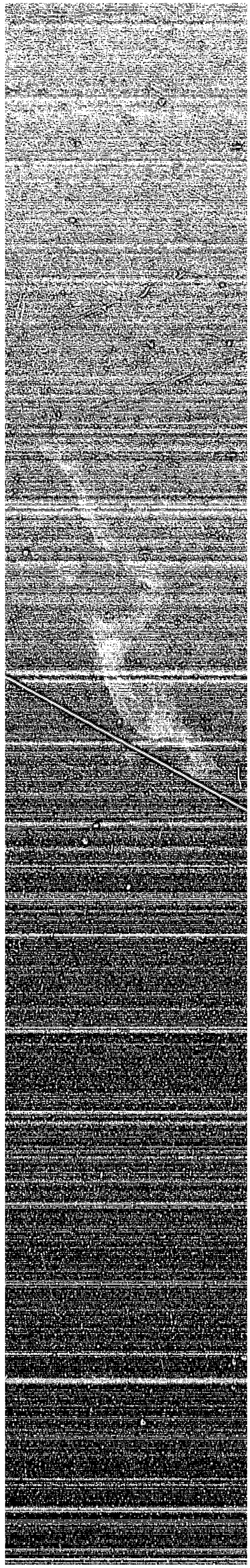
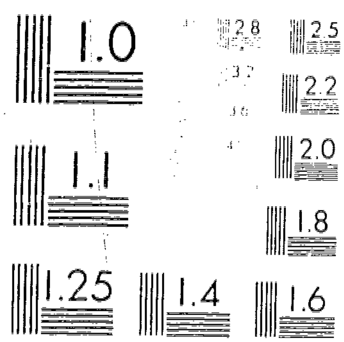



1.0
2.8
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

by a worker for a specific purpose. It is the work unit that deals with the methods, procedures, and techniques (the "What," "How," and "Why") by which parts of a job are carried out. The effort may involve physical or manipulative activities or mental processes such as analyzing and planning. Such effort may be exerted to change a material or merely to maintain its integrity. The material may be tangible, as metal and paper, or intangible, as numbers and words. Each task has certain distinguishing characteristics.

A. It is recognized, usually, as being one of the worker's principal responsibilities.

B. It occupies a significant portion of the worker's time.

C. It involves work operations which utilize closely related skills, knowledges, and abilities.

D. It is performed for some purpose, by some method, according to some standard with respect to speed, accuracy, quality, or quantity. This proficiency standard may be developed by the worker through trial and error or learned through experience; it may be provided to the worker by a supervisor in the form of oral, written, or graphic instruction; or it may exist as a directive, published operating procedure or some similar form.

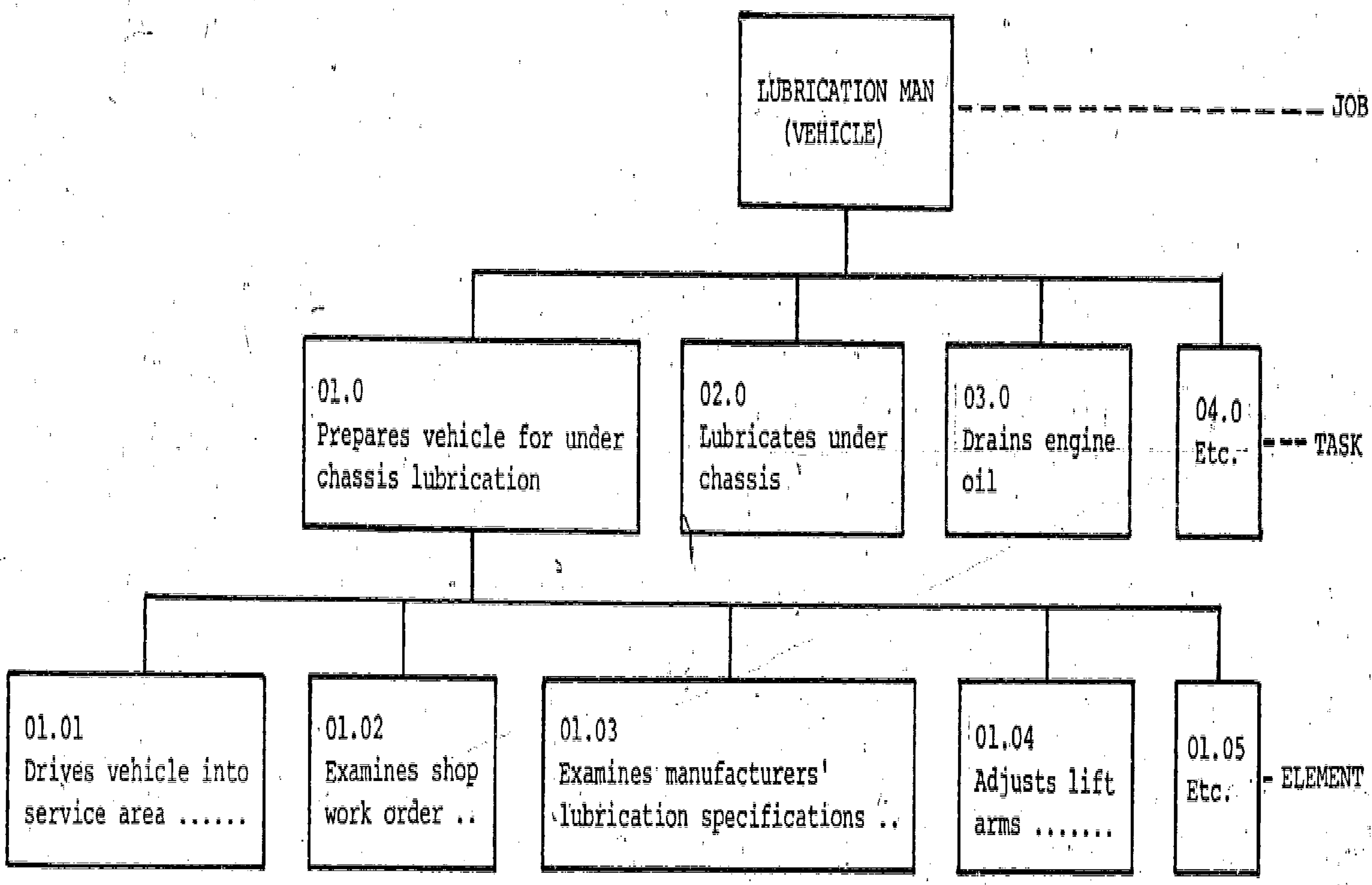
Tasks may be considered major or minor, depending on the extent to which they establish demands for skills, knowledges, aptitudes, physical capacities, and personal traits and upon the percentage of total work time involved in their performance.

3. JOB - a grouping of related responsibilities for human performance called tasks. A person employed to lubricate vehicles performs various lubrication and associated tasks. Such a person is identified as a LUBRICATION MAN (VEHICLE). The titles Numerical Control Part Programmer and Grocery Store Check-Out Clerk also identify jobs. Some jobs, such as Machinist are highly involved with equipment. The tasks which make up such jobs are generally based on the equipment and its operation. Figure 1 illustrates the Hierarchy of a Job by depicting the relationship of elements, tasks, and the job.

The first step in the analysis of a job is an exact determination of what the job is and its precise limits; that is, where the job begins and where it ends. The analyst therefore must be able to discover the exact nature of a job.

Each job analysis schedule must faithfully report the job exactly as it exists in an establishment at the time of the analysis, not as it should exist, not as it has existed in the past, and not as it exists in similar plants. While jobs are, to a certain extent, constantly changing and evolving, the analyst should not speculate on future plans given by employers or on how the analyst believes the job might change in the future.

HIERARCHY OF A JOB



NOTE: To illustrate the relationship of elements to tasks each has been classified by a numerical symbol. Tasks, the major units, are numbered (01.0, 02.0, etc.). The elements which make up each task are related to that task by the first two digits of the numbering system. The last digits show the number of each element (01.<u>01</u>, <u>01</u>.<u>02</u>, etc.). For example, element 01.02 is the second element of the first task.

Figure 1

CHAPTER III

THE JOB ANALYSIS SCHEDULE

Items 1 through 4 of the job analysis schedule identify a job accurately within the organization in which it occurs. Spaces are provided for entering the (1) Job title, (2) Date and Number of sheets, (3) Alternate titles as well as (4) Dictionary title and code. This identification permits a rapid reference and cross reference to schedules which contain desired information. The job analysis schedule in Appendix A illustrates items 1 through 4 completed in an appropriate fashion.

<u>Item 1, Job Title</u>

Enter the name by which the job is commonly called in the establishment where it is being analyzed. This title should be the one that the employer would use in advertising a job vacancy, or one which the workers use among themselves in referring to the job. The job title should be singular and entered using all capital letters.

If the title appears to be inappropriate or is not descriptive of the job, the analyst should qualify it with a word or phrase in parentheses after the title to make it as precise as possible, i.e., LUBRICATION MAN (VEHICLE). No portion of the job title as designated by the establishment should appear inside the parentheses. Under no circumstances should the analyst devise and insert a title of his/her own.

The analyst is concerned primarily with reporting facts about jobs in the establishment in which the analysis is being made. However, if he/she knows that there is something unusual concerning the use of a particular title, or if it is so general as to be meaningless, the title should be entered and fully explained in the "General Comments" section, Item 12, of the schedule and, where necessary, appropriate titles should be suggested.

Item 2, Date and Number of Sheets

The date on which the analysis was made and the total number of sheets in the schedule should be noted here. The number of each page should also be placed in the top right portion of the sheet together with the total number of pages. For example, Page 1 of 16. This practice should be continued throughout the job analysis schedule just as has been done in the example which appears in Appendix A.

Item 3, Alternate Titles

Enter here in capital letters any titles, other than the one entered in Item 1, by which the job may be known. These titles should be terms which are widely used and recognized in the plant or at the work site. The inclusion of alternate titles in this space is taken to mean that the titles are synonymous with the main title and that the entire analysis as written applies to all the titles listed. For example, LUBRICATION TECHNICIAN, LUBRICATOR, and INSIDE QUICK SERVICE SPECIALIST were found to be alternate titles for LUBRICATION MAN. On the other hand, Cash Register Operator and Scale Operator are not alternates for Grocery Store Check-Out Clerk because they refer to only a portion of the work done by the incumbent worker.

Item 4, Dictionary Title and Code

If the job being analyzed can be identified in volume I of the Dictionary of Occupational Titles, the Dictionary title and code should be entered here. It must be remembered, however, that a complete entry can be made here only when the job under analysis is identical in all significant respects to a job defined in the Dictionary.

CHAPTER IV

WORK PERFORMED

This section of the job analysis schedule is intended to present a clear, complete, concise, and factually accurate statement regarding the tasks performed by a worker in accomplishing the purpose of his/her job.

The extent of a job is determined by the total of all the tasks which must be performed on the job and by their specific nature. In the job analysis schedule, the extent of a job is established by the Work Performed and by associated descriptions of Equipment, Materials, and Supplies noted in the Work Performed. To define clearly the scope of the job, the Work Performed must describe what the worker does, how it is done, and why it is done. This portion of the schedule satisfies the first three parts of the Job Analysis Formula. The manner in which the information should be presented will be explained and discussed in detail.

Item 5, Work Performed

The Work Performed item must present, in concise form, a thorough and complete description of the tasks of the job. It should give a correct portrayal of the identity, purpose, content, and requirements of the job. However, it is not meant to be a detailed time and motion study. See Figure 2. It should consist of an introductory

WORK PERFORMED

Purpose:

To present, in concise form, a thorough and complete description of the tasks of the job.

Function:

1. It must illustrate correctly the job's
   A. Identity
   B. Purpose
   C. Content
   D. Requirements
2. It is not to be a detailed time and motion study

Figure 2

sentence that gives an overall identification to the job, followed by an orderly series of statements that describe each step of the job.

Introductory sentence. The introductory sentence of the Work Performed item is a composite job statement which orients the reader with respect to the scope of the job. Its function is to give the reader, in as few words as possible, an overall understanding of the purpose, nature, and extent of the tasks performed, and to show how the job differs generally from other jobs. In composing this sentence the selection of words is important. The terms used must be sufficiently precise to highlight the important aspects of the job and to distinguish the job from others. If the analyst cannot avoid the use of general terms, they must be qualified and explained in subsequent material. When writing this introduction, the analyst should ask:

1. What outstanding factor in this job differentiates it from all other jobs?
2. What words can be used in writing this sentence that will convey the most precise meaning to all readers?
3. What details should be added to the sentence that will clarify the total picture?

Figure 3 reviews the purpose and criteria for the introductory sentence. The following are two sample introductory sentences taken from Job Analysis Schedules which appear in Appendix B and C, respectively. The Job Analysis Schedule in Appendix A provides another example of an appropriate introductory sentence.

INTRODUCTORY SENTENCE

Purpose:

A composite job statement which orients the reader with respect to the scope of the job by providing an overall concept of the purpose, nature, and extent of the tasks performed, showing how the job differs generally from other jobs.

Criteria:

1. What outstanding factor in this job differentiates it from other jobs?
2. What words should be used to convey the most precise meaning?
3. What details are needed to clarify the total picture?

Figure 3

LUBRICATION MAN (VEHICLE)

Lubricates bearings, bushings, and gear boxes with a hand operated grease gun, hand operated gear lubricant dispenser, oil can, squirt can, and stick lubricant in accordance with the shop work order and manufacturers' specifications to reduce wear and extend the useful life of a vehicle.

CHECK-OUT CLERK, GROCERY STORE

Itemizes, tabulates, and bags, boxes or wraps customer purchases, operates a cash register to determine the total cost of merchandise purchased, collects payment and makes change.

The remainder of the Work Performed section consists of an organized presentation of the tasks of the job. This presentation expands upon the introductory sentence and explains the important details of the job so logically, concisely, and specifically that an uninformed reader can gain a clear understanding of the work performed.

Task arrangement. The tasks that comprise a job should be arranged in either a (1) chronological or a (2) functional order. Tasks can be arranged chronologically when a job has a specific cycle or sequence of operations. The analyst should describe the tasks the worker is regularly called upon to do in the order in which they are performed. The chronological order should begin with the first task the worker is called upon to do and consider the work steps successively. Figure 4 provides an example. The tasks of a Numerical Control Part Programmer could be arranged in the following

TASK ARRANGEMENT

Chronological:

Used where tasks are performed in a definite cycle or sequence of operations.

Tasks are described in the order the worker performs them.

Example: A typical machine operator

1. Sets up machine
2. Mounts work piece
3. Operates machine
4. Removes work piece
5. Inspects work piece
6. Maintains tools
7. Maintains machine

Figure 4

chronological order.

1. Coordinates preplanning
2. Prepares part drawings
3. Prepares part program manuscripts
4. Occasionally operates Tape Preparation Machine
5. Occasionally operates key punch machine
6. Occasionally operates various numerically controlled machine tools
7. May observe tape verification on N/C machine

See Appendix A for a complete list of tasks. Job tasks can usually be arranged chronologically with factory-production type jobs, jobs that are relatively simple, or jobs for which the skill involved is limited.

A functional arrangement of job tasks should be used by the analyst for jobs having no regular cycle of operations. This type of job is usually more difficult to analyze, since it involves a considerable variety of tasks that generally have no established sequence of operations. The functional arrangement is used frequently for clerical, technical, managerial, and professional jobs.

For example, the tasks of a secretarial job may be arranged as follows:

1. Types narrative and statistical reports
2. Tabulates and posts data in various record books
3. Files correspondence and reports
4. Receives callers, and provides them with information

connection with the following discussion.

It is at this point that the information the analyst has obtained about a job, as reported in the Work Performed section, must be supplemented by a detailed analysis of the report itself. This requires a concentrated analysis in the sense of weighing, considering, and evaluating that which has been learned. In preparing a Work Performed section, the purpose is to present a thorough and complete description of the tasks of a job as they exist. In preparing the PERFORMANCE REQUIREMENTS, the analyst must break down the job into four component factors, measure these factors and, by doing so, explain the fundamental nature of the job in terms of its successful performance.

The PERFORMANCE REQUIREMENTS primarily serve to establish the level of difficulty of the tasks described in the Work Performed, and, in so doing, aid in identifying the job tasks and in clarifying the "What," "How," and "Why" described in the Work Performed. This level of difficulty should not be confused with the "degree of skill," a parenthetical notation used in the Work Performed section.

In attaining this objective, the analyst should review carefully each task of the Work Performed in the light of the PERFORMANCE REQUIREMENTS, noting the presence and degree of each factor that is involved in the task. If this is done properly, the description of factors present in the total job will be complete and will cover the skills, abilities, and knowledge required of the worker. Treatment of this kind will avoid highly involved writing which would be necessary if the attempt were made to state the skills required for each task within the Work Performed section.

For this reason, the analyst usually will find it desirable to complete this section immediately following the preparation of the Work Performed. Each task then can be reviewed separately and the presence and degree to which each factor is involved in the task can be determined. This information then should be consolidated so that the written statement for each factor covers the degree to which that factor is involved in all the tasks which make up the job.

It must be emphasized that the mere statement that a given factor exists or does not exist is not sufficient. The degree to which it exists should be stated specifically. For example, under the factor "Responsibility," the fact that a worker is responsible for the safety of others means little by itself. The responsibility of the worker for what injuries to which worker(s) and the extent of the resulting injuries must be explained. In this connection, it is important to note also the degree to which the worker is responsible or is not responsible for the initial occurrence of the accident.

While the Work Performed and the PERFORMANCE REQUIREMENTS must be related to and must support each other, these two sections are fundamentally different. The PERFORMANCE REQUIREMENTS may be considered as devices which evaluate the Work Performed, measure its level of difficulty, and determine the exact nature of the tasks.

The PERFORMANCE REQUIREMENTS will contain some information alrealy given in the Work Performed because the two are related closely in terms of the tasks performed. In addition, the PERFORMANCE

REQUIREMENTS constitute a synthesis of all information, either stated or implied, concerning each factor throughout the scope of the job.

In many cases, it will not be possible to differentiate sharply between informational statements which must be given in more than one of the factors which make up the PERFORMANCE REQUIREMENTS. Such information may overlap or contain conditions which form a part of two closely related factors, such as Job Knowledge and Mental Application. However, the analyst should experience little difficulty, provided he/she describes each factor in terms of the definition of that factor. In many cases, the analyst will find that the same information, in different terms, must appear in two or more factors in order to give a clear understanding of what is involved in the job. This is not to be considered as duplication but as different viewpoints of the same circumstance.

All factors which are stated as existing in a job should be reflected in and related to the Work Performed. It should be possible for the schedule reviewer to refer to the Work Performed and find the exact phases of the work which are conditioned by a specific factor. Conversely, the reviewer should find it possible to locate in the PERFORMANCE REQUIREMENTS all the skills, abilities, and knowledge necessary to perform any task which is mentioned in the Work Performed.

Entries under this section will not follow a rigid writing style. Whenever possible the statements should be written in the form of requirements. That is, the subject (the worker) is understood and need not be specified. Therefore, each statement will begin with a phrase such as: "Solely responsible for," "must be able to," "must be alert to," "must have feel for," or similarly appropriate wording.

When composing the entries, the analyst should avoid the use of generalized words such as "normal," "careful," and the like which mean little except in a relative sense. In most cases, specific examples can be given, comparisons drawn, or limits described which will define accurately the degree to which a factor exists, and by so doing, will eliminate the necessity for overall limiting words. The analyst often will find it desirable to draw on his/her knowledge of jobs other than the one under consideration to provide a means of comparison.

In completing this section, the analyst should bear in mind that, since the PERFORMANCE REQUIREMENTS constitute fundamental information, there should be no omissions. The non-existence of any given factor in a single job, or its ~~existence~~ to a low level, provides pertinent information about that job as does the existence of any other factor, no matter how high the degree. It is, therefore, just as deserving of comment in the schedule as any other factor concerned with the job. In comparing jobs on the basis of job analysis schedules, the non or low level existence of information often provides specific clues to the nature of the jobs involved.

In order to make clear the type of information desired under each factor, each of the factors is discussed separately in items 6 through 9.

Item 6, Responsibility

This factor relates to (1) the nature and extent of supervision received and/or exercised, (2) the number of checks set up to prevent or catch errors, (3) the limits placed on decisions the worker makes, (4) the degree of loss that would result from error, or the saving that would be effected by foresight. and (5) other limitations placed on the responsibility of the worker.

Considerations affecting this factor include:

1. Does the worker delegate duties to others? To whom? How?
2. Does the worker coordinate the efforts of subordinates? How?
3. Is the worker accountable for progress, quality, the safety of others, and costs of the work?
4. Does the worker train others? Whom?
5. What are the nature and the magnitude of supervisory control?
6. Does the work require contacts with outsiders or others in the organization not in line of authority? Of what nature and with whom?
7. What are the nature and scope of commitments made?
8. To what extent is the work verified by others?

Jobs must be examined for the presence and relative amount of each of these considerations, if a true understanding of the total responsibility involved is to be presented.

The kinds of responsibility that exist in a job are usually relatively easy to determine and to interpret in quantitative terms; that is, in terms of the money value of equipment, materials, or products that the worker could ruin, the relative likelihood of spoilage or damage, the number of subordinates supervised, the cooperative effort required, or the nature and extent of possible injuries the worker could cause through carelessness.

Sentences in the statement of Responsibility usually begin with a phrase such as; "Is responsible for . . .," "Solely responsible for . . .," etc. The following sample statement of Responsibility is taken from the job analysis schedule for an N/C Part Programmer which is included in Appendix A.

6. Responsibility

> Is responsible, under limited supervision, for a variety of activities such as resolving questions of design intent, determining suitability and availability of standardized tooling and fixturing, analyzing alternative part programming methods and machining sequences, and reviewing computer output during the course of a single assignment. Responsible for making decisions on a judgmental basis using past experience and knowledge to select the best part programming techniques, sequence of machining cycles and incorporating portions of previously prepared part programs without trying out alternative methods, thereby reducing time and cost of preparing manuscripts. Responsible for making decisions on a factual basis, such as when assigning feedrates and speeds previously found to provide optimum balance of such factors as accuracies and surface finishes, machining time, and tool life. Utilizes accepted standards in recording processing statements in specialized part programming formats and languages. Adheres to standardized nomenclature when preparing setup instructions for operators and in complying with established machine feedrates and speed conventions. Responsible for providing close supervision and guidance when training workers in the programming, use, operation, and maintenance of N/C machines and peripheral equipment. Responsible to management for technical assistance in long-range N/C planning including time studies, cost analysis, job evaluations and recommendations for the acquisition of new equipment.

Item 7, Job Knowledge

This factor refers to the practical knowledge of equipment, materials, working procedures, techniques, and processes required of the worker for the successful handling of a job. The practical knowledge requirements include that which is a prerequisite to appointment as well as that which must be acquired after appointment to perform efficiently.

Job knowledge includes the amount and complexity of knowledge required of the worker by the job. Such knowledge may be gained by actual on-the-job experience, formal courses, training programs prior to entry on the job, or by all such methods. When thinking of this factor, consideration should be given to a variety of specifications, materials, and assignments encountered, and guidelines governing decisions and operations, such as precedent, regulations, standards, and practices.

Consideration should also be given to such requirements of pre-employment or on-the-job knowledge as:

1. Knowledge of machines and equipment used
2. Knowledge of materials used
3. Knowledge of working procedures and techniques
4. Knowledge of product flow or process as related to the job
5. Knowledge of dimensional or formulary calculations

When writing the Job Knowledge requirements, the analyst must review all the tasks which make up the job and determine just what specific knowledges the worker must have for satisfactory performance and the extent of each required knowledge. The extent of knowledge usually can be brought out only by a very careful choice of words and by specific statements. The statement "Must have a thorough knowledge of heat-treating metals " does not give an exact explanation of the extent of the knowledge required since the statement is too general. However, if it were stated, "Must know the heat-treating temperatures and types of quenches to be used when hardening, annealing, or normalizing steel parts," the specific knowledges required would be brought out and their extent indicated adequately.

The following example statement of Job Knowledge is taken from the job analysis schedule for an N/C Part Programmer which appears in Appendix A.

> 7. Job Knowledge
>
> Must have numerical ability at the level of shop arithmetic, geometry, trigonometry, analytic geometry and calculus to comprehend functions of N/C systems and prepare part programs, along with non-decimal arithmetic and Boolean algebra to comprehend functions of N/C system, read and interpret machine control tapes and MCU display lights. Mathematics at the level of vector analysis is required to select from alternate part programming methods, and achieve optimum balance of part programming, computer processing and machining time. Must have spatial ability to visualize raw and finished parts from engineering drawings, sketches and mathematical descriptions, avoid tool collisions, envision detailed sequence of machining cycles that will produce the part most efficiently and produce tool lay-up and setup sketches . . .

Item 8, Mental Application

"Mental Application" refers to the exercise and maintenance of mental processes required to perform properly the duties of a job. It may be stated as the degree and continuity of thought, mental planning, or mental alertness that must be exercised in performing an operation. It includes mental concentration required because of diversity of work or variety of problems.

Considerations affecting this factor include:

1. INITIATIVE - the need to face and solve new problems. This involves mental resourcefulness, analytical ability, the making of decisions, and the taking of independent action and should be considered according to the probable frequency of occasions on which the job will require it outside the control or routine of supervision.

2. ADAPTABILITY - the versatility required of the worker or the need, or lack of need, for the worker to adequately handle frequent changes in assignment or to carry on several tasks simultaneously.

3. JUDGMENT - the amount of independent decision making that must be exercised by the worker in performance of a job. The importance of results obtained by such independent decision making or the extent of the consequences of poor judgment must be considered.

4. MENTAL ALERTNESS - the attention necessary to tend and feed a machine properly, attention which must be given to orders, and alertness necessary to prevent damage to equipment and materials or injury to personnel.

When describing the degree to which this factor is present in a job, the analyst must consider questions such as: "Is the job repetitive or non-repetitive?" "What degree of supervision does the worker receive?" "What must the worker decide for himself and what are the consequences of poor judgment on his part?" "Must the worker improvise expedients in the course of his work and why is this necessary?" All of these points and many others are usually indicative of the Mental Application required of a worker by a job.

The analyst must not stop after determining the presence of those points which contribute to the total Mental Application in a job but must clearly indicate the degree to which they occur. If, for example, little initiative is required due to close supervision, an appropriate statement should be made. Or, if a worker must possess considerable adaptability to handle frequent changes in assignment, typical assignments should be mentioned to indicate specifically the degree of adaptability required.

The analyst must follow this procedure carefully in order to build a true understanding of the Mental Application required in any job. The following Mental Application statement is taken from the job analysis schedule for a N/C Part Programmer, which is included in Appendix A. It illustrates the principles outlined.

8. Mental Application

> Must take initiative to confer with design, engineering and operating personnel about difficulties in design interpretation, part programming, machining and maintenance. Must be able to plan and write concise, unambiguous part program commands and operator instructions. Must be mentally alert and able to form clerical perceptions, to visualize pertinent details, distinguish symbols on drawings and sketches, and to identify, record, and verify numbers, letters, words and special symbols that make up the machine commands of the part programming language. Must be able to coordinate planning, and decide method and sequence of operations by which parts are to be manufactured. Must be constantly alert to avoid errors in planning, programming and manufacturing parts by N/C. Must be alert to possible errors in engineering drawings.

Must use professional judgment in preparing part drawings, tooling analysis and part programming manuscripts for product manufacturing.

Item 9, Dexterity and Accuracy

This factor refers to the manipulative ability required in performing given work to a required degree of accuracy or precision and to the complexity or intricacy of manual processes involved. The characteristics to be considered here include (1) dexterity, (2) accuracy, (3) coordination, (4) expertness, (5) care, and (6) deftness required in manipulating, operating, or processing the materials, tools, instruments, machines, or gauges used. The number of units of work normally produced in a given period of time is also a measure of dexterity.

The major considerations affecting this factor are:

1. DEXTERITY - the quickness or deftness required, or the coordination of sight or other senses with the muscles.

2. ACCURACY - the degree of precision required in the handling of product or materials and for the adjustment and manipulation of equipment and tools to the required degree of precision.

The analyst must be careful to use only specific terms which will express the degree of the dexterity and accuracy required by the job. Statements such as "Dexterity is normal" or "Accuracy is close" should not be used because "normal," "close," and other general terms convey very little meaning or diverse meanings to the reader. Rather, this requirement should be written in terms of specific tasks in order to bring out more adequately the required degree.

Although dexterity, as such, cannot be expressed specifically in terms of the amount or degree required, it is closely related to accuracy which in many cases has specific measures. Often, the precision of work can be stated in terms of allowed tolerances, that is. plus or minus so much from an absolute standard. This range indicates how much work can depart from the ideal without impairment of job performance.

However, the relative ease or difficulty of maintaining a required standard of accuracy must be taken into consideration because a statement of allowed tolerance or required accuracy in itself will not give a true measure. To illustrate this, consider that one-hundredth-of-an-inch tolerance on an engine lathe is easier to achieve than one thirty-second of an inch in the use of carpenter's handsaw because of the nature of the equipment and material used. On the other hand, one-thousandth of an inch is 10 times as fine as one-hundredth, while one sixty-fourth of an inch is only twice as fine as one thirty-second. Yet the care and deftness required to increase the precision in the latter case may be just as difficult as that in the former. Therefore, the analyst should be sure that any requirement of accuracy relates to work performed and to the tools and equipment by which the accuracy is achieved.

The following Dexterity and Accuracy statement is taken from the job analysis schedule for a N/C Part Programmer. It illustrates the principles discussed.

9. Dexterity and Accuracy

> Must have good visual acuity and coordination of sight to analyze engineering drawings. Must be able to discriminate accurately between alphabetical, numerical, and special symbols in order to record them correctly and in sequence on work sheets and manuscripts. Must be able to read technical sketches, conventional and mathematical-analytical design data with absolute accuracy to determine steps and method of manufacture by N/C. Must use extreme care and a high order of manipulative dexterity in preparing part drawings and part program manuscripts. Must be able to set up and utilize various N/C machines and peripheral equipment with considerable care and dexterity to obtain accurate results.

The analyst must remember that this section refers only to manipulative ability and to required physical accuracy or precision. Mental considerations involving accuracy are not included here. A common mistake is to include considerations affecting what may be called "mental accuracy" such as maintenance of accurate records or the accurate planning of a sequence of a task. Considerations such as those belong under the factor Mental Application.

CHAPTER VI

COMMENTS

The COMMENTS section provides the analyst with an opportunity to present the user of the schedule with all the background information of a job which the user may not be able to obtain firsthand. Only too often an analyst has brought much confusion and doubt to schedule users by neglecting to enter the type of information which puts the job into its true perspective. Here the analyst can enter information which cannot readily be entered in other parts of the job analysis schedule. In addition, the analyst is urged to include collateral or supplementary information needed to give schedule users the best understanding of the job and its relation to the process or service in which it was observed.

Item 10, Equipment, Materials, and Supplies

All equipment, materials, and supplies used by the worker should be considered for inclusion in this item. Equipment is presented first, followed by materials and finally supplies. The COMMENTS section of Appendix A shows the recommended format for Item 10 entries.

Equipment. A definition and/or description is provided for all special and unusual equipment. By "equipment" is meant the machines, tools, and other devices which enable the worker to perform the job. Such units should be distinguished by capitalizing the initial workpiece specifications with those indicated on part program manuscript and part drawing. Applies independent judgment and knowledge of metalcutting practices to override tape controlled machine functions. Keeps record of deviation from programmed operations when minor machining problems are encountered and shuts down machine in event of machine error or malfunction. Operates machine in dial-in or manual mode, when necessary. Removes and replaces workpiece at end of machining cycle. (1-5%)

7. May observe tape verification on N/C machine: Verifies unproven N/C control tapes for accuracy by proofing in shop. Reviews performance of machine, without cutting tool in spindle, against process sheet information and data from visual display indicators on MCU in order to detect errors. Observes test run on first piece for final debugging, if necessary, to assure adequacy of part program before production (2-less 5%)

8. May operate N/C Drafting and/or Plotting Machine: Verifies N/C control tapes for accuracy before their release to manufacturing group for production, by running control tape through N/C drafting-plotting machine director and reviewing graphic output of workpiece profiles and paths of cutter centerlines (See comments). (1-less 5%)

9. May operate N/C Digitizing Machine: Prepares perforated control tapes with a digitizer by sensing points on existing engineering drawings, part models, patterns or loft plates and converts these points to numerical data on tape or other medium for input to N/C drafting machines and N/C machine tools. Places model, etc. on stage of probing unit, mounts suitable probe in probe carrier and causes probe to follow desired contours or position over desired points. At appropriate or designated point, probe is stopped and the coordinates, which are continuously displayed on the readout, are punched into the tape and registered on the printout by depressing a key or floor treadle actuator switch. This procedure eliminates hand written part program manuscript, a major source of human error in production of punched control tapes. (1-less 5%)

10. May operate Computer-Aided Design Machine: Designs parts for manufacture by N/C via the computer by drawing lines on input device, cathode ray tube, with phototlectric light pen. Presses buttons and keys to define design intent, modify portions of design and specify dimensions. Processes design through large general purpose digital computer which receives, converts, calculates, analyzes, and permanently records design information in computer memory or in a form suitable for operating N/C drafting machines and machine tools. (2-5%)

11. May specialize in particular type of part programming: Designated by employer according to type of or group of related machine tools for which preparing parts programs or by trade mark or single make of machine tool or MCU for which programs are prepared. Specializes in developing part program manuscripts in particular control language format or computer-aided part programming language and may be designated according to this specialization. (2-less 5%)

12. May conduct training in N/C: Coordinates all required training, organizes and develops training materials and instructs. Conducts formal and on-the-job training to employees and/or customers in part programming, operation of various N/C machines and equipment maintenance. Advises management on outside training of most value to personnel. (2-6%)

13. May make recommendations on improvement of N/C systems and coordinate equipment acquisitions: Analyzes N/C machines on hand by checking performance, productivity and versatility and makes suggestions to management on improving systems. To keep operation competitive, assists management in long-range planning for N/C utilization by projecting future equipment needs and investigating available hardware to meet these needs. Evaluates performance capabilities and cost and justifies expenditure showing probable return on investment and time required for "payback". Coordinates acquisition of new equipment by developing equipment specifications, inspecting vendor bids, conducting pre-delivery get ready and supervising installation and "customer acceptance test". (2-less 5%)

14. May act in liaison with maintenance department and other specialists: Develops maintenance and production methods by working in liaison with specialists in maintenance, quality control, etc. Develops maintenance schedules after referring to equipment manufacturers' specifications and consulting with specialists in the area, to reduce breakdowns and machine errors. (2-less 5%)

15. May develop or refine time and/cost data: Develops as a by-product of part programming, time studies and cost analysis, manually or with the aid of computer, to improve scheduling, cost control and machine justification, and eliminate duplication of effort by industrial engineering department. (2-less 5%)

16. May assist management in job evaluation and wage administration: Sets wage and salary standards after job evaluation and comparison with industry-wide rates. Resolves labor disputes by investigating grievances and making decisions based on knowledge and background (See comments). (2-less 5%)

PERFORMANCE REQUIREMENTS

6. Responsibility

Is responsible, under limited supervision, for a variety of activities such as resolving questions of design intent, determining suitability and availability of standardized tooling and fixturing, analyzing alternative part programming methods and machining sequences, and reviewing computer output during the course of a single assignment. Responsible for making decisions on a judgmental basis using past experience and knowledge to select the best part programming techniques, sequence of machining cycles and incorporating portions of previously prepared part programs without trying out alternative methods, thereby reducing time and cost of preparing manuscripts. Responsible for making decisions on a factual basis, such as when assigning feedrates and speeds previously found to provide optimum balance of such factors as accuracies and surface finishes, machining time, and tool life. Utilizes accepted standards in recording processing statements in specialized part programming formats and languages. Adheres to standardized nomenclature when preparing setup instructions for operators and in complying with established machine feedrates and speed conventions. Responsible for providing close supervision and guidance when training workers in the programming, use, operation, and maintenance of N/C machines and peripheral equipment. Responsible to management for technical assistance in long-range N/C planning including time studies, cost analysis, job evaluations and recommendations for the acquisition of new equipment.

7. Job Knowledge

Must have numerical ability at the level of shop arithmetic, geometry, trigonometry, analytic geometry and calculus to comprehend functions of N/C systems and prepare part programs, along with non-decimal arithmetic and Boolean algebra to comprehend functions of N/C system, read and interpret machine control tapes and MCU display lights. Mathematics at the level of vector analysis is required to select from alternate part programming methods, and achieve optimum balance of part programming, computer processing and machining time. Must have spatial ability to visualize raw and finished parts from engineering drawings, sketches and mathematical descriptions, avoid tool collisions, envision detailed sequence of machining cycles that will produce the part most efficiently and produce tool lay-up and setup sketches. Must be able to record data accurately and use a calculator and computer terminal for computational tasks. Must be able to read and understand engineering drawings, have a thorough knowledge of jig and fixture design, properties of metals, general shop and machining practices and a complete familiarity with N/C systems and methods of production. Must be able to learn specialized symbolic part programming languages and prepare written instructions for workers in areas of tooling, fixturing, and machine setup and operation. Must be able to utilize and/or operate N/C machine tools, digital computers, key punch machines, tape preparation machines, N/C drafting machines, plotting machines, digitizing machines, inspection machines, and computer-aided design machines. A working knowledge of the basis principles of physics and engineering is required. Must have understanding of what engineering and design information are and how they can be most effectively communicated to people and computers. Must know how to use precision measuring instruments, such as dial indicators, vernier calipers, micrometers, and the like.

8. Mental Application

Must take initiative to confer with design, engineering and operating personnel about difficulties in design interpretation, part programming, machining and maintenance. Must be able to plan and write concise, unambiguous part program commands and operator instructions. Must be mentally alert and able to form clerical perceptions, to visualize pertinent details, distinguish symbols on drawings and sketches, and to identify, record, and verify numbers, letters, words and special symbols that make up the machine commands of the part programming language. Must be able to coordinate planning, and decide method and sequence of operations by which parts are to be manufactured. Must be constantly alert to avoid errors in planning, programming and manufacturing parts by N/C. Must be alert to possible errors in engineering drawings. Must use professional judgment in preparing part drawings, tooling analysis and part programming manuscripts for product manufacturing.

9. Dexterity and Accuracy

Must have good visual acuity and coordination of sight to analyze engineering drawings. Must be able to discriminate accurately between alphabetical, numerical, and special symbols in order to record them correctly and in sequence on work sheets and manuscripts. Must be able to read technical sketches, conventional and mathematical-analytical design data with absolute accuracy to determine steps and method of manufacture by N/C. Must use extreme care and a high order of manipulative dexterity in preparing part drawings and part program manuscripts. Must be able to set up and utilize various N/C machines and peripheral equipment with considerable care and dexterity to obtain accurate results.

COMMENTS

10. Equipment, Materials, and Supplies

Equipment:

Computer Terminal: Teletype Model 35 ASR (automatic send-receive), manufactured by the Teletype Corporation, 5555 Touhy Avenue, Skokie, Illinois 60076.
A machine used for N/C control tape preparation for machine tools and/or drafting machines in addition to direct access to time-sharing computer service and other business machines. The model 35 features a keyboard, a printer, a paper tape punch, and a paper tape reader. These can be used in various combinations within the machine and to send to and receive from remote equipment. It has a 4-row keyboard similar to that of a regular typewriter. The letters, numbers, and certain punctuation marks are generated by pressing the appropriate keys. The printer has a friction feed or sprocket fed platen for 8 1/2 inch paper. The tape punch receives and recognizes information in the form of serial signals emanating from the signal line of the local set of from distant transmitting equipment. It fully perforates an 8-level, 1 inch tape in EIA, RS-358 (ASCII) code. Operating in conjunction with or independent of the other components, the reader senses the data stored on the punched tape and generates corresponding serial signals to send the data on to activate the printer and prepare a hard copy print out.

Calculator: Friden Model STW, manufactured by Friden, 31 Prince Street, Rochester, New York 14607.

A fully automatic calculating machine for performing the basic mathematical operations of addition, subtraction, multiplication and division. The machine consists of two keyboards, a carriage and many specialty dials, stops, keys and bars.

Digital Computer: PDS 1020, N/C System General Purpose Digital Computer, manufactured by Pacific Data Systems Inc., 185 Mammouth Parkway, West Long Branch, New Jersey.
Used to execute stylized procedures or programs, for solving such diverse problems as probing outer space, preparing checks and planning cities. They are used by problem solvers throughout government, business, industry, and education. The five main functions of a computer are:

1. input
2. storage
3. control
4. processing
5. output

Although there are many types of general purpose digital computers, their differences lie in speed, cost, or convenience to user, not in their logical power. From the viewpoint of the user, the machine manipulates two basic types of information:

1. operands or data
2. instructions, each of which usually specifies a single arithmetic or control operation and one or more operands which are the objects of the operation.

Within the machine, both instructions and data are represented as integers expressed in binary code. The heart of a general purpose digital computer system is the central processing unit comprised of: main storage, which holds both program and data; arithmetic logic unit, which contains processing circuitry such as an adder, shifter; and registers for holding the operands and instructions currently being processed.

Key Punch: IBM Key Punch. The most common means of recording information into punched cards. The operator transfers data into cards by an operation very similar to typewriting, frequently called "keypunching". Data being punched may also be printed at the top of the card. Basically, there are three types of card punches available: the 24, 26, and 29 card punches.

Machining Center: Cincinnati Cintimatic 2-Axis Vertical Machining Center, manufactured by the Cincinnati Milling Machine Company, Cincinnati, Ohio 45209.
A machining center is a versatile N/C machining system capable of automatically performing all the operations necessary to completely machine a wide variety of parts from start to finish. "Machining Center" has developed into a generic term used to describe almost any complex numerically controlled machine which is a combination drilling, boring and milling machine. Originally, the term was coined to describe a tape controlled machine with these three attributes:

1. It must drill, bore, mill, tap, counterbore, countersink and perform all operations on a part normally accomplished by the use of rotating cutting tools.

2. It must present at least four sides of the part to the cutting tools, preferably all sides.
3. It must have the capability of automatically selecting enough tools from a tool storage rack, turret or drum to machine a part completely.

So, basically a machining center originally had to have boring, drilling and milling capabilities and machine at least four sides of a part by selecting tools through an automatic tool changer. Machining centers available today are capable of performing such operations as boring, drilling, reaming, tapping, counterboring, countersinking, and milling multiple faces of the part on one machine with a single set-up of the workpiece. They are equipped with means for automatic tool changing and for controlling all aspects of the machining process, such as positioning, spindle speed, feed rate, and coolant on and off. For this reason, the machining center, actually a new concept of manufacturing, has no single counterpart among conventional machine tools.

Numerically Controlled Digitizing Machine: Auto-trol Digitizer, manufactured by the Auto-trol Corporation, 6621 West 56th Avenue, Arvada, Colorado 80002.
Digitizing machines were developed to perform functions in opposition to those of drafting machines. In general, the purpose of digitizers is to sense points on drawn or scribed lines on existing drawings or patterns (instead of drawing them), and convert those points to numerical data on a paper tape or other medium. These data then can be further processed by a computer, or used directly to control machine tool movements. Thus an engineering drawing, pattern, loft plate, or similar object placed on the machine table can be the input medium. After the operator zeros in the sensing device--with a built-in microscope on the machine, or by using a console with a closed circuit television display--he can instruct the machine to follow the rest of the line or curve by depressing console keys. On some machines he can also add instructions, such as coolant off-on commands and machine tool feedrates through the keyboard, to produce complete machining tapes, rather than tapes that merely define the configuration of parts to be machined. Until now, the major market for digitizing machines has been the aircraft and aerospace industries. However, development of more sophisticated and flexible digitizing systems may change this situation rapidly. Now on the market, for example, are machines capable of both digitizing and drafting functions, with moderate change-over time required of the operator. These machines are becoming recognized by management in many industries as very desirable; they add to manufacturing flexibility, and at a cost that is feasible.

Numerically Controlled Drafting Machine: Orthomat Mark II, built by Universal Drafting Machine Corporation, 5200 Richmond Road, Bedford Heights, Ohio 44014; Gerber Graphic Display System, built by Gerber Scientific Instrument Company; and Kingmatic Drafting Machine, built by Baldwin Kongsberg Company.
An automated device used to record digital computer output in graphic form. N/C drafting machines are used either directly connected to a general-purpose digital computer or off-line and use computer

output, usually in the form of punched cards or magnetic tape, as an input medium to provide a graphical representation of the computer operations. The basic N/C drafting machine is of gantry type construction with special servomotors driving the "Y" beam carriage and plotter head over the drafting surface. The drafting surface may be equipped with a vacuum chucking system to hold the drawing media. A console unit separate from the drafting table interprets the instructions from punched tape or manual input data and controls the drawing and printing of the proper lines and characters. The plotter head has a single or automatic indexing turret mechanism for mounting a variety of styluses such as pencils, pens, scribing tools, prick punch and in some systems a separate print wheel for alphabetic information or a photographic device to expose film. (See task 8, in item 12, General Comments, for additional details).

Numerically Controlled Machine Tools: MOOG HYDRA-POINT 3 Axis N/C Machine and MOOG Model 83-200 HYDRA-POINT N/C Machine. The primary difference between N/C machine tools and conventional or automatic machine tools lies in the method of supplying input data to the machine and obtaining feedback signals. With N/C, automatic operation is achieved by means of numerical instructions coded on tape. These instructions, prepared in advance by a part programmer and recorded on tape, can control the sequence of machining operations, machine positions, spindle speeds and rotational direction, distance and direction of movement of the tool or workpiece, coolant flow, table indexing and tool selection. The punched tapes are placed on the MCU which consists of a system of electronic interpreting devices, and when activated, guide the machine tool through the programmed commands with little or no human intervention. N/C machine tools are faster, more accurate, and more versatile than conventional or automatic machine tools where complex shapes are to be machined, and where otherwise many manual operations would be required.

Numerically Controlled Plotting Machine: Cal Comp Digital Incremental Plotter, manufactured by California Computer Products, Inc., 305 N. Muller Avenue, Anaheim, California 92803.
Plotting machines are quite similar in concept and operation to N/C drafting machines. The differences are primarily in the degree of accuracy and quality of the drawings that can be produced, and in the method of drawing. This type of digital plotting device has one axis of motion provided by a rotating drum. Plotters which are cheaper, smaller in size, and less sophisticated, are used more widely at present than the drafting machines. Bidirectional stepmotors are employed by plotters for both the "X" and "Y" axes. The plotting is regulated by the movement of a pen relative to the surface of the coordinate paper, with each input pulse causing a step of either 0.01 or 0.005 inches. The "X" axis deflection is produced by motion of the drum and the "Y" axis deflection is produced by motion of the pen carriage. Electrical signals raise and lower the pen from the surface of the paper. All plotting, discrete points, continuous lines (straight or curved), or symbols, is accomplished by the stepping action of the drum and carriage. Digital incremental plotters can be used on-line with most general purpose digital computers through an adapter which converts the computer output signals to a form suitable for driving the plotter. For off-line operation the

plotter may be combined with a magnetic-tape-storage and readout unit to provide a complete tape plotting system. Paper alignment is maintained by sprockets on the "X" axis drum. Various types of translucent and vellum papers are available in roll stock either 12 or 31 inches wide, depending on the drum sprocket width. The plotter has been used for verifying N/C control tapes, plotting weather maps, lofting in aircraft and ship design, highway construction (cut and fill problems), telemetry-data plotting, stress analysis studies and critical path scheduling for construction projects.

Tape Preparation Machine: Teletype Model 33TZ ASR; Strippit Tapetyper Number 80151-000; Dura Mach 10B, 15" Model; and Friden Flexowriter Model 2301. These tape preparation machines have typewriter keyboards, an integral tape punch and reader (code sensing device). They are operated manually through the keyboard in the same manner as a standard electric typewriter. In N/C applications, the operator reproduces the information from the hand written part program manuscript; this operation simultaneously causes a punched tape and hard copy to be prepared.

Materials:

None

Supplies:

Blueprints and/or whiteprints

Books and manuals

Data processing cards

Drawing instruments

Magnetic tape (computer input/output medium)

Paper

Part drawing work sheets

Part program work sheets

Pencils and erasers

Scales - architects and engineers

Specifications sheets

Tape splices (N/C machine control medium)

Machine control tapes (perforated tape) in various types of materials

- Mylar
- Mylar/Aluminum Foil/Mylar
- Mylar/Metalized Mylar

Paper - oiled and unoiled

Paper/Mylar/Paper - oiled and unoiled

11. Definitions of Terms

ABSOLUTE DIMENSION - (See also COORDINATE DIMENSION WORD) - A dimension expressed with respect to the initial zero point of a coordinate axis.

ALPHANUMERIC CHARACTERS - A code system in which the characters used are the letters of the alphabet and the numerals 0 to 9.

CARTESIAN COORDINATES - A means whereby the position of a point can be defined with reference to a set of axes at right-angles to each other.

CONTOUR CONTROL SYSTEM - A system in which the path of the cutting tool is controlled by a simultaneous, coordinated movement of two or more axes.

COORDINATE DIMENSION WORD - A word defining an absolute dimension with respect to a specified referenced zero.

DIGITAL COMPUTER - A computer that uses discrete numbers rather than physical quantities in processing data.

MACHINE CONTROL UNIT (MCU) - Sometimes referred to as the CONTROLLER, or DIRECTOR. This is the brains of the numerical control system. It consists of a tape reader plus the electrical and electronic equipment needed to change the tape codes into machine commands. The MCU contains the memory, computational abilities, and relatively simple switching circuits as needed for simple or complex machines. The machine operator's controls and indicator lights may be mounted on this unit, or all or part of these controls may be contained in a separate console.

MAGNETIC TAPE - Tape made of metal or plastic, coated with a magnetic material, upon which can be stored programmed information.

NUMERICAL CONTROL SYSTEM - A system where the actions are controlled by the direct insertion of numerical data at some point. The system must automatically interpret at least some portion of the data.

PERFORATED TAPE - Tape in which a pattern of holes and a tape feed hole have been punched in a row, so as to convey information.

POINT-TO-POINT CONTROL SYSTEM - See POSITION CONTROL SYSTEM.

POSITION CONTROL SYSTEM - A discrete or POINT-TO-POINT CONTROL SYSTEM in which the controlled motion is used as a means of reaching a given end point with no path control during the movement from one end point to the next.

POST PROCESSER - A computer program which converts the generalized output of a computer-processed part program into the specific input requirements of the machine tool-numerical control system on which the part is to be machined.

PUNCHED TAPE - See PERFORATED TAPE.

12. General Comments

Work Performed: The tasks in this job analysis schedule have been compiled from a number of different sources and therefore describe the job in a generalized composite form. Consequently the description may not coincide exactly with a specific job in a particular establishment.

Task 1: Significant attempts are being made to design products specifically for manufacture by numerical control. Manufacturing feasibility and cost analysis play a major role in the definition of optimum designs. The leaders in this effort include aircraft, aerospace and ordnance industries. Many employers are insisting that their design engineering personnel acquire a knowledge of numerical control processes, as well as machine capabilities and limitations. Thus, an increasing proportion of their new-products mix is being designed to take full advantage of the numerical control potential.

Task 3b: Part programming personnel often use computer part programming languages (such as APT) but are not required to know all the details of how a computer functions, its logic and arithmetic units, and its capabilities and limitations. However, the computer programmer for numerical control must be familiar with at least one make and type of digital computer, and must meet most of the requirements of a part programmer, in order to be able to prepare or modify numerical control computer programs effectively. Thus, to be effective, any computer programmer for numerical control must be competent as an engineering and scientific computer programmer, and must have acquired a fairly extensive background in machine shop practices, machining properties of materials, and machine tool and control capabilities. The ability and experience to perform adequately in only one of the two areas is just not enough. The job is inter-disciplinary in nature.

Task 8: Automatic drafting machines, basically X-Y plotters, but sophisticated, often large in size, and capable of high accuracy and rapid recording speed, are coming into use in the aircraft, automobile and aerospace industries to record digital computer output in graphic form. Exploratory work on the N/C drafting machine began in 1947, but it was not until 1956 and N/C profiling, that nonmanual data inputs were available. Early attempts at N/C drafting employed an N/C profile miller (using a 20-hp. spindle to grip a small scriber) to produce drawings. Even with this massively inappropriate equipment, cost savings were demonstrated and time saved. Today more sophisticated machines designed with drafting or plotting as their primary function do the routine work 20 times faster, more accurately and with less lead time than manual methods. Some machines can scale up and down, to produce drawings to the exact scale desired.

Probably the major use of most drafting machines is in verifying the accuracy of tapes before they are released for production, but there are many other applications such as pattern and template scribing, plotting, aircraft and ship lofting, mapping, surveying problems and straight drafting. The last of these may eventually have the greatest effect on personnel employed in the drafting occupations. Some of the machines now being marketed not only can develop three-view line drawings, but also have full alphabetic and numerical printing capabilities and thus can produce supporting data on drawings. However, as is the case with almost all new hardware, it probably will be some time before procedures to realize the full potential of the equipment are completely developed and appreciated. (See item 10, Equipment, for description of machines).

Task 16: Workable programs of formal job evaluation and wage administration in the area of numerical control operations have proven difficult to set up. One reason has been the tendency of employers to develop job evaluation systems based on machine functions, rather than job requirements. This is understandable because early steps are often tentative, with machines frequently acquired one or two at a time. Numerically controlled machine tools are commonly spotted, at least initially, in general machining areas, with the location often determined by the function and size of conventional machines they replace or augment. As a result, some fundamental differences in job requirements tend to be overlooked or understated. Physical effort requirements changed markedly with numerical control. Machine positioning in at least two axes of movement becomes a tape rather than manual function. But setup and takedown are more frequent because of high machine productivity, and as manufacturing planning for numerical control becomes more experienced, the operator could find it increasingly difficult to stay ahead of the machine. One of the most difficult conventional job evaluation factors to apply to numerical control is that of responsibility. Many of the duties and tasks previously assigned to the operator of a conventional machine tool--and his shop supervisor--have been transferred to the engineering department. Details of operator duties, and their sequence, are specified for him on operator manuscripts. Other functions of conventional machine operators now are a series of coded machine instructions. They are on the tape. But where does the final responsibility lie? Is the operator to be held accountable for workpiece quality, and will he be expected to notice machining problems, and either override feeds and speeds or notify his supervisor? Who is to be responsible for adequate tool life--the operator, the foreman, or the engineering department? In all cases, the operator is expected to remain alert, and try to shut down the machine in time to prevent major damage, when there is a control malfunction or part programming error. But is he required to anticipate problems such as those arising from variations in raw workpiece size, and trim the controls to prevent machining difficulties? As yet, there are no absolute answers to many of the administrative difficulties presented by numerical control. Patching conventional job evaluation and wage systems to adjust to numerical control has not proved adequate, and an increasing number of employers are now setting up entirely separate classification structures and standards for numerically controlled machine operating jobs. Numerical control already has considerably changed hiring standards, it's a new breed of cat, and to a certain extent so are its operators. Man-machine relationships are fundamentally changed. Numerical control has also forced changes in functional organization, as major users begin to view it as an entirely new manufacturing system, and not just as strange looking, expensive, and somewhat frightening pieces of hardware. Just as numerical machining has changed the content and interrelationships of jobs in manufacturing, it may compel fundamental improvement in design and operation of company wage systems. Questions--and major issues--are being raised both by management and labor, and current techniques of job evaluation and wage administration may not be good enough to provide the answers.

APPENDIX B

JOB ANALYSIS SCHEDULE
LUBRICATION MAN (VEHICLE)

JOB ANALYSIS SCHEDULE

1. Job Title LUBRICATION MAN (VEHICLE)
2. Date 8 September 1975
   Number of sheets 5
3. Alternate titles LUBRICATION TECHNICIAN; LUBRICATOR; INSIDE QUICK SERVICE SPECIALIST
4. Dictionary title and code LUBRICATION MAN 915.887

5. Work Performed

Lubricates bearings, bushings, and gear boxes with a hand operated grease gun, hand operated gear lubricant dispenser, oil can, squirt can, and stick lubricant in accordance with the shop work order and manufacturers' specifications to reduce wear and extend the useful life of a vehicle.

1. Prepares vehicle for under chassis lubrication: Drives vehicle into service area, positioning over Twin Post Hydrolic Pneumatic Lift by steering wheels of vehicle into guide depressions in garage deck, stopping when seated. Examines shop work order received to determine the kind and extent of lubrication required. Examines the manufacturers lubrication specifications chart for the particular make, model, and year of the vehicle to be lubricated. Manually adjusts lift arms at front of vehicle to a position under spring assembly, and at rear under axle housing. Hoists vehicle 1 to 2 feet above deck on twin post hydrolic pneumatic lift with compressed air controlled by hand operated control levers located on lift control panel. Visually examines lift arms for correct positioning. Repositions lift arms when necessary, for safety and to prevent damage to vehicle, by lowering lift to deck for manual readjustment of lift arms to correct points. Raises vehicle to work height by hand operated lift control levers for under chassis inspection and lubrication. Examines by visual inspection, underside of vehicle for obvious existing hazards, ex.: worn or damaged tires, faulty exhaust system, frayed emergency brake cable, damaged hydraulic brake lines, oil leaks, damaged shock absorbers and missing fasteners. Reports defects or malfunctions to supervisor. (3-10%)

Analyst C. P. Campbell Reviewer C. D. Campbell

for under chassis
visual inspection,
ards, ex.: worn c
ed emergency brake
eaks, damaged shoe
cts or malfunction

Campbell

obvious
haust
brake
steners.

ll.