the program.

Examples:

```
CALCULATE.
    IF AGE GREATER
    32 GO TO ADD-ROUTING ELSE SUBTRACT
    32 FROM AGE.
```

PERFORM

Format:

*Option 1:*

PERFORM *procedure-name-1* [THRU *procedure-name-2*]

*Option 2:*

PERFORM *procedure-name-1* [THRU *procedure-name-2*]

$$\left\{ \begin{matrix} identifier \\ integer \end{matrix} \right\} \text{ TIMES}$$

*Option 3:*

PERFORM *procedure-name-1* [THRU *procedure-name-2*]

UNTIL *condition*

Description:

This verb allows a temporary departure from the normal sequence of procedures in order to execute one statement or a sequence of statements a specified number of times or until a condition is satisfied and provides automatic return to normal sequence.

Examples:

```
PERFORM ADD-ROUTINE.
PERFORM ADD-ROUTINE THRU DIVIDE-ROUTINE.
PERFORM ADD-ROUTINE THRU DIVIDE-ROUTINE 6 TIMES.
PERFORM ADD-ROUTINE 6 TIMES.
PERFORM ADD-ROUTINE UNTIL ADD-COUNT IS GREATER THAN 6.
PERFORM ADD-ROUTINE THRU DIVIDE-ROUTINE UNTIL
ARITH-COUNT IS GREATER THAN 6.
```

The first statement of procedure-name-1 is the point to which control is transferred by PERFORM. The return mechanism is automatically inserted as follows:

1. If procedure-name-1 is a paragraph-name, and procedure-name-2 is not specified, then the return mechanism is inserted after the last statement of the procedure-name-1 paragraph.
2. If procedure-name-1 is a section-name, and procedure-name-2 is not specified, then the return mechanism is inserted after the last statement of the last paragraph of the procedure-name-1 section.
3. If procedure-name-2 is specified and is a paragraph-name, then the return mechanism is inserted after the last statement of the procedure-name-2 paragraph.
4. If procedure-name-2 is specified and is a section-name, then the return mechanism is inserted after the last statement of the last paragraph of the procedure-name-2 section.

When procedure-name-2 is specified, the required relationship between procedure-name-1 and procedure-name-2 is that of logical sequence; i.e., execution sequence must proceed from procedure-name-1 to the last statement of the procedure-name-2 paragraph or section. GO TO statements and other PERFORM statements are permitted between procedure-name-1 and the last statement of procedure-name-2, provided the sequence ultimately returns to the final statement of procedure-name-2.

When ELSE NEXT SENTENCE appears in the last sentence (to be executed) control returns to the statement following the PERFORM statement.

A procedure referenced by one PERFORM statement can be referenced by other PERFORM statements.

PERFORM may reference a NOTE; no action is taken and the automatic return to the proper line is generated.

In all cases, after the completion of a PERFORM, a bypass is automatically created around the return mechanism which has been inserted after the last statement. Therefore, when no related PERFORM is in progress, sequence control will pass around the return mechanism to the following statement as if no PERFORM has existed.

STOP

Format:

STOP { *literal* / RUN }

Description:

The STOP verb terminates the object program either permanently or temporarily. The format must specify a literal, or the key word RUN must be used with STOP. (If a literal is employed, it is displayed by the object program at the time STOP occurs either on the console printer or a substitute medium, such as console lights.) If the operator should elect, continuation of the object program begins with the execution of the next statement in sequence.

STOP RUN automatically activates the standard ending routine of the Executive Routine. Therefore, it should be used only as the final executable statement of the program.

Some examples of the use of STOP are:

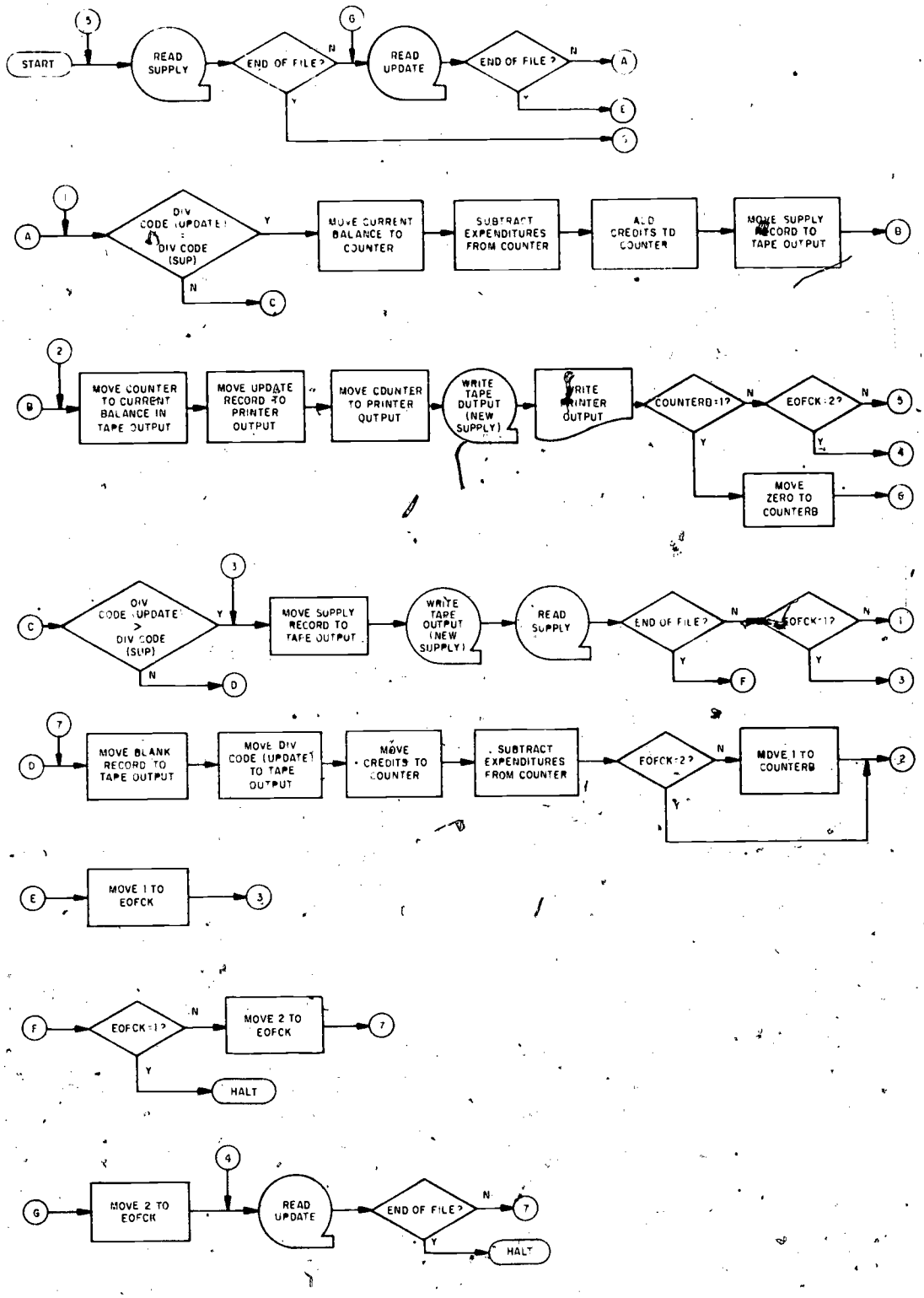
```
STOP 3.
STOP 127.
STOP "INPUT TAPE SHOULD BE DESCRIPTIONS".
STOP RUN.
```

Whenever a numeric literal is used, as in the first two examples, it is customary to specify a different number for each STOP. These numbers are then catalogued with their respective definitions, for use with the object program. The literal used may be numeric or nonnumeric or any figurative constant except ALL.

## SAMPLE PROGRAM

This sample program is provided as an aid in learning the complete structure of a COBOL program. Figure 5-1 is the programming flowchart used to write the program.

```
IDENTIFICATION DIVISION.
PROGRAM-ID. SUP-BAL-UPDATE.
AUTHOR. A. PROGRAMMER.
INSTALLATION. ELLYSON.
DATE WRITTEN. NOVEMBER 17 1974.
SECURITY. UNCLASSIFIED.
REMARKS. THIS PROGRAM UPDATES THE CURRENT BALANCE
    OF THE MASTER SUPPLY TAPE BY INSTALLATION DIVISIONS.
    UNMATCHED UPDATE RECORDS WILL CAUSE A NEW MASTER
    RECORD. ALL UPDATE RECORDS WILL BE PRINTED.
    UNMATCHED MASTER RECORDS WILL BE WRITTEN ON NEW
    TAPE. NO MASTER RECORDS WILL BE PRINTED.
    THIS PROGRAM WRITTEN IN CONJUNCTION WITH THE
    PROGRAMMING FLOWCHART IN FIGURE 5-1.
ENVIRONMENT DIVISION.
CONFIGURATION SECTION.
SOURCE-COMPUTER. IBM-360-H50.
OBJECT-COMPUTER. IBM-360-H50.
SPECIAL-NAMES. TOP-OF-NEXT-PAGE IS NEW-PAGE.
INPUT-OUTPUT SECTION.
    SELECT SUP-MASTER ASSIGN TO SYSIN1.
    SELECT TRANSFILE ASSIGN TO SYSIN2.
```




49.443

Figure 5-1. Completed programming flowchart.

```
    SELECT PRINTSIT ASSIGN TO PRINTER.
    SELECT NEW-SUPPLY ASSIGN TO SYSOUT1.
DATA DIVISION.
FILE SECTION.
FD  SUP-MASTER
    LABEL RECORD IS STANDARD
    BLOCK CONTAINS 50 RECORDS
    DATA RECORD IS SUP-REC.
01  SUP-REC.
    02  MAST-DIV-CODE PIC X999.
    02  FILLER PIC X(30).
    02  CURBAL PIC 9(8)V99.
    02  QTR-EXP PIC 9(6)V99.
    02  QTR-CREDITS PIC 9(6)V99.
    02  FILLER PIC X(22).
FD  TRANSFILE
    LABEL RECORD IS STANDARD
    BLOCK CONTAINS 50 RECORDS
    RECORD IS UPDATE-REC.
01  UPDATE-REC.
    02  DET-DIV-CODE PIC X999.
    02  FILLER PIC X(40).
    02  EXPEND PIC 9(6)V99.
    02  CREDITS PIC 9(6)V99.
    02  FILLER PIC X(20).
FD  PRINTSIT
    LABEL RECORD IS OMITTED
    RECORD IS PRINT-UPDATE.
01  PRINT-UPDATE PIC X(120).
FD  NEW-SUPPLY
    LABEL RECORD IS STANDARD
    BLOCK CONTAINS 50 RECORDS
    DATA RECORD IS OUTSUP.
01  OUTSUP.
    02  OUTDIVCODE PIC X999.
    02  FILLER PIC X(30).
    02  OUTBAL PIC 9(8)V99.
    02  FILLER PIC X(36).
WORKING-STORAGE SECTION.
77  LINE-NO PIC 99 VALUE IS ZEROS.
77  COUNTER PIC 9(8)V99.
77  COUNTERB PIC 9 VALUE IS ZERO.
77  EOFCK PIC 9 VALUE IS ZERO.
77  BLANKOUT PIC X(80) VALUE IS SPACES.
77  PRINTSPACER PIC X(120) VALUE IS SPACES.
01  PRINT-PICTURE.
    02  FILLER PIC X(10) VALUE IS SPACES.
    02  DIV-CODE PIC X999.
    02  FILLER PIC X(15) VALUE IS SPACES.
    02  PBAL PIC $$$$$$$$9.99.
    02  FILLER PIC X(10) VALUE IS SPACES.
    02  PEXP PIC $$$$$$9.99.
    02  FILLER PIC X(10) VALUE IS SPACES.
    02  PCREDITS PIC $$$$$$9.99.
    02  FILLER PIC X(39) VALUE IS SPACES.
```

```
01  PAGE-HDR.
    02  FILLER PIC X(8) VALUE IS SPACES.
    02  AA PIC X(8) VALUE IS 'DIV CODE'.
    02  FILLER PIC X(11) VALUE IS SPACES.
    02  BB PIC X(15) VALUE IS 'CURRENT BALANCE'.
    02  FILLER PIC X(7) VALUE IS SPACES.
    02  CC PIC X(12) VALUE IS 'EXPENDITURES'.
    02  FILLER PIC X(10) VALUE IS SPACES.
    02  DD PIC X(7) VALUE IS 'CREDITS'.
    02  FILLER PIC X(42) VALUE IS SPACES.
PROCEDURE DIVISION.
OPENING.
    OPEN INPUT SUP-MASTER, TRANSFILE.
    OPEN OUTPUT PRINTSIT, NEW-SUPPLY.
    PERFORM HEADER-PRINT.
READ-ONE.
    READ SUP-MASTER AT END GO TO G-ROUT.
READ-TWO.
    READ TRANSFILE AT END GO TO E-ROUT.
A-ROUT.
    IF MAST-DIV-CODE EQUAL TO DET-DIV-CODE NEXT
    SENTENCE ELSE GO TO C-ROUT. MOVE CURBAL TO COUNTER.
    SUBTRACT EXPEND FROM COUNTER. ADD CREDITS TO
    COUNTER. MOVE SUP-REC TO OUTSUP. MOVE ZEROS TO
    OUTBAL.
B-ROUT.
    MOVE COUNTER TO OUTBAL. MOVE UPDATE-REC TO PRINT-
    PICTURE. MOVE COUNTER TO PBAL. WRITE PRINT-UPDATE
    FROM PRINT-PICTURE AFTER ADVANCING 1 LINES. ADD 1
    TO LINE-NO. IF LINE-NO IS GREATER THAN 55 PERFORM
    HEADER-PRINT. WRITE OUTSUP. IF COUNTERB IS NOT EQUAL
    TO 1 NEXT SENTENCE ELSE MOVE ZERO TO COUNTERB
    GO TO READ-TWO. IF EOFCK EQUAL TO 2 GO TO 4ROUT
    ELSE GO TO READ-ONE.
C-ROUT.
    IF DET-DIV-CODE GREATER THAN MAST-DIV-CODE GO TO
    3ROUT ELSE GO TO D-ROUT.
3ROUT.
    MOVE SUP-REC TO OUTSUP. WRITE OUTSUP. READ SUP-
    MASTER AT END GO TO F-ROUT. IF EOFCK IS EQUAL TO
    1 GO TO 3ROUT ELSE GO TO A-ROUT.
D-ROUT.
    MOVE BLANKOUT TO OUTSUP. MOVE DET-DIV-CODE TO
    OUTDIVCODE. MOVE CREDITS TO COUNTER SUBTRACT
    EXPEND FROM COUNTER. IF EOFCK EQUAL TO 2 GO TO
    B-ROUT ELSE MOVE 1 TO COUNTERB GO TO B-ROUT.
E-ROUT.
    MOVE 1 TO EOFCK GO TO 3ROUT.
F-ROUT.
    IF EOFCK EQUAL TO 1 GO TO COMPLETE ELSE MOVE 2
    TO EOFCK GO TO D-ROUT.
G-ROUT.
    MOVE 2 TO EOFCK.
4ROUT.
    READ TRANSFILE AT END GO TO COMPLETE. GO TO D-ROUT.
```

```
COMPLETE.
    CLOSE SUP-MASTER, TRANSFILE, PRINTSIT, NEW-SUPPLY.
    STOP RUN.
HEADER-PRINT.
    MOVE PRINTSPACER TO PRINT-UPDATE. WRITE PRINT-
    UPDATE FROM PAGE-HDR AFTER ADVANCING NEW-PAGE
    LINES.
```

# CHAPTER 6

# SYSTEMS

The word system or systems is not unique to the Navy. Defined broadly, system refers to an organized whole or separate functioning parts that comprise the whole. An example of such organization is:

The armed forces of the United States of America
Specifically — The U.S. Navy
More specifically — an individual command

Those parts that comprise the whole are usually referred to as subsystems. A Data Processing Technician should have knowledge of a large subsystem such as Naval Personnel Accounting, although personal involvement will be at a much smaller subsystem level (i.e., local command preparation, processing and submission to higher command). Each subsystem has its own goal or mission and is often referred to as a system. As an example, a ship or station having its own input, processing and output, for supply accounting considers that it has its own supply system.

There are subsystems in an individual command's supply system, meaning that the reports that are to be produced require many individual program runs (system software) on an individual command's computer (system hardware) utilizing unique control programs (operating system).

It is important to remember that what is provided as input to a system has a lot to do with the quality of that system's output. It is important to realize that the output from most subsystems becomes the input to another subsystem. The input to a subsystem must be as accurate as possible, and the output must conform to all requirements by higher commands.

Every good data processor is a systems man. He should be concerned with his part in the jobs assigned for daily, weekly, or monthly processing, realizing their importance and how they fit into the "big picture."

## SYSTEM DEFINITIONS

Terms frequently used in reference to systems are defined in the following paragraphs.

### MANAGEMENT INFORMATION SYSTEM (MIS)

An MIS is an automated information system involving communications in which data are recorded and processed for operational purposes. Problem areas may be isolated and monitored. Through inquiry and feedback management is provided with needed, up-to-the-minute information for proper and immediate control.

An example of an MIS installation is the Personnel Management Information Center (PERMIC), which has combined the efforts of PAMI CONUS, PAMI LANT and PAMI PAC to form one data base. The mission of PERMIC is to collect, process and disseminate manpower and personnel information, as an integral component of the Manpower and Personnel Management Information System (MAPMIS), for all Navy active and inactive components. It provides data processing support to fleet and shore commands tasked with personnel resources management by the Chief of Naval Personnel.

### DATA SYSTEM

Data systems make use of combinations of personnel efforts, forms, formats, instructions, procedures, data elements, and related data codes, communications facilities, and ADP equipment. These resources provide for an organized means of recording, collecting, processing and communicating data, whether it be an automated, manual or combined method.

Data system is, therefore, the whole system or each subsystem. In order to provide the most effective and efficient method of achieving command missions, a thorough knowledge of resources is essential. Nothing can be done efficiently if available facilities and resources are not used.

## AUTOMATIC DATA PROCESSING SYSTEM (ADPS)

ADPS includes the equipment, personnel, programs, and application operations involved in the utilization of electronic data processing equipment along with associated electric accounting machines. These resources allow the solving of business and logistics data processing problems with a minimum of human intervention.

Broadly speaking, every ADPS is a Navy computer installation and every Navy computer installation is an ADPS. Therefore, the data processor's personal contact with systems will for the most part be related to an ADPS. Common ADPS terms are: SOFTWARE SYSTEM, HARDWARE SYSTEM and OPERATING SYSTEM.

It is also in this area and at this level that Data Processing Technicians First Class and above become concerned and involved with such things as automatic data processing system specifications, data system specifications, operations research, system analysis, system design, system engineering and system study.

## COMPUTER SYSTEM HARDWARE

Equipment that is associated with and that comprises the totality of one computer controlled interconnected group is referred to as the configuration. It may be referred to as the hardware configuration or the system configuration. Although there are no rigid requirements, the configuration of a system is usually predetermined by the manufacturer. The manufacturer's recommended configuration should depend on the software required to meet a command's problem solving specifications.

In order to support a particular operating system, the manufacturer would recommend that it contain a specific number of tape drives, disk units, printers, etc. The configuration, therefore, can be thought of as being directly proportionate to the sophistication of the software.

If all of the hardware configuration does not come from the same manufacturer, there are many, many problems to overcome. Most manufacturers' specifications do not allow direct compatibility. In a mixed configuration an interface device would probably be required. The cost of the interface device could offset what appears to be a savings of one manufacturer's peripheral equipment over that of another's.

The Navy has agencies or departments skilled and experienced in configuration selection. This relieves many hours of hard study and possible misjudgements on the part of individual commands. In most cases when an installation is to be established as, or converted to, an ADPS installation, the operating system and configuration have been predetermined. This, of course, does not totally preclude an installation's requests or recommendations.

Auxiliary equipment may be left more to the command's discretion. Care must be taken in this area to determine if it is more economical to use auxiliary equipment or to make use of the utility program provided by the operating system. A careful and thorough study must be made of any equipment specifications before a purchase can be considered.

## COMPUTER SYSTEM SOFTWARE

Software is defined as a set of computer programs, procedures, and possibly associated documentation concerned with the operation of a data processing system, e.g., compilers, library routines, manuals, circuit diagrams, etc. Software is the totality of programs and routines from manufacturer and user alike which is used to extend the capabilities of automatic data processing.

One of the best ways to describe the uses of software is to discuss an operating system. An operating system is a system in which software controls the execution of computer programs. It may also provide scheduling, debugging, input/output control, accounting, compilation, storage assignment, data management, and related services.

IBM has one of the more sophisticated operating systems and is one of the predominant systems found at Navy shore installations. An example is the IBM/360. These operating systems are discussed in the following paragraphs.

## OPERATING SYSTEMS

An operating system is an integrated set of processing programs and a control program designed to improve the total operating effectiveness of a computer. The operating system is directed by user-prepared control cards to pass automatically from job to job with a minimum of delay and operator intervention. Communication with the computer is via the operating system rather than directly, as was the case with most previous computers.

With today's more powerful machines, setup time is becoming proportionately larger for each job. As a result, large, expensive computers can sit idle at times while new work is being loaded. Even during the execution of a program, many components of the system may remain idle. Of all the resources available on a system, only certain parts of the total system may be required for a job. The operating system enables the user to stack jobs for continuous processing, thus reducing setup time between jobs. The operating system has the ability to call in any required programs, routines, or data. Some operating systems have the ability to schedule jobs and allocate resources more efficiently by concurrently processing two or more independent programs (multiprogramming). They can compile higher-level languages (COBOL, RPG, FORTRAN, PL/I), organize files, and act as a supervisor for the entire system.

In short, the operating system makes possible the maximum use of a computer.

In System/360, there are four different operating systems. Determining which is best for any particular S/360 depends upon the size of the system, the physical devices supported, and whether certain expanded functions are required, since features of one operating system may not necessarily be available in another. Briefly, the four operating systems are BOS/360 (Basic Operating System), DOS/360 (Disk Operating System), TOS/360 (Tape Operating System), and OS/360 (Operating System). Some of the similarities and differences in their makeup are discussed in the following paragraphs.

What is intended is a brief survey of some of the major reasons for selecting one operating system over the others. A discussion of all supported devices and features is far beyond the scope of this manual. Omission of any particular feature is not meant to indicate lack of availability of that feature.

All four operating systems are composed of two major sets of programs, which are known as control programs and processing programs.

Control programs supervise the execution of the processing programs, control the location, storage, and retrieval of data, and schedule jobs for continuous processing.

Processing programs consist of language translators, service programs, and user-written problem programs, all of which the programmer uses to define the work that the computing system is to perform and to simplify program preparation.

System users may also include their own service programs or language translators, which the programmer can then use as he would IBM-written programs. Figure 6-1 illustrates the DOS/360, TOS/360, and OS/360 operating systems facilities.

In all four System/360 operating systems, the work to be done is regarded as a stack of jobs to be executed under the management of a control program. A job may contain one or more job steps, and may be thought of as a series of logically related programs that must be executed in a given sequence. Job steps within a job are always executed in sequence and never operate concurrently.

Necessary information about each job is punched into job control cards by the user. These cards are read by a portion of the control program to instruct it as to which programs are to be executed; and in what sequence; they also contain information about the I/O device requirements for each job step. The control cards provide the information necessary to operate in a stacked job environment.

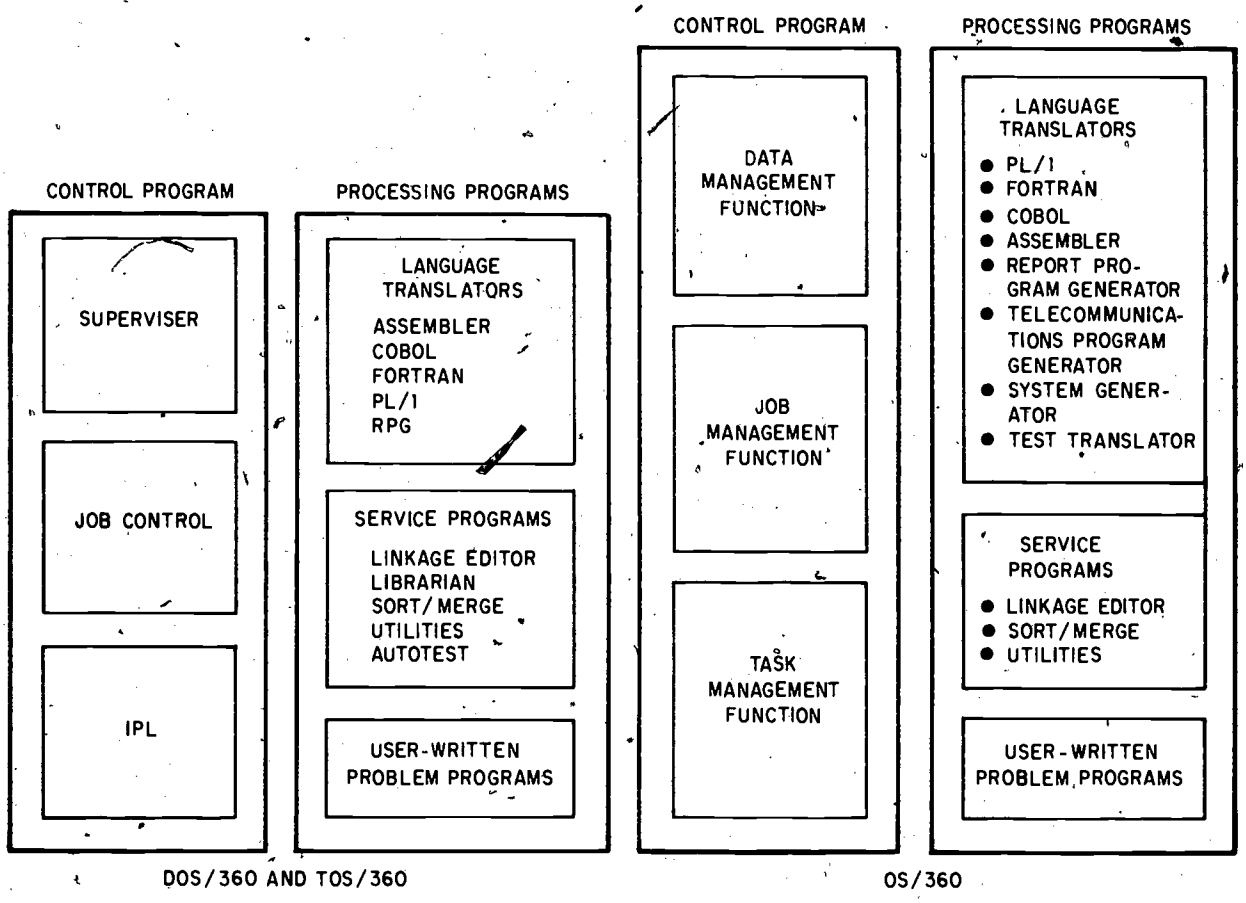
### BOS/360, TOS/360, AND DOS/360 CONTROL PROGRAMS

#### Initial Program Loader (IPL)

This program loads the supervisor into main storage when system operation is initiated. The IPL loader is loaded from the system residence unit by dialing its address on the load-unit switches on the system console and pressing the load key.

#### Supervisor

This program handles all input/output operations, interruption conditions, and other control




78.145

Figure 6-1.—Facilities available in three of the System/360 operating systems.

functions for all problem programs. Part of the supervisor resides in main storage at all times. Processing time is divided between the supervisor and the program being executed. This is true of user programs as well as the other IBM-supplied components of the system.

The physical IOCS routines of the supervisor handle the scheduling and supervise the execution of channel programs. The problem program (or logical IOCS within the problem program) supplies the channel programs and issues physical I/O macro instructions to request their execution.

The supervisor starts the I/O operation and returns control to the problem program. When the operation is completed, the supervisor checks for, and handles, any device error conditions. Thus, the user's program need not contain any I/O device error routines.

The checkpoint/restart routines of the supervisor provide a means of recording program status at desired points so that the program can be restarted there at a later time. The problem program resumes processing after each checkpoint. In response to a CHKPT (checkpoint) macro instruction, the checkpoint routine writes the problem program, along with other information needed to restart the program, onto magnetic tape. The restart routine can reload the program

later and resume processing at the point of interruption. The restart program can reposition magnetic tape files before resuming program execution.

The supervisor transfers control of the system to job control at the end of each job step, providing transition between job steps and between jobs.

The storage print routine of the supervisor can provide a printout of core storage, and all registers, if an abnormal end-of-job condition occurs.

Some of the supervisor routines are loaded into main storage during system initialization. These routines are never overlaid and remain in main storage throughout execution of a stream of jobs. Other routines of the supervisor are called into main storage from external storage (tape or disk) only when their particular functions are needed. These are called transient routines. They are loaded into what is called a transient area, and they overlay any previous routines in the area. This allows numerous supervisor functions to be provided while using a minimum amount of storage.

### Job Control

This program runs between jobs and prepares the system for execution of all other programs; it is loaded by the supervisor whenever it is needed.

## LOGICAL IOCS

IBM furnishes a comprehensive set of macro definitions to create, access, and maintain data files. Descriptive macro instructions in the user's program generate the data and program logic for these files. (In BOS, the macro instructions must be assembled immediately preceding the rest of the problem program. Thus, they occupy an area of core storage between the user's program and the supervisor.)

Each imperative macro instruction issued by the programmer causes a branch to the proper instruction (in the generated IOCS logic) for the requested service.

Logical IOCS does the following:

1. Requests physical I/O operations, as necessary, by issuing the required physical IOCS macro instructions. The necessary channel programs are generated from the descriptive IOCS macro instructions.

2. Supplies logical input records to, or accepts logical output records from, the problem program. This includes blocking and deblocking logical data records (fixed-length or variable-length) from larger physical blocks. (Logical record refers to the individual unit of a data file; physical record refers to the block of logical records read or written as a single string of information.)

3. Switches between two I/O areas to provide time for processing while records are being read or written.

4. Handles end-of-file and end-of-volume conditions.

5. Constructs and maintains file organization structures. This includes additions and deletions to files, and the construction and use of index tables for processing files.

## LABEL PROCESSING

Disk and tape label-processing capabilities are included to provide:

1. Assurance that the correct editions of disk and tape data files are provided for input and (in the case of multipack or multireel files) that this input is provided in the correct sequence.

2. Assurance that areas of disk storage or tape reels designated for output contain no current information. If usable, new labels are written for the output areas or reels.

The actual label processing is performed by transient routines assembled as part of the supervisor during initial system generation. These routines are loaded into the transient area of the supervisor and executed in response to macro instructions in the problem program. TOS/360 has only tape label-processing routines, whereas BOS/360 and DOS/360 have both tape and disk routines.

## OS/360 CONTROL PROGRAMS

Like BOS/360, TOS/360, and DOS/360, OS/360 has an IPL loader to initialize the system.

## DATA MANAGEMENT

This facility handles all IOCS functions relating to tape, disk, drum, and telecommunication activities. It can build program libraries and extract programs as needed. The programmer calls for all data in essentially the same way.

In addition, data management provides:

1. Allocation of space on Direct Access Storage Device (DASD).

2. Automatic location of data sets.

3. Protection of data sets against such occurrences as unauthorized access to security files (for example, payroll information may require "passwords"), an accidental attempt to write over a file that is to be saved, concurrent updates of the same record in a multiprogramming environment, etc.

JOB MANAGEMENT

This facility handles the scheduling of jobs to be done in a stacked job environment. Two types of scheduling are possible: the sequential scheduler initiates jobs on a first-in, first-out basis; the priority scheduler initiates jobs on the basis of user-assigned priorities.

TASK MANAGEMENT

This facility controls the operation of the system as it executes tasks. A job step (program) becomes a task when its I/O devices have been allocated, and it is known to the control program as a unit of work to be done. The task supervisor, responsible for interrupt handling, program fetching, storage contents management, etc., may handle a single task, a fixed number of tasks, or a variable number of tasks, depending upon the version of OS/360 being used. If many tasks are contending for use of the CPU resource, the task supervisor determines which task is to gain control.

## SYSTEM/360 PROCESSING PROGRAMS

Each operating system discussed has, in addition to the control program, many other programs that are, for the sake of simplicity, classified as processing programs. To further break down this classification, there are: language translators, service programs, and user-written programs.

LANGUAGE TRANSLATORS

A language translator is defined as a routine that accepts statements in a programming language and produces equivalent statements in machine language.

BOS/360 supports the S/360 Assembler Language, which includes a complete set of macro instructions. The S/360 Assembler Language is a machine-oriented symbolic language used in all models of System/360.

In addition, BOS/360 also includes a Report Program Generator (RPG). RPG is a problem-oriented language designed specifically for report-writing and file-maintenance applications.

DOS/360 and TOS/360 have, in addition to the assembler and RPG, COBOL, FORTRAN, and PL/I language translators.

OS/360 has, in addition to all of the above-mentioned language translators, an ALGOL translator.

The source languages that are provided for System/360 are upward-compatible. For example, if a user has a source FORTRAN program written according to DOS/360 or TOS/360 specifications, he can use the same source program with OS/360.

SERVICE PROGRAMS

The system service programs for BOS/360, TOS/360, and DOS/360 include linkage editor, librarian, sort/merge, utilities and load-system (BOS/360 only).

Linkage Editor

The linkage editor links separately compiled decks, relocates these decks as required, resolves external references, and includes modules from the relocatable library as necessary.

All programs are edited onto the resident disk (DOS/360) or a utility tape (TOS/360) by the linkage editor. These programs can then be permanently placed into the core image library of the system, requiring only control statements to call them for execution. Alternately, they can be executed at once and then overlaid by new programs.

Librarian

This group of programs maintains the libraries and provides printed and punched output from them. Three libraries, all residing on tape or disk, are available:

1. Core Image Library.—All programs cataloged in the system (IBM-supplied and user programs) are loaded from this library by the system-loader routine of the supervisor.

2. Source Statement Library (DOS/360, TOS/360).—This library contains IBM-supplied and user-defined source statement books, such as macro definitions. A book is an arbitrary collection of 80-byte records that is cataloged

under a single name in the source statement library.

Books are maintained in compressed format on the resident volume to conserve space and improve their speed of retrieval. Complete books may be added or deleted from the library (but not individual records). These books can be copied, for example, into assembly source programs or COBOL source programs.

BOS/360 does not have the full source statement library facilities. Rather, its macro library stores IBM-supplied and user-defined macro definitions in resident packs built to provide program assembly capability.

3. Relocatable Library.—This library stores object modules for later linkage into complete programs.

## Load System (BOS/360 only)

This is an independent program that is loaded from cards. It has its own initial program loader (IPL), supervisor, and job control programs. The load-program builds a resident system from cards. This program can be used to build minimum systems for specialized applications. If two disk drives are available, the librarian can be used instead of the load-system program to build specialized systems.

## Sort/Merge Programs BOS, TOS, DOS

The IBM BOS/360, TOS/360, and DOS/360 sort/merge programs provide the user with the ability to sort files of random records, or merge multiple files of sequenced records, into one sequential file. The control data information can be contained in as many as twelve fields in each record. The records can be sorted or merged into ascending or descending sequence. An individual sequence can be specified for each control data field. The output sequence for a merge-only operation must be the same as the input sequence.

The sort/merge program is a set of generalized modules (in the relocatable library) that must be tailored at execution time to each application. The user furnishes appropriate parameters on control cards; the tailored sort/merge program is built in the core image library; and it is then automatically executed as a sequence of overlays from this library.

BOS/360 and DOS/360 furnish disk sort/merge programs; both DOS/360 and TOS/360 furnish tape sort/merge programs.

## OS/360 Sort/Merge and other Service Programs

The facilities available in OS/360 with respect to service and other sort/merge programs are basically the same as in DOS/360. However, they are an expanded set of service programs with far fewer restrictions than in DOS/360. For example, the DOS/360 sort/merge programs have extra restrictions as to size and number of files, whereas OS/360 sort/merge programs are more liberal in this respect. In addition, OS/360 sort/merge is faster and more versatile.

OS/360 does not have a librarian *per se*, as does DOS/360. However, a set of utilities is available for maintaining all data sets. In addition, OS/360 allows the user to supply his own programs or macro instructions for maintaining data sets.

## UTILITY PROGRAMS

BOS/360 contains 11 file-to-file utility programs:

1. Tape to tape
2. Tape to disk
3. Tape to card
4. Tape to printer
5. Disk to tape
6. Disk to disk
7. Disk to card
8. Disk to printer
9. Card to tape
10. Card to disk
11. Card to printer and/or punch

The two initializing utilities in BOS/360 are:

1. Clear disk, which clears as little as one track up to one disk pack.
2. Tape compare, which compares two files from two or more tapes to ensure that the files are identical.

TOS/360 has the same utilities as BOS/360, with the exception of those utilities involving disk. DOS/360 has all of the BOS/360 utilities, plus six additional utility programs for the 2321 data cell. The additional utility programs are:

1. Tape to data cell
2. Disk to data cell
3. Data cell to tape

4. Data cell to disk
5. Data cell to data cell
6. Data cell to printer

Testing and Debugging Programs

A programmer who has for his use a set of test service routines can be relieved of much time and frustration involved in debugging. Such a set of routines is available for System/360 operating systems. In BOS/360, TOS/360, and DOS/360, it is known as Autotest. In OS/360, it is known as Testran. Both perform services at certain points in the program (specified by the programmer). These test actions include dumping (recording for display) systems tables, registers, and main storage; also, tracing of transfers, calls for subroutines, and references to data. Consecutive tests can be run with different sets of data. They can also test conditions stemming from program execution and, according to the results, either carry out or not carry out the dumps, traces, etc.

USER-WRITTEN PROGRAMS

Computer users generate many programs to solve a specific set of problems. Some of the routines may be useful to other users in solving similar problems. The widespread incorporation of routines that have been written elsewhere makes well-defined programming conventions especially important. Such standards are necessary if programs are to be interchanged among computer users.

SUMMARY

In order to develop skills as a programmer or enter into systems analysis it is first necessary to become familiar with the background information in this chapter as well as the details of a particular system. The preceding description is relevant to designing, upgrading or maintaining any and all systems and/or subsystems.

In most cases in the Navy, the system configuration is predetermined with prewritten or "canned" software, provided from a central point. This central control point normally has responsibility for all systems (subsystems) involved with the same mission.

Each command, however, will usually generate requirements for its own inhouse special projects. These will require analysis, design and programming found in any good system. A general discussion of system development follows.

Given a function to be automated or programmed, the programs which achieve this automation can be called the *operational programs*. The programs which aid the writing and "puting on the air" of the operational programs are called *utility programs*. An assembler is a good example of a utility program.

Frequently the program solution to a given problem becomes so large and complex that the solution is broken down into smaller units. These smaller units are then called programs and the totality of the interrelated programs is called a system.

This can be carried even further by a system consisting of subsystems, where each subsystem consists of programs. Each system and subsystem, as a rule, has a program acting as control for the entire system or subsystem.

There are no hard and fast rules as to how one initially subdivides a system into subsystems or programs. It is usually done in some convenient arbitrary manner. For example, the system may be divided so that each program is small enough to be the responsibility of one programmer. Or the system may consist of a set of separate functions, and each function may be performed by one program. Or the machine might be able to hold 10,000 computer instructions, plus data, in it at one time; hence, each program would be about 10,000 instructions long. Meetings are held by the programming supervisors (who are preferably experienced programmers) and the subdivisions are made.

Since the utility programs aid in the writing and checking out of the operational programs, the utility programs are written first. While a group of personnel is writing utility programs, a team of system analysts can be studying the requirements of the operational system and planning its design.

Usually, a set of utility programs is provided as a package by the manufacturer of the computer. However, in very large program systems, these must usually be supplemented in order to deal with special features of the operational system. For example, the manufacturer will almost always supply an assembler for changing symbolic machine instructions to binary, but perhaps not a compiler for a higher level language, although supplying the latter also appears to be the trend.

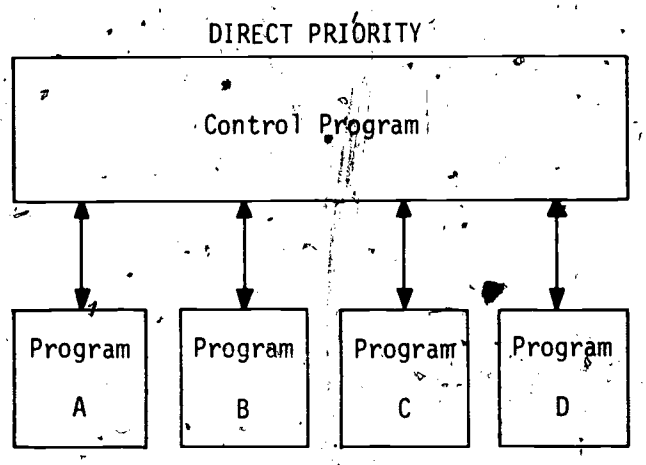
Utility tools for testing the operational system are generally produced by the developer of the operational system.

Utility programs usually take easily constructed human inputs and produce machine-usable inputs or take machine-produced outputs and produce easily understood outputs. Examples would be assemblers, compilers, compool assemblers, tape handlers, data insertion programs for use in testing, and data printing routines for use in testing.

The work on the development of a control program for a large system usually gets under way at the very beginning of a project. This is so because its development depends heavily upon the characteristics of the computer involved and its associated I/O equipment. The particular computer to be used in a particular project for automation is generally chosen at the very first—before the design of the system. This is not to say that this is the way it should be done, or always will be done, but it seems to have been historically the case.

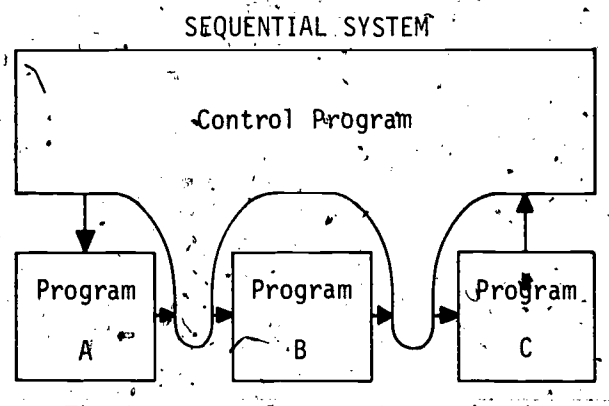
A control program can usually be classified as being one of two types. It controls either a "direct priority" type of system or a "sequential" type of system.

In a *direct priority type of system* the control program must be capable of bringing in and operating at a moment's notice any of the many possible programs.




Any program may follow or precede any other one depending on a priority code.

In a *sequential system*, as opposed to a direct priority system, the sequence of program operation is determined prior to the installation of the system in the machine.




The programs always operate in the sequence A, B, C, etc.

Since the control program attempts to keep I/O operations going on continuously while operating a program, this means that one program will be in core membry operating while a previously operated one and its data are being read out of core memory and a future one and its data are being read into core memory.

If we employ a direct priority type of system and also the philosophy of any three programs and their data in core at the same time, the control program must dynamically assign core memory locations to each program just prior to read-in from auxiliary storage. It must, likewise, dynamically assign core memory locations to the environment (tables and items) of a program and then communicate the whereabouts of this data to the using program. Dynamic allocation adds greatly to the complexity of a control program.

The process of developing a program system is quite variable as far as subdivisions of the process are concerned. Also, the terminology varies from system to system, but essentially the system documentation is as follows (refer back to Chapter 2 if necessary):

1. Feasibility Studies
2. Scope Documents (Describe the extent or capabilities of the system)
3. Operational Design Requirements (Describe the methods used to achieve the automation)
   a. Operational Program Requirements (Describe the functions performed by the machine)

b. Human Action Requirements (Describe the functions performed by users of the system)
4. Program System Specifications
5. Program Specifications
6. Test Specifications

The first three stages produce documents that are oriented in terms of the operational system. That is, the documents are written to describe in English procedures and mathematical formulae to be used in the automation of the particular problem at hand.

The last three stages are written making use of specific computer terminology and machine capability. The individuals taking part in any of the above stages should have written a computer program (be it ever so small) at one time in their career. This is so because the system-designer should have some "feel" for the consequences in machine programming involved to achieve his prose descriptions.

The proliferation in the number of stages of system design as the automation job increases in scope is somewhat appalling. This undoubtedly is connected in some way to Parkinson's Law. (Parkinson's Law states something to the effect that work expands to fill the time allocated.)

A good approach to system design and development seems to be to do the job in teams. Each team should be composed of members from the customer or user group and members from the system design and development group. The individuals comprising the customer component of the team should each have had about three to six months of programming experience or training. The individuals comprising the system development component of the team should have had a period of about equal time to study the user's current manual process. This tends to reduce the tendency towards a lopsided and unrealistic approach.

In extremely large systems, it is generally desirable to make a first pass at the design with a limited system capability. Much education on the part of all concerned takes place and many unforseeable problems arise. A second pass at the design can then be made with improved capability and wiser designers.

It would seem that a good way to train system developers might be to select a fairly good, responsible programmer and give him an assignment to automate some small function—say, for example, inventory records at the local supermarket. Then, four months later, after he has done this all by himself, give him a larger assignment, such as automating school bus scheduling at the local high school. For this, give him a subordinate. After six months and with this job solved, assign him to, perhaps, automating the billing at the county hospital or automation of records at the police department. For this, give him four or five programmers.

All of these assignments are jobs that should be contracted for and thus be real jobs, not just make-believe. After a company has five or ten of these competent teams, the company might tackle automating the United Nations, or some other such gigantic function. But this idea may be like building a tree house; workable in theory, but not always practical.

Management control and guidance are extremely important but difficult areas of system design and development. The difficulty seems to increase exponentially with the size of the system. This is probably due to the number of people involved, their lack of experience, and the complexity of the work.

It will be interesting to learn what the future holds as regards standardization of technology for large-scale system development.

# CHAPTER 7

# ADP PERSONNEL ORGANIZATION

There are many organizational planning needs to be met when a new installation is to be established or an existing system modified. Planning for the incoming hardware is primarily concerned with space, arrangement and environment. The planning for hardware installation is, in most cases, fairly routine as the specifications for each unit's required spacing (for repair access) and environment (air circulation, cooling, humidity, raised floor, etc.) are detailed by the manufacturer.

The arrangement of equipment should be of special concern to the senior DP's. Convenience of the operators and noise factors should be considered. If for instance, a printer can be located outside the area of the rest of the system without inconvenience, it should be. The harsh noise of a printer, plus the dust or paper lint, can add to the pollution problems for tape drives and the intake for blowers on other hardware. There are other problems concerning hardware that can usually be resolved by consulting the specification books, manufacturers' representatives, and your own or other DS's within the area.

Other major areas of concern are the requirements for personnel acquisition and training, applications to be developed, and procurement of other resources which are necessary to effectively use the ADP equipment. The following discussion on personnel acquisition and organization is meant to be informative and guiding but is not the only means of setting up an ADP installation.

## PERSONNEL ACQUISITION

As the senior DP ordered to a "new construction" billet or assigned to a command acquiring an additional or larger computer system, you may be required to participate in planning the DP allowance. It is also probable that the current allowance is ineffective and requires adjustment to meet the command's present ADP requirements. Requesting new or additional allowances requires a knowledge of all the skills that are required in a computer installation. Before discussing the different DP skills, Naval procedures for personnel administration and manpower management will be briefly reviewed.

## MANPOWER MANAGEMENT

Manpower management includes planning, statistical forecasting, balancing, and approving manpower requirements. These requirements relate to the specific numbers and kinds of military billets or civilian positions required by each activity (sea or shore) to perform its assigned mission and tasks. Billet and ashore position requirements must at all times adequately provide for operational readiness, augmentation of the fleets, maintenance, administration, training, and sea-shore rotation. Planning and control of manpower and the effective utilization of manpower to meet such requirements are properly functions of management (command) coordination.

## PERSONNEL ADMINISTRATION

Personnel administration is the administration of people as opposed to requirements. The administration of people involves recruitment, classification, training and development, assignment and rotation, transportation, discipline, advancement, personnel records, personnel accounting, performance evaluation, separations, retirement, as well as providing morale services.

## RESPONSIBILITIES

The aims of personnel administration in any organization are (1) to supply the organization

with a number of people sufficient to man the positions or billets making up that organization, (2) to effect the best possible distribution of these people throughout the organization, and (3) to contribute toward the efficiency and quality of the production of these people. The aims of manpower management are to determine manpower requirements and to ensure the effective use of available manpower. These concepts of the aims of personnel administration and manpower management hold as true for the Navy as they do for a business corporation, an educational system, or a research organization.

Naval manpower management and personnel administration, however, must be engineered to cope not only with the personnel problems inherent in any organization but also with the special problems posed by the size of the Navy, the variety of its functions, the global scope of its operations, the mobility of its forces, the rate of change and complexity of its technology, the turnover and rotation of its personnel, and the requirement to develop and implement its own training programs.

To cope with these formidable problems, the Navy assigns a large contingent of support personnel—military and civilian, commissioned and enlisted, in field and at departmental level, on shore and at sea—to aid in the planning and implementation of procedures and actions. These specialists and others who have responsibilities and duties connected with manpower management and personnel administration are, in turn, supported by a modern data gathering, processing, and reporting system which provides timely and accurate information necessary to make decisions.

Responsibility for manpower management in the Navy begins with the Secretary of the Navy, who has an Assistant Secretary for Manpower and Reserve.

## CHIEF OF NAVAL OPERATIONS

Management of Navy military manpower is a responsibility of the Chief of Naval Operations, who has a Deputy Chief of Naval Operations for Manpower and Naval Reserve. The officer assigned to this billet is also the Chief of Naval Personnel, which illustrates the close relationship between manpower management and personnel administration. (Marine Corps manpower management is a responsibility of the Commandant, Marine Corps.) Military manpower management is a function of command and operates through the chain of military command.

## CHIEF OF NAVAL PERSONNEL

The Chief of Naval Personnel commands the Bureau of Naval Personnel and assigned (shore) field activites. The Bureau and its field activities carry on the headquarters level functions of personnel administration. BuPers is also responsible for regulations concerning uniforms, naval ceremonies, and naval etiquette.

In support of its functions, BuPers conducts personnel research and maintains the Naval Manpower Information System. Its field activities include recruiting stations and personnel accounting machine installations. It operates the Naval Personnel Program Support Activity, the Personnel Research and Development Laboratories, the Naval Reserve Manpower Center, the Disciplinary Command, the Naval Home, and other activities.

## DETERMINING MANPOWER REQUIREMENTS

In order to meet the manpower requirements of both peace and war, the Navy maintains two parallel sets of plans, with provisions for orderly progress from one to the other as conditions require. For individual naval activities, this planning is expressed in allowances (conditional manning) and complements (battle manning).

### MARP

The Manpower Allocations and Requirements Plan (MARP) provides for peacetime manpower requirements (P-MARP) and mobilization (M-MARP). Allowances and complements are developed for the individual type of ship or station, to enable each to perform its peacetime and wartime missions. The overall plans provide the number of all types of activities the Navy will maintain and the timetable to be used in moving from peacetime to wartime strength.

### REQUIREMENTS, ALLOCATION, AND PROCUREMENT

The first task in manpower management is to determine the quality and quantity of manpower

requirements based on approved missions, with consideration for the ever changing international situation. Numbers and types of officer and enlisted billets must be determined for each activity in the Naval Establishment, for each new equipment, operation, mission, or change of mission. Such determinations are based on staffing criteria and verified by manpower surveys. When the requirements have been determined, allocation of personnel billets takes place.

Determining the number of personnel that must be obtained for active and Reserve forces is basically a problem of mathematics. It consists of comparing current onboard strength with future requirements, then compensating for the difference, including prospective losses. Such processing can be extended to the development of procurement plans for successive years, evaluation of plans versus performance, and analysis of trends in reenlistment rates.

## STAFFING CRITERIA

Staffing criteria are standards (consisting of defined functions accompanied by systematically developed staffing tables) which are used as guidelines to determine the appropriate kinds and numbers of personnel needed to perform the assigned functions of specific workloads of a command.

Staffing criteria are developed in coordination with the Chief of Naval Personnel, manpower sponsors, and/or bureaus, systems commands, and offices having technical cognizance over specific functions as a means for increasing effectiveness in planning and coordinating manpower requirements and in evaluating utilization. Staffing criteria relate military and civilian staffing to functional areas and develop a perspective for total manpower considerations.

## MANPOWER SURVEYS

The Chief of Naval Operations, under the policy direction of the Under Secretary of the Navy, is responsible for planning, directing, coordinating, and administering the Naval Manpower Survey Program.

The basic objectives of the Navy Manpower Survey Program are to:

1. Determine the optimum manpower required for each naval activity.

2. Establish a firm manpower requirements base from which future adjustments may be determined.

3. Determine the most efficient distribution and utilization of available manpower.

4. Verify staffing criteria.

5. Achieve equitable distribution of manpower among naval activities.

6. Strengthen liaison among CNO, distribution authorities, and user activities.

## BILLET DATA

New data on manpower requirements and allocations normally originate with sponsoring bureaus and offices. (A sponsor is the bureau, functional command, or office responsible to the Deputy Chief of Naval Operations (Manpower and Naval Reserve) for manpower matters relating to activities under the sponsor's cognizance.) When a sponsor wishes to establish new billets or change existing billets at one or more activities under his cognizance, he forwards to the Deputy Chief of Naval Operations (Manpower and Naval Reserve) a Manpower Authorization Change Request (OpNav 1000-3) for each activity concerned.

Upon receipt of the request, personnel in the Office of DCNO (M&NR) review and approve, or disapprove, the change. If approved, a copy of the request is forwarded to the Manpower Information Division, BuPers, for updating the central data bank.

## REQUESTING CHANGES TO MANPOWER AUTHORIZATIONS

Frequent and numerous billet changes result in a waste of naval manpower and funds. Each change requires a correction to the allowance of the activity which may require movement of personnel to fill the revised allowance. All levels of command should exercise a stringent degree of manpower management by minimizing requests for billet changes to attain greater billet stability and to achieve maximum utilization of naval manpower and funds. Responsibilities for submitting requests for changes to Manpower Authorizations are prescribed in OPNAVINST 1000.16 series.

## COMMANDING OFFICERS

While the Chief of Naval Operations is responsible for the preparation of Manpower

Authorizations, commanding officers can assist in ensuring the accuracy of their Manpower Authorizations by reviewing them and submitting justified requests for changes in accordance with OPNAVINST 1000.16 series.

Commanding officers have the responsibility of ensuring that the number of billets, in allowance and complement, including skills, pay grades, and special qualifications reflected in the Manpower Authorization are the minimum military requirements necessary to support the mission, tasks, and functions of the command. Data from 3-M analysis, manhour accounting, and other analytical data should be utilized to substantiate personnel change requests whenever possible.

ADMINISTRATIVE CHAIN OF COMMAND

When requests for changes are forwarded which include quantity, grade, or rate increases in allowance but do not identify compensation, the chain of command makes recommendations regarding compensation. The Chief of Naval Operations retains decision authority for all changes to approved manpower requirements and reviews all change requests and endorsements. In the case of requests which do not include necessary compensation, a determination must be made as to whether reprogramming (through reduction of other programs) to accommodate such changes is warranted by the relative priority of the program for which the change is proposed. As a general rule when requests for changes are received without compensation, the Chief of Naval Operations assumes that in the opinion of the originator and the chain of command the program upon which the increased requirements is based is of lesser importance or lower priority than all other programs currently being supported.

Forwarding endorsements should indicate whether changes are applicable to other activities having the same mission, tasks, functions, or equipment. Comments on standardization should be requested from other commands having similar activities but not in the chain of command. This is particularly applicable to recommendations for ship classes originating within the chain of command of a fleet or type commander. It is the policy of the Chief of Naval Operations to standardize allowances for activities having the same functions. Accordingly, efforts must be continued to eliminate variations in allowances which are not required by differences in equipment, configuration, tasks or functions, and to document requirements for necessary variations.

MILITARY MANPOWER SPONSORS

The military manpower sponsor is the command, bureau, or office of the Navy Department in the Washington area designated by the Chief of Naval Operations as military manpower sponsor for appropriate activities consistent with the functions and/or missions of such a command, bureau, or office. Sponsorship is assigned on the basis of special direct interest, knowledge or technical competence with relation to the sponsored activity. In those instances wherein a second command, bureau, or office has interest in an activity commensurate with that of the sponsor, a secondary sponsor may be designated. Sponsorship is not a function of command.

The military manpower sponsor, when proposing or sponsoring changes in mission, tasks, function, or configuration for a naval activity, has implicit responsibility to ascertain the manpower feasibility of the proposed change. This responsibility includes the requirement to arrange for associated programming of manpower in phase with changes in mission, tasks, etc.

PRIMARY SUPPORT COMMANDS AND OFFICES

Primary support commands and offices review allowance/complement change requests submitted by sponsored activities and make appropriate comments and recommendations by endorsement.

ORIGINATING CHANGE REQUESTS

All requests for changes in allowances and complements (except routine requests submitted on the short form discussed later) are submitted to the Chief of Naval Operations via the administrative chain of command. The primary support bureau or office, when not the activity manpower sponsor, and the activity manpower sponsor, when other than the Chief of Naval Operations, are included as intermediate addressees.

OPNAV 1000-3

Requests for changes are submitted on Manpower Authorization Change Request, OPNAV 1000-3, in accordance with OPNAVINST 1000.16 series. The request should be completed in detail, reflecting all information as it will appear in the Manpower Authorization.

The letter forwarding OPNAV 1000-3 must be addressed properly through the chain of command and reference the transaction number and date of the Manpower Authorization on which the requested change is based. Include the justification for the requested change and identify any required compensation. Do not write explanatory notes in unused spaces nor cut the form to letter size.

A revised Manpower Authorization is not promulgated each time a change is made. Significant changes usually result in a complete reprinting, while minor changes do not justify the cost of printing and distribution. The current information in the manpower system can be determined by checking the latest BuPers Report Symbol 1080-14 for enlisted personnel. When a new Manpower Authorization is received, the previous Manpower Authorization is superseded and should be disposed of.

## SHORT FORM FOR FLEET REQUESTS

A short form used only for ships and staffs (other than air) to request changes to Manpower Authorizations is provided in order to improve the response time. The form is adaptable for use in official correspondence and messages but is intended primarily for use in speedletter format and is designed to reduce preparation and processing time.

When the originator of a request for a minor change to a Manpower Authorization believes that the Chief of Naval Operations can act on the request without comment or recommendation by officers in the chain of command, the request may be sent direct to CNO with copies to the chain of command. This procedure is particularly applicable to requirements for NEC's incident to changes of shipboard equipment and correction of errors detected in Manpower Authorizations. It does not apply to requests for additional billets or changes in pay grades.

The short form (see OpNavInst 1000.16 series) may be used in lieu of OPNAV Form 1000-3 for routine requests.

The following information should be given:

Situation.—Description of change requirements and authority or cause of them.

Billets.—Identify by Billet Sequence Code, title, designator or rating and grade. Indicate recommended changes on separate line.

Specific Action Recommended.—Include the estimated time to implement if immediate action is not required.

The paragraphs should be adapted to the nature of the request, be concise, and present specific substantiating data, including equipment identification for NEC revisions.

## PERSONNEL REQUIREMENTS

As a senior DP, you may be called upon to identify and perhaps readjust the various skill areas at your installation. It is, therefore, important to have a thorough knowledge of the various skills that are required at an ADP installation. The Navy assigns billets mostly by NEC's. The NEC's available do not, however, truly reflect in their descriptions the many diversified positions that could be required in a large organization. The various DP positions must first be defined, and then the descriptions of the available NEC's can be screened, and those best fitting the various positions at your installation selected.

As a guide figure 7-1 helps identify the various positions in a large organization described in the following paragraphs. These descriptions are guides to the personnel function to be used in making up suitable job descriptions to fit an installation's own needs. Responsibilities and duties can be culled and adapted to the requirements of the organization.

## MANAGER OF DATA PROCESSING

The incumbent is the administrative and technical head of all data processing activities. In this capacity he is responsible for the fulfillment of all data processing performed, including systems analysis, programming, and operations. In this capacity he provides liaison with authorized users of data processing services and develops improved techniques and methods for assisting all command activities.

### Responsibilities

Provides cost forecasts for all data processing activities.
Maintains and develops computer systems to use the equipment efficiently.
Reviews performance of personnel and equipment.

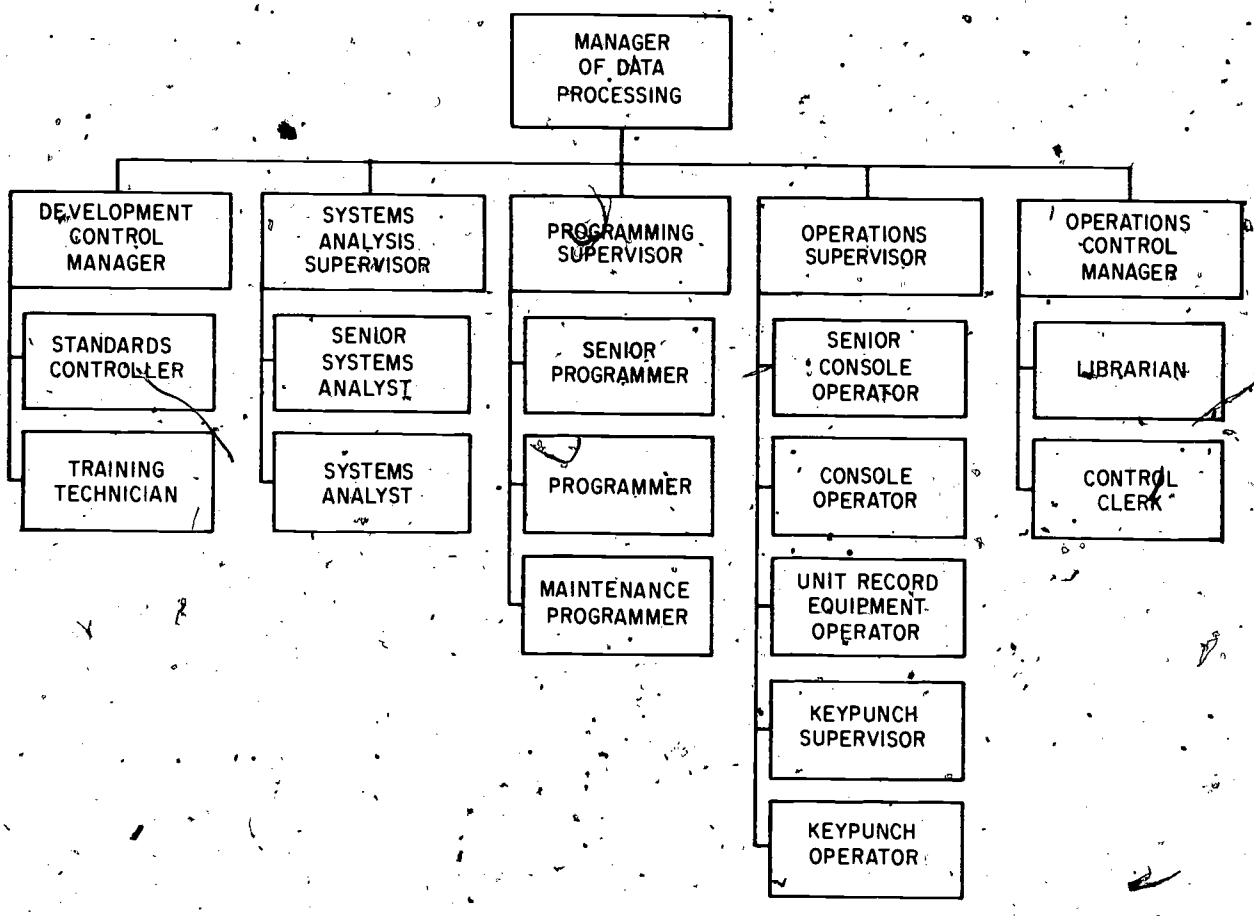



Figure 7-1.—Large ADP organization. 78.146

Directs professional development and training of staff.
Evaluates applicability of new technical developments.
Reports to top management on the performance of data processing functions and the progress of data processing development planning.

Duties

Reviews computer systems and applications.
Reviews and requests additional data processing services.
Evaluates new equipment and manufacturer's support capabilities.
Participates in management education in data processing concepts.
Evaluates utilization of equipment and personnel.
Reviews personnel performance.
Reports activity and performance to management.

DEVELOPMENT CONTROL MANAGER

This position is a staff function to the manager of data processing. The incumbent performs administrative and planning assignments in the following areas:

Personnel selection and training
Data processing standards development

Performance review
Administrative services

Responsibilities

Coordinates departmental personnel repositioning.
Organizes and conducts internal training programs for data processing personnel.
Develops, publishes, and maintains a manual of data processing methods and performance standards.
Provides cost estimates for data processing activities.
Reviews project schedules.
Evaluates equipment requirements and analyzes available equipment capabilities.
Provides adequate work space, facilities, and supplies to the department.

Duties

Establishes curriculum and schedules for courses in training programs.
Designates areas in which standards will be developed and prepares necessary instructions and documentation for implementation.
Evaluates technical capabilities and qualifications of programmers, operators, and other technical personnel.
Approves new standard techniques and procedures.
Reviews project schedules with supervisory personnel.
Designs office layout, control inventory of office supplies, and plan for contraction or expansion of facilities.

SYSTEMS ANALYSIS SUPERVISOR

Provides technical analytical assistance in identification and solution of systems problems. Deals with personnel throughout the command and is required to:

Summarize problem characteristics.
Define information requirements.
Describe procedural and operating improvements.
Define data processing support.

Responsibilities

Defines scope and tasks of systems study.
Schedules tasks and assigns systems personnel.
Reviews documentation prepared by systems personnel.
Directs the design of new systems or systems improvements.
Reviews project progress and reporting status to management.
Presents systems recommendations to data processing and user department management.
Reviews systems performance and directs corrective action.

Duties

Evaluates performance of systems personnel.
Assigns personnel to projects.
Reports project status and personnel activity to management.
Organizes systems study schedules.
Estimates development cost, time, and personnel commitment.
Evaluates operating advantages and savings of proposed systems.
Prepares material for management presentation.
Defines systems logic and equipment requirements.
Directs improvements and corrections of operating systems.

PROGRAMMING SUPERVISOR

Provides technical and administrative direction to the development of new programs and maintenance of operational programs. In this capacity, the programming supervisor is in direct liaison with systems personnel, operations personnel, and representatives of user departments.

Responsibilities

Reviews and accepts systems specifications and selects proper equipment configuration.
Organizes programming projects and assigns personnel to tasks.
Develops programming time estimates.
Prepares project schedules.
Reviews programmer performance.
Reviews program design with senior programmers.
Evaluates operational performance of programs.
Reports programming activity, progress, and performance to the data processing department manager.

Duties

- Designs program systems.
- Analyzes systems specifications to determine adequacy and programming implications.
- Designs system controls with systems personnel.
- Evaluates results of test runs and determines whether program can be considered operational.
- Reviews operating problems of programs with operations supervisor.
- Coordinates and controls revision of operating program(s).
- Enforces programming standards.
- Reviews personnel performance.
- Assigns personnel to projects.
- Reports activity, progress, and performance regularly to departmental manager.

OPERATIONS SUPERVISOR

Supervises the operation of all digital computing equipment, unit record equipment, keypunching and verifying machines and other media conversion devices. In this capacity, reviews equipment and personnel performance and develops techniques to improve performance. The incumbent reviews new applications and programs, and projects their effect on equipment operation for management evaluation.

Responsibilities

- Maintains accurate records on equipment utilization.
- Enforces scheduled processing requirements.
- Controls integrity of all data files received, processed, and produced by the operating section.
- Implements operations procedures and techniques to improve efficiency of equipment operation.

Duties

- Evaluates equipment utilization.
- Enforces production schedules.
- Authorizes acceptance of new programs into production status.
- Evaluates new equipment developments as directed.
- Reviews quality of output and scrutinizes causes of reruns, rejects, and delays.
- Enforces operations controls as defined by operations control manager.
- Reviews personnel performance.
- Makes personnel assignments.
- Reports activity and performance regularly to departmental management.

OPERATIONS CONTROL MANAGER

Directs the control and coordination of all operational facilities through supervising library activities, production control procedures, and operating standards. Concerned with developing and enforcing procedures, and in several instances, with supervising the personnel who execute the procedures.

Responsibilities

- Directs the activities of program and tape library facilities.
- Controls inventory of data processing supplies and materials.
- Develops operating schedules and provides procedures for their implementation.
- Develops a system for data control and coordination.
- Provides operating performance and methods standards.
- Specifies machine and personnel time recording procedures.
- Reviews compliance to procedures and standards continuously.

Duties

- Organizes and directs operation of program and tape libraries.
- Investigates recurring operating problems.
- Publishes directives containing operating standards and authorized procedures for data handling and control.
- Develops scheduling systems and schedule review criteria.
- Evaluates equipment utilization statistics.
- Approves orders and requests for supplies and materials.
- Evaluates performance of operations control personnel.

SENIOR SYSTEMS ANALYST

Assigned to systems projects to provide direction and control within the specifications of the project schedule. As project leader, the senior systems analyst participates in the project organization and scheduling and is in direct liaison

with the management and personnel of the user department. The position carries project, but not administrative, responsibility over the systems analysts assigned. The incumbent fulfills the detailed duties of systems analyst, as required.

Responsibilities

Organizes and directs execution of systems analysis and design tasks performed by systems analysts.
Analyzes present systems and procedures.
Designs improved approaches to operating situations.
Organizes and prepares systems documentation.
Designs procedures and schedules for supplementary recommendations.
Coordinates implementation.

Duties

Prepares data flowcharts.
Defines data requirements for systems study.
Writes narrative descriptions of system operation.
Defines logical requirements for programming.
Designs documents, reports, and forms.
Organizes data files.
Projects processing volumes.
Trains systems analysts by on-the-job direction and guidance.
Participates in personnel assignment.
Reports project progress and activity to systems analysis supervisor.

## SENIOR PROGRAMMER

Assigned to programming projects to provide direction and control within the specifications of the project schedule. As senior programmer on the project, participates in project organization and scheduling and is in direct liaison with the systems analysis project leader. This position carries project but not administrative responsibility over the programming personnel assigned. As required, the incumbent fulfills the duties of a programmer.

Responsibilities

Organizes and directs execution of programming tasks performed by programmers.
Designs logic for individual programs or program systems.
Selects program language, standard subroutines, and other programming aids.
Determines optimum equipment configuration.
Defines test schedule and test data requirements.
Organizes and prepares program documentation.
Defines computer controls and input/output specifications.

Duties

Prepares program logic flowcharts.
Reviews program coding.
Prepares test data.
Analyzes test results.
Specifies data control procedures.
Designs data codes and data files.
Calculates machine utilization requirements.
Reviews program system with systems personnel and user representatives.
Reports project progress and activity to programming supervisor.
Trains programmers by on-the-job direction and guidance.
Participates in personnel assignment.

## SENIOR CONSOLE OPERATOR

Operates and controls digital computing equipment by means of a peripheral console device or auxiliary control panel. The senior console operator prepares the computer for program processing and is responsible for the satisfactory completion of each scheduled computer operation.

Responsibilities

Initializes computer system for each program in accordance with operating instructions.
Prepares peripheral equipment with forms, cards, and tape files.
Verifies that all necessary files and data have been submitted to the computer room.
Operates the computer and takes corrective action as defined in operating instructions.
Verifies that reports and other outputs are complete before release from computer room.
Records time and equipment utilization.
Maintains a neat and orderly equipment area.
Notifies supervisor of equipment or program malfunctions.

Duties

Operates console keyboard or control panel.
Diagnoses causes for interruptions in processing.
Verifies that proper cards, forms, and tape files are being used.
Enforces time recording procedures.
Assigns console operators.

LIBRARIAN

Stores and circulates program documentation, material, and data files kept on cards, discs, and tapes.

Responsibilities

Provides correct data files to operations in accordance with schedule.
Provides programs and operating instructions to operations in accordance with schedule.
Stores program materials and documentation in an organized, accessible manner.
Controls tape reel or disc pack use on a rotational basis.
Retires tape reels or disc packs as required.
Ensures completeness of documentation.
Records circulation of material stored in library.

Duties

Maintains tape reel and disc pack use log.
Issues and receives data files and programs.
Circulates program material in accordance with authorized procedures.
Files all library material in an organized, uniform manner.
Completes checklists to determine whether all elements of documentation have been submitted.
Checks tape reels and disc packs to detect damage.

STANDARDS CONTROLLER

Coordinates data processing standards development and implementation; enforces methods and performance standards. Audits adherence to the prescribed standards and reports deficiencies to the manager of development control.

Responsibilities

Reviews new technical developments to determine applicability to department.
Researches use of standards in other data processing installations.
Originates procedures and techniques and publishes supporting documentation.
Evaluates software and special equipment features.
Evaluates requests for configuration or equipment replacement.

Duties

Analyzes software developments.
Analyzes new equipment technology.
Disseminates technical data of this nature to interested managers.
Prepares and issues documentation of standard procedures and techniques.
Distributes revisions to standards.
Audits departmental performance in technical proficiency, service to users, and adherence to standards.

TRAINING TECHNICIAN

Organizes, schedules, and coordinates all data processing training activities, including:

Departmental instruction for new employees
Programmer and operator training.
Professional technical development
Management and supervisory training

Responsibilities

Assigns instructors for in-house courses.
Schedules data processing personnel attendance in training programs.
Schedules attendance in available manufacturer educational programs.
Reviews courses, quality of instructor, and contribution of programs.

Duties

Prepares and distributes course outlines.
Prepares and circulates schedule of courses.
Schedules alternate attendance dates for personnel.
Reviews course content and presentation.
Evaluates students' performance in courses.

Spot-checks students' performance in fields related to course content.
Maintains cumulative record of student training.

SYSTEMS ANALYST

Under the direction of a senior systems analyst, participates in the analysis of systems problems and the development of problem solutions. Responsible for working with personnel in problem areas and defining the pertinent specifications of information requirements and operational needs. Required to make formal presentations and submit written reports for review purposes.

Responsibilities

Gathers data for analysis of problem areas.
Analyzes documents, files, reports related to workflow.
Organizes information into accessible work files.
Documents present procedures and operating methods.
Designs systems improvements and identification of data processing applications.
Documents recommendations.
Develops methodology for implementing improvements.

Duties

Prepares work load statistical projections.
Develops accounting control procedures.
Prepares systems diagrams (flowcharts) of information movement.
Designs computer-oriented controls.
Organizes data files for use in computer systems.
Designs card, tape, and report formats.
Prepares personal activity reports and project status reports.

PROGRAMMER

Under the direction of a senior programmer, participates in analysis, program design, coding, and other programming tasks needed to produce reports and mathematical computations or to maintain information files. Prepares the required logical interface between related programs. Assists as required in the solution of operation difficulties encountered in executing programs.

Responsibilities

Prepares all elements of program documentation.
Prepares test data and organization of program testing schedule.
Analyzes program performance during testing.
Designs conversion procedures.
Determines optimum equipment configuration.
Trains and prepares training material for operators and users of the program.

Duties

Designs program logic.
Selects appropriate subroutines.
Documents logic of program.
Codes program instructions.
Analyzes test results.
Develops operators instructions.
Organizes data control procedures.
Designs data codes and data files.
Calculates machine utilization requirements.
Prepares personal activity and program status reports.

CONSOLE OPERATOR

Operates digital computing equipment with a console device or auxiliary control panel. Under the direction of the senior console operator, prepares the computer for program processing and operates the equipment for the completion of a scheduled program.

Responsibilities

Initializes the computer for each program in accordance with operating instructions.
Prepares peripheral equipment with forms, cards, and tape files.
Records time and equipment utilization.
Operates computer and takes appropriate action as defined in operating instructions.

Duties

Operates console keyboard or control panel.
Diagnoses causes for interruptions in processing.
Logs elapsed time for each program.
Loads cards, sets up printer, and mounts tape reels.

## CONTROL CLERK

Performs a quality control function for input and output. Examines, approves, and dispatches reports based on quality criteria defined by operations control. Rejects all material that does not meet the criteria or does not satisfy the input or output specifications of the application.

### Responsibilities

- Reviews input and determines its acceptability.
- Maintains controls on input received.
- Reviews appearance of output.
- Checks output accuracy and consistency.
- Ensures that all steps of processing are completed.
- Dispatches acceptable material to users.
- Investigates causes for discrepancy or inaccuracies.
- Notifies affected offices of delays in schedule or inadequacies of input.

### Duties

- Audits input to department.
- Maintains batch or detailed controls on all acceptable input.
- Distributes input to operations.
- Balances control records to output.
- Checks format, form numbers, and number of copies on output.
- Reconciles discrepancies and reports causes.
- Verifies that reports are properly collated and bound.

## MAINTENANCE PROGRAMMER

Under the direction of a senior programmer, takes action to improve program performance or to correct deficiencies. Performs all programming tasks needed to implement the changes, including testing and updating of program documentation.

### Responsibilities

- Modifies program logic.
- Codes necessary instructions.
- Tests changes.
- Modifies documentation.
- Provides reassembled program decks and documentation to library.
- Analyzes program performance during execution.

### Duties

- Analyzes program logic.
- Identifies logic changes.
- Codes and tests changes, with complete test data.
- Analyzes test results.
- Reviews documentation and prepares and inserts modified material.

## UNIT RECORD EQUIPMENT OPERATOR

Operates all unit record equipment, including interpreter, sorter, collator, reproducer, calculator, and tabulator. Wires simple control panels if required.

### Responsibilities

- Performs all machine operations on unit record equipment.
- Times recording of machine utilization.
- Maintains a neat and orderly equipment area.
- Controls data files processed on unit record equipment.
- Wires and tests control panels as specified by systems description.
- Prepares documentation of unit record processing.
- Supplies technical advice, as required, to systems and programming personnel.

### Duties

- Loads cards into unit record equipment.
- Installs control panels and sets external switches.
- Wires and tests control panels.
- Documents control panels.
- Duplicates mutilated cards.
- Follows error and exception procedures defined in systems description.

## KEYPUNCH SUPERVISOR

Supervises all personnel engaged in keypunching, key verification, and in the operation of other input conversion devices.

### Responsibilities

- Schedules workloads.
- Distributes work assignments.
- Checks accuracy of keypunched material.

Evaluates keypunch personnel performance.
Prepares keypunch machine control cards.
Maintains control of data while in keypunch section.

Duties

Prepares schedules for all keypunching work.
Assigns work to personnel familiar with source documents.
Checks balances and other checkpoints to isolate errors before releasing.
Maintains production log of work status.
Reviews personnel performance.

KEYPUNCH OPERATOR

Keypunches and keyverifies data as directed by keypunch supervisor.

Responsibilities

Prepares punched cards in accordance with instructions provided by supervisors.
Maintains sequence and control of source documents.
Detects errors and repunches corrected information.

Duties

Keypunches alphabetic and numeric information in prescribed format.
Keyverifies alphabetic and numeric information in prescribed format.
Rejects source documents that do not contain sufficient information to meet program requirements.

All of the previously described positions or any that are desired at your installation must be designated by an NEC. A complete listing of NEC's may be found in the MANUAL OF NAVY ENLISTED CLASSIFICATIONS, NAVPERS 15105-Z (due to become the MANUAL OF NAVY ENLISTED OCCUPATIONAL STANDARDS).

## SMALL ADP INSTALLATIONS

Smaller ADP installations are not allowed the luxury of having specialized people for each specialized position. However, smaller installations, such as most ships, do have other advantages. The most evident advantage is that as a DP aboard a ship you are more involved with all aspects of data processing. Depending on your paygrade, you may be required to function as the Senior Systems Analyst, Development Control Manager, Programming Supervisor, Operations Supervisor and Operations Control Manager, all at one time.

The cross training you receive aboard ship is very advantageous as it allows you to be a complete data processor. Close working relations with the departments and divisions requesting your services and complete follow-through of each job will help you to develop into a "systems man." That is, your ship's main function may be that of 3M or Supply with Personnel Accounting thrown in. Even though smaller in volume, all functions of 3M, Supply, or Personnel Accounting are usually processed. This allows complete familiarity with a "system" of accounting and is an invaluable background for your future Navy duty assignments and advancement opportunities.

# CHAPTER 8

# SUPERVISION

As a First Class or Chief Petty Officer you will be functioning as a front line supervisor. You will be in immediate control of the worker. You will be the liaison between management and worker. It will be up to you to ensure that the details of planning the work, issuing jobs, instructing the men, checking the work and reporting the progress on assigned tasks to management are completed.

As a DP1 or DPC, you will have many responsibilities added to those which you had at the second class level. You have acquired a lot of valuable knowledge, and now it is your turn to pass on the technical know-how of your job to others. In this chapter, we will discuss some of the various factors that will aid you in handling the supervisory duties and responsibilities of your job.

The type of activity to which you are assigned will determine just how you carry out your supervisory responsibilities. But, applying effective techniques of supervision, maintaining discipline, achieving teamwork within your group, knowing how to get along with your men and superiors—these and other basic qualities of a supervisor will help you make a successful career in the Navy no matter what the activity to which you may be assigned.

The purpose of this chapter is to give you a brief overview of the theories and practices of management. Because the field is so vast, printed material on the subject is so voluminous, and the scope of this text is so limited, we can only give you this cursory glance at the subject. We hope that your interest will be stimulated by this short offering and that you will seek additional information elsewhere.

## THE SUPERVISORY POSITION

To most of us, it is a wonderful feeling to realize that we have been promoted to a supervisory position. Most of us like the feeling of added prestige, authority over others, and the feeling of progress that goes with promotion. Of course, that increase in pay adds to the general good feeling, too.

Supervision involves working with people, and a major responsibility of a supervisor is production. A good supervisor knows how to get a job done by getting the most out of his men. As a word of caution, however, the drive for production must not be overshadowed by consideration for the human element. People are not machines, and the supervisor who treats them as such will find that no amount of pressure will permanently increase the production rate. While a good supervisor wants to achieve a high level of production, he also wants his men to produce willingly and to show an interest in their work. If you have had even a small amount of experience in supervising others, you are perhaps well aware that the job of supervisor is not as easy as it might sometimes seem. The following discussion will give you an idea of some of the major factors involving the supervisory position.

## COMMON MISTAKES

In learning any job, learning what NOT to do is often as important as learning what to do. The following are some common mistakes which new supervisors tend to make, and which a new supervisor should avoid.

Your first days as a new supervisor are mighty important. Your men will be watching you to see how you react to this new responsibility. Your superiors will be observing you, too. This is the period to avoid some of the common mistakes made by supervisors.

"New broom" tactics are out! It is not unusual to see an inexperienced supervisor go into his new job with the idea that "things are going to be different around here." He wants to make a big showing, or he lets it be known that

he didn't like the way the last supervisor operated. He has forgotten a very potent psychological factor called "resistance to change." People fear and resent change. It is far better to let your men know that nothing will be changed for the time being; and, after you get your feet on the ground, to gradually make the necessary changes.

Don't make promises in order to gain your men's friendship and support. Even a hinted or implied promise can sometimes be dynamite.

Avoid dictatorial practices; they are fiercely resented. An overshowing of authority during your first days on the job will be particularly noticed.

Playing favorites, being partial to former friends, ignoring the more timid of your men, and assigning the best jobs to a chosen few will rapidly break down the morale of your shop or crew.

Careless remarks, which would go unnoticed if they came from one of the crew, take on new significance when they come from a supervisor. You must carefully weigh your remarks when members of your shop or crew are listening.

Failure to delegate work and fearing to trust subordinates are common failings of a new supervisor, and the result is that soon he becomes so stacked up with work that he bottlenecks the whole unit.

When you make a promise and are unable to keep that promise, accept the blame yourself. There may be a good reason for your inability to keep your promise or the fault may lie with one of your subordinates, but the important thing is that you accept the responsibility and do not pass the buck. Passing the buck when something goes wrong is a sure way to lose the respect of your men. And above all, don't lose your temper in front of your men. A man must be master of himself before he can control others.

## THE FINE LINE

A supervisor must draw a fine line in his relationships between himself and his men. Do not assume a false dignity; but at the same time, the old "buddy-buddy" relationships that you used to enjoy are no longer appropriate. Drawing this fine line is one of the most difficult parts of the job of a new supervisor, but it must be drawn. It is understood that the first class who is the shop supervisor or crew leader has the more difficult job in drawing this fine line, especially when on duty. He wears the same uniform, and in many cases eats and sleeps with his subordinates. He also attends the same clubs, but he must ensure that his subordinates understand that his general conversation in the relaxed atmosphere of the club and his comments on the job carry different weights and have different values. This does not mean that the supervisor has free rein to act 180° opposite of the way he acts in the shop, but it does allow him some relaxation. To accomplish this task and maintain balance, ask your men for advice and help rather than give the impression that you know it all. Let the men know that you have confidence in them; maintain a friendly but conservative attitude; treat the men alike; be consistent; and set a good example yourself.

## SUPERVISORY DUTIES AND RESPONSIBILITIES

A specific list of duties and responsibilities can be made concerning only a specific position; however, here are some typical duties and responsibilities:

1. Getting the right man on the job at the right time
2. Using and placing materials economically
3. Preventing accidents and controlling hazards
4. Keeping morale high
5. Maintaining quality and quantity of work
6. Keeping records and reports
7. Maintaining discipline
8. Planning and scheduling work
9. Training your men
10. Procuring the supplies and equipment to do the work
11. Inspecting, caring for, and preserving equipment
12. Giving orders and directions
13. Maintaining liaison with other units
14. Checking and inspecting jobs and men
15. Promoting teamwork
16. Maintaining good housekeeping on the job
17. Keeping operations running smoothly and efficiently

By analyzing the typical duties and responsibilities listed above, we find that the following major areas are common to all supervisory positions:

1. Production
2. Safety, health, and physical welfare of the men

3. Development of cooperation
4. Development of morale
5. Training and development of subordinates
6. Records and reports
7. Balanced supervision

Now let us briefly discuss each of these areas of responsibility.

Production

Whether his job is in the office or in the shop, it is the supervisor's responsibility to see that the work is done properly and on time. To do this he functions in three main ways:

1. He must organize or plan work to get maximum production with minimum effort and confusion.
2. He must delegate as much of the responsibility and authority for the actual work as he can, but keep in mind that he is still responsible for the final product.
3. He must supervise or control the work to see that it is done properly.

Safety, Health, and Physical Welfare

Safety and production go hand in hand. The safe way is the efficient way. When a man is absent because of an injury, he is a non-producer. A good supervisor stresses safety to his men; he sets the example by working safely himself; he teaches safety as an integral part of each job; and most of all, he plans each job with safety in mind. He does not wait until after an accident happens to start safety measures.

Showing concern over the health and physical welfare of the men will also pay off in increased production. It will add to their feeling of trust and confidence in their supervisor and increase the amount of respect they have for him.

Development of Cooperaion

The necessity for developing cooperation between the members of a supervisor's own unit goes without saying. Some supervisors, however, tend to overlook the necessity for cooperation in two other directions, which are:

1. Cooperation with management
2. Cooperation with the supervisors of other units

In carrying out his job, the DP1 or DPC often has dealings with persons in other units of the activity. It is particularly essential, therefore, that supervisors of these units develop the cooperation listed in (1) and (2) above.

Development of Morale

The esprit de corps of a group and the willingness of its men to work toward common goals depend to a great extent upon the leadership of the supervisor. A producing group will be found to be a group with a high morale.

Training and Development of Subordinates

A good supervisor is invariably a good teacher, and a good leader is a developer of men. One of the basic policies of Navy supervision reads:

"The greatest contribution a supervisor can make is the development of the men under him."

A good supervisor arranges to have at least one man trained and ready to take his place. It is a sign of good leadership when a supervisor can take leave, and the job continues to run smoothly. Do not be afraid to teach every phase of your own work to at least one or two subordinates. A great deal of the supervisor's time involves teaching, so cultivate your teaching ability.

Reports and Records

Most supervisors, particularly shop men, do not like to keep records and prepare reports, yet they are a vital part of the work. Make it a point to keep neat, accurate records and reports, and get the reports in on time. Paperwork may look like a waste of time to you, but some day you will realize how much your job depends upon it.

Balanced Supervision

Analyze these major duties and responsibilities we have just briefly covered. You, as a supervisor, must pay proper attention to each phase of your job. Do not emphasize production at the expense of safety or training. Also, don't become so concerned with the human element that you neglect production. Keep up with your paperwork and in so doing avoid its accumulation to the extent that you will have periods when you will have to devote your entire interest to this responsibility at the expense of others.

Always strive to put the proper emphasis on each of your responsibilities and you will be practicing balanced supervision.

## TRAITS OF A GOOD SUPERVISOR

There are various traits that are desirable in supervisors. Some of these traits are discussed below.

### Loyalty

One trait that should stand out in every supervisor is loyalty. It is important that you show loyalty to your country, to the Navy, to your unit, to your superiors, and to the men who work for you. Surely, you will agree that to get the respect and loyalty of your men, you must be loyal yourself.

### Positive Thinking

Good leaders will always be positive thinkers. They think in terms of how things can be done, not why they can't. They maintain an open mind to changes, new ideas, and training opportunities. Positive thinkers look to the future with confidence, and this confidence is catching. They are enthusiastic about their job and the part they play in the Navy. Everything worthwhile that has ever been accomplished in this world was accomplished by positive thinkers. If you want to lead others, start today and practice the art of positive thinking.

### Genuine Interest in People

Have you ever met a really great leader? If so, instead of being a cold, aloof individual, he probably turned out to be a warm, friendly, human being who seemed to make you feel important by his close attention to your words.

One of the first steps a new supervisor should take is to get to know his men personally. This not only creates the feeling of genuine interest in the individual but helps the supervisor in his ability to place the right man in the right job at the right time.

The importance of knowing your men personally increases when the need arises to convert from a data processing technician to a professional defensive tactician and fighter. Here, the wrong man in the wrong place could prove disastrous.

### Initiative

People with initiative are always needed in the naval service. Initiative is evidence of an open and alert mind. The man with initiative continually looks for better ways to do things; he doesn't wait for the other fellow to do them. He doesn't put off until tomorrow what should be done today. If he sees an unsafe condition, he takes action to correct it before an accident occurs. If he sees that a new form or procedure would simplify the job, he devises the new form or procedure. If he sees an inadequacy in himself, he sincerely tries to overcome the inadequacy. Weak people lack initiative. Leaders are characterized by strong initiative.

### Decisiveness

Leaders are able to make decisions. One of the commonest complaints heard from subordinates is, "You can't get a decision from him."

A great majority of the decisions that have to be made by supervisors in the naval service concern relatively petty things. As often as not, the man merely wants the supervisor's approval to perform some minor action which the man already knows should be done. A prompt "yes" from the supervisor is all that is necessary. In many trivial matters it makes little difference whether the answer is "yes" or "no." The important thing is to get an answer. The supervisor who stalls, puts off, evades, or refuses to give a decision is a bottleneck.

Of course, there are times when a decision requires careful consideration of many factors and therefore much deliberation. In such cases, the supervisor should tell the man when to return for the decision and see to it that the decision is ready when promised.

### Tact and Courtesy

Good leaders are habitually tactful and courteous. Whether in the shop or office, supervisors can be gentlemen. Being a gentleman does not imply that the supervisor is a weakling or a sissy; rather, it implies that he is thoughtful of others.

Tact can be defined as "saying and doing the right thing at the right time." It is the lubricating oil in human relationships. It is the regard for the feelings of others based on an understanding of human nature—the little considerations that make the job pleasant and smooth.

Courtesy can be defined as "treating others with respect." It means treating people as important human beings, not tools to be used for your convenience. It means following the accepted rules of conduct, being polite. Courtesy is one of the marks of a gentleman. Courtesy is important to the supervisor. One discourteous act, even though unintentional, can make you an enemy — and the supervisor cannot afford to have enemies. "If you have one enemy, you have one too many." Remember, courtesy is contagious.

Fairness

The men in a shop or crew are extremely sensitive to partiality by the supervisor. They will even single out little incidents where there was absolutely no intent to show favoritism. For this reason, the supervisor must think ahead on changes he makes, decisions he hands down, work he assigns, recommendations for promotion, and the like. In each instance he must say to himself, "This action will make this man happy, but how will every other individual in my unit feel about it?"

Many experienced supervisors will tell you of cases where they were very friendly with certain men. When the time came for discipline or some other adverse action, it was very difficult to deal with these men.

Sincerity and Integrity

Supervisors who deal with their men squarely and honestly all the time win and hold their respect. They talk to their men on a man-to-man basis. They are not afraid to face the facts and say what they think. "Give me the man who looks you straight in the eye and tells the truth every time!"

Consistency of thought and action are important if the men are going to know where they stand. Being too strict one day and too lax the next is worse than being consistently strict or consistently lax. It is not wise to exhibit good and bad moods to your men. Strike a happy medium between firmness and laxness and be consistent.

Dependability, one of the marks of integrity, involves meeting obligations promptly. A reputation for being a "square-shooter" is worth every effort on your part. This reputation must be built early, even prior to appointment as a supervisor. One violation of integrity may take months to rectify — or forever.

Teaching Ability

A great part of the supervisor's job consists of instructing his men in one way or another. Even the giving of orders is a form of instruction. Every supervisor should learn and practice the art of public speaking, the principles of on-the-job instruction, and the techniques of conference leadership. The man who cannot stand up on his feet and express his ideas to one man or a group of men should not be a supervisor. The Navy must have men in supervisory positions who can train and develop others.

Confidence

Good supervisors have a quiet confidence (not an arrogant or cocky manner) based on thorough knowledge of the job and belief in their own ability. Confidence begets confidence. The mousy, hesitant supervisor who lacks confidence in himself cannot inspire confidence in his men. It is amazing to see how people will follow a man who is charged with confidence in himself and an idea. Even crackpots or cranks can win followers if they appear confident. Some men put on a front of aggressive confidence to hide an inferiority complex. They ridicule the opinions of others; they dominate conversations; they are arrogant. Such men get their come-uppance sooner or later. However, we respect and follow the man who has quiet inner confidence, which is expressed in his confident manner, his actions, and his words.

## MAINTAINING DISCIPLINE

One of the major problems which the new supervisor may encounter is that of maintaining discipline of his men. The following discussion provides some pointers that will help you achieve success in maintaining discipline of those under your supervision.

### THE ART OF GIVING ORDERS

A good supervisor will give much thought to the art of giving orders. Proficiency in this area will reap many benefits and since most disciplinary problems are the result of the failure of men to carry out orders, this subject cannot be overemphasized. There are three basic types of orders:

1. The command
2. The request
3. The suggestion

Consideration should always be given to (1) the situation under which the orders are to be given, and (2) the individual who is to carry out the orders. In succeeding paragraphs we shall examine the types of orders listed above in the light of each of these two considerations.

### The Situation

In military formations, the direct command, or formal type order, is always used. The direct command should also be used when there is immediate danger, a fire, an accident or other emergency, disobedience of safety rules, and so forth.

The simple request is the best type of order to give for daily routine work. The request is used for most orders given by good supervisors.

The suggestion is excellent when you wish the man to go ahead on his own, when you do not have time to work out the details, or when you do not know yourself exactly how the job should be done. It is also excellent for building initiative. This method of giving orders builds morale and shows your men that you have confidence in them. However, it is not clear-cut, and you certainly would have no recourse if the job were not done properly.

### The Individual

The direct command might have to be used in giving orders to the careless, lazy, insubordinate, or thick-skinned individual. Except in the unusual situations mentioned above, the direct command is normally reserved for those to whom we must speak firmly and positively.

The request is by far the best type of order to use with normal men. With most men a simple request in the form of a question has the full effect of a direct order. Moreover, it fosters a feeling of cooperative effort, of teamwork.

The suggestion is excellent for those to whom a suggestion or hint is sufficient. Men with real initiative like to be "put on their own." In dealing with a sensitive, highly intelligent individual, a mere hint that something is desired is enough to get a project started. Toss him an idea like this: "Joe, I wonder if it would be a good idea to do this?" or, "Do you have any ideas on how this can be done?" or, "One thing we really need is ..." This makes Joe a key man in the project, makes him feel important, shows him that you have confidence in him, and provides excellent training. The suggestion type of order stimulates the man to show what he can do.

Although the situation and the individual are the prime considerations in giving orders, the attitude and tone of voice in which they are given are very important. Give all orders in accordance with the five "C's"—Clearly, Completely, Concisely, Confidently, and Correctly. Also avoid orders that are unnecessary and/or superfluous.

## THE ART OF REPRIMANDING

When an order is disobeyed or not carried out, the supervisor would be remiss in his duties if he did not do something about it. The most common type of discipline used by supervisors is the simple reprimand.

The reprimand, too, must be fitted to the individual and the situation. Just the slightest hint of something wrong will be more crushing to the sensitive individual than the severe rebuke you might give the thick-skinned fellow.

The reprimand should be a calm, constructive action, not a destructive one. You are interested in building men, not tearing them down. You are interested in the underlying causes, not in how to get even with the man.

Failure to act when a reprimand is due is a sign of poor supervision. We do not like a supervisor who is too lenient and ingratiating. If one of his men "gets by" with something, the supervisor may lose control. Issuing too many reprimands is just as bad: an inexperienced school teacher, for instance, may keep scolding her pupils until complete bedlam results!

A fine line should be drawn between harshness and leniency. Only a man with a keen understanding of human nature can discern this line.

Practice the three "F's" of discipline: Fairness, Firmness, and Friendliness. The recommended procedure for administering reproof follows:

1. Get all the facts.
2. A man should not be reprimanded in front of others.
3. Put the man at ease. Give him a word of praise first, if appropriate, to take out the sting.
4. Use no sarcasm, anger, or abuse.
5. Fit the reprimand to the individual.
6. Have all the facts at hand; the man may attempt to deny the charge.
7. Present the facts.

8. Ask the man why he erred.
9. Try to get him to admit his mistake.
10. Don't threaten; he knows how far you can go.
11. Once he admits that he was wrong, the reprimand is over.
12. Leave on a friendly note, and let him know the incident is closed. Do not nag.
13. Later, follow up with a casual and friendly contact at his shop.

To test the effectiveness of your reprimand, ask yourself, "Did it build morale?" Remember that you must get along with the man in the future; you must keep him a working, producing unit; and you must be able to get along with your own conscience. You don't have to be soft, but remember that there is a great deal of difference between dignity and arrogance.

## POSITIVE AND NEGATIVE DISCIPLINE

So far we have talked of discipline in terms of punishment. Actually, discipline is much more than reprisal for wrong-doing. Discipline exists also where no disciplinary actions ever have to be taken. Most people realize that they can't get along without self-discipline, and that no organization can function, no progress can be made, unless individuals conform to what is best for the whole group. The supervisor who can build the spirit of cooperation, which is the basis for true discipline, has no discipline problem.

Positive discipline, the trend in discipline that is being studied widely by intelligent executives and supervisors, is the force that originates within the man that prompts him to obey the rules and regulations. People in a Navy organization do what is right because they do not want to hurt the group as a whole, and because they believe that by following the accepted rules the group's objectives will be accomplished. The supervisor who builds up this esprit de corps has little need to resort to negative discipline. Negative discipline is a discipline of fear, based on threat of punishment. This type of discipline originates from without the man. When a man is subjected to this type of discipline, he will do only enough to get by when you are watching. When you leave for a few minutes, discipline leaves too. The man's only motivation for working is fear of reprisal.

Discipline and high morale go hand in hand. Positive discipline is closely tied in with the admiration and respect of the men for their supervisor. This, in turn, is based on good human relations.

## THE HUMAN RELATIONS ASPECT OF DISCIPLINE

When good human relations exist between the supervisor and the working force, it is usually an indication that the supervisor appreciates and understands his men, that he has their interest and welfare at heart, and that he respects their opinions, knowledge, and skill.

Some of the human relations factors that lead to positive discipline are listed below. A good supervisor:

1. Understands the principles, standards, rules, and regulations necessary to good conduct. He believes in these things and practices them himself.
2. Knows his men as individuals, and treats them fairly and impartially.
3. Develops the feeling of "belonging" and security in the group.
4. Gets information to his group through proper channels, and promptly eliminates rumors.
5. Uses his authority sparingly and always without displaying it.
6. Delegates authority as far down the line as possible.
7. Never makes issues of minor infractions or personal issues of disciplinary matters.
8. Displays confidence in the group, rather than suspicion. (Workers are reluctant to betray expressed confidence.)
9. Trains his group technically.
10. Looks after the mental and physical welfare of the group.
11. Tries to avoid errors, but shows willingness to admit errors when made.
12. Develops loyalty in the group and of the group.
13. Knows that idle hands or minds lead to trouble, so he keeps them busy. (Slack work periods can be used for training.)
14. Knows that because of individual differences discipline cannot be a completely routine matter. Discontent, idleness, lack of interest in the job, misunderstanding of regulations, lack of uniform enforcement of regulations, resentment, and emotional strain are some of the

principle causes of misconduct. The wise supervisor will avoid the necessity for formal discipline by removing as many of these causes as possible.

## ACHIEVING TEAMWORK WITHIN YOUR OWN GROUP

Since primitive times men have learned to band together for protection, to build, or to attain a goal too large to be accomplished by an individual. They have learned that in unity there is strength. There are also psychological factors involved and every supervisor should know and appreciate these pyschological rewards that a group must give to hold its members:

1. A feeling of security
2. A feeling of "belonging"
3. A feeling of "being somebody" within the group
4. A feeling of pride in the group
5. A feeling of recognition from outside the group (The harder it is to get into the group, the more important the members feel.)
6. A feeling of accomplishment (The group is attaining common goals.)
7. A satisfaction of certain needs (advancement, pride in work, acquiring new skills, and so on) while attaining the goals of the group

A good leader will encourage these feelings, since the stronger these psychological rewards, the stronger will be the group. Some supervisors achieve such a strong feeling of group pride that their men actually feel that it is a privilege to work in the group. The men we supervise are human beings with individual differences, and they usually produce only to the extent that they feel like producing; and their will to produce is based primarily on the ability of supervisors to win their cooperation. Good leadership is reflected in this ability to get cooperation; and cooperation, in turn, is a reflection of the respect the men have for their supervisors. Teamwork or cooperation, then, is based on good human relations.

When you walk into any shop or office, you can almost feel whether or not the spirit of cooperation is present. If it is there, you can see it in the faces of the people, in the appearance of the work spaces, in the reception you receive, in the way the work is performed.

Poor cooperation is indicated whenever bickering, jealousy, and friction are present. Low production is the inevitable result. Frequent accidents, indifference, sloppy work, griping, complaints and grievances, criticism of the unit, buck-passing, loafing, many requests for transfer, poor planning, poor training or indifference to training—all these danger signals indicate lack of cooperation.

## ELEMENTS TO CONSIDER IN DEVELOPING COOPERATION

Developing cooperation within your group is largely a matter of adapting your behavior to meet the varying situations encountered daily—and in going out of your way to show a willingness to cooperate. You don't just order cooperation!

### Resistance to Change

People resist change. This is demonstrated every time anyone tries to start something new. Even when the change is clearly for the better, people persist in clinging to the old way. Remember, unless ordered by higher authority, changes must not be made too fast. They should be properly timed, and if possible, explained before they are placed in effect.

### Correcting Mistakes

In correcting a mistake a man is making, unless safety is involved, make the correction through those who deal directly with the man. There may be a valid reason for the performance of what you may consider to be a mistake. Remember the man takes orders from his immediate supervisor, and this supervisor may have a valid reason for making changes to your orders.

### Delegation of Responsibility and Authority

Good supervisors soon learn to delegate work. They develop their subordinates and get them to do all the routine work. These supervisors then have time to handle personnel problems, time to study, time to do the necessary planning and creative work. Those who do not learn the knack of delegation, develop ulcers—and a noncooperative group!

### Keeping the Men Informed

Keeping the men informed means exactly that. It is extremely important that your men

know the reasons "why" regarding changes that affect them. If security prevents you from giving reasons, tell your men so. Remember, "Morale does not well up from the bottom—rather does it trickle down from the top!"

### Training

Train at least one man for your position, and do not be aftraid that he will surpass you. The man who trains and develops his subordinates for higher positions usually advances with them.

A good supervisor provides for every person in his unit. He encourages his people to take advantage of educational opportunities. When the men feel that the supervisor is interested in their welfare and that the job offers more than just pay, cooperation and loyalty are bound to follow.

### Setting the Example

It is your job to set the example. The supervisor who is enthusiastic about his job, who is friendly and good-humored, and who fosters harmony among his associates, attains his ends—and does much to create a cooperative attitude in his group by his own example.

### Giving Credit

Do not fail to give credit where credit is due, and don't forget to pass on any credit given to you. Good supervisors give full credit to the team. Frequent and sincere praise is a wonderful incentive to individuals and to the group as a whole.

### Tactful Handling of Personal Problems

Personal problems come up almost daily in any group of people. The supervisor must tactfully handle each of these. Rumors about any of your men, disputes between the men, family troubles, and similar situations can disrupt the efficiency of the group. Usually positive action by the supervisor is required.

You, as a supervisor, should try to solve problems that arise in your shop or crew that are within your capability of solving. This does not mean that you should act as chaplain, marriage counselor, and/or psychiatrist, rather it emphasizes the need to be able to recognize the symptoms of those problems requiring special ability in solving, so that you may arrange to have them placed in proper hands as soon as possible.

In each case, the supervisor must first listen and get all the facts, then tactfully bring about a solution so that all concerned can go back to the job and work in harmony. Facing problems squarely and honestly, bringing them out into the open on a man-to-man basis, and solving them before they explode, are usually the best courses of action.

## COOPERATION WITH YOUR SUPERIOR

Your boss is a mighty important person to you. In his hands rests much of your success in your job. Whether you like him personally or not, you are going to have to cooperate with him if you hope to advance.

Many supervisors rate loyalty at the top of the list of desirable qualities. The loyal supervisor does not criticize his boss to others, even if he does not see eye to eye with him.

Dependability is another desirable quality your superior looks for in you. Your boss likes to know that once an assignment is given to you, it will be carried out to completion to the best of your ability, and on time. There are few things more annoying than the man who always has an alibi—who cannot be depended upon.

Don't be a "yes" man, but on the other hand, don't go to the extreme of being a "no" man. A good boss wants subordinate supervisors who are not afraid to tell him tactfully what they think, even if it means telling him that he is wrong. But he doesn't like the fellow who is against everything and who stubbornly resists every idea!

### Make Suggestions Tactfully

Most bosses resent employees who make it a common practice to tell them bluntly what should be done or what shouldn't be done. It's easy to get your ideas across to the boss without incurring resentment; just put them in the form of a question: "What do you think about this idea?" or, "Do you think this would work?"

If the boss gives you an assignment that is obviously a mistake, tactfully ask him what he thinks of handling it from another angle. However, if he insists on carrying out the order his way, don't argue with him.

### Keeping the Boss Informed

The boss likes to know what is going on, but he doesn't want to be bothered with all the petty details. Keep him advised of personnel problems, proposed changes, and other important matters.

If you make a serious mistake, it is a lot better to tell the boss about it immediately, before he discovers it himself. And remember—he doesn't like lengthy explanations of your actions, either.

## COOPERATION WITH YOUR FELLOW SUPERVISORS

Friction and jealousy are your prime enemies in establishing a feeling of cooperation with your fellow supervisors. It is the good supervisor who avoids "back-stabbing," gossiping, or criticizing of his fellow supervisors when the competition becomes keen. The big thing to remember is that you do not rise by crushing others. Eventually unkind actions will boomerang, and if enough people dislike you, you will start failing in your job.

In addition to being cooperative himself, a good supervisor may sometimes have to encourage cooperation on the part of other supervisors. In the long run, it is the fellow who is able to foster and maintain harmony in all his relationships who is needed for the Navy's key jobs.

## TECHNICAL SUPERVISION

The first part of this chapter has dealt with the supervision of personnel. Areas of concern in supervising the technical aspects of a data processing installation are taken up next.

The data processing supervisor is responsible for carrying out the objectives set forth by management. He must have the authority to accomplish his responsibilities and must have the complete cooperation of all levels of management in performing his duties. In accomplishing the objectives set forth, he must keep management informed of progress made as well as any problems which may arise.

Although the procedures for ADP equipment vary according to the purpose for which equipment is to be used, problems of supervision are quite similar among all ADP installations. No Navy activity using ADP is relieved from the task of applying the most economical contract terms, assuring proper computation of rental and maintenance costs, accurate recording of time, obtaining the most effective use of equipment and all the other aspects of good management.

The concept of ADP supervision and equipment utilization for command, control and support systems is basically the same as that for multifunctional application operations, although the operating nature of each differs somewhat. ADP equipment for command, control and support systems is generally required to provide information rapidly for making operational decisions. Equipment used for multifunctional and/or management support applications processes data on a scheduled basis for effectiveness and economy. Because of improved capability of ADP systems to process data routinely, subject to automatic interrupt for high priority processing, the same equipment system can usually be used for management supporting and operational supporting. Full and economical use of Navy ADP systems should be exploited regardless of principal purpose of applications when such use is operationally and economically feasible.

Regardless of differences in required responsiveness, supervisory procedures are fundamentally similar for all ADP equipment in that they will involve:

1. Establishing a production control or scheduling system to facilitate the smooth flow of data and to enable the optimum use of equipment and manpower.
2. Program maintenance to make relatively minor changes in operating programs to update them, solve program-operating problems, adapt to scheduling changes and correct errors in programs after they have gone into operating status.
3. Maintenance of up-to-date documentation of all current applications to ensure efficient control and operation of the installation.
4. Recording machine utilization time to provide a basis for computing charges (rental and/or maintenance) and utilization rates for management purposes.
5. Establishing inspection and maintenance procedures.
6. Developing procedures for the care and control of magnetic tapes.

7. Monitoring the availability of punch cards, magnetic tape, tabulating paper and other supplies.

8. Ensuring compliance with security directives regarding the handling of classified information.

9. Analyzing ADP installation operations continuously to determine areas of low effectiveness and efficiency and then correcting the discrepancies.

10. Control of personnel by measuring work performed against either historical data or developed standards.

11. Continuous review of records, procedures, and operational effectiveness of all data processing locations at an installation, including physical inspection.

12. Continual training of new personnel and updating the training of older personnel.

LIAISON. — The unusual position of the data processing activity within the larger organization — half service, half operating — greatly heightens the importance of the liaison function at the supervisory level. The ADP supervisor is faced with particularly difficult relationships. He often shares in making decisions that do not relate directly to his own department, and acts as an intermediary with other departments. The problem of translating technical information into management terms is always with him. Finally, in day-to-day operations, he must act to assure a smooth, timely flow of data.

## OPERATING PROCEDURES

Operating procedures vary from installation to installation. It cannot be expected that a system using EAM equipment would or could use the same operating procedures as a small EDP system. There are normally different operating procedures for small EDP systems and large EDP systems. For that matter, operating procedures can and do vary between large EDP systems. In every operating system, decisions must be made as to the type of controls and operations. Open and closed shops are discussed in the following paragraphs.

### OPEN SHOP

Data processing installations operating under the rule of open shop charge the programmer with the responsibility of performing all functions encountered from the inception to the completion of a given program. Included are:

1. Loading all input units with cards, tapes, etc.
2. Operating the console
3. Unloading all output units of reports, cards, tapes, etc.

There is one major disadvantage in the operations of an open shop. For instance, if the programmer had just finished writing a program and had it on the computer for the first time, the chances are that the program will contain errors, and it is only natural for him to try to debug the program while it is on the machine. However, this should not be attempted, because a DP system is expensive, and the time is valuable and must be utilized to the utmost.

### CLOSED SHOP

Data processing installations operating under the rule of closed shop never expect the programmer to perform any operating functions. As a matter of fact, it is desired that the programmer not be allowed on the computer floor. If programmers were allowed on the computer floor there would surely be friction between the computer operators and programmers. In a closed shop the operators, under the control of the senior in charge, or designated section, perform all operating functions and should not be interfered with by unauthorized individuals. An unorganized installation creates undue hardship on both operating and management personnel.

### COMBINATION OPEN/CLOSED SHOP

There is a commonly used variation between open and closed shop operations. In certain cases it is important for program development personnel to attend the running of development programs and/or for program test and integration purposes. However, this should only be allowed upon request and where their presence is required to complete the run. Although it is not recommended practice, in some cases, installations do allow programmers to be on the computer floor while their programs are being run, but they are not allowed to participate in the actual operation of the equipment.

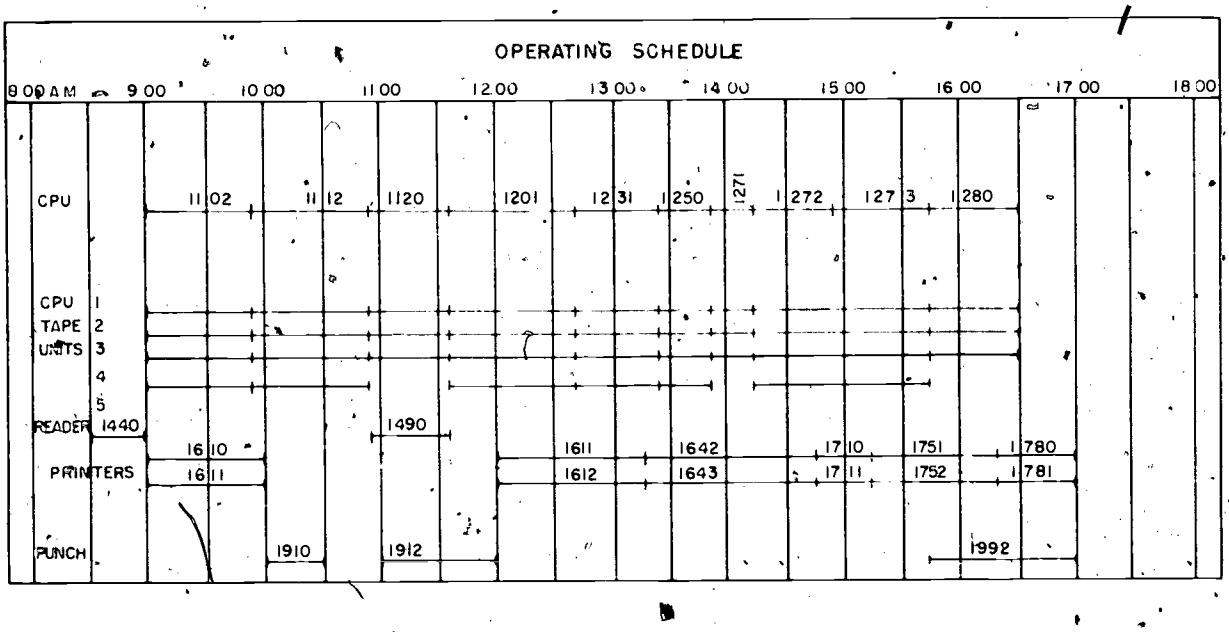



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Figure 8-1.—Typical operating schedule.

## SCHEDULING

Scheduling is one of the most important and difficult jobs of an operating installation. Schedules should be tight enough to preserve valuable machine time; yet flexible enough to allow for setup time, manual operations in case of errors, and unavoidable delays. Scheduling requirements will generally be determined by the characteristics of an installation. The following cases present two extremes:

1. An installation that operates within rigidly prescribed standard application
2. An organization that provides service for a multitude of users

Most installations fall somewhere between these extremes, and the scheduling must be tailored to meet the needs of the particular installation. Operating under rigidly prescribed standard applications normally ensures a relatively fast turn around. Whereas, with a multitude of users the turnaround time depends on the total workload, and the distribution of this workload. To do an effective job of scheduling, the schedule must be realistic. A realistic schedule allows for buffer periods. The basic reason for buffer time involves the required coordination in time of several activities in a data processing run. Perfect coordination of all activities cannot be expected.

The value of scheduling specific time for program testing has been proven by experience. A continuing need for test time is evidenced by the development of new applications, and maintenance and improvement of existing programs.

To keep setup time to a minimum, optimum scheduling must be employed. Also useful in minimizing setup time is intelligent programming which keeps to a minimum the number of changes of tape reels.

A typical example of an operating schedule is shown in figure 8-1. This schedule shows time across the top and auxiliary and system components down the left margin. The solid horizontal lines indicate the time that each unit is in use. The numbers above the lines indicate the run number for which the unit is being used. This example shows that 5 tape units are available and that 3 and sometimes 4 are being used in

these runs. The auxiliary operations, tape to cards, cards to tape, and tape to printer, are performed when the main system is not using the number 4 and 5 tape units. The printer, reader and/or punch could also be used on line.

In addition to scheduling testing time, all production runs must be scheduled to ensure utilization of the equipment. In the case of standard runs, they should not exceed certain set limits on input/output (I/O) and running time. Reasonable limits can only be determined through a study of the systems environment. For instance, do all applications utilize all I/O time? The norm usually reveals that I/O time just about doubles that of the processor.

Special nonstandard runs that exceed the set time limits for standard runs usually are run at night in a busy installation. In the case of often expected longer runs, it might be feasible to have a monitor with an automatic interrupt feature. With this system the computer can alternate between standard and special runs. Some time may be lost each time an interrupt is required because appropriate storage of all conditions within the main processor is required at the time of the interrupt. But this loss is normally insignificant compared to the improvement in the overall computer utilization.

## SCHEDULING OPERATIONS

Scheduling operations cannot be a hit or miss proposition. Machine utilization at all times should accord with a predetermined schedule. The schedule should give the operating group either a specific listing of jobs to be done, or a specific timetable of the sequence in which jobs should be processed. Input data availability and all demands for machine time must be coordinated and reflected in the schedule. The schedule must make provision for regular production runs, special requests, program testing and assembly, unscheduled maintenance, and rerun time.

Scheduling can be considered as the act of screening all requests for machine time and allocating time on the basis of optimizing machine usage, meeting all prearranged commitments, reducing idle machine time, minimizing personnel overtime, and designating sufficient time for contingencies.

There are several ways of establishing an effective schedule. Basically, the scheduling operation is spread out over a time period. Repetitive requirements may be planned as soon as they are known. For example, if a specific report is to be prepared on a specific date and the time requirement is two hours, this can be planned because the requirement will remain static for as long as the job exists. Further, the approximate time of day can be specified according to availability of input data or need for output data.

A preliminary schedule should be devised on a monthly basis and should include recurring jobs. In developing this schedule, an examination of the following factors will provide enough information to outline operations throughout the month with some degree of accuracy:

1. Is this a repetitive run or a onetime request? If it is repetitive, is it permanent or temporary?
2. Does the volume of data vary from one run to the next?
3. Does the production time take into consideration setup time?
4. Is the availability of the input data always on time or is it often late and incomplete?
5. Does the input data require extensive setup time?
6. Are there occurrences of poor data preparation or invalid controls?
7. What are the number and type of data errors and exceptions encountered?
8. What is the relationship of one application to another—can the setup functions be consolidated to facilitate setup time?

There are many things which will cause a variation in setup time. Examples include individual operators, the number of manual interventions required for a given program, and the mode of operation at the data processing center. Historical data that will aid in making reasonable estimates of setup time can be accumulated.

Estimates of program running time should be included with requests for machine time. The programmer can determine this estimate when he is in the final stages of testing the program. An example of a machine time request form is shown in figure 8-2. Note that the entry "estimated running time" does not include setup time or provision for error recovery. These should be estimated by the scheduler and added to the programmer's time estimate.

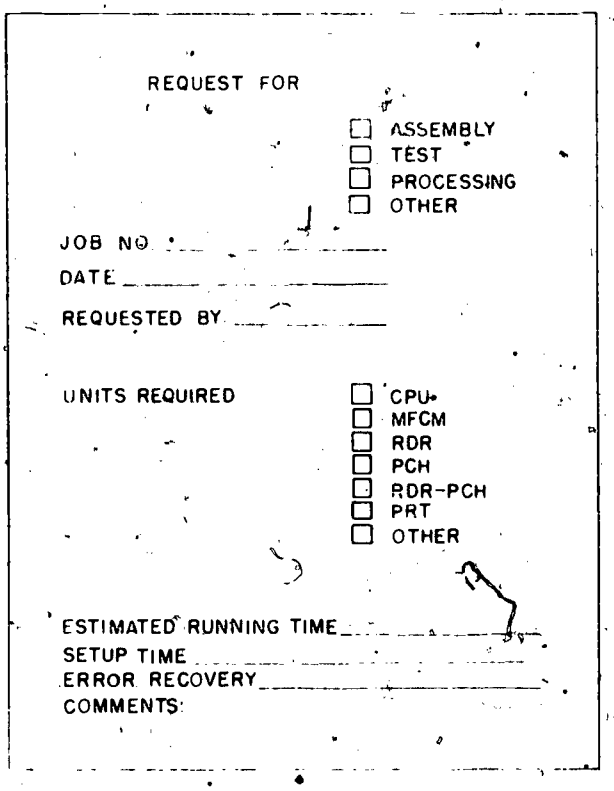


Figure 8-2. — Job Request.

The following questions must be answered for each installation before scheduling procedures can be established:

1. Who determines the priority and sequence of processing and issues schedule commitments?

2. To whom are requests for machine time made?

3. From whom do machine operators receive final machine schedules that indicate actual job processing sequence?

The answers may differ greatly among installations, depending on the nature of the processing done, size of the installation, organization of management, and the extent of computer operation.

Several scheduling techniques may be applied during the scheduling period to determine final sequence of processing. They are summarized below:

Priority System. — For many reasons, one program can take precedence over another. It may be determined, for example, that all requests from the supply department will receive immediate attention, ahead of the requests from other departments. It may be that priority is dictated by the processing sequence of an application, or priority may have to be decided on the basis of a subjective evaluation.

Normal Frequency. — Regularly scheduled (that is, repetitive) jobs may take precedence over all others. In some cases repetitive work may not be required on a specific date and can be processed within a specified range of time.

Demand. — Jobs may be accepted and processed in striot chronological sequence, as requests for processing time are received.

Combination of the Above. — In most installations, actual scheduling is a combination of all the above techniques.

When scheduling machine time and when reviewing machine utilization, distinction must be made between different categories of time. This is of value for analysis, and for projections of machine requirements. If machine utilization analysis is done manually, forms used for scheduling machine time should have room for actual time to be posted after the fact. The Daily Log form, illustrated in figure 8-3, can be useful in this respect. However, the layout is not an important consideration as long as there is provision for the following categories of time:

1. Production time — time used for processing an application.
2. Assembly time — time used for program assembly or compilation.
3. Testing time — time used for program testing, whether used by operations or programming.
4. Training time — time used for training operation or programming personnel.
5. Preventive maintenance — regularly scheduled time when the machine is to be made available for maintenance.
6. Unscheduled maintenance or downtime — any time that computing equipment is under maintenance that has not been scheduled.

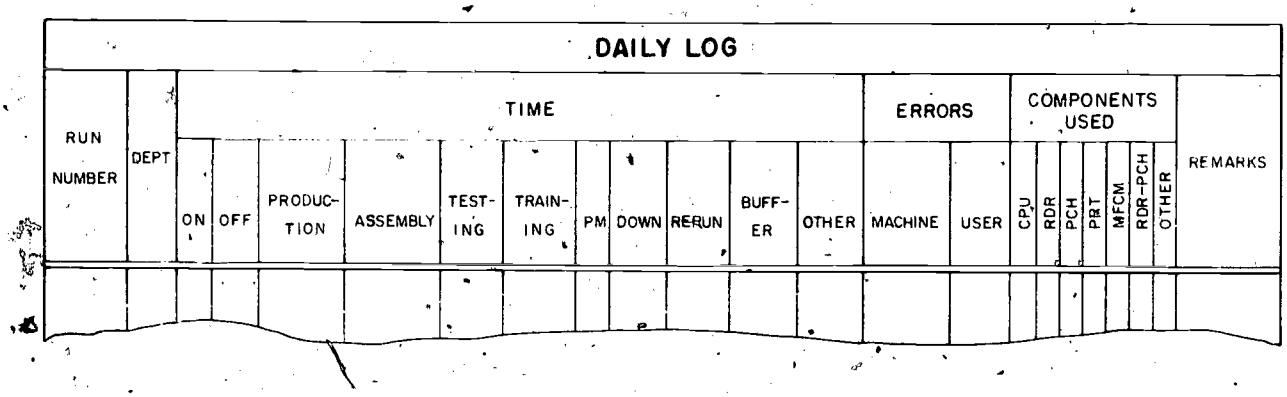


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Figure 8-3. — Daily Log.

7. Rerun time — required because of either operator error, data error, machine malfunction, or faulty input or output media. Whenever a job must be reprocessed, the reason should be indicated.

8. Buffer time — idle time allowed to give some schedule protection for unpredictable events during processing.

Another guide to providing categories of time is SECNAVINST 5238.1 (Series), Automatic Data Processing Program Reporting Systems (ADPPRS) — Resources Accounting. Any or all information in it requested by an appropriate command should be included.

Run Scheduling

Use of the run scheduling method permits estimating the completion time of any run, assuring the user when delivery can be met. For each individual operation, the setup time, start time, and completion time must be specified. Under this method it is necessary to develop a program for setting accurate time standards and an adequate internal communications system. For each run the following minimum information is required:

1. Availability of input data
2. Volume or number of items handled or produced
3. Identification of computer or work center assigned to do the operation
4. Time necessary to set up each required operation
5. Required running time for job
6. Knowledge of the exact status of the run and its inputs and outputs as it relates to other runs

Scheduling by Shift

By this method periods of time are allocated for various processing such as production, test, compile, and maintenance. Instead of attempting to do detailed planning normally associated with run scheduling, each application is assigned to a specific shift or portion of the shift. No attempt is made to specify when, within the time period, the processing is to be started. At the beginning of each time period, each facility is provided a list of runs that must be completed during the period. It becomes the responsibility of the section supervisor to determine the best sequence for doing the processing, etc. In short, the supervisor is responsible for the detailed scheduling within a shift.

## PRODUCTION CONTROL AND SCHEDULING

In discussing scheduling, it becomes apparent that some of the production control functions are highly interrelated with scheduling computer operations. For instance, realistic scheduling is quite dependent on routing of work. Dispatching of work is dependent on planning and reporting. However, whatever technique is used, a good production control and scheduling system can reduce cost and be responsive to the user. As computer time runs at a fixed rate of speed the

techniques to get the work done faster generally involve new setup, scheduling, and handling techniques. A portion of the usable time of an ADP system is consumed by assembly, compiling, program checkout, sort, or other get-ready work to keep it running smoothly. It is this get-ready phase where a fertile area exists for cutting costs through better scheduling and handling.

## WORK LOADS AND TIME FACTORS

Determining work loads and establishing time factors for performing various jobs are essential elements in the efficient supervision of an ADP installation. They lend assistance in maintaining a realistic operating schedule, establishing standards of performance, and in compiling cost figures for jobs performed.

Proper control over workloads entails keeping records of the actual quantity of documents, materials, and reports, and how the quantity fluctuates from time to time. These records provide valuable assistance when applying time factors to operations.

Data processing essentially includes clerical, key-driven, and automatic operations. The time required for operations of a clerical nature must be determined by experience, test, or estimate, or a combination of these factors. The time required for key-driven operations may be determined from production records of previous operations, taking into consideration such factors as the experience of operators, the design and complexity of source documents, and the physical environment. The time required for automatic operations is determined by a more scientific approach, using your own knowledge of rated maching speeds, setup time required, and the amount of handling time involved. The combined time for clerical, key-driven, and automatic operations required in the performance of a given job yields the total time required for that job.

## MEASURING WORK VOLUME

Information concerning the volume of work encountered must be available before realistic time factors can be assigned to each operation in all regularly scheduled jobs. It is essential to have accurate knowledge of the number and types of source documents received, number and types of cards punched and processed, and the number and types of reports produced. Insufficient knowledge of these facts often causes deficiencies in scheduling. Many supervisors complain that fluctuating or unexpected workloads create difficulty in mainfaining schedules; such situations warrant a close analysis of workloads.

There are several ways in which information about the number of source documents can be obtained, depending upon the particular type of document controls established. In some cases item counts and number of batches are recorded as part of the document control routine. In other cases the actual number of documents received may be counted and posted to a control ledger. When gathering information about the volume of source documents, a good sampling period should be selected, corresponding as closely as possible to average conditions. The maximum and minimum volumes expected within this time period, and when they will occur, should be established.

Card volumes are another important item to compile figures on. There is a twofold reason for having an accurate record on card volumes:

1. They have a direct bearing on determining the best method for accomplishing a job.
2. They are applicable to machine workloads for the low, average, and peak periods of the month.

The time required, particularly for EAM operations, is dependent primarily upon the number of cards involved, and the number of times the cards must be run through a given machine. Fairly accurate card counts can be obtained when cards are punched, provided the card punching section maintains production records.

Another volume figure affecting the assignment of time factors is the net output of the installation. A count of the number of pages produced in all reports and documents over a period of time generally will indicate the expected output volume. These counts may be obtained automatically during report preparation, or by manual tabulations as each report is completed.

## DETERMINING TIME FACTORS

Any function performed in a data processing installation can be classed as one of three types: clerical, key-driven, or automatic. Some

jobs may be performed solely through the utilization of only one type of function; other jobs may require either two or all three types. Different methods must be employed for determining time factors applicable to each type of function.

Clerical Operations

Clerical operations are extremely difficult to plan or schedule, since human variables and individual job peculiarities are present to a great extent. One basis for determining clerical time factors is by reference to statistical analysis and efficiency records pertaining to standard and clerical functions performed in the installation. In some cases time factors from a similar operation can be used, provided the clerical routines in both operations closely parallel each other. A more realistic approach is to establish a carefully selected and controlled test period using samples of the actual work. Clerical operations commonly are tried out before any definite plans or schedules are prepared, simply because the human variables involved and the errors encountered in educated guesses preclude the use of any other method.

Key-Driven Operations

Time factors for key-driven operations are more easily established than for clerical operations because the production rate of an operator usually is known. The efficiency and accuracy of key-driven operations are affected by many different factors, each of which should be given careful consideration in determining time factors, evaluating work performed, planning new procedures, or improving existing procedures. A resume of these factors, including applicable considerations, follows:

Document and Card Design. — The design of source documents and card forms is an important factor in attaining speed and accuracy of card punching. The best design provides for exactly the same arrangement of items on both the documents and the cards. The ideal source document for card punching has all information which is to be punched in one card recorded on one line, arranged so that reading and punching can be performed from left to right. Card punching speed and efficiency are affected further by the design of the card with respect to fields which are to be punched, duplicated, or skipped. Best operation is realized when duplicated information appears at the left of the card, and when all manually punched fields are grouped together so that punching need not be interrupted by skipping.

Legibility of Source Documents. — One of the most important factors that affect production in card punching is the degree of legibility of source data. When multiple copies of source documents are prepared, the keypunch section should be given the original if possible; otherwise, it should be furnished the clearest carbon copy available. Source documents which require manually recorded data should be designed to provide enough space for writing large, legible characters.

Number of Columns Punched. — The number of columns to be punched per card has a direct bearing on the number of cards punched per hour. When evaluating production of card punch operators, it is customary to express production in terms of columns punched, or key depressions, per hour. The number of cards punched per hour multiplied by the average number of key strokes per card yields the gross hourly production.

Skill and Experience of Operators. — The training and experience of operators must be considered when determining time factors for key-driven operations. For new operators, it is important to know how much improvement they are making rather than their production record or number of errors made. An absolute proficiency evaluation can be made only after an operator has reached a level rate of production.

Type of Equipment Used. — Changes in the type of key-driven equipment used, and the installation of time-saving devices, may affect the production rate of operators. For example, the use of an alternate program device should be considered if two types of cards requiring two separate program controls are to be punched from the same source document. An alternate program device eliminates the necessity of handling the source documents twice.

Instructions to Operators. — Clear and complete instructions contribute toward increased production and error reduction. Written instructions are preferable, since verbal instructions may be misinterpreted or lost in the shuffle.

Complete documentation of all instructions for key-driven operations should be included as a part of the operator's manual of procedure.

Volume of Transactions.—Operators who prefer routine work usually have a higher production rate when working on large volumes of source documents which require no change in machine setup, documents, or cards. Conversely, operators who prefer change and novelty will become fatigued quickly when they are faced with the prospect of performing unchanging, repetitive operations on a mass of documents. Individual temperaments should be considered when weighing the element of fatigue against the volume of transactions.

Flow of Work.—Decrease in production results when an operator is interrupted continually to perform special jobs, when a job is shifted between operators, or when work is done sporadically as documents become available. If more than one operator is required for a job, the work should be equally distributed to all operators concerned, in accordance with their productive capabilities.

Duties Other Than Card Punching.—Assigning other duties to card punch operators such as coding, auditing, and operating automatic equipment, inevitably lowers their card punching production rate. On the other hand, variety may contribute to higher morale and reduce the fatigue factor. It is necessary to strike a balance between continual card punching and other duties so that a desirable production rate can be maintained without placing undue hardships on the operators.

Working Conditions and Morale.—The production rate of card punch operators is affected to a considerable degree by the factors of working conditions and morale. These are intangible factors which too often are overlooked by supervisors. The comfort of operators should be considered by providing a room in which the temperature, humidity, and ventilation are controlled properly. Extraneous noises should be kept to a minimum. Coffee breaks, or rest periods, should be provided at regular intervals to reduce the fatigue factor.

### Automatic Operations

The determination of time requirements is dependent primarily on the type of machines used and the type of operations performed. Basically three factors must be considered in computing time requirements for completion of a job:

Setup Time.—The first element of operation time is setup time. Setup time includes mounting tapes, inserting control panels and printer forms, bringing input media to the machine, making necessary switch settings and adjustments, and perhaps receiving instructions pertaining to the operation to be performed. All such operational details performed prior to actual processing contribute to setup time.

Machine Time.—The second and usually the major element of time is machine time. This is determined by an analysis and segmentation of each application into elements which identify each processing step, the volume and flow of all processing workloads and the type of processing involved for each step, e.g., sorting, collating, summarizing. By first identifying the volume of workloads and comparing them to machine processing capacities, a preliminary estimate of machine requirements can be derived.

Handling time.—The third element of time applied to an automatic operation is handling time. After the operation begins, it is normal to expect short interruptions in the operations of the machine. These interruptions may be caused by such details as handling I/O data, spot-checking the results of machine operation, checking or balancing results, making minor adjustments to the machine, and handling many other details for good operational control. The amount of handling time involved depends upon the duration of the operation. The longer the operation lasts, the more handling time accumulated. For this reason, handling time is figured as a percentage of machine or total time rather than as a set amount. Realistic determination of handling time can perhaps best be made by analysis and evaluation of previous runs of the job.

## EVALUATION AND IMPROVEMENT

An effective ADP installation involves the use of skilled Data Processing Technicians and expensive, complex equipment. To employ these resources in an optimum manner demands continuing analysis of the operation. The establishment of good operating procedures and techniques

does not necessarily mean that these methods will always be the best for continued operation. Changes in production requirements, workloads, and equipment necessitate continuous review of present procedures in an endeavor to obtain optimum results through a minimum of effort and cost.

Most Department of the Navy activities and contractor operations are required by SECNAVINST 10462.18 to report on the equipment utilization and application. Although SECNAVINST 10462.18 specifies the format for these reports, most activities require utilization data for their own use above and beyond what they are required to report.

The collection of operating data, analysis of utilization and performance, and continuous review of existing procedures are factors which can be used for evaluating the effectiveness of existing data processing systems and for improving the original plans.

When practical, results of the analysis can be presented in chart form displaying trends. These should illustrate to the manager the trend of the operations and point out areas which need detailed attention. Other results may be in report form for future guidance. Principal review areas of an installation's operations are:

1. Equipment utilization
2. Utilization rates
3. Benefits
4. Equipment capabilities
5. Manpower effectiveness
6. Maintenance
7. Production schedule
8. Adherence to the installation's approved data processing program

EVALUATION DATA

Analysis of ADP will vary in intensity according to the size of the installation. Larger installations of the multicomputer variety may expend continuous effort along these lines and may devote one or more personnel towards this end.

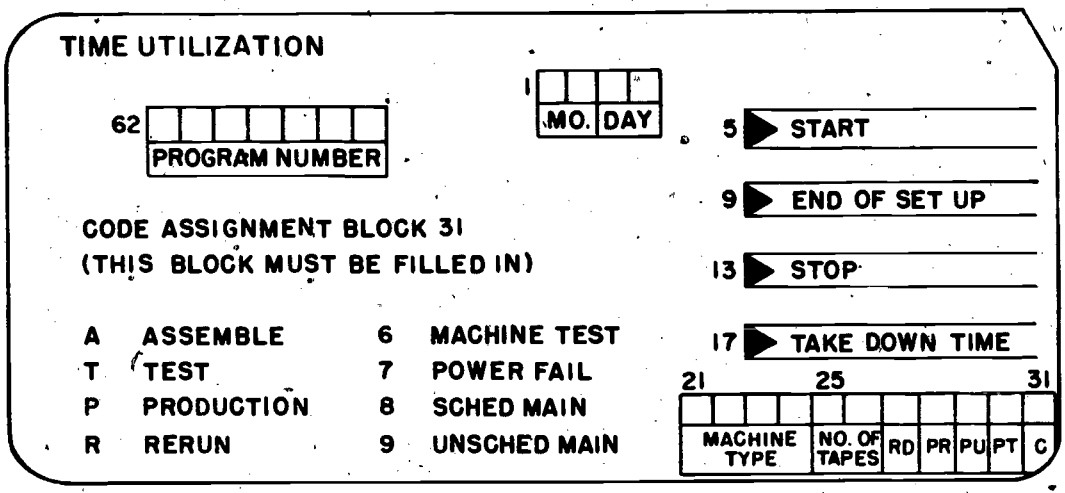
While time estimates may present a fairly good indication of the time required for a job, actual machine utilization statistics should be kept so that comparisons with the estimates, and adjustments as necessary, can be made. Job requirements, workloads, and operating procedures are subject to change from time to time, and careful evaluation of machine utilization can provide valuable assistance in revising operating schedules necessitated by such changes. Operating data can be obtained from machine utilization sheets and job cards, or other forms used for recording machine and personnel usage facts. Such data can be used for performing several types of evaluations by desired form.

Various methods may be used for recording machine utilization. In many installations, a time clock is made available near or on the console in order to allow exact clocking in and out of all program runs. A time card should provide for recording such items as which programs are run, when started, when finished, type of operation (production, program test, rerun, etc.), and components used. A sample time utilization card is shown in figure 8-4. Other forms may be devised and used, depending upon the needs of the particular installation.

The advantage of this DUAL CARD method is that it serves as both a source document and processing medium, allowing the manipulation of facts and the preparation of reports to be performed by mechanical means, thus saving considerable clerical effort.

A realistic picture of machine utilization is based on the PERCENTAGE of available time used rather than on the ACTUAL time used. Available time is based on the number of hours included in a normal work shift, minus any machine downtime. The actual time used, divided by the net time available, yields the percentage of machine utilization. Statistics of this sort, when analyzed over a period of time, may indicate a need for revising the operating schedule so that peak workloads can be reduced. They may indicate also the need for procurement of additional equipment or the possibility of releasing some of the existing equipment.

Machine utilization statistics can be used to determine the total time required for completion of each data processing job, to show the time during a given period when each job was actually performed, and to indicate the machines used in completing the job. Such statistics will provide for maintaining more rigid and realistic operating schedules, as well as providing the basis for determining time and cost figures for each job. Machine hourly rental rates (or prorated hourly cost rates for purchased equipment) and operator pay rates can be introduced into machine utilization cards through the use of master cards




78.138

Figure 8-4.—Sample time utilization card.

to permit computations of the total cost for each job.

Operating data may be used to a certain extent as an assist in maintaining equitable work distribution among machine operators. It must be kept in mind, however, that machine operation does not, in many cases, represent the total effort required in executing a data processing procedure. Manual steps required for posting and checking control totals, handling exceptions, and performance of other clerical functions increase the total time required for the complete processing routine.

## IMPROVEMENT THROUGH EVALUATION

Managers of ADP installations should be on a constant lookout for ways in which to improve the operating efficiency of the installation. Improvements may be made occasionally on the basis of sudden inspirations but, more likely than not, they are the result of careful review and analysis of existing reports, procedures, machine usage, operation, and experience. Cooperation on the part of all personnel concerned, from upper management to data handlers, is essential if improvements most beneficial to an installation are to be realized.

Improvement of Reports.—All reports being produced by a data processing installation should be reviewed periodically to determine if the preparation of each report is justified, and if any changes can be made which will improve their quality. Increases in job requirements often result in the establishment of new reports, some of which may contain information similar to that in reports presently being prepared. It may be possible to consolidate two or more reports into one that will provide recipients with the required information, resulting in substantial savings of time and money within the installation.

Improvement of Procedures.—Changes in report requirements may necessitate establishing new operating procedures or modifying existing procedures. New procedures which are put into effect without first analyzing existing procedures may cause an overlap or duplication of work already being performed. On the other hand, cancellation of job requirements may eliminate some of the job steps in existing procedures. In the interest of realizing the most efficient operation, all operating procedures should be reviewed from time to time to determine whether any changes are required so that procedures may serve the most useful purpose.

Improvement of Machine Usage.—One of the principal objectives of a supervisor should be to achieve maximum utilization of the data processing equipment for which he is assigned control. Maximum value is assured only when such equipment is used productively to the maximum extent possible during a regularly scheduled work shift. A careful analysis of machine utilization over a period of time may reveal several

important facts. It may reveal that certain machines are standing idle for several hours each day during the "slack period" but are used extensively for overtime work during a peak period. Machine rental rates generally are based on a stipulated charge for a specified number of hours of operational use time for each machine during a calendar month. Additional charges accrue when equipment is used in excess of the operational use time. In the interest of economy, the operating schedule should be analyzed and revised if possible to provide for more evenly distributed work throughout the rental period, thus reducing peak workloads and the amount of extra use charges.

In some cases an analysis of machine utilization may indicate consistent idle time for certain machines throughout the month. While this may be construed to mean that jobs are being performed in the most efficient manner, it means also that room for improvement still exists if maximum value is to be derived from the equipment. In this case, the supervisor should search for additional work which would produce results of value to the recipient without placing an undue workload on any given machine required for the job.

It is impossible to realize optimum machine utilization if equipment is not kept in good working order. Equipment needs periodic attention, not only for repair of malfunctions but for preventive maintenance as well. The supervisor should work out inspection schedules with the customer engineer, maintain close control over machine performance, and secure the cooperation of machine operators in exercising necessary care in the use of equipment. Just as "an ounce of prevention is worth a pound of cure," so will a small amount of preventive maintenance on the part of operators go a long way toward keeping machines in top working condition.

Improvement of Operation.—When productive tools are provided for performing jobs better and faster, there is a natural tendency to forget the job the PERSON is doing and to concentrate attention on the job the MACHINE is doing. While data processing equipment may perform many of the detailed, repetitive, and routine functions, the operator still performs important duties which the equipment cannot do. He must exercise the functions of control, analysis, judgment, decision, and evaluation, which remain the most important aspects of a given operation. Operation efficiency will vary, depending upon the training and experience of the operator and the nature of the job.

As equipment with greater productive potential is brought into use, the THINKING function of the operator increases in importance. To illustrate, consider the difference between an operation performed with an accounting machine and one performed with an electronic data processing system. If an operator using an accounting machine fails to set alteration switches correctly, he may produce a worthless report. When his error is discovered, the only corrective action necessary is to set the switches correctly and re-run the report. If he is using an EDPS, however, he may accidentally use master tape reels for a writing operation, and by inserting protective rings can destroy valuable records which may be extremely difficult or impossible to reconstruct.

Past performance records determine the standard operation efficiency which the supervisor uses when assigning time requirements to various jobs and when establishing schedules. It should be the objective of each supervisor to raise this standard gradually and continually. There are a number of ways in which the operating standards of a data processing installation can be raised. A continuous on-the-job training program should be instituted and maintained for machine operators. Manuals of procedure containing accurate operating instructions for all jobs performed should always be available to operators. Morale should be kept high by promoting better working conditions, improving administrative relationships, and by being fair and impartial. Above all, supervisors should exhibit those traits which mark a man as being a real leader of people.

Use Idle Time Productively

Another method of improvement is to use idle machine time for productive purposes. Some of this idle time may be used in relieving the peak workload period, as indicated previously. Other ways of reducing idle time include providing more information on existing reports, preparing additional reports in those areas not previously mechanized, and adding more record-keeping functions to the machines when it is economical to do so. The economies that can result from mechanizing additional parts of the

record-keeping activities of an organization can well justify the cost. When idle machine time is employed for additional work, the cost may be negligible compared with the results.

The use of idle machine time is more easily controlled for EAM applications than it is for EDP systems. Sometimes it may be found that one installation cannot possibly find enough jobs to keep its hardware in full-time operation. In this case, the possibility of sharing the system with another organization should be investigated. In this way, maximum utilization of the system may be realized while at the same time lowering the operating costs for the installation and providing services to additional users.

## PERSONNEL EVALUATION

The efficiency of machine operators must be considered when assigning time factors to various jobs and establishing schedules for EAM operations. Likewise, the skill and experience of programmers must be considered when setting a target date for completion of a program for an EDPS. In either case, evaluation generally is based on a comparison of an individual's capabilities against standards established from past performances of skilled personnel.

When evaluating the work of a machine operator, it is important to consider his training and experience. For a new operator, the number of cards processed and the number of errors made are not so important as how much improvement he is making. This trend is the best indication of the type of production that can be expected in the development of each operator. The efficiency of an operator should be measured against established standards only after he has reached a level rate of production.

Skill and experience must be taken into consideration also when evaluating the efficiency of a programmer. A new programmer may require an excessive amount of time and may encounter considerable difficulty during his early attempts at writing programs. These programs may require extensive desk checking and machine testing before they can be executed successfully. Eventually, he will have been at the job of writing programs long enough so that his efficiency can be measured against what is expected of him. If he measures up to expectations, he may be considered a qualified programmer. On the other hand, if he does not have what it takes to be a programmer, it may be better to reassign him to other duties more in keeping with his capabilities.

## PROGRAM MAINTENANCE

Program maintenance should be a matter of concern to everyone associated with it. Once a program is successfully converted to the data processing system, it is subject to change. Experience has proved the need for and value of making periodic changes to a program after it is in operation. Some of the more common reasons for making program changes can be attributed to many such things as:

1. Additional output needs
2. Desire for I/O format changes
3. Normal changes—such as new or obsolete requirements
4. Changes in ADP equipment, new or improved programming techniques, change in auxiliary equipment, etc.
5. Changes in the scope of application
6. Realization that some aspects of a program's results are not acceptable
7. Unrealistic input requirement
8. Misunderstandings regarding the output requirements of the program
9. A possible or unforeseen condition or occurrence

Once a program is released for production after final review and found acceptable under operating conditions, it must be completely documented, as outlined in chapter two of this manual.

Once these areas are covered, the original programmer should be relieved of most of the responsibilities of the program, so that he may work on another program. Since it is possible the original programmer may be transferred before a program is completed, all programs should be maintained by a predetermined section or division. Where major changes to a program are required, the original programmer, if available, may be called on for assistance.

The need for keeping documentation current is essential. Procedures must be established to ensure that changes made to programs are immediately and completely documented.

The section or division charged with program maintenance should maintain also a master copy

of each run manual. This master copy has a twofold purpose:

1. To prevent loss or destruction of program instructions
2. To facilitate the preparation of new run manuals in the machine room when they become dirty and/or torn

## MAINTENANCE OF EQUIPMENT

Although the increase in purchased ADP equipment has aroused considerable interest regarding ADP equipment maintenance, it is fundamental that whether the equipment is leased or purchased, the user must be assured of its reliable operation. Consequently, the data processing manager must devote special attention to scheduled and unscheduled maintenance to assure uninterrupted flow of products to the customers. Also, continued review of maintenance can avoid unnecessary data processing equipment costs.

The following common maintenance classifications and definitions are used:

CORRECTIVE MAINTENANCE (CM).—Maintenance performed by the technician (contractor or Government) which results from equipment failure and which is performed as required, and, therefore, on an unscheduled basis.

PREVENTIVE MAINTENANCE (PM).—Maintenance performed by the technician (contractor or Government) which is designed to keep the equipment in proper operating condition and which is performed on a scheduled basis.

Close liaison with the vendor's local representative on maintenance matters is encouraged. The vendor is required, contractually, to keep the equipment in first class operating condition. It is, therefore, mandatory that there is a complete understanding on all equipment maintenance matters between the installation and the vendor's representative.

Local management must be thoroughly knowledgeable concerning all terms and conditions of pertinent contracts. In the maintenance areas, as in all others, these terms and conditions must be applied with care to ensure that the best interests of the Navy are served.

The Navy in recent years expanded its potential to maintain ADP equipment with its own personnel, namely for that ADP equipment being employed aboard ships, remote locations, and security. When in-house maintenance capability is employed, the scope of the data processing manager's responsibility will increase.

Close coordination with assigned DS's is mandatory for proper maintenance. The manager's attention should also be focused on such items as stock levels, replenishment of peculiar parts through vendor distributors, and the host of problems associated with in-house supplies.

## EMERGENCY BACKUP PROCEDURES

Great strides have been made in improving the reliability of hardware and reducing downtime. When a computer breaks down, it is usually assumed that it will not be for long. In spite of the progress that has been made, the possibility of a prolonged breakdown during a critical period does exist.

An organization may be extremely dependent on the ADP system, and a breakdown of the computer could paralyze the whole operation. Provision for backing up the system should be tailored to the specific installation needs. In general, the backup procedure need not be elaborate. These procedures may consist of working arrangements with another installation having a compatible ADP system. In some cases an alternative manual procedure may be the answer. An additional possibility would be to perform only partial processing while the system is inoperative and catch up when the system again becomes operational. In the event of a total breakdown in equipment consideration must be given to the following:

Where is the nearest duplicate system?
How does it differ?
Is it available?

If the maintenance technicians cannot find the problem, work stacks up, the situation becomes more and more critical, and by the time the decision is made to seek another computer the situation may be approaching the panic stage. Included in the plans for the backup procedure should be a time element for delay—that is, the plans should specify how long the system can be inoperative before the procedure is implemented.

Emergency conditions requiring planning action include local disasters such as a fire, explosion, flooding, or a similar catastrophe.

## SECURITY

Proper procedures and controls should be established for handling, stowing, and processing classified data. Much of the information required can be found in OPNAVINST 5510.1 series. The OPNAVINST contains the DOD directive 5200.28, Security Requirements for ADP systems, and DOD manual 5200.28-M, ADP Security Manual.

## SUMMARY

Supervision is a strange and seemingly undefinable ability, trait or quality. Some people appear to be natural leaders. Others appear to be loners who will not be led and do not want to lead. Still other people appear to be followers always being and wanting to be led. Boot camp seems to take all types of people and put them on the road to being the leaders and supervisors required in the Navy.

In an atmosphere such as boot camp, everybody starts to learn about the "world" of which they are to become a part. They have the chance to learn and progress on an equal basis. They are in essence "from the same mold" as those before and after them. They are usually all treated in much the same manner (disciplinary, hygiene requirements, meal servings, clothing, etc.). This tends to put everyone on the same basic footing. When a person is sure of the rules he lives under, what his job is, how long he has in which to accomplish things, etc., he is more willing to learn and progress, as he is more self-assured.

This environment may not be evident to the "boot," but it is present, and it is a building block for his future. As the recruit learns about his military requirements in boot camp, he learns of his future technical occupation in a (at least for most apprentices) Class "A" school. Again, regulations are set forth. Most all people are starting to train professionally at the same knowledge level, and they are still exposed to the same environment as in boot camp. That is, they are observing the senior petty officers instruct, conduct inspections, counsel and in general perform all the military and professional duties. This exposes the young Navy people to the path that they will follow in the Navy.

They are in training for the leadership/supervisory position they are to eventually assume in their career. Examples are being set by the senior people. These examples must be good, or the desire to remain and attain the senior positions will not be instilled.

Most training courses for leadership/supervision/management are comprised of fictional situations. These situations are then discussed as to which solution would be the best. Most all solutions are based upon thorough knowledge of all factors contributing to the specific problem and what will be the probable outcome. These courses, together with technical experience in a rating and the constant exposure to a well-supervised environment, almost always successfully develop the "natural" supervisory qualities required by the senior petty officers in the Navy.

# APPENDIX I

# RESERVED WORDS

The following is a list of reserved words used in COBOL. These words should not be used as names, or the results may be unpredictable.

ACCEPT
ACCESS
ACTUAL
ADD
ADDRESS
ADVANCING
AFTER
ALL
ALPHABETIC
ALTER
ALTERNATE
AND
ARE
AREA
AREAS
ASCENDING
ASSIGN
AT
AUTHOR
BEFORE
BEGINNING
BLANK
BLOCK
BY
CF
CH
CHARACTERS
CLOCK-UNITS
CLOSE
COBOL
CODE
COLUMN
COMMA
COMP
COMPUTATIONAL
COMPUTE
CONFIGURATION
CONTAINS
CONTROL
CONTROLS
COPY
CORR
CORRESPONDING
CURRENCY
DATA
DATE-COMPILED
DATE-WRITTEN
DE
DECIMAL-POINT
DECLARATIVES
DEPENDING
DESCENDING
DETAIL
DISPLAY
DIVIDE
DIVISION
DOWN
ELSE
END
ENDING
ENTER
ENVIRONMENT
EQUAL
ERROR
EVERY
EXAMINE
EXIT
FD
FILE
FILE-CONTROL
FILE-LIMIT
FILE-LIMITS
FILLER
FINAL
FIRST
FOOTING
FOR
FROM
GENERATE
GIVING
GO
GREATER
GROUP
HEADING
HIGH-VALUE
HIGH-VALUES
HOLD
I-O
I-O-CONTROL
IDENTIFICATION
IF
IN
INDEX
INDEXED
INDICATE
INITIATE
INPUT
INPUT-OUTPUT
INSTALLATION
INTO
INVALID
IS
JUST
JUSTIFIED
KEY
KEYS
LABEL
LAST
LEADING
LEFT
LESS
LIMIT
LIMITS
LINE
LINE-COUNTER
LINES
LOCK
LOW-VALUE
LOW-VALUES
MEMORY
MODE
MODULES
MOVE
MULTIPLE
MULTIPLY
NEGATIVE
NEXT
NO
NOT
NOTE
NUMBER
NUMERIC
OBJECT-COMPUTER
OCCURS
OF
OFF
OMITTED
ON
OPEN
OPTIONAL
OR
OUTPUT
PAGE
PAGE-COUNTER
PERFORM
PF
PH
PIC
PICTURE
PLUS
POSITION
POSITIVE
PROCEDURE
PROCEED
PROCESS
PROCESSING
PROGRAM-ID
QUOTE
QUOTES
RANDOM

RD
READ
RECORD
RECORDS
REDEFINES
REEL
RELEASE
REMARKS
RENAMES
REPLACING
REPORT
REPORTING
REPORTS
RERUN
RESERVE
RESET
RETURN
REVERSED
REWIND
RF
RH
RIGHT
ROUNDED
RUN
SA
SAME
SD
SEARCH
SECTION
SECURITY
SEEK
SEGMENT-LIMIT
SELECT
SENTENCE
SEQUENTIAL
SET
SIGN
SIZE
SORT
SOURCE
SOURCE-COMPUTER
SPACE
SPACES
SPECIAL-NAMES
STANDARD
STATUS
STOP
SUBTRACT
SUM
SYNC
SYNCHRONIZED
TALLY
TALLYING
TAPE
TERMINATE
THAN
THROUGH
THRU
TIMES
TO
TYPE
UNIT
UNTIL
UP
UPON
USAGE
USE
USING
VALUE
VALUES
VARYING
WHEN
WITH
WORDS
WORKING-STORAGE
WRITE
ZERO
ZEROES
ZEROS

# INDEX

## QUALIFICATIONS FOR ADVANCEMENT

This booklet provides you with a list of qualifications for advancement that pertain to Data Processing Technician 1&C. The official source of this list is the Manual of Qualifications for Advancement, NAVPERS 18068-C, change 3. The assignment numbers given opposite the qualifications refer to the assignments in the NRCC, Data Processing Technician 1&C, NAVEDTRA 91275-2. Each course assignment contains information related to a practical or knowledge factor, as shown.

## DATA PROCESSING TECHNICIAN

Data Processing Technicians operate data processing equipment to record source data; set up and operate data processing equipment, including data transceivers, sorters, collators, reproducers, interpreters, accounting machines, and digital electronic data processing machines for accounting and statistical purposes; process incoming information and make routine and special reports as required; operate general purpose digital computers; and in the higher paygrades participate in programming, system analysis and designing electronic data processing systems.

| QUALIFICATIONS FOR ADVANCEMENT | Required for Advancement to DP | Covered in Assignment |
|---|---|---|
| A. SAFETY | | |
| 1.00 Practical Factors | | |
| No specific ones for E-6, E-7 | | |
| B. ELECTRIC ACCOUNTING MACHINE SETUP AND OPERATION | | |
| 1.00 Practical Factors | | |
| .60 Wire and/or diagram a reproducer control panel for summary punching | E-6 | |
| .61 Wire and/or diagram a collator control panel for selection between limits | E-6 | |
| .62 Wire and/or diagram an accounting machine control panel for summary punching, storage, special program, Multi-Line Read (MLR), Multi-Line Print (MLP), and crossfooting | E-6 | |
| C. ELECTRONIC DATA PROCESSING AND PERIPHERAL EQUIPMENT | | |
| 1.00 Practical Factors | | |
| .60 Construct decision tables | E-6 | 1, 2 |
| .61 Write, debug, and document a sort/merge program with minimum supervision | E-6 | 1, 2 |
| .62 Analyze an EAM to EDP system conversion and determine data input, processing, and output requirements with minimum supervision | E-6 | 1, 3 |
| .63 Prepare a program run book | E-6 | 1 |
| .80 Write, debug, and document a program utilizing multiple file input, multiple format output, and table lookup without supervision | E-7 | 1, 2 |
| .81 Analyze and document conversion of a card oriented EDP system to a tape or disk oriented EDP system without supervision | E-7 | 1, 2, 3 |
| 2.00 Knowledge Factors | | |
| .60 Types, descriptions, and consequences of overflows | E-6 | 1 |
| .61 Characteristics of open and closed subroutines | E-6 | 2 |
| .62 Methods and differences of infix and prefix notations | E-6 | 2 |
| .63 Functions of index registers | E-6 | 2 |
| .64 Applications and differences of fixed- and variable-word length machines | E-6 | 2 |

| QUALIFICATIONS FOR ADVANCEMENT | Required for Advancement to DP | Covered in Assignment |
|---|---|---|
| C. ELECTRONIC DATA PROCESSING AND PERIPHERAL EQUIPMENT - Continued | | |
| 2.00 Knowledge Factors - Continued | | |
| .65 Procedures for maintaining programs | E-6 | 1, 2, 3 |
| .66 Basic methods and applications of systems analysis | E-6 | 1, 3 |
| .67 Process and purpose of binary searches | E-6 | 2 |
| .68 Construction and advantages of subroutine program | E-6 | 1, 2 |
| .69 Differences and uses of null, space, and numeric zero characters | E-6 | 2 |
| .70 Functions and purposes of checkpoint, breakpoint, and branchpoint routines | E-6 | 1 |
| .71 Methods and purposes of multiplexing | E-6 | 1, 3 |
| .72 Characteristics and functions of chained, pushdown, and pushup lists | E-6 | 1, 2 |
| .73 Characteristics and functions of Macro instruction | E-6 | 2 |
| .74 Methods of serial, parallel, and random access processing | E-6 | 2 |
| .80 Methods and applications of fixed and floating point arithmetic calculations | E-7 | 2 |
| .81 Purposes and characteristics of absolute, automatic, relative, skeletal, specific, straight line, and symbolic coding | E-7 | 1, 2 |
| Z. ADMINISTRATION | | |
| 1.00 Practical Factors | | |
| .60 Ensure accurate and timely processing using local operating, data collection, and verification methods | E-6 | 1, 3 |
| .61 Train and evaluate subordinates in local machine operations | E-6 | 3, 4 |
| .80 Administer local procurement program and ensure efficient use of expendable items | E-7 | 3, 4 |
| .81 Prepare and maintain flow charts for manual and machine operating procedures | E-7 | 1 |
| .82 Design report forms | E-7 | 1 |
| .83 Provide administrative control and ensure reporting and work schedule efficiency | E-7 | 1 |
| .84 Analyze proposed EDP changes | E-7 | 1, 3 |
| .85 Revise and improve operating and scheduling procedures | E-7 | 1, 3, 4 |
| 2.00 Knowledge Factors | | |
| .60 Methods of computing machine workload | E-6 | 3 |
| .61 Purpose of audit trail | E-6 | 1, 3 |
| .80 Methods and procedures for ADP site preparation, installation, and operation | E-7 | 3 |
| .81 Scopes and general contents of ADP installation instructions, manuals, and handbooks | E-7 | 1, 3 |
| .82 Procedures for ADP installation technical instruction development and promulgation | E-7 | 3 |
| .83 Scope and general contents of ADP Review and Evaluation Program SECNAVINST 10462.18 series | E-7 | 1 |
| .84 Scope and general contents of ADP Program Reporting System Resources Accounting SECNAVINST 5238.1 series | E-7 | 4 |

# DATA PROCESSING TECHNICIAN 1 & C

**NAVEDTRA 10265-C**

This course was prepared by the Naval Education and Training Program Development Center, Pensacola, Florida

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## INTRODUCTION

This course consists of this assignment booklet, the accompanying rate training manual, and the answer sheets. Each assignment is made up of a series of items based on assignment readings in the textbook. At the beginning of each assignment is listed the specific text material that should be studied. The answer sheets to be completed are enclosed as a separate package.

If there is an errata sheet included with this course, make all indicated changes and corrections in the assignment booklet and textbook.

## PREREQUISITE

Although there is no mandatory prerequisite, it is recommended that the Data Processing Technician 3&2, NAVEDTRA 91274-2, be completed prior to taking this course.

## HOW TO COMPLETE THIS COURSE SUCCESSFULLY

To complete this course successfully, you must meet the following standards: If you are on active duty, the average of the grades earned on all assignments must be at least 3.2. If you are NOT on active duty, the average of the grades earned on all assignments in each CREDITABLE UNIT of the course must be at least 3.2. (See the Naval Reserve Retirement box for the retirement points evaluated for this course.)

Study those pages of the textbook listed for each assignment. Pay particular attention to the illustrations as they give a lot of information in a small space. Making your own drawings will help you understand some of the explanations you read. Also, read the learning objectives. They will tell you what you will be able to do after having read the material and answered the study items.

Read each item carefully. Consult your textbook to help you select the BEST ANSWER. You may discuss difficult points in the course with your Division Officer of shipmates. However, the answer that you select must be your own. Indicate your answer directly on the answer sheet by erasing the appropriate block. If a page number appears, you have made an incorrect answer. Re-study the text, starting at that page, and make another selection. A correct answer for each item is made when a "C", "CC", or "CCC" is exposed. Scoring the answer sheets is explained later in this booklet.

Use only the designated answer sheet for each assignment. Follow the directions found on the answer sheet to determine the proper procedures for completing it.

The enrollee should exercise care in erasing, as an inadvertent erasure will be considered an error. However, the scoring table is adjusted to absorb occasional error in erasures without course failure.

## WHO WILL ADMINISTER YOUR COURSE

If you are assigned to a command which maintains your records, your nonresident career course will be administered by your Command. All other courses will be administered by the Naval Education and Training Program Development Center. Consult your Division Officer and follow the instructions stated below for Local Administration if your course is administered by your Command. Follow the instructions for Naval Education and Training Program Development Center administration if your course will be administered by the Center.

## SELF-SCORING ANSWER SHEETS

Before making any erasures on the answer sheets, fill out all blanks.

Submit your completed assignments to the officer designated. He will check the accuracy of your score and discuss with you any of the questions that you do not understand. You may wish to record your score in the assignment booklet as a check of your progress since self-scoring answer sheets are not returned. When the entire course has been completed and a satisfactory grade attained, a notation to this effect should be made by your local command in your

service record. By this means you will be given credit for your work.

The Naval Education and Training Program Development Center does not issue Letters of Satisfactory Completion to enrollees who have their courses administered by their own command.

TEXTBOOK

The textbook for this course need not be returned to the Center.

WHEN THE COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

Adhere as closely as possible to the schedule prescribed by the Chief of Naval Education and Training of at least one assignment per month. If unusual circumstances prevent this, write to the Center explaining the difficulty. Time extensions are granted when justified. Remember, however, that unnecessary delay in completing the course may, if you are a Reservist, prevent you from earning enough retirement credits to complete a year of Satisfactory Federal Service.

SELF-SCORING ANSWER SHEETS

Fill out all blanks on the answer sheet. Unless you supply all the information required, it will be impossible to give you credit for your work.

Enrollees are to RETAIN each completed assignment until a creditable unit is finished (or the entire course if the course is NOT divided into units), at which time the assignments are to be forwarded to the Center in one of the envelopes provided. The enrollee should record his grades, as the IKOR answer sheets are not returned by the Center.

The Center will verify and record your assignment scores and will notify you of your final grade by issuing a letter of satisfactory completion. Completion of creditable units of a course will be certified by stamping the last assignment of each unit with the unit average grade and date and returning it to the enrollee.

WHEN PREPARING FOR YOUR ADVANCEMENT EXAMINATION

Your examination for advancement will be based on the latest edition of the Manual of Navy Enlisted Manpower and Personnel Classification and Occupational Standards (NAVPERS 18068). It is possible that the qualifications for your rating may have changed since this nonresident career course and its accompanying textbook were printed.

The study suggestions that are in this nonresident career course, in the Rate Training Manual, and in the current edition of Bibliography for Advancement Study (NAVEDTRA 10052) are intended to help you locate study materials on which the examinations will be based.

Be sure to refer to the latest editions of NAVPERS 18068 and NAVEDTRA 10052 when preparing for your examination.

NAVAL RESERVE RETIREMENT

This course is evaluated at 8 Naval Reserve retirement points. These points are creditable to personnel eligible to receive them under current directives governing retirement of Naval Reserve personnel. Points will be credited upon satisfactory completion of the entire course.

Naval Reserve retirement credit will not be given for this course if the student has previously received credit for any Data Processing Technician 1&C, ECC, ECC/FITS, or NRCC.

WHAT IS THE COURSE OBJECTIVE

While completing this nonresident career course, the student will demonstrate his understanding of course materials by correctly answering items on the following: data processing career promotion system, optional and required publications for study, standard data processing documentation, basic elements of COBOL, COBOL Identification Division, COBOL Environment Division, COBOL Data Division, COBOL Procedure Division, various definitions of the term system, hardware and software planning, and personnel and equipment management.

Naval nonresident career courses may include a variety of items -- multiple-choice, true-false, matching, etc. The items are not grouped by type; regardless of type, they are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Some courses use many types of items, others only a few. The student can readily identify the type of each item (and the action required of him) through inspection of the samples given below.

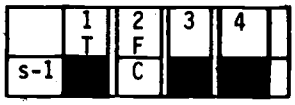
## MULTIPLE-CHOICE ITEMS

Each item contains several alternatives, one of which provides the best answer to the item. Select the best alternative and erase the appropriate box on the answer sheet.

### SAMPLE

s-1. The first person to be appointed Secretary of Defense under the National Security Act of 1947 was
1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

The erasure of a correct answer is indicated in this way on the answer sheet:



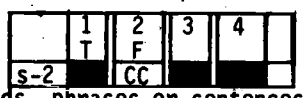

## TRUE-FALSE ITEMS

Determine if the statement is true or false. If any part of the statement is false the statement is to be considered false. Erase the appropriate box on the answer sheet as indicated below.

### SAMPLE

s-2. Any naval officer is authorized to correspond officially with a bureau of the Navy Department without his commanding officer's endorsement.

The erasure of a correct answer is also indicated in this way on the answer sheet:




## MATCHING ITEMS

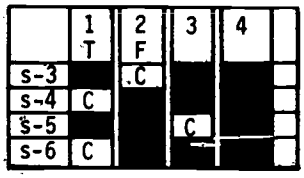
Each set of items consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Specific instructions are given with each set of items. Select the numbers identifying the answers and erase the appropriate boxes on the answer sheet.

### SAMPLE

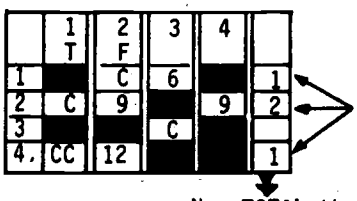
In items s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions.

| A. Officers | B. Departments |
|---|---|
| s-3. Damage Control Assistant | 1. Operations Department |
| s-4. CIC Officer | 2. Engineering Department |
| s-5. Assistant for Disbursing | 3. Supply Department |
| s-6. Communications Officer | |

The erasure of a correct answer is indicated in this way on the answer sheet:




## How To Score Your Immediate Knowledge of Results (IKOR) Answer Sheets




Total the number of incorrect erasures (those that show page numbers) for each item and place in the blank space at the end of each item.

Sample only

| Number of boxes erased incorrectly | 0-2 | 3-7 | 8- |
|---|---|---|---|
| Your score | 4.0 | 3.9 | 3.8 |

Now TOTAL the column(s) of incorrect erasures and find your score in the Table at the bottom of EACH answer sheet.

NOTICE: If, on erasing, a page number appears, review text (starting on that page) and erase again until "C", "CC", or "CCC" appears. For courses administered by the Center, the maximum number of points (or incorrect erasures) will be deducted from each item which does NOT have a "C", "CC", or "CCC" uncovered (i.e., 3 pts. for four choice items, 2 pts. for three choice items, and 1 pt. for T/F items).

# Assignment 1

Advancement, Documentation, Introduction to COBOL

Textbook Assignment: Data Processing Technician 1&C, NAVEDTRA 10265-C, pages 1 through 37

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*Learning Objective: Indicate the benefits, responsibilities, requirements, and sources of additional information associated with advancement in the Data Processing Technician rating.*

1-1. Advancement in rating is profitable to both you and the Navy. What is one of the most lasting of the personal benefits you receive from advancement?

1. The higher standard of living made possible by increased pay
2. The greater prestige you acquire
3. The satisfaction you derive from increasing your knowledge and skills
4. The more challenging assignments you receive

1-2. What should be your attitude toward understanding the duties and responsibilities of other ratings?

1. It is important that I maintain good personal relations with senior petty officers in other ratings, but this does not necessarily mean becoming familiar with their duties.
2. As a Data Processing Technician, I can perform my work without knowing anything about the duties and responsibilities of other ratings.
3. My basic responsibility is to train my subordinates and master my own field, so I should not waste my time learning about other ratings.
4. I should learn as much as possible about the duties and responsibilities of personnel having other ratings in order to coordinate my efforts with theirs.

1-3. As you advance in rating, you should strive continually to improve your knowledge of grammar and to enlarge your vocabulary in order to

1. communicate more easily and effectively with others
2. avoid criticism from subordinates who have higher formal education
3. vitalize your instruction techniques
4. impress your subordinates with your superior command of the language

1-4. You happen to read about a new development in electromagnetic research which may be applied in electronic data processing devices. You treat this news as something to

1. disregard until you receive indications the Navy is concerned
2. keep alert about in case it should affect your work
3. forget because practical applications may be years away
4. get immediate particulars about from your division officer

1-5. Which of the following naval activities use data processing services?

1. Personnel, supply, and fiscal
2. Research and security
3. Communications and operations control
4. All of the above

1-6. All of the following actions are qualifications for advancement to DP1 except

1. completing required military and professional training courses
2. being recommended by your educational services officer
3. passing a servicewide competitive examination
4. demonstrating the ability to perform all the practical factors

1-7. DP1 Reynolds has passed the written examination for advancement to DPC. Which of the following factors is among those which bear on Reynold's chances for actually advancing to DPC?

1. His length of time in service
2. His examination score
3. The quota for DPC
4. All of the above

*Learning Objective: Define the term documentation and discuss the document components as required by SECNAVINST 5233.1.*

1-8. Documents are a medium that can best be described by which of the following statements?

1. Any record that has permanence
2. Any record that can be read by man
3. Any record that can be read by machine
4. All of the above

1-9. Documentation may cause lost time by those people utilizing it if, according to the text, what is found in the documents?

1. Many illustrations
2. Over wording
3. Unfamiliar terms
4. Organized layout

1-10. What is the instruction that attempts to standardize documentation pertaining to ADS in the Navy?

1. SECNAV 5322.1 series
2. SECNAV 5233.1 series
3. SECNAV 5232.1 series
4. SECNAV 5323.1 series

In items 1-11 through 1-14, select the mnemonic from column B that is assigned to the document listed in column A.

| A. DOCUMENT | B. MNEMONIC |
|---|---|
| 1-11. Program Maintenance Manual | 1. FD |
| | 2. RT |
| 1-12. Data Requirements Document | 3. RD |
| 1-13. Test Analysis Reports | 4. MM |
| 1-14. Functional Description | |

1-15. What total number of components is required for each complete document?

1. 7
2. 6
3. 5
4. 4

*Learning Objective: Discuss in general the 11 different document types and their uses at ADP installations.*

1-16. Which of the following is a true statement pertaining to the FD?

1. It provides the user with a statement of the technical aspects of software.
2. It should be written in computer-oriented language.
3. It does not require user concurrence for any portion of development or updating.
4. It reflects the initial definition of a programming project.

1-17. Which of the following is the normal reason for preparation of the RD?

1. When a user group is generating and maintaining system files
2. When many analysts/programmers will utilize the same data
3. When data elements are required
4. When programmers require data limitations for a system

1-18. Many data elements have been standardized to help principally in which of the following areas?

1. Software simplification
2. Commonality of data structures
3. Limiting RD wording
4. Manufacturer adherence to specifications

1-19. What document is written after the FD to define further the systems separate areas of responsibilities, such as functions?

1. Data Requirements Document
2. System/Subsystem Specifications
3. RT
4. RD

1-20. Which of the following statements is true concerning changes to the scope of the system effort during drafting of the SS?

1. The SS cannot modify the scope as set forth in the FD.
2. The SS can modify the scope without regard of the FD.
3. The SS cannot modify small system scopes.
4. The SS can modify the scope but should submit the change for the FD.

1-21. If it is prepared, which of the following documents would most probably be used for guidance in program development?

1. FD
2. RD
3. PS
4. SP

1-22. The Data Base Specification will usually be prepared for which of the following situations?

1. When many programmers will be using different data
2. When many programmers are coding for different data
3. When many analysts are developing many subsystems requiring the same data
4. When many analysts are developing many subsystems requiring different data

1-23. The Data Base Specification should be developed for agreement with which other document due to the standardization of data elements?

1. RD
2. FD
3. SS
4. PS

1-24. What section(s) of the CM will provide user staff personnel with the most detail for responding to system requests?

1. One and two only
2. Two and three only
3. Two and four only
4. Three and four only

1-25. Which of the following is NOT a section of the CM?

1. System summary
2. Staff functions related to technical operation
3. General distribution
4. File query

1-26. Which of the following control/operating requirements is NOT precisely detailed in the Computer Operations Manual?

1. Internal logic of a program
2. Initiation of a system
3. Run procedures of a program
4. Abnormal termination of a program run

1-27. The supporting illustration in the OM shall be concerned with which of the following?

1. Program logic
2. Delineation of program flow
3. Input data flow
4. Programming flowchart

1-28. What document is produced primarily for upkeep or updating of programs?

1. PS
2. DS
3. OM
4. MM

1-29. For small projects, how many total manuals may be combined into the Project Manual?

1. One
2. Two
3. Three
4. Four

1-30. Which of the following documents provides a presentation of deficiencies of proposed systems?

1. PT
2. RT
3. RD
4. PS

*Learning Objective: Recognize and determine the amount of documentation required at various ADP installations.*

1-31. By referring to figure 2-2 of the text, what value would be given if a response time to data inputs averaged three weeks?

1. One
2. Two
3. Three
4. Four

1-32. Figure 2-3 of the text suggests what level of complexity is required to produce an FD?

1. 38
2. 27
3. 26
4. 24

1-33. If local command requirements are less than those specified in SECNAVINST 5233.1, what two things are recommended as an aid for documenting?

1. Local terms and Technical Note 02 of SECNAVINST 5233.1
2. Terms and Technical Note 02 of SECNAVINST 5233.1
3. Unique command terms and Technical Note 02 of SECNAVINST 5233.1
4. Terms and Technical Note 03 of SECNAVINST 5233.1

1-34. For local documentation, anticipation of changes for a system could be included in which subject area?

1. Project References
2. Objectives
3. Table Definitions
4. Control Instructions

1-35. If a system is planned for local use only and there are to be four programs, which of the following is true concerning documenting objectives?

1. There should be a narrative statement of the system only with a problem solution included.
2. There should be a narrative statement of the system and a single program problem statement only.
3. There should be only four program problem statements.
4. There should be at least a narrative statement of the system and four program problem statements.

1-36. Which of the following local documentation areas contain a section which should be distributed to the key punchers?

1. Project References
2. Objectives
3. Input Sources
4. Data Base Layouts

1-37. Which of the following is a true statement concerning a data base?

1. A data base is a collection of unrelated records.
2. A data base is always a file.
3. A data base is always at least as large as a file.
4. A data base is never as large as a file.

1-38. If a table were constructed of the four elements Arizona, Arkansas, Alaska, and Alabama, which should logically be the third element?

1. Arizona
2. Arkansas
3. Alaska
4. Alabama

1-39. Parameters should be listed under which area of local documentation?

1. Table Subparts
2. Control Instructions
3. Program Logic
4. Input Sources

In items 1-40 through 1-43, select the subject description from column B that would appear in the documentation area title listed in column A.

| A. DOCUMENT | B. SUBJECT DESCRIPTION |
|---|---|
| 1-40. Backup Procedures | 1. Source language program deck listed |
| 1-41. Program Logic | 2. Primary system failure procedures |
| 1-42. Program Listing(s) | 3. Programming flowchart |
| 1-43. Operator's Manual | 4. Step-by-step physical operation requirements |

*Learning Objective: Determine the number of divisions required in a COBOL program and recognize the general utilization and composition of each division.*

1-44. What is the total number of divisions in a COBOL program?

1. One mandatory and three optional
2. Two mandatory and two optional
3. Three mandatory and one optional
4. Four mandatory

1-45. During compilation, what is the name of the first division required of a COBOL program?

1. Identification
2. Environment
3. Data
4. Procedure

1-46. Which of the following is the most important entry in the Identification Division?

1. Author's name
2. Date of coding
3. Program name
4. Classification code

1-47. The Environment Division can describe the computer to be used for which of the following functions?

1. Program execution only
2. Program execution and compilation
3. Program compilation only
4. Program coding and translation

1-48. What division of COBOL is termed mostly hardware-dependent?

1. Identification Division
2. Environment Division
3. Data Division
4. Procedure Division

1-49. The Data Division provides which of the following descriptions?

1. Physical records only
2. Logical records only
3. Physical and logical records
4. Data blocks only

1-50. What record is available to the COBOL program being executed?

1. Logical record
2. Physical record
3. Buffer record
4. Block record

1-51. The Procedure Division contains which of the following entries?

1. The hardware configuration
2. The security classification
3. The narrative description of the problem
4. The programmer coding for problem solving

1-52. Which of the following should be followed in coding the Procedure Division?

1. Data flowchart
2. Compiler configuration
3. Programming flowchart
4. Narrative program description

Items 1-53 through 1-56 are to be judged True or False.

1-53. There are at least 5 divisions of a COBOL Program.

1-54. COBOL Programs may be compiled on one computer and executed on another computer.

1-55. Detailed descriptions of files are found in the Environment Division.

1-56. A magnetic tape used for data input will move each time a logical record is called into memory.

*Learning Objective: Recognize the standard character set of COBOL characters and their use in structuring words, statements, sentences, and paragraphs.*

1-57. Which of the following would NOT be an acceptable COBOL word?

1. 1Ø
2. DØG
3. Z-IG
4. ØA/T

1-58. Which of the following statements is correct concerning every COBOL word?

1. A word may contain no more than 37 characters.
2. A word may contain only 10 alphabetic characters.
3. A word may contain only 30 characters.
4. A word may contain no more than 30 characters and must end with a period.

1-59. Which of the following is a correct statement concerning a COBOL data name?

1. It is found only in the Environment Division.
2. It is formed by any combination of the 39 characters.
3. It is used to denote a data item.
4. It is technically referred to as a record name.

1-60. Which of the following words may NOT be used as a data name?

1. Words beginning with an alphabetic character
2. A hyphenated alphabetic word
3. Words that are only different in spelling
4. A hyphenated reserved word

*Learning Objective: Define the areas of a COBOL coding sheet.*

1-61. What columns are sorted to correctly sequence a punched program deck?

1. 1-3
2. 1-6
3. 4-6
4. 4-11

1-62. In your textbook, figure 3-1 shows that column 7 is used to denote _____(A)_____ of various words continuation, divisions coded in _____(B)_____ of the coding sheet.
Margin A, Area B

1. (A) continuation, (B) Margin A
2. (A) continuation, (B) Area B
3. (A) divisions, (B) Margin A
4. (A) divisions, (B) Area B

1-63. What columns in a punched program deck have no effect during compilation?

1. 1-6
2. 1-7
3. 72-80
4. 73-80

*Learning Objective: Interpret the symbols, rules, and notations found in the format of COBOL statements.*

1-64. Braces enclosing 2 or more elements of a statement indicate which of the following to a programmer?

1. He may use any one of the choices, but must use at least one.
2. He may use any number of the choices.
3. He must use only the one underlined.
4. He must use the choice of literal if it is an option.

1-65. What term applies to all uppercase COBOL words?

1. Keywords
2. Required
3. Optional
4. Reserved

1-66. Repetition may occur for what portion of a format statement that pertains to an ellipsis?

1. To the left, enclosed in brackets only
2. To the right, enclosed in brackets or braces
3. To the right, enclosed in braces only
4. To the left, enclosed in brackets or braces

In items 1-67 through 1-69, select from column B the example for the phrase in column A.

| A. PHRASE | B. EXAMPLE |
|---|---|
| 1-67. A Keyword | 1. ALTER |
| 1-68. Programmer supplied word | 2. {literal} |
| | 3. ERROR |
| 1-69. An optional statement portion | 4. [PROCEED TO] |

*Learning Objective: Recognize the entries for the COBOL Identification Division.*

1-70. What is the first required entry in the IDENTIFICATION DIVISION?

1. DIVISION HEADER
2. IDENTIFICATION DIVISION
3. PROGRAM-ID
4. ID-DIVISION

1-71. What is the total number of required keywords in the IDENTIFICATION DIVISION?

1. 1
2. 3
3. 9
4. 12

1-72. Which of the following, if any, optional statements has a direct effect on the object program?

1. DATE-COMPILED
2. PROGRAM-ID
3. SECURITY
4. No optional statement does

# Assignment 2

**Introduction to COBOL, COBOL Data Division, COBOL Procedure Division**

**Textbook** Assignment: Data Processing Technician 1&C, NAVEDTRA 10265-C; pages 37 through 86

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*Learning Objective: Define the composition of the COBOL Environment Division and recognize the entries of each section.*

2-1. What is the total number of sections in the ENVIRONMENT DIVISION?

1. One
2. Two
3. Three
4. Four

2-2. What is the name of the paragraph that identifies the compiling computer?

1. SOURCE-COMPUTER
2. SOURCE COMPUTER
3. CONFIGURATION-SECTION
4. CONFIGURATION SECTION

2-3. What entry in the CONFIGURATION SECTION supplies the memory size of the computer for program execution?

1. Computer-name following the first paragraph
2. Implementor-name following the first paragraph
3. Computer-name following the second paragraph
4. Implementor-name following the second paragraph

2-4. Which of the following is the best description of the SPECIAL-NAMES paragraph?

1. It allows a subroutine to be developed during program execution.
2. It allows a programmer to write a subroutine for off-line control.
3. It allows a reserved word to be substituted by a programmer assigned mnemonic.
4. It allows a reserved word to be assigned for use in the IDENTIFICATION DIVISION.

2-5. When four files are to be used with a program, how many total times will the FILE-CONTROL paragraph name appear?

1. One
2. Two
3. Three
4. Four

2-6. Which of the following is a correctly written SELECT statement?

1. SELECT DO-GFILE ASSIGN TO SYSIN1.
2. SELECT DOG/FILE ASSIGN TO SYSIN1.
3. SELECT DOGFILE ASSIGN TO SYSIN 1.
4. SELECT DOG FILE ASSIGN TO SYSIN1.

*Learning Objective: Recognize and define the terms used for data organization in a COBOL Data Division.*

2-7. The Data Division is made up of two sections called the _____(A)_____ and the _____(B)_____.

(A) FILE SECTION, FILE-SECTION
(B) WORKING STORAGE SECTION, WORKING-STORAGE SECTION

1. (A) FILE SECTION, (B) WORKING-STORAGE SECTION
2. (A) FILE-SECTION, (B) WORKING-STORAGE SECTION
3. (A) FILE SECTION, (B) WORKING STORAGE SECTION
4. (A) FILE-SECTION, (B) WORKING STORAGE SECTION

2-8. Which of the following is NOT a term used to denote entry types in the data division?

1. Elementary item
2. Data record
3. File record
4. Independent item

2-9. Which of the following related items would constitute a data record?

1. Data files and elementary groups
2. Elementary items and files
3. Group items and elementary items
4. Group items and independent items

2-10. A data record may be referred to by what other name?

1. Elementary file
2. Logical record
3. Physical record
4. Data group

2-11. Which of the following items is used to define constants of the elementary item type?

1. Record
2. File
3. Group
4. Independent

*Learning Objective: Determine the file section entry codes required for file description in a COBOL program.*

2-12. What will normally be the first level indicator found in the data division for file description?

1. FILE SECTION
2. FD
3. DF
4. FILE DESCRIPTION

2-13. Which of the following statements is correct in regard to the file-name entry for file description?

1. It is an arbitrary name given by the programmer.
2. It must be from the list of reserved words.
3. It must be the same as the file-name in the SELECT statement.
4. It must be entered in the A Margin.

2-14. If a record description indicates 130 characters and the blocking clause indicates 10 records, how many total characters are in the physical record?

1. 10
2. 130
3. 140
4. 1300

2-15. Which of the following is a correct label record clause for a multireel file?

1. LABEL RECORDS IS STANDARD
2. LABEL RECORDS STANDARD
3. LABEL RECORD ARE STANDARD
4. LABEL RECORD IS STANDARD

2-16. Which of the following statements is correct regarding the data-name in the data records clause?

1. It is an arbitrary name given by the programmer.
2. It must be from the list of reserved words.
3. It must be the same as the file-name in the SELECT statement.
4. It must be an A Margin entry and end with a period.

*Learning Objective: Describe the record description entries available for coding a COBOL program including the item description entries, FILLER option, and the PICTURE clause with appropriate data character symbols.*

2-17. In a data record description of a record with: one group item with four elementary items, two group items, and one group item with two elementary items, what level indicators would be required?

1. 01, 02, 03, 03, 03, 03, 02, 02, 03, and 03
2. 01, 02, 03, 03, 03, 02, 02, 02, 03, 03, and 03
3. 01, 02, 03, 03, 03, 03, 02, 02, 02, 03, and 03
4. 01, 02, 03, 03, 03, 02, 02, 03, 03, and 03

2-18. Which of the following specifications are provided by an elementary item description?

1. Physical record size only
2. Logical record size only
3. Physical record size and class of item
4. Logical record size and class of item

For items 2-19 through 2-21, select the statement in column B that pertains to the PICTURE character category in column A.

| A. CATEGORY | B. STATEMENT |
|---|---|
| 2-19. Editing symbol | 1. The character T |
| 2-20. Data character symbol | 2. Indication of an assumed decimal point |
| 2-21. Operational symbol | 3. The character X |
| | 4. Replacement symbols |

2-22. Which of the following is the correct character-string indication for a data item containing eleven alphabetic characters?

1. (A)11
2. A+10
3. A11
4. A(11)

2-23. If a six-character data item to be described contained special characters, the character-string would appear as which of the following?

1. A(6)
2. AAAX(4)
3. X(6)
4. XXXXXXX

2-24. If the input data is 4652 and the picture is 999V99, how will the data appear in storage for calculations?

1. 465.00
2. 465.20
3. 652.00
4. 046.52

2-25. If the input data is -1458 and the picture is S9999V, how will the data appear in storage for calculations?

1. +1458.00
2. -4580
3. +01458
4. -1458

2-26. If the input data is 3467 and the picture is 9999PP, how will the data appear in storage for calculations?

1. 346700
2. .346700
3. 340067
4. 000034

```
FD STUDENT-HELP
   BLOCK CONTAINS 20 RECORDS
   LABEL RECORDS ARE STANDARD
   DATA RECORD IS READING-AID.
01 READING-AID.
   02 FOR-MATH PIC IS S999V99.
   02 MORE-MATH PIC is PPP99.
   02 NON-MATH.
      03 ELEM-ONE PIC IS A(16).
      03 ELEM-TWO PIC IS XXA(5).
   02 FILLER PIC IS X(20).
   02 CARD-NO PIC IS AA.
```

Figure 2-A.--File description.

For items 2-27 through 2-29, refer to figure 2-A.

2-27. What is the character length of the physical record?

1. 1100
2. 1080
3. 1024
4. 1000

*Learning Objective: Recognize the 11 symbols utilized for editing of data.*

2-28. If the input for FOR-MATH is 15500 and the input for MORE-MATH is 40, what would the product be if they were multiplied?

1. .62000
2. .0062000
3. .062000
4. .6200000

2-29. Which of the following could be a legitimate input data for CARD-NO?

1. Ø1
2. 2A
3. Z
4. R@

2-30. If an editing picture of $****.99 is provided for the data 008024, how will the printed data appear?

1. $**8*.24
2. $$$80.99
3. $**80.24
4. $*802.40

2-31. If an editing picture of $$$$$.99+ is provided for the data -483088, how will the printed data appear?

1. $$483.88+
2. $4830.99-
3. $+483.09
4. $4830.88-

2-32. If an editing picture of 99B999.BB999 is provided for the data 01354622, how will the printed data appear?

1. 1 546. 200
2. 01 354. 622
3. 91B354.BB622
4. 1 354. 622

*Learning Objective: Define the COBOL working storage entries including record items, independent items, and condition-name conditions.*

2-33. Which of the following is NOT a type of entry that may appear in the working-storage section?

1. Unconditional-item
2. Independent item
3. Conditional item
4. Record item

2-34. Which of the following is NOT a legal item description for the file section?

1. 02 FILLER PIC IS X(10)AA.
2. 02 DATA-ONE PICTURE IS $$$$$$.99.
3. 02 2-THREE PICTURE IS 9999V99.
4. 02 DATA-TWO PIC IS 99 VALUE IS 53.

2-35. If a data item is defined in the working-storage section as: 02 DATA-ONE PIC IS A(5), which of the following value clauses is legal?

1. VALUE IS '43A C'.
2. VALUE IS ABCDE.
3. VALUE IS 'AC DE'.
4. VALUE IS 63841.

2-36. If an independent item is to be set up in working storage and it is to be used as a counter, which of the following entries would ensure an initially cleared counter?

1. 77 CTR-A PIC IS 9(4) VALUE IS SPACES.
2. 77 CTR-A PIC IS 9(4) VALUE IS ZEROES.
3. 02 CTR-A PIC IS 9(4) VALUE IS ZERO.
4. 02 CTR-A PIC IS 9(4) VALUE IS LOW-VALUE.

2-37. In a record description in the file section, which of the following would be a correct condition-name entry for an item described as: 02 COLOR PIC IS AAA.?

1. 88 COLOR VALUE IS '84'.
2. 88 RED VALUE IS COLOR.
3. 88 GREEN VALUE IS 'AAA'.
4. 88 BLUE VALUE IS 943.

*Learning Objective: Identify the COBOL Procedure Division format and define the associated terms.*

2-38. In the Procedure Division, what basic unit makes up a processing step?

1. Paragraph
2. Section
3. Procedure
4. Sentence

2-39. One or more sentences may make up one routine and must always be preceded by which of the following?

1. Routine-name
2. Paragraph-name
3. Procedure-name
4. Subroutine-name

2-40. Which of the following is a correct example of a procedure name?

1. 03AID.
2. 03A1G
3. A4FOX
4. RIGHT

*Learning Objective: Identify the input/output verbs and define their functions.*

For items 2-41 through 2-44, select the verb from column B that matches the category in column A.

| | A. CATEGORY | B. VERB |
|---|---|---|
| 2-41. | Data Movement | 1. MULTIPLY |
| 2-42. | Input/Output | 2. STOP |
| 2-43. | Sequence Control | 3. ACCEPT |
| 2-44. | Arithmetic | 4. MOVE |

2-45. Which of the following verbs is used to initiate the processing of data files?

1. ACCEPT
2. OPEN
3. PERFORM
4. READ

2-46. The file-name of a READ statement must be the same as which of the following entries?

1. The 01 record description
2. The section-name
3. The close statement
4. The FD entry

2-47. What data will become accessible in the defined input area of memory by execution of a READ statement?

1. A physical record
2. A file
3. A logical record
4. A label

2-48. If the INTO option is used in a READ statement, which of the following statements is true?

1. The data is immediately available in two areas.
2. The data is available in the input record area only.
3. The data is available in the INTO area only.
4. The data is available in only one area.

2-49. If a previous WRITE statement was to WRITE OUTFILE BEFORE ADVANCING 3 LINES, how many lines would intervene between printing if a WRITE OUTFILE AFTER ADVANCING 2 LINES is executed?

1. Five
2. Two
3. Three
4. Four

2-50. With a multireel file, what would happen if a CLOSE file-name with no option were executed?

1. All reels belonging to the file are rewound.
2. All reels are rewound and the current one locked.
3. Current reel is rewound; all the rest are rewound and locked.
4. Current reel is rewound; all the rest are left as they were.

2-51. Which of the following is true concerning the statement ACCEPT EXTRA-DATA FROM CONSOLEONE?

1. EXTRA-DATA is a reserved word.
2. CONSOLEONE must be specified in the Environment Division.
3. The identifier must be specified in a SPECIAL NAMES paragraph.
4. The mnemonic-name must be specified in the Identification Division.

2-52. Which of the following is an incorrect statement?

1. DISPLAY "TOTAL" ZEROES.
2. DISPLAY "TOTAL" COUNTER-A.
3. DISPLAY "TOTAL" ALL.
4. DISPLAY "TOTAL" 1345.

2-53. If the verb NOTE starts the third sentence of a 6-sentence paragraph, which of the following statements is true?

1. The commentary ends at the first following period.
2. The commentary ends with the next procedure-name.
3. The commentary ends with the last period in the paragraph.
4. The commentary makes the entire paragraph noneffective at object time.

*Learning Objective: Identify the arithmetic verbs and define their functions.*

2-54. When will truncation of a computed result occur in the receiving field?

1. When the result is shorter than the receiving field
2. When the ROUNDED option is used.
3. When both numbers have decimal places
4. When the result is longer than the receiving field and the ROUNDED option is not used

2-55. In the statement, ADD X, Y, Z TO A, which field would have its original contents destroyed?

1. Z
2. A
3. Y
4. X

2-56. If A = 12, B = 4, and D = 48, what would the answer be and where would it be located for the following statement: SUBTRACT A, 10, B FROM D GIVING F.

1. 22 in A
2. 22 in B
3. 22 in D
4. 22 in F

2-57. If multiplication has to be performed on two numbers that are to be kept intact for later use, which of the following represents the correct method?

1. MULTIPLY A BY B ROUNDED.
2. MULTIPLY A BY B GIVING C.
3. MULTIPLY A BY B ON SIZE ERROR STOP.
4. MULTIPLY A BY B.

2-58. Which of the following is an illegal DIVIDE statement?

1. DIVIDE A INTO B GIVING D.
2. DIVIDE A BY B GIVING D.
3. DIVIDE A BY B.
4. DIVIDE A INTO B.

*Learning Objective: Identify the data movement and sequence control verbs, and define their functions.*

2-59. Movement of data is the primary function of which of the following verbs?

1. MOVE
2. ADD
3. DIVIDE
4. MULTIPLY

2-60. If the original contents of A, B, C, and D are 12, 34, 56, and 78 respectively, what would be in B and D after the statement: MOVE A TO B, C, D.?

1. 12 in B and 12 in D
2. 34 in B and 56 in D
3. 12 in B and 78 in D
4. 34 in B and 12 in D

2-61. If the sending field (A) contains 1394 and the receiving field (B) contains FGHIJK, what will be in field B after the statement: MOVE A TO B.? (# symbolizes a space.)

1. 139413
2. 1394JK
3. ##1394
4. 1394##

2-62. If the source area picture is 999V9 and the receiving area picture is $$$$.99, what would be the value of the receiving area after a MOVE of source data 1384?

1. $#13.84
2. $13.84
3. $138.40
4. $$13.84

2-63. If the source area contains ACDEGI with a picture of X(6) and the receiving field picture is A5, what letter will be the last to be MOVEd?

1. I
2. G
3. E
4. D

2-64. FIELD-A IS EQUAL TO 4466 means which of the following?

1. After execution, FIELD-A will contain 4466.
2. After execution, the literal 4466 will be changed to the contents of FIELD-A.
3. FIELD-A is to be compared against the literal 4466.
4. Whenever FIELD-A is used, it will be the same as 4466.

2-65. What would be the result of a comparison of -146 against +148?

1. -146 would be greater than +148.
2. +148 would be less than -146.
3. Only the numbers are considered and 148 is greater.
4. Algebraic rules are followed for numeric comparisons and +148 is greater.

2-66. If FIELDA contains ACEDF and FIELDB contains ACEEF, which letter would terminate the comparison and what would the result be of FIELDA compared to FIELDB?

1. 4th letter, comparison high
2. 5th letter, comparison low
3. 5th letter, comparison high
4. 4th letter, comparison low

For items 2-67 through 2-69, select the statement from column B that is an example of the conditional expression in column A.

| A. CONDITIONAL EXPRESSION | B. STATEMENT |
|---|---|
| 2-67. Relational Condition | 1. MOVE ZERO |
| 2-68. Sign Condition | 2. TOMA NUMERIC |
| 2-69. Class Condition | 3. 18 LESS HEIGHT |
| | 4. FIELDA IS ZERO |

```
IF AGE IS LESS 17 NEXT SENTENCE
ELSE SUBTRACT 17 FROM AGE.
SUBTRACT AGE FROM 17.
```

Figure 2-B.--Sample procedure.

For items 2-70 and 2-71, refer to figure 2-B.

2-70. If an input record contains an AGE of 16, what would AGE contain after execution of the two sentences?

1. 1
2. 16
3. 17
4. 33

2-71. If an input record contains an AGE of 22, what would AGE contain after execution of the two sentences?

1. 39
2. 22
3. 5
4. 4

2-72. What are the two COBOL sequence control verbs used to alter normal operation sequence?

1. GO and TO
2. PERFORM and GO
3. PERFORM and GOTO
4. GO TO and PERFORM

2-73. If in a PERFORM statement procedure-name-2 is not specified and procedure-name-1 is a section-name, where will the return mechanism be inserted?

1. After the last statement of the procedure-name-1 paragraph
2. After the last statement of the procedure-name-1 sentence
3. After the last statement of the procedure-name-1 section
4. After the last statement of the procedure-name-1 division

2-74. Which of the following would automatically activate the standard ending routine of the Executive Routine?

1. HALT RUN.
2. STOP RUN.
3. END RUN.
4. LAST RUN.

# Assignment 3

**Systems, ADP Personnel Organization, Supervision**

**Textbook Assignment:** Data Processing Technician 1&C, NAVEDTRA 10265-C; pages 87 through 114

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*Learning Objective: Define in general the term system in nonautomated and automated areas to include hardware and software.*

3-1. What is the term that refers to the portions required to comprise a whole?

1. System
2. Minisystem
3. Subsystem
4. Monosystem

In items 3-2 through 3-4, select the element from column B that comprises the system in column A.

| A. SYSTEM | B. ELEMENT |
|---|---|
| 3-2. SYSTEM HARDWARE | 1. Unique control programs |
| 3-3. OPERATING SYSTEM | 2. Individual program runs |
| 3-4. SYSTEM SOFTWARE | 3. Individual computer |

3-5. Which of the following is the main method of getting up-to-the-minute information for management utilizing an MIS?

1. Problem isolation
2. Input monitoring
3. Immediate control
4. Inquiry and feedback

3-6. The type of system that refers to an automated, manual, or combination of methods for data handling is termed which of the following?

1. Management Information System
2. Data System
3. Automatic Data Processing System
4. Operating System

3-7. Which of the following systems will the bulk of DP's have contact with pertaining to duty?

1. MAPMIS
2. MIS
3. EDPS
4. ADPS

3-8. If a system is to have a mixed configuration, what would probably be required for compatibility?

1. Compatibility device
2. Interface device
3. Peripheral device
4. Linkage device

3-9. Which of the following are considered to be the totality of software?

1. Manufacturer and library routines
2. User routines and compilers
3. User routines and manufacturer circuits
4. Manufacturer and user routines

*Learning Objective: Recognize the various facilities available in general for IBM 360 operating systems.*

3-10. Operating systems are directed by which of the following methods for job to job passing?

1. User prepared control cards
2. Operator intervention
3. Manufacturer hardware
4. Assemblers and compilers

3-11. A method by which an operating system may allocate resources more efficiently is referred to as what?

1. Job stacking
2. Multiprogramming
3. Data management
4. Autoprogramming

3-12. A Disk Operating System is composed of what two major sets of programs?

1. Control and programming
2. Processing and operating
3. Processing and control
4. Operating and processing

By using figure 6-1 in the text, select the processing program from column B that is found in the operating system in column A.

| | A. OPERATING SYSTEM | B. PROCESSING PROGRAM |
|---|---|---|
| 3-13. | OS | 1. Librarian |
| 3-14. | DOS | 2. User-written problem programs |
| 3-15. | ALL SYSTEMS | 3. System Generator |

3-16. What type of program is the IPL?

1. Management
2. Processing
3. Supervisor
4. Control

3-17. What control program resides partially in main storage at all times and handles interruption conditions in a TOS?

1. Job control
2. IPL
3. Supervisor
4. I/O control

3-18. If an abnormal end-of-job occurs, which of the following supervisor routines can provide register printout in a DOS?

1. Checkpoint/restart
2. Checkpoint
3. Physical IOCS
4. Storage print

3-19. Which of the following type routines are called in by the TOS supervisor and overlay other routines?

1. Transient
2. Temporary
3. Transfer
4. Tentative

3-20. The program that prepares the system for its next job is called in by which TOS control program?

1. IPL
2. Job control
3. Supervisor
4. Initializer

3-21. In BOS, logical IOCS macros must be assembled in what position in regard to the problem program?

1. The macro instructions must be assembled immediately after the problem program.
2. The macro instructions must be assembled immediately before the problem program.
3. In BOS, it makes no difference.
4. BOS does not require macro inclusion.

3-22. While processing files, what provides for construction of index tables in DOS?

1. Logical IOCS
2. Table processor
3. Logical blocking
4. Multipacking

3-23. In DOS, what is provided for assurance of current/correct editions of disk files?

1. Check routine
2. Date check-processing
3. Label-processing
4. Channel checking

*Learning Objective: Define and discuss the various control and processing programs available as software for IBM 360 BOS, TOS, DOS, and OS.*

3-24. In an OS, which control program provides for file security?

1. IPL loader
2. Data management
3. Job management
4. System generator

3-25. Which of the following is the correct OS control program and type of scheduling for user-assigned priorities?

1. Job management; priority
2. Data management; sequential
3. Job management; sequential
4. Data management; priority

3-26. On an OS, if many units of work are contending for CPU use, what determines which unit gains control?

1. Priority management
2. Job management
3. Task management
4. Resource management

3-27. The language translator that is included in all models of S/360 systems is for which of the following languages?

1. Common Business Oriented Language
2. Formula Translator
3. Programming Language/1
4. Assembler Language

In items 3-28 through 3-30, select the provision in column B that is provided by the processing program in column A.

| A. PROCESSING PROGRAM | B. PROVISION |
|---|---|
| 3-28. Linkage Editor | 1. Resident system building from card input |
| 3-29. Librarian | 2. Random record sort ability |
| 3-30. BOS Load System | 3. Relocates compiled decks |
| | 4. Source statement books |

3-31. Which of the following is NOT a utility program of a BOS?

1. Tape to data cell
2. Tape to disk
3. Disk to disk
4. Disk to printer

3-32. The programmer aid in program debugging on an OS is known by which of the following terms?

1. Servicetest
2. Autotest
3. Testran
4. Detest

*Learning Objective: Discuss overall points of interest pertaining to developing a computer system.*

3-33. The programs which aid in the development of (A) operational, utility programs are called (B) assembler, utility programs?

1. (A) operational, (B) utility
2. (A) utility, (B) assembler
3. (A) operational, (B) assembler
4. (A) utility, (B) utility

3-34. Who usually produces the utility tools for testing an operational system?

1. The manufacturer
2. The developer of the subsystems
3. The supplier of the assembler
4. The developer of the operational system

3-35. Which of the following type of control program operates on input in a random procedure determined by a priority code?

1. Sequential
2. Sequential priority
3. Direct priority
4. Priority sequential

3-36. In system documentation which, if any, of the stages are written utilizing specific computer terminology?

1. First three stages
2. Last three stages
3. All stages if the system is small
4. None of the stages if the system is large

*Learning Objective: Recognise areas of responsibility of a senior DP in organisational planning for proposed hardware.*

3-37. Which of the following should be of special concern to a DP in the planning of hardware installation?

1. Access space
2. Arrangement
3. Air circulation and cooling
4. Raised flooring

3-38. In addition to hardware considerations, a senior DP will be involved with which of the following?

1. Training
2. Supply procurement
3. Personnel acquisition
4. All of the above

*Learning Objective: Define terms and describe forms required for personnel acquisition.*

3-39. Which of the following personnel positions are the result of manpower requirements?

1. Military and civilian at shore only
2. Military only
3. Military at sea/shore and civilians only at shore
4. Military and civilians at sea and shore

3-40. Which of the following, if any, must cope with personnel turnover as well as mobility of forces?

1. Manpower management only
2. Personnel administration only
3. Manpower management and personnel administration
4. None of the above

3-41. Which of the following carries on the headquarters level function of personnel administration?

1. Secretary of the Navy
2. Bureau of Naval Personnel
3. Chief of Naval Personnel
4. Naval Personnel Program Support Activity

3-42. What provides for peacetime mobilization requirements?

1. MARP
2. MAPP
3. M-MARP
4. M-MAAR

3-43. Who is responsible for administering the Naval Manpower Survey Program?

1. SECNAV
2. SECDEF
3. CNO
4. BUPERS

3-44. If it is desired to change existing billets, what form should be submitted?

1. OPNAV 1000-3
2. NAVOP 1000-3
3. MARP 1000-3
4. DCNO 1000-3

3-45. Who is responsible for the preparation of Manpower Authorizations?

1. CNO
2. Commanding officers
3. BUPERS
4. DCNO

3-46. What factor must be included in a request for changes to manpower requirements so that reprogramming will not be assumed by CNO?

1. Quantity
2. Compensation
3. Grade
4. Rate

3-47. What would a command be called that has a special direct interest in the mission of another command?

1. Military supporter
2. Manpower direction
3. Military sponsor
4. Manpower reviewer

3-48. Current information regarding a manpower system can be checked through the use of which of the following?

1. OPNAVINST 1000.16 series
2. BUPERS Report 1008-14
3. OPNAV Form 1000-3
4. BUPERS Report 1080-14

3-49. A short form in requesting manpower changes is intended to be used primarily in which of the following formats?

1. Official correspondence
2. Punched card
3. Messages
4. Speedletter

3-50. For routine requests on a short form, which of the following subheads includes data on designations?

1. Specific Action Recommended
2. Billets
3. Situation
4. Equipment

*Learning Objective: Define the duties and responsibilities of typical personnel positions at a large ADP installation.*

For items 3-51 through 3-54, select from column B the responsibilities that pertain to the positions in column A.

| A. POSITION | B. RESPONSIBILITY |
|---|---|
| 3-51. Systems Analysis Supervisor | 1. Evaluates applicability of new technical developments |
| 3-52. Development Control Manager | 2. Accepts systems specifications |
| 3-53. Manager of Data Processing | 3. Defines scope of systems study |
| 3-54. Programming Supervisor | 4. Publishes a manual of data processing methods |

3-55. Which of the following supervises all operations of media conversion devices?

1. Keypunch supervisor
2. Unit record operator
3. Operations supervisor
4. Control clerk

3-56. Library activities are supervised by which of the following?

1. Maintenance programmer
2. Operations control manager
3. Standards controller
4. Operations supervisor

For items 3-57 through 3-60, select from column B the duty that pertains to the position in column A.

| A. POSITION | B. DUTY |
|---|---|
| 3-57. Senior console operator | 1. Designs documents, forms, and reports |
| 3-58. Librarian | 2. Calculates machine utilization requirements |
| 3-59. Senior systems analyst | 3. Diagnoses processing interruptions |
| 3-60. Senior programmer | 4. Issues and receives data files |

3-61. Who coordinates the instruction of a new employee within a department?

1. Control clerk
2. Training technician
3. Standards controller
4. Operations supervisor

3-62. A department's projection of workload statistics would be the duty of which of the following?

1. Senior systems analyst
2. Operations control manager
3. Standards controller
4. Systems analyst

3-63. Who prepares the logical interfacing required between related programs?

1. The programmer
2. The senior programmer
3. The systems analyst
4. The senior systems analyst

3-64. Which of the following is a duty of the console operator?

1. Assigns console operators
2. Analyzes test results
3. Logs program elapsed time
4. Balances control records to output

3-65. Who gives direction to the maintenance programmer?

1. The systems analyst
2. The programming supervisor
3. The control clerk
4. The senior programmer

3-66. Testing unit record control panels is required of which of the following?

1. Training technician
2. Operations supervisor
3. Unit record equipment operator
4. Standards controller

3-67. What is the main advantage of having duty at a small installation?

1. You become skilled in a specific area.
2. You receive cross training.
3. You don't become involved in a "system."
4. You are isolated and don't have to work with other divisions.

*Learning Objective: Identify the principles and practices of good supervision, pointing out mistakes which supervisors sometimes make.*

Item 3-68 is to be judged True or False.

3-68. A high level of production indicates good supervision only when it is accomplished willingly and with interest on the part of the working crew.

3-69. Which of the following should a DP1 or DPC do upon assuming duties as a supervisor?

1. Make it clear that all things will be changed.
2. Tell the men that as of now no foolishness will be tolerated.
3. Tell the men that he intends to leave things as they are for the present.
4. Make the men feel good by indicating that he will do something about any gripes they have.

3-70. As a new supervisor on the job, a DP1 or DPC will be able to keep matters better in hand if he does which of the following?

1. Trusts none of his subordinates
2. Lets his men know that he is not going to be responsible for any of their mistakes
3. Immediately lets his men know who is boss and that his orders will not be questioned
4. Accepts full responsibility for anything that takes place on the job

3-71. The supervisor must do which of the following to ensure that work is done properly and is accomplished on time?

1. Organize the work.
2. Delegate as much responsibility and authority as is feasible, yet retain the overall responsibility.
3. Supervise and control the work.
4. Do all of the above.

3-72. Which of the following practices should a supervisor follow in building the proper relationships with his men?

1. Make clear by his actions that he considers himself a step above his men
2. Have answers for everything and make it clear that he does not need suggestions from his men
3. Be a regular guy with his men, both on and off the job
4. Maintain a friendly, conservative manner, be consistent, demonstrate confidence in his men, and set a good example

3-73. Which of the following is a good supervisory practice that is common to all positions?

1. Maintaining liaison with other units
2. Training and developing subordinates
3. Delegating no authority to subordinates
4. Disregarding suggestions by subordinates in major decisions

Items 3-74 and 3-75 are to be judged True or False.

3-74. Courtesy and fairness are important qualities for a Data Processing Technician 1 or C.

3-75. Since a supervisor's concern for the health and welfare of his men pays dividends in the form of increased production, he should plan every stage of a project with safety in mind and set a good example by following safety practices.

# Assignment 4

Supervision

Textbook Assignment: Data Processing Technician 1&C, NAVEDTRA 10265-C; pages 112 through 132

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*Learning Objective (continued): Identify the principles and practices of good supervision, pointing out mistakes which supervisors sometimes make.*

4-1. Which of the following usually reveals the greatest measure of a supervisor's value to the organization?

1. Number of training programs he sponsors
2. Morale of his group
3. Reduction in lost time accidents
4. Development achieved by the men under his direction

4-2. To be successful in his job, a supervisor must strive for balanced supervision by doing which of the following?

1. Stressing safety as the most important factor in the job
2. Allotting the major portion of his time to personnel matters
3. Emphasizing training as the most important attribute to a creditable production record
4. Placing the proper stress on each of his responsibilities

4-3. Loyalty is one of the most important traits of a good supervisor. Which of the following demonstrates the best means to instill loyalty?

1. Maintain a "buddy-buddy" relationship with your men.
2. Insist that your men "do as I say, but not as I do."
3. Believe and practice the maxim "loyalty encourages loyalty."
4. Do all of the above.

4-4. Which of the following characteristics would NOT be found in a positive thinking leader?

1. Displaying indifference to changes
2. Looking to the future with confidence
3. Going about his work with enthusiasm
4. Taking advantage of new ideas and training opportunities

The following information describes actions and traits of four Data Processing Chiefs. Moon places little significance in employee sentiment; he believes in "bearing down" when things get lax; he is always the dominant personality in a group. Starr is warm and friendly; he is enthusiastic about his job; he is always looking for a better way to do things. Day dismisses trifles as of no importance; he will relax with some employees but not with others; he exhibits a bold front to subordinates. Knight leaves decisions to his superior; he shows interest in his subordinates; he waits to see what other supervisors will do about common problems.

4-5. Which of the four DPC's show characteristics that are usually most desirable in a supervisor?

1. Knight
2. Day
3. Starr
4. Moon

Information for items 4-6 and 4-7: DP1 Tetreault refuses to do things which he knows are wrong. He carries out assignments to the best of his ability even when such assignments concern work he dislikes or work he thinks is unnecessary. He usually asks his men instead of giving a direct order and is always willing to lend a helping hand.

DPC Myers gives orders to his men without hesitation and when he gives an order, his men know that they must act immediately and not a few hours later. When he receives an assignment, he usually questions instructions and complains when his own ideas on how to do things are not accepted. Myers never helps with the actual work; he feels that he is a supervisor and, as such, it is his job to give the orders and not to do any of the work regardless of the amount involved or the difficulty of the job.

DPC Lewis refers to his subordinates as "Hardheads" and usually assigns the most difficult and unpleasant tasks to the most willing workers. When his men come to him with questions, he growls at them and then bawls them out when things go wrong. He assigns work at random, disregarding individual ability and character, and refuses to listen to complaints. Lewis accepts orders willingly and is a firm believer in doing things quickly and efficiently.

DP1 Smith works hard and is efficient. When a man has trouble with a job, Smith takes over and does the job for him. When a man complains about a task, Smith usually assigns it to another man or performs the work himself. Smith feels hurt when he makes a mistake and usually tries to find an excuse.

4-6. Which man is a good example of one who believes in high moral principles?

1. Tetreault
2. Myers
3. Lewis
4. Smith

4-7. Which of the following characteristics of Myers shows that he is NOT an effective leader?

1. Too demanding
2. Expects action too quickly
3. A poor follower
4. Expresses his personal opinions

4-8. Why (or why not) is Smith an effective leader?

1. Yes, because he sets a good example by being a hard and efficient worker.
2. No, because as a leader he should not perform any of the tasks himself.
3. Yes, because he listens to complaints and does not insist on a man's doing a task he dislikes.
4. No, because he does not teach his men how to do the job, but does it himself.

*Learning Objective: Specify the principles and techniques of giving orders and reprimands.*

4-9. Which of the following determines the words used in giving an order?

1. Rate of the person to whom the order is given
2. Personality of the individual to whom the order is given
3. Situation under which the order is given
4. All of the above

4-10. Assume a crewman has been seriously injured and you want Seaman Jones to call an ambulance. Which form of order(s) should you use?

1. "Jones, call the ambulance."
2. "Jones, will you call the ambulance, please."
3. "Jones, perhaps we should call the ambulance."
4. Either 2 or 3 above

4-11. Which type of order is recommended for a DP1 or DPC to use when he is supervising a group of normal, average men who are doing routine tasks?

1. Direct command
2. Request
3. Suggestion
4. Any of the above

4-12. The suggestion type of order is appropriate when it is directed toward which of the following type individual?

1. One who has initiative and likes to be on his own
2. One who is lazy and insubordinate
3. One who lacks initiative but is otherwise a good worker
4. One who is careless and indifferent to orders

4-13. Which of the following statements is usually true with respect to the request type of order?

1. It lacks authority.
2. It invites initiative, especially when a person likes to go ahead on his own.
3. It tends to create a feeling of cooperation and teamwork.
4. It is not recommended for the normal man.

Items 4-14 and 4-15 are to be judged True or False.

4-14. The tone of voice in which you give an order is immaterial so long as you use the correct words.

4-15. The reprimand is the most commonly used form of disciplinary action and should be fitted to the individual and the situation.

4-16. What is the first step to be taken when you reprimand a man?

1. Ask the man why he erred.
2. Get the man to admit his mistake.
3. Get all the facts in the case.
4. Call the man down on the spot.

4-17. Which motivation for working is produced in a group by the practice of negative discipline?

1. Esprit de corps of the organization
2. Desire to increase production
3. Desire to cooperate
4. Fear of reprisal

4-18. Which of the following human relations factors do NOT contribute to a positive disciplinary program?

1. Knowing each individual man in the group
2. Admitting errors, if made
3. Frequently showing his authority
4. Refraining from the use of authority to accomplish objectives

4-19. Which action is most typical of an approach to a policy of positive discipline by a supervisor?

1. Insists that action be taken in cases of minor disciplinary infractions as well as in major cases
2. Utilizes idle time for training activity whenever possible
3. Retains authority for the accomplishment of delegated functions
4. Investigates the veracity of statements of subordinates

Items 4-20 and 4-21 are to be judged True or False.

4-20. In pursuing a positive approach to discipline, a supervisor reduces the need for formal discipline by removing as many causes of misconduct as he can.

4-21. Although many of the benefits derived from teamwork are psychological, supervisors should encourage such feelings because with them comes a more tangible asset -- strength.

*Learning Objective: Identify the elements of teamwork that are necessary in an organization and delineate methods of achieving teamwork.*

4-22. Effective teamwork in an organization demands which of the following types of cooperation on the part of the supervisor?

1. Cooperation with the members of the staff
2. Cooperation with the other supervisors
3. Cooperation with the supervisor's superior
4. Each of the above

4-23. Which objective is basic to the goal of achieving teamwork?

1. Procurement of qualified personnel
2. Effective management in the field of human relations
3. Good working conditions
4. Performance equivalent to cost outlay for personnel

4-24. The principal obstacles to establishing a genuinely cooperative spirit with fellow supervisors are usually which of the following?

1. Competition for jobs and unrealistic deadlines
2. Friction and jealousy
3. Large workloads
4. Misunderstandings

4-25. In the interest of cooperation, which of the following means should be used to keep your supervisor informed?

1. Trying to keep him posted on everything that is said by employees during the day
2. Reporting all errors that have occurred during the day
3. Reporting those employees who fail to keep tidy work places
4. Letting him know about any personnel problems that exist and any changes in work procedures that you intend to make

*Learning Objective: Recognize some of the functions and responsibilities of the data processing manager.*

4-26. Which of the following responsibilities are a function of the data processing manager?

1. Applying the most economical contract terms
2. Assuring proper computations of rental and maintenance costs
3. Recording of time and obtaining the most effective use of equipment
4. All of the above

4-27. The general purpose of ADP equipment for Command, Control and Support Systems is to

1. provide a means for establishing ADP objectives
2. supply management with cost-control data
3. provide information rapidly for making operational decisions
4. supply routine data simultaneously with high priority information

Items 4-28 through 4-31 are to be judged True or False.

4-28. The management procedures employed in a small ADP installation are essentially the same as the management procedures used in a large computer center.

4-29. Establishing maintenance procedures is included in management procedures.

4-30. One method used by ADP managers to control personnel is to measure work performed against historical data.

4-31. The only liaison decisions required of an ADP manager are those that effect his own department.

*Learning Objective: Determine some of the informative guidelines for setting DP objectives that are used to provide a means of service, management and operational purposes to be served in an ADP installation.*

4-32. What is the normal relationship between the operating procedures in (A) a small EAM system and a small EDP system and (B) two large EDP systems?

1. (A) They are different, (B) they are different
2. (A) They are the same, (B) they are different
3. (A) They are different, (B) they are the same
4. (A) They are the same, (B) they are the same

4-33. In a data processing installation operating under an open shop rule, the programmers should NOT perform which of the following tasks?

1. Loading of input units with cards and tapes required for computer runs
2. Operating the computer's console during program runs
3. Debugging new programs on the computer
4. Unloading reports, cards, and tapes from output units

4-34. In a closed shop, (A) who supervises the loading of tapes and (B) who loads the tapes?

1. (A) Programmer, (B) computer operator
2. (A) Senior DP in charge, (B) programmer
3. (A) Senior DP in charge, (B) computer operator
4. (A) Programmer, (B) senior DP in charge

4-35. What factor should be introduced into a schedule to compensate for coordination variances?

1. Lead time
2. Lag time
3. Maintenance time
4. Buffer time

4-36. By which of the following means does intelligent programming inherently help to reduce setup time associated with large computer system operations?

1. Eliminating the need of scheduling program testing time
2. Keeping to a minimum the number of changes of tape reels required
3. Keeping to a minimum the total number of instructions in a program
4. Using the most efficient program instructions possible

4-37. What information regarding the punch is indicated on figure 8-1 in your textbook?

1. The punch was only used for approximately 1 hour and 30 minutes during the day.
2. The punch was in use whenever tape unit 5 was being used.
3. The punch was used both before and after the reader.
4. The punch was only used for approximately 2 hours and 45 minutes during the day.

4-38. What is the normal relationship between processor time and I/O time?

1. The processor time is twice the I/O time.
2. The I/O time is twice the processor time.
3. The I/O time is equal to the processor time.
4. The processor time will always be four times the I/O time.

4-39. For which of the following should allocations of time be made when scheduling operations?

1. Special requests
2. Unscheduled maintenance
3. Reruns
4. All of the above

4-40. You need the answers to numerous questions in order to develop a fairly accurate preliminary schedule of data processing operations. Which of the following would be the primary reason to ask the question, "What is the relationship of one application to another?"

1. Learn the relative priorities of data processing procedures.
2. Learn whether it is possible to consolidate setup functions for different operations.
3. Determine the relative processing times of the different procedures.
4. Determine the relative program testing times for the different procedures.

4-41. Programmers are able to estimate the running time of each program they prepare. You can use such estimates in scheduling computer operations after you modify them to include the time required for which of the following?

1. Equipment setup and the input and output of data
2. Equipment setup and error recovery provisions
3. Error recovery provisions and the input and output of data
4. Input and output of data

4-42. What method(s) is/are used in most installations to establish the actual schedule?

1. Priority system
2. Normal frequency
3. Demand
4. A combination of the above

Information for items 4-43 and 4-44: As an aid in scheduling data processing operations, you are developing a log to be kept of machine time (computer usage) at a new installation.

4-43. Which of the following log entry titles would include downtime?

1. Testing of programs
2. Regularly schedule preventive maintenance by a customer engineer (CE)
3. Unscheduled maintenance
4. Reprocessing made necessary by operator errors

4-44. Which of the following categories in the log would allow for buffer time?

1. Assembly of programs
2. Unpredictable events that occur during processing
3. Training personnel
4. Reprocessing operations that are due to faulty input media

4-45. What scheduling method should be used to inform a user when he may expect delivery of a run?

1. Run scheduling
2. Demand scheduling
3. Scheduling by shift
4. Scheduling by control

4-46. What information is furnished the section supervisor when using the scheduling by shift method?

1. Setup time and completion time of each individual operation
2. Start time of each individual operation and when the operation must be completed
3. Number of runs to be completed during the shift only
4. Start time for each run only

4-47. What is/are the net result(s) of a good production control and scheduling system?

1. Reduction in cost
2. Responsive to the user
3. Elimination of time consuming program checkout
4. Both 1 and 2 above

*Learning Objective: Determine some of the features relating to workloads and time factors that are required for efficient ADP installation management.*

4-48. Workload analysis and control provides aids for you in maintaining which of the following?

1. Avoiding unnecessary duplication of source document data analysis
2. Reducing fluctuations of source document flow
3. Compiling job-cost figures
4. Coordinating workflow between your installation and receiving activities

4-49. Accurate inventories of types and numbers of which of the following can help you avoid many scheduling problems?

1. Cards punched and reports produced
2. Cards punched, reports produced, and processing steps involved
3. Cards punched and processed, reports produced, and source documents received
4. Source documents received, processing steps involved, and reports produced

4-50. You may keep adequate source document control records by using which of the following control methods?

1. Batch numbers or card counts
2. Counts of actual document receipts or accounting machine card tallies
3. Batch numbers, item counts, or actual documents-receipt counts
4. Card punch production figures or accounting machine card tallies

4-51. Which of the following states the basic reasons for having an accurate record on card volumes?

1. They provide a direct bearing for determining the best method for doing a job and are applicable to machine workloads for buffer periods.
2. They supply an accurate count of all source documents and are applicable to machine workloads for the low, average, and peak periods of the month.
3. They supply an accurate count of all source documents and are applicable to machine workloads for buffer periods.
4. They have a direct bearing when determining the best method for doing a job and are applicable to machine workloads for the low, average, and peak periods of the month.

4-52. What is your most realistic approach to the problem of scheduling clerical operations in a new data processing procedure?

1. It is useless to assign time factors to clerical operations until the new procedure has been in effect due to the many human variables and individual job peculiarities involved.
2. Base your time factors for clerical operations on statistical analysis and standard clerical functions performed at your installations.
3. You should use the same time factors established for clerical operations in existing routines of a similar nature.
4. You should assign to clerical operations the time factors determined during a carefully controlled test period using actual work samples.

4-53. Which of the following methods will allow you to compute the gross hourly production rate of a card punch operator?

1. Multiply the number of cards punched per hour by 80.
2. Multiply the number of cards punched per hour by the average number of key strokes per card.
3. Multiply the number of cards punched per hour by 80 divided by the average number of columns per card.
4. Divide the number of cards punched per hour by the average number of key depressions per card.

4-54. A novice card punch operator is able to punch 35 cards per hour when producing cards that contain an average of 72 punched columns. Which of the following expresses his gross hourly production rate?

1. 35 cards/hr
2. 31.5 columns/hr
3. 2520 columns/hr
4. 30380 columns/hr

4-55. Which of the following supervisory measures may help you generally to improve lagging card punching production rates?

1. Freeing operators from all peripheral duties, ensuring operators work from legible source documents, procuring alternate programming devices, and cutting-out all coffee breaks
2. Freeing operators from all peripheral duties, ensuring operators work from legible source documents, breaking-up large volumes of source documents into small batches, and minimizing coffee breaks
3. Ensuring that operators work from legible source documents, assigning a few peripheral duties to operators, assigning volumes of transactions according to operator temperament, and ensuring the machine room has comfortable humidity, temperature, and ventilation
4. Using coffee breaks, peripheral duties, and rest periods as production incentives, shifting jobs between operators to provide variety, ensuring the machine room has comfortable humidity, ventilation, and temperature conditions, and personalizing your relations with operators by instructing them verbally

4-56. Which of the following factors affect the card punch operator's production rate?

1. Morale and temperament
2. Volume of transactions and type of equipment used
3. Flow of work and peripheral duties
4. All of the above factors

4-57. The time required for clerical, key-driven, and automatic operations make up the total time needed to complete a specific data processing job. You base the time element associated with automatic operation on considerations of

1. rated machine speeds, experience of the operators, and the amounts of handling time involved
2. rated machine speeds and the amounts of handling time and setup time involved
3. rated machine speeds, the design and complexity of the source documents, and the amount of setup time involved
4. amounts of setup time and handling time involved, the experience of the operators, and the rated machine speeds

*Learning Objective: Recognize some of the various factors that an ADP manager must consider to evaluate the effectiveness of and improve his system.*

4-58. For which of the following purposes can you use machine utilization statistics?

1. Determining the total cost of each data processing job
2. Showing the machines required to complete each data processing job
3. Determining the total time required to complete each data processing job
4. For all of the above purposes

4-59. Which of the following is the most usual form of rental rates for ADP equipment?

1. Straight hourly rates
2. Straight monthly rates
3. Standard monthly rates for a specified number of hours and extra charges for overtime machine usage
4. Variable monthly rates determined according to the average number of hours of actual machine usage

4-60. Of what relative importance is the human efficiency factor in EAM and EDPS operations?

1. Human efficiency factors are equally important in both EAM and EDPS applications because machines are unable to recognize errors.
2. Operator efficiency is more important in EAM than in EDPS applications because EAM's depend wholly on manual control and data handling.
3. Operator efficiency is more important in EDPS than in EAM applications because the operating speeds of EPDS magnify and compound human errors immediately.
4. Operator efficiency is more important in EAM than in EDPS applications because EAM's lack the complex automatic control and checking features of the EDPS.

Items 4-61 through 4-67 are to be judged True or False.

4-61. Time estimates provide an ADP manager with his only indication of how long a job should take to complete.

4-62. The use of a dual card to record time utilization has the advantages of having the card serve as both a source document and processing medium.

4-63. The establishment of new operating procedures or the modification of existing procedures may be required when report requirements are changed.

4-64. Operating data provides you with an accurate scale for evenly distributing work among the installation's personnel.

4-65. In some situations, an installation with an EDPS may lower its operating costs while maximizing system utilization by sharing the system with another organization.

4-66. The addition of record-keeping functions to a machine is one method that may reduce idle time.

4-67. SECNAVINST 10462.18 specifies the format for ADP equipment utilization and application reports.

*Learning Objective: Determine some of the actions necessary in an ADP center that are required to evaluate the efficiency of operators and understand the procedures for program maintenance.*

4-68. What personnel factor must be considered by an installation manager when he is setting the target date for completion of an EDPS program?

1. The skill of the programmers
2. The efficiency of the machine operators
3. The experience of the programmers
4. Both 1 and 3 above

4-69. As an installation manager, which of the following factors should you consider as being the most relevant when evaluating a new machine operator?

1. The number of cards processed
2. The number of errors made
3. The amount of improvement made
4. The amount of on the job training

4-70. Changes may have to be made to programs already in operation at a data processing installation as a result of changes to which of the following areas?

1. Input/output (I/O) format
2. Data processing equipment or data processing techniques
3. The scope of data processing applications
4. Any of the above

4-71. The purposes of maintaining a master copy of the run manual in the program maintenance division is to

1. prevent loss of program instructions and eliminate the need for maintaining a run manual in the machine room
2. facilitate the preparation of a new run manual for the machine room as needed and prevent loss of program instructions
3. eliminate both changes to an accepted program and the need for maintaining a run manual in the machine room
4. prevent loss of program instructions and eliminate changes to an accepted program

*Learning Objective: Recognize some of the management practices that are applied to ADP equipment operations.*

In items 4-72 through 4-74, select from column B the type of maintenance that is being performed in column A.

| | A. PERFORMANCE | B. MAINTENANCE |
|---|---|---|
| 4-72. | Computer operator repairs a casualty on government owned ADP equipment | 1. Corrective (CM) |
| 4-73. | Contract engineer performs a routine oiling on government owned ADP equipment | 2. Preventive (PM) |
| 4-74. | Computer operator performs a routine tape head cleaning on rented ADP equipment | 3. Functional (FM) |
| | | 4. Selective (SM) |

4-75. Which of the following procedures is currently being followed regarding the expansion of maintenance responsibilities for ADP equipments?

1. Joint, contractor/user clauses written into all contracts
2. The contractor solely responsible for all maintenance
3. The user, in certain situations, responsible for maintenance
4. The user responsible for maintenance in all new contracts

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