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# SAMICS Support Study

## Final Report

## Volume I

# Cost Account Catalog

## Jet Propulsion Laboratory

## Pasadena, California

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*Theodore Barry & Associates-Management Consultants*

TB&A



September 1977

Los Angeles • New York • Atlanta • Chicago

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JPL CONTRACT NO. 954800



This work was performed for the Jet Propulsion Laboratory, California Institute of Technology, under NASA Contract NAS7-100 for the U. S. Energy Research and Development Administration, Division of Solar Energy.

The JPL Low-Cost Silicon Solar Array Project is funded by ERDA and forms part of the ERDA Photovoltaic Conversion Program to initiate a major effort toward the development of low-cost solar arrays.

The Solar Array Manufacturing Industry Costing Standards (SAMICS) are a part of the LSSA Project Analysis and Integration Activity and are intended to provide a standard procedure and data base for estimating, from descriptions of the manufacturing processes, the price at which solar modules would have to be sold to realize a specified after-tax rate of return on equity.

September 1977

Los Angeles • New York • Atlanta • Chicago

ACKNOWLEDGMENTS

We extend our sincere appreciation for the courtesy and cooperation we received from the many individuals who participated in this study for the Low-Cost Silicon Solar Array project at the Jet Propulsion Laboratory.

Mr. Robert Chamberlain deserves special recognition for his effort to develop the Solar Array Manufacturing Industry Costing Standards.

SAMICS SUPPORT STUDY

FINAL REPORT

VOLUME I: COST ACCOUNT CATALOG

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# SECTION I
# SUMMARY

## A. SAMICS SUPPORT STUDY

The Jet Propulsion Laboratory (JPL) is currently examining the feasibility of a new industry to produce photovoltaic solar energy collectors similar to those used on spacecraft. To do this, a standardized costing procedure is being developed. Theodore Barry & Associates has been contracted to provide industrial management consulting and facilities design engineering support for the implementation of the Solar Array Manufacturing Industry Costing Standards (SAMICS).

The SAMICS support study will supply the following information:

1) SAMICS CRITIQUE

2) STANDARD DATA BASE

   a) Cost Account Structure
   b) Expense Item Costs
   c) Inflation Rates
   d) Indirect Requirements Relationships
   e) Standard Financial Parameter Values

3) FACILITIES CAPITAL COST ESTIMATING RELATIONSHIPS

4) CONCEPTUAL PLANT DESIGNS

5) CONSTRUCTION LEAD TIMES

6) PRODUCTION START-UP TIMES

7) MANUFACTURING PRICE ESTIMATES

The critique of the SAMICS methodology was documented separately during the initial stage of the study. The other support study results are documented in three volumes. Volume I contains a description of the cost account structure and the cost account catalog. This standard data base forms the exogenous input to describe manufacturing processes for the SAMICS model.

Volume II presents several submodel analyses, including the indirect requirements relationships, facilities capital cost estimating relationships, standard financial parameter values, and a model for estimating one-time costs. The one-time cost model refers to the construction and production start-up phases, and includes procedures for estimating the construction lead times and production start-up times. These submodel results will be used internally by the SAMICS model.

Volume III contains conceptual plant designs and the corresponding manufacturing price estimates for three alternative levels of solar array production: .5, 15, 500 MW of peak capacity per year. The price estimates will be used to validate the SAMICS model results.

## B. SAMICS MODEL

The Solar Array Manufacturing Industry Costing Standards consist of:

1. A cost account catalog containing standard prices (as functions of annual quantities) and inflation rates for all goods and services.

2. A standard format for expressing input data describing the manufacturing process equipment and direct requirements.

3. A standard set of relationships to determine the indirect process requirements from the direct.

4. A set of standard financial parameters to unify economic and accounting assumptions regarding overhead, facilities, capital, etc.

5. A collection of algorithms for combining the process descriptions with the standard financial data to produce an estimate of the manufacturing prices and process-by-process cost components.

The standards are being formulated as a computer simulation program (SAMIS III) which will incorporate the standard data provided in this report and will eventually be used to compare alternative manufacturing processes.

Alternative manufacturing processes are currently being synthesized by approximately 50 JPL subcontractors. Frequently, subcontractor cost estimates have not been comparable because of differences in accounting standards, economic assumptions, and financial parameters, and because processes have not been considered in the context of an integrated process sequence in a factory environment. In the future, these and other subcontractors will be asked to use the uniform standards to provide comparable cost estimates.

After the research and development efforts have provided enough understanding of the processes that technical feasibility has been established and that they can be described in a believable fashion, the resultant cost estimates can be compared to determine the best sequences of manufacturing processes to produce solar arrays as a function of the annual quantity produced. Hopefully these results will indicate the feasibility of the JPL project goal to reduce today's solar array prices of about $16/watt to less than $.50/watt for annual production quantities of 500 Megawatts by 1986.

## C. COST ACCOUNT CATALOG

This volume describes the structure and contents of the cost account catalog which contains a list of all items that may be required directly or indirectly by a solar array manufacturing company. The specific information for each item includes a catalog number, a description, and a standard unit of measure. Where appropriate, an inflation rate, price year, and price versus purchase quantity information are also assigned.

The expense items are organized into six account categories:

ACCOUNT A: FACILITIES
ACCOUNT B: PERSONNEL
ACCOUNT C: UTILITIES AND PLANT SERVICES
ACCOUNT D: BY-PRODUCTS
ACCOUNT E: COMMODITIES
ACCOUNT F: RESOURCES

The catalog does not contain manufacturing process equipment, since these items are a fundamental part of the process description input which is specified by the model user.

The starting point for the data collection activity was a description of all ingredients used by manufacturing processes that may be contained in the hypothetical SAMICS factories. While some of these requirements are common to all factories, many are unique to the specific production processes. Both kinds of requirements have been listed in the catalog and assigned standard prices.

To identify these ingredients, each of the LSSA Project Task Managers were asked to provide a list of direct requirements for their processes for which the technology is presently operational and cost effective, and for those that are likely to be seriously considered in the near future.

This list of direct requirements was augmented with indirect requirements common to all factories. Finally, price versus quantity information was compiled for all expense items.

The appendices contain the cost account catalog and other information to complement the catalog: personnel organization chart, personnel classification scheme, personnel job definitions, inflation rate statistics, and a standard chart of accounts.

The Personnel Organization Chart illustrates the relationships between the various types of personnel and forms the basis for specifying the associated indirect requirement parameters.

The organization chart provides a comprehensive set of personnel functions which would be required in varying degrees in solar array manufacturing plants of any size. However, the SAMICS model does not necessarily generate different people to perform each of the functions. That is, the model combines personnel functions in small plants by allowing fractions of people rather than separate integer quantities to perform each function. The total salary is then computed as the weighted average of the annual salary associated with each job title.

The Personnel Classification Scheme explains the Dictionary of Occupational Title code numbers which have been assigned to all personnel in the catalog.

The Personnel Job Definitions, from the Federal Dictionary of Occupational Titles, describe each job title in the personnel account.

The Inflation Rate Statistics were compiled from two government sources for the period 1967-1972. The statistics are separated into ten inflation categories and provide a basis for projecting future prices. The recommended rates listed should be substituted for the corresponding inflation codes given in the cost account catalog.

The Standard Chart of Accounts is a classification for all assets, liabilities, revenues, and expenses into balance sheet and income statement accounts. The chart is representative of an electronics firm and will facilitate the preparation of projected financial statements for the solar array companies.

The Cost Account Catalog contains a list of all items that may be required directly or indirectly by a solar array manufacturing firm. This list provides price information where appropriate (price year, inflation class, and either a price or price versus quantity table).

# SECTION II
# COST ACCOUNT STRUCTURE

DETAILED OUTLINE

II. COST ACCOUNT STRUCTURE

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## A. ORGANIZATION AND CONTENTS

### 1. Purpose and Scope

The purpose of the cost account structure is to establish a consistent and reliable data base to support the SAMICS model in estimating costs for the manufacture of solar arrays.

The cost account structure represents a comprehensive catalog of all expense items that are directly or indirectly required by a solar array manufacturing company. In addition, the cost account catalog contains specific information for each item. This includes catalog numbers, descriptions and, where appropriate, identification codes, standard units of measure, inflation rates, price years, and price versus quantity information. Finally, in recognition of the need to allow for additions and periodic updating, a numbering scheme has been devised so that the catalog can be expanded without destroying the usefulness and meaning of numbers already assigned. The scheme will also maintain all items in exact alphabetic and numeric order. The catalog is presented in Appendix F.

### 2. Direct and Indirect Manufacturing Requirements

The solar array technology development and requirements identification effort involves the assessment of new manufacturing processes which are currently being tested by approximately 50 industrial firms and universities. The subcontractor activities are divided into the following four tasks:

Task 1: Production of low-cost silicon material.

Task 2: Economical production of silicon in large-area sheets suitable for the manufacture of solar cells.

Task 3: Development of economical encapsulation materials and techniques for lifetimes greater than 20 years.

Task 4: Development of automated processes and equipment for low-cost high-volume production of solar arrays.

Following is a brief description of the cost account catalog information associated with each task.

- Task 1: Silicon Material

  Lamar University of Texas is involved with examining the commercial potential of the processes. Consequently, for the SAMICS cost account structure, purified silicon is treated as an input commodity. The price versus quantity functions are formulated for the potential by-products. In the future, it will be better for both Task 1 and the overall LSSA project purposes to include the silicon material processes in the SAMICS methodology.

- Task 2: Large Area Silicon Sheet

  Prices, as functions of quantities, are provided for the Czochralski crystal growth and wafer slicing process requirements. The information was obtained from Varian and Spectrolab. A memo, containing a preliminary cost account item list, was reviewed by all Task 2 subcontractors to ensure a reasonable degree of completeness.

- Task 3: Encapsulation Material

  The catalog includes several types of glass and polymers that have been investigated for the encapsulation task. A list of materials with price versus quantity information was provided by the JPL Task 3 group.

- Task 4

  The bulk of the facilities design work is related to Task 4. Price versus quantity information is included for the requirements associated with automated assembly processes.

3. Account Categories

The cost account catalog is organized into seven account categories:

A. Facilities
B. Personnel
C. Utilities and Plant Services
D. By-products
E. Commodities
F. Resources
G. Temporary.

Each account (A through F) contains items that may be required, directly or indirectly, by a solar array manufacturing firm. The temporary account (G) will be used by subcontractors for items that are not included in the catalog but used in their manufacturing processes. The cost account catalog does not contain process equipment items, since these will be described by users as input data.

4. Catalog Information

The cost account data base is stored on magnetic tape cassettes, and includes the following information for each item:

Cost Account Information

- SAMICS Catalog Number
- Requirements Class
- Item Description
- Units of Measure
- Job Class or Stock Number (if applicable)
- Inflation Class
- Base Price Year
- Minimum Quantity
- Maximum Quantity
- Number of Price Levels = N
- (Price, Quantity) Pairs:

$(P_1, Q_1)$, $(P_2, Q_2)$ ... $(P_N, Q_N)$

Facilities parameters are listed in the catalog but not assigned prices. These costs are specified separately in the facilities capital cost table of Volume II.

Personnel items are assigned standard job titles and definitions from a federal occupational handbook (Dictionary of Occupational Titles, third edition ). Federal wage stabilization data was used to allot wage rates to each personnel type.

Whenever possible, the commodities in Account E were assigned federal stock numbers. This classification is intended to provide a standard reference for the cost assignments rather than to specify the commodities that the subcontractors should use.

Resources are also identified in Account F. Their quantity requirements will be calculated to permit an assessment of their utilization. Prices are not assigned to these items.

## B. CATEGORY DEFINITIONS AND CLASSIFICATIONS

### 1. Category Definitions

The expense items listed in the cost account catalog are organized into seven categories. Each account classification is defined below with examples to illustrate the definitions.

Account A — Facilities parameters. These are the different types of real and personal property used in the production of revenues. Real property includes land, buildings, sidewalks, and other land improvements. Facilities also include warehouse space, production space, offices, furniture, fixtures, and other capital assets that are not bought and sold in the ordinary course of business. These parameters are used to determine the initial capital cost. They do not include equipment used

directly in the manufacturing processes. Account A also includes a special item "Leased or Rented Equipment" with units of "Dollars Per Year". This item can be used to describe a process performed partly or entirely with expensed (rather than capital) equipment.

Account B -- Personnel. Personnel consists of all types of manpower required to operate the company. Distinction is made between workers with different skills and supervisory needs. Standard federal job titles and descriptions are given so that users of the SAMICS methodology can decide which workers are required for their manufacturing operation. The catalog contains a comprehensive list of all the personnel that may be required, directly or indirectly, by a manufacturing firm. Examples are semi-conductor assembly line workers, financial analysts, and sales managers.

Account C -- Utilities and Plant Services. Utilities are those services such as power, water, and natural gas, normally provided by a public utility which for some scale of operation, require construction of special facilities. Plant services include compressed air, sewage and waste disposal, water supply, heating, ventilation, and air conditioning.

Account D -- By-products. By-products include both those kinds of items that generate income (such as rejected wafers) and those that must be hauled away. Reclaimable by-products (such as used acid and dirty solvent) and potential pollutants (such as poisonous fumes) may, for some scale of operation, require construction of special facilities. The associated facilities parameters are included in Account A.

Account E -- Commodities. These are material and supplies that are required to operate the company. The units in which they are usually purchased are specified. Examples of commodities include sulphuric acid, electrodes, and squeegees.

Account F -- Resources. By arbitrary definition for SAMICS, resources are not directly required by the manufacturing processes. Rather, they are inherent in priced expense items and, consequently, are not assigned prices. Nevertheless, the resources associated with the various priced expense parameters are identified. Their quantity requirements will be calculated to permit an assessment of their utilization. For example, each cubic foot of natural gas requires 0.302 kilowatt - hours of the resource "energy".

Account G -- Temporary. The temporary account will be used by subcontractors for items that are not included in the catalog. At regularly scheduled intervals, the catalog will be updated by transferring temporary account items to their proper account category.

2. Account Numbering System

A six digit numbering system is used to code each item in the seven account categories. The alpha-numeric system consists of:

- A letter prefix indicating the account category (A, B, C, D, E, F, or G).
- A four digit identification code following the letter prefix. The first digit indicates the account subcategory. For example, in Account B, administrative personnel are assigned the number 1 and finance personnel 2. The remaining three digits are a gapped numeric sequence code, with 16 spaces between each data item, to accommodate additions.
- A letter suffix that identifies the requirements class as Direct (D), Indirect (I), or Both (B). For expendiency, all items, in the seven account categories, are placed in alphabetical order by item description.

Example:

Definition:

| Catalog Number | Item Description |
|---|---|
| A1016I | Fencing |

A indicates the account category - Account A: Facilities
1 indicates the account subcategory - Site Parameters
016 indicates the gapped numeric sequence code
I indicates the requirements class, in this case, indirect.

Given the catalog sequence below, new items can be added as follows.

| Catalog Number | Item Description |
|---|---|
| B3208B | Electronics Engineer |
| B3224B | Industrial Engineer |
| B3240B | Mechanical Engineer |

Suppose that a new item, Engineering Aide, is to be introducted between Electronics Engineer and Industrial Engineer, then the differences between catalog numbers is divided by 2 and added to the first.

| | |
|---|---|
| B3208B | Electronics Engineer |
| ? | Engineering Aide |
| B3224B | Industrial Engineer |

$(3,224 - 3,208) \div 2 + 3,208 = 3,216$

The new item is assigned the number B3216B.

The expanded account would appear as follows:

| Catalog Number | Item Description |
|---|---|
| B3208B | Electronics Engineer |
| B3216B | Engineering Aide |
| B3224B | Industrial Engineer |
| B3240B | Mechanical Engineer |

Notice that the new item is added without destroying the usefulness and meaning of the numbers already assigned to the other items. Further, all items continue to be maintained in exact alphabetic and numeric order.

3. Classification of Facilities

Facilities parameters, that determine initial capital costs, have been identified based on effective design concepts for manufacturing operations. A distinction is made between site facilities (external to the building) and building space facilities (contained within the building). The design assumptions and parameter definitions are presented in Volume II.

4. Personnel Organization and Classification

Personnel items, in Account B, are divided into four major groups. Each organizational group is distinguished from the others by the activities and function of the personnel within it. The groups are:

- Administration, Personnel, and Plant Maintenance
- Finance, Accounting, and Data Processing
- Manufacturing, Quantity Control, and Material Handling
- Sales and Marketing

An organization chart is included in Appendix A to illustrate the functional and departmental personnel relationships. The chart delineates the formal lines of authority and communication between department units. Standard job titles were assigned to each personnel item in the catalog. The titles were extracted from the third edition of the Dictionary of Occupational Titles. Personnel are arranged in alphabetic order by job title and six digit occupational classification codes are assigned to provide:

- A standard approach to classifying the abilities, vocational experience, and potentials of workers; and

- A method of classifying worker trait characteristics so that the user can discern various relationships among occupations.

A complete description of this occupational coding scheme is presented in Appendix B. Appendix C contains a job title dictionary which defines each type of personnel listed in the cost account catalog.

5. Federal Stock Numbering Scheme for Commodities

Whenever appropriate, a five-digit Federal Supply Code, published by the U.S. Defense Logistics Services Center, is assigned to the commodity items listed in Account E, providing a reference for the commodity prices.

C. DATA COLLECTION PROCEDURES

1. Requirements Identification

As mentioned above, the cost account catalog contains a list of all ingredients which may be required by one of the solar array manufacturing processes. To identify these ingredients, each of the LSSA Project Task Managers was asked to provide a list of direct requirements for their processes for which the technology is presently operational and cost effective and for those that are likely to be seriously considered in the near future.

To ensure a complete and accurate list of items for the large area silicon sheet processes, the Task 2 subcontractors were asked to review an initial catalog list and to identify additional process requirements. Lamar University was asked to do the same for the Task 1 silicon material processes.

2. Units of Measure

Units of measure were assigned to each item in the catalog. These should be consistent with the typical purchase units.

3. Expected Quantity Ranges

An expected quantity range was computed for each cost item corresponds to solar array production levels ranging from $10^5$ to $10^{10}$ peak watts per year. These ranges established limits for the assignment of unit prices which in many cases vary nonlinearly with the quantity purchased. Caution should be used if the prices are applied to quantities outside of the indicated range.

4. Price Information and Price Versus Quantity Functions

Account A — Facilities. Prices are not included in the catalog for the facilities items in Account A. The associated costs are listed separately in the facilities capital cost table in Volume II. The required amounts of these items determine the initial capital cost of a manufacturing plant.

Account B — Personnel. Federal wage stabilization data was used to assign wage rates to personnel types in Account B. Wages were assumed not to vary with the quantity of labor required and were expressed in annual terms based on 1976 dollars.

Account C — Utilities. Utility prices vary considerably from one location to another. A location analysis was conducted to establish a representative site for both facilities costs and utilities prices. As explained in Volume III, Springfield, Illinois was chosen as the design site. Utility prices were obtained from Springfield and assigned as a function of quantity over the expected ranges.

Account D — By-Products. By-products are generated by the manufacturing processes and include both items that can be sold and those that incur a disposal cost. Items that can be sold should be assigned negative prices.

Account E — Commodities. Commodity prices were compiled from various sources, including JPL Task 4 personnel and the RCA 1977 annual report on "Automated Array Assemblies." Additional information was obtained from the following commodity brokers: Van, Waters & Rogers; Baker Commodities; and Mallinckrodt Chemicals. Finally, the Chemical Marketing Reporter and Motorola reports were also used as data sources.

Account F — Resources. Resources, by definition, are not expense items and are only listed in the cost account catalog to permit an assessment of their utilization. Consequently, prices were not assigned to resource items.

The base-price years associated with the various prices were also specified for each item so that adjustments can be made for inflation.

5. Inflation Rates

Due to the project time and scope constraints, a major economic study was not conducted to assign inflation rates. Rather, the items in Accounts B, C, D, and E were sorted into six classes based on the differences in inflationary trends. Data from the Department of Commerce and a Survey of Current Business Statistics were analyzed to forecast inflation rates for each class. The inflation classes and the recommended rates are listed on the following page. The detailed statistics are tabulated in Appendix D. Inflation rates were also forecasted separately for equipment, land, construction, and facilities. However, these are treated as standard financial parameters in the SAMICS model and, consequently, do not appear in the Cost Account Catalog.

| Catalog Code | Inflation Class | Inflation Rate |
|---|---|---|
| A. | Raw Materials | 11% |
| B. | Labor | 8% |
| C. | Industrial Chemicals | 13% |
| D. | Commodities and Supplies | 8% |
| E. | Energy | 12% |
| F. | Natural Resources | 15% |

In the catalog, the inflation rates are represented by the letter codes listed above rather than the numeric values. This will simplify future changes in the numeric values since the entire catalog will not have to be reprinted.

6. Standard Chart of Accounts

A standard chart of accounts was developed to classify all SAMICS cost parameters into standard balance sheet and income statement accounts for a typical manufacturing firm. The chart is listed in Appendix A with standard titles assigned to each account. A gapped numeric sequence code is used to classify all items by group, major category, and specific account. The numbering scheme allows for the addition of new accounts without destroying the relevance and meaning of numbers already assigned. The structure and characteristics of the five-digit numbering system is illustrated below:

Balance Sheet Accounts

| | |
|---|---|
| 1xx-xx | Assets Group |
| 111-xx | Cash Category |
| 111-10 | Demand Deposits Account |
| 2xx-xx | Liabilities Group |
| 211-xx | Accounts Payable Category |
| 211-10 | Domestic Customers Account |
| 3xx-xx | Owner's Equity Group |
| 311-xx | Capital Stock Category |
| 311-10 | Common Stock (Authorized) Account |

Income Statement Accounts

| | |
|---|---|
| 4xx-xx | Gross Profit Group |
| 411-xx | Operating Income Category |
| 411-10 | Sales Account |
| 6xx-xx | Operating Expenses Group |
| 600-xx | Sales Expenses Category |
| 600-10 | Supplies Account |

| | |
|---|---|
| 8xx-xx | Nonoperating Income and Expenses Group |
| 800-xx | Nonoperating Expense |
| 800-10 | Incidential Rental Expense |
| | |
| 9xx-xx | Taxes Group |
| 900-10 | Federal Income Tax (Current Year) |

## D. STORAGE AND CODING CONVENTIONS

### 1. Record Format

The cost account catalog is divided into two components: descriptive information and price information, with a single record for each expense item. Following is a description of the record format for the two components.

- Cost Account Catalog - Descriptive Information:

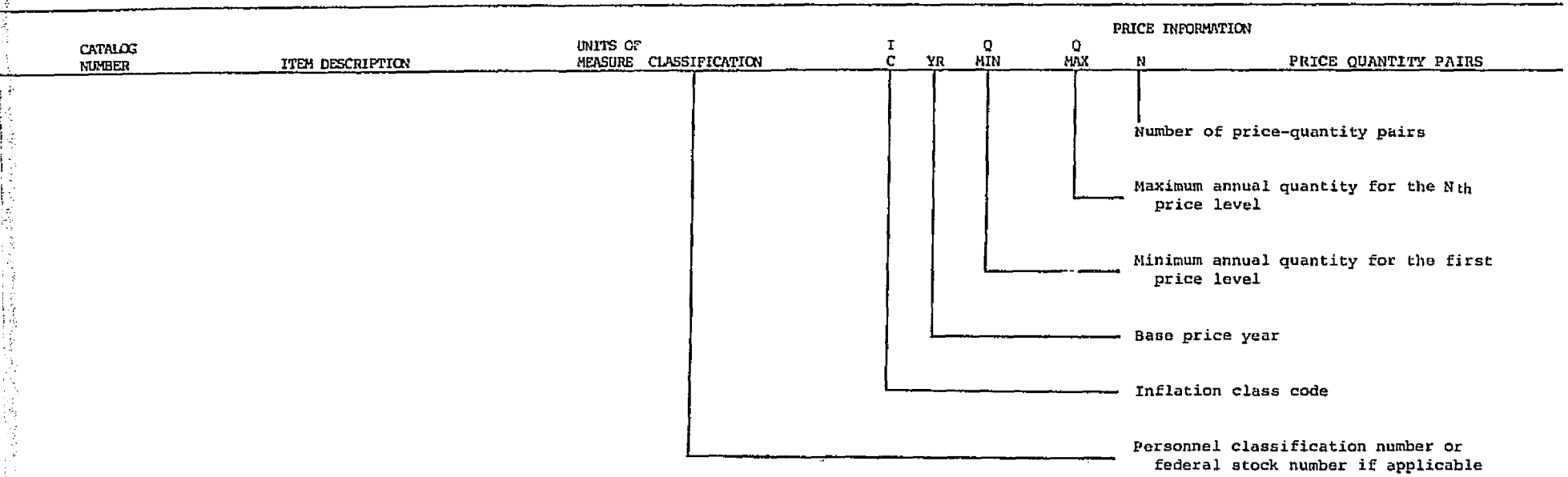
  This section contains catalog numbers, item descriptions, and units of measure for all the catalog items. In addition, classification numbers are assigned to personnel and commodity items. For each descriptive class, a fixed field space is allocated to facilitate differentiation between pairs of data values. The number of columns allocated to each field is specified below and illustrated graphically in the chart on the following page.

| Descriptive Field | # Of Columns |
|---|---|
| Catalog number | 6 |
| Item description | 50 |
| Units of measure | 8 |
| Classification (job class or stock number) | 10 |
| Interfield gaps | 6 |
| Total columns | 80 |

- Cost Account Catalog - Price Information:

  The price information includes inflation class, base price year, expected quantity range, number of price levels, and prices as a function of quantity. The number of columns allocated to each of the six fixed-length price information fields is specified on page II-11.

COST ACCOUNT CATALOG RECORD FORMAT



| Price Field | # Of Columns |
|---|---|
| Inflation class | 1 |
| Base price year | 2 |
| Minimum quantity | 6 |
| Maximum quantity | 6 |
| Number of price | 1 |
| Price quantity pairs (18 spaces each) | 72 |
| Interfield gaps | 9 |
| Total columns | 97 |

2. Numbering and Coding Schemes

Alpha-numeric codes were developed for the following catalog information:

- Catalog Number System:

  The account numbering system is a 6 digit alpha-numeric code as explained above in Section II.B.

- Personnel and Commodity Classification Scheme:

  Personnel items are assigned 6 digit occupational codes in Account B and the federal stock numbers are assigned to commodities in Account E as explained above in Section II.B.

- Inflation Class Coding Scheme:

  A letter coding system is used to denote the six inflation categories, as follows:

| Code | Inflation Class |
|---|---|
| A | Raw materials |
| B | Labor |
| C | Industrial chemicals |
| D | Commodities and supplies |
| E | Energy |
| F | Natural resources |

- Price-Quantity Coding Scheme:

  Space was allocated to allow for four price-quantity levels. For each pair, the price value precedes the associated quantity figure. All prices are expressed as dollars for the associated quantity values rather than as unit prices.

  The prices in Accounts C, D, and E are assigned as a function of quantity over the expected quantity range. Starting with the lowest quantity value ($Q_1$) at level 1, each consecutive level indicates a change in the price-quantity relationship.

In order that the price-quantity values are not misinterpreted, all numbers are right-justified.

3. Storage Medium

The cost account catalog data base is stored on two 120 column lexitron magnetic tape cassettes. The information is arranged so that the data values can be read across, and in order, for each item in the cost account catalog.

## E. MODIFICATION AND EXPANSION PROVISIONS

1. Addition of New Process Requirements

The cost account catalog should be modified as subcontractors identify new process requirements and which are not included. JPL will also identify additional expense items as the SAMICS model is refined.

2. Updating Procedures

The temporary account should be used by subcontractors for items that are not included in the catalog. At regularly scheduled intervals, the catalog should be updated by "clearing" the temporary account and placing the temporary items in regular categories with standard prices, inflation rates, and indirect requirement relationships. A procedure for locating the proper position and assigning the appropriate number to a new catalog item is given above in Section II.B. The updated cost account catalog should then be sent to all users.

3. Contingency Instructions and Guidelines

The SAMICS model users should be given a complete set of contingency instructions and guidelines for using the Cost Account Catalog. This will reduce errors and allieviate problems in preparing the input data. Use of the temporary account should be limited if possible since the prices assigned to temporary items will not be standardized and indirect requirements relationships will not be defined. The contingency instructions should restrict the use of the temporary account to avoid these problems.

# SECTION III
# APPENDICES

# III. APPENDICES

A. PERSONNEL ORGANIZATION CHART

B. PERSONNEL CLASSIFICATION SCHEME

C. PERSONNEL JOB DEFINITIONS

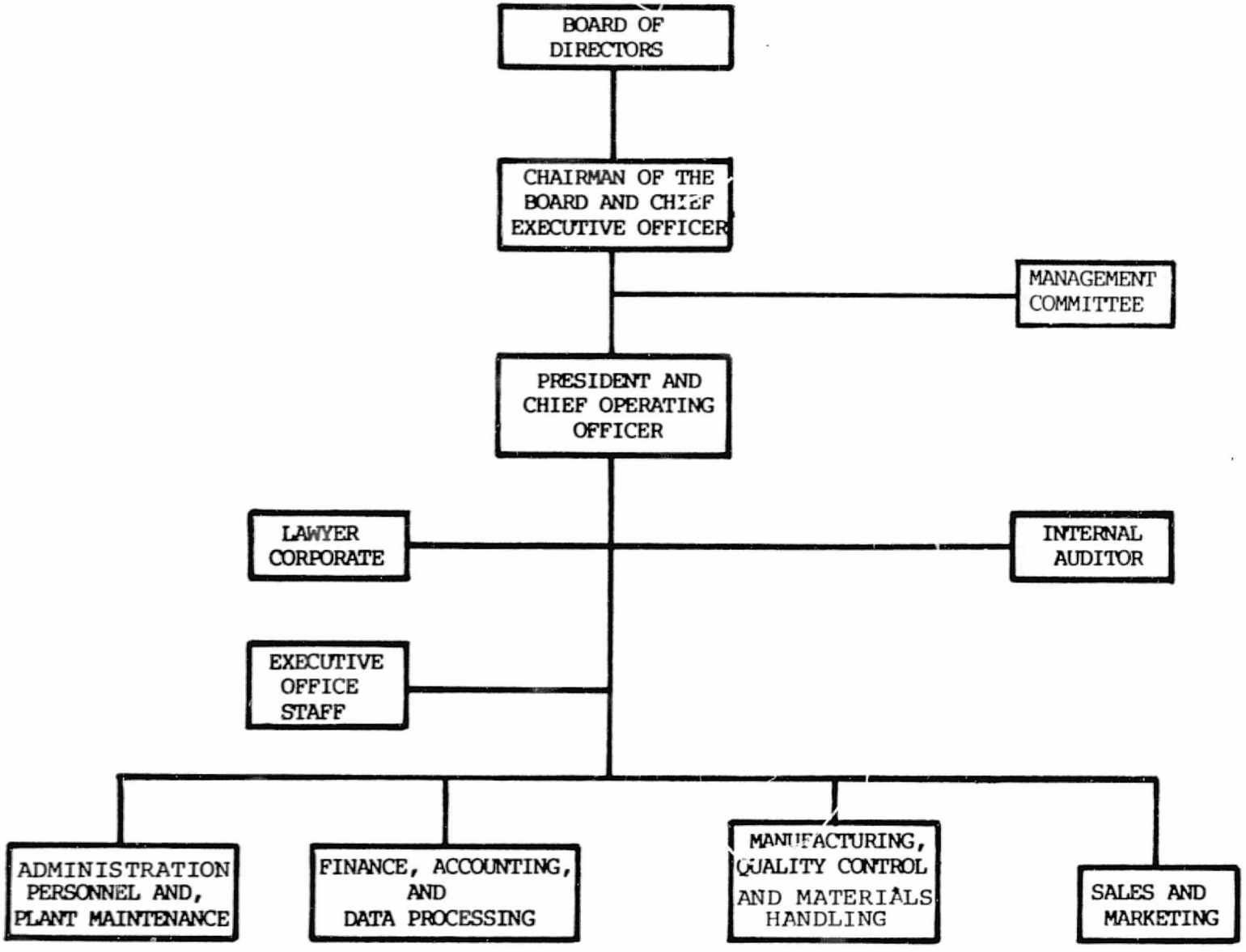
D. INFLATION RATE STATISTICS

E. STANDARD CHART OF ACCOUNTS

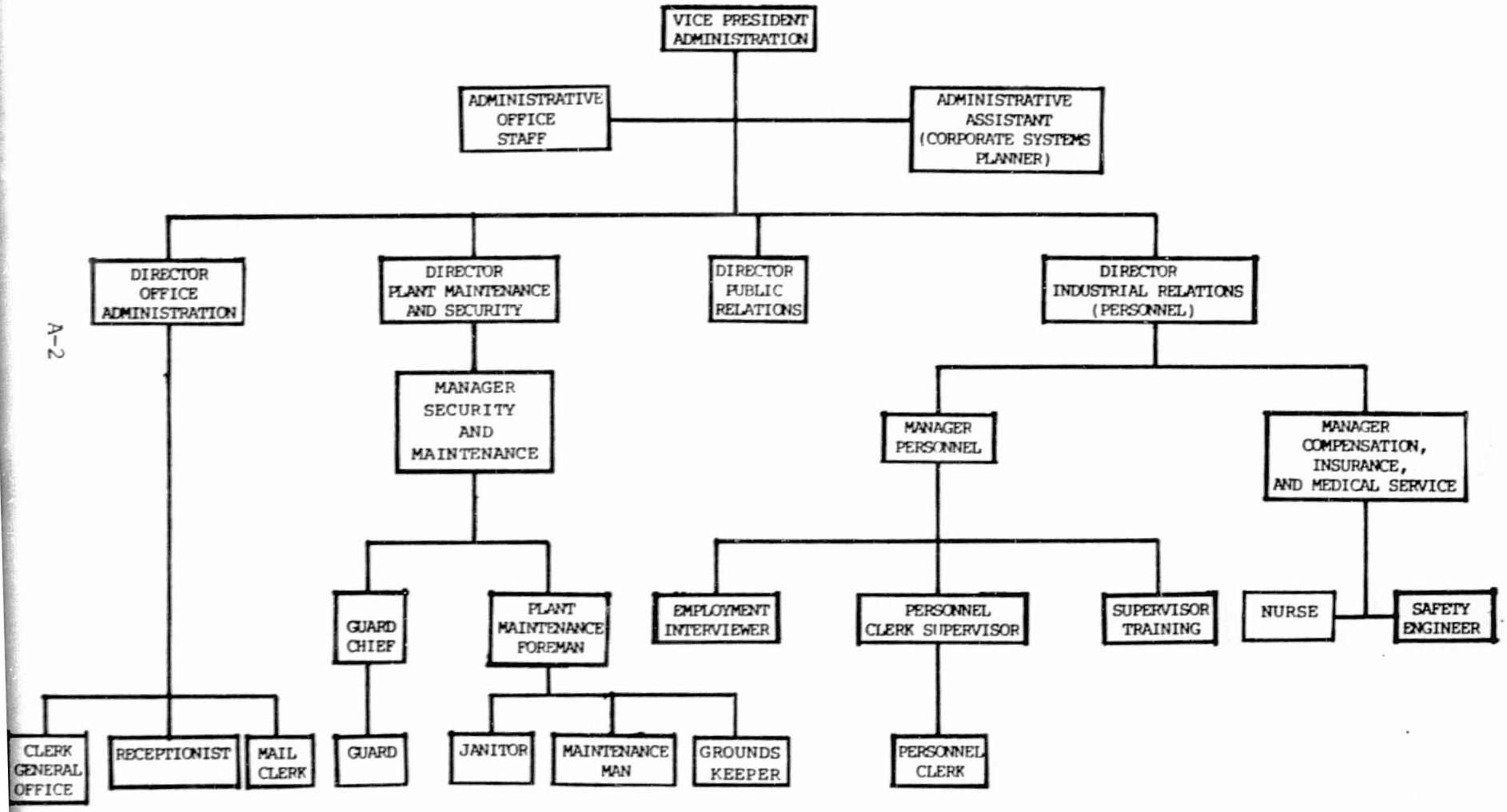
F. COST ACCOUNT CATALOG

APPENDIX A
PERSONNEL ORGANIZATION CHART

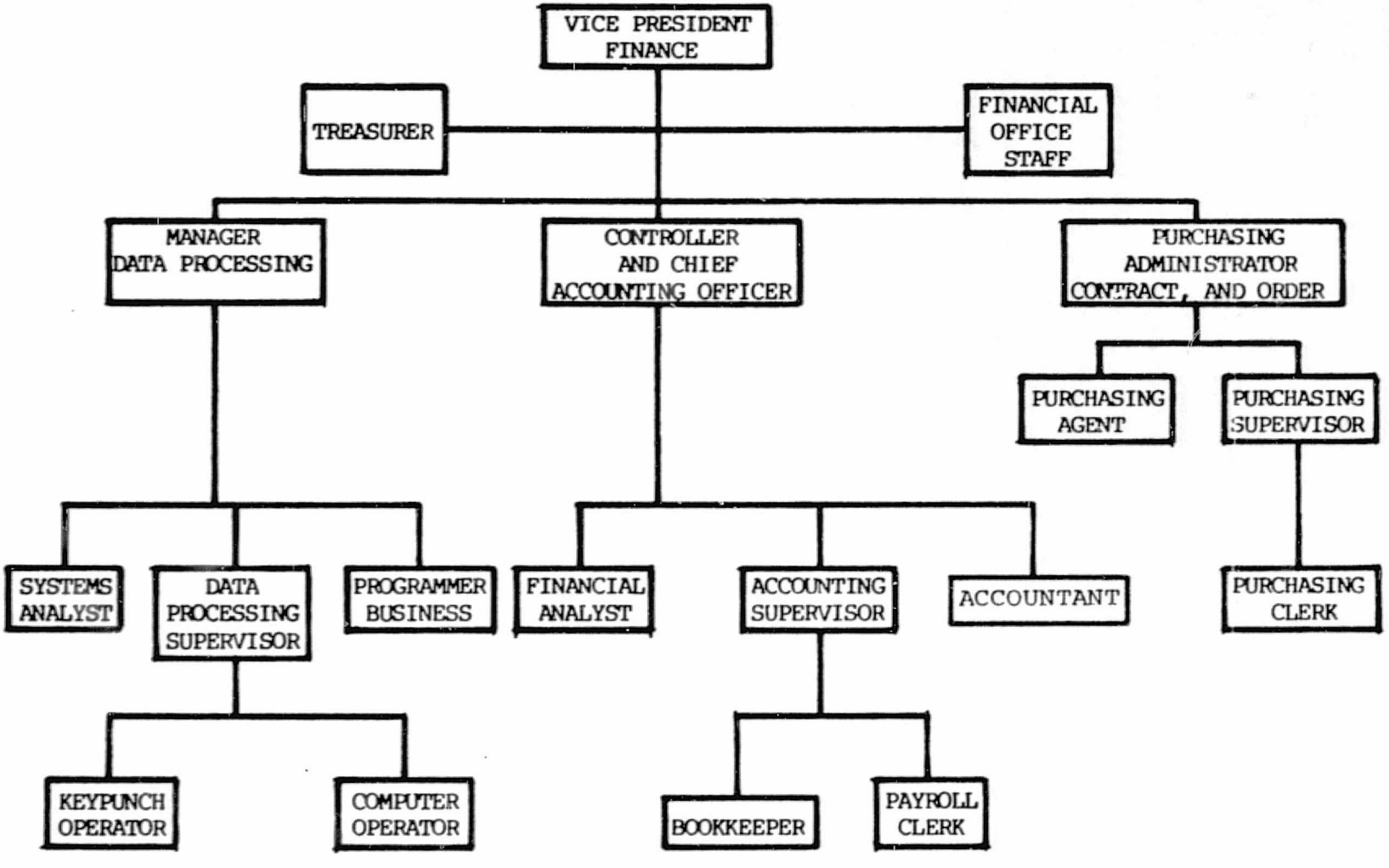
## ORGANIZATION CHART - FRAMEWORK



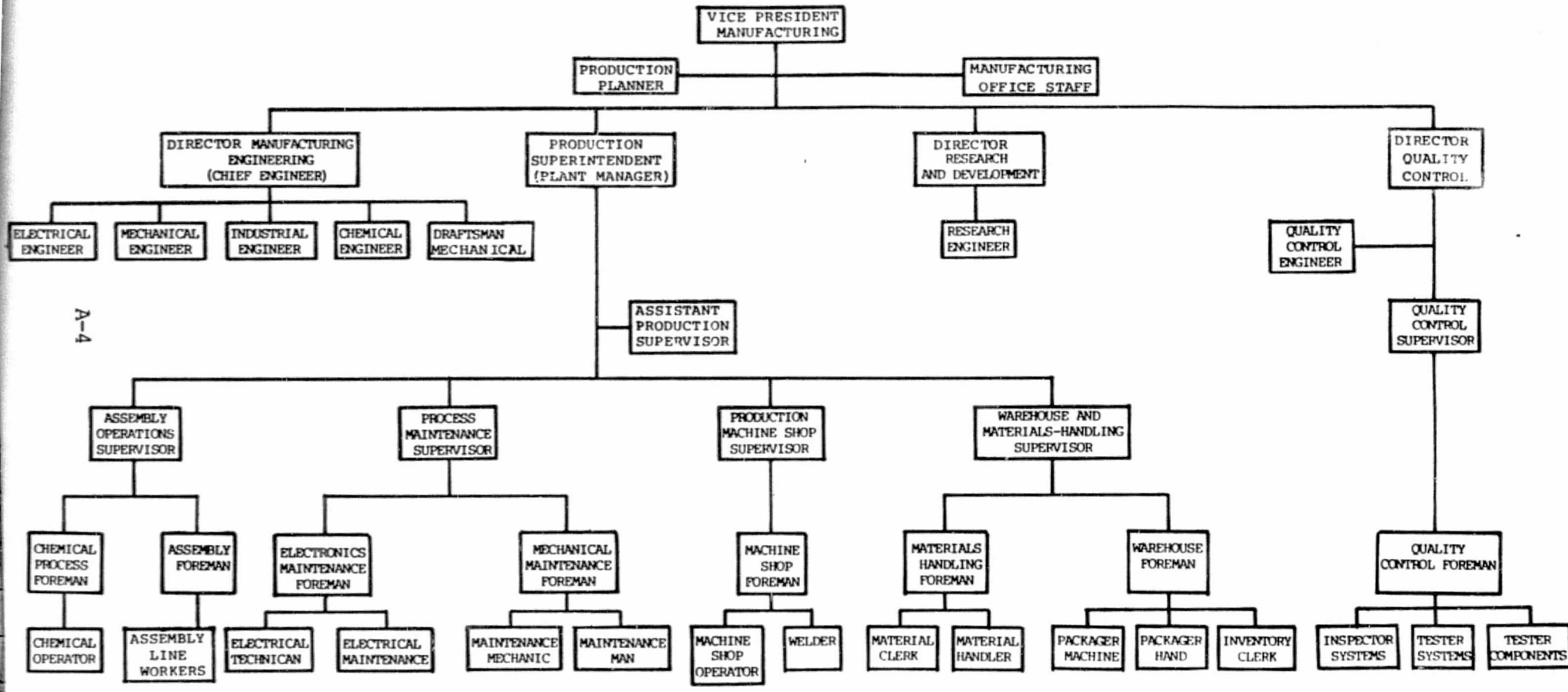
ORGANIZATIONAL CHART - ADMINISTRATIVE, PERSONNEL, AND PLANT MAINTENANCE



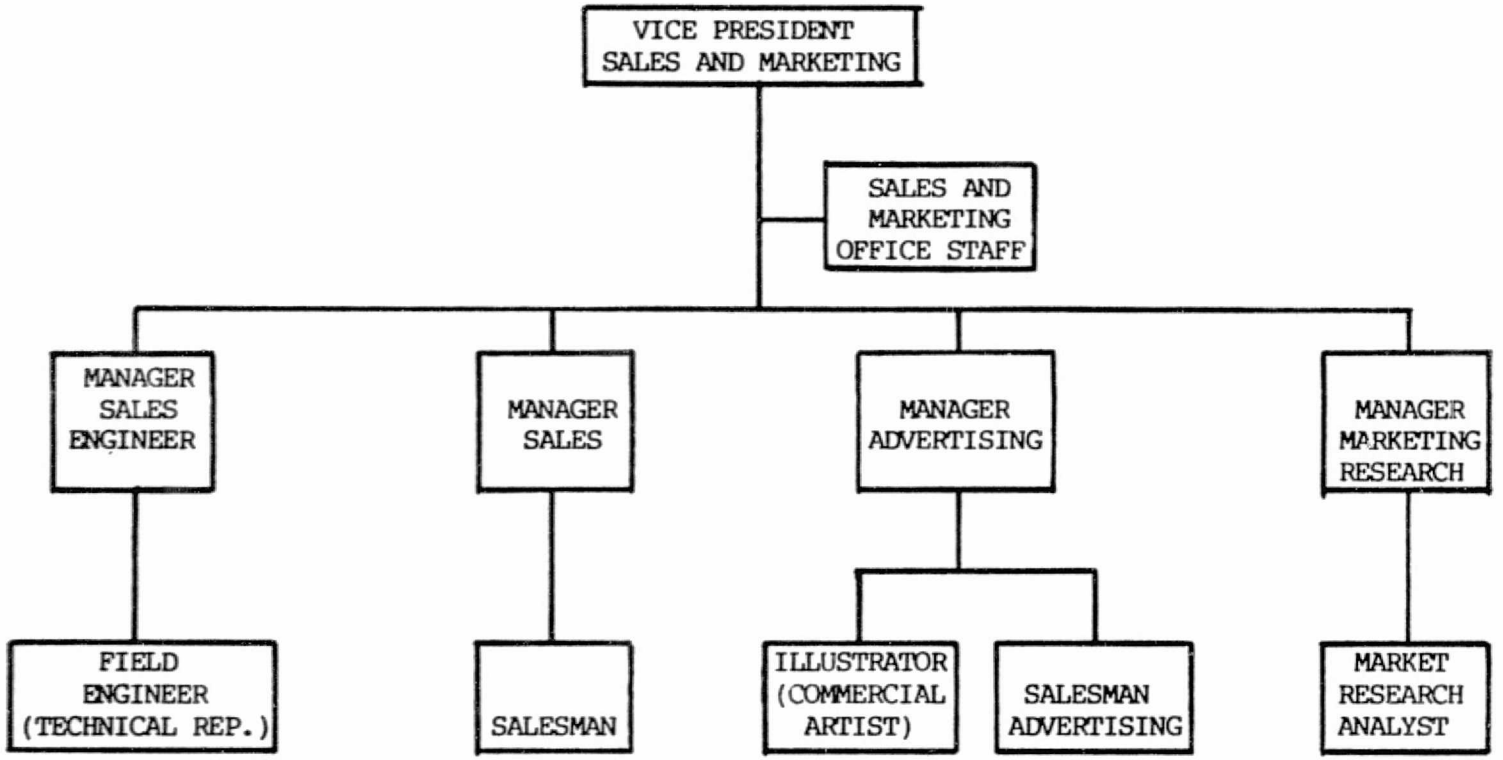
## ORGANIZATION CHART - FINANCE, ACCOUNTING, AND DATA PROCESSING



ORGANIZATION CHART - MANUFACTURING, QUALITY CONTROL, AND MATERIAL HANDLING



## ORGANIZATION CHART - SALES AND MARKETING



APPENDIX B
PERSONNEL CLASSIFICATION SCHEME

As illustrated in the preceding organization chart, personnel are divided into four major departments. The chart delineates the formal lines of authority and functional relationships between each of the departments. The major organizational divisions are:

1. Administration, Personnel, and Plant Maintenance
2. Finance, Accounting, and Data Processing
3. Manufacturing, Quality Control, and Material Handling
4. Sales and Marketing

Account B of the cost account catalog contains standard job titles for all personnel in each of these categories. The next section of this appendix lists definitions for each job. These definitions were extracted from the third edition of the Dictionary of Occupational Titles. Personnel are arranged in alphabetical order by job title. A six-digit occupational classification code is assigned to provide:

1. A standard approach to classifying the abilities, vocational experience, and potentials of workers; and

2. A method of classifying worker trait characteristics so that the user can discern various relationships among occupations.

All occupations are grouped into nine broad categories, which, in turn, are divided into divisions and then groups.

The nine occupational categories are identified by the numbers 0-9. This is reflected in the first digit of the code number, as follows:

| | |
|---|---|
| 0, 1 | Professional, technical, and mangerial occupations |
| 2 | Clerical and sales occupations |
| 3 | Service occupations |
| 4 | Farming, fishery, forestry, and related occupations |
| 5 | Processing occupations |
| 6 | Machine trades occupations |
| 7 | Bench work occupations |
| 8 | Structural work occupations |
| 9 | Miscellaneous occupations |

The categories are further divided into 2-digit divisions, and the divisions, in turn, are subdivided into distinctive 3-digit groups. Following are examples to illustrate the codes.

Example of a Category:

2 Clerical and Sales Occupations

This category includes occupations concerned with preparing, transcribing, transferring, systematizing, and preserving written communications and records.

Example of a Division:

20 Stenography, Typing, Filing, and Related Occupations

This division includes occupations concerned with making, classifying, and filing records, including written communications.

Example of a Group:

201 Secretaries

This group includes occupations concerned with carrying out various administrative and general office duties in addition to taking and transcribing dictation.

The last three digits of the code are based on the premise that:

1. Every job requires the worker to function, in relation to three primary variables: Data, People, and Things.

2. The relationships specific to Data, People, and Things can be arranged in each case from the simple to the complex in the form of a hierarchy so that, generally, each successive function can include the simpler ones and exclude the more complex functions.

| Data (4th Digit) | People (5th Digit) | Things (6th Digit) |
|---|---|---|
| 0 Synthesizing | 0 Monitoring | 0 Setting-up |
| 1 Coordinating | 1 Negotiating | 1 Precision working |
| 2 Analyzing | 2 Instructing | 2 Operating - controlling |
| 3 Compiling | 3 Supervising | 3 Driving - operating |
| 4 Computing | 4 Diverting | 4 Manipulating |
| 5 Copying | 5 Persuading | 5 Tending |
| 6 Comparing | 6 Speaking - Signaling | 6 Feeding - Offbearing |
| 7 No significant | 7 Serving | 7 Handling |
| 8 relationship | 8 No significant relationship | 8 No significant relationship |

Example: Secretary 201368

The last three digits of the code number express the total level of complexity at which the job requires the worker to function.

The numbering code could be expanded to include traits or qualifications profile (e.g., training time, apitudes, physical working conditions, and minimum educational requirements), since these factors affect the wage rates that have been assigned.

A complete description of this personnel coding scheme is provided in Volume II of the Dictionary of Occupational Titles published by the federal government Department of Labor.

# APPENDIX C
# PERSONNEL JOB DEFINITIONS

## I. ADMINISTRATIVE, PERSONNEL, AND PLANT MAINTENANCE

ADMINISTRATIVE ASSISTANT. 169168 - Administrative Analyst. Aids executive in staff capacity by coordinating office services, such as personnel, budget preparation and control, housekeeping, records control, and special management studies. Studies management methods in order to improve workflow, simplify reporting procedures, or implement cost reductions. Analyzes unit operating practices such as recordkeeping systems, forms control, office layout, suggestion systems, personnel requirements, and performance standards, to create new systems or revise established procedures. Analyzes jobs to delimit position responsibilities for use in wage and salary adjustments, promotions, and evaluation of workflow. Studies methods of improving work measurements or performance standards. Coordinates collection and preparation of operating reports, such as time and attendance records, terminations, new hires, transfers, budget expenditures, and statistical records of performance data. Prepares reports including conclusions and recommendations for solution of administrative problems. Issues and interprets operating policies. Reviews and answers correspondence. May assist in preparation of budget needs and annual reports of organization. May interview job applicants, conduct orientation of new employees, and plan training programs. May direct services such as maintenance, repair, supplies, mail, and files.

AUDITOR, INTERNAL. Conducts independent protective and constructive audits for management to review effectiveness of controls, financial records, and operations. Examines records of departments to insure proper recording of transactions and compliance with applicable laws. Inspects accounting systems to determine their efficiency and protective value. Reviews records pertaining to material assets, such as equipment, buildings, or manpower, to determine degree to which they are utilized. Analyzes data obtained for evidence of deficiencies in controls, duplication of effort, extravagance, fraud, or lack of compliance with management's established policies or procedures. Prepares reports of findings and recommendations to management. May conduct special studies for management, such as those required to discover mechanics of detected frauds and to develop controls for their prevention.

CLERK, GENERAL OFFICE. 219388 - Administrative Clerk. Performs variety of following or similar clerical duties, utilizing knowledge of systems or procedures. Copies data and compiles records and reports. Tabulates and posts data in record books. Computes wages, taxes, premiums, commissions, and payments. Records orders for merchandise or service. Gives information to and interviews customers, claimants, employees, and sales personnel. Receives, counts, and pays out cash. Prepares, issues, and sends out receipts, bills, policies, invoices, statements, and checks. Prepares stock inventory. Adjusts complaints. Operates office machines, such as typewriter, adding, calculating, and duplicating machines. Opens and routes incoming mail, answers correspondence, and prepares outgoing mail. May take dictation. May prepare payroll. May keep books. May purchase supplies.

DIRECTOR, INDUSTRIAL RELATIONS. 166118 - Industrial Relations Adviser. Organizes, directs, and coordinates industrial relations activities of organization. Assembles and analyzes data concerning problems, such as absenteeism, labor turnover, and employment of physically handicapped and women. Conducts surveys on living costs and wage rates. Studies current labor laws and regulations, arbitration decisions, collective bargaining contracts, and other labor relations trends. Formulates, interprets, and recommends manpower policies concerning recruitment, selection, placement, wage and salary administration, collective bargaining, maintenance of personnel records, and education, health, safety, and incentive programs. Develops company policies concerning layoffs, performance reporting, and employee rating. Participates in collective bargaining negotiations or advises other company representatives. Consults with legal staff to insure adherence to laws, regulations, and contracts.

DIRECTOR, OFFICE ADMINISTRATION. 169168 - Administrative Secretary. Keeps official corporation records and executes administrative policies determined by or in conjunction with other officials. Prepares memorandums outlining and explaining administrative procedures and policies to supervisory workers. Plans conferences. Directs preparation of records, such as notices, minutes, and resolutions for stockholders' and directors' meetings. Directs recording of company stock issues and transfers. Acts as custodian of corporate documents and records. Directs preparation and filing of corporate legal documents with government agencies to conform with statutes. In small organizations, such as trade, civic, or welfare associations, often performs publicity work. Depending on organization, works in line or staff capacity.

DIRECTOR, PUBLIC RELATIONS. 165068 - Public Relations Man. Plans and conducts public relations programs designed to procure publicity for groups, organizations, or institutions through such media as magazines, newspapers, radio, and television. Selects and assembles publicity material that accords with organizational policy. Writes news releases and submits photographs to newspapers. Writes scripts for radio and television presentation, such as spot announcements, cooperative broadcasts, or educational programs, to promote facilities, services, and activities of organization. Directs advertising campaigns in newspapers and magazines, or on radio and television, purchasing space or time as required. Assigns and approves art work, such as posters, signs, or displays. Participates in community and civic programs. May edit material and direct preparation of organization publications. May direct public opinion polls to obtain information on effectiveness of advertising and public relations programs.

EMPLOYMENT CLERK. 205368 - Interviewer. Interviews applicants for employment and processes application forms. Interviews applicants to obtain information, such as age, marital status, work experience, education, training, and occupational interest. Informs applicants of company employment policies. Refers qualified applicants to employing official. Writes letters to references indicated on application or telephones agencies, such as credit bureaus and finance companies. Files applications forms. Compiles reports for supervisors on applicants and employees from personnel records. May review credentials to establish eligibility of applicant in regard to identification and naturalization. May telephone or write applicant to inform him of acceptance or rejection for employment. May administer aptitude, personality, and interest tests. May compile personnel records (PERSONNEL CLERK).

EMPLOYMENT INTERVIEWER. 166268 - Interviewer. Interviews applicants to determine their suitability for employment with company. Records information and impressions gained from applicants and evaluates information to determine suitability for employment. Administers tests and interprets results. Prepares rating on applicants and makes recommendations for future consideration of those not immediately employed. Supplies such information to applicants as company and union policies, duties, responsibilities, working conditions, hours and pay, and promotional opportunities. Prepares and maintains records of those interviewed, accepted, or rejected, and those declining appointment. Discusses hiring activity with supervisors to determine adequacy of selection techniques or recruitment program. Observes jobs to obtain first-hand information of job requirements and needs.

GROUNDS KEEPER. 407884 - Caretaker, Grounds. Maintains grounds of industrial, commercial, or public property, performing combination of following tasks. Cuts lawns, using hand mower or power mower. Trims and edges around walks, flower beds, and walls, using clippers and edging tools. Prunes shrubs and trees to shape and improve growth, using shears. Sprays lawn, shrubs, and trees with fertilizer or insecticide. Rakes and burns leaves and cleans or sweeps up litter, using spiked stick or broom. Shovels snow from walks and driveways. Plants, grass, flowers, trees, and shrubs. Waters lawn and shrubs during dry periods, using hose or by activating fixed or portable sprinkler system. Repairs fences, gates, walls, and walks, using carpentry and masonry tools. Paints fences and outbuildings. Cleans out drainage ditches and culverts, using shovel and rake. Depending on size and nature of employing establishment, may operate tractor equipped with attachments, such as mowers, lime or fertilizer spreaders, and lawn roller.

GUARD. 372868 - Watchman. Stands guard or walks about premises of business or industrial establishment to prevent theft, violence, or infractions of rules, to direct patrons or employees, and to answer questions relative to services of establishment. Patrols assigned area or sits or stands at post to watch for suspicious persons and activities. Warns violators of rule infractions, such as loitering, smoking, or carrying forbidden articles. Reports irregular activities or apprehends or expels miscreants. Keeps order to prevent disturbances. Answers questions and gives directions on request. May guard shipments of valuables between establishment and bank. May collect tickets or examine credentials at entrance.

GUARD, CHIEF. 372168 - Supervises and coordinates activities of guard force of establishment, such as industrial plant, department store, or museum. Assigns personnel to posts or patrol, according to size and nature of establishment and indicated protection requirements. Interprets security rules and directs subordinates in their enforcement, such as issuance of security badges, photographing of employees, and safekeeping of forbidden articles carried by visitors. Responds to calls from subordinates to direct activities during fires, storms, riots, or other emergencies. Inspects or directs inspection of premises to test alarm systems, detect safety hazards, and to insure that safety rules are posted and enforced. Examines fire extinguishers (FIRE INSPECTOR) and other safety equipment for serviceability. Reports irregularities and hazards to appropriate personnel. Selects and trains subordinates in protective procedures, first aid, fire safety, and other duties. Cooperates with police, fire, and civil defense authorities in problems affecting establishment.

JANITOR. 382884 - Superintendent, Building. Keeps hotel, office building, apartment house, or similar building in clean and orderly condition and tends furnace and boiler to provide heat and hot water for tenants, performing any combination of following duties. Sweeps and mops or scrubs hallways and stairs. Regulates flow of fuel into automatic furnace or shovels coal into hand-fired furnace. Empties tenants' trash and garbage containers. Keeps building in good repair, performing routine painting, plumbing, electrical wiring, and other related maintenance activities, using hand tools. Cautions tenants regarding complaints about excessive noise, disorderly conduct, or misuse of property. Notifies management concerning need for major repairs or additions to lighting, heating, and ventilating equipment. Cleans snow and debris from sidewalk. Mows lawn, trims shrubbery, and cultivates flowers, using hand tools and power tools. Posts signs to advertise vacancies and shows empty apartments to prospective tenants. May reside on property.

LAWYER, CORPORATION. 110118 - Corporate Counsel. Advises corporation concerning legal rights, obligations, and privileges. Studies Constitution, statutes, decisions, and ordinances of quasi-judicial bodies. Examines legal data to determine advisability of defending or prosecuting lawsuit. May act as agent of corporation in various transactions.

LEGAL SECRETARY. Prepares legal papers and correspondence of legal nature, such as summonses, complaints, motions, and subpoenas, in addition to other secretarial duties.

MAINTENANCE FOREMAN. 891138 - Building and Grounds Foreman. Supervises and coordinates activities of workers engaged in keeping buildings and grounds in clean and orderly condition and in maintaining and repairing utility systems and physical structures of buildings. Directs workers engaged in mowing lawns, trimming hedges, and raking and burning leaves and refuse. Directs workers engaged in making structural repairs to masonry, woodwork, and furnishings of buildings and similar structures. Directs workers engaged in maintaining and repairing building utility systems, such as electric wiring and controls, heating, ventilating, and steam generating systems (UTILITIES AND MAINTENANCE FOREMAN). Directs workers engaged in maintaining and repairing plumbing systems (PLUMBER FOREMAN, MAINTENANCE). May compile reports of cost of completed work. May supervise workers engaged in servicing and repairing mechanical equipment. May requisition tools, equipment, and supplies. May inspect completed work for conformance to blueprints and other specifications.

MAINTENANCE MAN, FACTORY. 899281 - Handyman, Factory. Repairs and maintains machinery, plumbing, physical structure, and electric wiring and fixtures of commercial and industrial establishments in accordance with blueprints, manuals, and building codes, using hand tools and carpenters', electricians', and plumbers' tools. Inspects machinery and mechanical equipment for defects. Dismantles machines or equipment to gain access to defective parts, and repairs them, using hand tools. Repairs canvas, leather, or rubber drive belts and replaces them on machines. Cleans and lubricates shafts, bearings, gears, pulleys, and other parts of machine, using rags, brushes, and grease gun. Measures, cuts, and installs pipe and tubing for gas, water, and hydraulic lines, using ratchet, cutting die, and threading die. Repairs and replaces gages, valves, pressure regulators, and other plumbing equipment, and opens clogged drains, using plunger and plumbers' tools. Installs electrical equipment and repairs or replaces wiring and fixtures. Makes and repairs counters,

benches, partitions, and other wooden structures, using saws, braces, bits, and other carpenters' tools. Paints walls, floors, woodwork, and fixtures of establishment, using spray gun and brushes. Replaces and repairs brick and plaster walls, using trowel.

MANAGER, COMPENSATION, INSURANCE, AND MEDICAL SERVICE. 199118 - Plans and carries out policies relating to medical service, compensation, and insurance.

MANAGER, PERSONNEL. 166118 - Manager, Employee Relations. Plans and carries out policies relating to all phases of personnel activities. Organizes recruitment, selection, and training procedures, and directs activities of subordinates directly concerned. Confers with company and union officials to establish pension and insurance plans, workman's compensation policies, and similar functions. Establishes social, recreational, and educational activities. Studies personnel records for information, such as educational background, work record, and supervisor's reports, to determine personnel suitable for promotions and transfers. May represent company in negotiating wage agreements with labor representatives. May act as liaison between management and labor within organization.

MANAGER, SECURITY AND MAINTENANCE. 199118 - Plans security and maintenance policies, and arranges for the execution of these policies.

NURSE, PROFESSIONAL. Nurse, Registered. A term applied to persons meeting the educational, legal, and training requirements to practice as professional nurses, as required by a State board of nursing. Performs acts requiring substantial specialized judgment and skill in observation, care, and counsel of ill, injured, or infirm persons and in promotion of health and prevention of illness.

PERSONNEL CLERK. 205368 - Interviewer. Interviews applicants for employment and processes application forms. Interviews applicants to obtain information, such as age, marital status, work experience, education, training and occupational interest. Informs applicants of company employment policies. Refers qualified applicants to employing official. Writes letters to references indicated on application or telephones agencies, such as credit bureaus and finance companies. Files applications forms. Compiles reports for supervisors on applicants and employees from personnel records. May review credentials to establish eligibility of applicant in regard to identification and naturalization. May telephone or write applicant to inform him of acceptance or rejectiuon for employment. May administer aptitude, personality, and interest tests. May compile personnel records.

PERSONNEL CLERK SUPERVISOR. 205138 - Supervises and coordinates activities of workers engaged in compilation and maintenance of personnel records, performing duties as described under SUPERVISOR. Coordinates recording and filing of information about company personnel, such as promotions, wage scales, absences, training status, and discharges. Compiles reports of absences, accession rates, salaries, and other matters of interest to company management, using typewriter and calculator. May hire and discharge subordinates.

PRESIDENT. 189118 - As head administrator of business organization, develops and administers policies of organization in accordance with corporation charter. Establishes operating objectives and policies for firm. Coordinates plans to

insure effective flow of work between divisions. Reviews progress and makes necessary changes in company plans. Directs preparation of major financial programs, such as pricing policies and salary and wage schedules, to insure operating efficiency and adequate investment and dividend returns. Plans and develops policies to maintain satisfactory company relations with employees, stockholders, and public. Evaluates performance of executives to insure compliance with overall objectives of firm. May preside over board of directors. May serve as chairman of committees, such as management, executive, and engineering, and as member of committees, such as production, sales, and development.

RECEPTIONIST. 237368 - Schedules appointments, gives information to callers, and otherwise relieves officials of minor administrative and business detail.

SAFETY ENGINEER. 012081 - Plans, establishes, and executes all phases of activity related to safety.

SECRETARY. 201368 - Lower Management (I), Middle Management (II), and Upper Management (III). Schedules appointments, gives information to callers, takes dictation, and otherwise relieves officials of clerical work and minor administrative and business detail. Reads and routes incoming mail. Locates and attaches appropriate file to correspondence to be answered by employer. Takes dictation in shorthand or on Stenotype machine (STENOTYPE OPERATOR) and transcribes notes on typewriter, or transcribes from voice recordings (TRANSCRIBING-MACHINE OPERATOR). Composes and types routine correspondence. Files correspondence and other records. Answers telephone and gives information to callers or routes call to appropriate official and places outgoing calls. Schedules appointments for employer. Greets visitors, ascertains nature of business, and conducts visitors to employer or appropriate person. May not take dictation. May arrange travel schedule and reservations. May compile and type statistical reports. May supervise clerical workers. May keep personnel records (PERSONNEL CLERK). May record minutes of staff meetings.

SUPERVISOR, TRAINING. 166228 - Supervises and coordinates activities of training force.

VICE-PRESIDENT, ADMINISTRATION. 189118 - Aids head administrator in administering and formulating organization policies, and supervises activities of one or more departments, such as purchasing, sales, manufacturing, engineering, or finance. Participates in formulating company policies and assists in developing long-range plans. Coordinates programs in departments as approved by PRESIDENT or board of directors to attain company's goals. Confers with PRESIDENT to discuss analyses of activities, costs, budgets, and forecasts to determine changes needed for attaining company goals. May be responsible for current information on legislation related to operations and for action to secure favorable legislation. May perform duties of PRESIDENT. May serve as member of management committees.

ACCOUNTANT. 160188 - Manager, Office. Applies principles of accounting to install and maintain operation of general accounting system. Designs new system or modifies existing system to provide records of assets, liabilities, and financial transactions of establishment. Maintains accounts and records or supervises subordinates in such bookkeeping activities as recording disbursements, expenses, or tax payment, or in maintenance of accounting controls over inventories or purchases. Audits contracts, orders, and vouchers, and prepares reports which substantiate individual transactions before their settlement. Prepares and files tax returns and other regular and special reports to government agencies (ACCOUNTANT, TAX). May represent establishment before such agencies upon certification by agency involved. May work independently for fee or as member of accounting firm and be designated ACCOUNTANT, PUBLIC.

ACCOUNTING SUPERVISOR. A term applied to any accountant who is considered a senior member of an accounting department or organization. May supervise staff of ACCOUNTANTS.

BOOKKEEPER. 210388 - Full-Charge Bookkeeper. Keeps records of financial transactions of establishment. Verifies and enters details of transactions as they occur or in chronological order in account and cash journals from items, such as sales slips, invoices, check stubs, inventory records, and requisitions. Summarizes details on separate ledgers, using adding machine, and transfers data to general ledger. Balances books and compiles reports to show statistics, such as cash receipts and expenditures, accounts payable and receivable, profit and loss, and other items pertinent to operation of business. Calculates employee wages from plant records or timecards and makes up checks or withdraws cash from bank for payment of wages. May prepare withholding, Social Security, and other tax reports. May compute, type, and mail monthly statements to customers. May complete books to or through trial balance. May operate calculating and bookkeeping machines.

CONTROLLER AND CHIEF ACCOUNTING OFFICER. 186118 Comptroller. Directs financial affairs of an organization. Prepares financial analyses of operations for guidance of management. Establishes major economic objectives and policies for company. Prepares reports which outline company's financial position in areas of income, expenses, and earnings, based on past, present, and future operations. Directs preparation of budgets and financial forecasts. Determines depreciation rates to apply to capitalized items. Prepares governmental reports. Advises management on desirable operational adjustments due to tax revisions. Arranges for audits of company's accounts. Advises management about insurance coverage for protection against property losses and potential liabilities. May act as TREASURER. Applies principles of accounting to install and maintain operation of general accounting system. Designs new system or modifies existing system to provide records of assets, liabilities, and financial transactions of establishment. Maintains accounts and records or supervises subordinates in such bookkeeping activities as recording disbursements, expenses, or tax payment, or in maintenance of accounting controls over inventories or purchases. Audits contracts, orders, and vouchers, and prepares reports which substantiate individual transactions before their settlement. Prepares and files tax returns and other

regular and special reports to government agencies (ACCOUNTANT, TAX). May represent establishment before such agencies upon certification by agency involved. May work independently for fee or as member of accounting firm.

DIGITAL-COMPUTER OPERATOR. 213382 - Computer Operator. Monitors and controls electronic digital computer to process business, scientific, engineering, or other data, according to operating instructions. Sets control switches on computer and peripheral equipment, such as external memory, data communicating, synchronizing, input, and output recording, or display devices, to integrate and operate equipment according to program, routines, subroutines, and data requirements specified in written operating instructions. Selects and loads input and output units with materials, such as tapes or punch cards, and printout forms, for operating runs or oversees operators of peripheral equipment who perform these functions. Moves switches to clear system and start operation of equipment. Observes machines and control panel on computer console for error lights, verification printouts and error messages, and machine stoppage or faulty output. Types alternate commands into computer console according to predetermined instructions to correct error or failure and resume operations. Notifies supervisor of errors or equipment stoppage. Clears unit at end of operating run and reviews schedule to determine next assignment. Records operating and down time. Wires control panels of peripheral equipment. May control computer to provide input or output service for another computer under instructions for operator of that unit.

FINANCIAL ANALYST. 020188 - Investment Analyst. Conducts statistical analyses of information affecting investment program of public, industrial, and financial institutions, such as banks, insurance companies, and brokerage and investment houses. Interprets data concerning investments, their price, yield, stability, and future trends, according to daily stock and bond reports, financial periodicals, securities manuals, and personal interviews. Constructs charts and graphs regarding investments. Summarizes data setting forth current and long-term trends in investment risks and measurable economic influences pertinent to status of investments. May perform research and make analyses relative to losses and adverse financial trends and suggest remedial measures. May transmit buy-and-sell orders to broker based on securities analysis.

KEY-PUNCH OPERATOR. 213582 - Card-Punch Operator. Operates alphabetic and numeric key-punch machine, similar in operation to electric typewriter, to transcribe data from source material onto punchcards and produce prepunched data. Attaches skip bar to machine and previously punched program card around machine drum to control duplication and spacing of constant data. Loads machine with decks of punchcards. Moves switches and depresses keys to select alphabetic or numeric punching, and transfer cards through machine stations. Depresses keys to transcribe new data in prescribed sequence from source material into perforations on card. Inserts previously punched card into card gage to verify registration of punches. Observes machine to detect faulty feeding, positioning, ejecting, duplicating, skipping, punching, or other mechanical malfunctioning and notifes supervisor. Removes jammed cards, using prying knife. May tend machines that automatically sort, merge, or match punchcards into specified groups. May key-punch numerical data only.

MANAGER, DATA PROCESSING. 169168 - Plans and carries out policies relating to all phases of data processing.

PAYROLL CLERK. 215488 - Computes wages and posts wage data to payroll records. Computes earnings from time sheets and work tickets, using calculator. Operates posting machine to compute and subtract deductions, such as income tax withholdings, social security payments, insurance, credit-union payments, and bond purchases. Enters net wages on earning record card, check, check stub, and payroll sheet. May prepare annual reports of earnings and income tax deductions. May keep records of sick leave pay and nontaxable wages. May prepare and distribute pay envelopes. May compute wages for employees working on bonus, commission, or piecework systems.

PROCUREMENT CLERK. 223368 - Assistant Buyer. Compiles information and records to draw up purchase orders for procurement of material for industrial firm, governmental agency, or other establishment. Verifies nomenclature and specifications of purchase requests. Searches inventory records or warehouse to determine if material on hand is in sufficient quantity. Consults catalogs and interviews salesmen to obtain prices and specifications. Types or writes invitation-of-bid forms and mails forms to supplier firms or for public posting. Writes or types purchase order and sends copy to supplier and department originating request. Compiles records, such as of items purchased or transferred between departments, prices, deliveries, and inventories. Confers with suppliers concerning late deliveries. May compare prices, specifications, and delivery dates, and award contract to bidders or place orders with salesmen or mail-order firms. May compute total cost of items purchased, using calculating machine. May classify priority regulations. May verify bills from suppliers with bids and purchase orders and approve for payment.

PROGRAMMER, BUSINESS. 020188 - Assists in the design and development of applications software.

PURCHASING ADMINISTRATOR. 162118 - Contract Administrator. Directs activities concerned with contracts for purchase or sale of equipment, materials, products, or services. Examines estimates of material, equipment, and production costs, performance requirements, and delivery schedules to insure completeness and accuracy. Prepares bids, process specifications, test and progress reports, and other exhibits that may be required. Reviews bids from other firms for conformity to contract requirements and determines acceptable bids. Negotiates contract with customer or bidder. Requests or approves amendments to or extensions of contracts. Advises planning and production departments of contractual rights and obligations. May compile data for preparing estimates. May coordinate work of sales department with production and shipping department to implement fulfillment of contracts. May act as liaison between company and subcontractors. May direct sales program (MANAGER, SALES).

PURCHASING AGENT. 162158 - Buyer. Purchases machinery, equipment, tools, raw materials, parts, services, and supplies necessary for operation of an organization, such as an industrial establishment, public utility, or government unit. Reviews requisitions. Interviews vendors to obtain information relative to product, price, ability of vendor to produce product, service, and delivery date. Reviews proposals from several vendors and negotiates with acceptable bidder for contracts, keeping within budgetary limitations. Keeps records pertaining to

items purchased, costs, delivery, product performance, and inventories. Discusses defects of purchased goods with quality control or inspection personnel to determine source of trouble and takes corrective action. May approve bills for payment. May follow up orders to insure specified delivery date (EXPEDITER I).

SYSTEMS ANALYST. 012168 - Commercial-Systems Analyst and Designer. Analyzes business problems, such as development of integrated production, inventory control and cost analysis system, to refine its formulation and convert it to programmable form for application to electronic data-processing system. Confers with PROJECT DIRECTOR, BUSINESS DATA PROCESSING and department heads of units involved to ascertain specific output requirements, such as types of breakouts, degree of data summarization, and format for management reports. Confers with personnel of operation units to revise plans for obtaining and standardizing input data. Studies current, or develops new systems and procedures to devise workflow sequence. Analyzes alternative means of deriving input data to select most feasible and economical method. Develops process flow charts or diagrams in outlined and then in detailed form for programming, indicating external verification points, such as audit trail printouts. May direct preparation of programs.

TREASURER. 161118 - Treasury Representative. Directs financial planning, procurement, and investment of funds for an organization. Delegates authority for receipt, disbursement banking, protection, and custody of funds, securities, and financial instruments. Analyzes financial records to forecast future financial position and budget requirements. Evaluates need for procurement of funds and investment of surplus. Advises management on investments and loans for short- and long-range financial plans. Prepares financial reports for management. Develops policies and procedures for account collections and extension of credit to customers. Works closely with and may act as CONTROLLER. Signs notes of indebtedness as approved by management.

VICE-PRESIDENT, FINANCE. 189118 - Aids head administrator in administering and formulating organization policies and supervises activities of one or more departments, such as purchasing, sales, manufacturing, engineering, or finance. Participates in formulating company policies and assists in developing long-range plans. Coordinates programs in departments as approved by PRESIDENT or board of directors to attain company's goals. Confers with PRESIDENT to discuss analyses of activities, costs, budgets, and forecasts to determine changes needed for attaining company goals. May be responsible for current information on legislation related to operations and for action to secure favorable legislation. May perform duties of PRESIDENT. May serve as member of management committees.

## III. MANUFACTURING, QUALITY CONTROL, AND MATERIALS HANDLING

### Assembly Line Workers

CHASSIS ASSEMBLER. 729884 - Chassis-Line Operator. Assembles chassis of electronic equipment, such as radio and television receivers, electric organs, and record players, using hand tools and power tools and following wiring diagrams or sample assemblies. Bolts and rivets parts, such as coils, transformers, tuning units, printed-circuit subassemblies, tube sockets, and switches to chassis, using hand tools, rivet gun, and pneumatic wrench. Inserts ends of precut wires into chassis terminals, trims ends with cutters, and solders ends to terminals to connect components. Fastens wires to terminals of printed-circuit boards installed on chassis, using wire-wrapping-and-welding device or soldering iron. Inserts tubes in sockets. May assemble cables, following wiring diagram and color code.

ELECTRONICS ASSEMBLER. 726781 - Bench Assembler. Assembles electronic equipment, such as computers, movie sound recorders, radar and sonar, machine-tool numerical control devices, and telemetering systems, using electronic test equipment, hand tools, and power tools and following blueprints, wiring diagrams, and manufacturing standards. Bolts components, such as transformers, switches, jacks, tube sockets, and terminal and circuit boards to panel, chassis, or cabinet, using hand tools and pneumatic wrench. Connects lead wires of components, such as resistors, capacitors, transistors, diodes, and rectifiers, to specified terminals, using soldering iron or spot welder. Routes and fastens precut jumper wires and cables to specified contact points, following writing diagram and wire lists, to form circuit wiring. Tests circuits for shorts and open wires, using continuity meter. May solder precut wires to multiple-pin connectors, and lace wires with waxed twine or plastic strips to assemble cables. May cut and strip wires, using wire cutters, to prepare jumper wires. May test completed assembly, using test equipment, such as oscilloscope and multimeter. May resolder connections or replace defective components and wiring, following instructions of testing or inspection personnel, to repair defective equipment.

ENCAPSULATOR. 726887 - Sealer. Encapsulates electrical and electronic components, such as coil cases, transformers, capacitors, semiconductors and modules with material, such as tar, plastic, or epoxy to protect components from humidity and vibration by any of following methods: (1) Positions module or transformer case under outlet of tank containing encapsulating fluid. Moves controls to force preset amount of fluid through opening in module or transformer case. (2) Places components on rack, dips rack in encapsulating fluid, and hangs rack on drying frame or in oven to harden sealing compound. (3) Fills capacitor shells or semiconductor caps with encapsulating fluid or paste, using eye dropper or applicator. May heat components before encapsulating to remove moisture. May inspect encapsulation for defects, such as chips and pin holes. May stamp encapsulated components with color code or trademark. May weigh and mix materials following formula.

GENERAL ASSEMBLER. 726381 - Arranges layout of work stations on assembly line, following written specifications and oral instructions, to prepare line for production of electronic components, such as printed circuit boards, transformer

assemblies, and wiring harnesses and cables. Reads specifications, such as bills of materials, wiring diagrams, mechanical prints, and schematic diagrams to requisition equipment, such as piece parts, tools, test instruments, and jigs and fixtures for work stations. Positions equipment in specified arrangement at work stations. Notifies stock room when stations need resupply of piece parts, such as resistors, transistors, and color-coded wire, during assembly operations. May set and adjust controls for assembly line equipment, such as power supplies, timers, and multimeters. May test and repair assembled items by removing or adding turns of transformer wire or resoldering defective connections, using hand tools and test equipment, such as bridges and oscilloscopes.

MODULE ASSEMBLER. 726884 - Assembler. Assembles modules (units) of microelectronic equipment, such as satellite communications devices and hearing aids, using hand tools, magnifying lens, and spotwelder. Inserts lead wires of components, such as microdiodes, resistors, capacitors, and microtransistors, into mounting holes of plastic plate on which diagram or conductive pattern has been printed, using tweezers and following sample part or assembly drawing. Attaches color-coded wires between specified component leads to make circuit connections and attaches wires to circuit for module leads, using soldering iron or spot welder.

SEMICONDUCTOR ASSEMBLER. 726884 - Assembles semiconductor devices, such as diodes, rectifiers, and transistors, by performing any combination of following tasks, using tweezers, magnifying lenses, and binocular microscopes. Inserts parts, such as wafers, lead pins, and crystals into slots or holes in jigs, preparatory to plating and etching by CRYSTAL FINISHER, using tweezers or vacuum probes. Removes processed parts from jigs and stacks alternate layers of crystals, solder chips, and nickel disks in holes in graphite boat (holding fixture), using tweezers and vacuum probe. Places cover on boat and positions lead wires through holes in cover onto crystals. Places boat in furnace that melts solder and bonds crystal assembly together. Removes boat from furnace and places crystal assemblies in holes in graphite boat, using tweezers. Fits cover on boat and inserts alloy elements, such as nickel and aluminum, into holes in cover. Places boat in tunnel oven that fuses crystals and alloy elements together, forming alloy junctions on crystals. Removes fused parts from oven and examines crystals for defective fusion. Tests dice (crystals) for direction of current flow, using electric probe and test light (dice conducts current in only one direction), and inverts dice to orient them for subsequent assembly operations. Places diode crystal leads in holding fixture of fusing machine and positions crystal on leads, using tweezers and microscope. Moves controls of machine to electrically fuse parts together. Removes parts and places them in fixture for cooling. Positions pieces of precut wire on transistor headers to form transistor leads. Fastens one end of lead to header terminal pins, using spotwelder, and bends other end of lead to specified points on crystal, using needle. Positions header under stylus of lead-bonding device and pushes pedal to bond leads to crystal. May scribe breaking lines of transistor crystals on wafers in preparation for ultrasonic cleaving process, following patterns applied to wafers in photographic process and using diamond needle and microscope. May tend equipment that automatically welds, bonds, crimps, and fuses parts into finished semiconductor devices. May test diode or rectifier units for specified current flow or wave pattern, using ammeter and oscilloscope (TESTER, ELECTRONIC COMPONENTS).

WELDER. 812884 - Performs any combination of tasks involved in welding electronic units.

WIREWORKER. 728887 - Assembly-Preparation Worker. Performs any combination of tasks involved in cutting, stripping, and soldering wires used in electronic units, such as television sets, radar, and missile control systems. Cuts wire in specified lengths, using wire cutters and ruler or measuring jib. Strips insulation from wire ends, using stripping tool. Twists wire ends and dips them into pot of solder to prevent fraying. Solders wires to specified plugs and terminals, using soldering iron. Wraps numbered or colored identification tape around wires. Rolls wires of identical number or color together and attaches tag to roll. Inserts wires into plastic insulation tubing. May insulate wire or component leads by dipping them into paraffin solution. May paint various protective coatings on wires with brush.

## Engineers

CHEMICAL ENGINEER. 008081 - Designs chemical-plant equipment and devises processes for manufacturing chemicals and products, such as gasoline, synthetic rubber, plastics, detergents, cement, and paper and pulp, applying principles and technology of chemistry, physics, mechanical and electrical engineering, and related areas. Conducts research to develop new and improved chemical-manufacturing processes. Designs, plans layout, and oversees workers engaged in constructing, controlling, and improving equipment for carrying out chemical processes on commercial scale. Determines most effective arrangement of operations, such as mixing, crushing, heat transfer, distillation, oxidation, hydrogenation, and polymerization. Oversees workers controlling equipment, such as condensers, absorption and evaporation towers, columns, and stills.

DIRECTOR, MANUFACTURING ENGINEER. 007168 - Aids head administrator in administering and formulating organization policies and supervises activities of engineering department.

DIRECTOR, QUALITY CONTROL. 012168 - Supervises activities of quality control department and aids in administering and formulating organization policies.

DIRECTOR, RESEARCH AND DEVELOPMENT. 189118 - Directs research and development department and aids head administrator in formulating organization policies.

DRAFTSMAN, MECHANICAL. 007281 - Prepares clear, complete, and accurate working plans and detail drawings from rough or detailed sketches or notes for engineering or manufacturing purposes, according to specified dimensions. Makes final sketch of proposed drawing, checking dimension of parts, materials to be used, relation of one part to another, and relation of various parts to whole structure. Makes any adjustments for changes necessary or desired. Inks in all lines and letters on pencil drawings as required. Exercises manual skill in manipulation of triangle, T-square, and other drafting tools. Lays tracing paper on drawing and traces drawing in ink. Draws charts for representation of statistical data. Draws finished designs from sketches. Utilizes knowledge of various machines, engineering practices, mathematics, building materials, and other physical sciences to complete drawings.

ELECTRONICS ENGINEER. 003081 - Conducts research and development concerned with design and manufacture of vacuum and gaseous tubes, semiconductor and other solid-state devices, and electronic equipment, and their application to commercial, industrial, military, scientific and medical equipment, processes, and problems. Designs electrical circuits to specifications, utilizing ferroelectric, nonlinear, dielectric, phosphor, photoconductive, and thermoelectric properties of materials (DESIGN ENGINEERING I). Designs test apparatus and devises procedures to evaluate electronic equipment. Develops improved utilization of electric and dielectric properties of metallic and nonmetallic materials used in electronic components. May specialize in applications of electronic technology, such as telecommunications, telemetering, aerospace guidance systems, missile propulsion control, counter measures, acoustics, nucleonic instrumentation, electronic data reduction and processing equipment, industrial controls and measurements, high-frequency heating, laboratory techniques, teaching aids, radiation detection, encephalography, electron optics, and biomedical research. May direct field operation and maintenance of electronic equipment and recommend design changes according to operational evaluation to correct errors or to accommodate changes in system requirements.

ENGINEERING AIDE. 726281 - Assists engineers in a variety of functions.

INDUSTRIAL ENGINEER. 012188 - Management Engineer. Performs a variety of engineering work in planning and overseeing utilization of production facilities and personnel in department or other subdivision of industrial establishment. Plans equipment layout, workflow, and accident prevention measures to maintain efficient and safe utilization of plant facilities. Plans and oversees work study and training programs to promote efficient manpower utilization. Develops and oversees quality control, cost control, inventory control, and production record systems.

MECHANICAL ENGINEER. 007081 - Performs a variety of engineering work in planning and design of tools, engines, machines, and other mechanically functioning equipment, and oversees installation, operation, maintenance, and repair of such equipment, including centralized heat, gas, water, and steam systems.

PRODUCTION PLANNER. 012188 - Methods-and-Processing Man. Plans and prepares production schedules for manufacture of industrial or commercial products. Draws up master schedule to establish sequence and lead time of each operation to meet shipping dates according to sales forecasts or customer orders. Analyzes production specifications and plant capacity data and performs mathematical calculations to determine manufacturing processes, tools, and manpower requirements. Plans and schedules workflow for each department and operation according to previously established manufacturing sequences and lead time. Plans sequence of fabrication, assembly, installation, and other manufacturing operations for guidance of production workers. Confers with department supervisors to determine status of assigned projects. Expedites operations that delay schedules, and alters schedules to meet unforeseen conditions. Prepares production reports. May prepare lists of required materials, tools, and equipment. May prepare purchase orders to obtain materials, tools, and equipment.

QUALITY-CONTROL ENGINEER. 012188 - Reliability Engineer. Performs and oversees activities concerned with development, application, and maintenance of quality standards for processing materials into partially finished or finished material or product. Develops and initiates methods and procedures for inspection,

testing, and evaluation. Devises sampling procedures, designs forms for recording, evaluating, and reporting quality and reliability data, and writes instructions on use of forms. Establishes program to evaluate precision and accuracy of production and processing equipment and testing, measurement, and analytical facilities. Develops and implements methods and procedures for disposition and devises methods to assess cost and responsibility of discrepant material. Oversees workers engaged in measuring and testing product and tabulating quality and reliability data. Compiles and writes training material and conducts training sessions on quality control activities. May specialize in any of following areas of quality-control engineering as design, incoming material, process control, product evaluation, inventory control, product reliability, research and development, and administrative application. Usually required to have an engineering degree, such as chemical, mechanical, or electrical engineering which is related to technology of the product evaluated.

RESEARCH ENGINEER. A term applied to engineer primarily concerned with research activities directed toward investigation and evaluation of practical applicability of engineering theories and principles basic to development and improvement of new or existing products, services, or production processes and equipment. Major responsibilities include keeping up to date with technological developments; consulting with other engineering and scientific specialists; planning and performing or directing complex experiments to test, prove, or modify theoretical propositions on the basis of research findings and experience of others working in related technological areas; and preparing technical reports used by engineering, sales, and management personnel in short-range and long-range planning.

VICE PRESIDENT, MANUFACTURING. 189118 - Aids head administrator in administering and formulating organization policies and supervises activities of one or more departments, such as purchasing, sales, manufacturing, engineering, or finance. Participates in formulating company policies and assists in developing long-range plans. Coordinates programs in departments as approved by PRESIDENT or board of directors to attain company's goals. Confers with PRESIDENT to discuss analyses of activities, costs, budgets, and forecasts to determine changes needed for attaining company goals. May be responsible for current information on legislation related to operations and for action to secure favorable legislation. May perform duties of PRESIDENT. May serve as member of management committees.

## Foremen, Inspectors, Supervisors

FOREMAN, ELECTRONIC ASSEMBLIES. 726130 - Supervises and coordinates activities of ELECTRONICS ASSEMBLERS engaged in assembly of electronic equipment, such as radar and sonar units, missile control systems, computers, cables and harnesses, and test equipment. Demonstrates wiring and soldering techniques, using hand tools and soldering iron. Analyzes test reports and examines defective equipment to determine cause of equipment malfunctions. Installs dies, using hand tools, and adjusts guides and feeding mechanisms to set up wire cutting and stripping machines, and component lead wire forming machines. Turns dial controls to regulate heat of ovens used in soldering, baking, or fusing operations. Performs other duties as described under FOREMAN.

INSPECTOR, SYSTEMS. 722281 - Inspector, Electronic Assembly. Inspects electronic systems, such as radar navigation, telemetering equipment, and computer memory units, following blueprints, wiring diagrams, customer or contract specifications, and manufacturing standards, and using precision measuring instruments. Compares layout and installation of wiring, cables, subassemblies, hardware, and components with specifications to detect assembly errors. Examines joints, using magnifying glass and mirrors, and pulls wires and cables to locate soldering defects. Twists parts, such as dials, shafts, and gears, to verify operation of parts. Measures parts for conformance with specified dimensions, using precision measuring instruments, such as micrometers and vernier gages. Records inspection data, such as serial numbers of inspected equipment, type and amount of defects, and rework required for defective equipment. Stamps inspected equipment to indicate acceptance. May resolder broken connections. May perform functional tests, using electronic test equipment, such as frequency meters, oscilloscopes, and power measuring instruments (TESTER, SYSTEMS).

MACHINE-SHOP FOREMAN, PRODUCTION. 609130 - Supervises and coordinates activities of workers engaged in production-machining of metal workpieces, applying knowledge of machine shop procedures, machine tool set-up and operating techniques, and production machining methods.

MAINTENANCE FOREMAN. 891138 - Building-and-Grounds Foreman. Supervises and coordinates activities of workers engaged in keeping buildings and grounds in clean and orderly condition and in maintaining and repairing utility systems and physical structures of buildings. Directs workers engaged in mowing lawns, trimming hedges, and raking and burning leaves and refuse. Directs workers engaged in making structural repairs to masonry, woodwork, and furnishings of buildings and similar structures. Directs workers engaged in maintaining and repairing building utility systems, such as electric wiring and controls, heating, ventilating, and steam generating systems (UTILITIES-AND-MAINTENANCE FOREMAN). Directs workers engaged in maintaining and repairing plumbing systems (PLUMBER FOREMAN, MAINTENANCE). May compile reports of cost of completed work. May supervise workers engaged in servicing and repairing mechanical equipment. May requisition tools, equipment, and supplies. May inspect completed work for conformance to blueprints and other specifications.

MATERIALS-HANDLING FOREMAN. 929133 - Stock Foreman. Supervises and coordinates activities of workers engaged in lifting, transporting, storing, and loading materials and products by use of conveyors, cranes, hoists, or industrial trucks, applying knowledge of plant layout and materials-handling equipment and procedures. May verify or prepare records, such as routing slips, material requisitions, and job orders.

PRODUCTION SUPERINTENDENT. 183118 - Manager, Factory. Coordinates, through subordinate supervisors, all activities of production departments or subdivisions, applying knowledge of plant layout, and production capacities of each department. Consults with plant executives and analyzes economic trends, sales forecasts, and marketing and distribution problems to plan and develop production procedures and time and cost estimates. Interprets company policies and production procedures to subordinate supervisors, and directs their

activities. Confers with department heads to formulate programs regarding availability of raw materials, maintenance of plant equipment and physical structure, product quality control, related production records, labor and materials costs, and equipment depreciation, to insure that operating costs are maintained at budgeted level. Reports production figures and job completion dates to plant executives. Originates or assesses measures designed to improve production methods, equipment performance, and quality of product, and recommends changes in working conditions and modifications in machines and equipment. Plans surveys, such as those designed to determine effectiveness of manpower utilization, and projects manpower requirements. Negotiates with workers' representatives in connection with grievance procedures, and reports unsettled grievances to plant executives. In plants having no GENERAL FOREMAN, directly supervises subordinate foremen.

SEMICONDUCTOR-ASSEMBLY FOREMAN. 726130 - Supervises and coordinates activities of workers engaged in assembly of semiconductor devices, such as transistors, diodes, and rectifiers. Sets up welding, forming, and thermal compression bonding machines used to assemble semiconductor devices. Moves controls to regulate temperature and timers of soldering or alloying furnaces. Examines assembled parts under binocular microscope or tests parts, using electric meters, to verify conformance to design specifications and manufacturing standards. Repairs jigs, fixtures, and other machine parts, using hand tools.

TESTING SUPERVISOR. 726130 - Supervisor, Testing. Supervises and coordinates activities of workers engaged in testing semiconductors for characteristics, such as voltage, wave pattern, amperage, and impedance. Sets up and adjusts test instruments, such as voltmeters, oscilloscopes, ammeters, and impedance meters.

WAREHOUSE FOREMAN. 929138 - Supervises and coordinates activities of workers engaged in receiving, transporting, stacking, order filling, shipping, and maintaining of stock records in warehouse. May supervise labeling, and casing or packing of materials or products.

## Material Handlers and Packagers

FORKLIFT TRUCK OPERATOR. 922883 - Loads, unloads, and conveys materials within or near plant, yard, or worksite, using forklift truck.

INVENTORY CLERK. 233388 - Performs inventory or keeps perpetual inventory records.

MATERIAL CLERK. 223387 - Material Checker. Compiles records concerned with quantity, cost, and type of material received, stored, and issued in department or establishment or on job, and requisitions needed supplies. Verifies material received against requisitions, shipping notices, or invoices, to determine irregularities in order. Inspects articles and rejects defective ones. Prepares inventory or keeps perpetual inventory records (INVENTORY CLERK). Prepares requisitions for procurement of material and supplies.

MATERIAL HANDLER. 929887 - Conveyor Feeder. Loads, unloads, and conveys materials within or near plant, yard, or worksite performing any combination of the following duties, under specific instructions. Reads work order or follows supervisor's direction to ascertain materials or containers to be moved. Opens containers with steel cutters, crowbar, clawhammer, or other hand tools. Counts and weighs materials or containers and records information on form. Loads and unloads materials onto or from pallets, trays, racks, conveyors, furnaces, and machines by hand. Loads materials into vehicles and installs strapping, bracing, or padding to prevent shifting or damage in transit, using hand tools. Conveys materials from storage to designated area or between workers or department, using wheelbarrow, handtruck, electric dolly, elevator, industrial truck, or other device. Secures lifting attachments to materials and conveys load to destination, using floor-operated crane or hoist, or signals crane or hoisting operators to move load to destination. Records number of units of materials moved or handled on daily production sheet. Attaches identifying tags or labels to materials or marks information on cases, bales, or other containers. Loads truck for INDUSTRIAL-TRUCK OPERATOR. Stacks or assembles materials into bundles and bands bundles together, using banding machine and clincher. Clamps together sections of portable conveyor or places conveyor sections on blocks or boxes. Tends movable conveyor system or opens chutes to load loose materials, such as rock, sand, ore, chemicals, and coke, into railway cars and motor-trucks. Removes samples of materials, labels them with identifying information, and takes samples to laboratory for analysis. Aids machine operators by lifting heavy objects by hand or by use of power hoist, and cleaning work area, machines, and equipment, using broom, rags, and cleaning compounds. Aids in making simple adjustments or repairs, such as realining belts or replacing rollers. Assembles crates to contain products, such as machines or vehicles, using hand tools and precut lumber. Shovels loose materials, such as metals, plastics, chemicals, or small parts, into machine hoppers, and sand, gravel, sawdust, and metal chips into vehicles and containers, such as wheelbarrows, scrap truck, or barrels. Loads and unloads powdered materials, such as flour or fertilizer, into vehicles or containers, using suction hose, screw or bucket conveyor, or drag shovel. Releases gates of vehicles, such as ore cars or dump trucks, to dump materials into chutes, bins, hoppers, or conveyors. Operates platform lift to dump materials from truck.

PACKAGER, HAND. 920887 - Hand Packager. Packages materials and products by hand, performing any combination of the following duties. Cleans packaging containers. Lines and pads crates. Assembles cartons from flattened state. Obtains and sorts product. Wraps protective material around product. Starts, stops, and regulates speed of conveyor. Inserts or pours product into containers or fills containers from spout or chute. Weighs containers and adjusts quantity. Nails, glues, or otherwise closes and seals containers. Labels containers, container tags, or products. Sorts bundles of filled containers. Packs special arrangements or selections of product. Visually inspects materials, products, and containers at each step of packaging process. Records information, such as weight, time, and date of filled containers.

PACKAGER, MACHINE. 920885 - Machine Operator, Packaging. Tends machine that performs one or more packaging functions, such as cleaning, filling, marking, labeling, sorting, tying, weighing, inspecting, packing, wrapping, or closing containers. Starts machine and observes operation to detect malfunctions of machine and off-bearing mechanisms. Stops machine and reports malfunction to

supervisor. Makes minor adjustments or repairs, such as opening valves, changing forming and cutting dies, setting guides, or clearning away damaged products or containers. Inspects filled container to insure that product is packaged according to specifications. May feed product to conveyors, hoppers, or other feeding devices, and unload packaged product. May replenish packaging supplies, such as wrapping paper, plastic sheet, boxes, cartons, glue, ink, or labels, mounting supplies on spindles or placing them in hopper or other feeding devices (PACKAGING LABORER). May position and hold container in machine and press pedal or button or move lever to clean, glue, label, sew, or staple container. May cut stencils and stencil information on container, such as lot number of shipping destination. May tally number of units of product packaged or record other information, such as size, weight, and type of products packaged.

Operators, Technicians, Maintenance Men

CHEMICAL OPERATOR II. 558885 - Reactor Operator. Tends equipment units or semiautomatic system that processes chemical substances into industrial or consumer products, such as detergents, emulsifiers, salts, bleaching agents, acids, and synthetic resins. Dumps specified amounts of solid materials into heating vessels or blending tanks, and turns valves to feed liquid and gaseous materials through equipment units or sets controls in specified sequence on control panel to start automatic feed. Turns valves or moves controls to maintain system at specified temperature, pressure, and vacuum levels. Observes chemical reactions, monitors gages, signals, and recorders, and receives notification from control laboratory, supervisor, or other workers to make specified operating adjustments. Draws samples of products for laboratory analysis. Maintains log of gage readings and shift production. May perform chemical tests on product to insure conformance with specifications, using standard test equipment, materials, and procedure.

ELECTRONICS MAINTENANCE MAN. 828281 - Communication Technician. Repairs electronic equipment, such as computers, industrial controls, radar systems, telemetering and missile control systems, transmitters, antennas, and servomechanisms, following blueprints and manufacturers' specifications, and using hand tools and test instruments. Tests faulty equipment and applies knowledge of functional operation of electronic units and systems to diagnose cause of malfunction. Tests electronic components and circuits to locate defects, using instruments, such as oscilloscopes, signal generators, ammeters, and voltmeters. Replaces defective components and wiring and adjusts mechanical parts, using hand tools and soldering iron. Alines, adjusts, and calibrates equipment according to specifications. Calibrates testing instruments. Maintains records of repairs, calibrations, and tests. May install equipment in industrial or military establishments and in aircraft and missiles. May operate equipment such as communication equipment and missile control systems in ground and flight tests and be required to hold license from governmental agency.

ELECTRONICS TECHNICIAN, AUTOMATED PROCESS. 726281 - Tests and repairs electronic components of automated production lines that produce deposited carbon resistors for use in electronic equipment, such as missile control systems. Starts electronic units that control production machines and observes monitoring graphs and gages to verify operation of machines along automated line.

Types program onto punch tape following coded production order. Inserts punch tape into reader that types data on data sheet and transmits data to magnetic memory drum of digital computer. Compares typed data sheet with coded production order to verify information transferred to memory drum. Starts computer's output and input circuits to set up production machines according to program and close loop to effect feedback of data. Starts conveyors and machines and observes feedback data sheet, monitoring graphs, and gages to detect malfunctions in automated processing machinery and electronic equipment. Tests electronic circuits and analyzes data to isolate malfunctions, using oscilloscope, synchroscope, oscillators, galvanometer, voltmeter, and calibration charts, following schematic and wire diagrams. Repairs equipment by rewiring components, soldering loose connections, and replacing parts, such as coils, condensers, tubes, and resistors, using such hand tools as pliers, screwdrivers, tweezers, wirecutters, soldering iron, and knife. Adjusts circuit variables and calibrates and alines control components according to calibration charts and graphs.

INSPECTOR, SYSTEMS (Quality Control). 722281 - Inpsects complete electronic systems, for conformity to manufacturing standards, using electronic testing equipment.

MAINTENANCE MECHANIC II. 638281 - Fixer. Repairs and maintains, in accordance with diagrams, sketches, operation manuals, and manufacturer's specifications, machinery and mechanical equipment, such as cranes, pumps, engines, motors, pneumatic tools, conveyor systems, production machines, and automotive and construction equipment, using hand tools, power tools, and precision-measuring and testing instruments. Observes mechanical devices in operation and listens to their sounds to locate causes of trouble. Dismantles devices to gain access to and remove defective parts, using hoists, cranes, hand tools, and power tools. Examines form and texture of parts to detect imperfections. Inspects used parts to determine changes in dimensional requirements, using rules, calipers, micrometers, and other measuring instruments. Adjusts functional parts of devices and control instruments, using hand tools, levels, plumb bobs, and straightedges. Repairs or replaces defective parts, using hand tools and power tools. Installs special functional and structural parts in devices, using hand tools. Starts devices to test their performances. Lubricates and cleans parts. May set up and operate lathe, drill press, grinder, and other metalworking tools to make and repair parts. May initiate purchase order for parts and machines. May repair electrical equipment.

PRODUCTION-MACHINE (Machine Shop) OPERATOR. 609885 - All-Around-Machine Operator. Tends any of variety of machine tools, such as lathes, drill presses, milling machines, grinders, or special-purpose machines to machine metal workpieces to specifications on production basis. Lifts workpiece manually or with hoist and positions and secures it in fixture, or loads automatic feeding device. Starts machine, engages feed, and observes operation. Verifies conformance of machined workpieces to specifications, using such instruments as preset comparator, fixed gages, calipers, or micrometer. May move controls to adjust machine. Changes worn cutting tools, using wrenches. May operate bench grinder to sharpen tools. May machine plastics or other nonmetals. May tend machines and equipment other than machine tools, such as welders. May be required to transfer from one type of machine to another as situation demands. May be required to have experience with particular material, product, or size, type, or trade name of machine and be designated accordingly.

TESTER, ELECTRONIC COMPONENTS. 726687 - Electric Tester. Tests electronic components, such as coils, resistors, diodes, and capacitors for conformity to manufacturing standards, using instruments such as ohmmeter, voltmeter, ammeter, and oscilloscope. Connects component to test instrument and turns switch. Reads instrument dial or scope that indicates resistance, capacitance, continuity, or wave pattern of component, or defects, such as shorts and current leakage. Compares instrument reading with standards and rejects defective component. Records type and quantity of defects. May examine component for defects, such as short leads, bent plates, or cracked seals. May verify dimensions of component, using standard gages.

TESTER, SYSTEMS. 729381 - Quality Control Technician. Tests complete electronic systems, such as radio or television transmitters and computer memory units, using electronic testing equipment and following work orders, test manuals, and schematic and wiring diagrams. Constructs test-circuits, using hand tools and soldering iron and following schematic diagrams and test specifications. Connects system to be tested to equipment, such as test-circuits, oscilloscope, signal generator, frequency meters, spectrum analyzers, voltmeters, ohmmeters, and milliammeters. Reads dials that indicate electrical characteristics of system, such as output, power, frequency, voltage, current distortion, inductance, and capacitance. Compares dial reading with specifications and records test data or plots test results on graph. Calibrates system to obtain specified dial readings of characteristics, such as frequency or inductance. Traces circuits of defective systems using knowledge of electronic theory and electronic test equipment, to locate defects, such as wiring errors, open wires, shorts, and faulty components. Examines switches, dials, and other hardware for conformance to specifications. Replaces defective writing and components, using hand tools and soldering iron, or records defects on tag attached to system and returns system to production department for repair. Performs functional tests of system under specified environmental conditions, such as temperature change, vibration, pressure, and humidity to evaluate performance, using devices such as temperature cabinets, shaketest machines, and centrifuges. May verify dimensions of pins, shafts, and other mechanical parts, using calipers, vernier gages, and micrometers.

COMMERCIAL ARTIST. 141081 - Prepares all the necessary art work needed to support the advertising function.

FIELD ENGINEER. 829281 - Field-Service Representative. Installs and repairs electronic equipment, such as computer, radar, missile-control, and communication systems, in field installations. Consults with customer to plan layout of equipment. Directs workers to install equipment according to manufacturer's specifications. Operates system to demonstrate equipment and trains workers in service and repair techniques, using standard test instruments and hand tools. Analyzes malfunctions in operational equipment and interprets maintenance manuals, using knowledge of equipment and electronics, to train workers in repair procedures. Consults with manufacturer's engineering personnel to determine solutions to unusual problems in system operation and maintenance. May instruct workers in electronic theory. May supervise workers in testing, tuning, and adjusting equipment to obtain optimum operating conditions. May install and maintain equipment for customers who do not have personnel to perform these duties.

MANAGER, ADVERTISING. 164118 - Sales Promotion Director. Plans advertising policies of department store, factory, or other organization and arranges for execution of these policies. Confers with department heads to determine advertising needs. Confers with officials of newspapers, radio and television stations, billboard advertisers, and advertising agencies to negotiate advertising contracts. Allocates advertising space to departments or products of establishment. Reviews and approves television and radio programs and advertising proofs before release. Supervises workers in advertising department engaged in making up and illustrating advertisements. May authorize information for publication, such as interviews with reporters or articles describing phases of establishment activity. May have responsibility for geographical district or department of establishment represented. Directs activities of workers concerned with sale of display and classified advertising for a publication. Plans sales campaigns. Assigns sales areas or lists of customers or prospects to be contacted by SALESMEN, ADVERTISING. Checks individual sales records to determine amount of advertising sold, frequency of customer contacts, and development of new accounts. Consults with department heads and other officials to plan special campaigns and to promote sale of advertising to various industry or trade groups. Prepares sales progress charts by area, type of industry, or trade classification. Corresponds with customers relative to advertising rates and policies or to solicit new business. May select and train new sales personnel.

MANAGER, MARKETING RESEARCH. 050088 - Directs the marketing research division planning, staffing, training, and performance evaluation operations.

MANAGER, SALES. 163118 - Directs sales division planning and operations. Directs sales department staffing, training, and performance evaluations to develop and control sales program. Coordinates sales distribution through establishment of sales territories, quotas, and goals. Assigns sales territory to selling personnel. Evaluates dealer sales and assists dealers through training programs and sales promotion. Reviews market analyses to determine

customer needs, volume potential, price schedules, and discount rates and develops sales campaigns to meet company goals. Directs product simplification and standardization to eliminate unprofitable items from sales line. Represents company at trade association meetings to promote product. Supervises liaison between sales department and other units. Analyzes and controls expenditures of division. Assists engineering division in preparation of manuals and technical publications. Analyzes sales statistics to assist management in policy formulation. May direct sales for manufacturer, retail store, wholesale house, jobber, or other establishment. May direct and supervise product research and development. May recommend or approve budget, expenditures, and appropriations for research and development work.

MANAGER, SALES ENGINEERING. 003151 - Directs and supervises technical customer representation activities. Assists engineering division in preparation of manuals and technical publications.

MARKET-RESEARCH ANALYST. 050088 - Researches market conditions in local, regional, or national area to determine potential sales of a product or service. Examines and analyzes statistical data on past sales and wholesale or retail trade trends to forecast future sales trends. Gathers data on competitors and analyzes their prices, sales, and methods of operation. Collects data on buying habits and preferences of prospective customers.

SALESMAN. 278358 - Salesman, Industrial. Sells chemical, mechanical, electrical, or electronic equipment, supplies, or services which require professional engineering knowledge sufficient to make judgments involving complex engineering and economic principles and calculations to persuade potential buyers or lessees of practical value of production or service. Calls at industrial, commercial, and other establishments, and on engineers, architects, and other professional and technical workers, attempting to convince prospective customers of desirability of purchasing from firm he represents. Prepares financial and operational estimates from blueprints, plans, or other records submitted by potential customers. Draws up and proposes changes in equipment or use of materials which would result in cost reduction or more efficient operation. Usually specializes in selling one or a closely related group of products or services, such as electrical or electronics equipment, industrial machinery, airconditioning equipment, chemical goods, mineral products, or electric power.

SALESMAN, ADVERTISING. 258358 - Advertising-Sales Representative. Sells classified and display advertising space for publication. Prepares list of products from leads in other papers and from old or expiring accounts. Visits advertisers to point out advantages of own publication. Obtains pertinent information concerning prospect's current advertising and results derived from it. Prepares sample layouts with mats and writes copy and headings. May collect accounts payable. May originate and develop special advertising campaigns.

TECHNICAL ILLUSTRATOR. 017281 - Assists in the illustration of technical publications.

TECHNICAL WRITER. 139288 - Assists in the writing up of technical publications.

VICE PRESIDENT, SALES AND MARKETING. 189118 - Aids head administrator in administering and formulating organization policies and supervises activities of one or more departments, such as purchasing, sales, manufacturing, engineering, or finance. Participates in formulating company policies and assists in developing long-range plans. Coordinates programs in departments as approved by PRESIDENT or board of directors to attain company's goals. Confers with PRESIDENT to discuss analyses of activities, costs, budgets, and forecasts to determine changes needed for attaining company goals. May be responsible for current information on legislation related to operations and for action to secure favorable legislation.

# APPENDIX D
# INFLATION RATE STATISTICS

INFLATION RATE STATISTICS

| Code | A | | B | | C | | D | | E | |
|---|---|---|---|---|---|---|---|---|---|---|
| Class | Raw Materials | | Labor | | Chemicals | | Commodities | | Energy | |
| Year | Crude Materials Price Index | % Change | Manu-turing Labor Price Index | % Change | Industrial Chemicals Price Index | % Change | Producer Finished Goods Price Index | % Change | Electric Power Price Index | % Change |
| 1972 | 127.6 | | 135.4 | | 101.2 | | 119.5 | | 121.5 | |
| 1973 | 173.9 | 36.29 | 143.6 | 6.06 | 103.4 | 2.17 | 123.5 | 3.35 | 129.3 | 6.42 |
| 1974 | 196.1 | 12.77 | 156.0 | 8.64 | 151.7 | 46.71 | 141.0 | 14.17 | 163.1 | 26.14 |
| 1975 | 196.9 | .41 | 171.6 | 10.00 | 206.9 | 36.39 | 102.5 | 15.25 | 193.4 | 18.58 |
| 1976 | 204.1 | 3.66 | 183.6 | 6.99 | 219.0 | 5.85 | 172.6 | 6.25 | 207.7 | 7.39 |
| 4-year mean rate | | 13.28 | | 7.92 | | 22.78 | | 8.21 | | 14.63 |
| Sum-of-years-digits weighted average rate | | 7.77 | | 8.13 | | 22.71 | | 10.24 | | 14.40 |
| 9-year average growth rate (1967 base year) | | 11.57 | | 9.29 | | 13.22 | | 8.07 | | 11.97 |
| Recommended inflation rate | | 11 | | 8 | | 13 | | 8 | | 12 |

Sources: (a) Survey of current business statistics (1967 = 100) published by the U.S. Department of Commerce.

(b) Bureau of Labor Statistics.

INFLATION RATE STATISTICS

| Code | G | | H | | I | | J | | F | |
|---|---|---|---|---|---|---|---|---|---|---|
| Class | Land | | Facilities | | Construction | | Equipment | | Resources | |
| Year | Springfield, Illinois | % Change | Commercial Factory And Buildings Price Index | % Change | Construction And Contract Labor Price Index | % Change | Machinery And Equipment Price Index | % Change | Natural Resour. Price Index | % Change |
| 1972 | | - | 444.8 | | 135.4 | | 110.4 | | 114.1 | |
| 1973 | | 2.0 | 154.4 | 6.63 | 143.6 | 6.06 | 112.4 | 1.81 | 126.7 | 11.0 |
| 1974 | | 4.5 | 171.1 | 10.82 | 156.0 | 8.64 | 125.0 | 11.21 | 162.2 | 28.0 |
| 1975 | | 4.8 | 188.8 | 10.34 | 171.6 | 10.00 | 146.7 | 12.56 | 216.7 | 33.6 |
| 1976 | | 3.3 | 202.8 | 7.42 | 183.6 | 6.99 | 146.6 | 4.19 | 286.8 | 32.3 |
| 4-year mean rate | | 3.65 | | 8.80 | | 7.92 | | 7.47 | | 26.2 |
| Sum-of-years digits weighted average rate | | 3.86 | | 8.90 | | 8.13 | | 7.87 | | 29.7 |
| 9-year average growth rate (1967 base year) | | | | 11.42 | | 9.29 | | 5.18 | | 20.7 |
| Recommended inflation rate | | 4 | | 9 | | 8 | | 7 | | 15 |

Sources: (a) Survey of Current Business Statistics (1967 = 100) published by U.S. Department of Commerce.
(b) Bureau of Labor Statistics.
(c) Springfield Illinois Chamber of Commerce.

APPENDIX E
STANDARD CHART OF ACCOUNTS

| Number | Account Name |
|---|---|
| 111- | Cash on hand and in banks |
| 11110 | Demand deposits in domestic banks |
| 11120 | Demand deposits in foreign banks |
| 11130 | Special bank accounts |
| 11140 | Cash on hand |
| 11150 | Petty cash fund |
| 11160 | Other cash fund |
| 112- | Acconts receivable |
| 111210 | Domestic customers |
| 111220 | Foreign customers |
| 111230 | Employees |
| 111240 | Officers, directors, stockholders |
| 111250 | Intercompany |
| 111260 | Accounts receivable factored |
| 113- | Allowance for doubtful accounts |
| 114- | Notes receivable |
| 114110 | Domestic customers |
| 114120 | Foreign customers |
| 114130 | Employees |
| 114140 | Officers, directors, stockholders |
| 114150 | Intercompany |
| 115- | Marketable securities |
| 115110 | U.S. government securities |
| 115120 | State, city, and county securities |
| 115130 | Affiliated companies |
| 115140 | Other corporations |
| 115150 | Miscellaneous |
| 116- | Inventories |
| 116110 | Materials and supplies |
| 116120 | Goods in transit |
| 116130 | Work-in-process |
| 116140 | Allowance for shrinkage and obsolescence |
| 116150 | Finished goods |
| 117- | Prepaid Assets |
| 117110 | Insurance |
| 117120 | Rent |
| 117130 | Taxes |
| 118- | Investments |
| 118110 | U.S. government securities |
| 118120 | State, city, and county securities |
| 118130 | Affiliated companies |
| 118140 | Other corporatiions |
| 118150 | Miscellaneous |
| 121- | Land |
| 121110 | Operating property |
| 112120 | Future building site |
| 122- | Buildings |
| 122110 | Manufactured facilities |
| 112120 | Administrative facilities |

| Number | Account Name |
|---|---|
| 123- | Accumulated depreciation - buildings |
| 123110 | Manufacturing facilities |
| 123120 | Administrative facilities |
| 124- | Equipment and machinery |
| 124110 | Machinery |
| 124120 | Tools, dies |
| 124130 | Fixtures |
| 124140 | Furniture |
| 124150 | Construction in process |
| 124160 | Equipment |
| 125- | Accumulated depreciation - equipment and machine |
| 125110 | Machinery |
| 125120 | Tools, dies |
| 125130 | Fixtures |
| 125140 | Furniture |
| 125150 | Construction in process |
| 125160 | Equipment |
| 126- | Leasehold improvements |
| 126110 | Manufacturing facilities |
| 126120 | Administrative facilities |
| 127- | Accumulated depreciation - leasehold improvement |
| 127110 | Manufacturing facilities |
| 127120 | Administrative facilities |
| 128- | Automobiles, trucks, and other vehicles |
| 128110 | Automobiles |
| 128120 | Trucks |
| 129- | Accumulated depreciation - automobiles, etc. |
| 129110 | Automobiles |
| 129120 | Trucks |
| 130- | Intangibles and other assets |
| 130110 | Patents |
| 130120 | Organization costs |
| 130130 | Copyrights |
| 130140 | Franchises |
| 131- | Amortization - intangibles, etc. |
| 131110 | Patents |
| 131120 | Organization costs |
| 131130 | Copyrights |
| 131140 | Franchises |
| 211- | Accounts payable |
| 211110 | Domestic suppliers |
| 211120 | Foreign suppliers |
| 211130 | Current contracts |
| 211140 | Union dues |
| 211150 | Other |
| 212- | Accured salaries and wages |
| 212110 | Salaries, administrative |
| 212120 | Salaries, supervisory |
| 212130 | Wages, manufacturing |
| 212140 | Vacation and holiday |
| 212150 | Accident and health benefits |

| Number | Account Number |
|---|---|
| 213- | Accrued payroll taxes |
| 213110 | Federal withholding |
| 213120 | F.I.C.A. - employee |
| 213130 | F.I.C.A. - employer |
| 213140 | Federal unemployment |
| 213150 | State disability insurance |
| 213160 | State unemployment insurance |
| 214- | Accrued other taxes |
| 214110 | Federal income |
| 214120 | State franchise |
| 214130 | State sales and use |
| 214140 | Real and personal property |
| 214150 | Licenses |
| 215- | Other current liabilities |
| 215110 | Accrued interest payable |
| 215120 | Accrued workmen's compensation |
| 215130 | Dividends payable |
| 216- | Long-term obligations |
| 216110 | Notes payable - long-term portion |
| 216120 | Notes payable - current portion |
| 216130 | Mortgage payable - long-term portion |
| 216140 | Mortgage payable - current portion |
| 216150 | Bonds payable |
| 216160 | Loans payable - stockholders |
| 217- | Special reserves |
| 311- | Capital stock |
| 311110 | Common stock authorized |
| 311120 | Common stock issued at stated value |
| 311130 | Common stock paid in capital |
| 311140 | Preferred stock authorized |
| 311150 | Preferred stock issued |
| 311160 | Preferred stock paid-in capital |
| 311170 | Treasury stock |
| 312- | Earned capital |
| 312110 | Retained earnings |
| 312120 | Reserve for treasury stock |
| 312130 | Divideds paid |
| 411- | Operating income |
| 411110 | Sales |
| 411120 | Sales allowances |
| 411130 | Sales discounts taken (lost) |
| 411140 | Miscellaneous income |
| 412- | Non-operating income |
| 412110 | Interest |
| 412120 | Rents |
| 412130 | Dividends |
| 412140 | Gain (loss) on sale of capital assets |
| 412150 | Extraordinary gain (loss) |
| 413- | Cost of goods sold |
| 413110 | Product A |
| 413120 | Purchase discounts taken (lost) |

| Number | Account Name |
|---|---|
| 414- | Variances affecting gross profits - Product A |
| 414110 | Material prices |
| 414120 | Direct labor |
| 414130 | Burden |
| 415- | Variances affecting gross profits - Product B |
| 415110 | Material prices |
| 415120 | Direct labor |
| 415130 | Burden |
| 416- | Variances affecting gross profits - Product C |
| 416110 | Material prices |
| 416120 | Direct labor |
| 416130 | Burden |
| 417- | Variances other than cost |
| 417110 | Sales of waste |
| 417120 | Defective merchandise allowances |
| 417130 | Defective merchandise repair |
| 417140 | Inventory obsolescense and adjustments |
| 418- | Cost analysis for cost of sales |
| 418110 | Purchases |
| 418120 | Labor |
| 418130 | Transfers |
| 418140 | Purchase returns |
| 419- | Contra-accounts for 418 and 500 accounts |
| 500- | Production expenses |
| 500110 | Indirect material |
| 500120 | Indirect labor |
| 500130 | Insurance |
| 500140 | Depreciation |
| 500150 | Taxes |
| 500160 | Rent and utilities |
| 500170 | Freight |
| 500180 | Printing |
| 500190 | Research and development |
| 600- | Selling expenses |
| 600110 | Supplies |
| 600120 | Salaries |
| 600130 | Insurance |
| 600140 | Depreciation |
| 600150 | Taxes |
| 600160 | Rent and utilities |
| 600170 | Postage |
| 600180 | Advertising |
| 600190 | Bad debt expense |
| 700- | Administration and general expenses |
| 700110 | Supplies |
| 700120 | Salaries |
| 700130 | Insurance |
| 700140 | Depreciation |
| 700150 | Taxes |
| 700160 | Rent and utilities |
| 700170 | Postage |
| 700180 | Contributions |
| 700190 | Service charges |

| Number | Account Name |
|---|---|
| 800- | Other expenses |
| 800110 | Incidental rental expense |
| 800120 | Interest expense |
| 800130 | Factor expense |
| 800140 | Other expenses |
| 900- | Income and franchise taxes |
| 900110 | Federal income tax, current year |
| 900120 | Federal income tax, prior years |
| 900130 | State franchise tax, current year |
| 900140 | State franchise tax, prior years |
| 900150 | Foreign income taxes |

# APPENDIX F
# COST ACCOUNT CATALOG

# COST ACCOUNT CATALOG STRUCTURE

ACCOUNT A: FACILITIES

I EXTERNAL SITE PARAMETERS
II BUILDING SPACE PARAMETERS

ACCOUNT B: PERSONNEL

I ADMINISTRATIVE, PERSONNEL, AND PLANT MAINTENANCE
II FINANCE, ACCOUNTING, AND DATA PROCESSING
III MANUFACTURING, QUALITY CONTROL, AND MATERIAL HANDLING
IV SALES AND MARKETING

ACCOUNT C: UTILITIES AND PLANT SERVICES

I UTILITIES
II PLANT SERVICES

ACCOUNT D: BY-PRODUCTS

I DISPOSABLE
II RECLAIMABLE

ACCOUNT E: COMMODITIES

I SILICON MATERIAL
II LARGE AREA SILICON SHEET
III ENCAPSULATION
IV CELL MANUFACTURE AND AUTOMATED ARRAY ASSEMBLY
V PACKAGING
VI MISCELLANEOUS

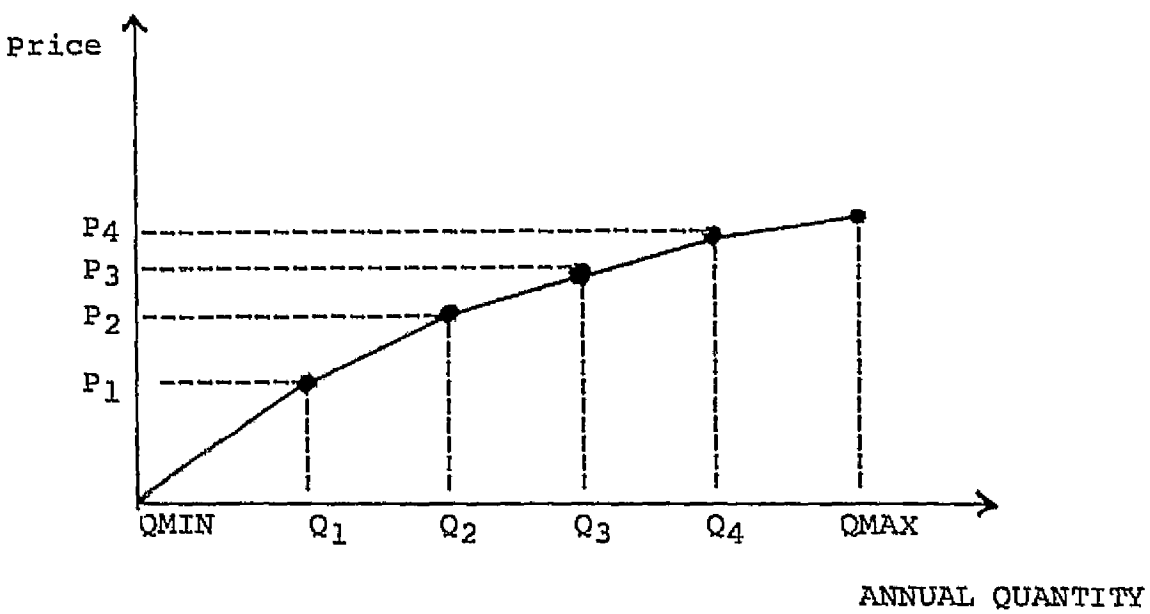
ACCOUNT F: RESOURCES

The cost account catalog contains a list of all items that may be required, directly or indirectly, by a solar array manufacturing firm. The list includes a catalog number, a name, and a unit of measure for each item. Where appropriate, it also provides price information (price year, inflation rate, and either a price or a price versus quantity table). The catalog expense items are organized into six accounts:

> Facilities parameters, which are primarily the independent variables used to estimate the initial facilities capital cost; Personnel, which includes all of the kinds of labor needed to operate the firm; Utilities and Plant Services, which in addition to having prices, may affect the facilities capital cost; By-products, which may in some cases affect facilities capital instead of having prices; Commodities, which are all of the materials and supplies needed to manufacture solar arrays; and Resources, which are included to permit an assessment of their utilization.

The price-quantity information should be interpreted as follows:

> N = Number of points needed to specify the piecewise linear price-quantity function.
>
> i = Index for the pairs of price-quantity points that define the piecewise linear approximating function (i = 1, 2, ..., N).
>
> $P_i$ = Dollar price for $Q_i$ units.
>
> $Q_i$ = Annual Quantity at the ith breakpoint in the price-quantity function.



## ABBREVIATIONS AND SYMBOL DEFINITIONS

- Table Column Labels

  IC = Inflation Class Code

  YR = Base Price Year

  QMIN = Minimum Annual Quantity for which the first price level is valid

  QMAX = Maximum Annual Quantity for which the Nth price level is valid

  N = Number of Price-Quantity Pairs required to define the piecewise linear approximating function

- Units of Measure

  BTU = British thermal units

  CFM = Cubic feet per minute

  Cu. Ft. = Cubic feet

  Cu. Mt. = Cubic meters

  Ft. = Feet

  Gals. = Gallons

  Kgs = Kilograms

  KW = Kilowatts

  KW-HR = Kilowatt hours

  Lbs. = Pounds

  Mt. = Meters

  MW = Megawatts

  PRSN*YRS = Person years

  Sq. Cm. = Square centimeters

  Sq. Ft. = Square feet

  Sq. Mt. = Square meters

- Inflation Class Codes

  IC = Inflation class code

  A = Raw materials

  B = Labor

  C = Chemicals

  D = Commodities

  E = Energy

  F = Natural resources

  G = Land

  H = Facilities

  I = Construction

  J = Equipment

- Base Price Year Codes

  YR = Base price year

  74 = 1974

  75 = 1975

  76 = 1976

  77 = 1977

- Maximum Quantity Codes

  QMAX = Maximum annual quantity

  inf = infinity

- Manufacturing Rooms

MANUFACTURING SPACE (TYPE A) (TYPICAL PRODUCTION ROOM). Walls - Metal stud and gypsum board/painted. Flooring - 1/8" vinyl asbestos tile/rubber base. Lighting - Recessed fluorescent fixtures providing 70 F.C. Ceiling - 2' x 4' mineral tile with exposed supporting 'T' grid. Telephone - Outlets at convenient locations. Doors - Solid core paint grade birch with hollow metal frames. Fire sprinklers - Ordinary hazard coverage with pendant heads/painted cones. Air conditioning - Comfort air conditioning.

MANUFACTURING SPACE (TYPE B) (CLEAN ROOM). Walls - Metal stud and gypsum board/vinyl wall fabric. Flooring - 1/8" sheet vinyl/covered base. Ceiling - Metal suspension system/gypsum board/vinyl fabric. Lighting - Recessed fluorescent fixtures providing 100 F.C. Telephone - Outlets at convenient locations. Doors - Solid core wood/plastic laminated surface/ hollow metal frames and gaskets. Fire sprinklers - Ordinary hazard coverage with flush heads. Air conditioning - Positive pressure laminar flow comfort air conditioning with 50% ± 10 R.H., filters to provide class 100 clean conditions. Vestible - Same construction as room and automatic shoe scrubber.

MANUFACTURING SPACE (TYPE C) (DARK ROOM). Walls - Metal stud and gypsum board/painted. Flooring - 1/8" vinyl asbestos tile rubber back. Lighting - Recessed fluorescent fixtures providing 70 F.C. Ceiling - 2' x 4' 'T' grid. Telephone - Outlets at convenient locations. Doors - Solid core wood/paint grade birch surface and hollow metal frames. Fire sprinkers - Ordinary hazard coverage with pendant heads/painted. Air conditioning - Comfort air conditioning with 50% ± 10 R.H.

- Trade Name Commodity Manufacturers and Suppliers

The following products are cited in the catalog by suppliers' brand names and are believed to be registered trademarks.

| Trade Designation | Supplier |
|---|---|
| ACRYLOID B-7 (polymeric adhesive) | Rohm and Haas Co., Philadelphia, PA |
| CAVALON 3100S (acrylic structural adhesive) | E.I. du Pont de Nemours and Co., Inc., Wilmington, DE |
| DC-3140 (silicone coating) | Dow-Corning Corp., Midland, MI |
| ECCOBOND 45 LV (epoxy adhesive) | Emerson and Cuming, Inc., Canton, MA |
| ECCOCOAT AC-8 (acrylic coating) | Emerson and Cuming, Inc., Canton, MA |
| EPOCAST 212/9617 (epoxy pottant) | Furane Plastics Co., Los Angeles, CA |
| EPOTEK 310 (epoxy adhesive) | Epoxy Technology, Inc., Watertown, MA |
| FEP "TEFLON" (adhesive) | E.I. du Pont de Nemours and Co., Inc., Wilmington, DE |
| KORAD A (acrylic polymer) | Rohm and Haas Co., Philadelphia, PA |
| KYNAR 202 (polyvinylidene fluoride resin) | E.I. du Pont de Nemours and Co., Inc., Wilmington, DE |
| LEXAN (polycarbonate film) | General Electric Co., Fairfield, CT |

| | |
|---|---|
| LUCITE (acrylic resin) | E.I. du Pont de Nemours and Co., Inc., Wilmington, DE |
| MONO (acrylic terpolymer sealant) | Tremco Manufacturing Co., Cleveland, OH |
| PLEXIGLAS (thermoplastic acrylic sheet) | Rohm and Haas Co., Philadelphia, PA |
| RC-5063Pyre M.L. (polyamic acid) | E.I. du Pont de Nemours and Co., Inc., Wilmington, DE |
| RESIN 650 (semi-inorganic polymer) | Owens-Illinois, Inc., Toledo, OH |
| RTV 108 (dimethyl silicone adhesive) | General Electric Co., Fairfield, CT |
| RTV 118 (dimethyl silicone adhesive/ sealant) | General Electric Co., Fairfield, CT |
| RTV 615 (dimethyl silicone pottant) | General Electric Co., Fairfield, CT |
| RTV 655 (silicone liquid) | General Electric Co., Fairfield, CT |
| SCOTCH-WELD 2216 B/A (adhesive) | 3 M Co., St. Paul, MN |
| STYCAST - 1269A (epoxy casting resin) | Emerson and Cuming, Inc., Canton, MA |
| SUN-LITE (fiberglass-reinforced polyester cover material) | Kalwall Corp., Manchester, NH |
| SYLGARD 184 (dimethy silicone rubber pottant) | Dow-Corning Corp., Midland, MI |
| TEDLAR (polyvinyl fluoride) | E.I. du Pont de Nemours and Co., Inc., Wilmington, DE |
| XT-365 (acrylic molding compound) | American Cyanamid Co., Wayne, NJ |

COST ACCOUNT CATALOG

ACCOUNT A: FACILITIES

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE CLASSIFICATION |
|---|---|---|
| I | EXTERNAL SITE PARAMETERS: | |
| A1016I | FENCING | Ft. |
| A1032I | FIRE LOOP AND SECONDARY WATER SUPPLY | Ft. |
| A1048I | GRADING | Sq. Ft. |
| A1064I | INDUSTRIAL WASTE CLARIFIERS AND HOLD TANKS | Gallons |
| A1080I | LAND | Sq. Ft. |
| A1096I | LANDSCAPING AND IRRIGATION | Sq. Ft. |
| A1112I | ELECTRICAL SERVICE FACILITIES | KW |
| A1128I | FUEL OIL SERVICE FACILITIES | Gallons |
| A1144I | NATURAL GAS SERVICE FACILITIES | Cu. Ft. |
| A1160I | LIQUID NITROGEN SERVICE FACILITIES | Cu. Ft. |
| A1176I | LIQUID OXYGEN SERVICE FACILITIES | Cu. Ft. |
| A1192I | SANITARY SEWERS | CFM |
| A1208I | STORM DRAINS | CFM |
| A1224I | TELEPHONE LINES | Phones |
| A1240I | WATER SERVICE FACILITIES | CFM |
| A1256I | PAVING (HEAVY DUTY) FOR ON-SITE ROADS | Sq. Ft. |
| A1272I | PAVING (LIGHT DUTY) FOR PARKING LOTS | Sq. Ft. |
| A1288I | SECURITY CONTROL FACILITIES | Dollars |
| A1304I | SIGNS AND FLAGPOLE | Dollars |
| A1320I | STORAGE AREA WALLS | Ft. |
| A1336I | STORAGE SPACE | Sq. Ft. |
| A1352I | SITE LIGHTING | Dollars |
| A1368I | WALKS, CURBS AND GUTTERS | Dollars |

ACCOUNT A: FACILITIES

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE CLASSIFICATION |
|---|---|---|
| II | BUILDING SPACE PARAMETERS: | |
| A2008I | AIR CONDITIONING FACILITIES | Tons |
| A2016I | CAFETERIA AND LUNCHROOM | Sq. Ft. |
| A2020I | COMPRESSED AIR FACILITIES | CFM |
| A2024I | COMPUTER ROOM | Sq. Ft. |
| A2032I | ELECTRICAL EQUIPMENT ROOM | Sq. Ft. |
| A2040I | EXTERIOR WALLS | Ft. |
| A2048I | HEALTH SERVICE FACILITIES | Sq. Ft. |
| A2056I | HEATING FACILITIES | BTU |
| A2064D | MANUFACTURING SPACE (TYPE A)* | Sq. Ft. |
| A2080D | MANUFACTURING SPACE (TYPE B)* | Sq. Ft. |
| A2096D | MANUFACTURING SPACE (TYPE C)* | Sq. Ft. |
| A2112I | MECHANICAL EQUIPMENT ROOM | Sq. Ft. |
| A2128I | OFFICE SPACE - ADMINISTRATION | Sq. Ft. |
| A2144I | OFFICE SPACE - MANUFACTURING | Sq. Ft. |
| A2160I | PASSAGES AND CORRIDORS | Sq. Ft. |
| A2176I | PLANT MAINTENANCE AND MACHINE SHOP | Sq. Ft. |
| A2192I | QUALITY CONTROL LABORATORY | Sq. Ft. |
| A2208I | SHIPPING AND RECEIVING DOCK | Sq. Ft. |
| A2224I | SOLVENT AND CHEMICAL STORAGE | Sq. Ft. |
| A2240I | TELEPHONE EQUIPMENT ROOM | Sq. Ft. |
| A2256I | TOILET AND LOCKER ROOM | Sq. Ft. |
| A2263I | VENTILATION FACILITIES | CFM |

*See Abbreviations and Definitions for a description of the different types of manufacturing rooms.

COST ACCOUNT CATALOG

ACCOUNT A: FACILITIES

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | CLASSIFICATION |
|---|---|---|---|
| A2272I | WAREHOUSE SPACE | Sq. Ft. | |
| A2288D | LEASED OR RENTED EQUIPMENT | Dollars | |
| A3016I | TOTAL FACTORY FLOOR SPACE | Sq. Ft. | |
| A3032I | TOTAL MANUFACTURING FLOOR SPACE | Sq. Ft. | |
| A3048I | TOTAL SUPPORT FLOOR SPACE | Sq. Ft. | |

COST ACCOUNT CATALOG

ACCOUNT B: PERSONNEL

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | OCCUPATIONAL CLASSIFICATION | I C | YR | Q MIN | Q MAX | N | PRICE $/(PRSN*YR) |
|---|---|---|---|---|---|---|---|---|---|
| I | ADMINISTRATIVE, PERSONNEL, AND PLANT MAINTENANCE: | | | | | | | | |
| B1016I | ADMINISTRATIVE ASSISTANT (CORPORATE SYSTEMS PLANNER) | PRSN*YRS | 169168 | B | 76 | 0 | inf | 1 | 37600 |
| B1032I | AUDITOR, INTERNAL | PRSN*YRS | 162118 | B | 76 | 0 | inf | 1 | 21200 |
| B1048I | CLERK GENERAL OFFICE (ADMINISTRATIVE) | PRSN*YRS | 219388 | B | 76 | 0 | inf | 1 | 8260 |
| B1064I | DIRECTOR INDUSTRIAL RELATIONS (PERSONNEL) | PRSN*YRS | 166118 | B | 76 | 0 | inf | 1 | 32960 |
| B1080I | DIRECTOR OFFICE ADMINISTRATION | PRSN*YRS | 169168 | B | 76 | 0 | inf | 1 | 32960 |
| B1096I | DIRECTOR PLANT MAINTENANCE AND SECURITY | PRSN*YRS | 169118 | B | 76 | 0 | inf | 1 | 32960 |
| B1112I | DIRECTOR PUBLIC RELATIONS | PRSN*YRS | 165068 | B | 76 | 0 | inf | 1 | 32960 |
| B1128I | EMPLOYMENT INTERVIEWER (PERSONNEL RECRUITER) | PRSN*YRS | 166268 | B | 76 | 0 | inf | 1 | 20360 |
| B1144I | GROUNDSKEEPER | PRSN*YRS | 407884 | B | 76 | 0 | inf | 1 | 8800 |
| B1160I | GUARD (SECURITY) | PRSN*YRS | 372868 | B | 76 | 0 | inf | 1 | 7100 |
| B1176I | GUARD CHIEF | PRSN*YRS | 372168 | B | 76 | 0 | inf | 1 | 11000 |
| B1192I | JANITOR | PRSN*YRS | 382884 | B | 76 | 0 | inf | 1 | 8800 |
| B1208I | LAWYER, CORPORATE (BUSINESS AND FINANCIAL COUNSEL) | PRSN*YRS | 110118 | B | 76 | 0 | inf | 1 | 23500 |

COST ACCOUNT CATALOG

ACCOUNT B: PERSONNEL

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | OCCUPATIONAL CLASSIFICATION | I C | YR | Q MIN | Q MAX | N | PRICE $/(PRSN*YR) |
|---|---|---|---|---|---|---|---|---|---|
| B1224I | LEGAL SECRETARY | PRSN*YRS | 201368 | B | 76 | 0 | inf | 1 | 10600 |
| B1240I | MAIL CLERK | PRSN*YRS | 231588 | B | 76 | 0 | inf | 1 | 8260 |
| B1256I | MAINTENANCE FOREMAN (PLANT AND UTILITIES) | PRSN*YRS | 891138 | B | 76 | 0 | inf | 1 | 15600 |
| B1272I | MAINTENANCE MAN (PLANT, UTILITIES, AND GROUNDS) | PRSN*YRS | 899281 | B | 76 | 0 | inf | 1 | 8800 |
| B1288I | MANAGER, COMPENSATION, INSURANCE, AND MEDICAL SER. | PRSN*YRS | 199118 | B | 76 | 0 | inf | 1 | 26500 |
| B1304I | MANAGER, PERSONNEL | PRSN*YRS | 166118 | B | 76 | 0 | inf | 1 | 26500 |
| B1320I | MANAGER, SECURITY AND MAINTENANCE | PRSN*YRS | 199118 | B | 76 | 0 | inf | 1 | 26500 |
| B1336I | NURSE, PROFESSIONAL (GENERAL DUTY) | PRSN*YRS | 075378 | B | 76 | 0 | inf | 1 | 12900 |
| B1352I | PERSONNEL CLERK | PRSN*YRS | 205368 | B | 76 | 0 | inf | 1 | 8260 |
| B1368I | PERSONNEL CLERK, SUPERVISOR | PRSN*YRS | 205138 | B | 76 | 0 | inf | 1 | 12500 |
| B1384I | PRESIDENT | PRSN*YRS | 189118 | B | 76 | 0 | inf | 1 | 88300 |
| B1400I | RECEPTIONIST | PRSN*YRS | 237368 | B | 76 | 0 | inf | 1 | 10600 |
| B1416I | SAFETY ENGINEER | PRSN*YRS | 012081 | B | 76 | 0 | inf | 1 | 23500 |
| B1432I | SECRETARY I (LOWER MANAGEMENT) | PRSN*YRS | 201368 | B | 76 | 0 | inf | 1 | 9750 |
| B1440I | SECRETARY II (MIDDLE MANAGEMENT) | PRSN*YRS | 201368 | B | 76 | 0 | inf | 1 | 10400 |
| B1444I | SECRETARY III (UPPER MANAGEMENT) | PRSN*YRS | 201368 | B | 76 | 0 | inf | 1 | 11350 |
| B1448I | SUPERVISOR, TRAINING | PRSN*YRS | 166228 | B | 76 | 0 | inf | 1 | 20360 |
| B1464I | VICE PRESIDENT, ADMINISTRATION | PRSN*YRS | 189118 | B | 76 | 0 | inf | 1 | 52500 |

COST ACCOUNT CATALOG

ACCOUNT B: PERSONNEL

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | OCCUPATIONAL CLASSIFICATION | I C | YR | Q MIN | Q MAX | N | PRICE $/(PRSN*YR) |
|---|---|---|---|---|---|---|---|---|---|
| II | FINANCE, ACCOUNTING, AND DATA PROCESSING: | | | | | | | | |
| B2008I | ACCOUNTANT | PRSN*YRS | 160188 | B | 76 | 0 | inf | 1 | 14000 |
| B2016I | ACCOUNTING SUPERVISOR | PRSN*YRS | 160188 | B | 76 | 0 | inf | 1 | 20600 |
| B2032I | BOOKKEEPER | PRSN*YRS | 210388 | B | 76 | 0 | inf | 1 | 10000 |
| B2048I | CONTROLLER AND CHIEF ACCOUNTING OFFICER | PRSN*YRS | 186118 | B | 76 | 0 | inf | 1 | 35300 |
| B2064I | DATA PROCESSING SUPERVISOR | PRSN*YRS | 169168 | B | 76 | 0 | inf | 1 | 17700 |
| B2080I | DIGITAL COMPUTER OPERATOR (CONSOLE OPERATOR) | PRSN*YRS | 213382 | B | 76 | 0 | inf | 1 | 10600 |
| B2096I | FINANCIAL ANALYST | PRSN*YRS | 020188 | B | 76 | 0 | inf | 1 | 19500 |
| B2112I | KEY PUNCH OPERATOR | PRSN*YRS | 213582 | B | 76 | 0 | inf | 1 | 8800 |
| B2128I | MANAGER, DATA PROCESSING | PRSN*YRS | 169168 | B | 76 | 0 | inf | 1 | 26500 |
| B2144I | PAYROLL CLERK | PRSN*YRS | 215488 | B | 76 | 0 | inf | 1 | 8260 |
| B2160I | PROCUREMENT CLERK | PRSN*YRS | 219138 | B | 76 | 0 | inf | 1 | 9800 |
| B2176I | PROGRAMMER, BUSINESS | PRSN*YRS | 020188 | B | 76 | 0 | inf | 1 | 17700 |
| B2192I | PURCHASING ADMINISTRATOR | PRSN*YRS | 162118 | B | 76 | 0 | inf | 1 | 30000 |
| B2208I | PURCHASING AGENT | PRSN*YRS | 162158 | B | 76 | 0 | inf | 1 | 20000 |
| B2224I | PURCHASING SUPERVISOR | PRSN*YRS | 162158 | B | 76 | 0 | inf | 1 | 17500 |
| B2240I | SYSTEMS ANALYST | PRSN*YRS | 012168 | B | 76 | 0 | inf | 1 | 19500 |
| B2256I | TREASURER | PRSN*YRS | 161118 | B | 76 | 0 | inf | 1 | 32960 |
| B2272I | VICE PRESIDENT, FINANCE | PRSN*YRS | 189118 | B | 76 | 0 | inf | 1 | 52000 |

COST ACCOUNT CATALOG

ACCOUNT B: PERSONNEL

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | OCCUPATIONAL CLASSIFICATION | I C | YR | Q MIN | Q MAX | N | PRICE $/(PRSN*YR) |
|---|---|---|---|---|---|---|---|---|---|
| III MANUFACTURING, QUALITY CONTROL, AND MATERIALS HANDLING: | | | | | | | | | |
| • ASSEMBLY LINE WORKERS | | | | | | | | | |
| B3016D | CHASSIS ASSEMBLER | PRSN*YRS | 729884 | B | 76 | 0 | inf | 1 | 8100 |
| B3032D | ELECTRONICS ASSEMBLER | PRSN*YRS | 726781 | B | 76 | 0 | inf | 1 | 8100 |
| B3048D | ENCAPSULATOR (ELECTRONICS) | PRSN*YRS | 726887 | B | 76 | 0 | inf | 1 | 8100 |
| B3064D | GENERAL ASSEMBLER (ELECTRONICS) | PRSN*YRS | 726381 | B | 76 | 0 | inf | 1 | 8100 |
| B3080D | MODULE ASSEMBLER | PRSN*YRS | 726884 | B | 76 | 0 | inf | 1 | 8100 |
| B3096D | SEMICONDUCTOR ASSEMBLER (ELECTRONICS) | PRSN*YRS | 726884 | B | 76 | 0 | inf | 1 | 8100 |
| B3104D | WELDER | PRSN*YRS | 812884 | B | 76 | 0 | inf | 1 | 10500 |
| B3112D | WIRE WORKER (ELECTRONICS SUB-ASSEMBLER) | PRSN*YRS | 728887 | B | 76 | 0 | inf | 1 | 8100 |
| • ENGINEERS | | | | | | | | | |
| B3128B | CHEMICAL ENGINEER | PRSN*YRS | 008081 | B | 76 | 0 | inf | 1 | 24000 |
| B3144I | DIRECTOR, MANUFACTURING ENGINEERING | PRSN*YRS | 007168 | B | 76 | 0 | inf | 1 | 32000 |
| B3160I | DIRECTOR, QUALITY CONTROL | PRSN*YRS | 012168 | B | 76 | 0 | inf | 1 | 32000 |
| B3176I | DIRECTOR, RESEARCH AND DEVELOPMENT | PRSN*YRS | 189118 | B | 76 | 0 | inf | 1 | 28000 |
| B3192I | DRAFTSMAN, MECHANICAL | PRSN*YRS | 007281 | B | 76 | 0 | inf | 1 | 12700 |

COST ACCOUNT CATALOG

ACCOUNT B: PERSONNEL

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | OCCUPATIONAL CLASSIFICATION | I C | YR | Q MIN | Q MAX | N | PRICE $/(PRSN*YR) |
|---|---|---|---|---|---|---|---|---|---|
| B3208B | ELECTRONICS ENGINEER | PRSN*YRS | 003081 | B | 76 | 0 | inf | 1 | 23500 |
| B3216I | ENGINEERING AIDE | PRSN*YRS | 726281 | B | 76 | 0 | inf | 1 | 11000 |
| B3224B | INDUSTRIAL ENGINEER | PRSN*YRS | 012188 | B | 76 | 0 | inf | 1 | 23000 |
| B3240B | MECHANICAL ENGINEER | PRSN*YRS | 007081 | B | 76 | 0 | inf | 1 | 23500 |
| B3256B | PRODUCTION PLANNER | PRSN*YRS | 012188 | B | 76 | 0 | inf | 1 | 23000 |
| B3272B | QUALITY CONTROL ENGINEER | PRSN*YRS | 012118 | B | 76 | 0 | inf | 1 | 23000 |
| B3288I | RESEARCH ENGINEER (ELECTRONICS) | PRSN*YRS | 003081 | B | 76 | 0 | inf | 1 | 20000 |
| B3304I | VICE PRESIDENT MANUFACTURING | PRSN*YRS | 189113 | B | 76 | 0 | inf | 1 | 52500 |
| • | FOREMEN, INSPECTORS, SUPERVISORS | | | | | | | | |
| B3320I | ASSEMBLY FOREMAN | PRSN*YRS | 726130 | B | 76 | 0 | inf | 1 | 14000 |
| B3336I | ASSEMBLY OPERATIONS SUPERVISOR | PRSN*YRS | 726130 | B | 76 | 0 | inf | 1 | 17000 |
| B3352I | ASSISTANT PRODUCTION SUPERVISOR | PRSN*YRS | 183118 | B | 76 | 0 | inf | 1 | 20000 |
| B3368I | CHEMICAL PROCESS FOREMAN | PRSN*YRS | 559130 | B | 76 | 0 | inf | 1 | 13000 |
| B3384I | ELECTRONICS MAINTENANCE FOREMAN | PRSN*YRS | 828138 | B | 76 | 0 | inf | 1 | 13500 |
| B3400I | MACHINE SHOP FOREMAN | PRSN*YRS | 609130 | B | 76 | 0 | inf | 1 | 13500 |
| B3432I | MATERIALS-HANDLING FOREMAN | PRSN*YRS | 929133 | B | 76 | 0 | inf | 1 | 13500 |
| B3448I | MECHANICAL MAINTENANCE FOREMAN | PRSN*YRS | 891138 | B | 76 | 0 | inf | 1 | 13500 |

COST ACCOUNT CATALOG

ACCOUNT B: PERSONNEL

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | OCCUPATIONAL CLASSIFICATION | I C | YR | Q MIN | Q MAX | N | PRICE $/(PRSN*YR) |
|---|---|---|---|---|---|---|---|---|---|
| B3464I | PROCESS MAINTENANCE SUPERVISOR | PRSN*YRS | 828138 | B | 76 | 0 | inf | 1 | 16500 |
| B3480I | PRODUCTION MACHINE SHOP SUPERVISOR | PRSN*YRS | 609130 | B | 76 | 0 | inf | 1 | 16500 |
| B3496I | PRODUCTION SUPERINTENDENT (PLANT MANAGER) | PRSN*YRS | 183118 | B | 76 | 0 | inf | 1 | 23500 |
| B3512I | QUALITY CONTROL FOREMAN | PRSN*YRS | 726130 | B | 76 | 0 | inf | 1 | 13500 |
| B3528I | QUALITY CONTROL SUPERVISOR | PRSN*YRS | 726130 | B | 76 | 0 | inf | 1 | 16500 |
| B3544I | WAREHOUSE AND MATERIALS HANDLING SUPERVISOR | PRSN*YRS | 233138 | B | 76 | 0 | inf | 1 | 16500 |
| B3560I | WAREHOUSE FOREMAN | PRSN*YRS | 929138 | B | 76 | 0 | inf | 1 | 13500 |
| | * MATERIALS HANDLERS, PACKAGERS | | | | | | | | |
| B3576D | FORKLIFT TRUCK OPERATOR | PRSN*YRS | 922883 | B | 76 | 0 | inf | 1 | 7000 |
| B3592D | INVENTORY CLERK | PRSN*YRS | 233388 | B | 76 | 0 | inf | 1 | 9650 |
| B3608D | MATERIAL CLERK (SUPPLIES CLERK) | PRSN*YRS | 223387 | B | 76 | 0 | inf | 1 | 9700 |
| B3624D | MATERIAL HANDLER | PRSN*YRS | 929887 | B | 76 | 0 | inf | 1 | 12000 |

COST ACCOUNT CATALOG

ACCOUNT B: PERSONNEL

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | OCCUPATIONAL CLASSIFICATION | I C | YR | Q MIN | Q MAX | N | PRICE $/(PRSN*YR) |
|---|---|---|---|---|---|---|---|---|---|
| B3640D | PACKAGER HAND | PRSN*YRS | 920887 | B | 76 | 0 | inf | 1 | 9800 |
| B3656D | PACKAGER MACHINE | PRSN*YRS | 920885 | B | 76 | 0 | inf | 1 | 9800 |
| | • OPERATORS, TECHNICIANS, MAINTENANCE MEN | | | | | | | | |
| B3672D | CHEMICAL OPERATOR II | PRSN*YRS | 558885 | B | 76 | 0 | inf | 1 | 10050 |
| B3688D | ELECTRONICS MAINTENANCE MAN | PRSN*YRS | 828281 | B | 76 | 0 | inf | 1 | 11000 |
| B3704D | ELECTRONICS TECHNICIAN, AUTOMATED PROCESSES | PRSN*YRS | 726281 | B | 76 | 0 | inf | 1 | 11000 |
| B3720D | INSPECTOR SYSTEMS (QUALITY CONTROL) | PRSN*YRS | 722281 | B | 76 | 0 | inf | 1 | 8250 |
| B3736D | MAINTENANCE MECHANIC II | PRSN*YRS | 638281 | B | 76 | 0 | inf | 1 | 11800 |
| B3752D | PRODUCTION-MACHINE (MACHINE SHOP) OPERATOR | PRSN*YRS | 609885 | B | 76 | 0 | inf | 1 | 9400 |
| B3768D | TESTER, ELECTRONIC COMPONENTS | PRSN*YRS | 726687 | B | 76 | 0 | inf | 1 | 8200 |
| B3784D | TESTER, SYSTEMS (QUALITY CONTROL TECHNICIAN) | PRSN*YRS | 729381 | B | 76 | 0 | inf | 1 | 8200 |

ACCOUNT B: PERSONNEL

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | OCCUPATIONAL CLASSIFICATION | I C | YR | Q MIN | Q MAX | N | PRICE $/(PRSN*YR) |
|---|---|---|---|---|---|---|---|---|---|
| IV SALES AND MARKETING: | | | | | | | | | |
| B4016D | COMMERCIAL ARTIST | PRSN*YRS | 141081 | B | 76 | 0 | inf | 1 | 8800 |
| B4032D | FIELD ENGINEER (TECHNICAL REPRESENTATIVE) | PRSN*YRS | 829281 | B | 76 | 0 | inf | 1 | 22000 |
| B4048I | MANAGER, ADVERTISING | PRSN*YRS | 164118 | B | 76 | 0 | inf | 1 | 32000 |
| B4064I | MANAGER, MARKETING RESEARCH | PRSN*YRS | 050088 | B | 76 | 0 | inf | 1 | 32000 |
| B4080I | MANAGER, SALES | PRSN*YRS | 163118 | B | 76 | 0 | inf | 1 | 32000 |
| B4096I | MANAGER, SALES ENGINEERING | PRSN*YRS | 003151 | B | 76 | 0 | inf | 1 | 32000 |
| B4112I | MARKET-RESEARCH ANALYST | PRSN*YRS | 050088 | B | 76 | 0 | inf | 1 | 21000 |
| B4128D | SALESMAN | PRSN*YRS | 278358 | B | 76 | 0 | inf | 1 | 12900 |
| B4144D | SALESMAN, ADVERTISING | PRSN*YRS | 258358 | B | 76 | 0 | inf | 1 | 12500 |
| B4160D | TECHNICAL ILLUSTRATOR | PRSN*YRS | 017281 | B | 76 | 0 | inf | 1 | 14000 |
| B4176D | TECHNICAL WRITER | PRSN*YRS | 139288 | B | 76 | 0 | inf | 1 | 14000 |
| B4192I | VICE PRESIDENT SALES AND MARKETING | PRSN*YRS | 189118 | B | 76 | 0 | inf | 1 | 52000 |
| B5016I | TOTAL DIRECT PERSONNEL | PRSN*YRS | | | | | | | |
| B5032I | TOTAL PERSONNEL | PRSN*YRS | | | | | | | |
| B5048I | TOTAL STAFF PERSONNEL | PRSN*YRS | | | | | | | |

COST ACCOUNT CATALOG

ACCOUNT C: UTILITIES AND PLANT SERVICES

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | CLASSIFICATION | I C | YR | Q MIN | Q MAX | N | PRICE - QUANTITY PAIRS [P = $PRICE @ Q = ANNUAL QUANTITY] P | Q | P | Q | P | Q | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | UTILITIES: | | | | | | | | | | | | | | | |
| C1016B | DOMESTIC WATER | Cu. Ft. | | P | 77 | 0 | 150000 | 4 | .64 | 400 | 8.48 | 2000 | 410.28 | 100000 | 480 | 150000 |
| C1032B | ELECTRICITY | KW hr. | | E | 77 | 0 | 300 | 3 | 3.60 | 100 | 6.86 | 200 | 9.56 | 300 | | |
| C1048B | FUEL OIL | Gallons | | E | 77 | 0 | 10000 | 3 | 439 | 1000 | 2912 | 7000 | 3980 | 10000 | | |
| C1064B | NATURAL GAS | Cu. Ft. | | E | 77 | 0 | 40000 | 4 | 555 | 1500 | 2680 | 10000 | 255000 | 1500000 | | |
| C1080D | NITROGEN (LIQUID) | Cu. Ft. | | C | 77 | 0 | inf | 1 | 5.66 | 1 | | | | | | |
| C1096D | OXYGEN (LIQUID) | Cu. Ft. | | C | 77 | 0 | inf | 1 | 21.03 | 1 | | | | | | |
| C1112I | TELEPHONE SERVICE | Extensions | | J | 77 | 0 | inf | 1 | 144 | 1 | | | | | | |
| C1128D | WATER - COOLING | KW hr. | | F | 77 | 0 | inf | 1 | .565 | 100 | | | | | | |
| C1144D | WATER - DEIONIZED | Cu. Ft. | | C | 77 | 0 | inf | 1 | .037 | 1 | | | | | | |
| II | PLANT SERVICES: | | | | | | | | | | | | | | | |
| C2016I | CAFETERIA SERVICE | PRSN*YRS | | D | 77 | 250 | inf | 3 | 0 | 249 | 6985 | 250 | 139750 | 500 | | |
| C2032D | COMPRESSED AIR | Cu. Ft. | | E | 77 | 0 | inf | 0 | | | | | | | | |
| C2048B | POWER SUPPLY | KW | | E | 77 | 0 | inf | 0 | | | | | | | | |
| C2064B | SEWAGE AND PROCESS WASTE DISPOSAL | Cu. Ft. | | F | 77 | 300 | inf | 4 | 14.4 | 3600 | 131.0 | 36000 | 302.0 | 96000 | 426.2 | 150000 |
| C2080B | WATER SUPPLY | Cu. Ft. | | F | 77 | 0 | inf | 0 | | | | | | | | |
| C2096B | AIR CONDITIONING | KW hr. | | E | 77 | 0 | inf | 0 | | | | | | | | |
| C2112B | HEATING | Cu. Ft. | | E | 77 | 0 | inf | 0 | | | | | | | | |
| C2128B | VENTILATION | Cu. Ft. | | E | 77 | 0 | inf | 0 | | | | | | | | |
| C2144B | SOLID WASTE DISPOSAL | Cu. Ft. | | F | 77 | 0 | inf | 4 | 162 | 468 | 186 | 702 | 330 | 4212 | 3640 | 54912 |
| C2160I | LIGHTING | Lumens | | E | 77 | 0 | inf | 0 | | | | | | | | |

COST ACCOUNT CATALOG

ACCOUNT D: BY-PRODUCTS

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | CLASSIFICATION | I C | YR | MIN | MAX | N | PRICE - QUANTITY PAIRS [PRICE = $PRICE @ Q = ANNUAL QUANTITY] P | Q | P | Q | P | Q | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D1016B | FUMES | Cu. Ft. | | F | 77 | 0 | inf | 0 | | | | | | | | |
| D1032D | POISONOUS ACID | Gallons | | F | 77 | 0 | inf | 3 | 6.42 | 100 | 66.00 | 1200 | 105.60 | 6000 | | |
| D1048B | POLLUTED WATER | Gallons | | F | 77 | 0 | inf | 4 | 13.46 | 25000 | 121.62 | 250000 | 315.37 | 750000 | 379.78 | 100000 |
| D1064D | REJECTED WAFERS | Wafers | | (USE MINUS 10% OF CURRENT PRICE GOALS) | | | | | | | | | | | | |
| D1080I | SEWAGE WASTE | Gallons | | F | 77 | 0 | inf | 4 | 13.46 | 25000 | 121.62 | 250000 | 315.37 | 750000 | 379.78 | 100000 |
| D1096B | SOLID WASTE | Lbs. | | F | 77 | 0 | inf | 4 | 166.10 | 10000 | 191.00 | 15000 | 376.00 | 100000 | 185.00 | 100000 |
| D1128D | USED SOLVENT | Gallons | | F | 77 | 0 | inf | 3 | 6.42 | 100 | 66.00 | 1200 | 105.60 | 6000 | | |
| D1160D | WARM COOLING WATER | Gallons | | F | 77 | 0 | inf | 4 | 13.46 | 25000 | 121.62 | 250000 | 315.37 | 750000 | 379.78 | 100000 |
| D1176D | REJECTED CELLS | Cells | | (USE MINUS 5% OF CURRENT PRICE GOALS) | | | | | | | | | | | | |
| DE1588D | SILICON TETRACLORIDE (also a commodity) | | | | | | | | | | | | | | | |

COST ACCOUNT CATALOG

ACCOUNT E: COMMODITIES

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | FEDERAL STOCK CODES | I C | YR | Q MIN | Q MAX | N | PRICE - QUANTITY PAIRS [P = $PRICE @ Q = ANNUAL QUANTITY] P | Q | P | Q | P | Q | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E1016D | ACETIC ACID | Lbs. | 12735 | C | 77 | 0 | inf | 4 | 132 | 400 | 945 | 3150 | 1296 | 4500 | 1486 | 8740 |
| E1032D | ACETONE | Lbs. | 12101 | C | 77 | 0 | inf | 4 | 104 | 358 | 859 | 3850 | 1204 | 6509 | 6639 | 39055 |
| E1048D | ACRYLOID B-7* (Polymeric Adhesive) | Lbs. | 11297 | C | 77 | 0 | inf | 2 | 43 | 25 | 381.6 | 530 | | | | |
| E1064D | SILVER (AG.) PASTE (80%) | Grams | | C | 77 | 0 | inf | 1 | .3858 | 1 | | | | | | |
| E1072D | SILVER PLATED COPPER WIRE | Ft. | | C | 77 | 0 | inf | 1 | 2633 | 1 | | | | | | |
| E1080D | ANTIREFLECTIVE COATING | Liters | | C | 77 | 0 | inf | 1 | 10 | 1 | | | | | | |
| E1096D | ALUMINUM | Lbs. | 12579 | D | 77 | 0 | inf | 1 | .75 | 1 | | | | | | |
| E1100D | ALUMINUM CHANNEL | Ft. | | C | 77 | 0 | inf | 1 | .01 | 1 | | | | | | |
| E1104D | ALUMINUM RIBBON | Dollars | | C | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1108D | AMMONIA GAS | Cu. Ft. | | C | 77 | 0 | inf | 1 | .16 | 1 | | | | | | |
| E1110D | AMMONIUM HYDROXIDE | Cu. Ft. | | C | 77 | 0 | inf | 1 | 25.2 | 1 | | | | | | |
| E1112D | ARGON GAS | Cu. Ft. | 16832 | C | 77 | 0 | inf | 1 | .14 | 1 | | | | | | |
| E1120D | BOATS (12" x 4") | Boats | | D | 77 | 0 | inf | 1 | 550 | 1 | | | | | | |
| E1128D | BUTYL ACETATE (Ink Solvent) | Lbs. | 12115 | C | 77 | 0 | inf | 4 | 164 | 400 | 1440 | 4000 | 2220 | 7280 | 12667 | 43680 |
| E1136D | CAVALON 3100 S* (Acrylic Structural Adhesive) | Lbs. | | C | 77 | 0 | inf | 1 | 3 | 1 | | | | | | |
| E1140D | CELLS, SOLAR | Cells | | (USE CURRENT PRICE GOALS) | | | | | | | | | | | | |
| E1144D | CONFORMAL COATING | Sq. Ft. | | C | 77 | 0 | inf | 1 | .11 | 16 | | | | | | |
| E1160D | CONNECTOR, PANEL | Units | | C | 77 | 0 | inf | 1 | 1.315 | 1 | | | | | | |
| E1176D | COPPER INK | Dollars | | C | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1180D | CRATES, WOODEN | Cu. Ft. | | C | 77 | 0 | inf | 1 | .0796 | 1 | | | | | | |
| E1184D | DC-3140 (COATING)* | Lbs. | | C | 77 | 0 | inf | 1 | 12.25 | 1 | | | | | | |
| E1204D | DIAMOND BLADES | Dollars | | D | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |

*See Abbreviations and Definitions for a list of trade-name commodity manufacturers and suppliers.

COST ACCOUNT CATALOG

ACCOUNT E: COMMODITIES

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | FEDERAL STOCK CODES | I C | YR | Q MIN | Q MAX | N | PRICE - QUANTITY PAIRS [P = $PRICE @ Q = ANNUAL QUANTITY] P | Q | P | Q | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E1206D | DIBORANE 5% IN HYDROGEN | Cu. Ft. | | C | 77 | 0 | inf | 1 | .80 | 1 | | | | |
| E1228D | ECCO BOND 45LV (Epoxy Adhesive) | Lbs. | | C | 77 | 0 | inf | 1 | 2.25 | 1 | | | | |
| E1230D | ECCOCOAT AC-8* (Acrylic Coating) | Lbs. | | C | 77 | 0 | inf | 1 | 1.90 | 1 | | | | |
| E1232D | EDGE SEAL | Dollars | | D | 77 | 0 | inf | 1 | 1 | 1 | | | | |
| E1240D | ELECTRODES | Units | | D | 77 | 0 | inf | 1 | .32 | 448 | | | | |
| E1248D | END CAPS | Sq. Ft. | | D | 77 | 0 | inf | 1 | .06 | 16 | | | | |
| E1250D | EPOCAST 212/9617* (Epoxy Pottant) | Lbs. | | C | 77 | 0 | inf | 1 | 151.60 | 40 | | | | |
| E1252C | EPO-TEK 310* (Epoxy Adhesive | Lbs. | | C | 77 | 0 | inf | 2 | 163.35 | 9 | 605 | 50 | | |
| E1256B | EXPENDABLE TOOLS | Dollars | | C | 77 | 0 | inf | 1 | 1 | 1 | | | | |
| E1272D | FEP "TEFLON"* (5 Mils Adhesive) | Lbs. | | C | 77 | 0 | inf | 1 | 13 | 1 | | | | |
| E1280D | FILAMENTS/INSULATORS | Units | | D | 77 | 0 | inf | 1 | 23.19 | 1 | | | | |
| E1282D | FILTERS | Dollars | | D | 77 | 0 | inf | 1 | 1 | 1 | | | | |
| E1284D | GLASS TUBING | Dollars | | D | 77 | 0 | inf | 1 | 1 | 1 | | | | |
| E1304D | HELIUM GAS | Cu. Ft. | 16834 | C | 77 | 0 | inf | 1 | .044 | 1 | | | | |
| E1312D | HYDRAZINE | Lbs. | | C | 77 | 0 | inf | 1 | 55.84 | 1 | | | | |
| E1320D | HYDROCHLORIC ACID | Lbs. | 12742 | C | 77 | 0 | inf | 4 | 103.7 | 128 | 416 | 640 | 1137.5 | 2500 | 3262.5 | 7500 |
| E1328D | HYDROFLORIC ACID | Lbs. | | C | 77 | 0 | inf | 3 | 151.25 | 275 | 738.38 | 1375 | 1430 | 2750 | | |
| E1336D | HYDROGEN PEROXIDE | Lbs. | 11952 | C | 77 | 0 | inf | 4 | 49.4 | 130 | 806 | 2600 | 3640 | 13000 | 6132.75 | 24050 |
| E1352D | ISOPROPYL ALCOHOL | Gals. | 30400 | C | 77 | 0 | inf | 4 | 210.1 | 110 | 858 | 550 | 1175 | 1000 | 6420 | 6000 |
| E1360D | KORAD A* (76.2 MM THICKNESS) (Acrylic Polymer) | Lbs. | | C | 77 | 0 | inf | 1 | 1.95 | 1 | | | | |
| E1368D | KYNAR 202* | Lbs. | | C | 77 | 0 | inf | 1 | 11 | 1 | | | | |
| E1376D | LIME | Lbs. | | C | 77 | 0 | inf | 1 | .021 | 1 | | | | |
| E1378D | LEXAN* (1/8 IN. SHEET) | Sq. Ft. | | C | 77 | 0 | inf | 1 | 2.39 | 1 | | | | |
| E1380D | MONO* (ACRYLIC TERPOLYMER SEALANT) | Lbs. | | C | 77 | 0 | inf | 1 | 3.64 | | | | | |

*See Abbreviations and Definitions for a list of trade-name commodity manufacturers and suppliers.

COST ACCOUNT CATALOG

ACCOUNT E: COMMODITIES

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | FEDERAL STOCK CODES | I C | YR | Q MIN | Q MAX | N | PRICE - QUANTITY PAIRS (P = $PRICE @ Q = ANNUAL QUANTITY) P | Q | P | Q | P | Q | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E1382D | LUCITE* (ACRYLIC RESIN) | Lbs. | | C | 77 | 0 | inf | 1 | .60 | 1 | | | | | | |
| E1383D | INK, ALUMINUM | Dollars | | C | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1384D | INK, NICKEL | Dollars | | C | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1392D | INK, SILVER | Dollars | | C | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1400D | ACID, NITRIC | Lbs. | 12749 | C | 77 | 0 | inf | 4 | 64.5 | 75 | 275.6 | 375 | 521.25 | 750 | 197.5 | 1500 |
| E1408D | NITROCELLULOSE LACQUER | Cu. Ft. | | C | 77 | 0 | inf | 1 | 42.47 | 1 | | | | | | |
| E1416D | NITROGEN GAS, REGULAR PRE-PURIFIED | Cu. Ft. | 16836 | C | 77 | 0 | inf | 1 | .08 | 1 | | | | | | |
| E1424D | O-RINGS AND FILTERS | Dollars | | C | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1432I | OFFICE SUPPLIES | Dollars | 14104 | C | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1448D | OXYGEN GAS | Cu. Ft. | 16854 | C | 77 | 0 | inf | 1 | .0052 | 1 | | | | | | |
| E1472D | PHOSPHINE 5% IN HYDROGEN | Cu. Ft. | | C | 77 | 0 | inf | 1 | .82 | 1 | | | | | | |
| E1480D | PLEXIGLAS* (3.175 mm) | Sq. Mt. | | C | 77 | 0 | inf | 1 | 29.81 | 1 | | | | | | |
| E1504D | POCl | Lbs. | | C | 77 | 0 | inf | 1 | 9.26 | 1 | | | | | | |
| E1520D | QUARTZ | Dollars | | C | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1524D | RC-5063* (PYRE-M.L.) | Cu. Mt. | | C | 77 | 0 | inf | 1 | 8748 | 1 | | | | | | |
| E1528D | RESIN 650* (SILICONE "GLASS" RESIN) | Lbs. | 19690 | C | 77 | 0 | inf | 3 | 300 | 20 | 2800 | 200 | 12527 | 1000 | | |
| E1544D | RESIST (IC) | Gallons | | C | 77 | 0 | inf | 1 | 69.50 | 1 | | | | | | |
| E1552D | RTV 108* | Lbs. | | C | 77 | 0 | inf | 2 | 1161 | 450 | 10260 | 4500 | | | | |
| E1556D | RTV 118* | Lbs. | | C | 77 | 0 | inf | 2 | 2725 | 450 | 27900 | 4500 | | | | |
| E1560D | RTV 615* (SILICONE) | Lbs. | 19690 | C | 77 | 0 | inf | 1 | 8.84 | 1 | | | | | | |
| E1568D | RTV-655* | Lbs. | | C | 77 | 0 | inf | 2 | 6470 | 500 | 12670 | 1000 | | | | |
| E1570D | SCOTCH-WELD* 2216 B/A | Gallons | | C | 77 | 0 | inf | 1 | 114.28 | 1 | | | | | | |
| E1576D | SCREENS | Screens | 02423 | D | 77 | 0 | inf | 1 | 5 | 1 | | | | | | |
| E1584D | SILANE 100% | Lbs. | | C | 77 | 0 | inf | 1 | 183.4 | 1 | | | | | | |

*See Abbreviations and Definitions for a list of trade-name commodity manufacturers and suppliers.

COST ACCOUNT CATALOG

ACCOUNT E: COMMODITIES

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE | FEDERAL STOCK CODES | I C | YR | Q MIN | Q MAX | N | PRICE - QUANTITY PAIRS [P = $PRICE @ Q = ANNUAL QUANTITY] P | Q | P | Q | P | Q | P | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E1586D | SILICON, POLYCRYSTALINE (Solar Grade) | Kgs. | | (USE CURRENT PRICE GOALS) | | | | | | | | | | | | |
| E1588D | SILICON TETRACHLORIDE | Lbs. | | C | 77 | 0 | inf | 1 | 2.60 | 1 | | | | | | |
| E1589D | INGOTS, SINGLE CRYSTAL SILICON | Kgs. | | (USE CURRENT PRICE GOALS) | | | | | | | | | | | | |
| E1590D | WAFERS, SINGLE CRYSTAL SILICON | Wafers | | (USE CURRENT PRICE GOALS) | | | | | | | | | | | | |
| E1592D | SILVER | Grams | 10905 | C | 77 | 0 | inf | 1 | .1614 | 1 | | | | | | |
| E1600D | SODIUM HYDROXIDE | Lbs. | 12530 | C | 77 | 0 | inf | 1 | .0171 | 1 | | | | | | |
| E1608D | SPARE PARTS | Dollars | | D | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1624D | SQUEEGEES | Squeegees | 04460 | D | 77 | 0 | inf | 1 | .40 | 1 | | | | | | |
| E1632D | STYCAST* 1269A | Lbs. | | C | 77 | 0 | inf | 1 | 3.70 | 1 | | | | | | |
| E1640D | SULFURIC ACID | Lbs. | 08354 | D | 77 | 0 | inf | 2 | 132.3 | 294 | 875 | 2500 | | | | |
| E1644D | SUN-LITE* (.040 IN. SHEET) | Sq. Ft. | | C | 77 | 0 | inf | 1 | 4.95 | 1 | | | | | | |
| E1648D | SUSCEPTORS | Dollars | | D | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1656D | SYLGARD* 184 (SILICONE) | Lbs. | 19690 | C | 77 | 0 | inf | 1 | 9.02 | 1 | | | | | | |
| E1664D | TANTALUM PENTOXIDE | Grams | | C | 77 | 0 | inf | 1 | .74 | 1 | | | | | | |
| E1672D | TEDLAR* (1 MIL POLYVINYL FLUORIDE) | Sq. Ft. | | C | 77 | 0 | inf | 1 | .04 | 1 | | | | | | |
| E1696D | THERMOCOUPLE | Dollars | | D | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1704D | TITANIUM | Lbs. | 16103 | D | 77 | 0 | inf | 1 | 31.78 | 1 | | | | | | |
| E1712D | TRANSDUCERS AND TUBES | Dollars | | D | 77 | 0 | inf | 1 | 1 | 1 | | | | | | |
| E1716D | TRICHLOROSILANE | Lbs. | | C | 77 | 0 | inf | 1 | .899 | 1 | | | | | | |
| E1720D | VMP | Gallons | | C | 77 | 0 | inf | 1 | 0.75 | 1 | | | | | | |
| E1732D | XT-365* | Lbs. | | C | 77 | 0 | inf | 1 | 0.51 | 1 | | | | | | |
| E1764D | SILICONE GELL | Lbs. | | C | 77 | 0 | inf | 4 | 90 | 12 | 320 | 80 | 3000 | 800 | 3750 | 1000 |
| E1780D | NITROGEN GAS, HIGH PRESSURE | Cu. Ft. | | C | 77 | 0 | inf | 1 | .1 | 1 | | | | | | |
| E1796D | NITROGEN GAS, ULTRAPURE | Cu. Ft. | | C | 77 | 0 | inf | 1 | .24 | 1 | | | | | | |
| E1812D | FLOAT GLASS, 1/8" SODA LIME | Sq. Ft. | | C | 77 | 0 | inf | 1 | .22 | 1 | | | | | | |
| E1828D | TEMPERED FLOAT GLASS, 1/8" SODA LIME | Sq. Ft. | | C | 77 | 0 | inf | 1 | .44 | 1 | | | | | | |

*See Abbreviations and Definitions for a list of trade-name commodities manufacturers and suppliers.

COST ACCOUNT CATALOG

ACCOUNT F: RESOURCES

| CATALOG NUMBER | ITEM DESCRIPTION | UNITS OF MEASURE CLASSIFICATION |
|---|---|---|
| F1016B | ENERGY | KW. hr. |
| F1032B | FUEL OIL | Cu. Ft. |
| F1048B | NATURAL GAS | Cu. Ft. |
| F1064D | SILICON | Kgs. |
| F1080B | WATER | Cu. Ft. |