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COST ACCOUNTING

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COST ACCOUNTING

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PREFACE

The past thirty years have brought revolutionary changes in management methods. The earlier pioneering of Taylor, Gantt, Gilbreth, and others has born fruit, and the application of scientific method in management has become widespread. One phase of this development is that cost accounting has been broadened in scope and vitalized in its services to management. Originally its chief function was the allocation of costs to products for purposes of costing inventories and shipments and systematically compiling data for use in connection with pricing. Its viewpoint was mainly historical. Today in the more progressive industrial enterprises the cost accounting procedures are designed not merely to supply historical data but also to aid management in cost control and cost reduction and to supply information bearing on many other economic problems arising in enterprise operation. Where such practices have been adopted, cost accounting is an integral part of management with the forward-looking viewpoint of management.

It is the object of this book to describe cost accounting as an integral part of industrial management and to present the subject in a form suitable for introductory study. The author has sought to build the discussion upon a logical and coherent outline, to provide adequate illustrative material, and to supplement the text by review exercises and problems that are relevant but will require thought for their solution.

The groundwork for the presentation of managerial applications of cost information is laid in the first chapter. Then, because the characteristics of any cost system depend to a large extent upon the type of product costing employed, the principal product cost methods (job-order, process, and standard) are described (Chapters 2 through 5). This is followed by an explanation of account classification and the ledger procedure for each type of cost system (Chapters 6 through 11). Methods of controlling and recording the costs of material, labor, and factory overhead are then presented (Chapters 12 through 25); at each step in this final phase of the discussion the procedures in standard cost systems are explained as well as those found in job-order and process cost systems. Throughout the text the author has sought to weave into a pattern the threads of cost bookkeeping, product costing, and cost control.

As a textbook in introductory cost accounting for students in business and in engineering, it may be used for two, three, or four semester hours

of study. The main outline can be covered successfully by mature students in two semester hours with a minimum of problem work. Where a more thorough study is desired, particularly of the ledger procedures, and a substantial portion of the problems are to be assigned, three or four semester hours will ordinarily be required.

The author gratefully acknowledges his debt to associates and friends in industry and in the teaching profession and to students in his evening classes who have contributed over the years to his education in cost accounting. Many of these, more than it would be possible to name, have taken part in the present project. To John G. Moss and Herman K. von Kaas he is especially obligated for invaluable assistance in planning the outline of the book, supplying much of the illustrative material, and reading many of the chapters; and to Howard C. Greer and Russell S. Willcox for permission to use material from their *Problems in Cost Accounting*. Among others who have given generously of their time and talent are Leonard E. Zastrow, J. Arthur Leer, Robert Beyer, William E. Dickerson, Velna Wells, and Kenneth E. Maxted. To the National Association of Cost Accountants and the individuals who have contributed articles for its publications credit is due for much of the background without which the book could not have been written.

JAMES H. MARCH

MILWAUKEE, WIS.
April, 1949

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CHAPTER 1

COST ACCOUNTING AND MANAGEMENT

The development of cost accounting in a manufacturing enterprise that has grown from a small beginning into a large and complex organization is likely to be marked by four stages, namely,

1. Noncost accounting
2. Cost finding
3. Historical type of cost accounting
4. Cost accounting for control

Noncost Accounting

In noncost accounting the expenditures are classified according to their nature and cumulated in the accounts during the year. At the end of the fiscal year adjustments are made for depreciation, accrued and prepaid items, and inventories so that financial statements and tax returns can be prepared. The year-end inventories are determined by physical count. The cost of material put into production, the cost of product completed by the factory, and the cost of goods sold are computed by the physical-inventory method. The formulas for these computations are as follows:

> Cost of raw material put into production = initial inventory of raw materials + purchases of raw materials − final inventory of raw materials
>
> Cost of product completed by the factory = initial inventory of goods in process + cost of raw material put into production + labor and overhead for the period − final inventory of goods in process
>
> Factory cost of goods sold = initial inventory of finished product + cost of product completed by the factory during the period − final inventory of finished product

In noncost accounting the cost of goods sold is shown as a total. The accounting records do not record the cost of individual products. When it is necessary to have product costs for quoting sale prices or for costing the annual inventory, cost estimates are prepared by foremen or other employees who are familiar with the work of the shop. Noncost systems

are found in many of the smaller companies where one or a few executives manage the factory and are in close personal touch with operations.

Cost Finding

In a cost finding system a systematic record is kept of the costs of individual products, but the cost records are operated independently of the double-entry accounts. Cost finding systems are usually developed and supervised by the operating executives to furnish information that they need. The bookkeeping procedure is the same as in noncost accounting except that the annual inventory is costed from the product cost records.

The cost of goods sold is determined by the physical-inventory method, and the operating statements as a rule are prepared only once a year. The cost of taking a physical inventory is generally too great to be justified oftener than that.

Historical Type of Cost Accounting

In a cost accounting system the product cost records are operated as an integral part of the accounting system. Usually they are kept under the supervision of accounting executives. The cost records are brought under double-entry control, thus being interlocked or tied in with the books. There is then greater assurance that they will be accurate, for all costs must be accounted for in the cost compilation. It is the integration of the product cost records with the double-entry accounting system that distinguishes cost accounting from cost finding.

Integration of Product Cost Records with the Accounting System

The integration is accomplished by using the cost records as a basis for periodical journal entries that trace the flow of materials through the various stages of manufacture. Thus, Raw Material Inventory account is charged with the purchases of raw material and credited with the cost of raw material issued to the factory. The amount of the credit is determined by "costing" the issued items at the unit costs shown by the material cost records, then multiplying quantities by unit costs and adding. Product completed by the factory and put into finished stock is costed from the product cost records, and the total cost of the goods completed is transferred by journal entry from Goods in Process account to Finished Goods account. The factory cost of goods sold is determined by costing the shipments to customers and is credited to Finished Goods and charged to Cost of Goods Sold.

Inventory accounts are kept by the perpetual-inventory method, the general formula for which is

$$\text{Initial inventory} + \text{input} - \text{output} = \text{final inventory}$$

In the Finished Goods account, for example, the initial inventory of finished goods and the cost of goods completed by the factory during the period would appear on the debit side; the cost of goods shipped to customers would appear on the credit side. The balance of the account would be the book inventory of finished goods on hand at the end of the period.

TABLE 1.1

END-OF-YEAR ADJUSTMENTS DUE TO ERROR IN PRODUCT COSTING

	Factory cost of goods sold	Profit	End-of-period book inventory
Cumulative data from monthly statements			
Jan. 1 (initial inventory)			$400,000
Three months ending Mar. 31	$ 500,000	$ 50,000	420,000
Six months ending June 30	940,000	85,000	460,000
Nine months ending Sept. 30	1,480,000	150,000	490,000
Twelve months ending Dec. 31	2,000,000	200,000	500,000
End of year			
Physical inventory, Dec. 31, $400,000			
Inventory adjustment ($500,000–$400,000)	+100,000	−100,000	−100,000
Adjusted data for the year	$2,100,000	$100,000	$400,000
Percentage of error in monthly data	5	50	20

At least once a year a physical inventory should be taken, and the book inventory should be adjusted. The amount of the error in the book inventory is a measure of the accuracy of the product cost records, for it is almost always caused by errors in the costing of goods produced and goods shipped. Failure to account for all costs in costing the shipments would result in an understatement of the credit to inventory and, hence, in an overstatement of the final book inventory. Vice versa, if product costs were overstated, the final book inventory would be understated because too much would be credited to the inventory account.

An error in the costing of shipments throughout the year would generally be a cumulative error. In the illustration in Table 1.1 a 5 per cent error in costs resulted in a 20 per cent error in book inventory and a 50 per cent error in the monthly profit estimates. A 5 per cent error would not usually be considered serious in a cost finding system; in fact it might not even be discovered. But in a cost accounting system the percentage of error is seldom more than 1 per cent or at most 2 per cent. If the error is greater than that, the inventory adjustment at the end of the year is almost certain to be excessive and the cost accountant in charge of the product cost records is likely to be subject to censure.

Perpetual-inventory Records

The factory inventory accounts (such as Raw Materials, Goods in Process, and Finished Goods) are usually referred to as *controlling accounts.* Detailed records of the different items of material in stores and at the various stages of manufacture are commonly referred to as *subsidiary records.* Their principal purposes are to aid in inventory control and in production planning and control. They help to safeguard the investment in inventory by disclosing where losses occur through theft or carelessness. They are used also to check the quantities shown by the physical inventory. When discrepancies are analyzed, it is frequently the physical inventory that must be corrected.

The cost of maintaining absolute agreement throughout the year between inventory control accounts and the subsidiary perpetual-inventory records would in most cases be prohibitive. It would place too much of a burden on the men in the shop to require 100 per cent accuracy and completeness in the recording of all the many transactions that occur. Once a year, when the books are closed, the control accounts are adjusted to agree with the subsidiary records and with the physical inventory, but during the year substantial agreement is all that is customarily expected.

Careful Classification of Periodic Costs

The classification of periodic costs in a cost accounting system is generally more carefully planned than in a noncost system. In the first place, greater care is taken to distinguish factory costs from selling and administrative costs. In a noncost system, for example, the entire cost of telephone service is generally charged to an administrative expense account; whereas, in a cost accounting system it is likely to be apportioned to manufacturing, selling, and administrative divisions according to the service received by each division. In the second place, there is generally a more detailed classification of factory costs according to their nature; if the factory is departmentized, there is usually a departmental classification of costs. As will be explained later, the departmental classification is an aid both in obtaining reliable product cost data and in the control of costs.

Monthly Operating Statements

Manufacturing industries are subject to marked fluctuations in earnings. The profits are likely to be exceptionally good at times, but conversely the losses at other times are likely to be exceptionally severe. A concern frequently shifts from a profitable basis of operation to a loss basis on short notice. The management of an enterprise needs to know the results

of past operations in order to counteract unfavorable trends, and in most cases it needs this information more often than once a year.

In cost accounting systems the journal entries to record the flow of costs through the accounts are made monthly. When that is done, monthly operating statements and balance sheets can be prepared from the books even though a physical inventory is not taken. That is one of the important advantages of cost accounting.

It is also noteworthy that the annual financial statements are more accurate when cost accounting is employed than they can be otherwise. This is mainly because the annual inventory is more accurate. The inventory quantities are checked by the perpetual-inventory records, and the product costs used in pricing the inventory are subject to accounting control. As a matter of fact, in large-scale mechanical industries it would be impossible without cost accounting to prepare dependable annual financial statements.

To summarize, the principal characteristics of the historical type of cost accounting are

1. Product cost records, an integral part of the double-entry accounting system
2. Perpetual inventories
3. Careful classification of periodic costs
4. Monthly operating statements

The same features or characteristics are found in the control type of cost accounting, but there are additional features as well, and there is more emphasis upon making the accounting serviceable to management.

Cost Accounting for Control

Although the accounting function is essentially historical, modern cost accounting practice is coming more and more to have the forward-looking viewpoint of management. In competitive industry where cost control and cost reduction are vital to profitable operation, the accounting procedures should be designed to assist management in those activities. Merely reporting what costs were is not considered sufficient, for management needs to know how such costs compare with predetermined standards of what the costs should be. Accounting reports are therefore designed to show variations of actual costs from standards. Variations are reported at the points where costs are subject to control, that is, where materials and labor and other services are procured and utilized, and they are reported at frequent intervals to enable management to take remedial action where it is needed.

Cost accountants—many of whom are trained in engineering as well as in accounting—collaborate with shop engineers and operating executives in making cost studies and forecasts as a basis for future planning. One

important field of such collaboration is the development and administration of operating budgets. Budget standards are based to a large extent on accounting data, but to be useful for this purpose the data must be suitably classified and intelligently interpreted. Both the historical type of cost accounting and the control type furnish data on the costs of individual products for comparison with selling prices, but the latter type is usually better adapted to supply data for estimates of future costs.

According to a study prepared for the Committee on Research of the National Association of Cost Accountants,

> The collection and analysis of cost data should be directed at serving the following essential purposes:
> *a.* Determination of periodic profit, including inventory valuation
> *b.* Budgetary planning
> *c.* Cost control
> *d.* Pricing policy
> *e.* Current applications of plans and policies[1]

The experience of many successful companies indicates that accounting can be made a valuable tool of management provided that the operating executives and the accountants work in harmony and also skillfully in developing cost data for managerial use. Cost accounting in such companies is not only an integral part of the accounting system, but also an integral part of management and an important factor in promoting industrial efficiency.

Cost Accounting and Management

To describe cost accounting as an integral part of management is the primary purpose of this book. Management objectives and techniques are therefore discussed briefly at various points as background for the study of cost accounting. The individual who intends to become an expert in the control type of cost accounting will find it advisable to extend his study of management beyond the material presented here. Training in motion and time study, production planning and control, factory management, personnel management, and business economics is recommended. In some industries engineering training is also desirable, if not essential, as preparation for responsible positions in cost accounting.

Management

Management means control. In business it consists of (1) planning the operation of a business enterprise and (2) directing the performance of operations in accordance with the plan.

[1] "The Uses and Classifications of Costs," *N.A.C.A. Bulletin.*, Vol 27, No. 18, Sec. II, p. 940.

Management involves coordination. In a manufacturing industry the services of many different machines, materials, and men must be brought together in order to form a finished product. Standards of quality, quantity, time, and cost must be established and met.

Management also involves measurement of results to determine whether performance is up to standard, to fix responsibility for deviation, and to give a factual basis for rewarding good work. Inspection and accounting are examples of measurement activities.

All persons engaged in planning and directing the work of others are a part of the managerial staff. Except in very small establishments management is more than a one-man job, and in large industrial units the work of management is usually divided among a large number of individuals. The larger and more complex the enterprise, the more important are the problems of coordination and measurement.

Organization for Management

Organization for management is a form of planning and a means of coordination. It has to do with the division of managerial duties, the assignment of duties to individual positions and to departments, and the relationships of the various positions and departments to one another.

The form of organization should be designed for the individual enterprise, with its size, the nature of its activities, and the characteristics of available personnel being taken into consideration. Because of the "vested interests" of strong and competent individuals, an organization plan is likely to represent a compromise between an ideal and an existing situation.

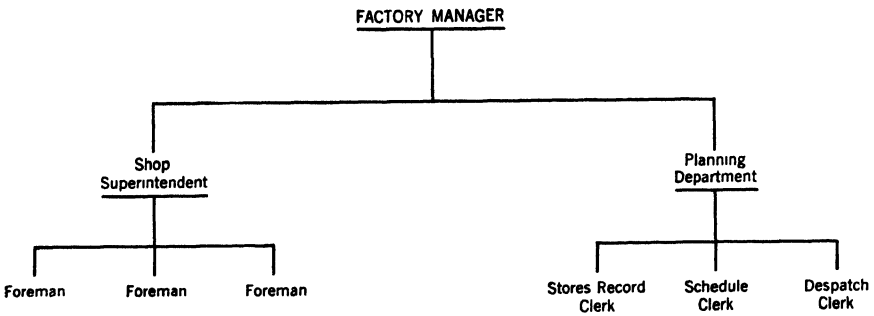
Managerial duties are usually divided to a large extent on a functional basis; that is, similar activities are grouped together. Four major functions are generally recognized: finance, production, distribution, and accounting. Engineering, personnel management, and purchasing are also in some cases treated as major functions if the importance in the particular enterprise makes it advisable.

Line Authority and Functional Authority

Within the major divisions of the organization, particularly in the production division, many of the planning functions are centralized. Thus, the scheduling of work through the shop is likely to be assigned to a production planning department instead of being entrusted to the foremen of the various shop departments.

When there is centralization of planning functions, there are two types of authority in an organization: direct or line authority and indirect or

functional authority. In the situation diagramed below, for example, the shop superintendent has direct authority over the foremen and the schedule clerk has functional authority to issue production schedules and related instructions to the foremen. As another example, the chief accounting executive or his representative would have functional authority to issue instructions covering those matters of stores-record procedure which affect the accounts even though he does not have direct authority over the planning department or the stores-record clerk.



Conflicts of authority sometimes arise. There is an old and true saying that no man can serve two masters. Morale suffers if workmen are given conflicting instructions by different "bosses." In order to avoid this, when there is a conflict, the line authority should take precedence until a settlement can be made by the proper executives. A disagreement between the schedule clerk and a foreman which they cannot settle themselves should be referred to the shop superintendent and the head of the planning department and by them, if it is necessary, to the factory manager. Disputes should not be aired on the floor of the shop, and a workman should not be put in a position where he must decide for himself between two conflicting orders.

Organization Charts

To prevent conflicts of authority the various executives should be trained to understand the functional relationships within the organization. It is usually desirable to have an organization chart to indicate the relationship of the various departments to one another. Some companies have organization manuals as well, which explain in detail the functions of each position and department.

Figure 1.1 is an illustration of an organization chart. It is designed for a company manufacturing machine-shop products and employing approximately 1,000 people.

The chief executive of the production division is referred to on the

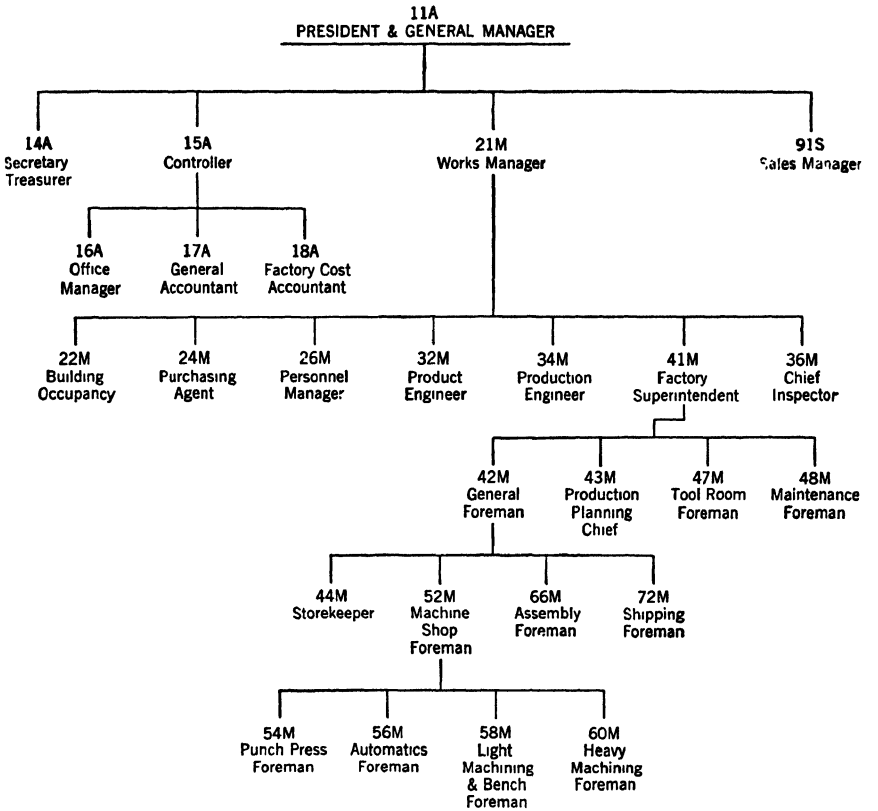


FIG. 1.1. Ecidil Manufacturing Company (an imaginary enterprise) organization chart. Effective January 1, 19- -.

chart as the Works Manager. The departments under his jurisdiction that are concerned mainly with planning functions are shown in the accompanying table.

Department number	Title of department head	Name of department
32M	Product engineer	Product engineering
34M	Production engineer	Production engineering
43M	Production planning chief	Production planning

The functions of the *product engineering* department in this particular case are product development and design, furnishing drawings of parts and assemblies, preparing bills of material and material specifications, filing and indexing engineering data in regard to products and component

parts. The functions of the *production engineering* department are selection of manufacturing methods; machinery and equipment specification; design of jigs, fixtures, special tools, and accessory equipment; plant layout; time and motion study; rate setting; cost estimating. The functions of the *production planning* department are preparation and issuance of production orders; routing and scheduling production; dispatching and follow-up of work in progress; keeping subsidiary records of material in stores, in process, and in finished stock; issuing requisitions for material purchases. Cost accounting for control dovetails at many points with the activities of the departments engaged in planning factory operations, both in furnishing and in receiving information.

The Controller

The controller is the chief accounting executive. He has direct authority over the work of the accounting departments and, in many organizations, over the office management department as well. In such cases his functional authority extends to all matters affecting accounting records and reports and office methods.

The controller has traditionally been vested with functional authority to require that the resources of the enterprise be conserved and safeguarded against losses from fire, theft, or other casualty. In modern industry his authority frequently extends to the more positive duty of seeking through his reports and counsel to gain for the enterprise the most efficient and economical utilization of its resources. In many corporations the controller is one of the top executives, the adviser to management on economic matters, with a voice in the determination of major policies.

We all know that during the past few years corporate executives have had to guide their companies through a maze of complications never before experienced. These difficulties have largely originated with a succession of related social and economic upheavals, such as the vastly changed relationship between business and government, the growing recognition of a greater responsibility of business to the individual and the quick, uncertain, and sometimes abnormal movements in economic forces that so vitally affect business results, and finally the quick transition to an almost complete and controlled war economy.

These developments during the past ten years, following the vast expansion in many business enterprises during the 1920's, have now placed a burden upon management which requires a standard of service and utility from the control-accounting function that has not heretofore existed. Since early in the 1900's industry in the United States has passed through a broad period of years in which the manufacturing function and then the selling function have occupied the first place in furnishing management with its problems. I think it is not too much to say that we are now probably entering into a period in our business

history where control and financial problems will for a time require foremost consideration in the management function.[1]

The title *controller* is somewhat misleading. Except for the work of the departments over which he has direct authority, his duties are advisory. He does not make the decisions required to control the operations of the enterprise. That is the duty of the operating executives. It is because he is not directly responsible for the control of the business that he is in a position to furnish unbiased reports and opinions to management as a factual basis for managerial control.

Except in small organizations the controller generally delegates much of his authority. In the organization chart in Fig. 1.1 there are three executives reporting to the controller. They are the office manager, the general accountant, and the factory cost accountant. In large organizations the executive in charge of factory cost accounting is frequently given the title Works Accountant, and there may be a number of department heads reporting to him.

Place of Factory Cost Accounting in the Organization

Cost is a factor in all the economic problems of business management. If the controller functions as the principal adviser to management on economic matters, he is generally given direct authority over the factory cost accounting. There are some organizations, however, where the factory cost accountant reports to the works manager. In such cases the controller exercises only functional authority over cost accounting activities. Which is the better plan is ably discussed by W. N. Mitchell in the following passage:

> Cost accounting has, for example, long been regarded as being peculiarly the tool of production management. In fact, many production managers still insist that they, and not the accountants, should have control over cost accounting activities. In many instances this claim has no doubt been fully justified. There is much truth in the contention of production executives that accountants have failed to appreciate their needs. Too often they have lacked the vision and broad experience which would enable them to render valuable service to departmental executives.
>
> This is unfortunate, but it does not appear to be sufficient reason for insisting that cost accounting should be placed under the production manager rather than the chief accountant. Cost accounting and general ledger accounting employ the same double-entry technique. Many of the data which the cost accountant employs are derived from the source of information relied upon by both divisions of the accounts. Most important of all, no doubt, is the fact that cost accounting

[1] Donaldson, John A., "Controllership and Some of Today's Management Problems," *The Controller*, Vol. 10, No. 5, p. 192.

provides a technique which can be utilized by all departments. To insist that it shall be placed under the control of the production manager tends to restrict its sphere of usefulness. The remedy lies in broadening the vision of the accountant, if this is deficient, rather than in depriving him of authority over this important tool of management.[1]

There are two reasons that might be mentioned in addition to those given by Mitchell for putting factory accounting under the controller's jurisdiction. (1) The cost figures are more certain to be free of bias. If he is under the works manager, the cost accountant is naturally inclined to be loyal to him and in some cases, perhaps without realizing it, may present a more favorable report than the facts justify. (2) The usual line of promotion for the factory cost accountant and the members of his department is to other accounting positions, and it is generally easier to arrange for promotion and transfers if the factory accounting is a part of the accounting division of the organization.

Attitude of Business Executives toward Cost Data

The competent business executive is *objective and open-minded* in his business affairs. He bases his decisions upon facts. He is eager to learn about new products and new methods; if the facts justify changes, he makes them. Business moves rapidly, and decisions must be made. Indecision is often more costly than a wrong decision. Rough-and-ready calculations therefore must serve as a basis for many of the decisions that an executive makes in the course of his daily work. Business judgment developed from previous experience is in many cases an adequate basis for a good decision. Novel situations and far-reaching decisions, however, call for a careful search for data and a thorough study of their significance. In the business world today more emphasis is placed than formerly upon the recording and reporting of business facts. This is partly because of the increased size and complexity of business units, and partly because executive positions are coming to be held more and more by persons who have had training in the analysis of numerical data.

In studying accounting data the management of an enterprise is principally *interested in the future.* The study of past performance is of value to business executives only when it aids them in making improvements in the future. If the causes of excessive costs are known, management can act to prevent their recurrence.

The efficient executive uses the *principle of exceptions.* It is impossible for him to know all that is going on in the business or the department under his supervision, nor is it necessary provided that procedures are

[1] Mitchell, W. N., *Organization and Management of Production*, p. 100, McGraw-Hill Book Company, Inc., New York, 1939.

set up to inform him promptly when something goes wrong. He can then concentrate his effort on the unsatisfactory conditions. Cost reports that point out variations from standard performance aid the business executive in singling out situations that call for his attention.

Factory executives as a rule are *cost-minded.* Cost-mindedness is an attitude of seeking to reduce costs. The factory accountant can play a large part in the development of cost-mindedness throughout a factory organization by reporting significant facts to shop executives in language that they can understand.

Planning the Cost System

The cost accounting system should be planned to fit the needs of the enterprise. Consideration should be given to the nature of the product and the manufacturing processes, the type of management, and the cost of compiling the data that are wanted. Valuable pointers can be obtained from books and other publications, particularly those of trade associations and professional associations. Visits to other plants are helpful. The final plan, however, should be designed for the plant in which it is to be used.

The procedure should be designed jointly by the factory cost accountant and the production engineer and other production executives who are interested, and it should be approved by the controller. The production men are more familiar than the accountant with conditions in the shop, and they are likely to have fairly definite ideas as to what information they need for control purposes. The impetus for the introduction of cost systems and for changes in existing systems often comes from the production executives. In case the company does not have men on its own staff who are competent and available to do the work, it may be desirable to employ a firm of consulting accountants or industrial engineers to supervise the design and the installation of the procedure.

The system should be made as simple as possible. The benefits obtainable from proposed records should be weighed against the cost of compiling the records. The cost in the shop as well as the cost in the office should be taken into consideration. If the system is too elaborate, it is likely to hinder production. Elaborate records, for that matter, are not necessarily the most useful. The aim should be to obtain accurate and prompt reports of the facts that are significant and to avoid cluttering the records with nonessential data.

Records and reports that have outgrown their usefulness should be discontinued. Many cost systems, like Topsy, "just growed." In many cases a record originally established for a definite purpose has been continued long after its usefulness has ceased.

Controls and checks should be established so as to obtain the desired standard of accuracy. Because many of the cost accounting records cannot be balanced out exactly with controlling accounts, it is important that other means be set up to ensure accuracy.

One of the principal problems of the factory accountant is to obtain accurate reports of shop transactions. Workmen and foremen are not usually good clerks, and it would not be reasonable to expect them to do a great deal of clerical work. The procedure should therefore be planned to keep to a minimum the recording that must be done by the workmen and the foremen and, then, to hold them responsible for doing a good job on that necessary minimum. In most plants the clerical work in the shop can be organized so that shop clerks, such as timekeepers, dispatch clerks, and storekeepers, can perform most of it. These clerks as well as the clerks in the office should be selected and trained to do accurate work. The factory cost accountant as a representative of the controller should be given functional authority over the record work in the shop where it affects the accounts.

Methods of performing the clerical operations should be studied. Suitable office appliances and printed forms should be selected. In most plants a cost system even when it is carefully planned calls for the recording and summarizing of a tremendous amount of detail. Mechanical methods of doing that type of work are more accurate than hand methods and, unless the volume of work is small, are usually more economical and quicker in producing the desired reports. In fact, the development of cost accounting techniques in recent years has been based to a large extent upon the development of improved office equipment.

CHAPTER 2

PRODUCT COSTS

The items to be included in the cost of a product depend on the purpose for which the cost is to be used. In costing the inventory of flour in a bin, for example, only the grain cost and the milling cost would be counted in and not the cost of packaging. In costing shipments of packaged flour, however, the packaging cost would be included. If price quotations are made on the basis of cost estimates, to take another illustration, replacement cost of raw materials should ordinarily be used in preparing a cost estimate, even though the articles covered by the quotation are carried at a different cost in the inventory.

The cost accountant and the cost estimator when furnishing cost data should study the purpose for which the figures are to be used, and the executive who uses the data should make sure that he understands what costs are included and whether the data are suitable for his purpose. Needless arguments sometimes arise as to whether cost figures are right or wrong where the crux of the matter is that the figures are reliable for the purpose for which they were intended, but not suitable, without adjustment, for the purpose to which they are being put.

Relation of Volume to Unit Costs

A certain daily train running from Madison to Milwaukee, a distance of 81.5 miles, carries two coaches with a total capacity of 136 passengers. On some trips there are not more than 40 passengers; on other trips the train is filled. The cost of running the train is practically the same in either case. If the cost for a trip is $120, the average cost per passenger is $3 for the trip when 40 passengers are carried; it is $1.20 when there are 100 passengers and 88 cents when there are 136 passengers. What is the cost to the railroad of carrying a passenger on this trip? Is it $3, $1.20, 88 cents, or some other figure? In order to make an intelligent answer to these questions a person would need to premise his answer by stating the volume of traffic to which his unit-cost figure applies.

The daily cost of operating the train is a fixed cost, provided that the same equipment is used; it is not affected by the volume of traffic carried. The cost per passenger therefore varies inversely with volume.

Fixed Costs and Variable Costs

In manufacturing industries the fixed costs make up a smaller proportion of the total cost than in transportation industries; yet they are a large factor. A fixed cost is one that is the same in amount each month at any volume of production within a given range of volume. It is a stand-by cost, a cost of being ready to produce. Building rental is an example of a fixed cost. If the factory building is rented, the rental as a rule is the same each month. If the building is owned by the manufacturing enterprise, the building taxes, insurance, depreciation, and repairs are the same each month on the average. Within the range of volume that the building will accommodate, these costs are not affected by changes in the volume of production. Depreciation, taxes, and insurance on machinery and other equipment are generally fixed costs, and the costs of supervisory, technical, and clerical services are to a large extent fixed costs.

A variable cost is one that for a given method of manufacture varies directly with the volume of production. It is definitely a cost of production. The cost of the materials of which the product is made and the wages of factory workers engaged in processing the material, for example, are almost wholly variable. So, too, is the cost of purchased electric power; for when a machine is running, the power is turned on, and when the machine is idle, the power is turned off. The costs of shop supplies, perishable tools, and machinery repairs are for the most part variable.

Fixed cost is fixed only within a given range of volume, the upper limit of which is existing plant capacity. Expansion of plant would step up the fixed cost to a higher level. Variable costs are directly variable with volume only when production methods remain about the same. In some cases changes in volume bring changes in methods. Increasing the output beyond the practical capacity of a plant usually brings a disproportionate increase in the variable costs due to overtime pay, employment of inexperienced workmen, and subcontracting at costs above normal. Changes in plant capacity and changes in methods, therefore, frequently alter the fixed-cost and variable-cost factors.

Within a given range of volume and within a given range of methods, however, the total amount of the fixed cost is uniform each month, it is a function of time; while the amount of variable cost varies with volume of production, it is a function of volume. The fixed cost per unit of product therefore varies inversely with volume, while the variable cost per unit of product is a constant. Because of the reduction in the fixed cost per unit, the total cost per unit decreases as volume increases (see Table 2.1).

How much fixed cost to include in reporting the cost of a product or, in other words, what volume to use as a base in the computation

of product costs depends upon the purpose for which the cost is wanted.

For the purpose of costing a final inventory it is customary to base the unit-cost figures on a volume that is fairly representative of either the actual volume for the year or a normal volume based on the experience of the company over a period of years. For the purpose of costing government cost-plus-fixed-fee contracts the actual volume for the period in which the work is done must as a rule be used as the base. Costs applicable to excess plant facilities may not ordinarily be costed to the contract. For the purpose of deciding what is the lowest price at which new business can profitably be taken, it might be desirable to compute factory cost at the maximum volume that the plant has the practical capacity to produce. In fact, provided that the new business would not disturb the existing business of the enterprise, any price that exceeds the variable cost per unit would increase the profit of the company. From the foregoing examples it is evident that the purpose for which a cost is to be used should be considered before deciding how much fixed cost to include.

TABLE 2.1

FIXED COST AND VARIABLE COST PER UNIT OF PRODUCT

	Production volume, units		
	1,000	1,250	1,500
Monthly cost:			
Fixed	$10,000	$10,000	$10,000
Variable	10,000	12,500	15,000
Total monthly cost	$20,000	$22,500	$25,000
Cost per unit of product:			
Fixed cost per unit	$10.00	$ 8.00	$ 6.67
Variable cost per unit	10.00	10.00	10.00
Total cost per unit	$20.00	$18.00	$16.67

The routine of compiling product costs must ordinarily be set up to give the costs at some one selected volume. Otherwise, the clerical cost would be excessive and the results might be confusing. The classification of costs, however, should be designed so as to make it possible for a cost accountant or a cost estimator to determine costs at different volumes.

Factory Cost

Manufacturing consists of procuring material and converting it into finished products. Manufacturing cost or factory cost is the sum of the material cost and the conversion cost.

Material Cost

Materials are the things of which a product is made. They may be broadly classified as follows:

1. Raw materials including
   a. Materials in a natural or nearly natural state, such as logs, cottonseed, iron ore
   b. Refined materials, for example, copper ingots or pig iron
   c. Materials on which considerable processing has been done although the material has not yet been cut into shapes and sizes for a specific purpose, for example, brass rod, cloth in the bolt, strip steel, tubing, plywood
2. Rough parts, already formed for a specific purpose but requiring further processing, for example, castings and forgings
3. Purchased finished parts and assemblies that are ready for assembly (radio tubes, ball bearings, and tires)

It should be noted that the material of one plant is the finished product of another plant. Thus, castings are rough parts to a machine shop but finished product to the foundry that molded them.

The materials to be used in manufacturing each product are specified by the product engineering department. Material specifications are released to the shop organization by means of engineering drawings, material lists, and other forms of instruction.

Theoretically, material cost includes not only the invoice cost of the material but also the costs of procuring it. Freight on purchased material, for example, as well as a portion of the costs of operating the purchasing department and the receiving department is logically material cost. If there are many items of material, however, a great deal of clerical work would be required to allocate the procurement costs to the various items, and the allocation could not be exact. It is common practice therefore to include in material cost only the invoice cost and the more significant of the costs of procuring the materials, the remainder of the procurement cost being treated as conversion cost. Thus, freight-in on lumber is generally counted as material cost, for it is a substantial portion of the cost of lumber delivered to the factory floor. Freight on miscellaneous items of hardware is likely to be treated as conversion cost, because it is a small amount in relation to the invoice cost and because the clerical work required to allocate the freight to the various items of hardware would entail more expense than the information would be worth.

Conversion Cost

Conversion cost consists of (1) salaries and wages of manufacturing personnel, (2) employee security costs, (3) the cost of the services of plant

and equipment and supplies, (4) the cost of purchased utility and professional services, and (5) the cost of processing material outside the plant.

The Manufacturing Operation

The manufacturing operation is a step in a conversion process. It is generally the smallest step that it is practical to recognize for product-costing purposes. The operation is performed at a work point. Examples of work points are a machine, a bench, a furnace, a retort, an

TABLE 2.2
MANUFACTURE OF PORTLAND CEMENT
List of Operations

Operation	Work Point
Crushing and mixing	Tube mills and blending tanks
Burning	Kilns
Clinker grinding	Ball mills

TABLE 2.3
PROCESSING OF CONNECTING ROD
List of Operations

Work Point (Machine Number)	Description of Operation
258	Drill small end
201	Ream small end
201	Chamfer 2 sides of pinholes
310	Straddle mill for locating on rod
310	Straddle mill joint face and for boltheads
229	File burrs off rod
289	Drill and ream bolt holes in rod and cap
201	Face cap and burr bolt holes in rod and cap
304	Mill notches for shell in rod and cap
206-1	Assemble rod and cap for boring
2	Finish grind sides of large end
223	Rough bore large end
223	Chamfer 2 sides of large end
450	Broach large end
201	Broach small end
500	Hone large end
310	Split small end and mill for boltheads
293	Drill small end for bolt and tap
229	File burrs and final operation
FAB	Check for alignment
FAB	Face sides of large end for alignment
X	Inspect

assembly line, a location on an assembly floor. A processing department generally contains a number of work points that are related to each other either because of similarity in the operations performed or because of being assigned to effect a series of operations on a certain type of product or component part. In a great majority of manufacturing processes the

material moves and the processing equipment remains at fixed locations. When this is the case, the beginning and the end of an operation are marked by the movement to and from the work point.

Table 2.2 contains a list of the operations in the wet process of making Portland cement. Table 2.3 contains a list of the operations required in the processing of a certain connecting rod.

It is a production engineering function to prepare a list of operations for each product and each component part. The operation list or production routing in many plants is issued as an instruction to the shop departments. In addition to describing each operation concisely, the operation list indicates the equipment and tools required and frequently shows the standard time for each operation.

The conversion costs of individual products should as a rule be compiled so as to show the cost by operations. Operation cost data are needed for pricing the inventory of goods in process at different stages of manufacture. They are also needed as a basis for cost estimates and for purposes of cost control in the shop.

Cost Estimates

Before the production of a new product is authorized, an estimate of the cost to manufacture the article is generally prepared. Figure 2.1 is an illustration of a cost estimate of this type.

In some companies cost estimates are used as a basis for price quotations. In other cases, where the price is set by the market or by government regulation, the cost estimate is management's guide in planning whether to go into the manufacture of a new product or not. Cost estimates are used extensively by executives as an aid in reducing costs. How much will this article cost if we do so and so? What will it cost if we do that? The answers to such questions are obtained from cost estimates. Before a new product or a new model is put into production, alternative designs and materials and methods are studied; frequently a number of cost estimates are prepared in order to select the most favorable combination.

The cost estimate, if it has been worked out in detail, can be used as an instrument for controlling costs in the shop. In a certain small jobbing shop making tool stands, display racks, and other light fabricated steel products, for example, a detailed cost estimate is prepared before a price is quoted. Then when an order is received from a customer, the cost estimate is the basis for ordering material and setting labor piece rates. In mass-production industries when a new model is being put into production, the final cost estimate indicates fully what methods and materials

are to be used. It is a starting point for the determination of the manufacturing-cost standards.

Cost estimating is an important function, and the cost estimator should have some engineering training and considerable experience with the products and the production methods of the industry in which he is employed. He does not need to be an accountant, although he should be

ESTIMATED COST SHEET

Customer *U S Aerial Bomb Depot, Manchester, Mass* Date *7/20/'42*

10" Alloy Steel Shaft Figures in Lots of *100* Total Quantity *30,000* Price *120,000*

Dept No	Operation	Operating Labor				Setup Labor				Overhead		
		Pcs/Hr	Hrs/Lot	Rate/Hr	Cost/Lot	%Oper	Hrs/Lot	Rate/Hr	Cost/Lot	Tot Lab	Rate	Charge
5	1 Cut off	25	4 00	60	2 40					2 40	75	1 80
4	2 Center, rough turn, face, & finish	4	25 00	85	21 25					21 25	1 20	25 50
3	3 Drill & tap	12	8 35	80	6 70	6	50	1 40	70	7 40	1 20	8 90
2	4 Mill	7	14 30	100	14 30	3	45	1 20	55	14 85	1 10	16 35
6	5 Heat treat & straighten	5	20 00	1 05	21 00					21 00	2 00	42 00
7	6 Cylindrical grind	4	25 00	1 00	25 00	10	2 50	1 30	3 25	28 25	1 50	42 40
7	7 Form grind	6	16 65	100	16 65	12	2 00	1 35	2 70	19 35	1 50	29 05
	TOTAL				107 30				7 20			166 00

Total Cost Per Lot			Total Load			Special Tools Cost		
Material plus %Allowance			Dept	Machine	Hrs Load	Material	18 00	
Labor	114 50		2	M 20, 21, 23	4 300	Labor	8 300	
Factory overhead	166 00		3	T 38, 39	2500	Factory overhead 65%	54 00	
Factory cost		280 50	4	L 70, 71, 72, 73	7500	Factory cost		155 00
% S F			5	U 54	1200	% S F		
Unpack, pack, and ship 3%		8 40	6	H 32, 33, 34	6000	Tools purchased Gauges		106 20
Administrative burden 30%		84 15	7	C 64, 65, 66, 67	7500	Packing and transportation		4 30
Extra setups			7	S 22, 23, 24	5000	Designing labor	108 00	
Transportation						Designing overhead	87 00	
Perishable tools		4 30				Designing total		195 00
TOTAL		377 35				Administrative burden		48 00
SELLING PRICE		400 00		TOTAL	34000	TOTAL		508 50

Estimated by *JHK* First delivery *9/7/42* Approved by *EHS, RM, OEB, DF.*

FIG. 2.1. Cost estimate. (*Boyan, Edwin A., Handbook of War Production, McGraw-Hill Book Company, Inc., New York*, 1942.)

well enough acquainted with the cost system in the plant where he works to be able to make use of accounting data in preparing and checking his estimates. Cost estimates as a rule are not recorded in the accounts.

Historical Costs and Standard Costs

The principle of historical costing is to allocate the total manufacturing cost for an accounting period to the individual products worked on during the period. The product costs are compiled after the processing has been done. Historical costs are generally referred to as actual costs. Strictly speaking, however, it is impossible to determine the actual cost of any product. There are a number of estimates, such as the amount of

depreciation, which are made in the calculation of the costs of an accounting period. Then, unless the plant manufactures only one product, there are a number of estimates involved in allocating the periodic cost to individual products. Furthermore, in many historical-cost systems the factory overhead cost is allocated to products not at actual rates but at predetermined rates.

Standard costs are predetermined costs computed in advance of production and used both to develop accounting entries tracing the flow of costs and also to reveal variances from standard performance as an aid to management in the control of costs. In some cases estimates can be used as the standard costs, but more often the cost estimate is only a starting point in the determination of the standard. The latter figure is computed after the production of an article has been authorized and after standard material specifications and standard manufacturing methods have been adopted.

Historical costs are likely to be employed if the major purpose of the cost system is to furnish data for the financial statements. Standard costs are favored in plants where the control function of accounting is emphasized.

Product Cost Methods

Selection of methods of allocating costs to individual products is governed to some extent by the number of different materials that are used and to a larger extent by the number of different products and parts and the number of different operations and work points. A cement mill uses three materials and performs three operations at three work points to produce a single product. In the Allison Aircraft engine there are approximately 7,000 parts. The connecting rod alone requires 93 operations.[1] A plant producing heavy-duty motor trucks manufactures 15,000 different parts that require a total of 73,000 different machining operations. There are 1,800 machines in the plant. Additional operations, such as heat-treating, plating, painting, and assembly operations would also run into the thousands. Besides the manufactured parts there are a great many purchased finished parts and assemblies. Obviously the cost system that would be suitable for a cement mill would not be suitable for a factory making aircraft engines or for a motor-truck plant.

There are three basic types of historical costing. They are

1. Process cost method, also known as the unit cost method. This method is explained in Chapter 3.

[1] Hunt, O. E., "Model Changes—War Style," Department of Public Relations, General Motors Corporation, Detroit, 1942.

2. Job-order cost method, or job cost method. This method is discussed in Chapter 4.

3. Operation cost method, or specification cost method, discussed in Chapter 5.

A plant may use any one or two or all three of these methods depending upon the circumstances.

Predetermined costs, such as cost estimates and standard costs, are computed by the operation cost method. Standard costs are discussed in Chapter 5.

CHAPTER 3

PROCESS COST METHOD

The essence of the process cost method is the averaging of departmental cost over departmental output. The factory cost for an accounting period is first allocated to departments or processes, and then the periodic cost of each process[1] is divided by the units of output to obtain a unit cost.

The process cost method is suitable when the following conditions exist:

1. The process is a large enough unit so that it is feasible to allocate material costs and conversion costs to it periodically.
2. The operation or the series of operations performed in each process is the same or nearly the same for all the materials processed.
3. The product of the process is homogeneous or nearly so.

Examples of industries in which these conditions are found are the cement industry, oil refining, the making of industrial alcohol, the explosive industry, flour milling, meat packing. These industries are known as continuous-process industries because the equipment of each work point is used continuously on the same operation and because the material flows from one operation to the next with little or no interruption.

Although the essential feature of averaging the costs of a process over the output is common to all applications of the process cost method, there are additional points to consider if there is more than one process in a plant or more than one product, or in case the inventory in process at the

[1] The word *process* is used here to mean a department. Note, however, that the word has a number of different meanings.

As a noun it may represent (1) A work point: the burning kiln in a cement mill may be referred to as the burning process. (2) An operation: the burning operation in a cement mill may be referred to as the burning process. (3) A series of operations: the process of making cement, the process of machining a connecting rod, or the process of assembling a sewing machine. (4) A department in which an operation or a series of operations is performed.

As a verb it may mean (1) to perform a manufacturing operation, (2) to perform a series of operations, (3) to convert material into finished product.

When used as an adjective it may designate (1) a certain type of cost method, the process cost method; (2) a department engaged in the conversion of material into finished products as distinguished from a service department which furnishes services to the process (or processing) departments; (3) an industry of the continuous-process type; (4) the present participle *processing*, which may be used to mean conversion, for example, processing cost is the equivalent of conversion cost.

end of the accounting period is substantial in amount and varies from one period to another.

Outline of Cases

Seven cases are presented to illustrate process cost procedure under various circumstances. They may be outlined as follows:

1. Single product
   - *a.* Single process, no inventory in process at end of accounting period or inventory considered negligible in amount and ignored for cost purposes (see Case 1)
   - *b.* Series of processes, no inventory in process at end of accounting period or inventory considered negligible (see Case 2)
   - *c.* Series of processes, inventory between processes taken into consideration (see Case 3)
   - *d.* Series of processes, inventory between processes and inventory in the individual processes taken into consideration (see Case 4)
2. Two or more products
   - *a.* Quantity of each product controllable, class cost method (see Case 5)
   - *b.* Proportions of individual products not controllable

     By-product cost method, where some of the products are of secondary importance, being manufactured only as an incident to the manufacture of the major products (see Case 6)

     Joint-product cost method, where there are two or more major products (see Case 7)

Portland Cement

Four different ways of computing the cost of producing Portland cement are used to illustrate the first four cases. The departmental costs shown in Table 3.1 are used throughout the four illustrations.

Portland cement is made by crushing and mixing materials containing silica, lime, and alumina in proper proportions; firing the mixture in a kiln; and then grinding the clinker thus obtained into a fine powder, with gypsum added to retard setting. In the dry process the raw materials are kept dry during crushing, and the resulting mixture is a powder. In the wet process water is added in the crushing operation to obtain a soupy mixture which is called slurry. After the final grinding the cement is stored in silos or bins until shipment is to be made.

When the cement plant is in operation, there is material in process in each operation. Also there is an inventory of clinker that is stored between the burning operation and the clinker-grinding operation. At

TABLE 3.1
CEMENT PLANT
Costs by Departments for the Month Ending June 30, 19—

	Crushing and Mixing	Burning	Clinker grinding	Total
Material cost				
Limestone 7,500 tons @ $ 0.50	$ 3,750			$ 3,750
Shale 5,000 tons @ $ 0.70	3,500			3,500
Gypsum 150 tons @ $10.00			$ 1,500	1,500
Total material cost	$ 7,250		$ 1,500	$ 8,750
Conversion cost—variable				
Payroll	$14,000	$12,000	$ 8,000	$34,000
Payroll taxes and insurance	700	600	400	1,700
Coal		5,000		5,000
Miscellaneous supplies	300	400	300	1,000
Repairs	600	2,500	400	3,500
Power	1,500	2,000	1,000	4,500
Other	700	600	500	1,800
Total variable conversion cost	$17,800	$23,100	$10,600	$51,500
Conversion cost—fixed				
Building occupancy	$ 400	$ 500	$ 800	$ 1,700
Machinery depreciation, taxes, and insurance	600	1,500	500	2,600
Supervision and laboratory	800	800	800	2,400
Total fixed conversion cost	$ 1,800	$ 2,800	$ 2,100	$ 6,700
Production cost, current month	$26,850	$25,900	$14,200	$66,950

the end of the fiscal year, however, the cement mill is likely to be shut down, for the manufacture of cement is a seasonal business. When the plant is shut down, the inventory in process is negligible.

Case 1: Single Product, Single Process, Inventory in Process Negligible

This case illustrates the simplest application of the process cost method. The three steps that must be taken are (1) compute the cost of the process

TABLE 3.2
CEMENT-MILL PROCESS COST SHEET (CASE 1)
For the Month Ending June 30, 19—

Costs for the month	
Material input	$ 8,750
Conversion	58,200
Total	$66,950
Units of output, barrels of cement put into storage bins	62,000
Unit cost, bin cost per barrel ($66,950 ÷ 62,000 barrels)	$1.0798

for the period, (2) tally the units of output, and (3) divide to obtain the cost per unit.

If a cement mill were looked upon as a single process and if the inventories in process were disregarded, the cost of producing cement would be computed as in Table 3.2.

Case 2: Single Product, Series of Processes, Inventory in Process Negligible

If the cement plant is treated as a series of processes, and if the inventories in process are ignored for product-costing purposes, unit costs would be calculated in the same way as in Case 1 except that unit costs would be computed for each process (see Table 3.3).

TABLE 3.3
CEMENT-MILL PROCESS COST SHEET (CASE 2)
For the Month Ending June 30, 19—

	Crushing and mixing	Burning	Grinding	Total
Cost for the month:				
Material input	$ 7,250	.....	$ 1,500	$ 8,750
Conversion	19,600	$25,900	12,700	58,200
Total	$26,850	$25,900	$14,200	$66,950
Units of output, 62,000 barrels				
Unit cost (cost per barrel):				
Material	$0.1170	.....	$0 0242	$0.1412
Conversion cost	0 3161	$0.4177	0 2048	0 9386
Total by operations	$0 4331	$0 4177	$0 2290	$1 0798
Cumulative	$0 4331	$0.8508	$1.0798	

Case 3: Single Product, Series of Processes, Inventory between Processes Taken into Consideration

Table 3.4 illustrates what is usually the most practical method of computing cement costs at monthly intervals. Consideration is given to the inventory of clinker that is stored between the burning process and the clinker-grinding process. During the month covered by the illustration 62,000 barrels of cement were ground and put into storage bins, but the inventory of clinker decreased 2,000 barrels. Clinker burned therefore was enough for only 60,000 barrels of cement. The latter figure is used as the units of output for the kiln process and also for the crushing and mixing process.

Note that two separate unit cost figures are computed for clinker for the month. One is the cost of production and output for the current month,

namely, $0.8792; the other is the cost of clinker transferred to the grinding process, namely, $0.8802. The latter figure is a weighted average of the unit cost of clinker in inventory at the beginning of the month ($0.90) and

TABLE 3.4
CEMENT-MILL PROCESS COST SHEET (CASE 3)
For the Month Ending June 30, 19—

	Barrels	Cost for the month	Unit cost
Slurry			
Material input	60,000	$ 7,250	$0.1208
Conversion cost, crushing and mixing	60,000	19,600	0.3267
Slurry to kiln	60,000	$26,850	$0.4475
Clinker			
Slurry used	60,000	$26,850	$0 4475
Conversion cost, burning	60,000	25,900	0 4317
Clinker production and output	60,000	$52,750	$0.8792
Add: initial inventory of clinker	3,000	2,700	0 9000
	63,000	$55,450	0 8802
Deduct: final inventory of clinker*	1,000	880	0 8802
Clinker to grinder	62,000	$54,570	0 8802
Cement in Bins			
Clinker used	62,000	$54,570	$0.8802
Material added		1,500	0 0242
Conversion cost, clinker grinding	62,000	12,700	0 2048
Cement output to storage bins	62,000	$68,770	$1 1092
Add: initial inventory in bins	5,000	5,600	1 1200
	67,000	$74,370	1.1100
Deduct: final inventory in bins†	10,000	11,100	1.1100
Bin cost of cement shipped	57,000	$63,270	1 1100
Cement Shipped			
Bin cost of cement shipped	57,000	$63,270	$1 1100
Packing and loading		5,700	0 1000
Sack cost in excess of amount charged to customers for sacks		2,280	0.0400
Factory cost of cement shipped	57,000	$71,250	$1 2500

* Costed at weighted average unit cost of $0.8802. ($55,450 ÷ 63,000 barrels = $0.8802.)
† Costed at weighted average unit cost of $1.1100. ($74,370 ÷ 67,000 barrels = $1.1100.)

the unit cost of clinker output for the month ($0.8792). Note also that the cost of cement put into the storage bin, $1.1092, is about 3 cents a barrel more than the cost as figured in the previous two cases, because in Case 3 the cost of 2,000 barrels of clinker that were drawn from storage is included in the cost of the completed cement. Incidentally, the cost

sheet in Table 3.4 shows the cost of cement shipped as well as the cost of cement manufactured.

Case 4: Single Product, Series of Processes, Consideration Given to Inventory within Processes

In the process industries the inventory within a process is likely to be small with relation to the monthly output. Where this is the case, particularly if the inventory is about the same at all times, the inventory may usually be ignored for product-costing purposes. There are other cases, however, where it is desirable to take cognizance of it. A cement plant using the wet process is likely to have a considerable quantity of slurry in tanks in the crushing and mixing process for final mixing and blending. The monthly unit cost figures are somewhat distorted when this inventory is ignored. In Table 3.5 unit costs for the crushing and mixing process are worked out on the assumptions (1) that the tanks at the beginning of the month contained material sufficient for the production of 3,000 barrels of cement on which 90 per cent of the work in this process had been completed and (2) that there was a final inventory of material sufficient for 3,600 barrels, 80 per cent completed in the process.

The input of material in terms of barrels of finished cement (60,600 barrels) is calculated in footnote † of the table. The method is to add the units of output and the units of material in the final inventory and then to subtract the units of material in the initial inventory. The unit cost of the material put into process ($0.1196) is obtained by dividing the cost of the material ($7,250) by the units of input (60,600).

The equivalent conversion units for the month as computed in footnote ‡ of the table were 60,180 barrels. Equivalent conversion units or equivalent production units are a measure of work done. In other words, the work done in the crushing and mixing process during the month was equivalent to that required for the complete conversion of 60,180 units in this process. The computation is made by adding the units of output and the units of work in the final inventory and then subtracting the units of work in the initial inventory. The cost of the work done, the conversion cost, for the month was $19,600. The conversion cost per unit in this process was therefore $19,600 divided by 60,180 units, or $0.3257.

The unit cost of the production of slurry for the current month is the sum of the unit costs of material and conversion.

Unit cost of material used	$0.1196
Unit conversion cost	0.3257
Unit cost of current production	$0.4453

The unit cost of slurry output for the month is $0.4442. It is computed simply by dividing $26,654, the cost allocated to the units completed, by

TABLE 3.5

CRUSHING AND MIXING PROCESS COST SHEET (CASE 4)

For the Month Ending June 30, 19—

Slurry	Barrels*	Cost for the month	Unit cost
Material input	60,600†	$ 7,250	$0.1196
Conversion	60,180‡	19,600	0 3257
Total production		$26,850	$0.4453
Add: initial inventory, 90% finished in this process	3,000	1,170§	0.4200§
		$28,020	
Deduct: final inventory, 80% finished in this process	3,600	1,366‖	0.4443‖
Slurry output to kiln	60,000	$26,654	0 4442

* In terms of barrels of finished cement.

† Computation of material input units

Slurry output to kiln	60,000 barrels
Add: final inventory (all of the material has been supplied)	3,600 barrels
Total	63,600 barrels
Deduct: initial inventory	3,000 barrels
Material input	60,600 barrels

‡ Computation of equivalent conversion units

Slurry to kiln	60,000 barrels
Add: final inventory, 3,600 barrels, 80% finished in this process; since 80% of the work in this process has been done, the work done is equivalent to 80% of 3,600, or	2,880 barrels
	62,880 barrels
Deduct: initial inventory, 3,000 barrels, 90% finished in this process, equivalent to	2,700 barrels
Equivalent conversion units	60,180 barrels

§ Detail of cost of initial inventory

Material cost, 3,000 units @$0.12	$ 360
Conversion cost, 3,000 units @90% of $0.30	810
Cost of initial inventory	$1,170

‖ Final inventory costed at weighted average unit costs

Material cost, 3,600 units @$0.1197	$ 431
Conversion cost, 3,600 units @80% of $0.3246	935
Cost of final inventory	$1,366

Weighted average costs per unit computed as follows:

Material cost	Units	Amount
Initial inventory	3,000	$ 360
Input	60,600	7,250
Total	63,600	$7,610

Average material cost per unit $7,610 ÷ 63,600 = $0.1197

Conversion cost	Units	Amount
Initial inventory, equivalent to	2,700	$ 810
Work done, equivalent to	60,180	19,600
Total	62,880	$20,410

Average conversion cost per unit $20,410 ÷ 62,880 units = $0.3246

60,000 barrels, the units of output. The method of inventory costing employed in the illustration is a weighted-average method (see Table 3.5, footnote ||). An alternative method would be to cost the final inventory at the unit costs of the current month's production. The latter procedure would be an application on a monthly basis of the first-in–first-out method of costing.

Table 3.6 is a summary of unit costs of cement production and the unit costs of cement output which would be reported for a given month under the procedures illustrated in Cases 1 to 4. The procedure in Case 4 is the

TABLE 3.6

PROCESS COST METHOD

Summary of Costs per Barrel of Cement

Computed by Four Different Procedures

	Case 1	Case 2	Case 3	Case 4
Unit cost of current month's production				
Crushing and mixing:				
Material cost	.....	$0.1170	$0 1208	$0.1196
Conversion cost	....	0.3161	0.3267	0.3257
Burning:				
Conversion cost	.....	0.4177	0.4317	0.4317
Clinker grinding:				
Material cost	.....	0.0242	0.0242	0.0242
Conversion cost	....	0.2048	0.2048	0 2048
Total bin cost	$1.0798	$1.0798	$1.1082	$1 1060
Unit cost of output				
Slurry to kiln	....	$0.4331	$0.4475	$0.4442
Clinker to clinker storage		0.8508	0.8792	0 8759
Clinker to grinding	....	0.8508	0.8802	0.8771
Cement to storage bins	$1.0798	1.0798	1.1092	1 1061

most accurate. It takes into account the inventory in the crushing and mixing process as well as the inventory of clinker ready for grinding. For practical purposes, however, the procedure in Case 3 would generally be sufficiently accurate. It recognizes the inventory of clinker but ignores the inventories within processes. Although the inventory in the crushing and mixing process is not small, it is generally about the same each month. For the circumstances covered by the illustrations the results in Case 3 differ but slightly from those in Case 4.

Case 5: Two or More Products, Quantity of Each Product Controllable; Class Cost Method

By varying the ingredients and the operations it is practical in some of the process industries to obtain two or more different classes of products from

the same equipment. Thus, to take a simple example, a certain vegetable cannery puts up peas in June and July and sweet corn in August and September. Under such circumstances, in order to compute unit costs of the different products, the class cost method may be used. Material cost and conversion cost are allocated separately to the different classes of products. Records are kept of the output of each class of product, and

TABLE 3.7

LIQUEFACTION PROCESS, CLASS COST SHEET (CASE 5)
Conversion Cost Allocated on Basis of Process Hours
For the Month Ending June 30, 19—*

	Total	Oxygen	Nitrogen
Conversion cost for the month	$2,800		
Actual hours in operation	700	490	210
Conversion cost per hour	$4		
Conversion cost allocated at $4 an hour	$2,800	$1,960	$840
Output, cubic feet		490,000	280,000
Unit cost, per hundred cubic feet		40¢	30¢

* Data from American Institute of Accountants Examination, November, 1939.

unit costs for each class are then computed by dividing the total cost of each class of product by the units of output.

The allocation of material costs to product classes is usually not difficult. The principal materials as a rule can be classified at the time of purchase. Thus, the purchase invoices covering the principal raw materials of the vegetable cannery, peas and corn, can be charged to separate ledger accounts. In the case of materials that cannot be distributed according to class of product at the time of purchase, the quantity of material used for each product would be tallied at the time the material is put into production. Salt and other seasoning used in the cannery, for example, would be recorded so as to show separately the quantity used during the pea-canning season and the quantity used during the sweet-corn season.

The allocation of conversion costs is usually made on the basis of the processing time for each class of product. In the case of the vegetable cannery, the allocation is relatively easy, for the processing of each product extends over a period of several weeks. Payrolls, payroll taxes, power, fuel, and many of the factory supplies can be specifically allocated to the period of use. Other items, such as depreciation, insurance, property taxes, and repairs, can be allocated according to the time spent by the factory on each product. If the shifting from one product to another occurs at frequent intervals, however, so that it is not a simple matter to tally or prorate the various conversion costs for each interval, the total conversion costs of the process for a period of time, such as a

month, would first be determined and then allocated to the various classes of product in proportion to the work done on each class. The work done is usually measured by process hours or man-hours, sometimes by such units as pounds or feet, and in some cases by equivalent conversion units.

TABLE 3.8

LIQUEFACTION PROCESS, CLASS COST SHEET (CASE 5)
Conversion Cost Allocated on Basis of Equivalent Conversion Units
For the Month Ending June 30, 19—*

	Total	Oxygen	Nitrogen
Conversion cost for the month	$2,800		
Output for the month:			
Cubic feet	...	490,000	280,000
Equivalent unit value (per 100 cubic feet)	.....	1.33⅓†	1.0†
Equivalent conversion units for the month	9,333	6,533	2,800
Conversion cost per equivalent conversion unit	30¢		
Conversion cost allocated to class of product at 30¢ per equivalent conversion unit	$2,800	$1,960	$840
Unit cost, per hundred cubic feet	....	40¢	30¢

* Data from American Institute of Accountants Examination, November, 1939.

† Computation of equivalent unit values
The standard unit is 100 cubic feet of nitrogen.
Minutes required to produce 100 cubic feet: oxygen 6, nitrogen 4.5.
Unit equivalent for 100 cubic feet: oxygen 1.33⅓, nitrogen 1.0.

In the liquefaction process of manufacturing oxygen and nitrogen from atmospheric air, the equipment can be used for obtaining either class of product but not for both simultaneously. If a record is kept of the number of hours spent producing oxygen and the number of hours spent producing nitrogen, then the total conversion cost for a month can be allocated on the basis of the hours spent. This is done in Table 3.7. In case it is not feasible to keep a record of the hours spent on each class of product, the work done can be measured in terms of predetermined standard hours or in terms of equivalent conversion units, as illustrated in Table 3.8.

Equivalent Conversion Units

The equivalent conversion unit is a measure of work done. It may be employed for product costing purposes in plants manufacturing a limited variety of products. A certain quantity of one of the products is selected as the standard conversion unit. The equivalent unit value of each of the other products is determined by comparing the amount of work that it requires with that required for the production of a standard unit. The comparisons may be based on standard man-hours, standard machine-hours, or some other factor, depending on the circumstances. In order to

determine the equivalent conversion units for a period of time the number of equivalent output units is first computed by multiplying the output of each product by its equivalent unit value and adding the products. An adjustment is then made for fluctuations of work in process if such fluctuations are of sufficient consequence to be taken into consideration. The calculation of equivalent conversion unit values for oxygen and nitrogen is shown in footnote † in Table 3.8. The inventory in process in this case is negligible. There is an illustration, however, in footnote ‡ to Table 3.5 showing the adjustment of output units to equivalent conversion units to give recognition to inventory fluctuations. The illustrations of equivalent conversion units in this chapter pertain to their use for product costing purposes. In plants making a great variety of products, equivalent conversion units are seldom used for product costing but are frequently employed for statistical purposes and as the basis for budget standards.

Joint Products and By-products

Because of the natural characteristics of certain raw materials it often happens that in order to produce one product, it is necessary to produce other products as well. The quantity of the various products is not controllable by management but is governed by the composition of the material in its natural state. When a log is sawed into lumber, several different grades of lumber are obtained, and the sawyer cannot control to any great extent the proportions of the different grades. A plant producing gas from coal must also produce coke, tar, and other products. Many other examples could be mentioned.

The point where the different products are separated is known as the split-off point. Material costs and conversion costs up to the split-off point are common to all the products. They are joint costs. Market values or realizable values are generally employed in making an allocation of joint costs to the various products. The use of market values for this purpose may appear to be "putting the cart before the horse," but it is not. The businessman who purchases raw material for processing expects the income from the sale of all the resulting products to compare favorably with the total cost. Otherwise he would not make the purchase. Market value is therefore a cost-determining factor.

If there are two or more major products derived from the same raw material, they may be referred to as joint products. Secondary products, of relatively small value, are known as by-products. Every industry produces by-products, but it is in the process industries that they are of the greatest importance. In some plants both joint products and by-products are obtained.

Case 6: Two or More Products, Quantities of Individual Products Not Controllable; By-product Cost Method

Under the by-product method of costing, with some minor exceptions, the entire gross margin is attributed to the principal product. If the by-products are sold without further processing after the split-off point, there are three ways of applying the income from the sale of by-products. They are

1. Credit the proceeds of the sale of by-products to Other Income. Under this procedure the entire cost of material and conversion is allocated to the principal product.

TABLE 3.9
BY-PRODUCT COST SHEET (CASE 6)
By-products Not Processed after Split-off Point
For the Month Ending June 30, 19—

Cost of material put into process			$15,000
Conversion cost			6,000
Total manufacturing cost			$21,000
Less: By-product recoveries:			
Net realizable value of by-products produced			
Market value		$800	
Estimated cost of selling		0	
		$800	
Gain on by-products sold			
Proceeds of sale	$1,200		
Less: inventory value	1,175*	25	
Total by-product recoveries			825
Cost of major product			$20,175

* Inventory value of by-products sold

Inventory, June 1, at market	$ 750
Input, from factory	800
	$1,550
Inventory, June 30, at market	375
By-products sold, at inventory value	$1,175

2. Credit proceeds of sale of by-products to manufacturing costs. Under this procedure the factory cost of the main product is reduced by the amount received from the sale of by-products. The credit is not made, however, until the by-products are sold.

3. Credit the net realizable value of by-products at the time of split off to manufacturing cost. This method is illustrated in Table 3.9. The net realizable value in this case is the excess of market value over estimated cost of selling. Where the by-products have substantial value, this is generally the best procedure for it credits the value of by-product recoveries to the manufacturing cost of the month in which the by-products are

produced. When by-products are sold, there may be a gain or loss due to fluctuations in market price between date of split off and date of sale. The gain or loss is generally a small amount. It may be credited either to manufacturing cost or to other income.

In case the by-products are processed after split off, it is necessary to (1) cumulate the costs up to the split-off point, which are joint costs, (2) apportion the costs at the split-off point between by-products and main products, and (3) record separately the cost of processing each by-product and each main product subsequent to the split-off point. The apportionment of the joint costs is made by first determining the amount to be allocated to by-products and then allocating the remainder to the main products.

The amount of joint cost allocated to by-products may be either market value or net realizable value.

1. Allocation to by-products on basis of market value. Under this practice the market value of the by-products in their state at the split-off point is treated as their cost at that point. Market value is the amount that could be obtained for the by-products if they were sold without further processing. Costs of subsequent processing are added to determine the cost of by-products sold. Gain or loss on sale of by-products is computed by deducting cost of by-products sold and by-product selling expense from by-product sales. The gain or loss in this case indicates to management whether or not it is profitable to process the by-products after the split-off point.

2. Allocation to by-products on basis of net realizable value (see Table 3.10). Under this practice the net realizable value of the by-products in their state at the split-off point is treated as their cost at that point. Net realizable value in this case is the estimated sales value of the by-products when additional processing will have been completed less the estimated costs of processing and selling. Whether or not it is profitable to perform the additional processing is predetermined by comparing the net realizable value of by-products with their market value at the split-off point. The gain or loss reported on by-product sales represents only the effect of variations of actual costs and prices from estimates. The cost of the main product is reduced by the amount of profit expected through processing the by-products subsequent to split off.

The procedure just described is used in the cattle division of the meat-packing industry. Its application there is illustrated by Table 3.10. Dressed beef is the major product; hides, fats, tongues, livers, bones, and other items are by-products. In the illustration the total manufacturing cost of a lot of 30 steers is $2,255.84. Subtracting by-product credits amounting to $254.12 leaves a remainder of $2,001.72 as the cost of

TABLE 3.10
COST OF DRESSED BEEF
By-product Cost Method (Case 6)
(30 good steers bought from Q Company)*

	Yield, per cent	Pounds	Cost	Cost per cwt.
Live basis				
Material cost, live cattle		33,360	$2,135.04	$ 6.40
Conversion cost:				
Killing and dressing (@ $2.15 a head)			64.50	0.19
Cooler (@ $0.29 per cwt. dressed)			56 30	0.17
Total manufacturing cost			$2,255.84	$ 6.76
By-product credits:				
Hides		2,160	$ 121.15†	$ 0.36
Fats		1,230	42 62	0.13
Other items		2,146	90.35	0 27
		5,536	$ 254 12	$ 0.76
Net cost of dressed beef to cooler			$2,001.72	$ 6.00
Dressed basis				
Cost of dressed beef to cooler	58 2	19,415	$2,001.72	$10.31
Shrinkage, cooler trim, etc	0.5	155		0.08‡
Cost of salable beef	57 7	19,260	$2,001.72	$10.39

* Adapted from Greer, H. C., "Accounting for By-products and Joint Products," *N.A.C.A. Bulletin*, Vol. 17, No. 24, Sec. 1, pp. 1409–1410.

† Calculation of credit for hides:

	Green weight, lb.	Estimated cured weight, lb.	Estimated selling price cured per cwt.	Value
20 heavy hides	1,456	1,194	$8 25	$ 98.51
5 heavy hides, branded	364	298	6.75	20.12
5 light hides	340	279	7 25	20 23
	2,160	1,771		$138.86
Estimated cost of processing hides after split off, 1,771 lb. cured weight @ $1 per cwt.				17 71
Estimated net realizable value of hides at split-off point				$121.15

‡ $10.39 − $10.31 = $0.08.

dressed beef. The calculation of the credit for hides at net realizable value is outlined in footnote † of the table. Calculations of the value of the other by-products are not shown.

Yield and Shrinkage Data

In Table 3.10 the unit costs of material and of conversion are computed on a live-weight basis. The unit cost of dressed beef put into coolers is com-

TABLE 3.11
SAW-MILL COST SHEET
Joint-Product Cost Method (Case 7) for the Year Ending December 31, 19—*

	Units, 1,000 board feet	Cost		Unit cost
Factory cost for the year:				
Material, logs	24,000		$292,500	$12.1875
Conversion				
Unloading at mill		$31,500		1.3125
Sawing		96,000		4 0000
Sorting		24,000		1.0000
Piling in yard		36,000		1.5000
			187,500	7.8125
Total output	24,000		$480,000	20.0000

Allocation to grades on basis of average market value

Grade	1,000 board feet of output	Market value			Cost allocation	Cost per 1,000 board feet
		Per 1,000	Total	Per cent of total		
A	7,200	$35	$252,000	38 36	$184,128	$25 57
B	6,000	30	180,000	27.40	131,520	21.92
C	4,800	25	120,000	18.26	87,648	18.26
D	3,600	20	72,000	10.96	52,608	14.61
E	1,800	15	27,000	4.11	19,728	10.96
F	600	10	6,000	0.91	4,368	7.28
Total	24,000		$657,000	100 00	$480,000	

* Data from American Institute of Accountants Examination, November, 1938.

puted both on the live-weight basis and on a dressed-weight basis. The yield of dressed beef is 19,415 pounds, which is 58.2 per cent of the live weight. Shrinkage in the cooler due to trimming and other causes amounts to 155 pounds. The net yield of salable beef is therefore 19,260 pounds, which is 57.7 per cent of the live weight. The unit cost of the

shrinkage is 8 cents per hundredweight of dressed beef. That figure is computed by subtracting the cost per hundredweight of dressed beef delivered to cooler ($10.31) from the cost per hundredweight of salable beef ($10.39). Statistical data in regard to yields and shrinkages are frequently shown on process cost reports, for such data are of great interest to management.

Case 7: Two or More Products, Proportions Not Controllable, Joint-product Cost Method

Under the joint-product cost method the viewpoint is adopted that each of the joint products contributes to the profit or loss. Costs up to the split-off point as a rule are allocated to joint products either on the basis of market value or on the basis of net realizable value. The allocation in Table 3.11 is made on the basis of market value. Market value may be computed at the current market price at date of split off, at an average price over a period of time, or at a predetermined normal market price. Costs subsequent to the split-off point are allocated to products in accordance with the work required on each type of product.

Instead of the conventional practice of allocating *costs* to joint products, it is the practice in some cases to inventory the various products at *net realizable values* at the split-off point and at subsequent stages as well. The effect of thus substituting realizable value for cost is to recognize a profit or loss at the split-off point and at subsequent points in the processing of the individual products. H. C. Greer cites the hog division of the packing industry as a case in which this method is applicable for the following reasons:

1. The difference between cost and selling price is very small.
2. There are so many individual products that it would be cumbersome to allocate costs by the conventional joint-product method.
3. The various products go through numerous processes subsequent to the split-off point.
4. There are frequent fluctuations in market prices. If inventories were carried by the usual costing method, frequent adjustments would be needed "to insure that no cost on the books were in excess of market value."[1]

Joint Products, Method of Computing Allowable Purchase Price of Raw Material

It was previously pointed out that the price which can profitably be paid for a raw material depends upon the amount of income expected from the

[1] Greer, H. C., "Accounting for By-products and Joint Products," *N.A.C.A. Bulletin*, Vol. 17, No. 24, Sec. I, pp. 1418–1420.

TABLE 3.12

CALCULATION OF ALLOWABLE PURCHASE PRICE OF A CERTAIN BATCH OF LOGS*

Calculation of price that could profitably be paid for each grade of lumber if it were possible to purchase separately the raw material for each grade.

Grade of lumber	A	B	C	D	E	F
Estimated selling price per 1,000	$35	$30	$25	$20	$15	$10
Less: Provision for profit and selling and administrative expense, 20%	7	6	5	4	3	2
Available for factory cost	$28	$24	$20	$16	$12	$8
Less: Conversion cost and purchasing cost	8	8	8	8	8	8
Allowable purchase price of logs per 1,000 board feet, f.o.b. factory	$20	$16	$12	$ 8	$ 4	0

Estimate of board feet by grades in a certain batch of logs that are available for purchase, and computation of allowable purchase price, which is $13 per 1,000 board feet.

Grade	Board feet per 1,000 estimated† (*a*)	Allowable price per 1,000 ft. (*b*) (computed above)	Product (*a*) × (*b*)
A	250	$20	$ 5.00
B	250	16	4 00
C	200	12	2 40
D	150	8	1 20
E	100	4	0 40
F	50	0	0 00
Total	1,000		$13.00

* The method outlined in this table is suggested by I. W. Keller in an article entitled "The Function of Costs in a Joint-products Industry," *N.A.C.A. Bulletin*, Vol. 21, No. 6, Sec. I.

† Estimates made by inspection of the raw material.

sale of the products. Table 3.12 illustrates a method of calculating the allowable purchase price or the price that can profitably be paid for a lot of raw material from which various joint products or various grades of products would be obtained.

CHAPTER 4

JOB-ORDER COSTS

The essence of the job-order cost method of computing product costs is that material and conversion costs, so far as possible, are specifically allocated to order numbers or job numbers. Construction work is usually identified by job numbers, factory work as a rule by order numbers. The specific allocation is based on a tally of materials and services used on individual jobs or orders. Those costs which cannot be specifically applied, known as indirect costs, are totaled and then prorated to orders. In case an order calls for two or more identical articles, the unit cost can be obtained by dividing the cost of the order by the number of articles.

The job-order cost method is applicable where the production is not highly repetitive and, in addition, consists of distinct jobs or lots so that material and labor costs can be identified by order number. These conditions are found in the construction industries and also in jobbing shops or factories manufacturing to special order. Job-order costing is the customary procedure in commercial foundries and drop-forging shops and in plants making specialized industrial equipment such as power shovels, heavy-duty motor trucks, turbogenerators, laboratory equipment, and special tools.

At the other extreme in the mechanical industries are shops producing a large volume of standardized products by mass-production methods. Here, although the job-order cost method could be used, the standard cost method is generally preferred. There are many shops, falling between the two extremes, that produce both special orders and standard or stock items. Often the component parts of a special assembly are to a large extent stock parts. In such cases if the production to special order predominates, job-order cost procedure is likely to be adopted for all the work. If production of stock items predominates or is a large proportion of the total, and if management is interested in the development of cost records for cost-control purposes, then the standard cost procedure is likely to be adopted.

In some plants both methods are used, the standard cost method for costing the production of stock items and the order cost method for special orders. Even where standard costs are used for costing all production, arrangements may be made for obtaining job-order costs of

special items when the occasion requires it, and the costs of maintenance work and toolroom work are generally compiled by the job-order cost method. During the Second World War the job-order method was widely used for costing war contracts, especially cost-plus-fixed-fee contracts and time-and-material contracts.

The principle of the job-order cost method is not difficult except for the allocation of indirect costs. The practical problems involved are chiefly to get dependable information from shop departments and to set up office procedures so that the costs are compiled accurately, economically, and as promptly as possible.

Direct Costs

In a process cost system it is not necessary to make a distinction between direct cost and indirect cost, for the entire cost of a process is averaged over the output. But in plants where the job-order cost method is applicable, because of the variety of products it would not be satisfactory to average the entire cost over the various products. So far as it is practicable, therefore, the costs are specifically allocated to orders by keeping a tally of what is used on each order. Only those costs which cannot be specifically allocated are averaged or prorated to orders.

Costs that are allocated specifically to individual orders or products are called direct costs.[1] The total direct cost of an order is sometimes referred to as the prime cost. Direct cost is made up of (1) direct material, (2) direct labor, and (3) sundry direct costs.

Direct material consists of those things which become a part of the finished product and which can economically be identified with an item of product. In a job-order cost system the direct material is the material that can, without too much expense, be tallied by order number. *Direct labor* is labor that is spent in shaping the material, changing its physical properties, assembling parts to form a finished product, finishing, and shipping the product, and that can economically be identified with an item of product. In a job-order cost system it is that labor which can, without too much expense, be tallied or recorded by order number. *Sundry direct costs* are not very common in manufacturing industry. One example is outside processing, sometimes referred to as outside labor. (It is preferable to use the word labor only when referring to the services

[1] It should be noted that the term *direct* is a relative term. Here the term is used to refer to a cost that is "direct" with relation to the product being manufactured. The word may also be used with relation to a department to refer to costs that can be specifically allocated to that department, for example, direct departmental overhead. In the analysis of selling expenses the word direct may be used to refer to those selling expenses which are direct as to class of product, those which are direct as to customers, or those which are direct expenses of a certain sales territory, etc.

of men on the company's own payroll.) Engineering costs and outlays for patterns, dies, and special tools are in some cases treated as sundry direct costs. In the construction industry sundry direct costs are quite numerous. Examples are fees for engineering services, supervision, timekeeping, insurance, rent of equipment, power, fuel, and office supplies to the extent that such items are specifically allocable to a particular job.

Indirect Costs

Indirect factory cost or *factory overhead* consists of costs that cannot be allocated specifically to the product being manufactured. Other names for factory overhead are burden and indirect maunfacturing expense. (In the author's opinion the use of the word *expense* is objectionable when referring to factory overhead because the factory overhead of an accounting period is not necessarily an expense of that period. The overhead cost is first allocated to the asset Goods in Process, later it is transferred to Finished Goods, and it does not become an expense chargeable to Profit and Loss until the finished goods are shipped.)

Factory overhead is composed of indirect material, indirect labor, and other indirect costs. Indirect material consists of those items of material which although a part of the product cannot economically be allocated specifically to orders. Glue, tacks, paint, and instruction booklets, for example, are sometimes treated as indirect material. Indirect labor includes labor on the product which cannot feasibly be allocated to orders and also the wages paid for supervision, clerical work, trucking, janitor work, and other necessary factory services. Other indirect costs are, for example, tools, supplies, defective work, cost of building occupancy, and cost of the services of machines and equipment.

Factory Orders

Factory orders are instructions to shop personnel to do work. They are an important instrument of production control as well as a means of identifying the direct costs of an order. The orders are usually numbered for reference in the shop and office. They must be numbered if order costs are wanted.

The principal types of factory orders are
Shipping orders
Production orders
  Special orders
  Stock orders
Maintenance orders
Toolroom orders
Rework or salvage orders
Construction orders

Shipping orders and production orders in most plants nowadays are issued in the office, usually by a production planning department. When production is to customer order, the shipping order and the production order are likely to be combined. In many cases the production order contains a complete list of the operations, known as a production routing, showing for each operation the department number, machine number, and piece rate or standard time allowance. The data for the production routing are supplied by the production engineering department. Drawings and other written instructions as well as oral instruc-

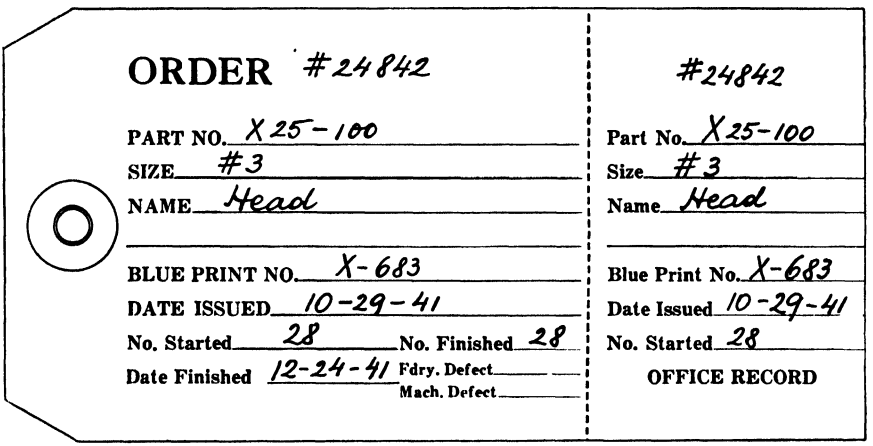


FIG. 4.1. Production order used in a small machine shop.

tions are furnished to the shop to supplement the instructions on the production orders.

Figure 4.1 is a simple form of a production order which shows what is wanted but not how to proceed. Reference is made, however, to the blueprint or drawing number. Figure 4.2 is an example of a combined shipping order and production order used in a drop-forging shop. Figure 4.3 is an illustration of a combined production order and production routing for the machining of a water-pump body. Figure 4.3 (front) is an order for the manufacture of a special tool.

Suborders are sometimes used in addition to the original or master order in case a job is a large one requiring the work of several departments or in case it is an assembly or an installation made up of a number of special component parts or units. The suborder is a means of distributing the instructions to the shop; it also serves a useful purpose from the cost standpoint, for it makes it possible to divide the cost of a job into significant parts. Suborders may also be used when an order is broken up into two or more lots for convenience in processing or to expedite the

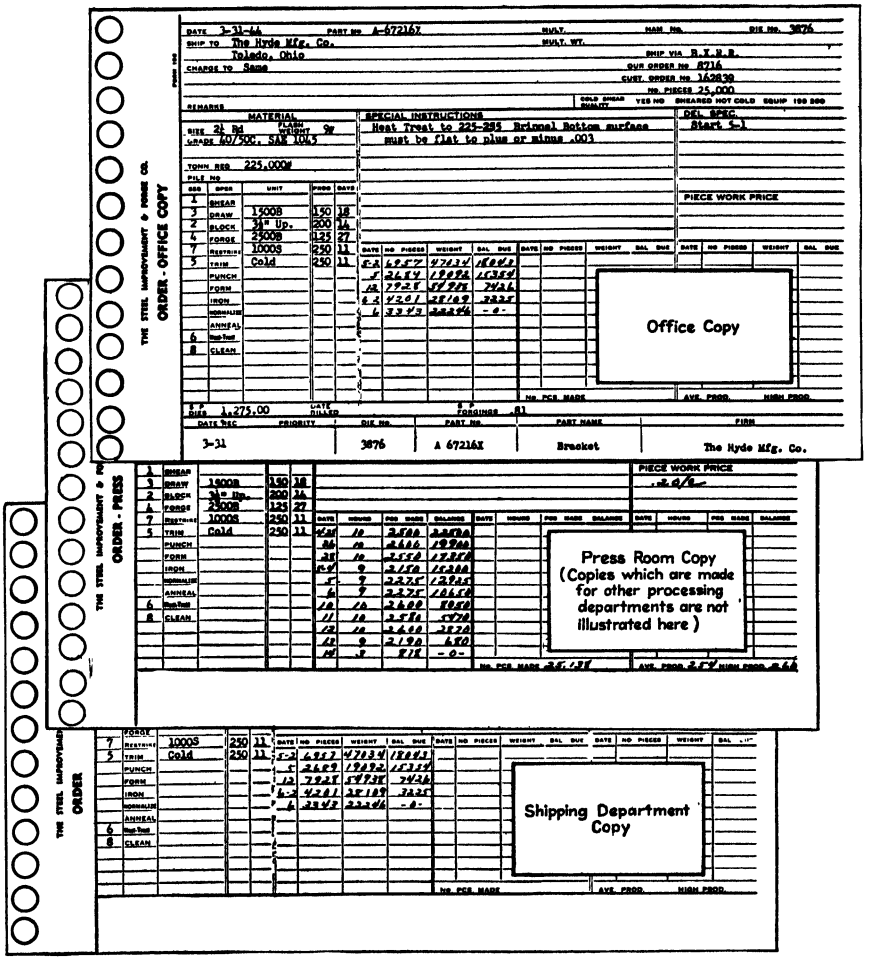


FIG. 4.2. Combined production order and shipping order. (*Adapted from Naujoks, Waldemar, "The Engineer and Shop Forms," 1933, a M.E. thesis on file in the University of Wisconsin Library.*)

completion of a part of the order. Suborders of the latter type are called partial-production orders or split-lot orders.

Job-order Cost Sheet

The job-order cost sheet is a form on which the factory cost department compiles the cost of an order. In some cases, a copy of the factory order is designed to serve as a cost sheet. Separate spaces are generally provided for direct material, direct labor, and factory overhead.

Material as it is issued from stores is reported on material requisitions.

If it is chargeable to a factory order, the order number is written on the material requisition. Materials that are purchased especially for an individual order are either (1) charged to the order direct from the purchase invoice or (2) recorded as if they went into stores, the invoice being charged to stores and a material requisition made to credit stores and charge the production order. Outside processing would be charged to orders in the same manner as purchases of special material except that, theoretically at least, it should be classified on the cost sheet as sundry direct cost. In many cases it is tabulated as direct material cost, a treatment that is theoretically wrong but may be justifiable because of a saving effected in clerical cost and form cost.

Direct labor is applied to job-order cost sheets on the basis of time tickets. Factory overhead is prorated to orders.

Application of Factory Overhead to Orders

Factory overhead costs are joint costs of the various products of a production center. Because the proportions of the various products are controllable, the principle of the allocation of overhead is the same as in the class cost method (Chapter 3, Case 5). Generally the overhead is applied to orders either on the basis of direct man-hours or on the basis of direct labor cost. The effect is to charge the individual orders approximately in proportion to benefits received.

A production center or burden center is a segment of a factory, or in some cases the entire factory, which is treated as a unit for the accumulation of factory overhead and the application of overhead to products. It may be a single work point, such as a machine, or a group of work points. In many plants the processing departments are the production centers, and sometimes the entire factory is treated as a single production center.

Methods of applying the overhead or burden of a production center are discussed more fully in a later chapter, but the steps that are usually taken in a job-order cost system may be briefly outlined as follows:

1. Determine what volume of production is to be used for product costing purposes, measuring the volume in terms of a factor that has been selected as the basis for prorating overhead to orders such as, for example, direct man-hours, machine-hours, or direct labor cost.
2. Estimate the total overhead of the production center at that volume.
3. Divide the estimated total overhead by the total quantity of the base factor to determine the overhead rate. The rate may be, for example, a rate per machine-hour, a rate per direct man-hour, or a percentage of direct labor cost—depending upon the base selected.
4. Obtain a tally of the quantity of the base factor for each individual production order that was worked on by the production center.

5. Multiply the quantity of the base factor, for example, the number of direct man-hours, on the production order by the production-center overhead rate. The result is the overhead cost applied to the order in that production center.

For example, assume that the production volume per month is estimated at 10,000 direct man-hours and the estimated monthly overhead for that volume is estimated at $20,000. The overhead rate would be $20,000 ÷ 10,000 hours, or $2 per direct man-hour. Then, if the direct hours worked on a certain order were 75, the burden applied to the order would be 75 times $2, or $150.

Itemization of Charges to Cost Sheets

The extent to which charges are itemized on the job-order cost sheets varies. In some plants each item of material and each time ticket for direct labor is recorded. In other cases the individual charges are summarized by order number periodically, once a week, for example, and the totals for the period are then posted to cost sheets. In other cases the transaction reports chargeable to orders are merely filed by order number until an order is completed. The charges to the completed order are then added, and the totals are posted.

Because of the large number of items that are dealt with in cost accounting the first procedure is usually too cumbersome, particularly for items of labor cost. The itemization of material charges, however, is sometimes necessary or desirable. In the case of a shipyard that is working on repair orders, for example, the cost sheet may be the foundation for an itemized invoice to the customer.

Whether the items are posted or not, the material requisitions, time tickets, and other supporting papers should be filed for a reasonable time so that they can be referred to in case a verification or an analysis of the job-order cost is wanted. In some cases the job-order cost sheet is the front of a folder or an envelope in which the supporting papers are filed, but more often they are filed separately.

Classification of Costs on Cost Sheets

Closely related to the problem of itemization is the problem of classification on the cost sheet. Spaces are customarily provided for the major classifications such as direct material, direct labor, and factory overhead, and in some cases for sundry direct cost. In addition material cost is sometimes classified by kind of material, and labor cost either by operation or by department. If departmental overhead rates are used, both the labor and the overhead are likely to be classified departmentally on the cost sheet.

Assembled Products

An assembled product is made up of component parts and subassemblies some of which are purchased finished, ready for final assembly, whereas others are manufactured in the plant. In the case of a final assembly that is made to special order, some of the manufactured parts and subassemblies are generally stock items, others are manufactured especially for the order.

Unit cost records are maintained for stock parts and subassemblies. From these records the requisitions for stock items that are put into final assembly can be costed to the job order. Spaces should be provided on the cost sheet to show separately the material, labor, and overhead costs of stock parts.

There are at least two ways of dealing with the cost of specially manufactured parts and subassemblies. One way is to charge to one original order number all the cost of making the special parts for an assembled product as well as the costs of purchased parts, manufactured stock parts, and assembly costs. Separate manufacturing releases would be issued for the special parts, but the same order number would be used on all releases. Under this procedure the cost of all the special parts as well as the final assembly and finishing operations would be merged on the order cost sheet. Individual costs of special parts would not be compiled.

Another method is to have a separate suborder for each part and each subassembly that is specially manufactured. The costs of individual parts would be compiled on suborder cost sheets. The cost of the assembled product would then be obtained by summarizing the cost of the various suborders and the cost of the final assembly order. The latter method is usually the better one, for the cost sheets are more suitable for checking and for analysis.

Controlling Accuracy of Order Costs

Typical causes of error in the operation of an order cost system are

1. Shop errors
   a. In reporting material used, for example, failure to report, wrong report of quantity, wrong description of material, wrong order number on requisition
   b. In reporting labor, for example, carelessness in reporting starting time and stopping time on each job, total time not accounted for, wrong tally of pieces produced, wrong rate on time tickets, wrong order number on time ticket, failure to report rework operations
2. Office errors
   a. In costing material requisition

b. In rating time ticket
c. In extending material requisitions and time tickets
d. In sorting and filing requisitions and time tickets by order number
e. In posting to cost sheet
f. In adding cost sheet
g. In applying overhead on cost sheet

In order to have accurate order costs the first essential requirement is to establish adequate control of material inventory so that the requisitions for material are accurate. A second essential is to have an accurate timekeeping and payroll procedure. The subjects of material control and timekeeping are discussed in later chapters.

The office work of costing, extending, and sorting requisitions and time tickets should be systematically organized, and the clerks doing this work should be selected and trained to do accurate work. When inexperienced workers are assigned to these operations, the supervisor should explain the work carefully and have their work checked at the outset. Precautions should be taken to guard against the loss of requisitions and time tickets.

The extended time tickets and requisitions for a selected period of time (day, week, or month) should be totaled and the total used as a control of the postings to the cost sheet. If the accumulation of costs on the cost sheets is done by machine methods, the cost sheets are likely to be kept in agreement with the control figures. If the cost sheets are posted by hand, it is usually a laborious job to prove the cost sheet totals with a control figure, and the proof is likely to be omitted.

Because errors are bound to occur, no matter how careful a control is established of the work in the shop and the office, it is customary to have an experienced cost clerk check the completed cost sheets. This checking is usually done by comparing the completed cost sheet with the cost estimate, with a previous cost of the same product, or with the cost sheet for a similar job. If there are engineering specifications that show the material required and a list of operations, the charges to the cost sheet can be analyzed and compared with the engineering specifications. The latter procedure is followed as a matter of routine in many order cost systems.

Outline of Cases

Eight cases are presented to illustrate practical procedures of compiling job costs in different situations. The cases are outlined as follows:

1. Cost sheet on back of order, columns for major cost classifications only
2. Small machine shop, stock forms

3. Drop-forging shop, labor and overhead classified by operation
4. Foundry and machine shop, labor and overhead classified departmentally, costing of partial shipments recorded on cost sheet
5. Unit process costs applied to orders
6. Specialized furniture, cost sheet folder for filing supporting documents
7. Assembled product, suborders
8. Job costs compiled by means of punched cards

Case 1: Cost Sheet on Back of Order, Columns for Major Classifications Only

The simplest form of job-order cost sheet is one in which a column is provided for each of the major classifications: material, direct labor, and overhead. Charges to the order are entered in the appropriate columns. Upon completion of the order the columns are totaled. Subtotals of the columns can be obtained periodically if desired while the order is in process.

Figure 4.3 is an illustration of a form of maintenance and construction order and cost sheet. The cost sheet is printed on the back of the accounting department's copy of the order.

Case 2: Small Machine Shop, Stock Forms

Figure 4.4 illustrates a hand-posted cost sheet called Job Cost Ledger which is designed for use in small machine shops and similar enterprises. The spaces for the cumulation of costs are similar to those in the previous illustration except that there are two columns for labor cost which are used in this case as departmental columns. In case the labor and overhead were not classified departmentally, one of the labor columns might be left blank, or it might be used for sundry direct costs.

To indicate the source of labor and material charges a sample strip of time tickets (called daily time cards) and a storeroom requisition are illustrated as well as a stores credit form on which would be reported unused material returned to stores for credit. It is apparent that labor charges are posted once a week to the cost sheet and the material requisitions are posted individually. Overhead is applied to the order once a month. The departmental overhead rates are 40 cents an hour for Milling and 60 cents an hour for Lathe Department.

The forms[1] in Fig. 4.4 are reproductions of stock forms, that is, forms which are carried in stock by an office stationery supplier. When the quantity required is small and when the design of the stock form is suit-

[1] Manufactured by Charles R. Hadley Company.

TOOL ROOM AND MAINTENANCE ORDER			FOR DEPARTMENT 58M	ORIGINAL ORDER NO. M-8985
DATE ISSUED	TO DEPARTMENT	PART NUMBER	TOOL NUMBER	SUB ORDER NO.
4-20-44	47M	45289x	T8241	

WORK REQUESTED Make drill jig for Marietta drill press, machine #185. B/P attached.

For operation 20 on end plate, part number 45289x

DELIVER TO 58M-Tool crib

Requested by	Authorized by	Cost Summary	Material	Labor	O'Head	Total
J. Mauk	Snyder 34M	Estimate	12.50	20.00	-	32.50
Date Wanted 5-5-44	Date Completed 5-5-44	Actual	11.20	25.00	—	36.20

BUFF COPY to department doing work; when completed to cost department
WHITE COPY. to cost department PINK COPY: File

FRONT

TOOL ROOM AND MAINTENANCE ORDER COST SHEET					DEPT. & ACCT DR. 58.36		SUBORDER NO. —	ORIG. ORDER NO. M-8985	
1944	REFERENCE	MAT'L	LABOR	O'HEAD	194_	REFERENCE	MAT'L	LABOR	O'HEAD
4-28	MR 9461	8.20				Forwarded			
4-30	47M		5.-						
5-4	MR 9589	3.-							
5-5	47M		20.-						
		11.20	25.-						

BACK

FIG. 4.3. Maintenance and construction order (front) and order cost sheet (back).

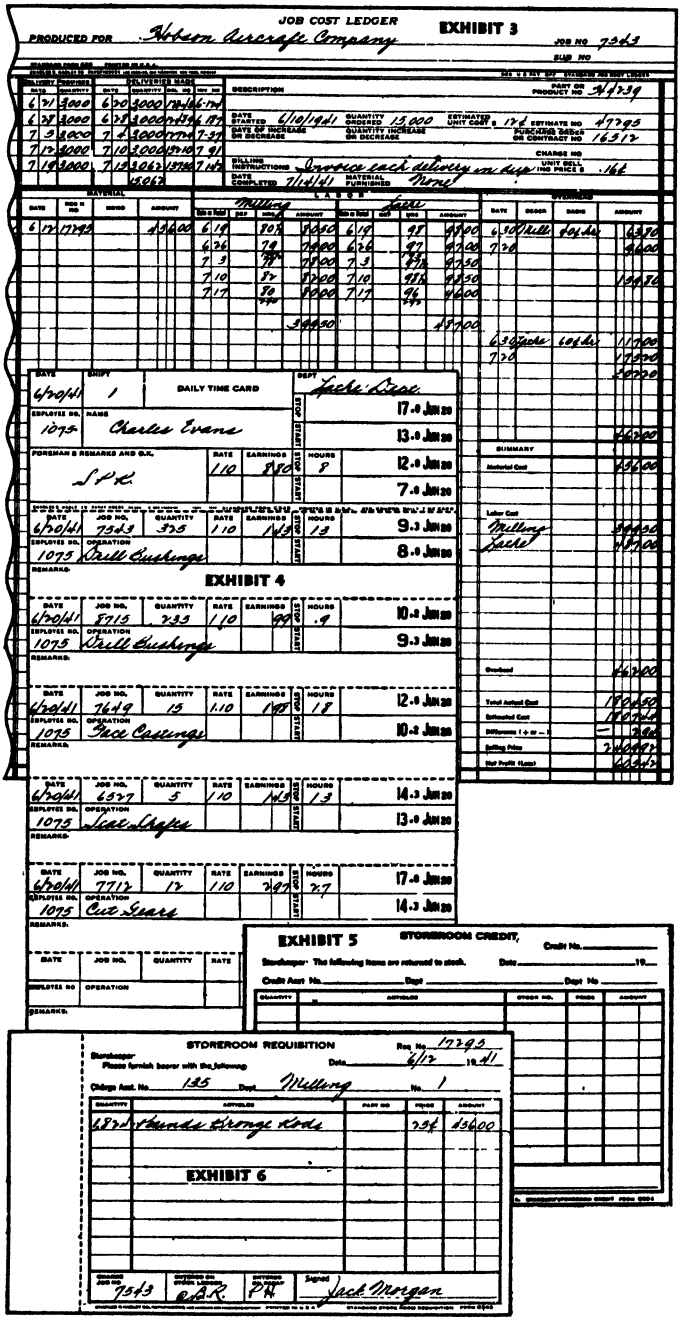
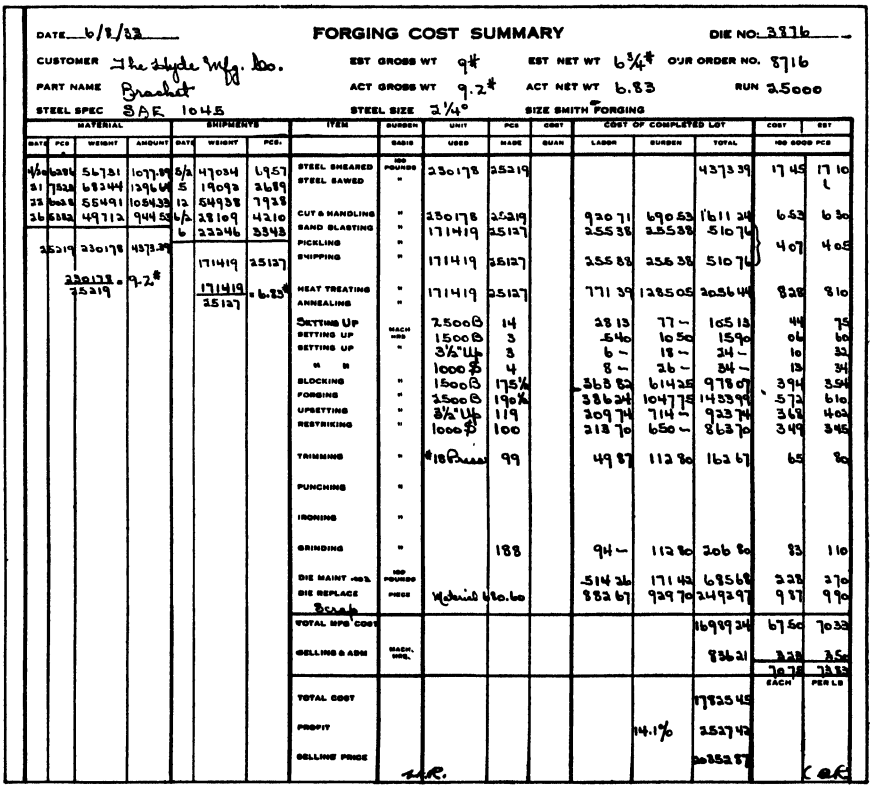


FIG. 4.4. Stock forms for job-order cost systems in small machine shops. (*Pathfinder Service Bulletin, No. 153, September, 1941. Charles R. Hadley Company.*)

able for the work, it is frequently more economical to use a stock form than to have a special form designed and printed.

Case 3: Drop-forging Shop, Labor and Overhead Classified by Operation

On the drop-forging cost sheet (called Forging Cost Summary), Fig. 4.5, the labor and burden are classified by operation. The machine-hours and



DATE 6/2/33 — FORGING COST SUMMARY — DIE NO. 3716

CUSTOMER The Hyde Mfg. Co. — EST GROSS WT 9# — EST NET WT 6¾# — OUR ORDER NO. 8716

PART NAME Bracket — ACT GROSS WT 9.2# — ACT NET WT 6.83 — RUN 3.5000

STEEL SPEC SAE 1045 — STEEL SIZE 2¼" — SIZE SMITH FORGING

MATERIAL DATE	PCS	WEIGHT	AMOUNT
4/26	6284	56731	1077.89
27	7528	68344	1296.64
28	6028	55491	1053.33
29	5382	49712	944.53
	25219	230178	4373.39

SHIPMENTS DATE	WEIGHT	PCS.
5/2	47034	6957
5	19092	2689
12	54938	7928
5/4	28109	4210
6	22346	3343
	171419	25127

230178 ÷ 25219 = 9.2#

171419 ÷ 25127 = 6.83#

ITEM	BURDEN BASIS	UNIT USED	PCS MADE	COST QUAN	COST OF COMPLETED LOT LABOR	BURDEN	TOTAL	COST 100 GOOD PCS	EST
STEEL SHEARED	100 POUNDS	230178	25219				4373 39	17 45	17 10
STEEL SAWED	"								
CUT & HANDLING	"	230178	25219		920 71	690 53	1611 24	6 63	6 30
SAND BLASTING	"	171419	25127		255 38	255 38	510 76		
PICKLING	"							4 07	4 05
SHIPPING	"	171419	25127		255 38	255 38	510 76		
HEAT TREATING	"	171419	25127		771 39	1285 05	2056 44	8 28	8 10
ANNEALING	"								
SETTING UP	MACH HRS	2500 B	14		28 13	77 —	105 13	44	75
SETTING UP	"	1500 B	3		5 40	10 50	15 90	06	60
SETTING UP	"	3½" Ut	3		6 —	18 —	24 —	10	22
" "		1000 $	4		8 —	26 —	34 —	13	34
BLOCKING	"	1500 B	175¾		368 82	614 25	978 07	3 94	3 94
FORGING	"	2500 B	190¾		386 24	1047 75	1433 99	5 72	6 10
UPSETTING	"	3½" Ut	119		209 74	714 —	923 74	3 68	4 02
RESTRIKING	"	1000 $	100		218 70	650 —	868 70	3 49	3 45
TRIMMING	"	#18 Press	99		49 87	112 80	162 67	65	80
PUNCHING	"								
IRONING	"								
GRINDING	"		188		94 —	112 80	206 80	83	110
DIE MAINT 100 POUNDS	100 POUNDS				514 26	171 42	685 68	2 75	2 70
DIE REPLACE	PIECE	Waldemar 460.60			882 67	929 70	2492 97	9 97	9 90
Scrap									
TOTAL MFG COST							16999 34	67 60	70 32
SELLING & ADM	MACH. HRS.						836 21	3 28	3 50
								70 78	73 82
TOTAL COST							17835 45	EACH	PER LB
PROFIT						14.1%	3527 42		
SELLING PRICE							21362 87		

FIG. 4.5. Drop-forging cost sheet. (*Naujoks, Waldemar, "The Engineer and Shop Forms," 1933, a M.E. thesis on file in the University of Wisconsin Library.*)

the direct labor cost for the blocking, forging, upsetting, restriking, trimming, and grinding operations are cumulated on the back of the cost sheet (see Fig. 4.6). Setup labor, which is paid at hourly rates, is entered directly to the Forging Cost Summary (Fig. 4.5) from time tickets. Labor and burden costs for cutting, sandblasting, shipping, and heat-treating are computed on a poundage basis.

The burden application basis for each operation is indicated on the cost summary. Machine rates are used to apply burden to the major operations, a separate rate being used for each type of machine.

Note the column for unit cost by operations and the comparison with estimated unit costs. Note also that in order to save space on the form no separate column is provided for material cost. The amount of material ($4,373.39) is extended into the total column.

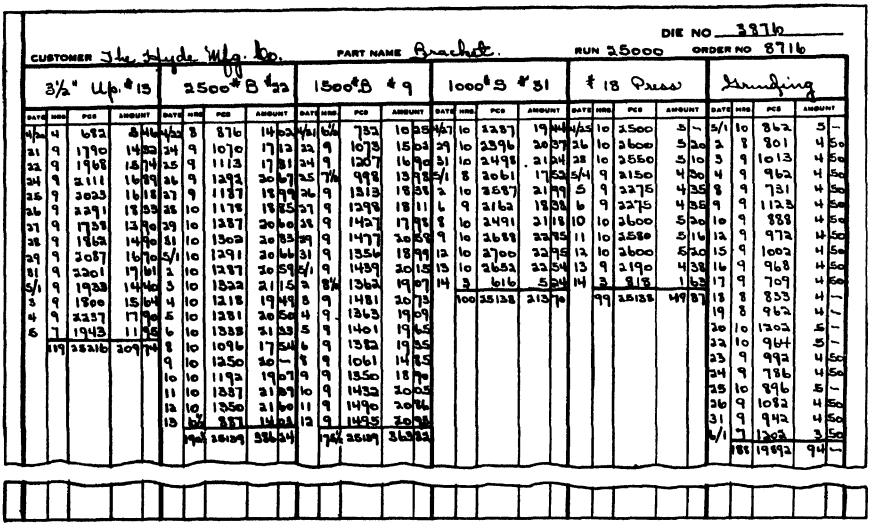
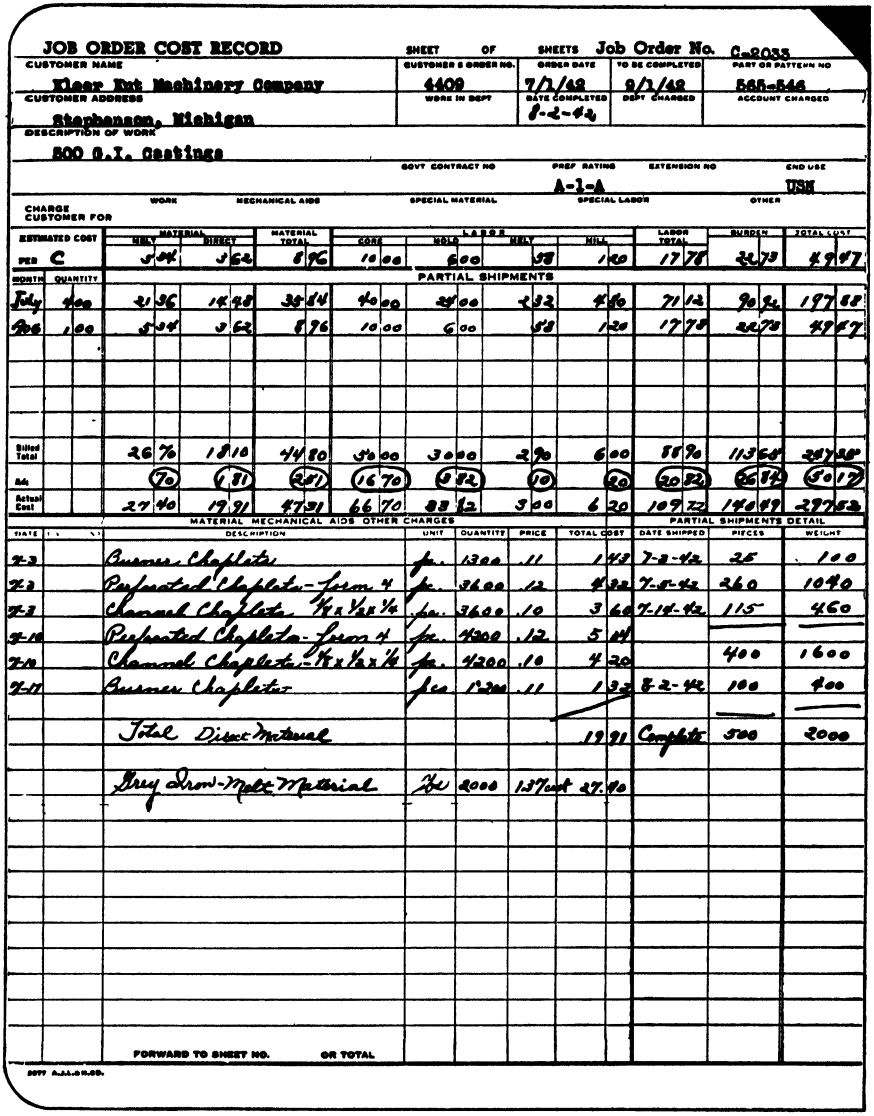


FIG. 4.6. Back of cost sheet—record of machine hours, pieces produced, and direct labor cost by operations. (*Naujoks, Waldemar, "The Engineer and Shop Forms," 1933, a M.E. thesis on file in the University of Wisconsin Library.*)

Case 4: Foundry and Machine-shop Labor and Overhead Classified Departmentally, Costing of Partial Shipments Recorded on Cost Sheet

Figure 4.7 is a job-order cost sheet that was designed for use in a foundry and machine shop doing a jobbing business. Figure 4.8 is the back of the form, which is used for cumulating the labor cost and showing the computation of burden applied. The cost data in these two illustrations are for a foundry order. Figures 4.9 and 4.10 illustrate the use of the same form for a machine-shop order. The features of these illustrations that are especially noteworthy are the method of compiling labor costs and the method of showing the costing of partial shipments.

Direct labor cost is compiled departmentally on the back of the cost sheet (see Fig. 4.8). Seven departmental columns are provided. Although there are more than that many processing departments in the plant, very few orders require work in more than seven departments. The numbers (or names) of departments working on an order are recorded as column headings. The foundry departments are the melting or cupola department where the metal is melted; the coremaking department (number 41) where cores are prepared for use in building the molds for



JOB ORDER COST RECORD — SHEET OF SHEETS — Job Order No. C-2035

CUSTOMER NAME	CUSTOMER'S ORDER NO.	ORDER DATE	TO BE COMPLETED	PART OR PATTERN NO
Kleer Kut Machinery Company	4409	7/1/42	8/1/42	565-566
CUSTOMER ADDRESS	**WORK IN DEPT**	**DATE COMPLETED**	**DEPT CHARGED**	**ACCOUNT CHARGED**
Stephenson, Michigan		8-2-42		

DESCRIPTION OF WORK: 800 G.I. Castings

GOVT CONTRACT NO — PREF RATING: A-1-A — EXTENSION NO — END USE: USN

CHARGE CUSTOMER FOR: WORK — MECHANICAL AIDS — SPECIAL MATERIAL — SPECIAL LABOR — OTHER

ESTIMATED COST	MATERIAL: Mfg'y	MATERIAL: Direct	MATERIAL TOTAL	LABOR: Core	LABOR: Mold	LABOR: Mfg'y	LABOR: Mill	LABOR TOTAL	BURDEN	TOTAL COST
PER C	$.04	3.62	8.76	10.00	6.00	.98	1.80	17.78	22.73	49.27
MONTH / QUANTITY	**PARTIAL SHIPMENTS**									
July 400	21.36	14.48	35.84	40.00	24.00	3.92	4.80	71.12	90.92	197.88
Aug 100	5.34	3.62	8.96	10.00	6.00	.98	1.20	17.78	22.78	49.27
Billed Total	26.70	18.10	44.80	50.00	30.00	4.90	6.00	88.90	113.64	247.15
Adj.	(70)	(.81)	(2.51)	(16.70)	(9.82)	(.70)	(.80)	(20.32)	(26.82)	(50.17)
Actual Cost	27.40	19.91	47.31	66.70	39.82	3.00	6.20	109.22	140.09	297.32

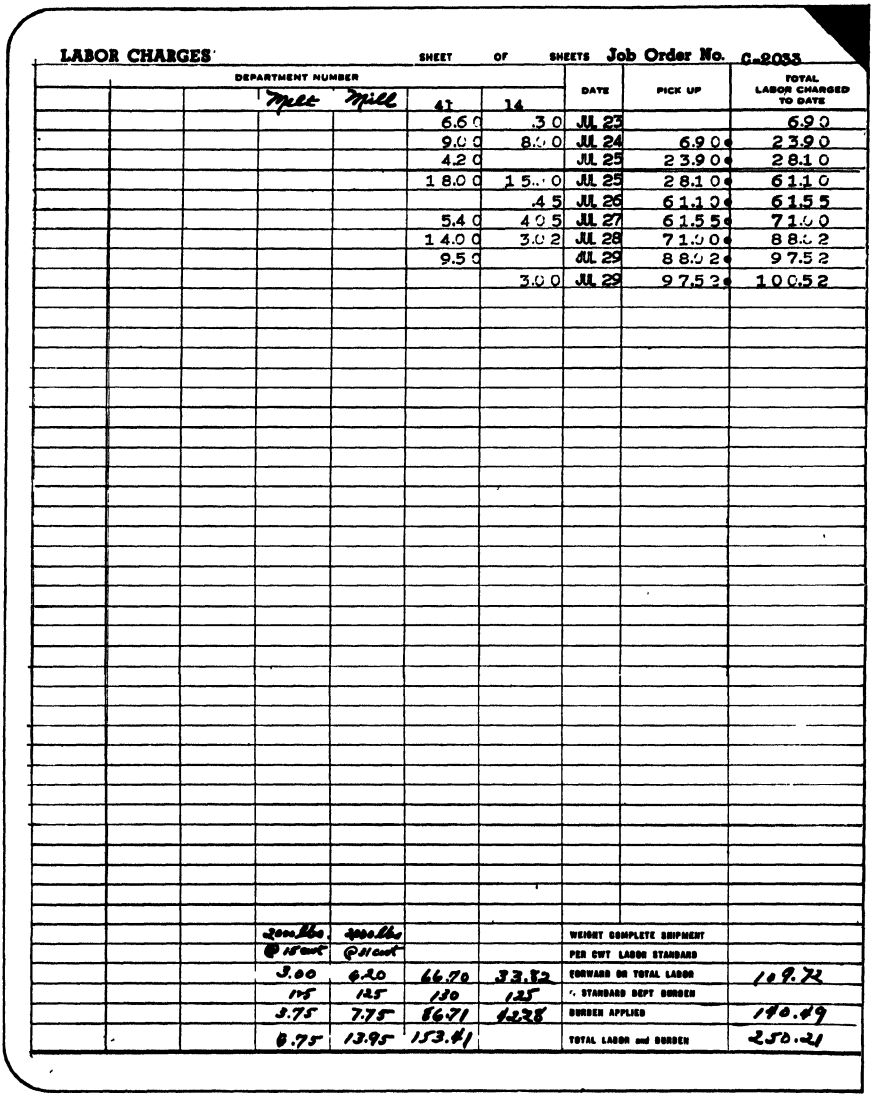
MATERIAL MECHANICAL AIDS OTHER CHARGES — PARTIAL SHIPMENTS DETAIL

DATE	DESCRIPTION	UNIT	QUANTITY	PRICE	TOTAL COST	DATE SHIPPED	PIECES	WEIGHT
7-3	Burner Chaplets	Jo.	1300	.11	143	7-2-42	25	100
7-3	Perforated Chaplets - Form 4	Jo.	3600	.12	432	7-8-42	260	1040
7-3	Channel Chaplets 4"x1/2"x1/4"	Jo.	3600	.10	360	7-14-42	115	460
7-10	Perforated Chaplets - Form 4	Jo.	4300	.12	516			
7-10	Channel Chaplets - 4"x1/2"x1/4"	Jo.	4200	.10	420		400	1600
7-11	Burner Chaplets	Jo.	1200	.11	132	8-2-42	100	400
	Total Direct Material				1991	Complete	500	2000
	Grey Iron-Melt Material	Lb.	2000	1.37 cwt	27.40			

FORWARD TO SHEET NO. OR TOTAL

FIG. 4.7. Order cost sheet (front) foundry order. (*A. J. Lindemann & Hoverson Company.*)

casting; the molding department (number 14) where the molds are prepared, the cores placed, the metal poured, and the castings removed from the molds; and the milling department where the castings are cleaned. The labor costs of the coremaking and molding departments and of the machine-shop departments as well are posted from time tickets.



LABOR CHARGES SHEET OF SHEETS Job Order No. C-2033

DEPARTMENT NUMBER						DATE	PICK UP	TOTAL LABOR CHARGED TO DATE
		Mill	Mill	41	14			
				6.60	.30	JL 23		6.90
				9.00	8.00	JL 24	6.90	23.90
				4.20		JL 25	23.90	28.10
				18.00	15.00	JL 25	28.10	61.10
					.45	JL 26	61.10	61.55
				5.40	4.05	JL 27	61.55	71.00
				14.00	3.02	JL 28	71.00	88.02
				9.50		JL 29	88.02	97.52
					3.00	JL 29	97.52	100.52
		2000 lbs @ 15 cwt	4000 lbs @ 31 cwt			WEIGHT COMPLETE SHIPMENT		
						PER CWT LABOR STANDARD		
		3.00	6.20	66.70	33.82	FORWARD OR TOTAL LABOR		109.72
		175	125	130	125	% STANDARD DEPT BURDEN		
		3.75	7.75	86.71	42.28	BURDEN APPLIED		140.49
		6.75	13.95	153.41		TOTAL LABOR and BURDEN		250.21

FIG. 4.8. Labor cost cumulation (back of cost sheet) foundry order. (*A. J. Lindemann & Hoverson Company.*)

The labor cost is posted daily. A total of the time tickets for the day is first obtained for use as a control figure. The time tickets are then sorted by order number and by department. A desk-model posting machine equipped with two totalizers or registers is used for the posting operation. Time tickets are added simultaneously in both registers. The items are not printed. Departmental totals are printed from the first register in

the appropriate departmental columns of the cost sheet, the first register being cleared each time a departmental total is posted. When the charges to the cost sheet for the day have all been recorded in the departmental columns, the second register contains the total of the labor charges to the order for the day. The old balance, that is, the labor cost accumulated prior to the current posting, is next "picked up" and printed on the cost sheet in the pick-up column. The total in the second register at this point is the sum of the postings for the day and the old balance; in other words, it is the new balance. It is printed in the last column of the cost sheet, and the register is cleared.

The cost sheet to which the postings have been made is offset in the tray until the daily postings have been completed and verified. After all the time tickets have been posted, an old-new-balance proof is made. This is done by referring to the cost sheets that have been offset in the tray, adding the new balances appearing on those sheets, and subtracting the old balances. The resulting total should agree with the control total of the time tickets for the day.

Upon completion of an order, the departmental labor columns are totaled and crossfooted by means of a key-driven calculator. The cross total must agree with the final figure in the last column. For example, in Fig. 4.8, the total of the labor charges from Department 41 ($66.70) plus the total from Department 14 ($33.82) equals $100.52, which is the balance in the last column immediately after the posting of the last of the time tickets.

Melting and milling labor are computed at predetermined unit costs based on the finished weight of good castings produced. Thus, the unit cost of melting labor is $0.15 per hundredweight; for the 2,000 pounds of good castings produced on order C-2033, therefore, a melting labor cost of $3 is applied to the cost sheet. Adding the melting labor ($3) and the milling labor ($6.20) to the total labor posted from time tickets ($100.52) gives $109.72, the total direct labor cost of the job.

Departmental burden percentages are shown on the line just below the total labor; the amounts of burden applied are on the next line. The total burden applied is $140.49.

At the end of the fiscal year, to obtain the cost of orders in process for the annual inventory, subtotals would be taken of the departmental labor costs charged to those orders and the overhead would be computed. The labor subtotals and the corresponding overhead amounts would be entered in the body of the form (Fig. 4.8) in the department columns, but in a distinctive color.

Material costs and sundry direct costs are cumulated on the face of the cost sheet (Fig. 4.7) in the space headed "Material, Mechanical Aids, Other Charges." Charges from material requisitions, invoices, and tool

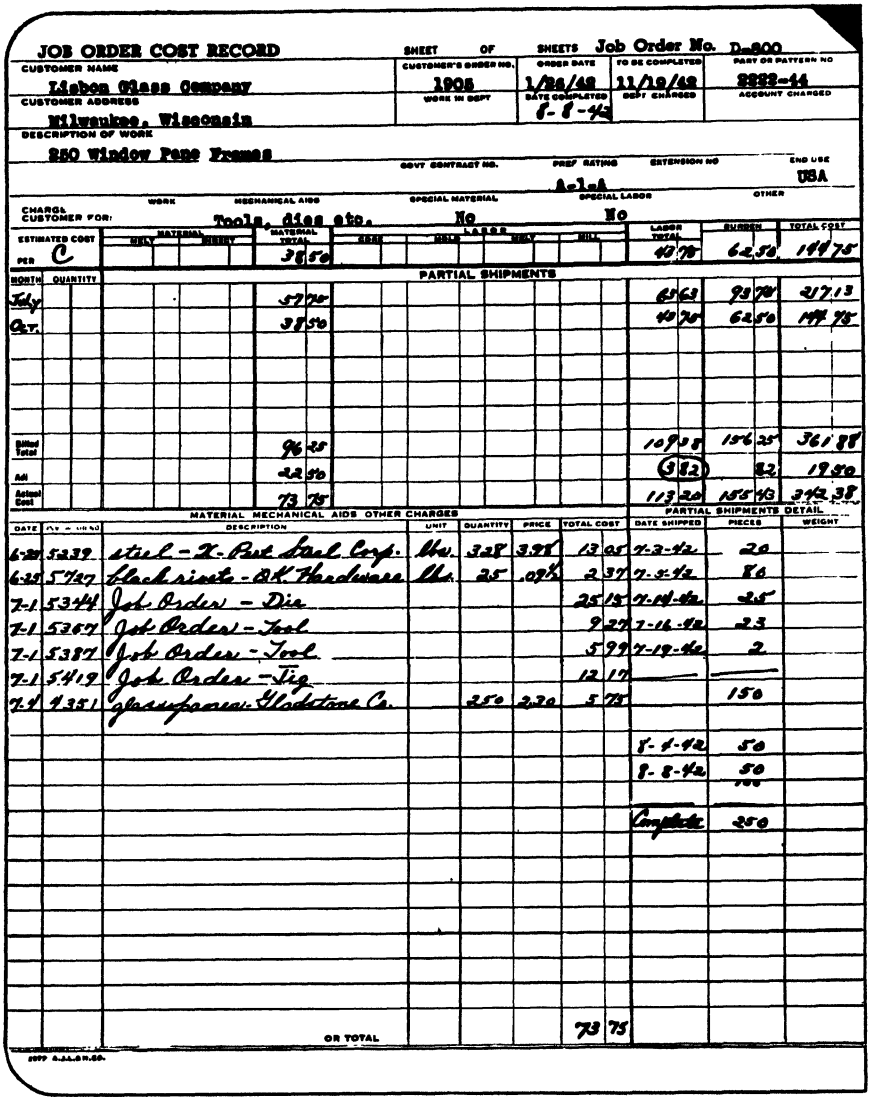
orders are posted individually. Melting materials are costed at a predetermined cost per hundredweight of good castings. Thus, in Fig. 4.7, the material required for the 2,000 pounds of good castings produced is costed at $1.37 a hundredweight, making a total of $27.40 for melting materials. The cost of other materials is $19.91.

The costs of the completed order are summarized on the "Actual Cost" line, which is just above the middle of the form (Fig. 4.7). The amounts are crossfooted to determine the total cost of the order, which is $297.52.

Purchase orders are frequently issued for larger quantities than the purchaser cares to receive at one time. This is frequently the practice in ordering castings. The supplier in such cases makes partial shipments from time to time in accordance with the purchaser's delivery schedule. The supplier generally schedules his work on the order somewhat in accordance with the delivery schedule. The different shipments on one order may extend over a period of several months. In order to obtain monthly financial statements it is necessary to cost each month's shipments. The cost of the order, however, cannot be compiled by the order-cost method until the order is completed.

In the procedure illustrated by Figs. 4.7 and 4.9 partial shipments are costed each month at estimated unit costs, which are shown on the line captioned "Estimated cost per—." The date and quantity of each shipment is entered in the space headed "Partial Shipments Detail." At the end of each month the quantities shipped during the month are added and the total is entered in the "Quantity" column of the section of the form headed "Partial Shipments." The quantity shipped is multiplied by the estimated unit costs. Thus, in the month of July, 400 pieces were shipped on order C-2033 (see Fig. 4.7). The estimated total cost per hundred pieces is $49.47. The cost of the month's shipments on this order is therefore reported as $197.88 (400 × $49.47 ÷ 100). The cost is detailed according to the classifications shown by the column headings, as follows:

Material:		
Melt	$21.36	
Direct	14 48	
Total		$ 35.84
Labor:		
Core	$40.00	
Mold	24.00	
Melt	2.32	
Mill	4.80	
Total		71.12
Burden		90.92
Total cost		$197.88



JOB ORDER COST RECORD

SHEET OF SHEETS Job Order No. D-800

CUSTOMER NAME: Lisbon Glass Company
CUSTOMER'S ORDER NO.: 1905
ORDER DATE: 1/26/42
TO BE COMPLETED: 11/10/42
PART OR PATTERN NO: 2822-44
CUSTOMER ADDRESS: Milwaukee, Wisconsin
WORK IN DEPT
DATE COMPLETED: 8-8-42
DEPT CHARGED
ACCOUNT CHARGED
DESCRIPTION OF WORK: 250 Window Pane Frames
GOVT CONTRACT NO.
PREF RATING: A-1-A
EXTENSION NO
END USE: USA

CHARGE CUSTOMER FOR: Tools, dies etc. | WORK: No | MECHANICAL AIDS: No | SPECIAL MATERIAL | SPECIAL LABOR | OTHER

ESTIMATED COST PER C	MATERIAL: HOLT	MERRY	MATERIAL TOTAL	LABOR:	HOLT	MERRY	HILL	LABOR TOTAL	BURDEN	TOTAL COST
			38 50					43 75	62 50	144 75

PARTIAL SHIPMENTS

MONTH	QUANTITY	MATERIAL	LABOR	BURDEN	TOTAL COST
July		57 70	65 63	93 70	217 13
Aug.		38 50	43 75	62 50	144 75
Billed Total		96 20	109 38	156 25	361 88
Adj		22 50	(9 82)	32	19 50
Actual Cost		73 70	113 20	155 43	342 38

MATERIAL MECHANICAL AIDS OTHER CHARGES

DATE	REF	DESCRIPTION	UNIT	QUANTITY	PRICE	TOTAL COST
6-29	5239	steel - K. Post Steel Corp.	lbs	328	3.95	13 05
6-29	5797	blacksmith - A.K. Hardware	lbs	25	.09½	2 37
7-1	5344	Job Order - Die				25 15
7-1	5367	Job Order - Tool				9 27
7-1	5387	Job Order - Tool				5 99
7-1	5419	Job Order - Jig				12 17
7-1	4351	Glassfamous Globetrot Co.		250	.220	5 75
						73 75

PARTIAL SHIPMENTS DETAIL

DATE SHIPPED	PIECES	WEIGHT
7-3-42	20	
7-7-42	80	
7-14-42	25	
7-16-42	23	
7-19-42	2	
	150	
8-1-42	50	
8-8-42	50	
	100	
Complete	250	

FIG. 4.9. Job-order cost sheet (front) machine-shop order. (*A. J. Lindemann & Hoverson Company.*)

Upon completion of the order the estimated costs of partial shipments are totaled and compared with the actual cost. The difference that is shown on the line captioned "Adj" is included in the cost of shipments in the month when the order is completed. The difference would be added if the actual cost exceeded the estimate, as in Fig. 4.7; it would be subtracted if the actual were less than the estimate, as in Fig. 4.9.

LABOR CHARGES SHEET OF SHEETS **Job Order No. D-800**

DEPARTMENT NUMBER							DATE	PICK UP	TOTAL LABOR CHARGED TO DATE
9	11	28	29	51					
5.96	3.20		1.19	5.40			JL 25		15.75
	4.05	3.00	1.20				JL 26	15.75 ¢	24.00
	5.75		3.30	2.10			JL 26	24.00 ¢	35.15
9.00	8.00			4.05			JL 27	35.15 ¢	56.20
21.00			5.76	1.20			JL 28	56.20 ¢	84.16
	4.44	5.60		19.00			JL 28	84.16 ¢	113.20
							WEIGHT COMPLETE SHIPMENT		
							PER CWT LABOR STANDARD		
35.96	25.44	8.60	11.45	31.75			FORWARD OR TOTAL LABOR		113.20
120	178	160	125	125			% STANDARD DEPT BURDEN		
43.15	44.52	13.76	14.31	39.69			BURDEN APPLIED		155.43
79.11	69.96	22.36	25.76	71.44			TOTAL LABOR and BURDEN		268.63

FIG. 4.10. Labor cost cumulation (back of cost sheet) machine-shop job. (*A. J. Lindemann & Hoverson Company.*)

Case 5: Unit Process Costs Applied to Orders

In factories using job-order cost systems it frequently happens that there are some operations for which the process cost method is most suitable. Illustrations are the melting process in a foundry, the cutting or shearing operation in a drop-forge plant, and electroplating processes. The cost of

such processes may be applied to orders by (1) computing the unit cost of the process by the process cost method, (2) tallying the number of units for each production order, and (3) multiplying to obtain the cost applicable to each order. Table 4.1 illustrates an application of this technique, using historical costs. In Fig. 4.7 melting material and labor and cleaning labor are costed to a foundry order at predetermined unit costs. In Fig. 4.5 the labor and overhead of the cutting, sandblasting, heat-treating, and shipping operations are costed at predetermined unit costs on a

TABLE 4.1
GREY-IRON FOUNDRY
Unit Cost of Poured Metal Applied to Production Order*

1. Unit cost of poured metal, month ending June 30, 19—:	
Metal put in cupola	
Pig iron, 400,000 lb. @ $0.015	$6,000
Foundry scrap, 100,000 lb. @ $0.01	1,000
	$7,000
Less: credit for foundry scrap (gates, sprues, and defective castings) 110,000 lb. @ $0.01	1,100
Net cost of metal	$5,900
Conversion cost	1,100
Cost of good castings	$7,000
Finished weight of good castings	350,000 lb.
Cost per pound of good castings, finished weight ($7,000 ÷ 350,000)	$ 0.02
2 Number of units on a certain production order: The foundry production report shows that 1,010 good castings were produced on order 1679, part 10-4251.	
The finished weight of the good castings was	20,250 lb.
3. Poured-metal cost applied to order 1679:	
20,250 lb. @ $0.02	$4,050

* The cost of the other operations in the foundry would have to be added in order to obtain total cost of castings produced on this order. The other operations (coremaking, molding, and cleaning) would be costed by the job cost method, operation cost method, or some other method, depending upon the circumstances.

poundage basis. In both of the latter cases, although the cost methods are essentially of the historical type, predetermined unit costs are used in order to expedite the completion of cost sheets.

Case 6: Specialized Furniture, Cost-sheet Folder for Supporting Documents

A factory that manufactures specialized wood and steel furniture uses a cost sheet similar to the one illustrated in Fig. 4.11. Order costs are compiled both for stock orders and special orders. The cost sheet is printed on the front of a folder. A copy of the production order and the material requisitions, time tickets, and other documents pertaining to it

are assembled in the folder while an order is in process. Upon completion of the order the documents are removed from the folder and sorted according to the cost-sheet classification. Totals are obtained by means of a key-driven calculator and posted by hand to the cost sheet. The documents are then filed in the folder.

The cost-sheet form provides for a classification of material costs by class of material and for a classification of labor and overhead by depart-

Order No _____

JOB COST FOLDER Customer _____ Date Ordered _____ Product Class _____ Drawing Number _____

Quantity _____ Article _____ Their Order No _____ Preference Rating _____ End Use _____

Estimated Cost	Factory Cost Summary					Labor			Factory Overhead	Labor Cost Estimate
		Material	Labor	Overhead	Total	Department	Man Hours	Amount		
	Lumber					WOOD SHOP				
	Veneer					Cutting				
	Steel					Molding				
	Hardware					Veneer				
	Finish Mtl					Cabinet Machine				
						Job Assembly				
						Production Assb y				
	Crating Mt					Wood Finishing				
						Wood Trimming				
	Mfd Parts					STEEL SHOP				
						Press Room				
	Semi Fin Stock					Welding				
						Assembly				
						Trim				
						Enamel				
	Labor & Overhead					MACHINE SHOP				
	Total Factory Cost									
	Unit Cost					CRATING				
						Total				

← *Note Folder is closed on both sides below the arrows to form a pocket for papers.* →

Despatch	Date	Initial
Completed in Shop		
Cost Compiled		
Total & Ext		
Checked		
Entered		

SUMMARY		
Factory Cost		%
Selling & Adm	%	
Freight Out		
Total Cost		%
List Price		
Discount		
Net Sales Price		100%
Shipping Weight		

FIG. 4.11. Cost-sheet folder. (*Hamilton Manufacturing Company.*)

ment. Because it is a summary and not a means of cumulating individual items or periodic totals, the cost sheet can be designed to show a comprehensive classification. The arrangement for summarizing the costs of manufactured stock parts and subassemblies is good, for there are spaces to show separately the material, labor, and overhead costs. Both the hours and the cost of direct labor covered by the order are classified departmentally on the cost sheet. Overhead is applied at departmental rates per direct labor hour.

Parts and subassemblies that are manufactured on the order are not costed separately. Their costs as well as the costs of final assembly and

finishing are merged on the cost sheet. However, if the customer's order calls for a complicated assembly or installation, separate suborders are issued for the different units making up the order.

For the annual inventory the costs of orders in process are compiled as if the orders were completed, except that the totals are posted to inventory cost sheets instead of to the regular cost sheets. The inventory cost sheets are then summarized to obtain the total inventory of goods in process. The cost sheets are not checked with the Goods in Process control except at the end of the year.

Charges to completed cost sheets are checked against engineering specifications, which are detailed on the production orders. Costs of stock orders are compared with previous costs. Costs of special orders are compared with cost estimates and with quoted prices. The cost clerk who checks the special-order cost sheets also prices the invoices to customers.

Case 7: Assembled Product, Suborders

Where special parts and subassemblies must be manufactured in order to produce an assembled product, suborders may be issued so as to obtain separate costs for the different parts and subassemblies. Both the original order number and the suborder number would be shown on each suborder.

A separate cost sheet would be made for each suborder, on which the costs charged to the suborder would be compiled. The cost sheet for the original order as a rule would show only the cost of the final assembly operations and the cost of parts and subassemblies drawn from stock for the final assembly. A summary of the costs of the original order and the suborders would be made to determine the total cost of the entire job. Table 4.2 is an illustration of a cost summary of that type.

Case 8: Job Costs Compiled by Means of Punched Cards

In case 7 the costs of suborders were first computed separately and then added so as to obtain the cost of an assembled product. This is the usual procedure where there are suborders. Another method of costing an original order and suborders is to obtain two sets of totals independently. If the assembly-order or original order number, as well as the suborder number is shown on each material requisition and time ticket, the charges can be tabulated so as to obtain a grand total of all the charges, and a separate tabulation can be made by suborder numbers. The total of the charges to suborders should agree with the grand total.

A shipbuilding company working during the Second World War on cost-plus-fixed-fee contracts for the Navy developed a procedure of this

type by making use of electric punched-card tabulating equipment. A single contract for the construction of a ship or a number of identical ships may run into millions of dollars. It is not sufficient to determine the total cost of the contract. For purposes of analysis the cost must be detailed. Each contract is therefore broken down by "job numbers" and each job by "order numbers."

TABLE 4.2

SUMMARY OF COST OF 100 EXHAUST FAN UNITS—PILOT RUN

Order Number JN88106, Completed June 27, 19—

Order number	Description	Material	Sundry direct costs	Direct labor	Factory overhead	Total
JN88106-1	Engineering work	.....	$ 550	....	.....	$ 550
JN88106-2	Fan (see below)					
JN88106-3	Shell	$ 100	140	$ 50	$ 150	440
JN88106-4	Back plate (see below)					
JN88106-5	Fan and motor subassembly (see below)	5,880	717	470	760	7,827
JN88106	Final assembly and finishing	150	.....	250	250	650
	Cost of units ready to ship	$6,130	$1,407	$770	$1,160	$9,467
JN88106-6	Shipping	120	.....	20	20	160
	Cost f.o.b.	$6,250	$1,407	$790	$1,180	$9,627

Summary of Cost of Fan and Motor Subassembly

Order number	Description	Material	Sundry direct costs	Direct labor	Factory overhead	Total
JN88106-2	Fan only	$ 900	$500	$170	$340	$1,910
JN88106-4	Back plate only	60	25	30	90	205
JN88106-5	Assemble fan, back plate, and motor	4,920	192	270	330	5,712
	Cost of subassembly	$5,880	$717	$470	$760	$7,827

On one contract, for example, there are more than 50 job numbers. Job 1 is for plans, job 2 for patterns, job 7 for insurance, job 13 for setting up keel, job 14 for launching, job 21 for hull on ground and ways—material only, job 22 for hull on ground and ways—labor only, job 33 for ventilation, job 39 for main propelling plant, and so forth.

Each job number is further broken down by order number. For example, job 13, setting up keel, consists of order number 43 for preparation of slip and keel blocks, order number 44 for stagings and derricks,

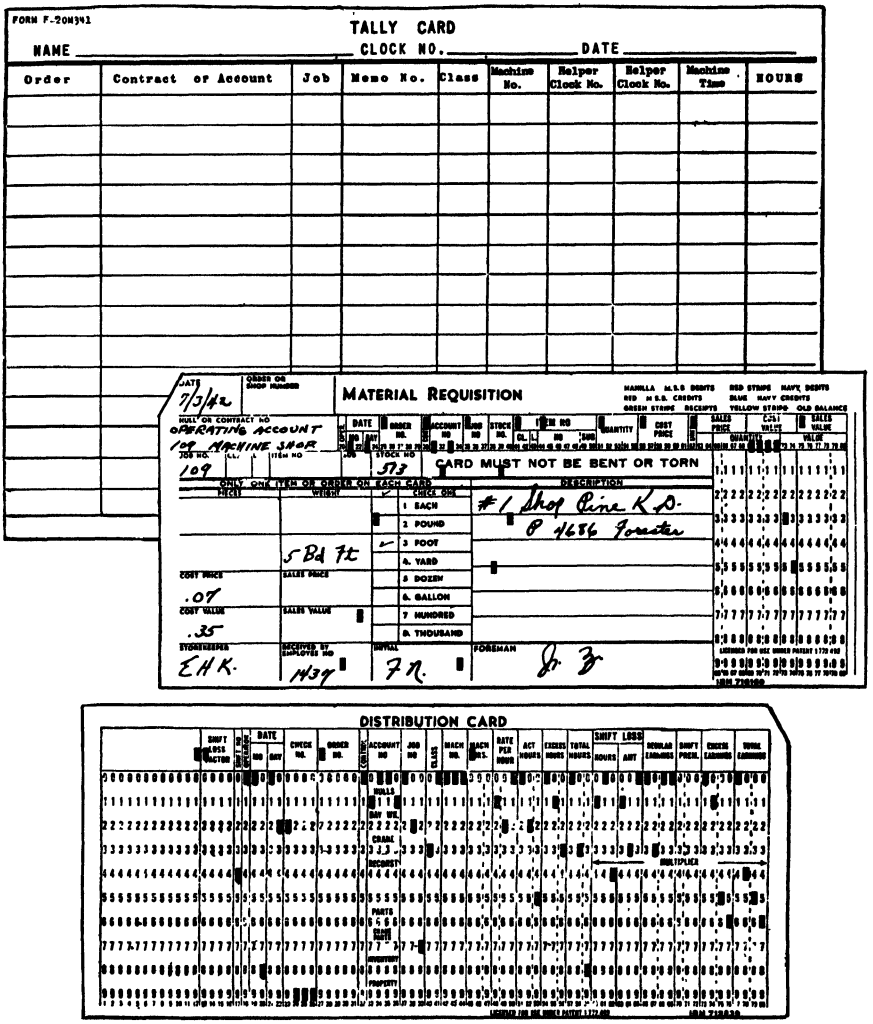


FIG. 4.12. Tally card and punched tabulating cards used to obtain material and labor costs of orders and suborders.

order number 45 for labor and material in laying keel, and order number 46 for alignment.

In addition to the breakdown by job number and order number, the labor cost is classified according to trade. There are approximately 60 labor classifications.

TABLE 4.3

SHIPS BUILT UNDER GOVERNMENT CONTRACT

Column Headings on Job Cost Sheet Showing Source of Data

Column number	Column headings	Source of data
1	Date	
	Material (section heading)	
2	Audited vouchers	Purchase vouchers for material and sundry direct costs, such as subcontracts for outside processing, which can be identified by order number when purchased
3	Stock	Runoff of material requisitions
4	Total	Sum of columns 2 and 3
	Labor (section heading)	
	Regular time (section heading)	
5	Hours	Runoff of labor distribution cards
6	Amount	Runoff of labor distribution cards
	Excess time (section heading)	
7	Hours	Runoff of labor distribution cards.
8	Amount	This is bonus for overtime work
9	Premium for night-shift amount	Runoff of labor distribution cards
10	Shift loss amount	Runoff of labor distribution cards. This is pay for 20-minute lunch period for night shift
	Overhead (section heading)	
11	Shop	Applied as a percentage of regular earnings. Rate on government contract is the actual rate for the entire plant for the month after deducting disallowed overhead. In practice the rate for the previous month is used tentatively in order to complete cost sheet for current month. Then an adjustment is made on the cost sheet in the following month so that the net charge for overhead is at the actual rate for the month in which the work was done
12	Administrative	
13	Total	Sum of columns 11 and 12
14	Remarks	
15	Grand total	Sum of columns 4, 6, 8, 9, 10, and 13

Timekeepers who circulate through the shops and yards prepare daily time tickets (called tally cards) from which labor distribution tabulating cards are punched. There were at one time approximately 10,000 labor distribution cards a day. At the end of each month the distribution cards are sorted and tabulated electrically and totals obtained for each contract number, for each job number, for each order number, and for each class of labor by order number. A tabulating card form is used for the material requisitions which are punched and then summarized so as to obtain monthly totals by contract number, job number, and order number. The monthly summaries are referred to as runoffs. The tabulating card forms as well as the tally card are reproduced in Fig. 4.12.

A separate cost sheet is made for each contract number, each job number, and each order number. Monthly totals are hand-posted to the cost sheets from the tabulating machine runoffs. The columns on the cost sheets are totaled each month, the total of each column on the contract cost sheet being a control figure that must agree with the sum of the totals appearing in the same column on the various job-number cost sheets pertaining to that contract. Likewise, each job-number cost sheet is a control of the order-number cost sheets pertaining to the job. Because the cumulation of costs is done for the most part by the tabulating machines, it is not difficult to keep the suborder cost sheets in agreement with the control figures.

The cost-sheet form is 11 by 17 inches in size with sections for material, labor, overhead, and grand total. In Table 4.3 the column headings are enumerated and the source of data for each column is indicated.

The summary of regular earnings by labor class for each order is posted to a separate series of sheets on which there are columns for the labor classes applicable to the order. The total of the labor for the various classes must agree with the total of the regular earnings appearing on the order-number cost sheet.

CHAPTER 5

OPERATION COST METHOD, STANDARD COSTS

In the operation cost method of determining product costs the material cost is usually computed on the basis of material specifications, and the labor cost by summarizing the unit labor costs of the various operations. The operation cost method is also known as the specification cost method. It can be used where the work is sufficiently standardized so that a list of operations can be obtained for each product as well as dependable data to indicate the labor cost of each operation. The method of applying overhead cost is similar to the method in job-order systems.

The operation cost method may be used for historical costing, but it has its widest application in the field of predetermined costs. Cost estimates (if worked out in detail) as well as standard costs are generally compiled by this method. It is widely used in the textile, clothing, and shoe industries and in some of the continuous-process industries, such as metal-rolling mills, where the variety of operations and products precludes the use of the process cost method. In the woodworking and metalworking industries, the operation cost method is popular where the work is repetitive.

The operation cost method resembles in some respects the process cost method. Thus, in both methods unit costs of product are developed and shipments are costed by applying unit costs to items shipped. There are important differences, however, between the two methods. Material, labor, and overhead are costed separately as a rule in the operation cost method; they are ordinarily merged in the process cost method. Material and direct labor costs are identified directly with the product in the operation cost method; in the process cost method all costs are charged first to processes and then to products. In these respects as well as in the costing of overhead the operation cost method more nearly resembles the order cost than the process cost method. The characteristics of the three methods are summarized in Fig. 5.1.

The growth in popularity of the operation cost method in the past fifteen or twenty years is probably due chiefly to two factors. One is the increasing use of accurate methods of motion study and time study, for a motion and time study is generally focused upon a manufacturing operation. The other is the increasing specialization in industry resulting in a

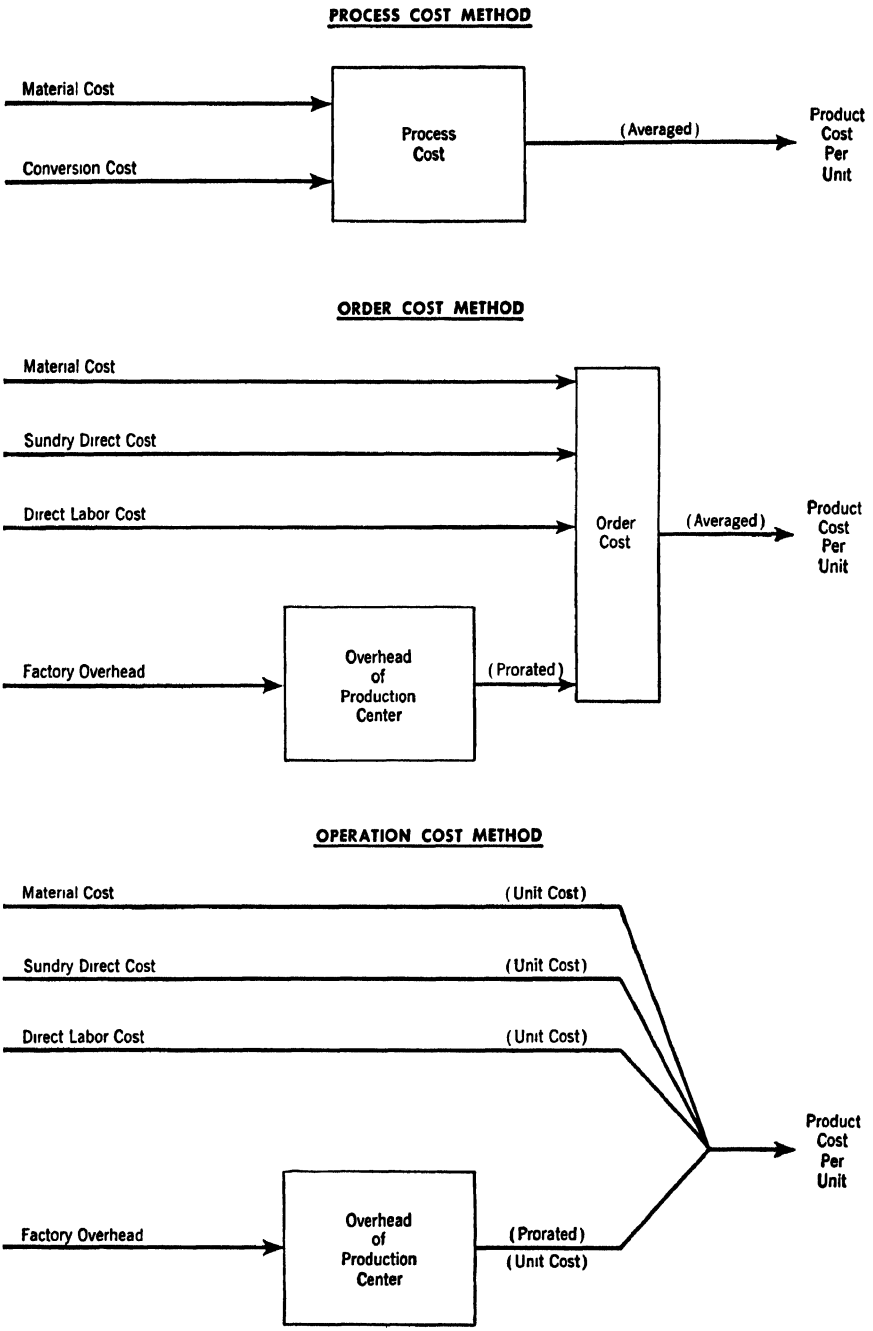


FIG. 5.1. Characteristics of three product cost methods.

tendency toward more and more repetitive manufacturing. This tendency is not confined to the large plants, for even small firms nowadays are likely to specialize.

Standard Costs

Standard costs are predetermined product costs that are used as a basis for entries in the accounts. They are usually compiled by the operation cost method. There are three important types of standard costs: basic, attainable ideal, and estimated.

Basic Standard Costs

Basic cost standards are:

> measures or yardsticks, set to include materials, labor, and burden in the right proportions, but at fixed price levels, unvaried as to prevailing trends in actual costs. It is the object to bring out these trends; therefore the standards are maintained unchanged in order to avoid the difficulties of comparing variables with variables. . . . Interpretation, when standard costs are so used, is not so much the comparison of actual with standard, as it is the comparison of successive achievements in relation to the same standard.[1]

A basic standard cost is the base or divisor used in computing a series of index ratios. Any figure could be taken as the standard, but it is customary to select a cost that is representative of the cost at the time the standard is adopted. Ratios of actual to standard costs are computed periodically, separate ratios being computed for materials, labor, and burden by class of product, by material class, or by department. The current cost of an individual product is computed by multiplying the standard material, labor, and burden costs of that product by current ratios.

Opportunities for making practical application of basic standard costs appear to the author to be limited to plants in which the kinds of raw material and the manufacturing processes are relatively few in number. An application of basic standard costs in the steel industry is described by E. J. Hanley.[2]

Attainable-ideal Standard Costs

The attainable-ideal cost standard is like the "bogey" of the duffer in golf. It is a high standard but one that can be met if things go right. In a well-managed factory things usually do go right. It is an exception

[1] Camman, Eric A., *Basic Standard Costs*, p. 35, American Institute Publishing Company, Inc., New York, 1932.

[2] Hanley, E. J., "An Application of Standard Costs in the Steel Industry," *N.A.C.A. Bulletin*, Vol. 22, No. 21, Sec. I, pp. 1269–1281.

when they do not. The performance in a factory can be controlled within closer limits than the performance on a golf course.

Like the golfer's bogey, attainable ideal standards can be revised as conditions change. As a rule, a general and thoroughgoing revision is made once a year. Then during the year, usually at 3-month intervals, revisions are made to give cognizance to any significant changes in material prices and wage rates.

The cost standards are based upon engineering specifications modified where necessary to reflect actual practice. Engineering drawings and bills of material are used in computing the material quantity required. Time-study standards are used in computing the time required in the shop. If the engineering specifications are complete and accurate, and if the scheduling of work and the performance in the shop are closely controlled by means of standards, then it is generally practical to use attainable-ideal standard costs, and the standard costs become a part of the control procedure. Under such circumstances it is claimed that standard costs have the following advantages over historical job costs:

1. Standard costs are a stimulus to good performance. The standard is a goal. Almost anyone works more effectively when he has a goal before him than he would otherwise.

2. Reports of variances, that is, the variations of actual costs from standards, can be used by executives in controlling costs. Variations are reported by departments and by operations so that the causes of off-standard performance can be readily located. The reports are made at frequent intervals so that prompt action can be taken to correct conditions that are causing excessive costs.

3. Standard costs of individual products are more reliable than job costs. When standard costs are used to control costs in the shop, they are subject to frequent check in the shop. The claim that standard costs are the more reliable is usually based, however, on a comparison between a standard cost system in a standardized shop and a job cost system in a nonstandardized shop. Job costs are likely to be as reliable as standard costs in a plant where production is controlled according to engineering standards, for the time and material standards would be used to check the job costs.

4. Monthly financial statements can be completed earlier. The costing of shipments at standard cost can be done the day the shipment is made because the standard costs are predetermined. There is usually a lag of several days or longer when historical costs are used.

5. Standard costs are more suitable for use in studying product cost trends. When cost revisions are made, all product costs are generally revised in accordance with the material price level and wage scale then

current. The effect upon the product costs of price and rate changes can therefore be measured, and the effect of other factors such as design changes and changes in manufacturing methods can be differentiated.

6. Standard costs are more suitable for use in studying how to reduce costs, for they are unit costs and they are built up by operations in the sequence that is followed in the shop in doing the work. In the case of an assembled product, the standard cost summary would show the unit cost of each component part.

7. Standard costs require less clerical work. This is generally true, for the detail of the costs of individual products is usually revised only once a year. Variances are recorded by operations and departments but not for individual products.

8. Standard costs are a means of internal check. In case the actual manufacturing costs were misstated due to clerical errors or fraud, a variance would result. Analysis of variances therefore tends to disclose errors and to indicate where there is need for improvement in office practice.

Estimated Standard Costs

In the estimated standard cost method the standards are merely estimates based upon previous experience. This method is adopted in many cases as an inexpensive means of tying in the product cost records with the books of account. A cost finding system in which operation costs are compiled can as a rule be converted to an estimated standard cost system without a great deal of difficulty. Estimated standard costs, like attainable-ideal standard costs, reflect current costs and are revised from time to time. For these two types of standard costs the forms used in compiling product costs are about the same. The estimated standard costs, however, are generally less accurate and do not indicate so well what the costs should be. In an estimated standard cost system the emphasis is generally upon costing shipments and inventories and not upon controlling costs. Cost variations as a rule are not recorded in much detail; in fact, the amount of variation is not accurately measured except when the annual inventory is taken.

In many plants the estimated standard cost method has been the forerunner of the attainable-ideal standard cost method. One of the author's first assignments in industrial accounting was to obtain so-called "standard" costs of operations in a factory where the planning of production methods was done by the shop foremen. The procedure was to hunt up the foreman of the department responsible for the part or assembly to be costed, obtain from him a list of the operations and his estimate of the time required for each operation. Some of the foremen kept records of

test runs which they used as a basis for estimates; others relied upon memory. Lists of the component parts of assemblies were obtained from the engineering department and checked by the foremen, and in some cases it was necessary for the cost clerk to study the assembled product or the assembly operation in order to obtain an accurate parts list. Today in the same plant the engineering specifications are complete and accurate both for material and labor, and the cost system is essentially of the attainable-ideal type. The development of engineering controls has made possible the gradual improvement of the cost procedure.

The distinction between the last two types of standard costs (attainable-ideal and estimated) is somewhat theoretical, for in practice most standard cost systems have some of the characteristics of each type. In a system that is chiefly of the attainable-ideal type, for example, if certain phases of production control are not developed, then the cost department must resort to estimates for the corresponding cost data. Furthermore, there are economic limits to the development of cost data and the reporting of variations even when there are engineering data available

Material Specifications

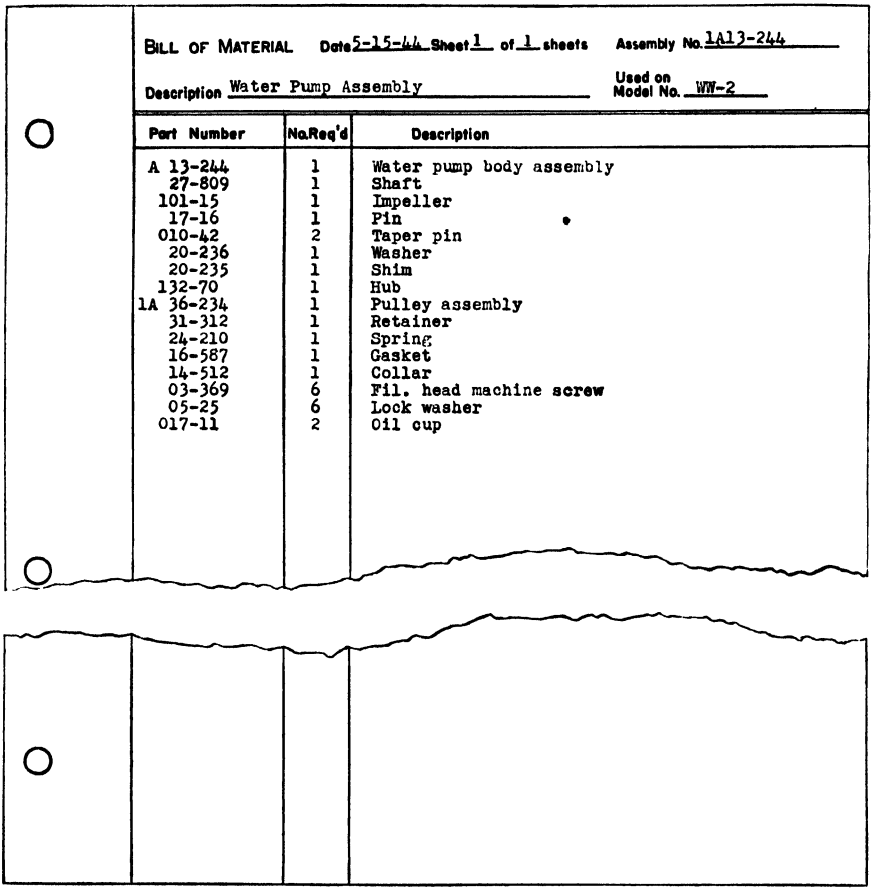
In order to build up the material cost of a product by the standard cost method it is necessary to have a description of the materials of which the product is manufactured. For costing purposes the description should include (1) a list of the parts or items required, (2) a statement of the kind of material to be used for each item sufficiently accurate so that the cost department can identify the material with purchase records, and (3) a statement of the quantity of each item required for a unit of product. The description of the materials is usually obtained from material specifications prepared by the product engineering department.

Material specifications are released in different forms in different industries. In the chemical industries, for example, they are in the form of a recipe or formula. In the mechanical industries the specifications for an assembled product usually consist of (1) assembly specifications, (2) subassembly specifications, and (3) component-part specifications.

An assembly specification is called a bill of material, a parts list, or a drawing list. The bill of material is printed on the assembly drawing, and in addition a separate form known as a bill of material is usually prepared by the engineering department. It is a list of the component parts and subassemblies showing the quantities of each item required for a unit of the finished assembly. Parts are generally identified by part numbers. Subassembly specifications are similar to assembly specifications. Figure 5.2 is a bill of material for a subassembly.

Component-part specifications or stock specifications are indicated on

the drawing for the part, usually in the title block. On the drawing the description of the material as a rule is abbreviated but is adequate to identify the material. A full description of each kind of material can be



BILL OF MATERIAL Date 5-15-44 Sheet 1 of 1 sheets Assembly No. 1A13-244

Description Water Pump Assembly Used on Model No. WW-2

Part Number	No. Req'd	Description
A 13-244	1	Water pump body assembly
27-809	1	Shaft
101-15	1	Impeller
17-16	1	Pin
010-42	2	Taper pin
20-236	1	Washer
20-235	1	Shim
132-70	1	Hub
1A 36-234	1	Pulley assembly
31-312	1	Retainer
24-210	1	Spring
16-587	1	Gasket
14-512	1	Collar
03-369	6	Fil. head machine screw
05-25	6	Lock washer
017-11	2	Oil cup

FIG. 5.2. Bill of material.

obtained from the product engineering department. Examples of stock specifications appearing on drawings are

Drop forging, S.A.E. 1020
Allegheny metal, 16 gauge
1 by $\frac{1}{8}$ inch hard-drawn seamless brass tubing
4/4 Birch, No. 2 Common

Production Routing

In order to build up the labor costs of a unit of product by the standard cost method, it is necessary to obtain a list of the various operations

required to manufacture the product. Such a list of operations is known as a production routing, a route sheet, or an operation list. The production routing generally shows for each operation the operation number, description, department, work point, and either the piece rate or the standard time allowed for the operation.

PRODUCTION ROUTING AND ORDER Sheet 1 of 1 sheets Part Number A13-244

Date 11-15-44 Number of Pieces 200 Order Number A13-244-5

Operation Number	Std. Minutes Set Up	Std. Minutes Cycle	Job Class	Dept. No.	Machine No.	Description of Operation
5	90	10.2	6	56	120	Drill, bore, face, chamfer & ream
10	18	.7	5	58	200	Face and chamfer hub
15	12	1.5	4	58	322	Mill eng. fit pad
20	18	8.0	4	60	185	Drill & tap complete
25	12	1.5	4	58	320	Mill clearance
30	-	1.8	3	58	SB	Clean & grind hose connection
35	12	2.3	4	58	119	Press in (2) bushings 11-127 & face flange on mandrel
				36		Inspect
				44		Mfd parts stock

Part Name Water pump body with bushings Standard Quantity 200 Part Number A13-244

Stock Specifications 13-244 Grey Iron Casting Model Number VW-2 Routing Date 10-5-43

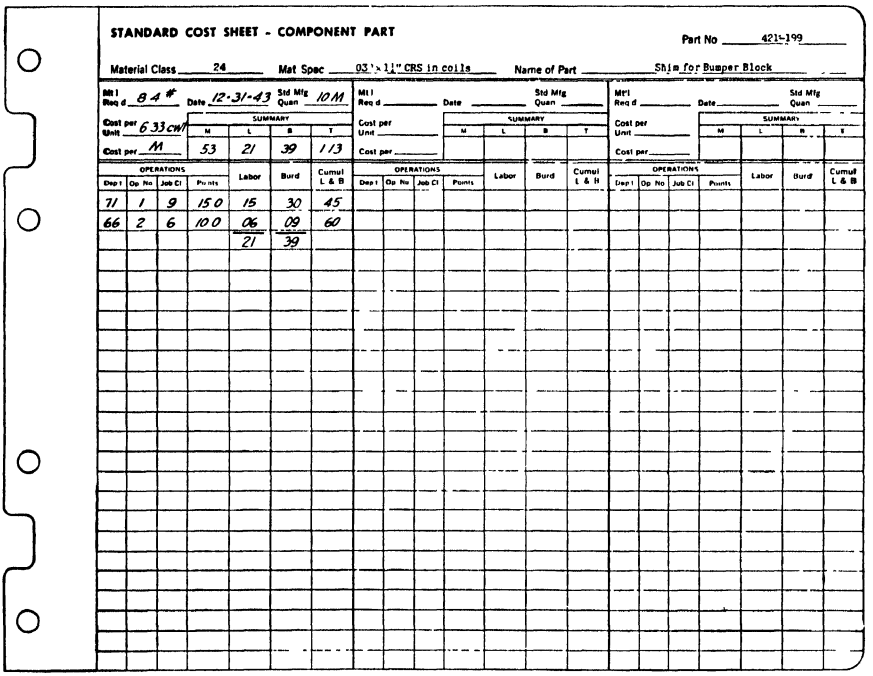
FIG. 5.3. Production routing and production order.

A company manufacturing an assembled product would have two types of production routings, namely, assembly routings and machining routings. As a matter of convenience to the production planning, cost, and shop departments the stock specifications as a rule are reproduced on the machining routings, and the bills of material are shown on the assembly routings. The production routings are primarily instructions to the shop departments, but they are also a source of information to the cost department. The use of production routings is not limited to plants having standard cost systems, and they are frequently used in plants that

manufacture to special order. The preparation of production routings is a production engineering function. Figure 5.3 is an example of a production routing and order.

Standard Cost Sheets—Machined Parts and Assemblies

The standard cost sheet for machined parts may be either a copy of the production routing or a separate form. The advantage of using a copy of the production routing as the cost sheet is that the operation data are



STANDARD COST SHEET - COMPONENT PART

Part No 4214-199

Material Class 24 Mat Spec 03"x 11" CRS in coils Name of Part Shim for Bumper Block

Mtl Req'd 84# Date 12-31-43 Std Mfg Quan 10M

Cost per Unit 6.33 CWT

Cost per M

SUMMARY

	M	L	B	T
	53	21	39	113

OPERATIONS

Dept	Op No	Job Cl	Points	Labor	Burd	Cumul L & B
71	1	9	150	15	30	45
66	2	6	100	06	09	60
				21	39	

FIG. 5.4. Standard cost sheet for a component part.

already written on routings when they are received by the cost department. The clerical work of copying that data to a separate cost sheet is saved, and the chances of error are reduced. Suitable spaces for showing the material costs as well as the labor and overhead costs and the steps in their calculation should be provided on the cost-department copy of the routing. Where this is not feasible, a separate cost-sheet form would generally be used.

Figure 5.4 illustrates a standard cost sheet of the latter type. The operation list and the stock specifications come from the production routing. The form has columns for a number of cost revisions. Altogether six cost compilations may be made on one cost sheet—three on the

front and three on the back. Such an arrangement facilitates the comparison of product cost data.

Figure 5.5 is a standard cost sheet for the cumulation of the unit cost of an assembly or a subassembly. The list of parts comes from the bill of material, the list of operations from the assembly routing. In some cases it is feasible to design a copy of the bill of material for use as the standard cost sheet for assemblies. Usually, however, it is better to have

STANDARD COST SHEET — ASSEMBLY

MODEL NO. WW-2 ASSEMBLY NO A 13-244

DESCRIPTION Water pump body with 2 bushings

STANDARD QUANTITY 200

COST SUMMARY

Date	Material	Labor	Burden	Total
12-31-43	.70	3396	5877	16273

PARTS & SUBASSEMBLIES

Part No	Req'd	UNIT COST M	UNIT COST L	UNIT COST B	TOTAL M	TOTAL L	TOTAL B
13-244	1	60	-		60	-	-
11-127	2	05	0121	0182	10	0242	0364
					.70		

COST SUMMARY

Date	Material	Labor	Burden	Total

OPERATIONS

Dept	Op No	Standard Min Set Up	Standard Min Cycle	Job Class	Labor	Burden	Cum
56	5	90	102	6	.1385	.2770	.4155
58	10	18	7	5	0095	.0143	4393
58	15	12	15	4	0172	.0258	.4823
60	20	18	80	4	.0890	1424	.7137
58	25	12	15	4	.0172	.0258	.7567
58	30	-	18	3	0180	0270	.8017
58	35	12	23	4	.0260	.0390	.8667
					3154	.5513	

FIG. 5.5. Standard cost sheet for an assembly.

a separate form for that purpose because the assembly cost sheet is a much more elaborate form than the bill of material.

Standardized Classification of Costs on Operation Cost Sheets

Where there is a similarity in the construction of the various products of a plant it may be advantageous to print a standardized cost classification on the cost sheets. Such a classification generally shows kinds of material and types of labor operation for each significant stage of manufacture. The practice is typical of the clothing industries. Products in these industries are generally identified by style number or sample number. Specification sheets indicate the kind of materials and the type of construction for each item of product. Although there may be a great deal of

XL-49758 Sample No. SEAMLESS COST CARD STYLE NO. 503

ARTICLE MEN'S - MERC. & WOOL SOCK Size 11

Class	Silk	%	Top	WILDMAN	
In Line	Merc. 53	%	Needle	3¾ - 160	
Out Line	W.F.	%	Foot Mach.	PLAIN	
List Price	Merino	%	Needle	3½ - 160	
Seconds	Elastic	%			
	Wstd. 47	%			

MATERIAL COST		1939			
Yarn Material Cost	Qt.	Price	Amount	Price	Amount
144 Top	.02	1			
2 - 1/30 - 50/50 MERINO	6.3	1.22	7 68		
Total					
Waste 5%			02		
149 Body 2 - 1/30 - 50/50 MERINO	11.9	1.22	91		
HEEL AND TOE:					
2 - 1/30 - 50/50 MERINO	1.1	1.22	31		
1/36 COTTON	1.5	.40	04		
Total	19.6		1.26		
Waste 5 %			09		
164 Total Yarn Cost	23.8		1.85		
Dye 23.8 @ .000769			.0183		
Packing Material 1/2 Doz Boxes @			.0200		
170 TOTAL MATERIAL COST			1.8883		

COST SUMMARY	
Material	1.889
Labor	.51
Burden	.324
COST OF MANUFACTURING	2.722
Finishing Waste	
Loss on 2nds 6% @ 1.00	.06
Royalty on Packing	
Mark Downs	
1sts INVENTORY COST	2.78
1sts COST OF SALES	2.78
SELLING PRICE	3.15
GROSS PROFIT—%	12%

FIG. 5.6. Standard cost card, seamless hosiery (front). (*Phoenix Silk Hosiery Company.*)

SEAMLESS COST CARD
Undyed Stock Cost

Style No. 507
Top. WILONAN
Needle 3 3/4 - 160
Mach PLAIN

			1939
LABOR			
Knitting Tops 149 COURSES @ .71 ÷ 100			0106
Cutting Tops			0136
Trimming Tops			
144			0241
147 Leg and Foot Knitting	Base rate	.2250	2560
	2 End Topping	.0300	
	Yarn Extra	.0100	
Beat Out Tops			
Looping	Base rate	.092	097
	2 Color yarn	.005	
Seaming			
Hemming			
Hem Covering			
Trimming			
Turning			008
DS and HS Cutting			
Pulling Ends			
150			105
162 Undyed Stock			010
164 Dyeing			0077
Boarding PARAMOUNT FORMS -			082
Piling			0025
Reworks 7%			008
167			0875
Inspecting			012
Pairing			0195
Trimming and Turning			0060
Folding	Base rate	.0070	0125
	Toe sticker	.0055	
Packing .21/C BOXES			0042
Colored Mending .355/Doz. - 5%			0158
Reworks 2% - (.012)			0002
170			0652
TOTAL LABOR			.5165
BURDEN			
144 Top Knitting	150%		0561
147 Foot Knitting	80%		2080
160 Looping and Seaming	15%		0158
162 Undyed Stock - 5%			0130
164 Dyeing 23.8 C .00065			0155
167 Boarding	45%		0214
170 Packing	20%		0130
TOTAL BURDEN			.9208

FIG. 5.7. Standard cost card, seamless hosiery (back). (*Phoenix Silk Hosiery Company.*)

SOUTHERN FURNITURE MANUFACTURERS ASSOCIATION—Upholsterers Division

COST SUMMARY

Date ____ Description ____ Pattern No. ____

FRAME

Lumber . . . . . $.....
Cabinet Hardware . . . .
Machine Labor . . . .
Cabinet Labor . . . .
Factory Burden....% . . . .
TOTAL FRAME IN WHITE . . . . $.....

FINISHING

Material . . . . . $.....
Labor . . . .
Factory Burden....% . . . .
TOTAL FINISHING COST . . . . $.....
TOTAL FRAME COST FINISHED . . . . . $.....

UPHOLSTERING MATERIALS Price

Spring Seat . . . .lbs ....
Spring Seat . . . .lbs ....
Spring Back . . . .lbs ....
Back Straps . . . .lbs ....
Springs Pillow . . . .ea ....
Springs Cushion . . ..ea ....
Springs Cushion . . ..ea ....
Edgewire . . . . . lbs ....
TOTAL SPRINGS . . . . . $.....
Burlap . . . .yds ....
Webbings . . . .yds ....
Spring Twine . . . .lbs ....
Paper Rope . . . .lbs ....
Mattress Twine . . .. lbs ....
Welt Cords . . . . . lbs ....
Piping . . . .lbs ....
Card Board . . . .lbs ....
Tacks, Nails, Staples, Clips . . ..
Thread . . . . . lbs ....
Cambric . . . .yds ....
Denim . . . .yds ....
Deck Cover . . . .yds ....
Gimp . . . .yds ....
Sheeting . . . .yds ....
TOTAL MISC UPH. MATERIAL . . . . . $.....

Brought Forward . . . . . $.....

Price

Cotton (Best) . . . .lbs ....
Cotton (Other) . . . .lbs ....
Wood Wool . . . .lbs ....
Moss . . . .lbs. ....
Fibre . . . .lbs ....
Kapoc . . . .lbs ....
....
TOTAL FILLING . . . . . $ ... ...

UPHOLSTERING LABOR

Spring Up . . . .
Cut Cover . . . .
Sew Cover . . . .
Sew Cushions . . . .
Make Buttons . . . .
Fill & Close Cushions . . . .
Upholster Seat . . . .
Upholster Arms . . . .
Upholster Back . . . .
Upholster Outside . . . .
TOTAL UPH LABOR . . . . . $.....
Factory Burden....% . . . .
TOTAL COST UPHOLSTERED . . . . . $.....

PACKING

Lumber . . . .
Burlap . . . .
Pads . . . .
Tape & Twine . . . .
Nails & Screws . . . .
Bags . . . .
TOTAL PACKING MAT'LS . . . . . $.....
Labor . . . . . $.....
Factory Burden....% . . . . . $.....
TOTAL PACKING COST . . . . . $.....
TOTAL FACTORY COST (less cover) . . . . . $.. . ...

GRADE																				
Total Factory (less cover)																				
Cover Yards																				
Cover Cost																				
TOTAL FACTORY																				
Adm & Selling.....%																				
Total Cost																				
Profit																				
Selling Price																				

FIG. 5.8. Cost summary, upholstered furniture. (*Southern Furniture Manufacturers Association.*)

variety in colors, sizes, and styles, the steps in making the different products are similar.

Figures 5.6 and 5.7 are an illustration of a standard cost card used for computing the unit cost of seamless hosiery. The material cost and the cost summary are on the front of the form (Fig. 5.6). The labor cost and the burden are cumulated on the back (Fig. 5.7). Piece rates, which are established by contract with the labor union in the industry, are used for costing the labor by operations. Although the cost card shows only 25 types of labor operations, there are thousands of different operation piece rates, depending on the kind of yarn, the type of construction, and other variables. Burden is applied at departmental rates expressed as a percentage of direct labor, except in the case of the dyeing department where the burden is computed on a weight basis.

The figuring of predetermined costs in the shoe industry is described by Harold S. Monson.[1] Thirty-seven material classifications are printed on the cost sheet that is illustrated in the article. These are grouped under the following headings: Upper Leather, Linings and Trimmings, Bottom Stock, Findings. Subtotals are obtained for each group. There are eight types of labor operations. General manufacturing overhead is applied at an average rate for the entire plant, but separate allowances are added for lasts, dies and patterns, royalty, indirect findings, cases and cartons, and social-security taxes.

Figure 5.8 is a form designed by the Southern Furniture Manufacturers Association for compiling the cost of manufacturing upholstered wood furniture. The stages of manufacture that are emphasized here are frame in white, frame finished, upholstering, packing, and cover. Columns are provided for showing costs of various grades, the grade depending on the cover used.

It is usually advantageous to print a standardized classification of cost components on the cost sheet form where conditions make it practical to do so. It saves the clerical work of writing the lists of materials and operations on cost sheets, for that information is printed on the forms in advance. The uniform arrangement of data on the form promotes efficiency in the preparation of the cost sheets and in referring to them for information besides facilitating cost comparisons.

[1] *N.A.C.A. Bulletin*, Vol. 23, No. 1, Sec. I, pp. 28–40.

CHAPTER 6

CLASSIFICATION AND SYMBOLS

An orderly, organized arrangement of facts and information concerning industrial operation and costs is a prime essential. In satisfying this requirement an important part is taken by each of three devices: symbols, classifications, and forms. A symbol is a contracted or shortened expression for an entity or idea; a classification is a grouping of items having similar characteristics, each item often being represented by a symbol; a form is a paper layout by means of which information is recorded and transmitted. Symbols and classifications greatly facilitate the use of forms.[1]

In any field where masses of detail are dealt with, orderly classification of data is a prerequisite to effective analysis. This principle is exemplified in factory accounting and management. In almost any factory there is a tremendous amount of detail. One of the characteristics of cost accounting that distinguishes it from noncost accounting is a more accurate and more complete classification of cost data. More care is taken, in the first place, to differentiate between factory costs and selling costs and to charge the factory the correct amount. In the second place, the factory costs are classified more adequately.

Classification of Accounts

A classification of accounts or chart of accounts is an orderly list of account titles. It is the framework of the accounting system, and the preparation of an account classification is one of the first steps in the installation of an accounting system. Copies of the classification are issued as instructions to the employees who are responsible for the distribution of data. If a company operates a number of branches, it is likely to issue a manual showing not only the names of the accounts, but also a description of the items to be charged and credited to each account. Table 6.7 illustrates a classification of general ledger accounts.

The starting point in the preparation of an account classification is a study of what information and reports are needed. The classification should be adapted to the needs of the enterprise. The accountant who is preparing it should consult the other executives in order to determine

[1] Alford, L. P., ed., *Cost and Production Handbook*, p. 1473, The Ronald Press Company, New York, 1934.

what reports are wanted by the management. He should also determine what types of data are required for reports to government agencies.

In order to develop a workable classification he must keep in mind the problems that will arise in the distribution of accounting data. The distribution of periodic data is a large part of the work of cost accounting. It is made in accordance with the classification of accounts. If the classification is too complicated, the cost of making the periodic distribution may be excessive.

It is generally helpful to examine the procedure of other companies in the same or similar types of industry. In some cases a uniform classification of accounts has been developed by the trade association as a result of a careful analysis of conditions in the industry. If there is a uniform classification applicable to the enterprise in question, it should be used as a rule so far as it is practicable to do so in the particular situation.

The accounts should be grouped in a logical way, proceeding from the general to the specific. Groupings should be clearly defined and not overlapping. Account titles should be carefully chosen. As far as possible they should be self-explanatory. Account symbols are generally desirable as a means of accurate identification. The scheme of symbolizing should be flexible so as to permit expansion when new accounts are needed.

When a classification has been carefully prepared, it should not be necessary to make frequent changes in it. Changes should be avoided as much as possible, because it is difficult to make valid comparisons of the data of different periods if the classification is not consistent.

General Ledger Accounts

The grouping of general ledger accounts usually follows the arrangement of the financial statements. The principal account groups would be somewhat as follows:

Assets

Current assets
  Cash
  Receivables
  Inventories
Prepaid expenses
Fixed assets
Other assets

Obligations

Current liabilities
Fixed liabilities
Other liabilities
Capital obligations
  Paid-in capital
  Earned surplus

Income and Expense

Ordinary or recurring
  Major operations
    Sales
    Factory cost of goods sold
    Factory cost variances
    Selling expense
    Administrative expense
  Secondary operations
Extraordinary or nonrecurring

Cost-clearing Accounts

Factory wages
Direct material
Direct labor
Other direct cost
Factory overhead
Factory overhead credit

The account groups with which the factory cost accountant is mainly concerned are inventories, fixed assets, sales and cost of goods sold, cost variances, and cost clearing accounts.

Inventory Accounts

At least three inventory control accounts are generally provided in the general ledger, namely, Materials and Supplies (or Stores), Goods in Process, and Finished Product. Frequently, however, more ledger accounts are provided. Thus, there are separate accounts for (1)

TABLE 6.1
A PORTLAND CEMENT PLANT
INVENTORY CLASSIFICATION

Limestone
Shale
Gypsum
Coal
Bags
Factory supplies and repair parts
Goods in process
  Crushing and mixing process (slurry)
  Kiln
  Clinker inventory
  Clinker grinding process
Cement in bins
Cement in bags

Material Stores and (2) Supply Stores in some classifications. If machined parts are put into stock awaiting assembly, a Manufactured Parts account is likely to be provided. In continuous-process industries separate accounts are frequently established for each of the principal raw

materials and for the goods in process at the different stages of manufacture (see Table 6.1).

TABLE 6.2
A MANUFACTURER OF SPECIALIZED FURNITURE
INVENTORY CLASSIFICATION

General Ledger Accounts	Subsidiary Ledger Accounts
Materials and Supplies	Lumber in yard and kiln
	Plywood and veneer
	Crating lumber
	Steel stores
	Hardware stores
	Paint stores
	Material in processing departments (Six departmental accounts for paint and trimming materials stored in processing departments prior to use on orders)
	Other materials
	Shop supplies
Goods in Process	Production orders in process
	Material
	Labor
	Overhead
	Maintenance and construction orders in process
	Material
	Labor
	Overhead
	Manufactured parts
	Material
	Labor
	Overhead
	Semifinished stock
	Material
	Labor
	Overhead
Finished Product	Accounts for material, labor, and overhead for each of eight product classes, 24 accounts altogether

If the inventory classes are numerous, they are likely to be kept in subsidiary ledgers. Table 6.2 illustrates an arrangement of this type. Table 6.3 is a portion of the subsidiary stores classification of a company that manufactures mining machinery. It has approximately 75,000 individual items in stores. There are altogether 72 subsidiary stores classes of which 37 are shown in Table 6.3. There are also 97 accounts for finished and semifinished stock.

TABLE 6.3
A MANUFACTURER OF MINING MACHINERY
PORTION OF STORES CLASSIFICATION
Subsidiary Ledger Accounts

Account Number	Title
—	Special purchases
1	Special purchases split invoices
2	Bolts, nuts, steel rivets
3	Bolts, buttonhead, carriage, stove, screws, etc.
5	Structural and related materials
6	Pig iron and scrap steel iron
7	Scrap brass
8	New melting stock brass
9	New melting stock and alloys—steel and iron
10	Refractories
11	All other materials—foundry (all except material listed above)
12	Large electrical units
13	Engines and tractors
14	Engine and tractor parts
15	Electrical parts
16	Wires and cables
17	Electrical accessories
18	Wire ropes
19	Pipe and tubing
20	Pipe fittings
23	Axles and parts
24	Babbitt
26	Bearings
27	Belting
30	Brake blocks
31	Boxes—all
34	Chain and parts
37	Clutches and parts
39	Couplings—Falk
40	Cylinders for hydraulic jacks, pistons for hydraulic jacks
42	Disks—steel and rubber
45	Cutting edges
47	Fans and parts
49	Forgings
50	Gaskets—all
52	Hoists
54	Gib keys

Advantages of a detailed classification of inventory accounts are

1. A check is obtained on the accuracy of monthly book inventories. Errors too small to cause a noticeable fluctuation in total inventory are likely to have sufficient effect on the balance of the detail account to be noticeable. The breakdown of goods in process into three elements,

Material in Process, Labor in Process, and Burden in Process, helps to disclose errors because the ratios of the various elements to the total do not ordinarily fluctuate beyond a limited range unless there are errors in the costing of goods completed.

2. The use of a detailed classification makes it practicable for the accounting department to prepare an analysis of purchases according to class of material. The purchasing agent generally needs that information, and in many plants the purchasing department compiles it. More accurate results, however, can usually be obtained with less clerical cost if the report is developed in the course of the accounting routine.

3. It aids management in forecasting the effect of purchase-price changes. Although commodity prices do not all go up or down simultaneously at the same rate, the price changes of the items in a detailed inventory classification are likely to be uniform.

4. Purchase-price variances can be computed for each class of material.

On the other hand, it is claimed that

1. It is not necessary to go to the work of keeping detailed inventory accounts in order to obtain a detailed classification of purchases. Most of the desired classified information pertains to purchases, not to inventory balances.

2. Even where there is a detailed classification of inventory accounts it is usually necessary to refer to the perpetual inventory records of the individual stores items in case detailed reports are needed. This was true, for example, in the Second World War in the preparation of government reports pertaining to priorities and production requirements. The itemized stores records can be filed by class of material so that classified inventory data can be secured when needed.

Fixed Asset Accounts

The classification of fixed asset accounts is closely connected with the problem of depreciation. Table 6.4 is a classification of the fixed assets of a metal foundry.

Sales and Factory Cost of Goods Sold

If a concern makes more than one type of product, it is generally desirable to classify sales, sale returns and allowances, and cost of goods sold by type of product. In addition it is frequently desirable to tabulate these incomes and costs by territory, by branch, and in some cases by salesmen. The analysis of sales and cost according to these classifications is an important result of cost accounting. It could not be obtained without product cost data. A shoe manufacturer's classification of sales by product class and by method of distribution is shown in Table 6.5. The classification of cost of goods sold would be exactly the same.

TABLE 6.4
A METAL FOUNDRY
CLASSIFICATION OF FIXED ASSET ACCOUNTS
General Ledger Accounts

Account Number	
260	Fixed Assets
261	Land
262	Land Improvements
263	Buildings and Building Equipment
263.1	Buildings
263.2	Building equipment
264	Machinery and Equipment
264.1	General
264.2	Cleaning
264.4	Core equipment
264.5	Melting
264.6	Motors and electrical equipment
264.7	Cranes and hoists
264.8	Furnaces and ovens
264.9	Bottom boards and boxes
264.10	Flasks
264.11	Flask weight and pig boxes
264.12	Foundry fixtures and benches
264.13	Foundry tools and equipment
264.14	Patterns
264.15	Automobiles
264.26	Office furniture and fixtures
264.27	Mechanical office equipment
267	Improvements in Process
270	Reserves for Depreciation

TABLE 6.5
A SHOE MANUFACTURER
CLASSIFICATION OF SALES

Ideal welts—regular—Milwaukee
Ideal welts—wholesale—Milwaukee
Ideal welts—job lots—Milwaukee
Ideal welts—regular—Oshkosh
Ideal welts—wholesale—Oshkosh
Ideal welts—job lots—Oshkosh
Ideal stitchdowns—regular
Ideal stitchdowns—wholesale
Ideal stitchdowns—job lots
Ideal littleways—regular
Ideal littleways—wholesale
Ideal littleways—job lots
General standards—regular
General standards—wholesale
General standards—job lots

Factory Cost Variances

The principal accounts for cost variances in a historical cost system are

1. Unapplied or overapplied overhead (caused chiefly by variation in volume)

2. Inventory adjustments (representing the discrepancy between the annual physical inventory and the book inventory as well as the reduction of the inventory to the lower of cost or market)

In a standard cost system the variances are usually classified according to the three cost components, material, labor, and burden, and then by

TABLE 6.6

CLASSIFICATION OF FACTORY COST VARIANCES IN A STANDARD COST SYSTEM

Ledger Accounts	Statistical Analysis by Causes
Material variance	Purchase-price variance, by material classes
	Quantity variance, by departments
	Excess material
	Defective work—material loss
	Substitution variance (specified material not available, different material used)
Labor variance	Wage-rate variance, by departments
	General rate change
	Variation between workman's rate class and job class
	Overtime excess pay
	Night-shift bonus
	Efficiency variance, by departments
	Performance either above or below standard (on operation paid at hourly rate)
	Guarantee more than piece-rate earnings
	Extra time allowance (because of off-standard materials or tools)
	Idle time
	Methods change
	Defective work—labor loss
Overhead variance	Volume variance, by departments (difference between overhead applied and flexible budget allowance for attained volume)
	Budget variance, by departments (difference between budget allowance for attained volume and the actual overhead for the period)
	Defective work—applied overhead loss
Inventory variance (difference between physical inventory and book inventory)	Material price variance caused by reduction to lower of cost or market
	Material variance not otherwise accounted for
	Labor variance not otherwise accounted for
	Overhead variance not otherwise accounted for

cause of variance. Many of the variances are also classified according to the department responsible. The ledger accounts are likely to show only the major classifications of variances, the analysis of variations being shown on subsidiary records. Table 6.6 is a classification of factory cost variances.

There are some accounts in the table that could appropriately be classed as overhead accounts instead of variance accounts. Defective Work, for example, may be treated as a factory overhead account. In that case the variation of the actual spoilage from a predetermined allowance would become a part of the overhead variance. Overtime excess pay and night-shift bonus are additional examples of accounts that may be treated as overhead accounts instead of variance accounts. From the standpoint of controlling these costs it makes very little difference which procedure is followed, because the charges are analyzed and reported by departments in either case.

As a matter of fact, a reasonable allowance for spoilage and also for overtime excess pay and night-shift bonus are often treated as direct costs. If the circumstances justify it, such items are allowable as direct costs in computing the cost of government cost-plus-fixed-fee contracts.

Cost-clearing Accounts

A cost-clearing account is an account that summarizes the periodic cost for a certain classification preliminary to transferring it to some other account. In process cost systems the periodic conversion costs and the costs of materials used are classified as a rule and summarized in departmental clearing accounts. In job-order cost systems and in standard cost systems it is customary to have clearing accounts for factory overhead, and in some cases there are clearing accounts for direct material used and for direct labor.

Factory Overhead Classification

The classification of factory overhead is generally a two-way classification. There is the natural classification according to the nature or kind of goods and services used. Indirect labor, shop supplies, machine repairs, purchased electricity, and property taxes, for example, are natural classes of overhead. There is also in most plants a functional or departmental classification. This classification is needed for purposes of cost control where the department foremen are made responsible for regulating the overhead costs of their departments. It is also required for product costing purposes where overhead is applied to work in process at departmental rates. The departments shown on the organization chart are functional classifications. In some cost systems there are functional classifications

also for production centers within departments. Table 6.8 is an illustrative classification of factory overhead.

There are two types of departments: processing departments and service departments. The processing departments are those in which the manufacturing operations are performed. Service departments furnish needed services to the processing departments and to each other but are not engaged directly in converting material into finished product. The planning department, the maintenance department, the works manager's office, and the building occupancy department are examples of service departments. For purposes of product costing the overhead costs of the service departments are redistributed periodically to the processing departments; for it is only as the materials pass through the processing departments that overhead costs can be allocated or applied to products. From the standpoint of the departments charged in the redistribution, the classification of service department costs is a natural classification (see accounts .91, .92, and .93 in Table 6.8).

Accounts in some form are needed for the various combinations of natural and departmental classifications that occur. Thus, if Machinery Repairs is one of the natural classifications adopted, an account for Machinery Repairs would be needed for each department having machinery. An account representing a combination of a departmental and a natural overhead classification may be referred to as a combination overhead account or a standing order. Thus, according to the classification of accounts in Table 6.8, the standing order number for machinery repairs for the Punch Press Department would be 54.32, machinery repairs for the Automatics Department would be charged to standing order 56.32, and so on.

Where the departments are at all numerous, there are likely to be a great many combination overhead accounts or standing orders. In such cases it is not an easy task to set up a satisfactory procedure for making the periodic distribution of factory overhead. One procedure is first to distribute the overhead according to the natural classifications and then after obtaining monthly totals to close out the natural accounts to departmental accounts. A second method is to cumulate the costs in accounts for the natural classifications from month to month until the end of the year and, concurrently, to record the distribution to standing orders in subsidiary records. These subsidiary records frequently are in the form of columnar analysis sheets, a sheet being provided for each department. A third method is to have a control account *Factory Overhead* in the general ledger (or the factory ledger if a self-balancing factory ledger is used) and to cumulate in that account the total overhead and then, on analysis sheets or other subsidiary records, make the two-way distribution

by departments and by natural classifications. The classification in Tables 6.7 and 6.8 is designed for a system where the third method is employed. The subject of overhead distribution is discussed more fully in Chapters 21 and 22.

Overhead applicable to production cost is debited or applied periodically to Goods in Process. An account called, for example, Factory Overhead—Credit, Factory Overhead Applied, or Burden Applied, may be provided to record the credit side of that entry. It would be an offset to the factory-overhead accounts. Such an account is required when either of the first two methods described above is used for distributing overhead; it is not required if the third method is employed, for in that case it is feasible to credit the applied burden to the Factory Overhead Control.

Other Classifications

There are in most plants numerous classifications intended primarily for nonaccounting purposes but useful to the accountant as an aid either in recording data for the accounts, in auditing, in preparing statistical data other than strictly accounting data, or in making cost studies. Examples are classifications of drawings, part numbers and assembly numbers, operations, machines, auxiliary tools, stores locations, and vendors.

Symbols

A symbol is a concise means of identifying an item or a class of similar items. It takes the place of a title or description. Symbols may be classified as (1) alphabetical, (2) numerical, (3) combination of alphabetical and numerical, and (4) other. Alphabetic symbols are more compact than numerical symbols, for there are 26 letters but only 10 digits. Some of the larger states make use of this principle in the assignment of automobile license symbols. If two letters are substituted for two of the digits on license numbers, the number of different license symbols that can be obtained in a row of six characters is almost unlimited. Alphabetic symbols often have the advantage of reminding one of the thing or idea symbolized. Mnemonic symbols, which are designed to aid the memory, are usually alphabetic symbols.

A system of numerical symbols, however, or a system combining alphabetical and numerical symbols, can usually be arranged in a more orderly way than a straight alphabetical system. Sorting, filing, and copying operations, particularly when mechanical equipment is used, are generally faster and more accurate with numerical symbols. The principal types of mechanical sorting equipment are designed to sort numerically.

Examples of other symbols are the arrow to indicate direction, different colors for the different copies of a printed form to aid in sorting and dis-

tributing the copies, and different colors painted on the ends of bars of steel to indicate the kind of steel.

A decimal numbering system is one of the most practical methods of symbolizing accounts. In this system the first digit of each number stands for a principal classification, the second digit for a major subdivision, and so on. However, when there are more than 10 coordinate classes in one group (but not more than 100) two digits would be needed instead of one. When planning a decimal numbering system, it is important to make allowance for expansion in the event new items or classes are added. The decimal system is used for symbolizing the accounts in Tables 6.7 and 6.8.

TABLE 6.7

ECIDIL MANUFACTURING COMPANY*

CLASSIFICATION OF GENERAL LEDGER ACCOUNTS

January 1, 19—

Accounts are opened in the general ledger only for the end classifications. Classification 111, Cash on Deposit—Commercial Account, for example, represents a ledger account; but classifications 110, Cash, and 100, Current Assets, do not. Totals of the latter classifications may be obtained by adding the balances of the appropriate accounts.

The nature of the account balance, whether a debit balance or a credit balance, is indicated in italics. A debit-balance account is debited to record an increase in its balance; it is credited to record a decrease. A credit-balance account is credited to record an increase in its balance; it is debited to record a decrease.

If a separate factory ledger were to be opened, the accounts in the 800 series would be put in the factory ledger. In their place in the general ledger a Factory Ledger Control (account 800) would be opened. The operation of a factory ledger is explained in Chapter 9.

Assets

(*Debit-balance accounts unless otherwise noted*)

100 Current Assets
- 110 Cash
  - 111 Cash on Deposit—Commercial Account
  - 114 Cash on Deposit—Payroll Account
  - 115 Cash on Deposit—Salary Account
  - 116 Petty Cash—Imprest Fund
- 120 Temporary Investments in Marketable Securities
- 130 Receivables
  - 131 Notes Receivable—Customers
  - 132 Accounts Receivable—Customers
  - 135 Other Current Receivables
  - 139 Reserve for Uncollectible Notes and Accounts (*credit-balance account*)
- 140 Accrued Interest Income
- 150 Inventory (accounts used at end of year only)
  - 151 Finished Product
  - 152 Goods in Process and Semifinished Stock

* An imaginary enterprise.

TABLE 6.7 (*Continued*)

153 Stores
154 Goods in Transit
160 Other Current Assets
200 Tangible Fixed Assets
210 Land and Buildings
211 Land and Land Improvements
212 Buildings
213 Building Equipment
219 Reserve for Depreciation—Buildings and Building Equipment (*credit-balance account*)
220 Machinery and Factory Equipment
221 Machine Tools
222 Power Plant and Power Transmission
223 Auto Trucks and Tractors
224 Other Material Handling Equipment
225 Patterns, Dies, Jigs, and Fixtures
226 Miscellaneous Shop Equipment
229 Reserve for Depreciation—Machinery and Factory Equipment (*credit-balance account*)
230 Office Equipment
231 Furniture and Fixtures
232 Office Machines
239 Reserve for Depreciation—Office Equipment (*credit-balance account*)
240 Construction in Process
250 Defense Facilities—Subject to Amortization
251 Land
252 Buildings
253 Machinery
259 Reserve for Amortization (*credit-balance account*)
300 Other Assets
310 Prepaid Expense
311 Unexpired Insurance
312 Freight Paid (clearing account)
314 Prepaid Interest Expense
315 Advances to Salesmen
320 Permanent Investments
330 Intangible Fixed Assets
331 Good will
332 Patents

Obligations

(*Credit-balance accounts unless otherwise noted*)

400 Current Liabilities
410 Notes Payable
420 Accounts Payable
430 Accrued Expense
431 Accrued Salaries
432 Accrued Wages
435 State Unemployment Tax Accrual
436 Federal Unemployment Tax Accrual

TABLE 6.7 (*Continued*)

437 Federal Old-age-benefit Tax Accrual
440 Accrued Property Tax
442 Federal Income Tax Accrual
443 Federal Excess Profits Tax Accrual
444 State Income Tax Accrual
446 Cumulated Provision for Vacation Pay
450 Deposits
451 Employee Deposits for Old-age Benefits
452 Employee Deposits for Group Insurance
453 Employee Deposits for War Bonds
454 Employee Deposits for Income Tax
460 Dividends Payable
500 Fixed and Other Liabilities
510 Debenture Bonds Payable
600 Capital Obligations
610 Paid-in Capital
611 Capital Stock
612 Paid-in Surplus
620 Surplus Reserves (Earned Surplus—Appropriated)
621 Reserve for Contingencies
630 Free Surplus (Earned Surplus—Unappropriated)
640 Profit or Loss (clearing account)

Income and Expense

700 Income and Expense
710 Sales (*credit-balance accounts*)
711 Milling Machines
712 Arbor Presses
713 Pin-setting Machines
717 Other Commercial
718 Munitions
720 Sale Returns and Allowances (*debit-balance accounts*)
721 Milling Machines
722 Arbor Presses
723 Pin-setting Machines
727 Other Commercial
728 Munitions
730 Factory Cost of Goods Sold (*debit-balance accounts*)
731 Milling Machines
732 Arbor Presses
733 Pin-setting Machines
737 Other Commercial
738 Munitions
740 Factory Cost Variances (*normally debit-balance accounts*)
741 Material Variance
742 Labor Variance
743 Overhead Variance
744 Inventory Adjustment
750 Selling Expense Control (*debit-balance account*)
760 Administrative Expense Control (*debit-balance account*)

TABLE 6.7 (*Continued*)

770 Other Income (*credit-balance accounts*)
780 Other Expense (*debit-balance accounts*)

Factory Costs and Inventories
(*Debit-balance accounts unless otherwise noted*)

800 Factory Costs and Inventories
- 810 Stores
  - 811 Material Stores
  - 812 Supply Stores
- 820 Cost-clearing Accounts
  - 821 Factory Wages
  - 822 Outside Processing
  - 825 Direct Labor
  - 831 Factory Overhead Control
  - 839 Factory Overhead Credit (*credit-balance account*)
- 840 Goods in Process
  - 841 Direct Material
  - 842 Sundry Direct Costs
  - 843 Direct Labor
  - 844 Factory Overhead
- 850 Manufactured Parts and Subassemblies
  - 851 Direct Material
  - 852 Sundry Direct Costs
  - 853 Direct Labor
  - 854 Factory Overhead
- 860 Finished Product
  - 861 Milling Machines
  - 862 Arbor Presses
  - 863 Pin-setting Machines
  - 867 Other Commercial
  - 868 Munitions
- 870 Shipping Cost in Process
  - 871 Material
  - 872 Labor and Overhead

TABLE 6.8

ECIDIL MANUFACTURING COMPANY

Subsidiary Factory Overhead Accounts

January 1, 19—

A combination factory overhead account or standing order consists of two parts: a functional classification and a natural classification. Thus the standing order number for electricity used by the Punch Press department would be 54.28, in which 54 represents the functional classification and .28 the natural classification.

Functional Classifications

Service Departments

21 Works manager
22 Building occupancy
24 Purchasing
26 Employment
32 Product engineering
34 Production engineering

TABLE 6.8 (*Continued*)

36 Inspection
41 Factory superintendent
42 General foreman
43 Production planning
44 Storekeeper
47 Toolroom
48 Maintenance
52 Machine-shop foreman

Processing Departments

54 Punch press
56 Automatics
58 Light machining and bench
60 Heavy machining
66 Assembly
72 Shipping

Natural Classifications
(*Debit-balance accounts unless otherwise noted*)

.0 Indirect Labor
- .01 Supervision
- .02 Technical and clerical
- .03 Inspection
- .04 Cleanup
- .05 Trucking
- .06 Idle time
- .07 Overtime excess pay
- .09 Other indirect labor

.1 Employee Security Costs
- .11 State unemployment tax
- .12 Federal unemployment tax
- .13 Federal old-age-benefit tax
- .14 Workmen's compensation insurance
- .15 Provision for vacation pay

.2 Supplies and Utilities
- .21 Shop supplies
- .22 Small tools
- .23 Abrasives
- .25 Office supplies
- .27 Fuel
- .28 Purchased electricity
- .29 Other purchased utilities

.3 Maintenance
- .31 Buildings
- .32 Machinery (including power plant)
- .33 Auto trucks and tractors
- .34 Other material handling equipment
- .35 Patterns and forge dies
- .36 Shop dies, jigs, and fixtures
- .37 Other shop equipment
- .38 Office equipment

TABLE 6.8 (*Continued*)

.4 Defective Work
- .41 Rework
- .42 Scrap
- .43 Labor lost on defective material returned to suppliers
- .44 Engineering changes

.5 Miscellaneous
- .51 Experimental
- .52 Patent and royalty charges
- .54 Travel
- .55 Telephone and telegraph
- .56 Postage
- .60 Rearrangement of equipment
- .62 Professional services
- .63 Annual inventory cost
- .64 Freight in
- .69 Other miscellaneous overhead

.7 Fixed Charges
- .71 Property taxes
- .72 Casualty insurance
- .73 Depreciation
- .74 General administration charged to factory

.8 Credits (*credit-balance accounts*)
- .81 Sales of waste and scrap
- .82 Engineering services charged to customers
- .83 Toolroom and maintenance overhead charged to orders
- .84 Overhead charged to selling and administrative expense

.9 Service departments redistributed
- .91 Toolroom and maintenance
- .92 Building occupancy
- .93 Other

CHAPTER 7

GENERAL LEDGER PROCEDURE AND THE FLOW OF COST THROUGH THE ACCOUNTS

It is customary to classify cost accounting systems according to the method of product costing employed. The discussion in this book deals chiefly with three types of systems: the process cost system, the job-order cost system, and the attainable-ideal standard cost system. A large majority of the cost systems actually in use represent one of the three types or a combination of two or more of them.

The nature of the general ledger procedure depends upon the type of cost system and also upon the extent to which the account classifications are detailed in the general ledger. In some cases the principal cost accounts are kept in a separate factory ledger. When this is done, an account with the factory is carried in the general ledger and expenditures for the factory are charged to that account. The distribution of factory costs is then made in the factory ledger and in the accounts subsidiary to it. The operation of a factory ledger is discussed in Chapter 9.

The present chapter outlines the characteristics of general ledger procedure when there is no separate factory ledger. First there is a general discussion of the flow of costs through the accounts. This is followed by illustrations of the procedure in job-order cost systems.

Although the procedures described are characteristic of actual practice, individual systems can be expected to have individual differences. Upon analysis one is likely to discover that some of the differences are merely differences in account titles, some are the result of short cuts made to save clerical work, and others are caused by differences in manufacturing processes or in management policies. The student who has the opportunity will find it interesting and instructive to compare methods actually in use with those which are outlined in the text.

The General Ledger

The general ledger is a book or file of income, expense, and balance sheet accounts. To a large extent the general ledger accounts are controlling accounts which are supported by detailed subsidiary records.

Because of the great number of classifications there is extensive use of controlling accounts and subsidiary records in most cost systems. In

job-order cost systems it is customary to have controlling accounts for the factory inventories, and frequently there are controlling accounts also for factory overhead and for factory wages. Table 7.1 indicates the types

TABLE 7.1
SUBSIDIARY COST RECORDS IN THREE TYPES OF COST SYSTEMS

Control accounts	Subsidiary records		
	Order cost system	Standard cost system	Process cost system
Material Stores	Balance-of-stores ledger	Balance-of-stores ledger	Usually none because raw materials are few in number and the individual accounts are usually kept in the general ledger
Supply Stores	Balance-of-stores ledger	Balance-of-stores ledger	Balance-of-stores ledger
Goods in Process	Production-order cost sheets	Usually none except for records of production scheduled and completed	Departmental goods-in-process accounts, but these accounts may be kept in the general ledger if they are not too numerous
Manufactured Parts	Manufactured parts ledger	Manufactured parts ledger	None
Finished Product	Finished stock ledger	Finished stock ledger	Finished stock ledger
Factory Overhead	Overhead analysis sheets	Overhead analysis sheets	None. Accounts are kept in the general ledger as a rule to show analysis of conversion cost
Factory Wages	Analysis by departments	Analysis by departments	Usually none, the analysis by departments being shown in general ledger accounts

of control accounts and subsidiary records that are likely to be found in each of the three principal types of cost systems.

There are sometimes two "layers" of control accounts. For example, some concerns have a Stores account in the general ledger which controls a series of subsidiary accounts representing various classes of material.

Each class account in turn controls the subsidiary balance-of-stores records of the individual items of material in its class.

It is not always feasible in cost accounting to maintain exact agreement between control accounts and subsidiary records. Balance-of-stores ledgers as a rule show quantities and unit costs but not dollar values, and it is not customary to compute dollar values every month for comparison with the control account balance. Job-order cost sheets if kept by hand methods are not likely to be in absolute agreement with the Goods in Process control. Subsidiary overhead accounts, on the other hand, should agree exactly with the Factory Overhead control, and the same is true of subsidiary records supporting the Factory Wages account.

The keeping of subsidiary records is a large part of the work of cost accounting. It is to a large extent routine work. Planning the procedure, designing forms, organizing the clerical work in the shop and in the office, selecting suitable mechanical equipment, and training the clerical staff, however, are not routine duties but require the exercise of analytical and executive ability.

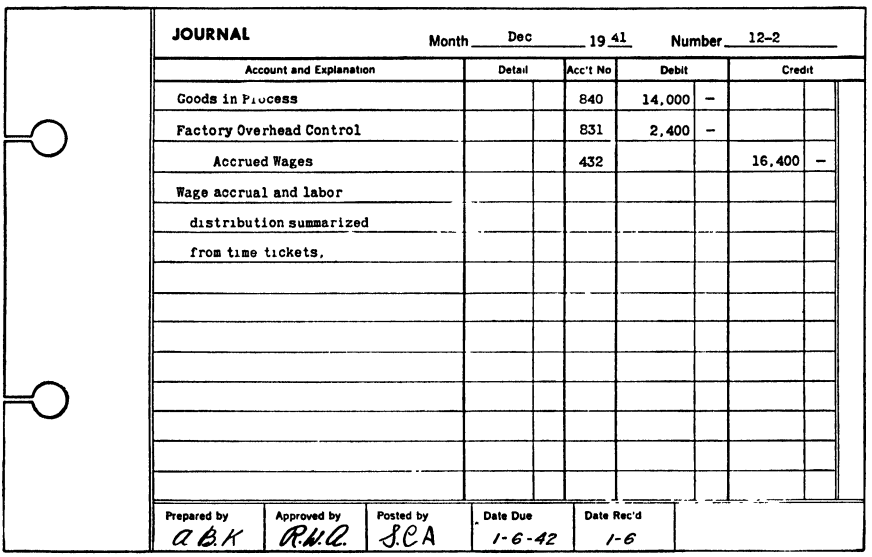
Journals

Entries are posted to the general ledger from journals, which are records of transactions showing the accounts to be debited and credited. In multicolumn journals such as sale journals and cash-receipt journals, it is customary to make a journal record of each transaction. Where the transactions are very numerous, however, they are likely to be summarized not in multicolumn journals but by means of analysis sheets, adding machine tapes, or punched cards. The monthly totals are then recorded in journal form. The latter practice is frequently adopted in cost accounting, for the individual transactions are so numerous that it is not economical to make a formal book record of each transaction. Thus, in making a distribution of daily time tickets to the appropriate general ledger accounts it would not be feasible to record each time ticket in a journal. Even a small factory is likely to have as many as a thousand time tickets each day. The time tickets are therefore sorted and summarized so as to obtain monthly totals which are journalized.

Where the journal records only monthly totals and not the individual transactions, the journal form as a rule is the simplest type. Only two amount columns are needed, one for debits, the other for credits. Figure 7.1 illustrates the form of a journal of this type.

If the general ledger work is organized as a separate section of the accounting department, and this is the usual practice in the larger companies, it is desirable to have all journal entries in the form illustrated by Fig. 7.1. Then the general ledger bookkeeper has a complete file of

journal entries supporting the postings in the general ledger. If he should need detailed supporting data, he requests it from the appropriate section of the accounting department. Inasmuch as most of the journal entries are repeated in the same form each month, the account numbers and account names can be typed on the journal entries in advance so that when the totals for the month are ready it is a short operation to complete the journal entries by inserting the totals in the proper spaces. Journal entries are numbered so that each of the recurring entries has its own number, which is the same each month except for a prefix designating



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Account and Explanation	Detail	Acc't No	Debit		Credit	
Goods in Process		840	14,000	–		
Factory Overhead Control		831	2,400	–		
Accrued Wages		432			16,400	–
Wage accrual and labor						
distribution summarized						
from time tickets.						

Prepared by	Approved by	Posted by	Date Due	Date Rec'd
A.B.K	R.M.C.	J.C.A	1-6-42	1-6

FIG. 7.1. Journal entry.

the month. Thus, the entry for sales for the month of January in a certain plant is numbered 1-25, the entry for February sales is numbered 2-25, and so on.

Debit and Credit

In the account classification in Table 6.7 the nature of each account balance is indicated. The principal debit-balance accounts are the asset accounts, the expense accounts, and the other cost-clearing accounts. The principal credit-balance accounts are the liability and capital accounts, the asset-valuation accounts, and the income accounts.

The application of the principles of debit and credit in cost accounting is not difficult. With but few exceptions the cost accounts are debit-balance accounts, being either asset accounts or cost-clearing accounts. Debit-balance accounts are debited (or charged) in order to record increases; they are credited to record decreases.

Liability accounts and income accounts are credit-balance accounts. So too are the asset-valuation accounts, such as the reserves for depreciation, for the reason that they represent deductions from related asset accounts. Credit-balance accounts are credited in order to record increases; they are debited (or charged) to record decreases. Only a small proportion of the cost entries affect the credit-balance accounts.

Flow of Costs through the Accounts

"There are three stages in the accounting treatment of costs, (1) initial recognition, measurement, and classification, (2) tracing subsequent internal movement and regrouping, (3) final matching with revenue in the present or some future fiscal period."[1] The first stage may be referred to as the cost-incurrence stage, the second as the cost-transformation stage, and the third as the expense stage.

For many types of cost it is not necessary to record all three stages in the books of account. Many of the selling costs, for example, become expenses deductible from revenue in the period in which they are first recognized in the accounts. As a practical matter such items are generally charged initially to expense accounts. In accounting for factory costs, however, there is need for a reasonably complete record of the flow of costs through the three stages.

Cost Incurrence

Cost is said to be incurred when an obligation is incurred to make a payment for goods or services that have been received. In the case of purchased goods and services the initial recognition of cost generally occurs when the purchase invoice has been received and audited. In the case of the services of employees there is no purchase invoice, and the cost is recognized as the wages accrue. Costs that are incurred in advance of the receipt of invoices are also recorded upon accrual, for example, property taxes.

Costs when incurred are classified according to the nature or kind of goods and services procured. A large proportion of the factory costs are charged to accounts that can be referred to as cost-incurrence accounts, such as Material Stores, Supply Stores, Unexpired Insurance, Machinery, and Factory Wages. The cost-incurrence accounts are for the most part asset accounts although some, for example, Factory Wages, are cost-clearing accounts. In most cost systems, however, there are some costs that for practical reasons are debited at the outset to cost-transformation accounts. Thus, in some cases direct material that has been purchased

[1] Paton, W. A., and A. C. Littleton, *An Introduction to Corporate Accounting Standards*, p. 25, Monograph 3, American Accounting Association, Chicago, 1940.

especially for a certain production order is debited when received to Goods in Process instead of being debited first to Stores and then transferred to Goods in Process. Many of the indirect costs are usually debited at the outset to Factory Overhead.

Credit for Costs Incurred

The credit side of a journal entry for cost incurred is generally to a liability account. In the case of purchased goods and services the credit is normally to Accounts Payable. Accruals of wages and of other services for which invoices have not been received are credited to accrued-expense accounts.

A voucher system is sometimes used in which all cash payments are supported by vouchers that have been recorded in a voucher register as a credit to Vouchers Payable. When a system of that type is in use, wages incurred as a rule are first credited to Accrued Wages account; then the payroll vouchers are debited to Accrued Wages in the voucher register, Vouchers Payable being credited. The latter entry is merely a transfer of the liability from the Accrued Wages account to the Vouchers Payable account.

As a short cut some companies follow the procedure of booking purchases only when payment is made. In such cases a cash account is credited in the entry that records purchase costs incurred.

Cost Transformation

The second or cost-transformation stage may be subdivided into steps. There are generally not more than four steps, namely, (1) periodic cost distribution, (2) cost application (to goods in process), (3) worked-material-cost transfer prior to completion of product, and (4) completed-product-cost transfer.

Periodic Cost Distribution

The term periodic cost distribution is used here to refer to the process of grouping the costs of goods and services utilized in the factory during an accounting period according to the departmental and the natural classifications that are called for in the chart of accounts. Cost-clearing accounts may be provided in the general ledger to record periodic cost distribution. Examples of accounts of this type are Direct Material Used, Sundry Direct Cost, Direct Cost, and Factory Overhead. These are debit-balance accounts and are debited with the cost of goods and services utilized during the accounting period. Cost-incurrence accounts, asset-valuation accounts, liability accounts, and cash accounts are credited.

As a short cut the clearing accounts for direct costs may in many cases be omitted, the periodic direct costs being debited direct to Goods in Process. Information in regard to periodic direct costs would then be obtained either from analysis sheets or by analysis of the Goods in Process account. There must be a clearing account (or a series of clearing accounts) for factory overhead, however, except in process cost systems.

Cost Application

Goods in Process is a debit-balance account representing the inventory of materials, principally worked materials, in the processing departments. Costs of materials and services put into production are debited periodically to Goods in Process to show the increases in that inventory. This step is referred to as cost application.

In case all costs are cleared through periodic-cost-distribution accounts, a compound pro forma journal entry for cost applied would be somewhat as follows:

Goods in Process	xxx	
Direct Material Used		xxx
Sundry Direct Cost		xxx
Direct Labor		xxx
Factory Overhead (or Factory Overhead Applied)		xxx

When the periodic-cost-distribution accounts for the direct costs are omitted, the source of the entries for cost applied would be somewhat as indicated by the accompanying diagram.

Goods in Process

Initial balance, forwarded	xxx
Costs applied:	
Material, from stores requisitions (credit Stores)	xxx
Direct Labor, from labor distribution (credit Accrued Wages)	xxx
Sundry Direct Costs, from purchase records (credit Accounts Payable)	xxx
Factory Overhead, from periodic-cost-distribution account (credit Factory Overhead)	xxx

Worked-material Transfer Prior to Completion of Product

Process cost systems often provide for departmental goods-in-process accounts, and in that case it is customary to transfer the cumulated cost of

worked material as the material passes from one department or process to the next. Job-order cost systems in plants where an assembled product is made often provide accounts for manufactured parts in stock. In this case the cost of parts that leave the factory floor to be put into stock is transferred from Goods in Process to Manufactured Parts. Then when parts are issued for assembly, there is a transfer from Manufactured Parts to Goods in Process.

The debits and credits required to record an inventory transfer are easily determined. The inventory accounts are debit-balance accounts. The inventory to which the material is moved is debited to record the increase. The inventory from which the material is transferred is credited to show the decrease.

Worked material rejected by inspectors in the processing departments because of defects in material or in workmanship is reported on rejected-material reports. Defective material is returned to stores and then debited back to vendors. The cost of processing defective material up to the point of rejection must usually be absorbed by the buyer. This cost and the cost of defective work in some cases is treated as a direct cost of production. In other cases it is charged to Factory Overhead and credited to Goods in Process. The treatment of defective material and defective work is discussed more fully in later chapters.

Completed-product Transfer

The account Finished Product (or Finished Goods) represents the inventory of product that has been finished by the factory ready for shipment. This account is debited when finished product is put in stock, the credit being to Goods in Process.

Material and labor used on construction orders may be charged to a work-in-process account. In some cases a special account Construction Orders in Process is provided, in other cases Goods in Process is debited. To record the completion of construction orders the work-in-process account is credited and the appropriate fixed asset accounts are debited.

Material and labor used on maintenance orders may be charged to Factory Overhead in the period of utilization. In this case the debit to overhead would come from periodic-cost-distribution entries, and the maintenance-order costs would be kept only as memorandum records; no journal entry would be needed to record the completion of maintenance orders. An alternative is to charge to a work-in-process account the costs of material and labor used on maintenance orders. In this case the cost of completed maintenance orders is debited to Factory Overhead and credited to the work-in-process account. Accounting for maintenance and construction orders is discussed more fully in Chapter 21.

Expense Stage

Matching cost with revenue, the third stage in the accounting treatment of cost, is referred to as the cost-expiration or the expense stage. It is customary to have expense accounts in the general ledger or in subsidiary ledgers for all the expense classifications. The expense accounts are debit-balance accounts. They are cost-clearing accounts that are closed annually into Profit and Loss.

Factory costs for the most part flow into expense as cost of goods sold. In a cost accounting system the factory cost of goods sold is computed by costing the shipments to customers from the product cost records. The total is debited to Factory Cost of Goods Sold and credited to Finished Product.

Shipping costs applicable to goods shipped to customers may be treated as an item of factory cost of goods sold, as a separate expense classification, or as an item of selling expense. When the shipping department is at the factory, either the first or the second treatment is generally adopted. When shipments are made from branch warehouses, either the second or the third method is followed. The classification of accounts in Table 6.7 provides accounts for Shipping Cost in Process (classification 870) but no separate account on the general ledger for shipping costs allocated to expense. Material, labor, and overhead utilized by the shipping department would be applied periodically to Shipping Cost in Process. The shipping cost applicable to shipments made to customers during the period would be credited to that account and debited to Factory Cost of Goods Sold. Analysis sheets and statements detailing the factory cost of shipments would show shipping costs as a separate item.

A portion of the factory cost, usually a small portion, in some cases is allocated to cost-variance accounts. Cost variances are generally treated as expenses.

Disposition of Cost Variances

Cost-variance accounts reflect the differences between the periodic cost distributed and the cost applied to production. Normally they are debit-balance accounts representing an excess of actual cost over applied cost, although they may have credit balances in some cases. A debit variance is generally treated as an expense at the end of the fiscal year, the entire amount being either merged with the cost of goods sold or reported under a separate expense classification. The latter practice is adopted in the illustration in Table 6.7, accounts 741, 742, 743, and 744. Credit balances in cost-variance accounts are generally treated as negative expenses.

Exceptions to the general practice of carrying the entire amount of the cost variance into the expense of the fiscal year are sometimes found. Thus, in some job-order cost systems the unapplied (or overapplied) overhead is regarded at the end of the year as a cost of production and apportioned, part to worked-material inventories and part to cost of goods sold. Where this practice is followed, the unapplied overhead is in effect applied to production and not treated as a variance. The disposition of overhead variances is discussed more fully in Chapter 25.

In standard cost systems of the attainable-ideal type there are cost-variance accounts for material and labor as well as for factory overhead. Because the standard costs are adjusted when there are changes in price levels and wage rates, the material and labor variances are for the most part the result of waste and inefficiency. They are not considered costs of production as a rule but are treated as expenses of the period in which they occur.

Inventory Adjustment account, representing the difference between physical inventory and book inventory, is a form of variance account found both in job-order and in standard cost systems. At the end of the fiscal year this account is closed either to Cost of Goods Sold or to Profit and Loss.

Adjusting and Closing the Ledger

Any account at times may contain a mixture of balance-sheet and income-or-expense elements, for it would be impractical in most concerns to differentiate these factors each day, and there is no object in doing so except when a balance sheet and a statement of profit are wanted. The process of differentiating assets, liabilities, incomes, and expenses in the accounts is known as adjusting the books. The adjusting entries "unmix" the mixed balances, with the result that the asset and liability accounts after adjustment show the amounts that are to appear on the balance sheet of the date to which the adjustments apply, and the income and the expense accounts show the amounts that are to appear on the statement of profit for the accounting period ending on that date.

An account is said to be closed when the debit entries and the credit entries in the account are equal. The general ledger is closed by closing the adjusted income and expense accounts. In closing the ledger it is customary to transfer or close the adjusted balances of the income and expense accounts to a clearing account called Profit and Loss and then to close that account by transferring the profit or the loss to Free Surplus account.

The ledger cannot properly be closed until after it has been adjusted. It can be adjusted, however, even though it is not to be closed. In non-

cost accounting as a rule the ledger is adjusted and closed once a year. In cost accounting systems the ledger is usually adjusted each month and closed once a year. In so far as factory costs and inventories are concerned, the entries that record the flow of costs through the accounts are the adjusting entries.

When the books have been closed, it is good practice to rule off the accounts and to bring down the balances of the balance sheet accounts so that there is a clear permanent book record of the results of the year's transactions. One method of performing these operations is illustrated in Table 8.5.

Cost-clearing Accounts

Cost-clearing accounts have been mentioned at several points in the discussion of the flow of costs through the accounts. A cost-clearing account is a debit-balance account used to assemble monthly costs applicable to a certain classification and to facilitate the computation of annual totals. In some cases the cumulative year-to-date total is shown each month in the clearing account.

How far to go in providing cost-clearing accounts is a matter of judgment. The information obtainable from an account of this type could usually be compiled when needed from some other account or record. The time required for the compilation, however, might be excessive, and the result might be difficult to check. At the expense stage it is considered the best practice nowadays to clear all costs through expense accounts so that classified expense data are readily accessible. At the periodic-cost-distribution stage, as previously explained, clearing accounts are needed for factory overhead and may be provided for direct costs if desired.

At the cost-incurrence stage commodity purchases are generally debited to asset accounts, but clearing accounts are frequently provided for recording the cost of services. Thus, an account Factory Wages may be provided to show the total wage cost. As a rule, however, the amount of service costs incurred can be ascertained without a great deal of difficulty either from the periodic-cost-distribution accounts or from an accrued-expense account. Machine rentals and purchased electricity are cases in point.

Machine Rentals

Charges for machine rentals are usually invoiced monthly at the first of the month. The amount of the invoices is the amount of cost incurred for the ensuing month, it is also the periodic cost of the services to be utilized that month, provided that the lessee's accounting period is the calendar month.

If a portion of the rentals are chargeable to the factory and a part to the general administrative division, then a cost-clearing account Machine Rental (incurred) might be provided to record the total of the rentals. Assuming that the total is $2,500 of which $2,000 is for the factory and $500 for the general office, the journal entries would be

(1)

Machine Rental (Incurred)	2,500	
Accounts Payable		2,500

Cost incurred, from purchase invoices.

(2)

Factory Overhead—Machine Rental	2,000	
Administrative Expense—Machine Rental	500	
Machine Rental (Incurred)		2,500

Periodic cost distribution, closing Machine Rental account.

In the situation just described the total of the machine rental can be ascertained quite readily by adding two amounts, one from the periodic-cost-distribution account, Factory Overhead—Machine Rental, the other from the expense account, Administrative Expense—Machine Rental. It would probably be good judgment, therefore, to omit the account for costs incurred. The journal entry would then be

Factory Overhead—Machine Rental	2,000	
Administrative Expense—Machine Rental	500	
Accounts Payable		2,500

Cost incurred and distributed, from purchase invoices.

Purchased Electricity

Public utility companies spread the work of reading consumer meters over a period of several weeks in each month. Monthly invoices for purchased electricity therefore cover a period that is different from the user's accounting period. The user, if he wishes to account for his costs accurately, makes his own meter reading at the end of each month in order to determine the cost of electricity purchased and used during the month. Assume that the electricity used by a certain company during the month of July, 19—, is estimated at $1,000 of which $900 is chargeable to factory, $50 to selling expense, and $50 to administrative expense and that the invoice from the electric utility covering the period June 20 to July 20 amounts to $920. Then if a clearing account were provided for electricity cost incurred, the journal entries would be

(1)

Purchased Electricity (Incurred)	1,000	
Accrued Electricity Cost		1,000

Cost incurred for the month, estimated.

(2)

Factory Overhead—Purchased Electricity	900	
Selling Expense—Purchased Electricity	50	
Administrative Expense—Purchased Electricity	50	
Purchased Electricity (Incurred)		1,000

Cost distribution, closing the cost-incurrence account.

(3)

Accrued Electricity Cost	920	
Accounts Payable		920

Purchase invoice.

If the cost-incurrence account were omitted, the journal entries would be

(1)

Factory Overhead—Purchased Electricity	900	
Selling Expense—Purchased Electricity	50	
Administrative Expense—Purchased Electricity	50	
Accrued Electricity Cost		1,000

Cost incurred and distributed, estimated.

(2)

Accrued Electricity Cost	920	
Accounts Payable		920

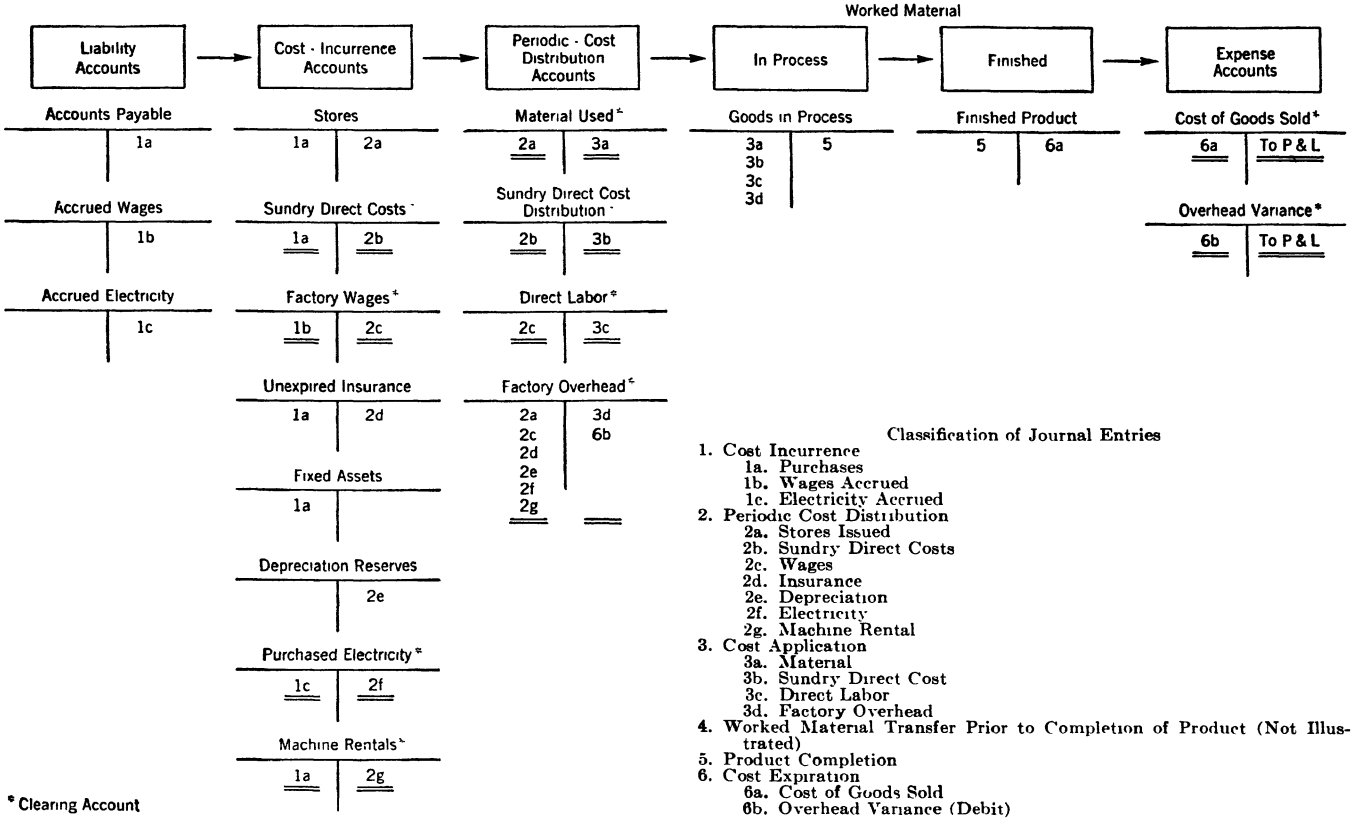
Purchase invoice.

The latter procedure would probably be satisfactory in this case, for the total of the cost incurred and distributed can readily be ascertained from the credit side of the Accrued Electricity Cost account.

Flow of Costs Diagrammed

Figure 7.2 is a diagram of the flow of factory costs through the accounts in a job-order cost system where each step is recorded. Nineteen representative accounts and seventeen representative transactions are used for purposes of illustration. The accounts, which are in T-account form, are arranged in columns according to the steps in the flow of costs. The journal entries covering the transactions are also arranged according to the steps in the flow of costs. The classification of the journal entries appears on the diagram. The effect of each journal entry is indicated by showing its code number in the appropriate T accounts. Thus, the entry for burden applied is coded 3*d*. This code number appears on the debit side of the Goods in Process account and on the credit side of the Factory Overhead account.

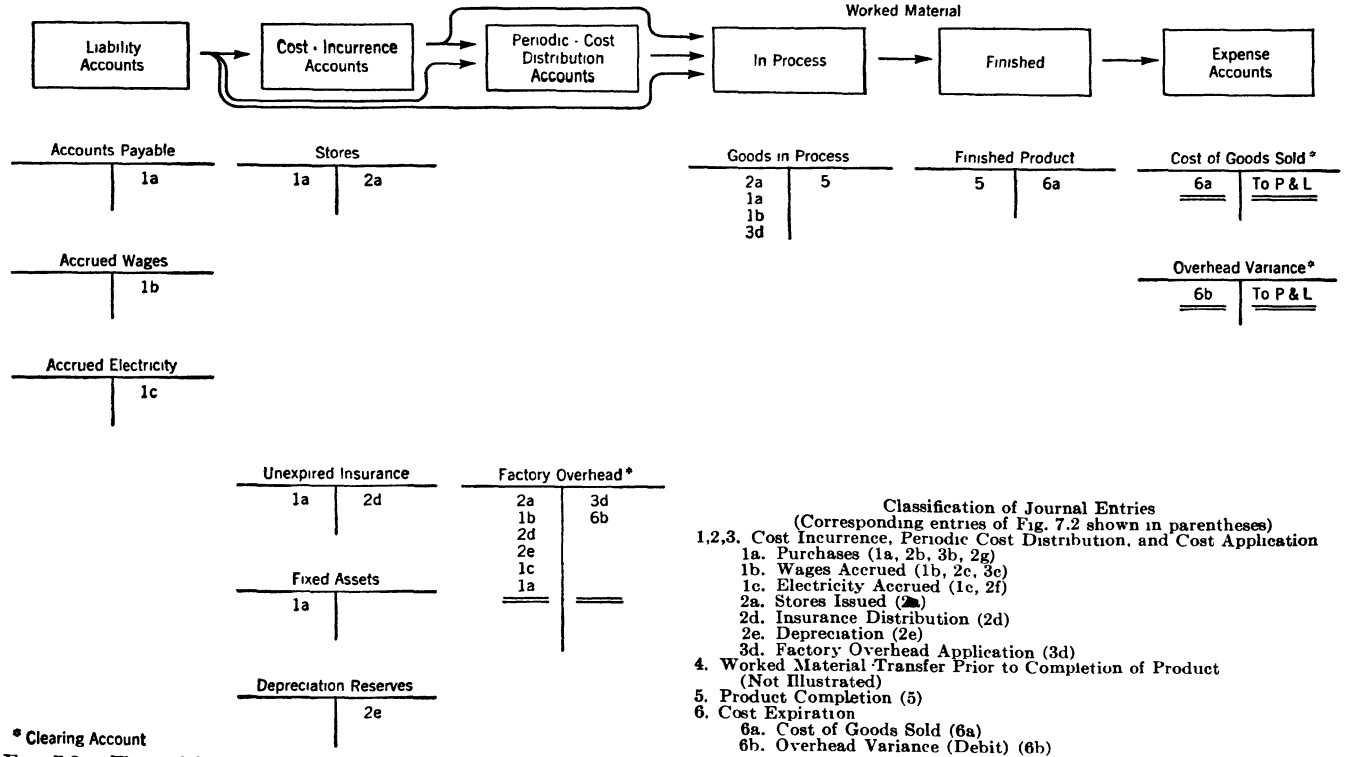
Because each step in the flow of costs is recorded, the pattern of the code numbers in the accounts is regular. Cost-incurrence entries, code 1, are all credited to liability accounts and debited to cost-incurrence accounts. Entries covering periodic cost distributions, code 2, are in each case credited to cost-incurrence accounts and debited to periodic-cost-distribution accounts. Costs applied, code 3, are credited to the latter



Classification of Journal Entries

1. Cost Incurrence
   - 1a. Purchases
   - 1b. Wages Accrued
   - 1c. Electricity Accrued
2. Periodic Cost Distribution
   - 2a. Stores Issued
   - 2b. Sundry Direct Costs
   - 2c. Wages
   - 2d. Insurance
   - 2e. Depreciation
   - 2f. Electricity
   - 2g. Machine Rental
3. Cost Application
   - 3a. Material
   - 3b. Sundry Direct Cost
   - 3c. Direct Labor
   - 3d. Factory Overhead
4. Worked Material Transfer Prior to Completion of Product (Not Illustrated)
5. Product Completion
6. Cost Expiration
   - 6a. Cost of Goods Sold
   - 6b. Overhead Variance (Debit)

FIG. 7.2. Flow of factory costs through the accounts in job-order cost system where each step is recorded (19 accounts, 17 journal entries).



Classification of Journal Entries
(Corresponding entries of Fig. 7.2 shown in parentheses)

1,2,3. Cost Incurrence, Periodic Cost Distribution, and Cost Application
- 1a. Purchases (1a, 2b, 3b, 2g)
- 1b. Wages Accrued (1b, 2c, 3c)
- 1c. Electricity Accrued (1c, 2f)
- 2a. Stores Issued (2a)
- 2d. Insurance Distribution (2d)
- 2e. Depreciation (2e)
- 3d. Factory Overhead Application (3d)

4. Worked Material Transfer Prior to Completion of Product (Not Illustrated)
5. Product Completion (5)
6. Cost Expiration
   - 6a. Cost of Goods Sold (6a)
   - 6b. Overhead Variance (Debit) (6b)

FIG. 7.3. Flow of factory costs through the accounts in a job-order system where clearing accounts are omitted except for expense and factory overhead (12 accounts, 10 journal entries).

TABLE 7.2

LIST OF TRANSACTION SUMMARIES IN A REPRESENTATIVE JOB-ORDER COST SYSTEM

Name of summary	Type of account debited	Transaction types	Type of account credited
(1)			
Purchase-invoice distribution, from suppliers' invoices and purchaser's debit memoranda	Stores	1	Accounts payable
	Prepaid expense	1	
	Fixed asset	1	
	Outside processing	1,2	
	Factory overhead	1,2	
	Selling and administrative expense	1,2,6	
	Accrued expense	10	
	Employee deposit	10	
(2*a*)			
Wage accrual and labor distribution, from time tickets	Factory overhead	1,2	Accrued wage
	Goods in process	1,2,3	
(2*b*)			
Salary accrual and distribution, from salary payroll	Factory overhead	1,2	Accrued salary
	Selling and administrative expense	1,2,6	
(3)			
Schedules of property taxes, social security taxes, electricity used, and other accruals	Factory overhead	1,2	Accrued expense
	Selling and administrative expense	1,2,6	
(4*a*)			
Summary of material requisitions	Factory overhead	2	Stores
	Goods in process	2,3	
	Selling and administrative expense	2,6	
(4*b*)			
Summary of supply requisitions	Factory overhead	2	Stores
	Selling and administrative expense	2,6	
(5*a*)			
Depreciation schedules	Factory overhead	2	Depreciation reserve
	Selling and administrative expense	2,6	
(5*b*)			
Schedule of insurance expired	Factory overhead	2	Unexpired insurance
	Selling and administrative expense	2,6	
(6*a*)			
Overhead applied	Goods in process	3	Factory overhead
(6*b*)			
Outside processing applied	Goods in process	3	Outside processing

TABLE 7.2 (*Continued*)

Name of summary	Type of account debited	Transaction types	Type of account credited
(7)			
Summary of rejected material reports	Stores	4,3	Goods in process
	Factory overhead	4,3,2	
(8)			
Summary of manufactured parts requisitioned for assembly	Goods in process	4	Manufactured parts
(9*a*)			
Summary of production orders completed	Manufactured parts	4	Goods in process
	Finished product	5	
(9*b*)			
Summary of construction orders completed	Fixed asset	5	Goods in process
(9*c*)			
Summary of maintenance orders completed	Factory overhead	5,2	Goods in process
(10)			
Cost of shipments (to customers)	Cost of goods sold	6	Finished product Manufactured parts
(11)			
Sale record	Accounts receivable	7	Sales
(12)			
Summary of cash receipts	Cash on deposit—commercial account	8	Accounts receivable
	Sale discount	6	
(13)			
Summary of checks issued (commercial account)	Accounts payable	9	Cash on deposit-commercial account
	Payroll payable	9	
(14*a*)			
Factory payroll	Accrued wage	10	Payroll payable
		10	Employee deposit
(14*b*)			
Salary payroll	Accrued salary	10	Payroll payable
		10	Employee deposit

CODE OF TRANSACTION TYPES

1. Cost incurrence
2. Periodic cost distribution
3. Cost application
4. Worked-material transfer, prior to completion of product
5. Completed-product transfer
6. Cost-expiration or expense
7. Income
8. Cash receipt
9. Cash disbursement
10. Liability transfer

accounts and debited to Goods in Process. Liberal use is made of clearing accounts in order to obtain the regular pattern of code numbers in Fig. 7.2. The clearing accounts are marked by asterisks.

As a short cut, some of the clearing accounts illustrated in Fig. 7.2 would generally be omitted in practice. Figure 7.3 illustrates the situation where a minimum of clearing accounts is used. The latter diagram covers the same transactions as Fig. 7.2. Fewer journal entries are required, however, because two or even three steps in the flow of costs are frequently merged in one entry. Thus, in Fig. 7.3 the entry for wages accrued during the period, entry 1*b*, records the wage cost incurred, the distribution of the periodic cost, and the application of direct labor cost—three steps. It takes the place of three entries in Fig. 7.2, entries 1*b*, 2*c*, and 3*c*.

The entries in Fig. 7.3 are coded according to the earliest step in the flow of costs represented. Thus an entry that records cost incurred is coded 1 even though it also represents one of the later steps. The T accounts are placed in the same positions as in Fig. 7.2. Spaces occupied in Fig. 7.2 by accounts that are omitted in Fig. 7.3 are blank spaces in the latter diagram. The pattern of code numbers in this diagram is an irregular pattern, but it is typical of actual practice. There are only 12 accounts and 10 journal entries in Fig. 7.3, whereas 19 accounts and 17 journal entries are required in Fig. 7.2 in order to record each step in the flow of costs.

Summarization of Transactions

The summarization of individual transactions so as to obtain monthly totals for journal entries is a large part of the work of an accounting department. Written reports of the transactions, known as business papers or business documents, are the original evidence of the transactions. The business papers are usually prepared on printed forms and are marked to show the accounts to be debited and the accounts to be credited. By procedures that are discussed in later chapters, starting with Chapter 12, periodic distributions are made to obtain debit and credit totals which are then written up in the form of journal entries.

A separate summary is made for each kind of transaction. In Table 7.2 are listed 21 transaction summaries that are prepared in a representative plant having a job-order cost system. The types of the accounts debited and credited are indicated in each case as well as the transaction types (cost incurrence, periodic cost distribution, etc.). Reference symbols are assigned to the transaction summaries in the table so as to indicate groupings of similar entries. Thus, the symbol 2*a* is used for the summary of wage accruals and labor cost distribution, and the symbol 2*b*

is used for the summary of salary accruals and salary cost distribution. The journal entries for these two transaction summaries are so nearly alike that the second one is readily understood once the first one has been mastered. Where two or more of the transaction summaries in the list are similar therefore the first one may be considered a key summary. The 14 key summaries are those numbered 1, 2*a*, 3, 4*a*, 5*a*, 6*a*, 7, 8, 9*a*, 10, 11, 12, 13, 14*a*. They should be studied with special care.

CHAPTER 8

GENERAL LEDGER PROCEDURE IN A JOB-ORDER COST SYSTEM

Illustration

This chapter is an illustration of general ledger procedure in a representative job-order cost system. The illustration consists of nine parts, namely,

Table 8.1. Condensed classification of general ledger accounts and trial balance, November 30, 1947, at the end of the eleventh month of the company's fiscal year

Table 8.2. Journal entries for the month of December, 1947

Table 8.3. End-of-the-year adjustments, December 31, 1947

Table 8.4. Closing entries, December 31, 1947

Table 8.5. Ledger accounts

Table 8.6. Condensed Statement of Profit, Month Ending December 31, 1947

Table 8.7. Factory Cost of Goods Sold, Month of December, 1947

Table 8.8. Condensed Balance Sheet, December 31, 1947

Table 8.9. Journal entry, January 1, 1948, to set up inventory by classes

Payroll Fund

In the illustration there is an account called Cash on Deposit—Payroll Fund (account 114). The payroll fund in this case is an imprest fund of $1,000. Each payday a check is drawn on the commercial deposit account for the amount paid or payable to factory employees. This check is deposited at the bank to the credit of the Payroll Fund account. The transfer of funds is journalized in entry 12-23. The amounts paid to employees are summarized in the payroll record, the total being credited to Cash on Deposit—Payroll Fund (see entry 12-25).

In the illustration there is also an account called Cash on Deposit—Salary Account (account 113). It has a balance of $2,000. The procedure of accounting for transactions affecting this account is similar to the procedure of accounting for the payroll fund (see entries 12-23 and 12-24).

TABLE 8.1
PROGRESSIVE JOBBING SHOP, INC.*
CONDENSED CLASSIFICATION OF GENERAL LEDGER ACCOUNTS AND TRIAL BALANCE
November 30, 1947

Account number	Account title	Debit	Credit
	Assets		
111	Cash on Deposit—Commercial Account	$ 36,000	
113	Cash on Deposit—Salary Account	2,000	
114	Cash on Deposit—Payroll Fund	1,000	
116	Petty Cash	500	
132	Accounts Receivable	42,000	
150	Inventory (used at end of year only)		
171	Unexpired Insurance	3,000	
200	Fixed Assets†	590,000	
299	Reserves for Depreciation†		$ 150,000
	Obligations		
420	Accounts Payable		20,000
431	Accrued Salaries		
432	Accrued Wages		2,400
435	Accrued Social Security Taxes		1,200
440	Other Accrued Taxes†		29,000
445	Accrued Electricity Cost		400
450	Employee Deposits†		300
611	Capital Stock		500,000
625	Free Surplus (Balance Jan. 1, $66,300; Dividends July 31, $20,000)		46,300
629	Profit or Loss (clearing account used at end of year only)		
	Income and Expense		
710	Sales†		785,000
720	Sale Returns and Allowances†	6,000	
730	Factory Cost of Goods Sold†	510,000	
741	Unapplied Overhead		
742	Inventory Adjustment		
750	Selling Expense Control	150,850	
760	Administrative Expense Control	59,150	
771	Purchase Discount		2,300
781	Sale Discount	5,200	
785	Income Taxes	20,000	
	Factory Costs and Inventories		
811	Material Stores	38,000	
812	Supply Stores	5,000	
822	Outside Processing		
831	Factory Overhead Control	132,200	
839	Factory Overhead Applied		128,000
840	Goods in Process	32,000	
850	Manufactured Parts	7,500	
860	Finished Product	24,500	
		$1,664,900	$1,664,900

* An imaginary enterprise.

† Representative of a series of general ledger accounts of the type indicated by the title. Number 200, Fixed Assets, for example, represents ledger accounts for Land, Buildings, Machinery, etc.

TABLE 8.2
PROGRESSIVE JOBBING SHOP, INC.
Journal Entries for the Month of December, 1947

Journal entry number	Account and explanation	Account number	Dr.	Cr.
12-1	Unexpired Insurance	171	2,100	
	Fixed Assets	200	18,000	
	Accrued Electricity Cost	445	1,000	
	Selling Expense Control	750	5,600	
	Administrative Expense Control	760	1,800	
	Material Stores	811	25,000	
	Supply Stores	812	4,200	
	Outside Processing	822	1,700	
	Factory Overhead Control	831	1,600	
	Accounts Payable	420		61,000
	Purchase-invoice distribution, from suppliers' invoices and our debit memos.			
12-2	Goods in Process	840	14,000	
	Factory Overhead Control	831	2,400	
	Accrued Wages	432		16,400
	Wage accrual and labor distribution from time tickets.			
	Dec. 1–6 $ 3,600			
	Dec. 7–13 3,800			
	Dec. 14–20 3,900			
	Dec. 21–27 3,300			
	Dec. 28–31 1,800			
	$16,400			
12-3	Selling Expense Control	750	2,200	
	Administrative Expense Control	760	3,000	
	Factory Overhead Control	831	2,400	
	Accrued Salaries	431		7,600
	Salary accrual and distribution from salary roll.			
	Dec. 1–15 $3,800			
	Dec. 16–31 3,800			
	$7,600			
12-4	Selling Expense Control	750	50	
	Administrative Expense Control	760	30	
	Factory Overhead Control	831	700	
	Accrued Social Security Taxes	435		780
	Schedule of employer's social-security taxes.			
12-5	Selling Expense Control	750	20	
	Administrative Expense Control	760	20	
	Factory Overhead Control	831	780	
	Other Accrued Taxes	440		820
	Schedule of property taxes.			

TABLE 8.2 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
12-6	Factory Overhead Control	831	900	
	Accrued Electricity Cost	445		900
	Schedule of electricity used.			
12-7	Goods in Process	840	22,700	
	Factory Overhead Control	831	300	
	Material Stores	811		23,000
	Summary of material requisitions.			
12-8	Goods in Process	840	100	
	Factory Overhead Control	831	2,400	
	Selling Expense Control	750	40	
	Administrative Expense Control	760	60	
	Supply Stores	812		2,600
	Summary of supply requisitions.			
12-9	Selling Expense Control	750	80	
	Administrative Expense Control	760	120	
	Factory Overhead Control	831	2,800	
	Reserves for Depreciation	299		3,000
	Depreciation schedule.			
12-10	Selling Expense Control	750	40	
	Administrative Expense Control	760	30	
	Factory Overhead Control	831	530	
	Unexpired Insurance	171		600
	Schedule of insurance expired.			
12-11	Goods in Process	840	1,700	
	Outside Processing	822		1,700
	Outside processing applied.			
12-12	Goods in Process	840	16,800	
	Factory Overhead Applied	839		16,800
	Overhead applied at 120% of direct labor.			
12-13	Goods in Process	840	6,000	
	Manufactured Parts	850		6,000
	Summary of manufactured parts issued for use on production orders.			
12-14	Material Stores	811	600	
	Factory Overhead Control	831	500	
	Goods in Process	840		1,100
	Summary of rejected material reports.			
12-15	Manufactured Parts	850	8,500	
	Finished Product	860	55,000	
	Goods in Process	840		63,500
	Summary of production orders completed.			
12-16	Fixed Assets	200	4,000	
	Goods in Process	840		4,000
	Construction orders completed.			
12-17	Factory Overhead Control	831	700	
	Goods in Process	840		700
	Maintenance orders completed.			

TABLE 8.2 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
12-18	Factory Cost of Goods Sold	730	60,000	
	Manufactured Parts	850		3,000
	Finished Product	860		57,000
	Cost of shipments to customers.			
12-19	Accounts Receivable	132	85,000	
	Sales	710		85,000
	Sale record.			
12-20	Sale Returns and Allowances	720	500	
	Accounts Receivable	132		500
	Summary of credit memos issued to customers.			
12-21	Manufactured Parts	850	150	
	Finished Product	860	200	
	Factory Cost of Goods Sold	730		350
	Cost of goods returned by customers.			
12-22	Cash on Deposit—Commercial Account	111	79,700	
	Sale Discount	781	500	
	Accounts Receivable	132		80,000
	Factory Overhead (crap sales)	831		200
	Summary of cash receipts.			
12-23	Cash on Deposit—Salary Account	113	7,560	
	Cash on Deposit—Payroll Fund	114	16,840	
	Petty Cash	116	880	
	Accounts Payable	420	64,000	
	Purchase Discount	771		250
	Cash on Deposit—Commercial Account	111		89,030
	Summary of checks issued on commercial account.			
12-24	Accrued Salaries	431	7,600	
	Employee Deposits	450		40
	Cash on Deposit—Salary Account	113		7,560
	Salary roll.			
12-25	Accrued Wages	432	17,000	
	Employee Deposits	450		160
	Cash on Deposit—Payroll Fund	114		16,840
	Factory payroll.			

Pay period	Date paid	Gross amount
Nov. 23–29	Dec. 3	$ 2,200
Nov. 30–Dec. 6	Dec. 10	3,800
Dec. 7–13	Dec. 17	3,800
Dec. 14–20	Dec. 24	3,900
Dec. 21–27	Dec. 31	3,300
		$17,000

TABLE 8.2 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
12-26	Selling Expense Control	750	250	
	Administrative Expense Control	760	80	
	Factory Overhead Control	831	550	
	Petty Cash	116		880
	Summary of petty-cash disbursements.			
12-27	Selling Expense Control	750	300	
	Administrative Expense Control	760	400	
	Factory Overhead Control	831		700
	Services of factory to sales and general office: building occupancy $700.			
12-28	Factory Overhead Control	831	800	
	Administrative Expense Control	760		800
	Administrative expense applicable to factory: cost accounting $800.			
12-29	Income Taxes	785	4,900	
	Other Accrued Taxes	440		4,900
	Estimated income taxes for the month of December, 1947.			

TABLE 8.3
PROGRESSIVE JOBBING SHOP, INC.
End-of-year Adjustments, December 31, 1947

Journal entry number	Account and explanation	Account number	Dr.	Cr.
12-51	Inventory (Post items)	150	98,000	
	Inventory Adjustment	742		98,000
	Physical inventory, Dec. 31, 1947, at lower of cost or market.			
	Material Stores $39,000			
	Supply Stores (at cost) 6,500			
	Goods in Process 22,500			
	Manufactured Parts 7,000			
	Finished Product 23,000			
	$98,000			
12-52	Inventory Adjustment	742	101,050	
	Material Stores	811		40,600
	Supply Stores	812		6,600
	Goods in Process	840		24,000
	Manufactured Parts	850		7,150
	Finished Product	860		22,700
	To close book inventories, Dec. 31, 1947			
12-53	Unapplied Overhead	741	148,660	
	Factory Overhead Control	831		148,660
	To close the latter account.			
12-54	Factory Overhead Applied	839	144,800	
	Unapplied Overhead	741		144,800
	To close account 839.			
12-55	Income Taxes	785	2,100	
	Other Accrued Taxes	440		2,100
	Income taxes for the year based on tentative tax returns $27,000			
	Amount previously provided 24,900			
	Additional $ 2,100			

TABLE 8.4
PROGRESSIVE JOBBING SHOP, INC.
Closing Entries, December 31, 1947

Journal entry number	Account	Account number	Dr.	Cr.
12-91	Sales	710	870,000	
	Purchase Discount	771	2,550	
	Profit or Loss (Post items)	629		872,550
12-92	Profit or Loss (Post items)	629	839,080	
	Sales Returns and Allowances	720		6,500
	Factory Cost of Goods Sold	730		569,650
	Unapplied Overhead	741		3,860
	Inventory Adjustment	742		3,050
	Selling Expense Control	750		159,430
	Administrative Expense Control	760		63,890
	Sale Discount	781		5,700
	Income Taxes	785		27,000
12-93	Profit or Loss	629	33,470	
	Free Surplus	625		33,470
	Profit to surplus.			

TABLE 8.5
PROGRESSIVE JOBBING SHOP, INC.
LEDGER ACCOUNTS

Cash on Deposit—Commercial Account — Account 111

1947				1947			
Nov. 30	Balance		36,000	Dec. 31		12-23	89,030
Dec. 31		12-22	79,700	31	Balance		26,670
			115,700				115,700
1948							
Jan. 1	Balance		26,670				

Cash on Deposit—Salary Account — Account 113

1947				1947			
Nov. 30	Balance		2,000	Dec. 31		12-24	7,560
Dec. 31		12-23	7,560	31	Balance		2,000
			9,560				9,560
1948							
Jan. 1	Balance		2,000				

TABLE 8.5 (*Continued*)

Cash on Deposit—Payroll Fund — Account 114

1947				1947			
Nov. 30	Balance		1,000	Dec. 31		12-25	16,840
Dec. 31		12-23	16,840	31	Balance		1,000
			17,840				17,840
1948							
Jan. 1	Balance		1,000				

Petty Cash — Account 116

1947				1947			
Nov. 30	Balance		500	Dec. 31		12-26	880
Dec. 31		12-23	880	31	Balance		500
			1,380				1,380
1948							
Jan. 1	Balance		500				

Accounts Receivable — Account 132

1947				1947			
Nov. 30	Balance		42,000	Dec. 31		12-20	500
Dec. 31		12-19	85,000	31		12-22	80,000
				31	Balance		46,500
			127,000				127,000
1948							
Jan. 1	Balance		46,500				

Inventory — Account 150

1947			
Dec. 31	Material stores	12-51	39,000
	Supply stores		6,500
	Goods in process		22,500
	Manufactured parts		7,000
	Finished product		23,000

Unexpired Insurance — Account 171

1947				1947			
Nov. 30	Balance		3,000	Dec. 31		12-10	600
Dec. 31		12-1	2,100	31	Balance		4,500
			5,100				5,100
1948							
Jan. 1	Balance		4,500				

TABLE 8.5 (*Continued*)

Fixed Assets — Account 200

1947				1947			
Nov. 30	Balance		590,000	Dec. 31	Balance		612,000
Dec. 31		12-1	18,000				
31		12-16	4,000				
			612,000				612,000
1948							
Jan. 1	Balance		612,000				

Reserves for Depreciation — Account 299

1947				1947			
Dec. 31	Balance		153,000	Nov. 30	Balance		150,000
				Dec. 31		12-9	3,000
			153,000				153,000
				1948			
				Jan. 1	Balance		153,000

Accounts Payable — Account 420

1947				1947			
Dec. 31		12-23	64,000	Nov. 30	Balance		20,000
31	Balance		17,000	Dec. 31		12-1	61,000
			81,000				81,000
				1948			
				Jan. 1	Balance		17,000

Accrued Salaries — Account 431

1947				1947			
Dec. 31		12-24	7,600	Dec. 31		12-3	7,600

Accrued Wages — Account 432

1947				1947			
Dec. 31		12-25	17,000	Nov. 30	Balance		2,400
31	Balance		1,800	Dec. 31		12-2	16,400
			18,800				18,800
				1948			
				Jan. 1	Balance		1,800

TABLE 8.5 (*Continued*)

Accrued Social Security Taxes — Account 435

1947				1947			
Dec. 31	Balance		1,980	Nov. 30	Balance		1,200
				Dec. 31		12-4	780
			1,980				1,980
				1948			
				Jan. 1	Balance		1,980

Other Accrued Taxes — Account 440

1947				1947			
Dec. 31	Balance		36,820	Nov. 30	Balance		29,000
				Dec. 31		12-5	820
				31		12-29	4,900
				31		12-55	2,100
			36,820				36,820
				1948			
				Jan. 1	Balance		36,820

Accrued Electricity Cost — Account 445

1947				1947			
Dec. 31		12-1	1,000	Nov. 30	Balance		400
31	Balance		300	Dec. 31		12-6	900
			1,300				1,300
				1948			
				Jan. 1	Balance		300

Employee Deposits — Account 450

1947				1947			
Dec. 31	Balance		500	Nov. 30	Balance		300
				Dec. 31		12-24	40
				31		12-25	160
			500				500
				1948			
				Jan. 1	Balance		500

Capital Stock — Account 611

				1947			
				Nov. 30	Balance		500,000

TABLE 8.5 (*Continued*)

Free Surplus — Account 625

1947				1947			
July 31	Dividends ...	....	20,000	Jan. 1	Balance.	.....	66,300
Dec. 31	Balance	.....	79,770	Dec. 31	Profit.....	12-93	33,470
			99,770				99,770
				1948			
				Jan. 1	Balance...	.....	79,770

Profit or Loss — Account 629

1947				1947			
Dec. 31	Sales returns and allowances . .	12-92	6,500	Dec. 31	Sales..... .	12-91	870,000
	Factory cost of goods sold .	. .	569,650		Purchase discount	.	2,550
	Unapplied overhead		3,860				
	Inventory adjustment . . .	.	3,050				
	Selling expense		159,430				
	Administrative expense . . .	. .	63,890				
	Sale discount.	. .	5,700				
	Income taxes...	.	27,000				
31	To Surplus...	12-93	33,470				
			872,550				872,550

Sales — Account 710

1947				1947			
Dec. 31	To close . . .	12-91	870,000	Nov. 30	Balance..	....	785,000
				Dec. 31	.... ..	12-19	85,000
			870,000				870,000

Sale Returns and Allowances — Account 720

1947				1947			
Nov. 30	Balance. .	...	6,000	Dec. 31	To close.	12-92	6,500
Dec. 31	. . .	12-20	500				
			6,500				6,500

Factory Cost of Goods Sold — Account 730

1947				1947			
Nov 30	Balance..	....	510,000	Dec. 31	....	12-21	350
Dec. 31	....	12-18	60,000	31	To close.	12-92	569,650
			570,000				570,000

TABLE 8.5 (*Continued*)

Unapplied Overhead — Account 741

1947				1947			
Dec. 31	Overhead for the year	12-53	148,660	Dec. 31	Overhead applied	12-54	144,800
				31	To close	12-92	3,860
			148,660				148,660

Inventory Adjustment — Account 742

1947				1947			
Dec. 31	Book inventory	12-52	101,050	Dec. 31	Physical inventory	12-51	98,000
				31	To close	12-92	3,050
			101,050				101,050

Selling Expense Control — Account 750

1947				1947			
Nov. 30	Balance		150,850	Dec. 31	To close	12-92	159,430
Dec. 31		12-1	5,600				
31		12-3	2,200				
31		12-4	50				
31		12-5	20				
31		12-8	40				
31		12-9	80				
31		12-10	40				
31		12-26	250				
31		12-27	300				
			159,430				159,430

Administrative Expense Control — Account 760

1947				1947			
Nov. 30	Balance		59,150	Dec. 31		12-28	800
Dec. 31		12-1	1,800	31	To close	12-92	63,890
31		12-3	3,000				
31		12-4	30				
31		12-5	20				
31		12-8	60				
31		12-9	120				
31		12-10	30				
31		12-26	80				
31		12-27	400				
			64,690				64,690

TABLE 8.5 (*Continued*)

Purchase Discount — Account 771

1947				1947			
Dec. 31	To close	12-91	2,550	Nov. 30	Balance		2,300
				Dec. 31		12-23	250
			2,550				2,550

Sale Discount — Account 781

1947				1947			
Nov. 30	Balance		5,200	Dec. 31	To close	12-92	5,700
Dec. 31		12-22	500				
			5,700				5,700

Income Taxes — Account 785

1947				1947			
Nov. 30	Balance		20,000	Dec. 31	To close	12-92	27,000
Dec. 31		12-29	4,900				
31		12-55	2,100				
			27,000				27,000

Material Stores — Account 811

1947				1947			
Nov. 30	Balance		38,000	Dec. 31		12-7	23,000
Dec. 31		12-1	25,000	31	To close	12-52	40,600
31	Defective material	12-14	600				
			63,600				63,600

Supply Stores — Account 812

1947				1947			
Nov. 30	Balance		5,000	Dec. 31		12-8	2,600
Dec. 31		12-1	4,200	31	To close	12-52	6,600
			9,200				9,200

Outside Processing — Account 822

1947				1947			
Dec. 31		12-1	1,700	Dec. 31		12-11	1,700

TABLE 8.5 (*Continued*)

Factory Overhead Control — Account 831

1947				1947			
Nov. 30	Balance . .	.....	132,200	Dec. 31	. . . .	12-22	200
Dec. 31		12-1	1,600	31	.... ..	12-27	700
31		12-2	2,400	31	To acc't 741.	12-53	148,660
31		12-3	2,400				
31		12-4	700				
31	.	12-5	780				
31	.	12-6	900				
31		12-7	300				
31	. ... .	12-8	2,400				
31		12-9	2,800				
31	.	12-10	530				
31		12-14	500				
31		12-17	700				
31	. .. ..	12-26	550				
31	. ...	12-28	800				
			149,560				149,560

Factory Overhead Applied — Account 839

1947				1947			
Dec. 31	To acc't 741	12-54	144,800	Nov. 30	Balance	....	128,000
				Dec. 31	. . . .	12-12	16,800
			144,800				144,800

Goods in Process — Account 840

1947				1947			
Nov. 30	Balance . .		32,000	Dec. 31	Rejected material	12-14	1,100
Dec. 31	Direct labor	12-2	14,000	31	Production orders	12-15	63,500
31	Material . . .	12-7	22,700	31	Construction orders	12-16	4,000
31	Material from supply stores	12-8	100	31	Maintenance orders	12-17	700
31	Outside processing..	12-11	1,700	31	To close.....	12-52	24,000
31	Overhead applied	12-12	16,800				
31	Manufactured parts..... ...	12-13	6,000				
			93,300				93,300

TABLE 8.5 (*Continued*)

Manufactured Parts — Account 850

1947				1947			
Nov. 30	Balance		7,500	Dec. 31		12-13	6,000
Dec. 31		12-15	8,500	31		12-18	3,000
31		12-21	150	31	To close	12-52	7,150
			16,150				16,150

Finished Product — Account 860

1947				1947			
Nov. 30	Balance		24,500	Dec. 31		12-18	57,000
Dec. 31		12-15	55,000	31	To close	12-52	22,700
31		12-21	200				
			79,700				79,700

TABLE 8.6

PROGRESSIVE JOBBING SHOP, INC.

CONDENSED STATEMENT OF PROFIT

For the Month Ending December 31, 1947

Gross sales		$85,000
Less: returns and allowances		500
Net sales		$84,500
Factory cost of goods sold (Table 8.7)		59,650
Gross margin		$24,850
Cost adjustments		
Add: overapplied factory overhead		340
Adjusted gross margin		$25,190
Selling expense	$8,580	
Administrative expense	4,740	13,320
Margin from major operations		$11,870
Financial expense and income		
Sale discount	$ 500	
Purchase discount	250	
Net financial expense		250
Net ordinary margin		$11,620
Income taxes, estimated		4,900
Profit		$ 6,720

TABLE 8.7
PROGRESSIVE JOBBING SHOP, INC.
FACTORY COST OF GOODS SOLD
For the Month Ending December 31, 1947

Costs applied to production		
Material		$22,800
Outside processing		1,700
Direct labor		14,000
Factory overhead for the period (actual)	$16,460	
Add: Overapplied*	340	
Overhead applied		16,800
Total costs applied to production		$55,300
Deduct: Transfers of worked material to factory-overhead and to fixed-asset accounts		5,800
		$49,500
Add: Decrease in worked-material inventories		
Goods in process	$ 8,000	
Manufactured parts	350	
Finished product	1,800	10,150
Factory cost of goods sold		$59,650

* Computation of overapplied factory overhead:

Overhead applied, from account 839, Factory Overhead Applied	$16,800
Actual overhead for the month, from account 831, Factory Overhead Control	16,460
Overapplied	$ 340

TABLE 8.8
PROGRESSIVE JOBBING SHOP, INC.
Condensed Balance Sheet, December 31, 1947
After End-of-year Adjustments

Assets		
Current Assets		
Cash on deposit—commercial account	$ 26,670	
Imprest cash funds	3,500	
Accounts receivable	46,500	
Inventory	98,000	
Unexpired insurance	4,500	
Total current assets		$179,170
Fixed Assets		
Fixed assets	$612,000	
Less: Reserves for depreciation	153,000	
Total fixed assets		459,000
Total assets		$638,170

TABLE 8.8 (*Continued*)

Obligations

Current Liabilities

Accounts payable		$ 17,000	
Accrued expenses			
Factory wages	$ 1,800		
Social security taxes	1,980		
Other accrued taxes	36,820		
Accrued electricity	300	40,900	
Employee deposits		500	
Total current liabilities			$ 58,400

Capital Obligations

Capital Stock		$500,000	
Free Surplus			
Balance, January 1, 1947	$66,300		
Increases: Profit for the year	33,470		
	$99,770		
Decreases: Dividends declared and paid	20,000		
Balance, December 31, 1947		79,770	
Total capital obligations			579,770
Total obligations			$638,170

TABLE 8.9

PROGRESSIVE JOBBING SHOP, INC.

Journal Entry to Open Inventory Accounts by Classes, January 1, 1948

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-51	Material Stores	811	39,000	
	Supply Stores	812	6,500	
	Goods in Process	840	22,500	
	Manufactured Parts	850	7,000	
	Finished Product	860	23,000	
	Inventory	150	.....	98,000
	To close account 150, and to set up the initial inventory by classes, Jan. 1, 1948.			

CHAPTER 9

FACTORY LEDGER

A factory ledger is a subsidiary ledger containing control accounts for current factory costs and factory inventories. In a plant where there is a separate factory accounting department, the use of a factory ledger is likely to be desirable as a means of dividing up the accounting work. As a rule it is advantageous to make the factory ledger a self-balancing ledger,[1] for then the factory accounting department can verify the accuracy of its own work periodically by preparing a trial balance. In this chapter the operation of a self-balancing factory ledger will be described and illustrated. The illustrations are a continuation of those in Chapter 8.

Factory Ledger Accounts

Before the factory ledger is opened it is necessary to decide what accounts shall be kept in it. Table 9.1 is a chart of factory ledger accounts adopted by Progressive Jobbing Shop, Inc.,[2] effective January 1, 1948. Eight of the accounts replace accounts formerly carried in the general ledger (see the Remarks column of the table). The other five (accounts 21, 71, 72, 73, and 99) are new.

Account 99, General Ledger Control, is a credit-balance account which is provided so as to make the ledger self-balancing. Upon the opening of the factory ledger this account is credited with the net amount of assets transferred from the general ledger. During the accounting period the account is credited with the amount of costs charged by the general office to the factory; it is debited with the cost of goods shipped from the factory and with the amount of other costs chargeable to the general ledger. As will be explained later, the General Ledger Control on the factory books and the Factory Ledger Control on the general books are reciprocal control accounts. Their balances are equal but on opposite sides.

[1] A self-balancing ledger is one in which an equality of debits and credits is maintained. A trial balance can therefore be prepared from the ledger itself without reference to a control figure elsewhere. The general ledger, for example, is a self-balancing ledger; the customers' ledger usually is not.

[2] An imaginary enterprise.

Account 21, Factory Wages, is a clearing account the purpose of which is to show on the factory ledger the periodic totals of labor cost incurred. This information could be obtained from the credit side of Accrued Wages account; but since the latter account is in the general books, it is not readily accessible to members of the factory accounting department. Factory Wages is debited with the amount of wage costs incurred. It is credited with the amount of the periodic labor cost distribution. At the end of an accounting period the account has a zero balance.

TABLE 9.1
PROGRESSIVE JOBBING SHOP, INC.
CHART OF FACTORY LEDGER ACCOUNTS
(All debit-balance accounts unless otherwise noted)

Account number	Account title	Remarks
11	Material Stores	Replaces account 811*
12	Supply Stores	Replaces account 812*
21	Factory Wages	New account
22	Outside Processing	Replaces account 822*
31	Factory Overhead Control	Replaces account 831*
39	Factory Overhead Applied (credit-balance account)	Replaces account 839*
40	Goods in Process	Replaces account 840*
50	Manufactured Parts	Replaces account 850*
60	Finished Product	Replaces account 860*
71	Cost of Shipments	New account
72	Unapplied Overhead (normally a debit-balance account)	New account
73	Inventory adjustment (normally a debit-balance account)	New account
99	General Ledger Control (credit-balance account)	New account

* See Table 8.1.

Account 71, Cost of Shipments, is a clearing account that is provided to show on the factory books the cost of goods shipped by the factory. Although this information also appears in the general ledger in account 730, Factory Cost of Goods Sold, it is not readily accessible there to members of the factory accounting department. Pro forma monthly journal entries on the factory books affecting account 71 are

(1)

Cost of Shipments (account 71)	xxx	
Manufactured Parts (account 50)		xxx
Finished Product (account 60)		xxx

Cost of shipments to customers.

(2)

Manufactured Parts (account 50)	xxx	
Finished Product (account 60)	xxx	
Cost of Shipments (account 71)		xxx
Goods returned by customers, at factory cost.		

(3)

General Ledger Control (account 99)	xxx	
Cost of Shipments (account 71)		xxx
To close the latter account.		

Under an alternative procedure, which is illustrated in Table 10.1, the cost of goods sold would be cumulated in account 71 from month to month. At the end of the year the total would be transferred to the general ledger. In this case the first two of the foregoing entries would be made every month, but the third entry would be made only once a year.

Accounts 72 and 73 are clearing accounts that are provided to record on the factory ledger the amount of unapplied overhead and the amount of inventory adjustments. These accounts duplicate accounts in the general ledger, accounts 743 and 744, and their balances would be transferred to the general ledger once a year or oftener.

Although Table 9.1 is a representative list of factory ledger accounts, the selection of the accounts to be used in any given case should be governed by the circumstances. In many cases the Accrued Wages account is placed in the factory ledger; in some cases the Factory Payroll Fund account is carried there. Accounts for fixed assets at the factory and the related valuation reserves are sometimes carried in the factory ledger, but more often they are kept in the general ledger along with the accounts for the other fixed assets.

Factory Journal

The form of journal illustrated in Fig. 7.1 is frequently used as a factory journal. The factory accounting department would prepare the factory journal entries and post them to the factory ledger.

Opening the Factory Books

To open the factory ledger a factory journal entry would be prepared, debiting the asset accounts that are to be kept in the factory ledger and crediting General Ledger Control. In case there are to be liability accounts in the factory ledger, another entry would be made to credit those accounts and debit General Ledger Control. The journal entry to open the factory ledger of Progressive Jobbing Shop, Inc., appears in Table 9.2.

Entries on General Books when Factory Ledger Is Opened

On the general ledger the accounts that are in the future to be carried in the factory ledger are closed, and in their place a Factory Ledger Control account is opened. The general journal entry for this transaction on the books of Progressive Jobbing Shop, Inc., appears in Table 9.2.

Monthly Journal Entries

Transactions that affect only general ledger accounts are recorded only on the general books. Thus, the payment of a purchase invoice would be completely recorded on the general books by crediting Cash and debiting Accounts Payable.

TABLE 9.2
PROGRESSIVE JOBBING SHOP, INC.
Journal Entries, January 1, 1948, to Open Factory Ledger and to Set Up Factory Ledger Control Account on General Ledger

I. FACTORY JOURNAL

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-52f	Material Stores	11	39,000	
	Supply Stores	12	6,500	
	Goods in Process	40	22,500	
	Manufactured Parts	50	7,000	
	Finished Product	60	23,000	
	General Ledger Control	99		98,000
	To open factory ledger.			

II. GENERAL JOURNAL

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-52	Factory Ledger Control	800	98,000	
	Material Stores	811		39,000
	Supply Stores	812		6,500
	Goods in Process	840		22,500
	Manufactured Parts	850		7,000
	Finished Product	860		23,000
	To close accounts that are to be carried in factory ledger and to open Factory Ledger Control.			

Transactions that affect only the factory ledger accounts are recorded only on the factory books. Thus, the application of factory overhead to

TABLE 9.3
PROGRESSIVE JOBBING SHOP, INC.
Factory Journal for the Month Ending January 31, 1948

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-1f	Material Stores	11	30,000	
	Supply Stores	12	3,000	
	Outside Processing	22	3,500	
	Factory Overhead Control	31	2,000	
	General Ledger Control	99		38,500
	Purchase-invoice distribution.			
1-2af	Factory Wages	21	19,000	
	General Ledger Control	99		19,000
	Wage accrual.			
1-2bf	Goods in Process	40	16,500	
	Factory Overhead Control	31	2,500	
	Factory Wages	21		19,000
	Labor distribution.			
1-3f	Factory Overhead Control	31	2,600	
	General Ledger Control	99		2,600
	Salary accrual and distribution.			
1-4f	Factory Overhead Control	31	864	
	General Ledger Control	99		864
	Schedule of social security taxes.			
1-5f	Factory Overhead Control	31	805	
	General Ledger Control	99		805
	Schedule of property taxes.			
1-6f	Factory Overhead Control	31	1,040	
	General Ledger Control	99		1,040
	Schedule of electricity used.			
1-7f	Goods in Process	40	26,000	
	Factory Overhead Control	31	150	
	Material Stores	11		26,150
	Summary of material requisitions less returns			
1-8f	Factory Overhead Control	31	2,700	
	General Ledger Control	99	200	
	Supply Stores	12		2,900
	Summary of supply requisitions less returns			
1-9f	Factory Overhead Control	31	3,100	
	General Ledger Control	99		3,100
	Depreciation schedule.			
1-10f	Factory Overhead Control	31	530	
	General Ledger Control	99		530
	Schedule of insurance expired.			
1-11f	Goods in Process	40	3,500	
	Outside Processing	22		3,500
	Outside processing applied.			

TABLE 9.3 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-12f	Goods in Process	40	19,800	
	Factory Overhead Applied	39		19,800
	Overhead applied at 120% of direct labor.			
1-13f	Goods in Process	40	7,000	
	Manufactured Parts	50		7,000
	Summary of manufactured parts issued for use on production orders.			
1-14f	Material Stores	11	400	
	Factory Overhead Control	31	400	
	Goods in Process	40		800
	Summary of rejected material reports.			
1-15f	Manufactured Parts	50	8,000	
	Finished Product	60	60,000	
	Goods in Process	40		68,000
	Summary of production orders completed.			
1-16f	General Ledger Control	99	500	
	Goods in Process	40		500
	Construction orders completed.			
1-17f	Factory Overhead Control	31	2,000	
	Goods in Process	40		2,000
	Maintenance orders completed.			
1-18f	Cost of Shipments	71	70,000	
	Manufactured Parts	50		4,000
	Finished Product	60		66,000
	Cost of shipments to customers.			
1-19f	No entry			
1-20f	No entry			
1-21f	Manufactured Parts	50	500	
	Finished Product	60	300	
	Cost of Shipments	71		800
	Goods returned put in stock.			
1-22f	General Ledger Control	99	250	
	Factory Overhead Control	31		250
	Cash received from sale of scrap.			
1-23f	No entry			
1-24f	No entry			
1-25f	No entry			
1-26f	Supply Stores	12	40	
	Factory Overhead Control	31	470	
	General Ledger Control	99		510
	Summary of petty-cash disbursements.			
1-27f	General Ledger Control	99	700	
	Factory Overhead Control	31		700
	Building occupancy charge.			

TABLE 9.3 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-28f	Factory Overhead	31	800	
	General Ledger Control	99		800
	Cost-accounting service.			
1-29f	General Ledger Control	99	69,200	
	Cost of Shipments	71		69,200
	Net cost of shipments transferred to general ledger.			
1-30f	No entry			

Goods in Process would be completely recorded on the factory books by debiting Goods in Process and crediting Factory Overhead Applied.

Transactions affecting accounts in both the general ledger and the factory ledger require entries in both books. Thus, the periodic distribution of depreciation on factory plant and equipment is a debit to Factory Overhead, a factory ledger account, and a credit to Reserve for Depreciation, a general ledger account. On the factory books the pro forma journal entry is

Factory Overhead	xxx	
General Ledger Control		xxx

On the general books the pro forma journal entry is

Factory Ledger Control	xxx	
Reserve for Depreciation		xxx

The General Ledger Control account on the factory books and the Factory Ledger Control account on the general books are reciprocal control accounts. Their balances at the end of the accounting period are equal in amount but on opposite sides. One is a credit-balance account, the other a debit-balance account. The significant feature of this relationship is that each account is a check upon the other and upon the accounts that make up the factory ledger.

Table 9.3 is the factory journal of Progressive Jobbing Shop, Inc., for the month of January, 1948; Table 9.4 is the general journal for the same month. In order to facilitate cross reference the factory journal entries in Table 9.3 are numbered the same as the corresponding general journal entries in Table 9.4, except that the letter "f" is suffixed to the factory journal numbers. In practice, however, the factory journal entries would be numbered independently.

TABLE 9.4
PROGRESSIVE JOBBING SHOP, INC.
General Journal for the Month Ending January 31, 1948

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-1	Fixed Assets	200	12,000	
	Accrued Social Security Taxes	435	1,980	
	Accrued Electricity Cost	445	950	
	Employee Deposits	450	400	
	Selling Expense Control	750	4,000	
	Administrative Expense Control	760	2,000	
	Factory Ledger Control	800	38,500	
	Accounts Payable	420		59,830
	Purchase-invoice distribution.			
1-2	Factory Ledger Control	800	19,000	
	Accrued Wages	432		19,000
	Wage accrual.			
1-3	Selling Expense Control	750	1,800	
	Administrative Expense Control	760	3,200	
	Factory Ledger Control	800	2,600	
	Accrued Salaries	431		7,600
	Salary accrual and distribution.			
1-4	Selling Expense Control	750	72	
	Administrative Expense Control	760	128	
	Factory Ledger Control	800	864	
	Accrued Social Security Taxes	435		1,064
	Schedule of social-security taxes.			
1-5	Selling Expense Control	750	20	
	Administrative Expense Control	760	25	
	Factory Ledger Control	800	805	
	Other Accrued Taxes	440		850
	Schedule of property taxes.			
1-6	Factory Ledger Control	800	1,040	
	Accrued Electricity Cost	445		1,040
	Schedule of electricity used.			
1-7	No entry			
1-8	Selling Expense Control	750	50	
	Administrative Expense Control	760	150	
	Factory Ledger Control	800		200
	Summary of supply requisitions chargeable to sales and administrative departments.			
1-9	Selling Expense Control	750	80	
	Administrative Expense Control	760	140	
	Factory Ledger Control	800	3,100	
	Reserves for Depreciation	299		3,320
	Depreciation schedule.			

TABLE 9.4 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-10	Selling Expense Control	750	40	
	Administrative Expense Control	760	30	
	Factory Ledger Control	800	530	
	Unexpired Insurance	171		600
	Schedule of insurance expired.			
1-11	No entry			
1-12	No entry			
1-13	No entry			
1-14	No entry			
1-15	No entry			
1-16	Fixed Assets	200	500	
	Factory Ledger Control	800		500
	Construction orders completed.			
1-17	No entry			
1-18	No entry			
1-19	Accounts Receivable	132	97,000	
	Sales	710		97,000
	Sale record.			
1-20	Sale Returns and Allowances	720	1,200	
	Accounts Receivable	132		1,200
	Summary of credit memos.			
1-21	No entry			
1-22	Cash on Deposit—Commercial Account	111	89,650	
	Sale Discount	781	600	
	Accounts Receivable	132		90,000
	Factory Ledger Control	800		250
	Summary of cash receipts.			
1-23	Cash on Deposit—Salary Account	113	7,524	
	Cash on Deposit—Payroll Fund	114	16,533	
	Petty Cash	116	700	
	Accounts Payable	420	62,000	
	Purchase Discount	771		310
	Cash on Deposit—Commercial Account.	111		86,447
	Summary of checks issued on commercial account.			
1-24	Accrued Salaries	431	7,600	
	Employee Deposits	450		76
	Cash on Deposit—Salary Account	113		7,524
	Salary roll.			
1-25	Accrued Wages	432	16,700	
	Employee Deposits	450		167
	Cash on Deposit—Payroll Fund	114		16,533
	Factory payroll.			

TABLE 9.4 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-26	Selling Expense Control	750	100	
	Administrative Expense Control	760	90	
	Factory Ledger Control	800	510	
	Petty Cash	116		700
	Summary of petty-cash disbursements.			
1-27	Selling Expense Control	750	300	
	Administrative Expense Control	760	400	
	Factory Ledger Control	800		700
	Building occupancy charge.			
1-28	Factory Ledger Control	800	800	
	Administrative Expense Control	760		800
	Charge to factory for cost-accounting service.			
1-29	Factory Cost of Goods Sold.	730	69,200	
	Factory Ledger Control	800		69,200
	Cost of shipments to customers less cost of goods returned.			
1-30	Income Taxes	785	7,200	
	Other Accrued Taxes	440		7,200
	Estimated income taxes for the month of January, 1948.			

Table 9.5 is an interim work sheet representing the factory ledger. The entry opening that ledger is recorded in the first amount column, the journal entries for the month are recorded in the next pair of columns, and the trial balance at the end of the month appears in the fourth column. Table 9.6 is an abstract of the Factory Ledger Control account which is kept in the general ledger.

Consolidation of Data for Financial Statements

At the end of each month the factory accounting department furnishes a copy of the factory ledger trial balance to the general accounting department, together with any detailed supporting data that may be required. The latter department in the preparation of the monthly balance sheet and the statement of profit substitutes the data appearing on the factory ledger trial balance for the control total that appears in the Factory Ledger Control on the general books. This substitution can be made on a work sheet; no journal entry is required.

At the end of the fiscal year any income or expense accounts that are on the factory ledger should be closed and their balances transferred to the

TABLE 9.5
PROGRESSIVE JOBBING SHOP, INC.
INTERIM WORK SHEET—FACTORY LEDGER ACCOUNTS
For the Month Ending January 31, 1948

Debit-balance Accounts

Account number	Account title	Opening entry 1/1/48	Transactions for the month (from Table 9.3)*		Trial balance 1/31/48
			Dr.	Cr	
11	Material Stores	39,000	(1) 30,000	(7) 26,150	43,250
			(14) 400		
12	Supply Stores	6,500	(1) 3,000	(8) 2,900	6,640
			(26) 40		
21	Factory Wages		(2a) 19,000	(2b) 19,000	
22	Outside Processing		(1) 3,500	(11) 3,500	
31	Factory Overhead Control		(1) 2,000	(22) 250	19,009
			(2b) 2,500	(27) 700	
			(3) 2,600		
			(4) 864		
			(5) 805		
			(6) 1,040		
			(7) 150		
			(8) 2,700		
			(9) 3,100		
			(10) 530		
			(14) 400		
			(17) 2,000		
			(26) 470		
			(28) 800		
40	Goods in Process	22,500	(2b) 16,500	(14) 800	24,000
			(7) 26,000	(15) 68,000	
			(11) 3,500	(16) 500	
			(12) 19,800	(17) 2,000	
			(13) 7,000		
50	Manufactured Parts	7,000	(15) 8,000	(13) 7,000	4,500
			(21) 500	(18) 4,000	
60	Finished Product	23,000	(15) 60,000	(18) 66,000	17,300
			(21) 300		
71	Cost of Shipments		(18) 70,000	(21) 800	
				(30) 69,200	
72	Unapplied Overhead				
73	Inventory Adjustment				
	Total	98,000			114,699

* Entries are numbered the same as in Table 9.3 except for the omission here of the month prefix and the "f" suffix.

TABLE 9.5 (*Continued*)

Credit-balance Accounts

Account number	Account title	Opening entry 1/1/48	Transactions for the month (from Table 9.3)*		Trial balance 1/31/48
			Dr.	Cr.	
39	Factory Overhead Applied.	.....	.....	(12) 19,800	19,800
99	General Ledger Control....	98,000	(8) 200	(1) 38,500	94,899
			(16) 500	(2*a*) 19,000	
			(22) 250	(3) 2,600	
			(27) 700	(4) 864	
			(30) 69,200	(5) 805	
				(6) 1,040	
				(9) 3,100	
				(10) 530	
				(26) 510	
				(28) 800	
	Total .	98,000	. .	.....	114,699

general ledger, leaving only asset and liability balances on the factory books. On the general ledger a journal entry may be made if desired to close the Factory Ledger Control account and to show instead the balances of the various inventory accounts and liability accounts that it represents. The latter entry would be reversed at the start of the following accounting period, its purpose being merely to provide a complete record on the general ledger of the data appearing on the company's annual balance sheet.

TABLE 9.6

PROGRESSIVE JOBBING SHOP, INC.

FACTORY LEDGER CONTROL ACCOUNT IN THE GENERAL LEDGER

For the Month Ending January 31, 1948

Factory Ledger Control — Account 800

1948				1948			
Jan. 1	Opening entry.	1-52	98,000	Jan. 31		1-8	200
31		1-1	38,500	31		1-16	500
31		1-2	19,000	31		1-22	250
31		1-3	2,600	31		1-27	700
31		1-4	864	31		1-29	69,200
31		1-5	805				*70,850*
31		1-6	1,040				
31		1-9	3,100				
31		1-10	530				
31		1-26	510				
31	*94,899**	1-28	800				
			165,749				

* Note that the $94,899 debit balance is equal to the balance of the General Ledger Control (account 99) in the factory ledger. The latter, however, is a credit balance (see Table 9.5). The trial balance of the factory ledger that the factory cost accounting department would furnish to the general accounting department would be as follows:

FACTORY LEDGER TRIAL BALANCE

January 31, 1948

Material Stores	$ 43,250	
Supply Stores	6,640	
Factory Overhead Control	19,009	
Goods in Process	24,000	
Manufactured Parts	4,500	
Finished Product	17,300	
Factory Overhead Applied		$ 19,800
General Ledger Control		94,899
	$114,699	$114,699

In preparing the balance sheet and the statement of profit the general accounting department would substitute the balances of the first seven accounts of the factory ledger trial balance for the balance of $94,899 appearing in the Factory Ledger Control.

CHAPTER 10

LEDGER PROCEDURE IN STANDARD COST SYSTEMS

The ledger procedure in standard cost systems is similar to the procedure in job-order cost systems. The flow of costs is traced in the accounts through the various stages of manufacture. Worked-material inventories, however, are booked at standard cost instead of actual cost, and cost variances are recorded for material and labor as well as for overhead.

Illustration

Table 10.1 is an interim work sheet representing the factory ledger of Standard Products, Inc.,[1] for the month ending July 31, 19—. Table 10.2 is the factory journal for the same period. For the sake of conciseness some of the journal entries have been condensed. The journal explanations describe quite fully how the journal amounts were obtained, particularly for those entries affecting the cost-variance accounts.

Costing Shipments

One of the characteristics of standard cost procedure is the costing of worked material at standard unit costs, which appear on standard cost cards or sheets such as those illustrated in Chapter 5. The file of standard cost cards is generally kept in the cost accounting department.

The shipping department reports daily the quantities of each product shipped. The reports may be merely copies of shipping orders, or they may be lists of the items shipped. Copies of the shipping reports are furnished to the cost department where they are costed. The costing operation consists of finding in the file of standard cost cards the unit cost of each item and writing it on the shipping report. The next operation is to extend each item, that is, to multiply the quantity shipped by the unit cost. The item amounts are summarized monthly to obtain the total standard cost of the products shipped, which is debited to Cost of Shipments and credited to Finished Goods (see Table 10.2, entry 7-12).

Costing Factory Output

In order to transfer each month the cost of products completed by the factory from Work in Process to Finished Goods, the cost department

[1] An imaginary enterprise.

TABLE 10.1
STANDARD PRODUCTS, INC.*
INTERIM WORK SHEET—FACTORY LEDGER ACCOUNTS
For the Month Ending July 31, 19—

Debit-balance Accounts

Account number	Account title	Balance 7/1/48	Transactions		Balance 7/31/48
			Dr.	Cr.	
11s	Material Stores (at standard)	80,000	(1) 15,000	(5) 17,750 (10) 70	77,180
12s	Supply Stores	12,000	(1) 1,500	(6) 2,000	11,500
21s	Factory Wages		(2) 10,000	(3) 10,000	
31s	Factory Burden		(1) 1,200 (3) 3,000 (4) 7,000 (6) 2,000 (8) 600	(7) 350 (9) 13,450	
41s	Work in Process (at standard)	25,000	(3) 6,620 (5) 17,500 (9) 13,240	(8) 600 (11) 38,000	23,760
61s	Finished Goods (at standard)	20,000	(11) 38,000	(12) 41,000	17,000
71s	Cost of Shipments (at standard)	240,000	(12) 41,000		281,000
81s	Material Variance	1,500	(1) 300 (5) 250		2,050
83s	Direct Labor Variance	600	(3) 380		980
87s	Burden Variance	550	(9) 210		760
89s	Inventory Adjustment	350	(10) 70		420
	Total	380,000			414,650

Credit-balance Accounts

Account number	Account title	Balance 7/1/48	Transactions		Balance 7/31/48
			Dr.	Cr.	
99s	General Ledger Control	380,000	(7) 350	(1) 18,000 (2) 10,000 (4) 7,000	414,650
	Total	380,000			414,650

* An imaginary enterprise.

TABLE 10.2
STANDARD PRODUCTS, INC.
Factory Journal for the Month Ending July 31, 19—

Journal entry number	Account and explanation	Account number	Dr.	Cr.
7-1	Material Stores (at standard cost)	11s	15,000	
	Supply Stores	12s	1,500	
	Factory Burden	31s	1,200	
	Material Variance (price variance)	81s	300	
	General Ledger Control	99s		18,000
	Purchase-invoice distribution. (The standard cost of material purchased is obtained by pricing the material invoices at standard, then extending and adding. The difference between standard cost and invoice amount is the material price variance.)			
7-2	Factory Wages	21s	10,000	
	General Ledger Control	99s		10,000
	Wage accrual, total wages earned.			
7-3	Work in Process (standard direct labor cost of operations completed)	41s	6,620	
	Direct Labor Variance	83s	380	
	Factory Burden	31s	3,000	
	Factory Wages	21s		10,000
	Labor distribution and application. (The standard direct hours for each operation performed are recorded on the time tickets. The total of the standard direct hours for the operations completed in each department is multiplied by the average standard labor rate for the department to determine the standard direct labor cost of the work done. This amount, $6,620 in this case, is debited to Work in Process. The actual direct labor cost is also recorded on the time tickets, the monthly total being $7,000 in this case. The excess of the actual direct labor over the standard direct labor is $380, which is debited to Direct Labor Variance.)			
7-4	Factory Burden	31s	7,000	
	General Ledger Control	99s		7,000
	Accruals of salaries, taxes, and electricity; insurance expiration; depreciation. (In practice there would be a separate journal entry for each of these factors.)			

TABLE 10.2 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
7-5	Work in Process (standard quantity at standard cost)	41s	17,500	
	Material Variance (quantity variance)	82s	250	
	Material Stores	11s		17,750
	Summary of material requisitions. (Two material-requisition forms are provided, one for standard material, the other for excess material. Requisitions for standard quantities are released by production planning department with production orders. When received by factory accounting department, these requisitions are priced at standard and debited to Work in Process. Requisitions for quantities in excess of standard are issued by shop foremen and must be approved by production planning department. Reason for using excess material is stated on each requisition. Factory accounting department debits excess-material requisitions to Material Variance as a quantity or usage variance.)			
7-6	Factory Burden	31s	2,000	
	Supply Stores	12s		2,000
	Summary of supply requisitions.			
7-7	General Ledger Control	99s	350	
	Factory Burden	31s		350
	Scrap sales.			
7-8	Factory Burden	31s	600	
	Work in Process	41s		600
	Summary of rejected material reports.			
7-9	Work in Process	41s	13,240	
	Burden Variance	87s	210	
	Factory Burden (actual)	31s		13,450
	Burden applied at departmental rates based on standard labor cost. (Departmental totals of standard direct labor cost are multiplied by standard burden percentages to obtain departmental totals of burden applied. The departmental totals are added to obtain the plant total, $13,240, which is debited to Work in Process. Actual overhead for the month is $13,450. The excess of the actual over the amount applied is $210, which is debited to Burden Variance.)			

TABLE 10.2 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
7-10	Inventory Adjustment	89s	70	
	Material Stores	11s		70
	Summary of continuous-inventory-audit reports.			
	Shortages $120			
	Overages 50			
	Net $ 70			
7-11	Finished Goods	61s	38,000	
	Work in Process	41s		38,000
	Summary of factory output reports costed at standard cost.			
7-12	Cost of Shipments	71s	41,000	
	Finished Goods	61s		41,000
	Summary of shipment reports costed at standard cost.			

obtains output reports either from the processing departments or from the production control department. The output reports are costed at standard unit costs by referring to the file of standard cost cards; then they are extended and added to obtain a monthly total, which is debited to Finished Goods and credited to Work in Process, as illustrated by entry 7-11 of Table 10.2.

As a short cut the costing of factory output is omitted in some standard cost systems, the accounts Work in Process and Finished Goods being merged except at the end of the year when a physical inventory is taken.

Cost Variances

The inventory of material in stores may be carried either at actual cost or at standard cost. The latter practice is adopted in the illustration. Purchases of material are costed at standard; the difference between the actual cost shown by the suppliers' invoices and the computed standard cost is then recorded as a material variance caused by variation of purchase prices from standard. In such cases the purchase-price variance is recognized at the cost-incurrence stage (see Table 10.2, entry 7-1). Where the stores inventory is carried at actual cost, the stores requisitions covering materials issued to production are costed both at standard and at actual, and the difference is recorded at the cost-application stage as a purchase-price variation.

Work in Process is carried at standard cost in systems of the attainable-ideal type. Two factors, quantity and unit cost, must be considered in order to determine the standard cost of material chargeable to Work in Process. Material specifications show for each product the standard quantity of material per unit. The number of product units started in process may be multiplied by the standard material quantities per unit to determine the standard quantity input of material. The standard cost of the standard input may be obtained by multiplying the standard quantities by standard unit costs. The actual input costed at standard unit costs minus the standard cost of the standard input is recorded as a material variance caused by variation in quantity used (see Table 10.2, entry 7-5). The method described in the explanation of entry 7-5 gives the same result as would be obtained by the method outlined in this paragraph and is better from the control standpoint, for it brings the variance to the attention of management more promptly.

Another method of computing the standard input of material is to determine first the standard material quantity for the output obtained and then to adjust for any variation in the inventory in process. Thus, if the units completed by a department in a given period required at standard an input of 500 units of certain material and if there were 50 units of the material in the department at the beginning of the month and 75 units at the end of the month, the standard material input for the month would be figured as 500 plus 75 minus 50, or 525 units. This method of computing input on the basis of output is practical where the materials processed are limited in variety and the inventory in process is relatively small. These conditions are found in process industries and frequently in mass-production industries.

The standard direct labor cost of the operations performed each month is debited to Work in Process. The difference between this amount and the actual cost of direct labor is the total labor variance (see Table 10.2, entry 7-3). The standard overhead cost of the operations performed is applied to Work in Process. The difference between the amount applied and the actual periodic overhead is the total factory overhead variance or burden variance (see Table 10.2, entry 7-9). Labor variance and burden variance is well as material-quantity variance are recorded at the cost-application stage.

Spoilage and Shrinkage

Spoilage occurring in the conversion processes must be accounted for. Spoiled materials are not credited to Work in Process in the entry for the factory output because only good products are counted in the tally of

output. To avoid overstating the inventory therefore the Work in Process account must be relieved of the cost of the spoiled material. Assume, for example, that material sufficient for 100 units is put into process, that 90 good units are completed, and that 10 units are spoiled and scrapped after some of the operations have been completed. Work in Process would be charged with material for 100 units and with the labor and burden on 100 units up to the point of spoilage as well as the labor and burden cost of the remaining operations on the remaining 90 units. It would be credited with the 90 good units costed at standard unit costs, which ordinarily do not include any provision for spoilage. Obviously, the Work in Process account must also be credited with the cost of the 10 spoiled units; otherwise their cost would continue to be included in the account balance even though the 10 units had been moved to the scrap heap.

Where it is feasible to do so, as it is in many metalworking plants, spoilage is generally accounted for by means of rejected-material tags, which are prepared by process inspectors when spoilage is discovered. The rejected-material tags are shown to the foreman and superintendent of the department responsible for the spoilage and to the process engineer also in case the method of manufacture appears to be faulty. Thus, management is given a timely report of defective work. Copies of the rejected-material tags are sent to the cost accounting department where they are used as the basis for crediting Work in Process (see Table 10.2, entry 7-8). The debit in most cases is to Factory Burden, as in the illustration, but in some cases a variance account is charged.

Shrinkage cannot as a rule be reported on rejected-material tags. In the continuous-process industries, where the material used to produce a given quantity of output is more than it should have been, the excess material is usually lost. It cannot be tagged. It may have disappeared into the air as vapor or into a drain as effluent. Or it may be in a heap of refuse so commingled with worthless materials as to be economically unrecoverable. If a standard cost system is used, allowance should be made in the standard product costs for a standard shrinkage. The actual shrinkage is usually calculated by working back from the output figures. Shrinkage in excess of standard may be debited to Material Variance as a quantity variance. It would be credited to Work in Process.

Variance Accounts in the Ledger

Ledger accounts are generally provided for Material Variance, Labor Variance, and Burden Variance. These are sometimes classed as periodic-cost-distribution accounts, the actual periodic costs being debited

to them and the standard cost being credited. Thus, the actual direct labor cost may be debited to Labor Variance from the monthly labor distribution. The standard direct labor cost of the work done would then be credited to Labor Variance and applied to Work in Process. In the months when the actual cost exceeded the standard, the debit to the variance account would be more than the credit, and the variance would be called a debit variance. Vice versa, if the standard cost were more than the actual cost, the credit to the variance account would be greater than the debit, and the variance would be called a credit variance.

An alternative method of showing the variances in the ledger is to classify the variance accounts as expense accounts, and then to debit or credit to them only the differences between actual cost and standard cost. This method is employed in the illustration in this chapter. Whether to class the variance accounts as expense accounts in the ledger or as periodic-cost-distribution accounts is merely a matter of bookkeeping preference. The reports to management and the disposition of the variances upon closing the books are not affected by the difference in classification.

Reports of Cost Variances

Cost reports that point out variations from standard performance enable the business executive to direct his attention to situations that merit attention. This is an application of the principle of exceptions. In order to be effective such reports should analyze variations according to causes; they should be timely, that is, they should be available before it is too late to correct conditions that are unsatisfactory.

In addition to monthly analyses of variances, daily or weekly reports of certain types of variance are usually wanted. A good example of a timely report of cost variance is the excess-material requisition. According to a procedure that is briefly described in the explanation of entry 7-5 in Table 10.2, the processing departments cannot obtain material in excess of the standard quantity except by means of an excess-material requisition that must be presented to the production planning department for approval. In many plants reports of labor variations are made daily. Figure 16.3 is a form of daily report that indicates how the actual performance compares with standard. This report shows the actual hours and the standard hours on each operation as well as the daily departmental totals.

Variances should be analyzed according to cause. Such analyses are not usually recorded in the ledger but in supplementary statistical records. The causes of variance are frequently classified as follows:

Material variance, caused by
  Purchase-price variations
  Quantity variations
Labor variance, caused by
  Wage-rate variations
  Efficiency variations
Burden variance, caused by
  Volume variations
  Usage or budget variation

Purchase-price variance may be further analyzed according to classes of material. The other types of variances are generally detailed by departments.

General formulas for analyzing variances according to the foregoing classification can be stated as follows:

Material price variance equals actual quantity at actual purchase price minus actual quantity at standard cost.

Material quantity variance equals actual input at standard cost minus standard input at standard cost.

Total material variance is the sum of the material price variance and the material quantity variance.

Labor wage-rate variance equals actual direct hours at actual wage rate minus actual direct hours at standard rate.

Labor efficiency variance equals actual direct hours at standard rate minus standard direct hours at standard rate.

Total labor variance equals actual direct hours at actual rate minus standard direct hours at standard rate.

Overhead volume variance equals overhead budget at volume actually attained minus overhead applied at standard rate.

Overhead budget variance equals actual overhead minus overhead budget at volume actually attained.

Total overhead variance equals actual overhead minus overhead applied at standard rate.

The July, 19—, variances in the illustration of ledger procedure in this chapter may be analyzed as follows:

Material Variance:	
Purchase-price variance (see Table 10.2, entry 7-1)	$300 Dr.
Quantity variance (see Table 10.2, entry 7-5)	250 Dr.
Total material variance	$550 Dr.

Direct Labor Variance:		
Wage-rate variance		$200 Dr.
(Obtained from time tickets. Where rate paid varies from the standard hourly rate for an operation, the amount of the difference is recorded on the time ticket as a rate variance. The rate variances shown on the time tickets are then added. The total for July, 19—, is a debit variance of $200. This is equal to the excess of the actual hours at actual rates over the actual hours at standard rates.)		
Efficiency variance		180 Dr.
(The actual direct hours at standard rates is $6,800. This is obtained by subtracting the $200 wage-rate variance, a debit variance, from $7,000, the actual direct hours at actual rates as shown by the labor distribution (Table 10.2, entry 7-3). The standard direct hours at standard rates amounts to $6,620. How the latter figure is obtained is explained in Table 10.2, entry 7-3. Subtracting $6,620 from $6,800 gives $180, the efficiency variance, a debit variance.)		
Total direct labor variance		$380 Dr.
Burden Variance:		
Volume variance		
Overhead budget for volume actually attained	$13,550	
Burden applied (see Table 10.2, entry 7-9)	13,240	$310 Dr.
Budget variance		
Actual overhead	$13,450	
Overhead budget for volume actually attained	13,550	100 Cr.
Total burden variance		$210 Dr.

A more detailed classification of causes of variance will be found in Table 6.6. It is a classification that is used in a representative standard cost system.

The analysis of variances is a complex problem. Further discussion of the problem will be found in later chapters. Especially complex is the problem of analyzing the burden variance, a subject that is discussed in Chapter 25.

Disposition of Variances

Attainable-ideal cost standards are realistic standards. They must be revised frequently enough to reflect current price and wage levels as well as changes in manufacturing methods. Otherwise they would be of limited usefulness from the cost-control standpoint.

Attainable-ideal standards may therefore be considered as representing the true cost of production, and costs in excess of standard may be considered as costs of waste, inefficiency, and idle plant capacity. Where this viewpoint is adopted, debit variances are treated in the operating statement as expenses. This is the usual procedure in standard cost systems of the attainable-ideal type. A debit variance caused by variation in volume may be classed as extraordinary expense. The other

types of debit variance are generally shown either as an addition to Cost of Goods Sold or as a deduction from standard gross margin, the latter figure being the excess of net sales over the standard cost of the goods sold.

Quantity variances, efficiency variances, and budget variances are almost invariably debit variances where attainable-ideal standards are used, for the actual performance is seldom better than standard over a period of time as long as a month. Price variances, rate variances, and volume variances occasionally are credit variances, for they are affected by external factors.

A credit variance indicates that actual cost is less than the standard cost. Inasmuch as the inventories should not as a rule be stated at more than actual cost, it is logical to say that a portion of any credit variance should be credited to the inventory, for the inventory must have been debited at a standard figure higher than actual cost at the time the variance account was credited. In practice the desired result is usually accomplished by costing the year-end inventory at actual cost or less and then debiting the amount of the reduction to an Inventory Adjustment account. If the Inventory Adjustment account is treated as an expense account, and this is the usual practice, then it is proper to treat the credit variance as an expense credit. Further discussion of the disposition of variances will be found in later chapters.

Inventory Adjustment

An expense account called Inventory Adjustment may be used at the end of the year to record the difference between the book inventory and the physical inventory. The journal entries for this adjustment would be similar in form to those in a job-order cost system (see Table 8.3, entries 12-51 and 12-52). In a standard cost system the inventory adjustment at the end of the year is in part the result of variances that have not been detected during the year as they occurred. In the worked-material inventory accounts whenever the costing of input is on a different basis from the costing of output, there is a variance. Unless it is accounted for as a variance, it will cause the book inventory to be wrong. Such errors are likely to be cumulative resulting in an inordinately large inventory adjustment when a physical inventory is taken.

In one installation, for example, the labor costs had been substantially reduced through methods improvement and standardization, but the reduction had not been reflected in the standard product costs that were used in costing the factory output. The direct-labor charge to Work in Process was computed by multiplying actual hours by standard wage rates. The wage-rate variance was accounted for, but the efficiency variance was not. As this practice continued for several months the

balance of the account Work in Process—Labor kept decreasing from month to month, and by the end of the year it actually had a credit balance. When the inventory was adjusted to the physical-inventory amount, there was a large credit to Inventory Adjustment.

The situation was corrected in subsequent years by (1) revising the standard product costs annually or oftener and (2) developing a method of measuring and recording the labor-efficiency variance each month and of charging to Work in Process the standard direct hours at the standard labor rate.

Where the stores inventory is under continuous audit, the counting of material in stores is a year-round operation. Some of the stores items are counted every day, and each item is counted at least once in the course of a year. The stores-ledger cards are corrected when errors are found. The stores account in the ledger may be corrected each month, although in some cases it is not adjusted except at the end of the year. The former practice is followed in the illustration in this chapter (see Table 10.2, entry 7-10).

When a revision of the standard product costs is made at a date other than the end of the fiscal year, it is generally desirable to adjust the inventory to the revised-cost basis. A downward revision in unit costs would be recorded by debiting Inventory Adjustment and crediting the inventory accounts. An upward revision would call for a debit to the inventory accounts and a credit to Inventory Adjustment.

The Inventory Adjustment account should be analyzed at the end of the year. The portion representing an adjustment from cost to the lower of cost or market may well be treated as an extraordinary expense. The remainder should generally be shown in the operating statements either in the Cost of Goods Sold section or immediately after the standard gross margin.

CHAPTER 11

LEDGER PROCEDURE IN PROCESS COST SYSTEMS

Characteristics

The ledger procedure in process cost systems is not at all uniform, but some of the more common characteristics are

1. Conversion costs are classified departmentally.
2. Inventories of goods in process are classified so as to show the accumulation of cost at those stages in the manufacturing process where the inventories are significant in amount, in other words, where the inventory must be considered for purposes of cost determination. Frequently this results in a departmental inventory classification. The goods-in-process accounts are sometimes referred to as process cost sheets.
3. No distinction is made between direct costs and indirect costs.
4. The physical inventory method is frequently used to compute end-of-month inventories. This procedure is feasible because the inventory items are few in number.
5. Relatively little use is made of subsidiary accounts.
6. In many cases the monthly inventory adjustments are made on a work sheet and not on the ledger.

When there is only one process or department and only one product, there is little distinction between a process cost system and a noncost system. In any plant where the process cost method is applicable throughout the plant, the raw materials, the manufacturing operations, and the finished products are few in number. The volume of routine cost work therefore is relatively small, and except in the larger enterprises it is usually unnecessary to have either a separate cost department or a separate factory ledger. For the sake of conciseness, however, a factory ledger is used in the following illustration.

Illustration[1]

Table 11.1 is a list of the factory ledger accounts of a cement mill and a trial balance June 1, 19—. The factory journal entries for the month ending June 30, 19—, are shown in Table 11.2. The natural classifica-

[1] Some features of the procedure outlined in the illustration are adapted from an article by Leon E. Smith entitled "Accounting in the Cement Industry," *N.A.C.A. Bulletin*, Vol. 23, No. 3, Sec. I, pp. 162–176.

TABLE 11.1
A CEMENT MILL
Chart of Factory Ledger Accounts
and Trial Balance, June 1, 19—

	Account	*Dr.*	*Cr.*
10	Material and Supplies		
11	Limestone	$ 2,500	
12	Shale	1,400	
13	Gypsum	1,200	
15	Coal	3,000	
18	Factory Supplies	6,000	
24	Cloth Bags (at standard)	4,000	
25	Paper Bags (at standard)	4,500	
28	Bag Cost Variance—Deferred	1,800	
30	Periodic Conversion Costs		
31	Conversion Costs		
31.01	Factory Wages	144,000	
31.05	Payroll Taxes and Insurance	7,600	
31.10	Coal Used	24,500	
31.11	Factory Supplies Used	5,600	
31.14	Repairs	18,000	
31.16	Power	22,000	
31.18	Miscellaneous	8,500	
31.21	Salaries	10,000	
31.25	Property Taxes	7,500	
31.26	Fire and Liability Insurance	2,830	
31.27	Depreciation	16,000	
39	Conversion Cost Applied		
39.61	Crushing and Mixing		$ 82,030
39.62	Kiln		107,900
39.64	Clinker Grinding		52,800
39.65	Packing and Loading		23,800
40	Goods in Process		
41	Crushing and Mixing Process		
43	Kiln (and Clinker Storage)	2,700	
45	Clinker Grinding Process		
60	Cement in Bins	5,600	
70	Expense		
71	Bin Cost of Cement Shipped		
72	Packing and Loading		
74	Bags Used (at standard)		
75	Bag Cost Variance		
99	General Ledger Control		32,700
	Total	$299,230	$299,230

TABLE 11.2
A CEMENT MILL
Factory Journal for the Month Ending June 30, 19—

Journal entry number	Account and explanation	Account number	Dr.	Cr.
6-1	Limestone (8,000 T. @ 50¢)	11	4,000	
	Shale (5,200 T. @ 70¢)	12	3,640	
	Gypsum (180 T. @ $10)	13	1,800	
	Coal	15	5,550	
	Factory Supplies	18	2,208	
	Cloth Bags (30 M. @ $100)	24	3,000	
	Paper Bags (152 M. @ $37.50)	25	5,700	
	Bag Cost Variance—Deferred	28	2,360	
	Repairs	31.14	506	
	Miscellaneous Conversion Costs	31.18	1,500	
	General Ledger Control	99	.....	30,264
	Purchase-invoice distribution.			
6-2	Factory Wages	31.01	36,200	
	Repairs	31.14	2,800	
	General Ledger Control	99	.....	39,000
	Wage accrual.			
6-3	Payroll Taxes and Insurance	31.05	1,870	
	Power	31.16	5,440	
	Salaries	31.21	2,100	
	Property Taxes	31.25	1,510	
	Fire and Liability Insurance	31.26	596	
	Depreciation	31.27	3,160	
	General Ledger Control	99	.....	14,676
	Salary, power, and tax accruals; insurance expiration; and depreciation. (In practice, there would usually be a separate entry for each factor.)			
6-4	Goods in Process—Crushing and Mixing	41	3,750	
	Limestone	11	.....	3,750
	Limestone used.			
	Inventory, June 1.. 5,000 T. @ 50¢ $2,500			
	Purchases..... 8,000 T. @ 50¢ 4,000			
	Total..... 13,000 T. $6,500			
	Inventory, June 30 5,500 T. @ 50¢ 2,750			
	Limestone used.. 7,500 T. $3,750			
6-5	Goods in Process—Crushing and Mixing	41	3,500	
	Shale	12	.....	3,500
	Shale used.			
	Inventory, June 1... 2,000 T. @ 70¢ $1,400			
	Purchases..... 5,200 T. @ 70¢ 3,640			
	Total..... 7,200 T. $5,040			
	Inventory, June 30 2,200 T. @ 70¢ 1,540			
	Shale used..... 5,000 T. $3,500			

TABLE 11.2 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
6-6	Goods in Process—Clinker Grinding	45	1,500	
	Gypsum	13		1,500
	Gypsum used, 150 T. @ $10.			
6-7	Coal Used	31.10	5,150	
	Factory Supplies Used	31.11	1,358	
	Repairs	31.14	1,040	
	Miscellaneous Conversion Costs	31.18	670	
	Coal	15		5,150
	Factory Supplies	18		3,068
	Summary of supply requisitions.			
6-8	Goods in Process—Crushing and Mixing	41	19,600	
	Goods in Process—Kiln	43	25,900	
	Goods in Process—Clinker Grinding	45	12,700	
	Packing and Loading	72	5,700	
	Crushing and Mixing Cost Applied	39 61		19,600
	Kiln Cost Applied	39 62		25,900
	Clinker Grinding Cost Applied	39 64		12,700
	Packing and Loading Cost Applied	39.65		5,700
	Periodic conversion cost applied. (Departmental conversion-cost accounts are kept in a subsidiary ledger. See Table 11.3 for summary of conversion-cost distribution by departments. Inasmuch as the actual costs for the period are applied to production, there is no conversion-cost variance.)			
6-9	Goods in Process—Kiln	43	26,850	
	Goods in Process—Crushing and Mixing	41		26,850
	Slurry to kiln, 60,000 barrels at $0.4475 (see Table 3.4).			
6-10	Goods in Process—Clinker Grinding	45	54,570	
	Goods in Process—Kiln	43		54,570
	Clinker to grinding process, 62,000 barrels at $0.8802 (see Table 3.4).			
6-11	Cement in Bins	60	68,770	
	Goods in Process—Clinker Grinding	45		68,770
	Cement ground and put in bins, 62,000 barrels at $1.1092 (see Table 3.4).			
6-12	Bin Cost of Cement Shipped	71	63,270	
	Cement in Bins	60		63,270
	Cement bagged and shipped, bin cost, 57,000 barrels at $1.11 (see Table 3.4).			
6-13	Cloth Bags	24	3,500	
	General Ledger Control	99		3,500
	35,000 cloth bags returned by customers for credit @ $0.10.			

TABLE 11.2 (*Continued*)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
6-14	Bags Used (at standard)	74	12,925	
	Cloth Bags	24		7,000
	Paper Bags	25		5,925
	70,000 cloth bags @ $0.10 $ 7,000			
	158,000 paper bags @ $0.0375 5,925			
	$12,925			
6-15	Bag Cost Variance	75	2,280	
	Bag Cost Variance—Deferred	28		2,280
	Price variance on new bags shipped to customers.			
6-16	General Ledger Control	99	84,175	
	Bin Cost of Cement Shipped	71		63,270
	Packing and Loading	72		5,700
	Bags Used	74		12,925
	Bag Cost Variance	75		2,280
	To transfer expense-account balances to general ledger.			

tions of conversion cost appear in the factory ledger. The department conversion cost accounts, which are in a subsidiary ledger, are summarized in Table 11.3. This table also shows the conversion costs applied, which in this case are the actual costs for the month. Space is provided in the table, however, for indicating the conversion cost variances in the event the conversion costs were applied at predetermined rates. The ledger accounts Goods in Process and Finished Product are shown in Table 11.4.

Process Cost Sheets

A statement of periodic manufacturing costs in process cost systems is frequently referred to as a process cost sheet. Table 3.4 is a process cost sheet based upon the same data as Tables 11.1, 11.2, 11.3, and 11.4. In it the processes are arranged vertically. This arrangement is flexible, for the report for each process is a separate unit, which need not follow a uniform pattern but can be adapted to the individual characteristics of any process. Table 11.5 is an example of a process cost sheet in which there are columns for the various processing departments, a horizontal arrangement. This form is compact but not very flexible, for the report on each process must follow a uniform pattern. Table 11.5 also illustrates a procedure of costing an inventory within a process and a method of reporting the unit cost of shrinkage.

TABLE 11.3
A CEMENT MILL
DISTRIBUTION OF CONVERSION COSTS BY DEPARTMENTS (SUMMARY OF DEPARTMENTAL CONVERSION-COST ACCOUNTS)
For the Month Ending June 30, 19—

	Code	Total	Building occupancy, Dept. 51	Laboratory, Dept. 52	Mill overhead, Dept. 53	Crushing and mixing, Dept. 61	Kiln, Dept. 62	Clinker grinding, Dept. 64	Packing and loading, Dept. 71
Factory Wages	01	$36,200	$ 400			$14,000	$12,000	$ 8,000	$1,800
Payroll Tax and Insurance	05	1,870	20	$ 24	$ 24	700	600	400	102
Coal	10	5,150	150				5,000		
Factory Supplies	11	1,358	40	20		300	400	300	298
Repairs	14	4,346	300	46		600	2,500	400	500
Power	16	5,440	60	80		1,500	2,000	1,000	800
Miscellaneous	18	2,170	80	40	50	700	600	500	200
Salaries	21	2,100		600	1,200				300
Property Tax	25	1,510	380	10	120	200	400	150	250
Fire and Liability Insurance	26	596	150	10	136	50	100	50	100
Depreciation	27	3,160	600	40	420	350	1,000	300	450
Total		$63,900	$2,180	$870	$1,950	$18,400	$24,600	$11,100	$4,800
Building Occupancy redistributed			$2,180	30	50	400	500	800	400
Laboratory and Mill Overhead redistributed				$900	$2,000	800	800	800	500
Actual Conversion Cost		$63,900				$19,600	$25,900	$12,700	$5,700
Applied Conversion Cost		63,900				19,600	25,900	12,700	5,700
Variance		0				0	0	0	0

Shrinkage

In the process industries there are many processes in which shrinkage is bound to occur. It is usually not necessary, however, in process cost systems to determine the dollar amount of the shrinkage. For product-costing purposes the shrinkage cost is spread over the good units of output. This is done automatically by dividing the cost of output by the number of good units completed.

TABLE 11.4
A CEMENT MILL
WORKED-MATERIAL INVENTORY ACCOUNTS

Goods in Process—Crushing and Mixing Process — Account 41

19—				19—			
June 30	Limestone 7,500 tons	6-4	3,750	June 30	60,000 bbl. slurry to kiln.	6-9	26,850
30	Shale 5,000 tons	6-5	3,500				
30	Conversion cost.	6-8	19,600				

Goods in Process—Kiln (and Clinker Storage) — Account 43

19—				19—			
June 1	Balance 3,000 bbl. @ $0.90		2,700	June 30	62,000 bbl. clinker to grinder	6-10	54,570
30	60,000 bbl. slurry	6-9	26,850				
30	Conversion cost (kiln). . . .	6-8	25,900				

Goods in Process—Clinker Grinding Process — Account 45

19—				19—			
June 30	62,000 bbl. clinker. .	6-10	54,570	June 30	62,000 bbl. cement. .	6-11	68,770
	Gypsum . . .	6-6	1,500				
	Conversion cost. . .	6-8	12,700				

Cement in Bins — Account 60

19—				19—			
June 1	Balance.	. .	5,600	June 30	Shipments 57,000 bbl. @ $1.1090.	6-12	63,270
30	Cement ground 62,000 bbl. @ $1.1072	6-11	68,770				

For cost control purposes shrinkage is usually reported to management as a percentage, which is determined by dividing the shrinkage quantity by the quantity of good units that might have been obtained had there been no shrinkage. The shrinkage percentage is the complement of the yield percentage. Thus, if the yield is 90 per cent, the shrinkage is 10 per cent. In many plants daily reports of yield and shrinkage are prepared. Quantities and percentages are shown, but not dollar amounts.

For financial accounting purposes no journal entry is needed, as a rule, to relieve the work-in-process inventory of the cost of units lost or spoiled. All costs charged to a process except the portion applicable to the final inventory are included in the cost of the output, and the final inventory is generally checked by physical count.

Where an analysis of unit costs is reported, it may be desirable to report the unit cost of shrinkage as one of the items in the analysis. A method

TABLE 11.5

PROCESS COST STATEMENT—HORIZONTAL ARRANGEMENT

Cost	Department 1		Department 2		Plant total	
	Amount	Per unit	Amount	Per unit	Amount	Per unit
Conversion cost						
Variable	$ 920	$0.17	$ 2,880	$0.64	$ 3,800	$0 81
Fixed	800	0 15	500	0.11	1,300	0.26
Total conversion cost	$ 1,720	$0.32	$ 3,380	$0.75	$ 5,100	$1.07
Material input cost	9,500	1.58			9,500	1 58
Unit cost of shrinkage				0.17		0 17
Subtotal	$11,220	$1.90	$ 3,380	$0.92	$14,600	$2.82
Worked material from previous department			9,512	1 90		
Current month's production cost	$11,220	$1 90	$12,892	$2 82	$14,600	$2.82
Initial inventory			4,800		4,800	
Total accountability	$11,220		$17,692		$19,400	
Final inventory	1,708		2,306		4,014	
Cost of output	$ 9,512	$1 90	$15,386	$2 80	$15,386	$2 80

Output and shrinkage	Department 1		Department 2		Plant total
	Units of material	Per cent completed	Units of material	Per cent completed	Units of material
Initial inventory			2,000	80	2,000
Input	6,000		5,000		6,000
Total	6,000		7,000		8,000
Deduct: Final inventory	1,000	40	1,000	60	2,000
Potential output	5,000		6,000		6,000
Actual output of good units	5,000		5,500		5,500
Shrinkage, units	0		500		500
Shrinkage, per cent	0		8.3%		

TABLE 11.5 (*Continued*)

Equivalent conversion units	Department 1	Department 2
Output of good units	5,000	5,500
Final inventory, equivalent units	400	600
	5,400	6,100
Deduct: Initial inventory, equivalent units	0	1,600
Equivalent conversion units, in terms of good units	5,400	4,500

All material required for units started is put into each process at the start of the processing. Shrinkage is not discovered until the end of the processing.

Valuation of final inventories, first-in–first-out basis

Department 1, 1,000 units 40% completed in this process:

Unit cost	
Material	$1 58
Conversion, 40% of $0.32	0 128
	$1 708

Final inventory, Department 1, at cost
1,000 units @ $1.708, or $1,708.

Department 2, 1,000 units 60% completed in this process:

Unit cost	
Worked material, as received	$1 90
Conversion, 60% of $0.676	0 406
	$2 306

Final inventory, Department 2, at cost
1,000 units @ $2.306, or $2,306.

The unit conversion cost of $0.676 used here is obtained by dividing $3,380 by 5,000 units. The latter figure is the equivalent conversion units plus shrinkage units.

Computation of unit cost of shrinkage

In Department 2 the shrinkage was 500 units.

The cost of 500 units of worked material received in this process would be 500 times $1.90, or $950.

This cost is averaged over the good units of output to obtain a unit cost of shrinkage. $950 ÷ 5,500 = $0.173. Conversion costs in the department where the shrinkage occurs are not included in this average.

Method of calculating the other unit cost figures

Departmental columns

Conversion costs per unit: Divide conversion cost amount by equivalent production units (in terms of good units).

Material input cost per unit: Divide material cost amount by units of input.

Unit cost of shrinkage: Method explained above.

Worked material from previous department, cost per unit: divide cost of worked material by number of units received; the result should agree with the unit cost of the output of the previous department.

Total input cost per unit: add the foregoing unit costs.

Output cost per unit: divide cost of output by the number of good units of output.

Plant-total columns

Conversion costs per unit
Material input cost per unit
Unit cost of shrinkage
} Add across; the plant per-unit costs are totals of the departmental per-unit costs.

Total input cost per unit: add down; the result should agree with the input cost per unit of the final process.

Total output cost per unit: divide cost of output by the number of good units of output; the result should agree with the output cost per unit of the final process.

of doing this is illustrated in Table 11.5. In this case there was a shrinkage of 500 units in Department 2. At $1.90 a unit, which is the unit cost of the worked material received from Department 1, the shrinkage represents a cost of $950. Dividing this amount by 5,500 units, the output of good units, gives 17 cents, the shrinkage cost per unit. As thus computed the unit cost of shrinkage includes only the cost accumulated in previous departments; it does not include any conversion cost of the department where the shrinkage occurs. To remedy this defect in the method, however, would make the procedure quite complicated without greatly increasing the utility of the result.

Standard Cost Systems of the Process Type

A company with a well-established process cost system will have accumulated reliable data on material usage and operation costs. Hence, it is usually not difficult to convert a process cost system to a standard cost system. Standard material costs and standard operation costs must be predetermined; then the material input and the conversion must be charged to Work in Process at standard cost, and the differences between actual and standard must be treated as variances. A standard cost system in a continuous-process industry may be referred to as a standard cost system—process type.

In so far as material is concerned the ledger procedure in such a system would be quite similar to the procedure described in Chapter 10. There would probably be no separate classification for direct labor. With respect to conversion costs, including process labor, the treatment would be the same in principle as the treatment of overhead described in Chapter 10, but viewed superficially the procedures found in practice are likely to appear to be more nearly in accord with those illustrated in the present chapter. One would probably find in the ledger a series of periodic-cost-distribution accounts for the various natural classifications of conversion cost and a separate account or series of accounts for conversion costs applied. The latter would be credit-balance accounts. The total conversion-cost variance would be the difference between (1) the sum of the debit balances in the natural-classification accounts and (2) the sum of the credit balances in the applied conversion-cost accounts.

The conversion-cost accounts provided in the chart of accounts illustrated in Table 11.1 would be suitable for a standard cost system of the process type. The accounts in the 39 series would record the credits for conversion costs applied. In the illustration the actual periodic costs are credited to those accounts. In a standard cost system the standard conversion costs for the operations performed each month would be credited to the accounts in the 39 series.

In so far as the worked-material inventories are concerned the ledger accounts would be the same in a standard cost system of the process type as they would be in a process cost system of the historical type. In the standard cost system, however, these inventories would be carried at standard cost.

An accounting must be made of shrinkage in a standard cost system of the process type. The standard costs used in costing the output should include a standard shrinkage. Excess shrinkage would be debited to a variance account and credited to Work in Process.

Standard cost systems of the process type are admirably suited to process industries having a variety of products due to varying combinations of ingredients, of operations, and of product sizes. A steel rolling mill, for example, uses various steel alloys and produces sheets of various sizes and of various finishes. The items of raw material are not numerous; neither are the operations performed. But used in various combinations they result in too great a variety of products to permit the use of the averaging procedure of historical process cost accounting. Elsewhere in modern industry similar conditions are frequently found as, for example, in plants manufacturing rubber goods, textiles, ceramics, paints, and packaged-food products.

CHAPTER 12

PURCHASES

The discussion turns now to transaction records and subsidiary accounts. It is in this area of cost accounting that the volume of routine detail work is the greatest, but paradoxically it is here that much of the zest of cost accounting is found. The detailed records in modern accounting systems are not merely historical records but are designed also to aid in controlling operations. Among the most absorbing problems of the cost accountant are the problems of developing efficient accurate methods for performing the detailed work and of designing and using the records for control purposes. The two problems are closely related.

In order to become expert in methods work an accountant should study (1) the principles of office machine application and form design and (2) management practice. The student who has access to a metropolitan library or a university library should be able to find numerous references to articles in technical and professional publications on both subjects by consulting the Industrial Arts Index, the Engineering Index, the Accountant's Index, and the Topical Index of N.A.C.A. (National Association of Cost Accountants) Publications. The N.A.C.A. publications, which are available in many plant libraries, contain much practical and timely information on these subjects.

Companies that manufacture and distribute office machines and office forms have done a great deal of research in office methods. Many of the bulletins and booklets that are published by these companies are highly instructive. Their representatives, who as a rule have had training and experience in methods work, are glad to cooperate with industrial accountants by working out applications of equipment and forms. The advice and the publications of the distributors of forms and equipment are instructive but obviously not impartial. The cost accountant must exercise his own judgment in order to appraise the merits of competing claims as applied to the particular problems of the plant where he is employed.

Functions Connected with Procurement

Table 12.1 is a list of the principal functions that are involved in the procurement of goods and services from suppliers. It shows the assign-

ment of functions to departments in a case that is typical of industries where a large number of materials and parts are purchased. In industries of this type the contacts with suppliers and the placing of purchase

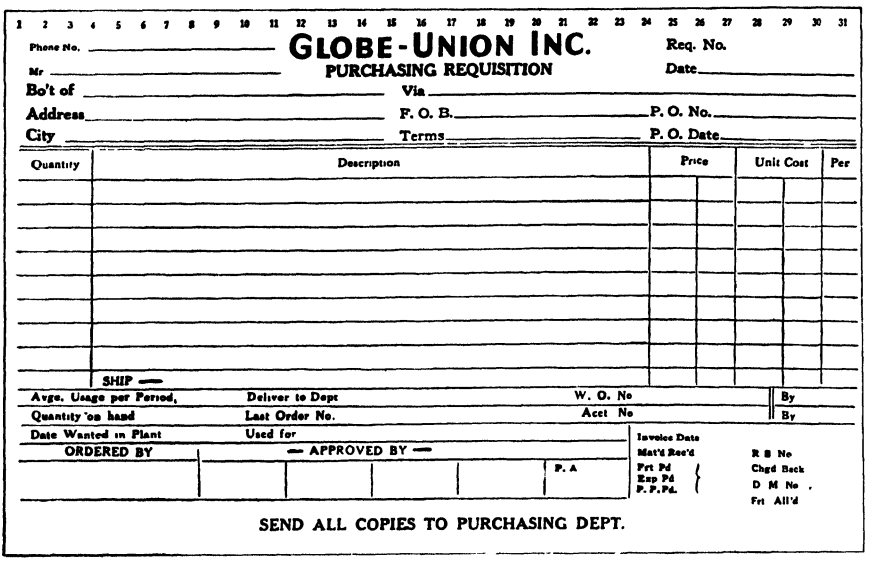
TABLE 12.1
AN ENGINE MANUFACTURER
PRINCIPAL FUNCTIONS CONNECTED WITH PROCUREMENT

Function	Department Responsible
1. Describe what is wanted, specify size and quality	Engineering department for material Production engineering department for machinery, shop equipment, shop tools and supplies Office manager for office equipment and office supplies Purchasing department should be consulted as to what commodities are obtainable, their characteristics and prices
2. Determine how much is wanted and when it is needed	Production planning department for material and for stock items of supplies Production engineering department for machinery, shop equipment, special tools, and supplies Office manager for office equipment and special items of office supplies Purchasing department should be consulted in regard to most economical purchasing quantities
3. Find out what suppliers are qualified to supply each item	Purchasing department; the engineers and executives who are acquainted with the work of various suppliers should be consulted
4. Obtain quotations	Purchasing department
5. Place purchase orders	Purchasing department
6. Issue shipping instructions (usually on the purchase order)	Purchasing department, in accordance with standards established by the traffic department
7. Follow up delivery if necessary	Purchasing department
8. Receive the incoming goods, and make a record of what is received	Receiving department
9. Inspect goods that have been received	Inspection department
10. Audit suppliers' invoices, and make accounting distribution	Purchasing department and accounting department
11. Make payment	Treasurer

orders are usually centralized in a purchasing department under the supervision of a purchasing agent. Centralization of purchasing has long been recognized as a desirable control measure.

It is the duty of the purchasing agent to keep himself informed about

sources of supply, new materials that are available, and market prices and to transmit the information to other departments that can make use of it in planning. He is in a position to suggest practical measures to reduce material costs through changes in design and specifications, through purchasing in the most economical quantities, and through taking advantage of favorable prices. Because all purchase requests must clear through his department, he can enforce a management requirement that



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Phone No. _____ **GLOBE-UNION INC.** Req. No.

Mr _____ **PURCHASING REQUISITION** Date _____

Bo't of _____ Via _____

Address _____ F. O. B. _____ P. O. No. _____

City _____ Terms _____ P. O. Date _____

Quantity	Description	Price		Unit Cost		Per
	SHIP —					

Avge. Usage per Period,	Deliver to Dept	W. O. No	By
Quantity on hand	Last Order No.	Acct No	By
Date Wanted in Plant	Used for	Invoice Date	
ORDERED BY	— APPROVED BY —	Mat'l Rec'd	R S No
	P. A	Frt Pd / Exp Pd / P. P. Pd.	Chgd Back / D M No / Frt All'd

SEND ALL COPIES TO PURCHASING DEPT.

FIG. 12.1. Purchase requisition. (*Globe-Union, Inc.*)

requests be properly authorized, and he can question unusual requests before issuing purchase orders. He can help to develop a purchase budget, and he can take responsibility for regulating purchases in accordance with the budget.

Forms Used

The forms used in connection with procurement that are of principal interest to the accountant are

Purchase Requisition
Purchase Order
Supplier's Invoice
Invoice Verification Stamp
Receiving Record
Debit Memorandum
Check and Remittance Advice

Purchase Requisition

The *purchase requisition* is a request to the purchasing department to procure certain specified goods or services. The members of the organization who are authorized to issue purchase requisitions are designated by the management. Thus, purchases of material and standard supplies must as a rule be requested by the department in which the stores ledger is kept.

The purchase requisition generally must contain the following information

Description of article or service wanted
Quantity needed
Reason for purchase
When needed
Delivery point
Account to be charged, usually a subsidiary account number

Figure 12.1 is an illustration of a purchase-requisition form. Two copies are usually prepared, one of which is sent to the purchasing department while the other is retained by the issuing department.

In some offices, as a short cut, the use of the purchase requisition is omitted in the case of materials, parts, and supplies that are carried in stores. Under a procedure that is satisfactory in a small office the stores-record clerk simply removes from the file the stores ledger card for the item that is to be purchased, attaches a notation showing the quantity needed, and hands the card to the purchasing agent. Under a slightly different procedure that is more satisfactory in larger offices, the stores record for each item consists of two cards. One of the cards, which remains in the file at all times, is a perpetual-inventory card. The other card, which is called a permanent-purchase requisition, contains information that the purchasing agent needs to have when making a purchase. Figure 14.2 is an illustration of a two-part stock-record form of this type. To request a purchase the stores-record clerk removes the permanent requisition card from the file, makes a notation on it to show the quantity needed, and sends it to the purchasing department. Another short cut, sometimes adopted in jobbing shops, is to use a copy of the production order as the purchase requisition in the case of material that is to be purchased especially for a particular order.

Purchase Order

The *purchase order* is a very important document, for it is the principal evidence of the contract between buyer and seller. Most manufacturing companies issue purchase orders on serially numbered forms and require that the supplier indicate the purchase order number on invoices and

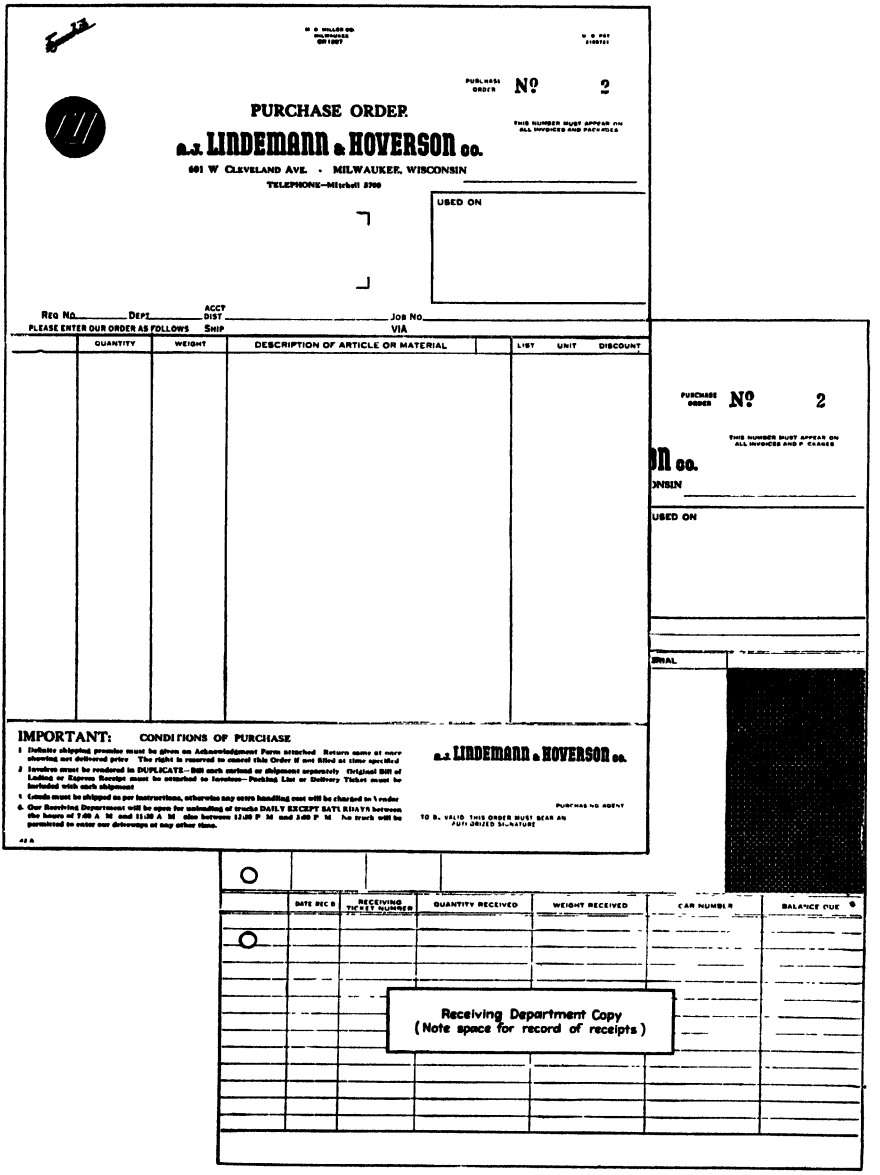


FIG. 12.2. Purchase order. (*A. J. Lindemann & Hoverson Company.*)

shipping tags. Figure 12.2 is a reproduction of a representative form of purchase order.

At least two copies of the purchase order are needed, one for the supplier and one for filing; usually, however, more copies are prepared. In a fairly representative case seven copies are made as follows:

1. Original copy, to supplier
2. Acknowledgment copy, also sent to supplier to be returned by him properly executed as his acknowledgment of the order
3. Binder copy, filed numerically in the purchasing department
4. Copy to department that issued the purchase requisition
5. Copy to accounting department for use by that department in the audit of the vendor's invoice
6. Copy to receiving department as advance notice of goods to be received
7. Follow-up copy, to follow-up section of purchasing department

In order to eliminate the operations of inserting carbon paper and aligning the various copies of the form in the typewriter, it is usually desirable, unless the volume of purchase orders is small, to use either forms in sets with carbon sheets interleaved by the manufacturer or continuous forms. Continuous forms can be designed either to be used with floating carbon paper, which is attached to the machine and not a part of the form, or to be furnished with interleaved carbon sheets.

On certain copies of the purchase order it may be desirable not to write the purchase price. In this case the space for price can be blacked out on those copies in printing the forms, or if interleaved carbon is used, a portion of the carbon may be either cut out or left uncoated in the position where the price would otherwise be recorded.

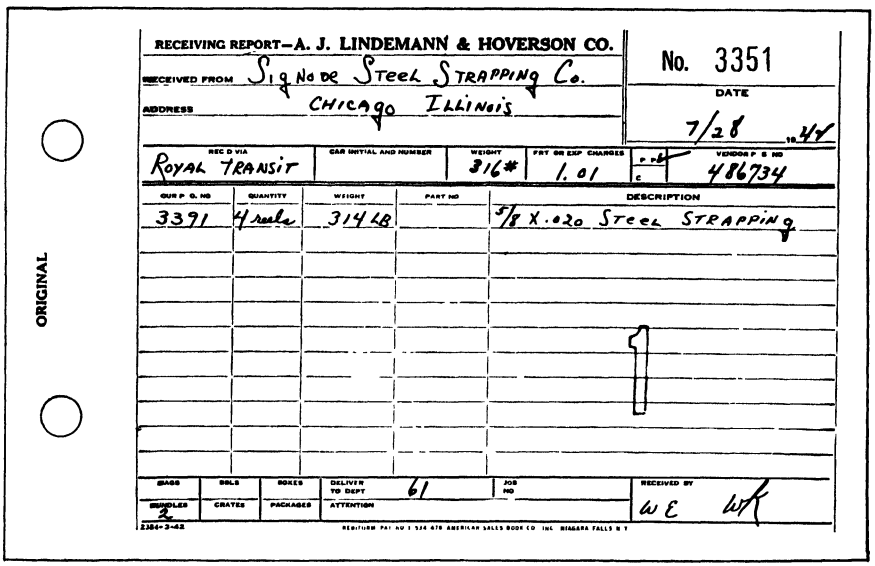
Some accountants advocate that the quantity be omitted on the copy of the purchase order that goes to the receiving department. The advantage claimed for this procedure is that the receiving department will then be forced to count the incoming material instead of merely copying to the receiving record the quantity shown on the purchase order. This claim appears to have little merit, however, for if the receiving department wishes to copy the quantity, it can do so from the supplier's packing slip that accompanies the shipment.

Receiving Record

In any business, whether it has a cost system or not, the receiving of purchased commodities is a function that should be systematically administered. Otherwise there are bound to be delays in the delivery of commodities to the departments needing them as well as mistakes in the payment of suppliers' invoices. In manufacturing concerns the respon-

sibility for the receiving function as a rule is centralized in a receiving department. So far as practical, incoming materials are delivered to the receiving department; in any event the records of goods received clear through that department.

The duties of the receiving department are to unload, unpack, and examine incoming goods; to count, weigh, or measure, checking quantity received with quantity shown on supplier's packing list; to check goods received against the description on the purchase order; to arrange for inspection by the inspection department when that is required; to make a


ORIGINAL

RECEIVING REPORT—A. J. LINDEMANN & HOVERSON CO. No. 3351

RECEIVED FROM Sig Node Steel Strapping Co. DATE 7/28 '44

ADDRESS Chicago Illinois

REC'D VIA	CAR INITIAL AND NUMBER	WEIGHT	FRT OR EXP CHARGES	P-P / C	VENDOR'S P.S. NO.
Royal Transit		316#	1.01		486734

OUR P.O. NO.	QUANTITY	WEIGHT	PART NO.	DESCRIPTION
3391	4 coils	314 LB		5/8 X .020 Steel Strapping

BAGS	BOLS	BOXES	DELIVER TO DEPT. 61	JOB NO.	RECEIVED BY
BUNDLES 2	CRATES	PACKAGES	ATTENTION		W E

2384-3-42 REORDER FROM AMERICAN SALES BOOK CO. INC. NIAGARA FALLS N.Y.

FIG. 12.3. Receiving record. (*A. J. Lindemann & Hoverson Company.*)

record of goods received; to notify purchasing department of any discrepancies discovered; to notify traffic department and purchasing department of any damage in transit; and to arrange for delivery of the accepted goods to the location in the factory shown on the purchase order.

In small shops the record of goods received may be merely a notation penciled and initialed by the receiving clerk on the supplier's packing slip, it may be a list or blotter with a page for each day's receipts, or it may be a notation made on the receiving department's copy of the purchase order. In larger shops, where several copies are required, a form known as a *receiving record* is provided. Figure 12.3 is a reproduction of a receiving-record form. In a representative case five copies of each receiving record are prepared. The copies are distributed as follows:

1. Travels with goods through inspection to stores or other destination, used for entry on balance-of-stores ledger

2. Travels with material to inspection, filed by inspection department with notation of action taken. In case material is rejected, inspection department makes a rejected-material report, copies of which are sent to purchasing department and to accounting department

3. Follow-up copy sent to follow-up clerk in purchasing department

4. Audit copy sent to purchasing department for use in verifying invoice

5. Receiving department's file copy

Because much of the information appearing on receiving records also appears on purchase orders, it is the practice in many plants to initiate the writing of the receiving record in the operation of writing the purchase order. When this is the practice, the purchase-order form and the receiving-record form are purchased together in sets. The two sets of forms make up one set for insertion in the form-writing machine that is used for the preparation of the purchase order. Data written on the purchase order are imprinted on the receiving record by means of carbon. The receiving-record set is then detached and sent to the receiving department where it is filed until the goods are received. It serves as a copy of the purchase order for reference purposes in the receiving department. When the goods are received, the receiving department fills in the necessary information to show the receipt. Blank sets of receiving-record forms are supplied to the receiving department to be used for reporting the receipt of partial shipments, the set prepared with the purchase order being kept on file by the receiving department as a master copy until the final shipment on the order is received.

The writing of purchase orders and receiving records in one operation is a simple illustration of a technique that is often employed in modern accounting systems. Where the work can be arranged so that a number of different records can be prepared in one instead of several operations, the advantages usually are

1. A reduction in the man-hours required to write the forms
2. A proportionate reduction in the time required for checking
3. Avoidance of errors
4. Earlier completion of records and reports

Purchase Invoice

The *purchase invoice* is the basis for the accounting record of a purchase transaction. The purchase invoice is prepared by the supplier. It is his sale invoice. In the absence of specific instructions as to the number of copies, suppliers generally furnish one copy. If additional copies are needed by the buyer, or if there are any special requirements as to form and content of invoice, the requirements should be stated on the purchase

order. In the case of purchases of goods for use on cost-plus-fixed-fee government contracts it is necessary for the buyer to obtain an extra copy of the invoice to furnish to the government cost inspector. In some cases the purchaser supplies the purchase-invoice form and requires the vendor to prepare the invoice on it.

MAY 28, 1948

VERIFICATION APPROVAL		PUR ORDER NO		DISC IF PAID BY		
QUAN RECD	BUYER			%		
		STANDARD		ACCT DIST	ACTUAL	
PRICE	DEPT EXEC					
EXT.	PLANT EQUIPT					
STD COST	MGMT APPR					
DISTRIBUTION	VOUCHER O K					

FIG. 12.4. Invoice-verification stamp.

Purchase invoices, except in retail trade, are generally received in the mail either before the receipt of the goods or shortly afterward. They are delivered by the mailing department to the purchasing department. An invoice-verification form is then imprinted on each invoice by means of a rubber stamp. This form, which is illustrated by Fig. 12.4, provides spaces for the initials of those who verify and approve the invoice as well as spaces for account number and other pertinent information. In case the purchaser supplies invoice forms to the supplier, the spaces for invoice-verification data are provided when the invoice is printed. The data then appear in the same position on each invoice, usually in the upper right-hand corner.

In some companies it is the practice to number the invoices as they are received and to prepare an invoice register as a means of tracing invoices that are in the process of verification. If the work of the office is well organized, however, this step can usually be omitted, thereby saving a substantial amount of clerical effort.

Under any system of accounting the purchase invoices should be carefully verified prior to final settlement with the supplier. The verification should cover the following points:

1. Description of goods or services. Does the description of the items on the invoice coincide with that on the purchase order and on the receiv-

ing record? In other words, did the supplier furnish and invoice the items that were ordered?

2. Quantity. Does the quantity invoiced agree with the quantity received and the quantity ordered?

3. Quality. Do the goods or services meet the quality specifications called for by the purchase agreement?

4. Price, terms, and freight. Are the price and the terms of payment shown on the invoice in accordance with the purchase agreement? Did the supplier either pay the freight or make adequate allowance on the invoice for freight to the delivery point agreed to?

5. Extensions and footings. Are the vendor's calculations of the invoice amount correct?

6. Executive approval. In most plants, before final settlement is made, invoices must be inspected and approved by the purchasing agent or his representative and by the controller or his representative. Invoices for purchased services, for machinery, and for other special items must generally be approved by the executives who have authorized the purchases.

7. Supporting documents. As a rule a copy of the receiving record is attached to the approved invoice, and unless the invoice represents a partial shipment, a copy of the purchase order is also attached.

The work of verifying purchase invoices is generally divided between the purchasing department and the accounting department, a major part of it being assigned to the purchasing department. That department negotiates with suppliers for the adjustment of errors that are disclosed in the verification process, and the negotiations can be conducted with a minimum of lost motion if that department also makes the verification. The work of the purchasing department should be audited, however, by the accounting department before the invoices are approved for payment. The sampling technique may be used, but the audit by the accounting department should not be merely perfunctory.

In some companies verification of purchase invoices is assigned to the accounting department instead of the purchasing department. The advantages claimed for this procedure are

1. Duplication of work is eliminated. It is unnecessary to audit the verification when it is done by the accounting department.

2. There is less opportunity for collusion between an employee and a supplier because the auditing function is divorced from the buying function.

In connection with the invoice verification the accounts to be charged are indicated in a space provided for that purpose in the invoice-verification form. This is done as a rule by the accounting department. Both

the control accounts and the subsidiary classifications are designated. Inasmuch as the account number is written on the purchase requisition and then copied to the purchase order and the receiving record, the charge number selected by the person who issued the purchase requisition can readily be ascertained. In fact some companies go a step further by instructing vendors to copy account numbers to invoices. The account number appearing on the receiving record or written by the vendor on the invoice is checked in the accounting department and the correct number entered in the proper space of the invoice-verification form.

The operation of costing material invoices at standard cost, when that is required, may also be performed in connection with the verification of invoices. As a rule the costing is done by the cost department. The invoice price of each item of material is compared with the standard unit cost. If they agree, a check mark is made. If they differ, the amount at standard cost is computed and written on the invoice. The standard cost data are generally written in a distinctive color. Spaces may be provided on the invoice-verification form for showing the standard cost (see Fig. 12.4). The recording of standard costs on invoices serves a useful purpose from the auditing standpoint, for the comparison of standard costs with invoice amounts sometimes discloses errors in the invoices.

Debit Memorandum

A *debit memorandum* is a form prepared by the purchaser to notify the supplier that his account is being debited. The reason for making the debit is explained either in the body of the debit memorandum or in an accompanying letter. In some cases the issuance of the debit memorandum is preceded by negotiations with the vendor to obtain an adjustment. The supplier may follow the practice of issuing a credit invoice (or supplier's credit memorandum) upon receipt of the debit memorandum in case he considers that the purchaser is entitled to credit.

Debit memoranda are issued to correct overcharges in vendors' invoices caused by errors in price, quantities, extensions, or footings, or by failure to make proper allowance for freight. Debit memoranda are also issued to charge vendors for material returned and for cost of reconditioning defective material. Figure 12.5 is an illustration of a debit-memorandum form.

A copy of the debit memorandum is sent to the accounting department where it goes through the same routine as the purchase invoice, except that its effect upon the accounts is the opposite. It is a debit to Accounts Payable instead of a credit and a credit to cost-incurrence accounts instead of a debit.

Purchaser's Credit Memorandum

A purchaser's credit memorandum is a form issued by the purchaser to notify the supplier that his account is being credited. The usual reason prompting a purchaser to issue a credit memorandum is to correct a debit memorandum that is found to be excessive in amount. The purchaser's

DEBIT MEMORANDUM

GLOBE-UNION INC.

MANUFACTURERS OF
Storage Batteries · Spark Plugs · Roller Skates · Centralab Radio Products
900 EAST KEEFE AVE · MILWAUKEE · WISCONSIN

NO. 11556
FACTORY
DATE

OUR ORDER NO
YOUR INVOICE
CHARGE TO
SHIPPED TO
DATE SHIPPED
SHIPPED VIA
COLLECT ☐ PREPAID ☐

QUANTITY	TYPE	ARTICLES	PRICE	PER	AMOUNT

TRANSPORTATION CHARGES
CREDIT W O NO
ACCT NO
TOTAL AMOUNT OF DEBIT $

WE ARE RETURNING FOR CREDIT ☐
WE DEBIT YOUR ACCOUNT AS FOLLOWS ☐ DEFECTIVE ☐ REASON
PLEASE SEND CREDIT MEMO ☐ ORIGINAL EXPRESS RECEIPT HEREWITH ☐ PAID FREIGHT BILL HEREWITH ☐
PLEASE SEND CHECK ☐ ORIGINAL BILL OF LADING HEREWITH ☐ PAID EXPRESS BILL HEREWITH ☐

Do not replace any material unless authorized by us on our formal purchase order.

FORM 124

FIG. 12.5. Debit memorandum. This form is printed in red ink to distinguish it from invoices. (*Globe-Union, Inc.*)

credit memorandum has the same effect upon the accounts as a purchase invoice.

Freight and Express

Invoices for freight and express are received by the receiving department with the incoming goods. In some cases the transportation charges must be paid in order to obtain delivery of the goods. If credit has been arranged with the carrier, the freight bills are payable usually within 48 hours after delivery. Because the payment must be made so promptly, the freight rates and the extensions and footings are usually not checked until after the bills have been paid.

The receiving department checks the weight and description appearing

on the freight bill and records on the receiving record the amount of the transportation charges. There are two reasons for the latter operation: to prevent the approval of duplicate freight bills and to furnish the department that verifies the suppliers' invoices the information it needs to have in order to determine whether the supplier has either paid or allowed the freight to the f.o.b. point agreed to in the purchase agreement. From the receiving department the freight invoices are sent to one of the office departments for approval and payment.

Internal Check

Internal check is defined by Victor Z. Brink as

> . . . the methods and practices of all kinds whereby the accounting forms and records, and the procedures affecting their use, are all coordinated and operated in such a manner that management derives from the accounting function the maximum utility for its purpose of information, protection, and control.[1]
>
> Internal check is in the last analysis a measure of the efficiency of the accounting system and the extent to which the system serves its intended needs at the most economical cost. Custom and convenience permit one to refer to internal check as if it had a separate entity or existence, but in fact this is not so. A system of internal check is nothing more than the parts of the accounting system judged and evaluated from a particular point of view—how efficiently they are designed, and how satisfactorily they function to produce the desired results.[2]

Brink discusses four general principles to be followed in order to obtain satisfactory internal check. They are

1. That no person be in complete control of an important part of a business transaction
2. That accounting and operation be separated
3. That proofs and control methods be utilized to the greatest practical extent
4. That responsibility be fixed to as great an extent as possible.[3]

Among the features of cost accounting systems contributing to internal check are the operation of cost records as an integral part of the double-entry system; the use of perpetual inventory records, checked from time to time by physical inventories; the application of the proof and control features of accounting machines; and the checking of cost figures with predetermined standards. The division of duties in the verification of purchase invoices is an excellent example of the application of the first principle of internal check which was cited above. When there is a division of duties, fraud is discouraged because it cannot be practiced

[1] Brink, Victor Z., *Internal Auditing*, p. 73, The Ronald Press Company, New York, 1941.

[2] *Ibid.*, p. 89.

[3] *Ibid.*, pp. 76–78.

unless there is collusion between two or more employees, and clerical errors are likely to be detected promptly because the work of each individual is a check upon the work of the others.

An accountant who was appointed controller of a manufacturing company relates an example of defective internal check caused not by a fault in the design of the accounting system but by careless administration. His attention was called to a supplier's credit memorandum for $900 carrying the explanation: "To cancel our invoice, number 19015, paid by your check, number 8624. This invoice was a duplicate of our invoice number 18590." Upon investigation the controller found that when an invoice was received by the purchasing department for which there was no receiving record on file it was the practice for the invoice-verification clerk in the purchasing department to telephone the receiving clerk to request a receiving record. Obligingly the receiving clerk would issue the receiving record without checking to determine whether one had previously been issued for the same material. No evidence of fraud was disclosed by the investigation, but a careless and costly habit had developed because the employees doing the work were not properly trained and supervised.

There should be no duplicate payments where there is a good internal check. If the receiving records represent bona fide receipts, and if a receiving record must be attached to each invoice for commodities before the invoice is approved, it is impossible to pay for the same goods twice. In the case of purchased services, there are some invoices that can be checked with receiving records, for example, freight bills and invoices for outside processing; those which are not covered by receiving records should be checked by some other means.

Purchase Invoice Distribution

After purchase invoices and debit memoranda have been verified, the distribution is summarized, the debit-memorandum amounts being subtracted from the invoice amounts. Entry 12-1 of Table 8.2 is an illustration of a journal entry for a purchase-invoice distribution showing the debits and credits to the control accounts in the general ledger. The debit side of the entry is often referred to as the distribution since the debits are distributed to a number of different accounts, whereas the credit is to a single account, usually Accounts Payable.

If the problem of accounting distribution were merely one of distributing data to control accounts, it would not be difficult. Because the data must also be distributed to numerous subsidiary accounts, however, the problem of distribution is one of the principal problems of cost accounting. In the case of the fixed-asset accounts, for example, in

addition to the control accounts there are likely to be subsidiary accounts for the different units of plant and equipment. These subsidiary accounts are kept in a plant ledger. Generally an itemized schedule of fixed-asset purchases is prepared also. Entries to the plant ledger and to the schedule of fixed-asset purchases are made from the audited invoices, two separate operations being required. In the case of material purchases, entries must be made to subsidiary accounts in the balance-of-stores ledger. These entries are usually made either from the receiving record or from a copy of the invoice. There are also likely to be accounts for different classes of material. Distribution to the material-class accounts is generally accomplished in conjunction with the distribution to the control accounts. In the case of supply stores the procedure is similar to that for material purchases. In the case of factory overhead there are usually subsidiary departmental classifications as well as the natural classifications. Distribution to subsidiary overhead accounts is frequently made in conjunction with the distribution to the control accounts. Distribution methods and their application to the distribution of purchase-invoice data are discussed more fully in Chapter 13.

Purchase Liabilities and Remittances

Accounting for purchase liabilities and for remittances, although a problem of general accounting rather than cost accounting, is so closely related to the work of cost distribution that it is discussed briefly here. The principal procedures of accounting for purchase liabilities and remittances can be classified as follows:

A. Dual-tabulation systems, in which one tabulation is made to set up the purchase liability, another to record the remittances
  1. Accounts-payable systems
     a. Liability recorded upon receipt of invoice
     b. Liability recorded after invoice has been audited
  2. Voucher systems

B. Single-tabulation systems in which only one detailed tabulation is made—when the remittances are recorded

It is customary to pay for purchases by check and to furnish the supplier a remittance advice with the check. The *remittance advice* is a list of (1) the supplier's invoices to which the payment applies, (2) deductions covered by purchaser's debit memoranda, and (3) deductions for cash discount. The check and the remittance advice may be two separate forms; they may be combined, being printed on two halves of a single sheet of paper that is perforated at the center; or they may be combined and nonseparable. The last type of form is known as a voucher check.

Accounts-payable Systems

In manufacturing industries it is not practical to operate a hand-posted accounts-payable ledger unless the number of suppliers' accounts is unusually small. Most plants procure goods and services from so many different sources that the accounts payable are very numerous. When the volume of invoices is sufficiently large to justify the use of a bookkeeping machine, it is practical to operate a mechanized accounts-payable system.

At frequent intervals, usually once a day, invoices and debit memoranda are listed individually in a purchase register. In the same operation the data are posted and new balances printed in the subsidiary accounts payable. The subsidiary account-payable forms are generally purchased in sets, three copies in each set, with interleaved carbons. The accounts-payable sets are filed alphabetically according to supplier's name until paid. The check number and amount is then written on the form; in the same operation the check and the check register are prepared. The three copies of the set are then separated, the carbon sheets being discarded. One copy is sent to the supplier as a remittance advice; one copy is filed numerically by check number; one copy is placed in an alphabetical file of paid accounts. Paid invoices are generally assembled and filed with the alphabetical file copy of the supplier's account. The monthly total of the purchase register is the amount credited to Accounts Payable Control. The total of the Accounts Payable column in the check register is debited to that control. The file of unpaid accounts is the subsidiary accounts payable ledger.

In case the liability is recorded as soon as invoices are received, the distribution must be recorded afterward when the invoice has been audited and classified. The purchase register total would be recorded in the general journal as a debit to Undistributed Purchases, a clearing account, and a credit to Accounts Payable. An additional entry would be made to distribute the purchase costs, debiting cost accounts and crediting Undistributed Purchases.

If the purchase liability is booked after the invoices have been audited, the cost distribution may be made in conjunction with the operation of writing the purchase register and the subsidiary accounts payable (for illustrations see Figs. 13.2, 13.3, and 13.4). The general journal entry under this procedure would follow the form illustrated by the entries for purchase-invoice distribution in Chapters 8 to 11 (see, for example, Table 8.2, entry 12-1).

Voucher Systems

Ordinary typewriters and adding machines are about the only pieces of mechanical equipment that are required for the operation of a purchase

voucher system. There are more manual operations in this procedure than in those previously discussed, but it is a practical procedure when the volume of invoices is small enough to justify the use of hand methods.

Invoices and debit memoranda, after they have been audited and classified, are filed alphabetically until time for vouchering. At the end of each month and at other regular intervals during the month, but usually not oftener than once a week, purchase vouchers are typed, one for each supplier. The purchase voucher, three copies of which are prepared, contains a list of the invoices and the debit memoranda covered by it and a summary of the accounting distribution. The vouchers are numbered consecutively and usually are entered in a voucher register. The cost distribution may be recorded in the voucher register, in which case a handwritten columnar form is generally used. Figure 13.7 is an illustration of a columnar voucher register. In other cases the voucher register is merely an adding-machine tape supported by the numerical file of vouchers, the credit to Vouchers Payable being obtained from the adding-machine tape, whereas the distribution to cost-incurrence accounts is summarized from the vouchers by some other means.

When a voucher is paid, the voucher number is written on the check and in the check register. For cross reference the check number and date of payment are written on each copy of the voucher and, in some systems, in the voucher register also. One copy of the voucher is sent to the supplier as a remittance advice. Another is filed alphabetically. The third copy, which is sometimes called the voucher jacket, is filed numerically with supporting invoices attached.

If all disbursements are vouchered, a practice often followed in voucher systems, the numerical file of vouchers contains documents in support of all disbursements, including payments to payroll funds and to petty cash funds as well as payments for purchases. This arrangement is sometimes cited as an advantage of the voucher system from an auditing standpoint. However, in any modern system of accounting the supporting papers are filed systematically and are readily available for audit. For most of the references that are made to invoices, an alphabetical file is the most convenient to use.

When the voucher system covers purchase invoices only, the journal entries are the same as for an accounts-payable system in which the invoices are audited before being recorded. Where it is the practice to voucher all disbursements, the voucher distribution includes debits for payrolls and for petty cash expenditures as well as for purchases, and the general-journal entries for the voucher distribution and the check register would be similar to those illustrated in Table 12.2. The journal entries in

Table 12.2 are based on the same data as those in Table 9.4 and would take the place of entries 1-1, 1-23, 1-24, 1-25, and 1-26 of that table.

TABLE 12.2

ILLUSTRATIVE GENERAL JOURNAL ENTRIES SUMMARIZED FROM VOUCHER REGISTER AND CHECK REGISTER UNDER A SYSTEM IN WHICH ALL DISBURSEMENTS ARE VOUCHERED

(Based on data in Table 9.4)

Journal entry number	Account and explanation	Account number	Dr.	Cr.
1-1v	Fixed Assets	200	12,000	
	Accrued Salaries	431	7,600	
	Accrued Wages	432	16,700	
	Accrued Social Security Taxes	435	1,980	
	Accrued Electricity Cost	445	950	
	Employee Deposits	450	400	
	Selling Expense Control	750	4,100	
	Administrative Expense Control	760	2,090	
	Factory Ledger Control	800	39,010	
	Employee Deposits	450		243
	Vouchers Payable	420		84,587
	Voucher distribution (compare with entries 1-1, 1-24, 1-25, and 1-26 of Table 9.4).			
1-23v	Vouchers Payable	420	86,757	
	Purchase Discount	771		310
	Cash on Deposit—Commercial Account	111		86,447
	Check register (compare with entry 1-23 of Table 9 4).			

The file of unpaid vouchers is the subsidiary record supporting the Vouchers Payable control account. At the end of any month the total of the unpaid vouchers should equal the balance of the control. In case check numbers and payment dates are noted in the voucher register, the total of the unpaid or open items in that register should also equal the control figure.

Single-tabulation Systems

In most concerns the purchase invoices with but few exceptions are paid either the month received or early the following month. Instead of making a detailed tabulation of invoices (or of vouchers) and then shortly afterward making a detailed tabulation of checks, some companies have developed systems in which only one complete tabulation is made. This tabulation is made at the time of making the remittance, the cost distribution also being recorded then. Because only one tabulation is

required instead of two, this type of method has effected substantial savings in many cases where it has been applied.

It should be noted that when this procedure is used an adjusting entry must be prepared each month to record the liability for unpaid invoices at the end of the month and their distribution. Then in the following month either this entry must be reversed or the payment of the invoices covered by it must be debited to Accounts Payable. The work required to make the adjustment entry and the reversal entry is not great provided that the number of invoices carried over from one month to the next is a small proportion of the monthly volume of invoices.

An application of the single-tabulation type of purchase-invoice accounting is described by William T. Collins in the *N.A.C.A. Bulletin* of January 15, 1942.[1] In the case that he describes, the individual invoices and debit memoranda are listed the same as in an accounts-payable system, and in the same operation a check and check register are prepared. It is the practice to pay invoices immediately after they have been audited. The resulting interest loss in this case is not more than $2.50 a month, a small amount relative to the saving from the adoption of the single-tabulation system. The monthly volume is approximately 2,000 invoices and 1,200 checks.

[1] Collins, William T., "Methods Study Applied to an Accounts Payable System," *N.A.C.A. Bulletin*, Vol. 23, No. 10, Sec. I.

CHAPTER 13

METHODS OF DISTRIBUTION

Because the distribution of data makes up a large part of the work of cost accounting, an outline of the different methods of distribution is presented in this chapter together with examples of their application. The illustrations all pertain to purchase invoice accounting, supplementing the discussion of that subject in the previous chapter.

Distribution Methods[1]

Professor Willard J. Graham says that "In effect, distribution is a sorting, accumulating, summarizing process, resulting finally in the posting of a large number of items, individually or in summary, to a smaller number of accounts. The 'account' so called, may be a cost sheet, a line on the tabulated report, a column on a multicolumn spread sheet or even a register of an accounting machine."

There are but five fundamental methods of distribution, which, alone or in combination, make up any method in use.

1. *Unit-account Method (Random Posting).* This method is the posting to the unit accounts of the items *in the order* in which they appear on the media. Most accounts-receivable and accounts-payable plans follow the unit-account method.

2. *Columnar Method.* This may be defined as the posting of each item to a multicolumn sheet. When the classifications are at the top of vertical columns, the form is commonly known as a spread sheet. This form is probably the most popular of distribution forms where pen-written records are in use. When the classifications are at the side of one or more vertical columns, the form is known as a summary strip, peg strip, or analysis strip.

3. *Exhaust Method.* Professor Graham defines exhaust as the "leafing through the posting media, selecting all of one item, then all of another, etc."

4. *Register Selection.* While the first three methods mentioned above may be used either by hand or by machine, this fourth method is limited to machines. It is the distribution of each item into an adding register selected from an automatic control or from the keyboard of the machine.

5. *Unit-slip Method.* This method is defined as the sorting of units containing only one distributable item into classifications and the accumulation of the total of each classification.

[1] The material under this heading is reproduced by permission from a booklet entitled "Statistical Tabulations—Methods and Equipment," Burroughs Adding Machine Company, 1934.

All existing distribution installations are combinations or variations of these five fundamental methods.

Media

Documents or records containing the data that are to be distributed are referred to as *media*. If each medium contains only one item, the media are referred to as *unit media*. In case some of the media contain two or more items affecting two or more classifications, the media are referred to as *multiple media*. Purchase invoices, for example, are multiple media because some invoices must be distributed to more than one account.

Unit-slip Method

In cost accounting much use is made of the unit-slip method of distribution, in which unit media are sorted by classification and then totaled. Shop forms such as material requisitions and time tickets, because their preparation is controlled by the organization using them, can be prepared as unit media at the outset if that is desired. In case the distribution data appear on multiple media, it is necessary to prepare unit media from the multiple media in order to use the unit-slip method. This is done, for example, when the unit-slip method is applied to the distribution of purchase invoices.

The sorting procedure under the unit-slip method may be one of three types, namely, hand-sort, notched-card sort, or punched-card sort. To obtain classification totals, when either of the first two types of sorting procedure is used, the unit slips after sorting are added on a nonlisting calculator, a listing type of adding machine, or a posting machine. When punched cards are used, totals are obtained by running the sorted cards through a tabulating machine. The punched cards or tabulating cards actuate the adding mechanism.

Hand Sorting

Hand sorting is an efficient method in many cases. It is a flexible method being readily adaptable to variations in requirements. Forms that are to be hand-sorted should be of a convenient and uniform size; usually a small form is best. The classification numbers that are referred to in sorting should be located in a convenient position and in the same position on each slip; near the upper right-hand corner of the form is usually a desirable place. In some cases the initial sorting operation can conveniently be performed in the shop, thus saving time in the office. Timekeepers, for example, can be instructed to arrange time tickets in sequence by man number for delivery to the payroll department if that is the sequence desired for the first operation in the latter department. Sorting

trays, of which there are many types, can frequently be used to advantage when the sorting classifications are numerous, particularly when large forms are to be sorted.

Notched-card Sorting

In McBee Keysort card forms the notched-card principle is employed. Keysort cards, which can be supplied in almost any practical size for office use, are delivered to the user with round holes punched adjacent to one or more edges of the card, depending upon the nature of the sorting job to be done. Exhibits B3 and B4 of Fig. 13.4 are illustrations of Keysort cards. The following quotations are reproduced by permission from literature prepared by the McBee Company:

A Keysort card is identified with a particular classification, or code, by slotting away that part of the card between the hole and the edge, making a notch.

One notch or a combination of them is the code which establishes the desired classification, just as a Yale-type key is notched along the edge to identify it with a particular lock.

Any number of sorting classifications or codes that may be required can be slotted along the four edges of a Keysort card. These cards are coded and slotted only for the sorting classifications. Inasmuch as the body of the card is printed and used as an ordinary record card or statistical unit, amounts, quantities, or any other information to be tabulated appear on the face of the card and are not slotted or punched. . . .

No special machines are required for tabulations. Adding, calculating, or accounting machines, such as are found in practically every office, are employed for this purpose. . . .

In Keysorting, the operator merely takes the steel tumbler (or needle) and passes it through the holes in a stack of cards designating the classifications or sorts desired. The tumbler is then raised and, since the cards in the particular classification desired have nothing to support them, they fall clear of the remainder. As many as 200 cards might fall at one sorting, which accounts for the tremendous speed of Keysort.

Figure 13.1 is a diagram illustrating the principle of the Keysort process. The initial cost of Keysort card forms is somewhat greater than the cost of forms designed for hand-sorting, and there is an extra operation in the Keysort process, that of notching the cards. There are many applications, however, where Keysort methods are more economical than hand methods. This is likely to be true where the forms must be sorted several different ways as, for example, in the case of time tickets if the time tickets are sorted first to man number, then to account number, then to job number, and then resorted to man number.

Punched-card Accounting

Punched-card equipment consists principally of punches, sorters, and tabulators. There are two makes of punched-card equipment: Remington Rand and International Business Machines. The cards are the same size (3¼ by 7⅜ inch) for both makes. On the Remington Rand card there are 45 columns, and on the International Business Machines card there are 80 columns. Each column contains 10 positions for the digits

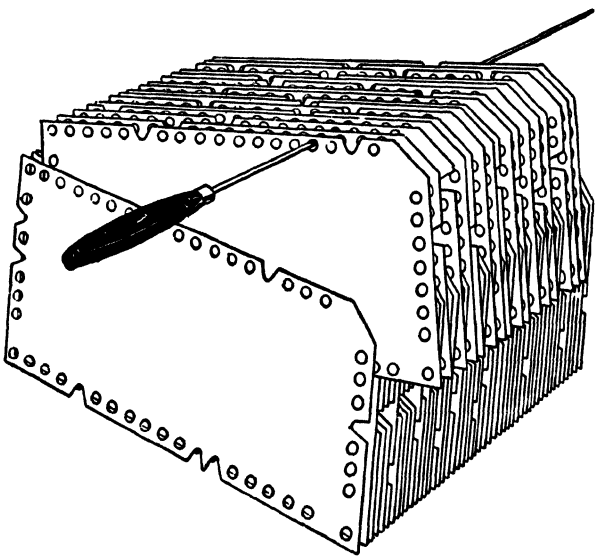


FIG. 13.1. Keysort. (*McBee Company.*)

0 to 9 and two extra positions. When received from the printer the cards are unpunched. The user punches holes in appropriate positions in the card to designate numerically the classification codes, reference numbers, and amount. When alphabetical equipment is available, names and descriptions may also be punched if desired.

The written record of the data to be punched may be on the face of the tabulating card, or it may be on a separate form. The material requisition in Fig. 4.12 is an illustration of a tabulating card of the first type. The labor distribution card in Fig. 4.12 is an illustration of a card that is punched from data appearing on a separate record.

"The purpose of punched cards is to actuate a variety of more or less automatic machines. These machines sense nothing but the position of the punched holes; they read no printing or writing that may be on the face of the cards."[1] After the punching of the cards has been completed

[1] Vannais, Leon E., "Punched Card Accounting from the Audit Viewpoint," *Journal of Accountancy*, Vol. 70, No. 3, p. 202.

and verified, the cards can be sorted to any desired classification that has been punched. They can then be tabulated to obtain class totals. The sorting and tabulating operations are almost automatic and very rapid. The punched cards actuate the sorting and adding mechanisms. Tabulating machines can be set either (1) to list each card and also to print totals or (2) to print totals only.

The initial cost of the cards and the cost of punching in the punched-card method is usually comparable to card cost and notching cost in the Keysort method. Machine rental, which is a small factor in a Keysort installation, is a substantial cost in punched-card accounting. With punched cards, however, tabulations can be made very rapidly merely by running the cards through a machine. With notched cards or hand-sorted forms the listing and the adding operations are usually slower. The punched-card method, like the notched-card method, is likely to be more economical than hand methods when there are several sorts and tabulations to be made. With the punched-card method it is usually feasible to balance the results with control figures; that is not always the case in cost work when hand methods are used. In many cases reports are printed by the tabulating machine, thus saving the work of typing reports and checking the typing as well as making it possible to deliver the reports more promptly.

It is common experience when punched-card methods have been installed that much useful information is obtained as a by-product of the main process. For example, in one case the punched-card method was adopted for obtaining (1) daily departmental performance reports, (2) payroll, and (3) employee earnings records. On these operations alone the cost was less than it had been by the method previously employed, and the tabulations were completed more promptly. By-products obtained were (1) a complete record of labor costs by operations and (2) a semi-monthly man-efficiency report. Neither of the latter tabulations had been prepared previously because the cost of doing so would have been prohibitive.

Outline of Illustrations

The five cases presented below are intended to illustrate various methods of accounting for purchase invoices and also various methods of distribution of data. The titles of the cases are selected according to the method of distribution emphasized, but in four of the five cases the procedure represents a combination of two or more distribution methods; this is characteristic of actual practice.

Accounts-payable systems of the type designated in Chapter 12 as procedure A1*b* are illustrated in the first three cases. In the fourth case a

voucher system, procedure A2 is illustrated. An accounts-payable system in which the liabilities are set up before the invoices have been audited, procedure A1*a*, is illustrated in the fifth case. This case also illustrates a technique of making the purchase-invoice distribution where there is a factory ledger.

Case 1. Unit-account method
Case 2. Register-selection method
Case 3. Unit-slip method, hand sort or Keysort
Case 4. Columnar method, voucher system
Case 5. Unit-slip method, punched card

Case 1: Unit-account Method

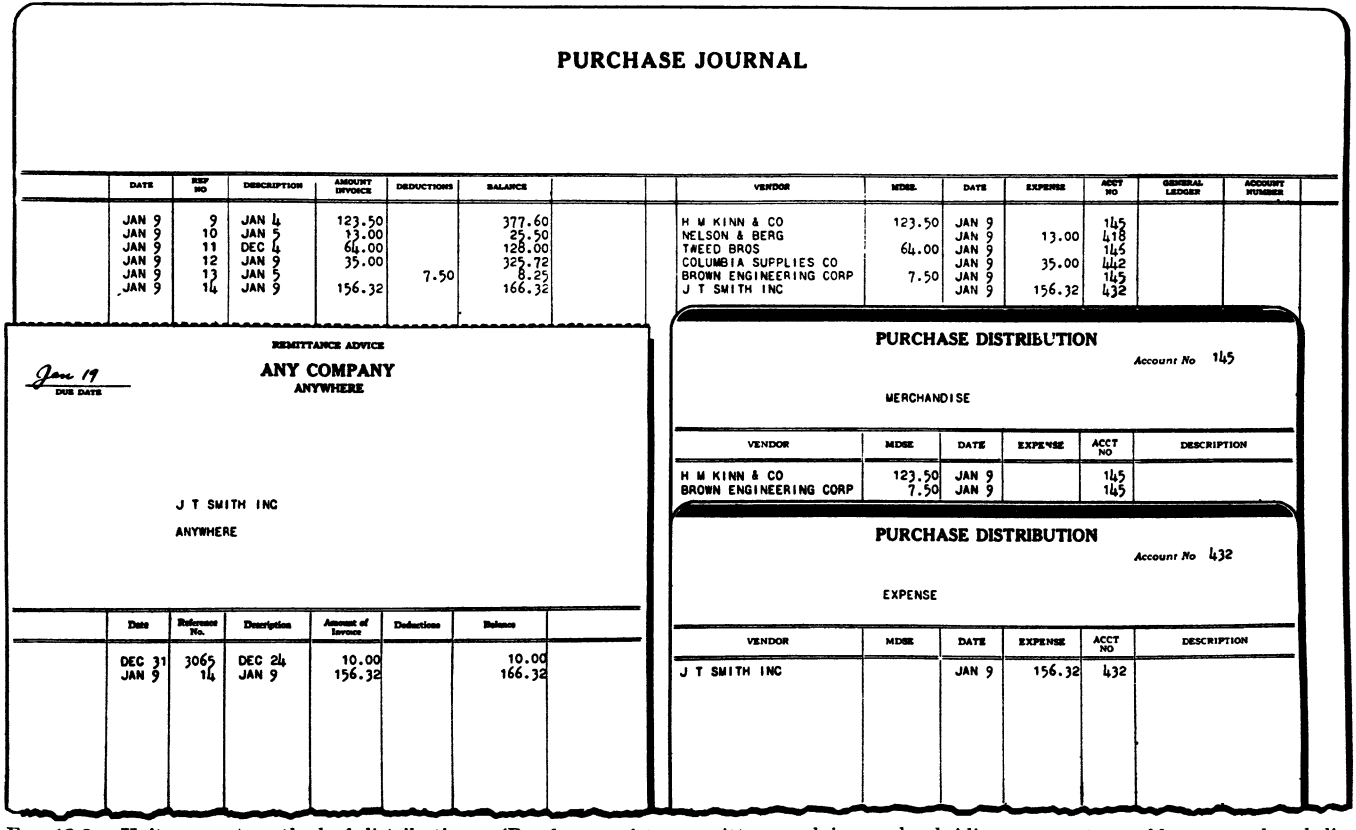
When the unit-account method is applied to a purchase invoice distribution, the debits from the audited invoices are posted to the individual subsidiary accounts. The subsidiary accounts in this case are referred to as unit accounts. The posting may be done as a separate operation, or it may be combined with the operation of preparing the purchase journal.

There are numerous makes of form-writing equipment by which the purchase register, the subsidiary account payable, the remittance advice, and the postings to subsidiary debit-balance accounts may be written in one operation. The forms illustrated in Fig. 13.2 were prepared on a Burroughs multiple-form-writing machine. This machine is basically a wide-carriage typewriter but is built with adding registers, a cross footer, and a number of other devices not found on standard typewriters.

The remittance advice in Fig. 13.2 is the first copy of a set of two, the other sheet in the set being the subsidiary account payable. Note that the last line of writing in the body of the remittance advice is identical with the last line on the left side of the purchase journal or purchase register. The other lines appearing on the remittance advice would also appear on the purchase journal but on previous sheets that are not shown in the illustration. The left side of the purchase journal and the account payable are written by means of carbon when the remittance advice is typed.

There are two subsidiary debit-balance accounts in the illustration. The account numbers are 145 and 432. The account forms are titled Purchase Distribution. Note that the last line of writing on account 432 is identical with the last line on the right side of the purchase journal; the last line of writing on account 145 is identical with the next-to-last line on the right side of the purchase journal. The right side of the purchase journal in this case is the distribution section. It is written by means of carbon when the subsidiary unit accounts are posted.

The distribution to general ledger accounts is obtained in part by the



PURCHASE JOURNAL

	DATE	REF NO	DESCRIPTION	AMOUNT INVOICE	DEDUCTIONS	BALANCE		VENDOR	MDSE.	DATE	EXPENSE	ACCT NO	GENERAL LEDGER	ACCOUNT NUMBER
	JAN 9	9	JAN 4	123.50		377.60		H M KINN & CO	123.50	JAN 9		145		
	JAN 9	10	JAN 5	13.00		25.50		NELSON & BERG		JAN 9	13.00	418		
	JAN 9	11	DEC 4	64.00		128.00		TWEED BROS	64.00	JAN 9		145		
	JAN 9	12	JAN 9	35.00		325.72		COLUMBIA SUPPLIES CO		JAN 9	35.00	442		
	JAN 9	13	JAN 5		7.50	8.25		BROWN ENGINEERING CORP	7.50	JAN 9		145		
	JAN 9	14	JAN 9	156.32		166.32		J T SMITH INC		JAN 9	156.32	432		

REMITTANCE ADVICE

Jan 19
DUE DATE

ANY COMPANY
ANYWHERE

J T SMITH INC

ANYWHERE

	Date	Reference No.	Description	Amount of Invoice	Deductions	Balance
	DEC 31	3065	DEC 24	10.00		10.00
	JAN 9	14	JAN 9	156.32		166.32

PURCHASE DISTRIBUTION

Account No 145

MERCHANDISE

VENDOR	MDSE	DATE	EXPENSE	ACCT NO	DESCRIPTION
H M KINN & CO	123.50	JAN 9		145	
BROWN ENGINEERING CORP	7.50	JAN 9		145	

PURCHASE DISTRIBUTION

Account No 432

EXPENSE

VENDOR	MDSE	DATE	EXPENSE	ACCT NO	DESCRIPTION
J T SMITH INC		JAN 9	156.32	432	

FIG. 13.2. Unit-account method of distribution. (Purchase register, remittance advice, and subsidiary account payable prepared and distribution posted to subsidiary cost account in one operation.) (*Burroughs Adding Machine Company.*)

columnar method. There are special columns for Merchandise control and Expense control. At the end of the month the totals of these columns would be debited to the respective controlling accounts. There is a column headed "General Ledger" for debits to miscellaneous general ledger accounts. Entries in the latter column (there are none in the illustration) may either be posted individually (the unit-account method) or they may be summarized by account number at the end of the month and the account totals posted. Either the exhaust method or the columnar method may be used to obtain the monthly summary.

The totals of the columns in the distribution section must agree with the total of the "Amount Invoiced" column on the left side of the purchase journal. The total of the latter column is a credit to Accounts Payable control.

When remittances are made, the check is written, the appropriate entries are made in the check register and the supplier's account, all in the same operation. The machine that is used for the purchase-register operation is also used for the check-register operation.

Case 2: Register-selection Method

In Fig. 13.2 there are two special columns in the distribution section of the purchase register for obtaining control totals. The number of columns that can be provided is limited by the width of the machine carriage.

By the register-selection method of distribution, on the other hand, the number of classification totals obtainable is limited only by the number of registers in the machine. Various types of machines employ the register-selection principle, the number of registers ranging from 2 to 27, depending on the type of machine. Many cash registers, for example, are equipped to cumulate and print totals for different classes of sales. The amount of each sale and its classification code are recorded on the cash-register tape at the time of the sale. Then at the end of the day, when the machine is cleared, a series of totals and code numbers is printed on the tape, one total for each code number or classification.

On some types of machines the number of classification totals obtainable can be increased by splitting registers. Thus, on an ordinary single-register adding machine two totals can be obtained by using one side of the keyboard for one classification and the other side for a second classification.

Figure 13.3 illustrates the application of the register-selection method for obtaining the control totals in a purchase-invoice distribution. The multiple-register Burroughs bookkeeping machine that is used is equipped with 20 registers. The forms shown in the illustrations are written in one operation.

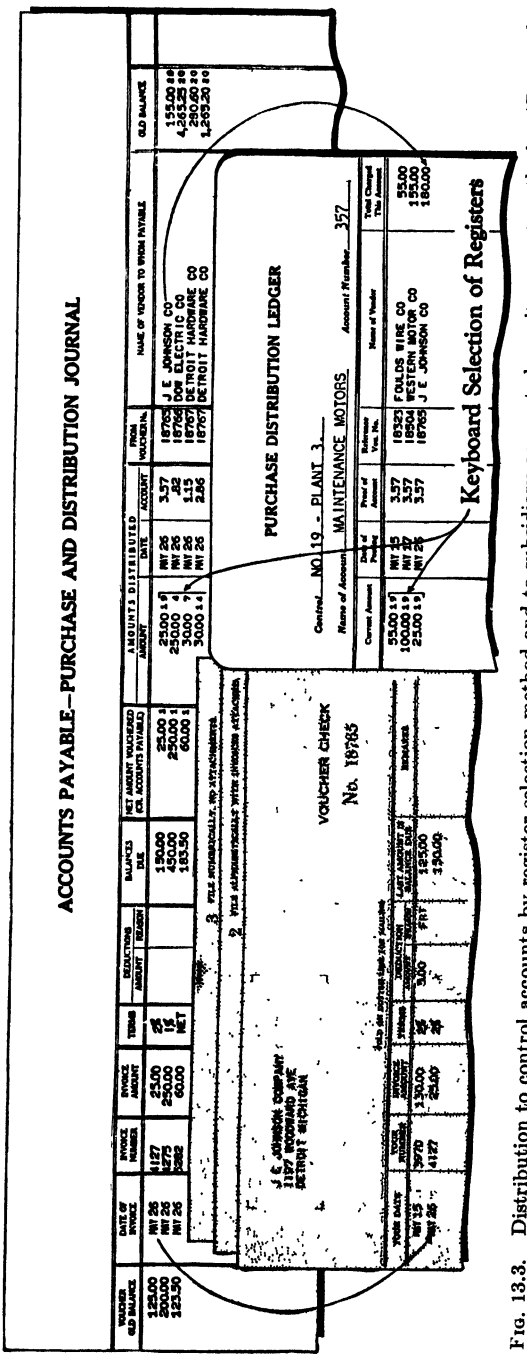


FIG. 13.3. Distribution to control accounts by register-selection method and to subsidiary accounts by unit-account method. (*Burroughs Adding Machine Company.*)

Note that there is only one amount column in the distribution section of the purchase journal. The first amount in this column is $25. In small characters immediately after this amount the number 19 is written, designating the control account. The control totals are cumulated in the machine until it is cleared. They are then printed by the machine either on the purchase journal or on a separate sheet of paper. There would be totals for account 19 and for the other control accounts for which registers were provided. At the end of the month the control totals obtained by the register-selection method are posted to the control accounts.

The number of the subsidiary account to be charged, account 357, is written in the "Account" column. The subsidiary account form is shown in the illustration, the $25 item appearing there on the last written line. The form is titled Purchase Distribution Ledger. The distribution to the subsidiary account is an illustration of the unit-account method as in Case 1.

Case 3: Unit-slip Method

The form-writing operation in Case 3 is very similar to that in Case 1. The principal differences are that (1) the unit slip takes the place of the unit account and (2) only one amount column is needed in the distribution section of the purchase register since the control totals as well as the subsidiary account totals are obtained from the unit slips. It is a faster operation because the time required in Case 1 to locate the unit account is saved as well as the time required to tabulate to the proper distribution column. Offsetting these savings, there is an additional operation in Case 3, that of sorting the unit slips.

The forms illustrated in Fig. 13.4 were written on a National accounting machine. The purchase register form (Exhibit B-1) is titled Distribution and Invoice Register. As in Case 1 the writing of this form is done by means of carbon. The left side of the form is the distribution section.

The operation of recording an invoice is described as follows:

The name and the address of the vendor are first inserted by typewriter in the body of the check. Then, the distribution and invoice register is placed in the accounting machine; the remittance section of the check is placed over the right side and the Keysort distribution card over the left side of this register.

With the three forms in the machine, the operator proceeds to record the invoice by first writing the data required on the Keysort card. If the invoice lists more than one item, a separate Keysort card is prepared for each item. Experience has shown that we average about 1.3 Keysort cards per invoice. When the required number of distribution cards have been completed, the total of the invoice is listed in the remittance section of the check. If there are other

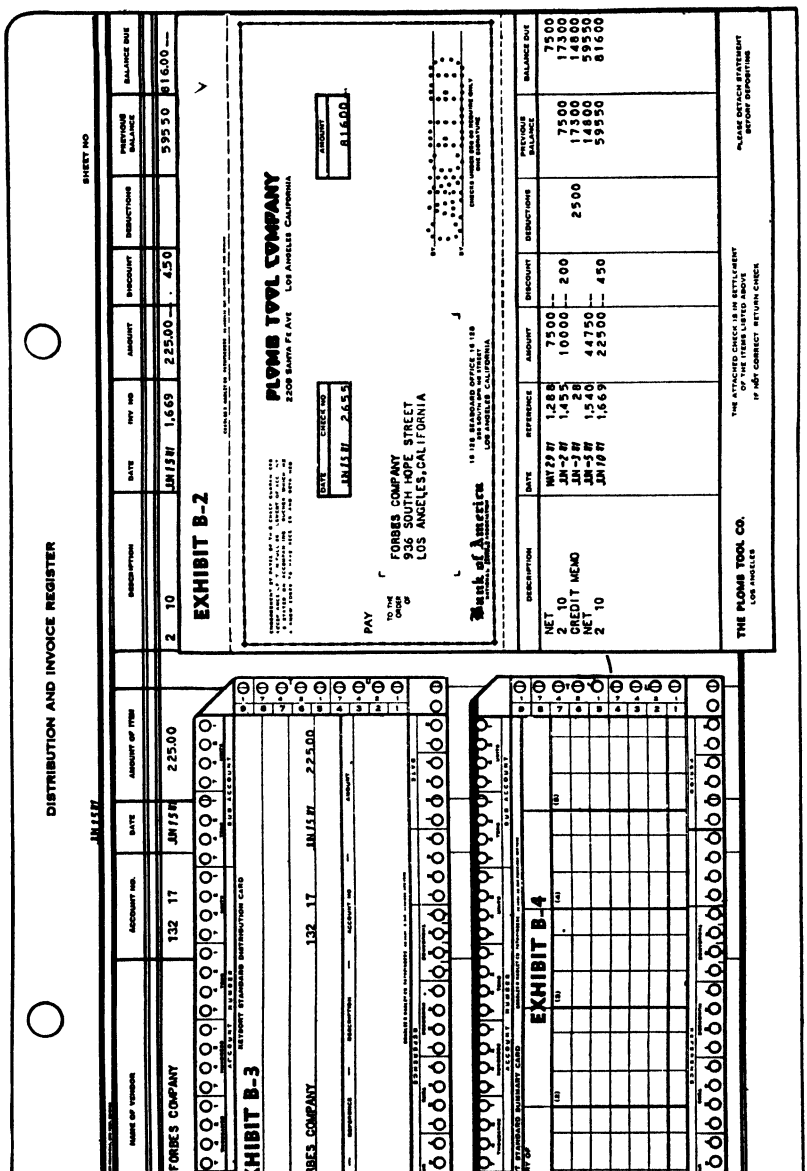


FIG. 13.4. Unit-slip method of distribution. Purchase register, remittance advice, subsidiary account payable, and unit slip for cost distribution prepared in one operation. (*Pathfinder Service Bulletin, No. 152, August,* 1941, *Charles R. Hadley Company.*)

invoices from the same vendor, they are registered in a similar manner. When all invoices of one vendor have been registered, his check and remittance advice is removed from the machine and filed in a tray. The invoices registered are filed in an unpaid invoices file until settlement.[1]

The unit slip in this particular application is a Keysort card. Either hand-sort forms or tabulating cards could be used instead. Any of the three types of unit slips could be written in the operation of preparing the purchase register.

After the writing of the Keysort card the account number (132) and the subaccount number (17) are notched in the position provided at the top of the card. The date and the vendor's code number are notched at the bottom. In the case of a debit memorandum the position near the upper left-hand corner marked "Cr" is notched. The notching is not illustrated in Fig. 13.4.

At regular intervals during the month, to eliminate a peak load at the end of the month, the distribution cards are sorted by account number and the account totals are recorded on summary cards (Fig. 13.4, Exhibit B-4). Each column on the summary-card form represents one month. A summary card is prepared for each control account and for each subsidiary account affected. Both the control totals and the subsidiary-account totals are obtained at the end of the month from the summary cards.

Case 4: Columnar Method, Voucher System

In any accounts-payable system each invoice is entered in a purchase register. Entries are made at frequent intervals, in many cases daily. In a voucher system the purchase vouchers, not the invoices, are registered. Purchase vouchers are usually prepared and registered only two or three times a month. A voucher may represent one, or two, or more invoices.

Purchase vouchers may be written either on a standard typewriter or by hand. They are numbered consecutively. Where they are typewritten, three copies are usually prepared: a remittance-advice copy, an alphabetical-file copy, and a numerical-file copy. Figure 13.5 is an illustration of a purchase voucher of that type. The invoices and other supporting documents are generally attached to the numerical-file copy. Where the vouchers are handwritten, only one copy is prepared. This is the numerical-file copy or, as it is sometimes called, the voucher jacket.

On the numerical-file copy spaces are provided for summarizing the accounting distribution of the invoices covered by the voucher. In the

[1] Kerr, R. W., "Streamlining the Accounting for a Defense Industry," *Pathfinder Service Bulletin*, No. 152, p. 2, August, 1941. Courtesy Charles R. Hadley Company.

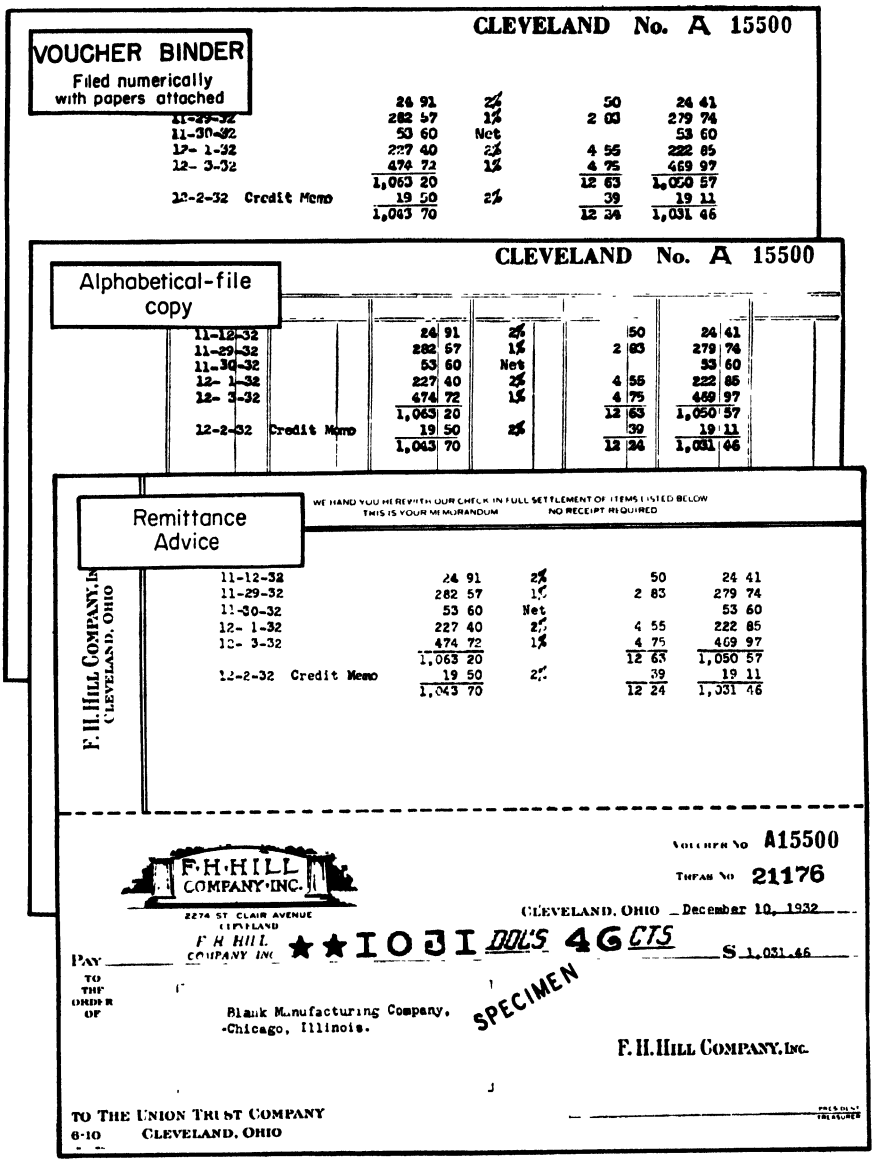


FIG. 13.5. Purchase voucher, check, and remittance advice. (*Adapted from Graff, F. W., Elements of Accounting Analysis, pp. 8–9, copyrighted by F. W. Graff, 1932, later published by Western Reserve University, 1932, and by John Carroll University, 1934.*)

form illustrated in Fig. 13.5 the distribution is not shown. It would be on the bottom half of the numerical-file copy or voucher binder. The exhaust method is generally the best method of obtaining that distribution.

In the voucher register the vouchers are listed in numerical order. In some cases, the voucher register is merely an adding-machine tape on which voucher numbers and amounts are printed. The total would be credited to Vouchers Payable. The distribution of the charges or debits

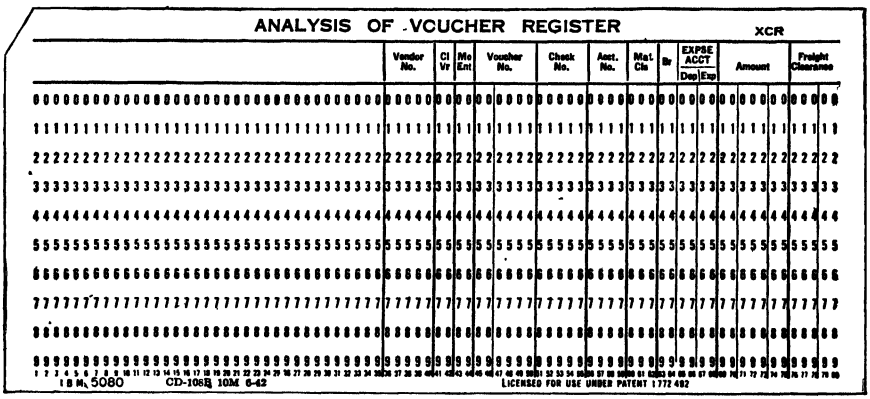


FIG. 13.6. Tabulating card form used for purchase distribution.

would generally be obtained by one of the unit-slip methods. Figure 13.6 is a reproduction of a tabulating card form which is used for that purpose.

In other cases the voucher register is a multicolumn form; in addition to the columns for voucher number and amount, it would have a number of distribution columns. The multicolumn voucher register may be either machine-written or hand-written. Figure 13.7 is a reproduction of a form of the latter type. It is a two-page form that would be kept in a post binder. There are 13 pairs of columns in the distribution section, each pair consisting of one column for account number and one for amount. The first of the pairs, which is headed "General Ledger—Dr.," is for debits to miscellaneous general ledger accounts. The general ledger account numbers would be recorded in the account-number column. The remaining 12 pairs are special columns for those general ledger accounts which are most frequently debited. As a rule they would be control accounts. The control account numbers would be written in the column headings of the special columns, and the subsidiary account numbers would be written in the account-number columns.

The columnar method of distribution is utilized in the case of those accounts for which special columns are provided. The monthly dis-

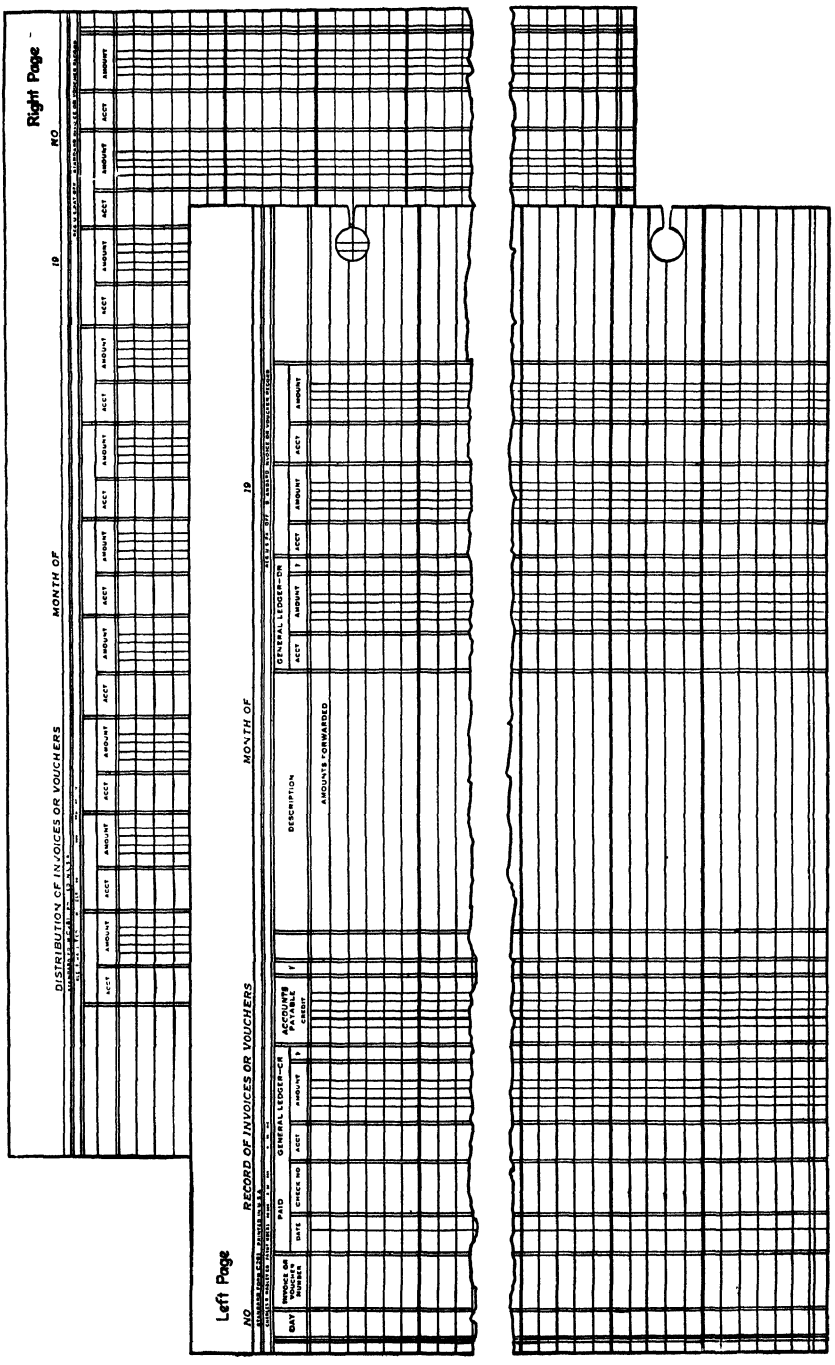


FIG. 13.7. Voucher register. (*Standard Pathfinder form from Charles R. Hadley Company.*)

tribution to those accounts is obtained from the column totals. In the case of miscellaneous debits appearing in the column headed "General Ledger—Dr.," the unit-account method is likely to be used, the individual debits being posted to the accounts in the general ledger. The distribution to subsidiary accounts from the special columns in the voucher register may be made by any of the methods of distribution. The choice would depend upon the circumstances. The columnar method is perhaps the most frequently used for this purpose, an analysis sheet being prepared with columns for the subsidiary accounts. The debits appearing in the voucher-register column are distributed to the appropriate columns of the analysis sheet, the columns are totaled, and the totals are entered in the subsidiary accounts.

The columnar method of distribution is widely used in cost accounting. In addition to the illustration here of its application in a voucher system, there are a number of examples of its use in the chapter on order costs (see Figs. 4.6, 4.8, and 4.10) and also in the chapters on labor and overhead distribution. In the latter chapters the use of summary strips to obtain a columnar distribution is explained.

Purchase Distribution Where a Factory Ledger Is Kept

Where there is a separate factory ledger, the problem of making the distribution to subsidiary factory ledger accounts is complicated by the fact that the factory ledger is kept by the factory accounting department, whereas the accounts payable records are kept by the general accounting department. Under such circumstances the work may be organized so that the general accounting department merely charges the factory invoices to Factory Ledger Control and furnishes the factory accounting department either copies of the invoices or office memoranda on which the nature of each charge is indicated as well as a reference to its source. The factory accounting department would then classify the charges and make the distribution to the subsidiary factory ledger accounts. Either the unit-slip method or the columnar method of distribution would generally be used for this purpose in the factory office.

As a short cut, in some cases the distribution to subsidiary accounts is made by the general accounting department, monthly totals by subsidiary account classifications being reported to the factory office at the end of each month. Thus, in the procedures illustrated in Cases 1, 2, and 3 of this chapter the distribution to subsidiary accounts is an integral part of the operation of registering purchase invoices. From the standpoint of clerical work required the procedure would be less efficient if the distribution were a separate operation.

There are objections, however, to having the general office make the

distribution unless the factory office is located near the general office. In the case of invoices charged to the factory the subsidiary account classifications should be determined by the factory accounting department. Those invoices must therefore be routed through the factory accounting department during the process of verification. If this department is at a distance from the general office, the verification of invoices is likely to be delayed. Furthermore, copies of invoices must be supplied to the factory accounting department unless it has convenient access to the files in the general office, for there are occasions when the factory accounting department is called upon to detail the charges to certain accounts.

Case 5: Unit-slip Method, Punched Cards

Case 5 illustrates an application of the punched-card method of distribution in a plant where a factory ledger is kept. The distribution of factory invoices is made by the factory office as a separate operation. The accounts-payable system is of the type designated in Chapter 12 as procedure A1*a*.

Punched cards may be used not only to make the purchase-invoice distribution, but also to write the purchase register, the remittance advices, and the suppliers' checks. In the present illustration, however, the punched cards are used only for distribution purposes.

Purchase invoices are routed first to the purchasing department. Catalogue material and correspondence accompanying the invoices are retained by that department, the invoice verification form is stamped on the invoices, discount dates are noted, and the invoices are then sent to the general accounting department. There the factory invoices are separated from the other invoices. The invoices are then numbered and recorded in purchase registers, the remittance advice and account payable being prepared in the same operation. There are two purchase registers, one for factory invoices, the monthly total of which is debited to Factory Invoices Undistributed; and one for other invoices, the monthly total of which is debited to Commercial Invoices Undistributed. The credit in each case is to Accounts Payable. The purchase-register form is similar to the forms in Cases 1, 2, and 3, except that the distribution section is omitted. Invoices are registered on the day received except for those arriving in the late afternoon mail which are held over until the following day.

One copy of each purchase register with invoices attached is sent daily to the purchasing department where the invoices are verified. Factory invoices are then sent to the factory accounting department for distribution. In the latter operation the account codes are written on the invoices, and then tabulating cards are punched. The tabulating-card

form is similar to that illustrated in Fig. 13.6. The punched cards are sorted by invoice number and run through the tabulating machine daily to obtain a numerical list of the invoices distributed and a daily total. A copy of the list with invoices attached is sent to the general accounting department where the invoice numbers are compared with those listed in the purchase register. Invoices returned by the factory office are checked off on the latter record. Making the comparisons is a rapid operation, for both lists are in numerical order. At the end of the month the general accounting department prepares a general journal entry debiting the total of the daily lists to Factory Ledger Control and crediting Factory Invoices Undistributed. The balance in the latter account at the end of the month should be equal to the amount of the unchecked invoices or open items in the purchase register. It would represent invoices held in the purchasing department pending receipt of material. The amount would be shown on the balance sheet as an inventory item called Materials in Transit.

The tabulating cards are retained by the factory accounting department. Once a week the cards affecting the factory overhead accounts are used in conjunction with similar cards from other sources, such as the labor distribution and the distribution of supply requisitions, to obtain departmental budget reports. At the end of the month the purchase-invoice-distribution cards are used to obtain the data for the factory journal entry debiting Stores Control, Factory Overhead Control, and other factory ledger accounts and crediting General Ledger Control (see Table 9.3, entry 1-1f). A monthly report of material purchased is also prepared from the punched cards showing purchases by class of material.

For the commercial invoices the distribution method is similar to the one just described. The general accounting department is responsible for the distribution of the invoices of this type, but the punching, sorting, and tabulating operations are performed by the factory accounting department where the punched-card equipment is located. In many plants a separate tabulating department is organized to serve all the departments that make use of punched-card methods. Centralization of the punched-card operations is obviously desirable in order to obtain the benefit of specialized skills and to avoid unnecessary duplication of equipment. Theoretically, a centralized tabulating department should come under the jurisdiction of the office manager. In many factories, however, the head of the tabulating department reports to the factory cost accountant, because a major part of the punched-card work as a rule is factory accounting work and the factory cost accountant is likely to be better versed than the other executives in the application of punched-card technique to accounting problems.

CHAPTER 14

MATERIALS AND SUPPLIES—CONTROL

Materials are the goods of which the product is made. They consist of raw materials, rough parts, purchased finished parts, and purchased assemblies. Factory supplies are those commodities, exclusive of plant and equipment, which are used by the factory departments but are not incorporated in the product. Thus broadly defined, factory supplies includes perishable tools, fuel, lubricants, abrasives, miscellaneous shop supplies, stationery, and office supplies. Where there are separate control accounts for Material Stores and Supply Stores, purchases of items normally used as materials are charged to the former account and items normally used as supplies are charged at the time of purchase to Supply Stores. The problems of accounting for the two classes of stores are similar.

Except in a few industries, material cost is by far the largest single element of cost. The principal stages at which management exercises control over material costs are design, purchase, stores, and processing. Control at the purchasing stage is discussed in Chapter 12. The present chapter deals chiefly with stores control, but the accountant's relation to material-cost control at the design stage and at the processing stage are briefly discussed.

Product Design

To a very large extent the material cost of a product depends upon the design of the product and the material specifications. The industrial accountant who understands the fundamentals of engineering can contribute to cost control at this stage by furnishing cost data to guide the engineer in achieving economical design.

Just as the designer must know more than the plain facts involved in the engineering technique required, so must the accountant, the manager, and all others who play a part in costs understand that the assimilation of all types of information for the designer will help him in his problem of designing cheaply. The best designer is one who knows engineering principles, knows the application of these principles to his product, and knows that these factors are restricted by reasonableness in the costs of the ideas developed. This designer is one who has been educated to consider these factors in the design that he places on the board. Education through adequacy in cost information is of prime importance to any

designer's work, and the accountant as well as the manager who is responsible for all the phases of the business must realize and stimulate the development of this information.[1]

Stores Control

Stores is a reservoir. The object of stores control is to have the required materials and supplies available when they are needed and at the same time avoid excessive investment in inventories. If stores are inadequate, sales may be lost through inability to make deliveries, and costs are likely to be high because of irregular employment and idle plant capacity. On the other hand, if inventories are excessive, the carrying costs are excessive and there is risk of loss through deterioration and obsolescence. The yearly cost of interest, insurance, taxes, and rent of storage space is seldom less than 10 per cent of the inventory investment; it is likely to be more than that. Material losses caused by deterioration and obsolescence vary, but in many industries they are substantial unless the purchases are carefully regulated.

Stores control is an important phase of the entire problem of inventory control, and to a large extent the principles and techniques of stores control are applicable to the control of other inventories. Although many of the operations involved in inventory control are assigned to departments in the production division, the factory cost accountant as a representative of the controller should have broad functional authority over procedures, standards, and records. The inventories represent a substantial investment, and it is a duty of the controller to see that the resources of the corporation are protected from loss and that they are efficiently utilized.

The elements of the perpetual-inventory method of stores control are

1. Determination of purchase quantities
2. Balance-of-stores ledger
3. Physical control of stores
4. Stores requisitions
5. Audit of inventory records
6. Analysis of inventory data

Determination of Purchase Quantities

The steps in the determination of how much and when to purchase are (1) adoption of a general policy, (2) establishment of purchase-quantity standards for individual materials and supplies, and (3) issuance of purchase requisitions.

[1] Gardner, F. V., *Variable Budget Control*, p. 231, McGraw-Hill Book Company, Inc., New York, 1940.

Broad policies governing purchase quantities should be established by top management, with the works manager, the sales manager, the purchasing agent, and the controller each being represented. Consideration should be given to the business outlook, probable future price trends, storage facilities available, and the company's working-capital position. The general plan or policy may be summarized in the form of a purchase budget.

Establishment of purchase-quantity standards for individual items of material is primarily a production problem. Where there is a production planning department, the problem is assigned to that department. For each item of stores the factors to be considered are probable future requirements, time required for delivery, and economical purchase quantities. The general policy is, of course, a controlling factor. Standards must be established for individual items, however, in order to carry out the policy. The standards adopted by the production planning department should be checked by the purchasing agent and the controller or their representatives. General policies and individual standards should be made subject to review as conditions change.

Purchase requisitions notifying the purchasing department what quantities to buy are released as a rule by the stores-record clerk. If there is a production planning department, he is likely to be a member of that department. Purchase requisitions are issued in accordance with purchase-quantity standards.

Individual purchase-quantity standards may be expressed in terms of (1) production schedules adjusted for desired increases and decreases in inventory or (2) predetermined ordering points and purchase quantities. The latter type of standard is commonly referred to as a minimum-and-maximum standard. In many plants the schedule basis is used in the case of the major items of material, and the minimum-maximum basis is used for the less important items.

Strangely enough the schedule basis is most widely applicable in two widely divergent types of manufacture, the mass-production type and the custom-order type. By reference to bills of material the scheduled production is analyzed or "exploded" in order to determine the quantities of the individual materials required. The production requirements thus computed may be adjusted to provide for desired increases or decreases in inventory.

Items that are regularly carried in stores, if not requisitioned on the basis of a schedule, are generally replenished on the basis of predetermined ordering points and standard purchase quantities. The ordering point is the sum of (1) the quantity that it is considered necessary to have available under all ordinary circumstances as a margin of safety and (2)

the quantity that would normally be used by the factory during the time required to procure a new supply of the item in question. The standard purchase quantity is the quantity to buy in order to obtain the lowest unit cost of material delivered to the processing floor. In estimating cost at the processing floor the freight, handling, buying, and storage costs should be included as well as the purchase-price quotations for different quantities. Risks of loss from deterioration and obsolescence should also be taken into consideration. It is a fairly common policy in peacetime to set standard purchase quantities at not more than a 3-month supply except for items on which a substantial price reduction can be obtained by exceeding that limit. In practice, the ordering point is frequently referred to as the "minimum," and this quantity plus the standard purchase quantity is referred to as the "maximum."

Either the ordering point and the standard purchase quantity or the minimum and maximum quantities are recorded on the stores record for each item. When the quantity available declines to the ordering point, the stores-ledger clerk issues a purchase requisition. Quantity available is defined as the quantity on hand plus the quantity on order minus the quantity that has been reserved or appropriated for scheduled production.[1]

Balance-of-stores Ledger

The stores ledger or balance-of-stores ledger is the central record in a perpetual-inventory system of stores control. It is a subsidiary accounting record supporting the stores inventory controlling accounts; in addition it is generally designed to aid the purchasing, stores, and production departments in carrying on their work. It may be kept by the stores department, the purchasing department, or the accounting department; but in industries where the problem of production control is a complicated one, the stores ledger is usually kept by the production planning department. Its most important service in such cases is in connection with scheduling production, coordinating purchases with production, and regulating the flow of material into the processing departments. An employee who is responsible for operating a stores ledger is called a stores-ledger clerk.

The stores ledger contains a record of each item of controlled materials and supplies in stores. Usually there is a card or sheet for each item. In its simplest form it has columns for quantities received, issued, and on

[1] In some plants, however, the expression "quantity available" is defined as quantity on hand minus quantity reserved, and the stores-ledger clerk would issue a purchase requisition when the sum of the quantity available as thus defined and the quantity on order declines to the ordering point.

hand and for appropriate dates and reference numbers. If stores requisitions are costed from the balance-of-stores record, there are spaces on the form for showing unit costs. In addition, for control purposes, spaces are frequently provided for purchase-order data, maximum and minimum standards, stores locations, quantities reserved for production orders or production schedules, and quantities available.

In a relatively few cases the dollar amounts of stores received, issued, and on hand are recorded in the stores ledger. Compiling the dollar amounts is a costly operation, however, that serves only one major

STORES LEDGER

Article	Style, Size or Kind	Unit	Bin Location		Max	Min.
½" x 3½" Mach Bolts w/ Sq Nuts	Rolled Thread	ea.	M	12	500	100

In				Out				Balance	Out				Balance
Date	Pur Ord	Quantity	Unit Cost	Date	Job No	Quantity	Unit Cost	—	Date	Job No	Quantity	Unit Cost	—
1-1-44	Inv't	200	0234	1944				200					
1-12-	7621			1-6	50824	20	0234						
1-28-	"	400	0264	1-10	A37-1	36							
				1-12	A112-1	80		64					
				1-20	50890	10							
				1-28				454					
				1-30	50955	12		442					
				2-9	A37-2	36							
				2-10	50816	6							
						34	0264	366					

FIG. 14.1. Balance-of-stores ledger.

purpose, namely, to make it possible to verify the accuracy of the perpetual-inventory records by checking the total each month with the balance of the Stores control account. Where the stores records are checked by constant use in connection with factory operations, however, they are likely to be accurate, and comparison with the control total is usually not necessary oftener than once a year.

Entries to stores records as a rule are made by hand. In case dollar amounts are to be recorded as well as quantities, however, it is usually necessary to use machine methods for economical operation.

Figure 14.1 illustrates a simple form of stores record. Replenishment in this case is on the minimum-maximum basis. Stores requisitions are costed by the first-in–first-out method. The costing operation is described in Chapter 15. The form is designed for filing in a tray or drawer.

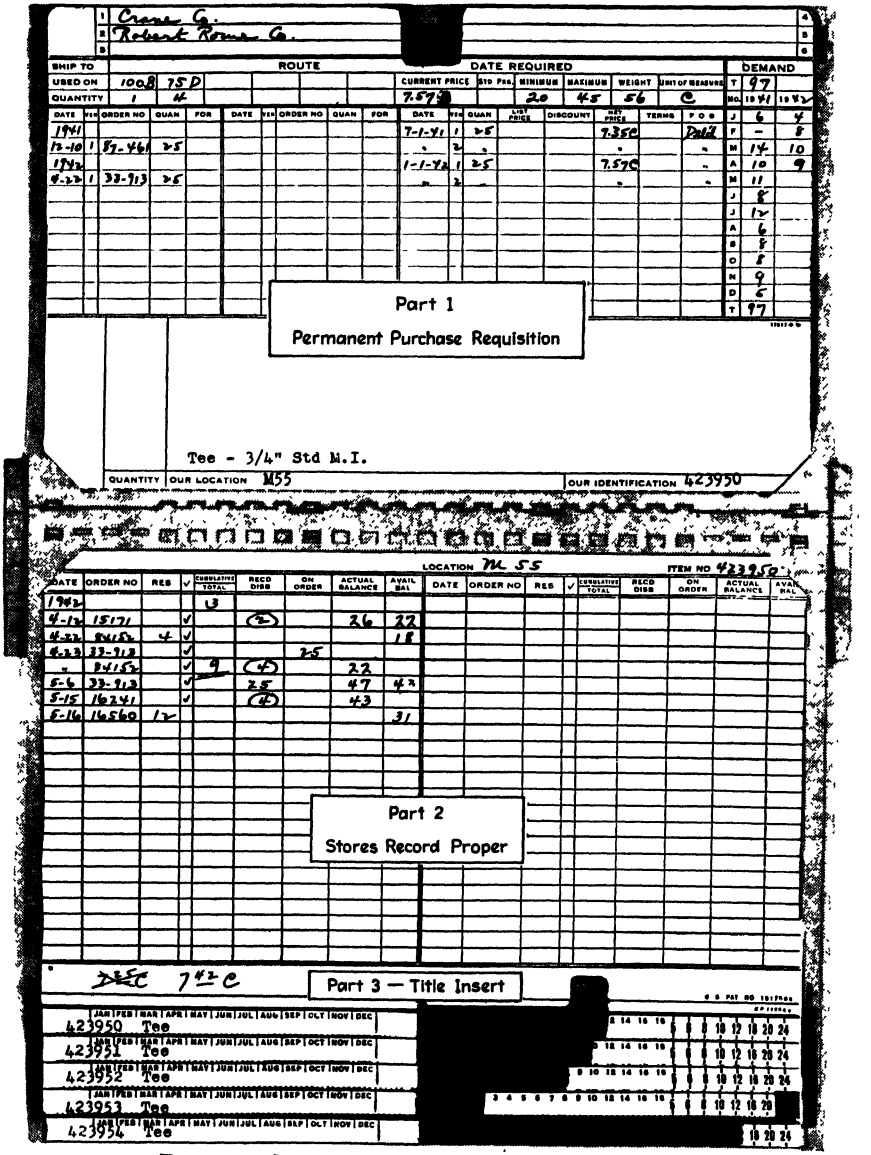


FIG. 14.2. Balance-of-stores ledger, visible-index form.

Figure 14.2 illustrates a stores-record form that is filed in a visible-index file. Visible filing speeds up reference to the file besides permitting the use of visible signals for control purposes. For these reasons visible filing is frequently employed for stores ledgers. The form illustrated is a Kardex (Remington Rand) form. It consists of three parts.

Part 1 is a permanent purchase requisition, also called a traveling purchase requisition. It contains data needed by the purchasing agent when he makes a purchase, for example, names of suppliers who are equipped to furnish the item, finished products in which the item is used, minimum and maximum quantities, a record of orders placed, a record of price quotations, and statistics of demand, that is, the usage of the item, over a term of months. To request a purchase the stores-record clerk removes the permanent purchase requisition from the file and forwards it to the purchasing agent. When he places the purchase order, the purchasing agent writes the supplier's code, the order number, quantity, and price on the form and then returns it to the stores-record clerk.

Part 2 is the stores record proper. The columns and their purposes are

Column Heading	Purpose
Date	Date of transaction
Order No.	Number of purchase order or production order
Res	Quantity reserved for specified production orders
√	Check mark to indicate closed transaction. For example, on May 6 upon receipt of the goods ordered April 23 check marks were made opposite (1) the entry of April 23 for the purchase order and (2) the entry of May 6 for the receipt of the items ordered. Prior to May 6 the purchase order of April 23 was unchecked—an open item
Cumulative Total	Monthly cumulation of quantity issued
Recd Disb.	Quantities received and quantities issued or disbursed. The latter are either entered in red or circled
On Order	Purchase-order quantity
Actual Balance	Quantity on hand in stores
Avail. Bal.	Available balance. In this case the available balance is defined as the quantity on hand less the quantity reserved

Part 3 is the title insert. The weighted average unit cost is written on the upper part of the insert for use in pricing stores requisitions. The item number or part number is typed on the lower half of the insert which is visible when the cards are in filing position. There are also three printed scales on the lower half of the insert. The January-December scale at the left is not used in the illustration. The two scales at the right are used in conjunction with the colored progressive signal. The 0-18 scale represents number of weeks, and the 5-24 scale represents number of months. When stores transactions occur that affect the available balance, the progressive signal is moved horizontally to indicate the available balance in terms of weeks' or months' supply. For the stores items in the illustration an 8-week supply is considered the minimum. When a purchase order has been issued, a colored signal tab is placed in the 24 position.

Thus, the progressive signals indicate that there is a 12-week supply of item 423950, a 10-week supply of item 423951, and an 8-week supply of item 423952. In the case of item 423953 there is only a 2-week supply, but the signal tab in the 24 position indicates that a purchase order has been placed. There is a 12-month supply of item 423954, apparently an overstock. The employment of visible signals in this case is an application of the principle of exceptions. Overstocked items and items of which the inventory is dangerously low are readily identified by glancing over the panels in which the cards are filed. It is not necessary to examine each card in order to find out which items require attention on the part of those who are responsible for inventory control.

Transaction Reports

Stores received and issued are reported to the stores-ledger clerk by the stores department. The forms used are

Receiving report
Stores requisitions
  Material requisition, supply requisition
Stores return slip

The stores-ledger clerk makes the appropriate entries in the stores records and in the same operation enters unit costs, if it is his job to do so, on the transaction reports. He then sends the stores requisitions and stores return slips to the factory accounting department and in some cases the receiving reports also.

Reservations of stores are made by the stores-record clerk, usually on the basis of production orders. The orders would either be routed over his desk during their preparation, or copies of the orders would be furnished to him prior to their release to the shop. If material requisitions are prepared in the office along with the production orders, the requisitions may be used instead of the production orders as the basis for making stores reservations. A reservation of a stores item reduces the available balance and may call for the placing of a purchase requisition. It does not call for an entry in the general ledger accounts.

Purchase-order data are furnished to the stores-ledger clerk by the purchasing department. In some offices he is furnished a copy of the purchase order. In other cases the purchase-order data are written on a copy of the purchase requisition that is returned to him.

There are several methods of furnishing unit-cost data to the stores-ledger clerk. The purchase price may be shown on his copy of the purchase order. A copy of the purchase invoice may be routed over his desk. The copy of the receiving report that is to go to the stores-ledger clerk

may be routed first to the invoice-verification desk where the price is copied on it from the invoice. If freight is to be included in the unit cost of material, the stores-ledger clerk can usually ascertain the freight cost from the receiving report.

Physical Control of Stores

Where the stores inventory represents a substantial investment, it is generally desirable to have a stores department that is responsible for the physical control of stores. The duties of this department are

1. To protect stores against loss from fire, theft, and action of the elements
2. To handle the movement and storage of materials and supplies efficiently and with a minimum of damage
3. To give prompt service to factory departments requiring goods from stores
4. To issue stores only upon proper authority, usually in the form of a stores requisition
5. To obtain accurate written reports of all stores transactions and to forward the reports to the stores-ledger clerk
6. To make physical counts of goods on hand

From the standpoint of inventory control, it is desirable that storerooms be kept locked except when a storeroom attendant is on duty and that access to storerooms be limited to employees of the stores department. These requirements can seldom be rigidly enforced, however, without causing delays in production. Where exceptions are made, the shop employees who have access to storerooms should be made responsible to the stores department for properly reporting any withdrawals from stores.

One of the most difficult steps in the establishment of a perpetual-inventory system of stores control is to obtain satisfactory reports of stores transactions. Where foremen and employees have been free to withdraw materials from stores without making requisitions, their habits are not easily changed. A system of this type cannot be successfully operated, however, unless accurate written reports are made of all stores transactions.

Stores Requisitions

A stores requisition is an order on the stores department to furnish materials or supplies. It is also the report of a withdrawal from stores and the basis for the distribution to stores records, to cost sheets, to subsidiary overhead accounts, and to control accounts. In addition, stores requisitions for material are sometimes used, before the stores have been issued,

as a basis for stores reservations. The information appearing on a stores requisition when it is presented to the stores department ordinarily includes

1. Description of material or supplies wanted
2. Quantity wanted
3. Location to which material is to be delivered
4. Account to be charged, either the production order number or the standing order number
5. Signature of person authorizing the withdrawal

SUPPLIES REQUISITION

WRITE SEPARATE REQUISITION FOR **EACH** SUPPLY ITEM.

FURNISHED BY DEPT. NO. | DELIVERED TO DEPT. NO. | DATE

PART NO.	TO BE USED ON JOB NO.	CHARGE EXPENSE ACCOUNT NO.		QUANTITY	UNIT

DESCRIPTION OF SUPPLIES

DEPARTMENT EXECUTIVE	STOREKEEPER
SIGNED	

LOWER SECTION OF THIS FORM FOR OFFICE USE ONLY

	QUANTITY	UNIT	PRICE		VALUE	

FIG. 14.3. Supply requisition.

Supply requisitions are generally prepared in the department using the supplies. Figure 14.3 is an example of a supply requisition. Departmental overhead accounts are generally charged at the time supplies are issued from stores even though the supplies may not be used up immediately. Departmental budgets, discussed in Chapter 20, are the principal means of controlling supply usage.

In one plant the foreman of each department is furnished with a small stock of requisition blanks for each of the major supply items used by his department, the item description and unit cost being written in advance

by means of an addressing machine. The principal object of this procedure is to help the foreman keep within his budget. Because he can figure out the cost before signing a supply requisition, he can schedule the withdrawals of supplies each week on a dollar basis in accordance with his budget for the week. The additional advantages of writing the description and price on the requisition in advance are as follows: (1) There is a reduction in the time required in the shop to write requisitions. (2) Because the descriptions on the requisitions are accurate, less time is required in the stores department to fill a requisition. (3) For the same reason the stores-ledger clerk can identify the item more quickly, thus saving time in posting. (4) The pricing operation is eliminated. For supply items that are requisitioned infrequently, however, it is not feasible to have prewritten requisitions.

Material requisitions may be prepared either in the processing departments or in the production planning department, depending upon the system of production control. Examples of the former type of requisition will be found in Figs. 4.4 and 4.12. An example of the latter type will be found in Fig. 16.1. When the production planning department prepares the material requisition, it is usually written at the same time as the production order and frequently in the same operation.

Time is saved in the shop and in the office through the use of prewritten stores requisitions, and the results are more accurate than they would be if the requisitions were prepared in the processing departments. In addition, and even more important, when the requisitions are released by the production planning department, better control is obtained of production and costs.

The stores requisitions thus far referred to are all unit media, a separate requisition being required for each item withdrawn from stores. For assembly operations, however, it is sometimes the practice to use multiple media. The requisition form in such cases is designed so that all the materials needed for an assembly order can be listed on one form. This would usually be done in the office by mechanical means from a master copy of the bill of material. There is a substantial saving of time in the writing of requisitions under this procedure, especially if the requisitions would otherwise be written by hand in the shop departments. Unit media are generally more convenient to post to the stores ledger, however, for they can be sorted in stores-ledger sequence for posting. This procedure is impossible with the multiple-media type of requisition.

After the required entries have been made in the stores ledger, the stores requisitions are forwarded to the factory cost accounting department. One copy of the stores requisition is generally sufficient for all purposes, although in some cases a file copy is retained by the issuer, and

in others an extra copy of the requisition is made to be used as a move ticket. The move ticket instructs the shop trucker where to deliver the material that is issued.

Stores Return Slips

The return of materials and supplies from a processing department to stores is reported on a stores return slip. The arrangement of this form may be similar to that of the material requisition, but it is usually printed on paper of a different color. It is routed from the stores department to the stores-ledger clerk and thence to the factory cost accounting department just as the material requisition, but it has the opposite effect upon the accounts. An example of a stores return slip is shown in Fig. 4.4, Exhibit 5.

Inventory Audit

The inventory balances appearing on the stores records are verified by physical count from time to time during the year. In some cases the stores-ledger clerk merely requests the stores department to count the stock of an item either when the stores-record balance appears questionable or when the inventory of the item is at a low point. The counting can be done economically when the stock is low. If there is an error in the book record, it is desirable to make the correction before placing a purchase requisition.

In many plants the inventory audit is organized as a continuous systematic audit under accounting supervision. When this is the practice, provided that the stores records are found to be reliable, it is not necessary to have a complete physical count of stores at the end of the fiscal year, for the quantities that appear on the stores records at year end can be accepted as the annual-inventory quantities.

Counts should be scheduled by the inventory auditor, a member of the controller's staff, when stocks are low and when requested by the stores-ledger clerk. The stores record should be initialed by the auditor when a verification has been made. Each item should be counted at least once a year. Additional counts should be scheduled where discrepancies have been found and for the major stores items. The physical work of counting may be done either by the stores department or by men working under the direct supervision of the inventory auditor.

Before comparing the physical count of an item with the stores-ledger balance, the inventory auditor should make sure that all transactions prior to the counting have been recorded in the stores ledger. This step is referred to as "making a cutoff and clearing the paper work." The cutoff point in this case is the time of counting; the term "paper work"

refers to the transaction reports and the operations required to record them. After the paper work has been completed for transactions prior to the cutoff point, if there is a discrepancy between the count and the stores-ledger balance, it may be good judgment to have the count rechecked. Then if the stores record appears to be wrong, it should be corrected.

The inventory auditor should prepare reports showing what verifications were made, what corrections were necessary, and the nature of the errors discovered. Figure 14.4 is a form of inventory-verification report. Periodical summaries of the inventory-verification reports would indicate how reliable the stores records are. The causes of the more serious dis-

INVENTORY VERIFICATION REPORT Date_____ Inventory Class _____

Item Name _____ Item Number _____

Physical Count _____ Counted by _____ Stores Ledger Adjusted by _____

Stores Ledger _____ Inventory Short _____ Over _____

Cause of Discrepancy _____

Signed _____
Inventory Auditor

	Material	Labor	Burden	Inventory Adjustment Acc't	
				Dr	Cr
Unit Cost					
Total					

FIG. 14.4. Inventory-verification report.

crepancies should be determined as a basis for action by factory management to prevent the recurrence of similar errors.

A copy of the inventory-verification report should be sent to the factory cost accounting department so that the control accounts may be corrected in case corrections are needed. Errors in the computation of the subsidiary stores ledger balances would require correction only in the subsidiary record, but errors in transaction reports would call for correction of the control account as well (see Table 10.2, entry 7-10).

Analysis of Inventory Data

One of the most important elements of stores control is the utilization of the records as a basis for improving control and reducing costs. The following quotation from an article by Frederic W. Kilduff covers this point effectively:

Recently I was asked to give my opinion with respect to a certain inventory situation. I first visited the storerooms and found them to be in very fine shape. Most of the material was neatly trayed, and the trays were placed in steel bins

and racks; all material was properly identified; the bins were numbered, the sections were numbered, and the aisles were lettered. Many materials were "bagged" for easy issue. Access to materials was restricted to authorized and bonded employees only. All in all, it was a splendid example of good storekeeping.

I next looked at their material ledgers. They were well kept; the postings were up to date; everything seemed to be done in orderly fashion. At random I selected a few items of material, jotted down the quantity of each as shown on the ledgers, and returning to the storeroom found that the physical counts agreed with the respective book balances of the items selected for test. Apparently the material ledgers were a true picture of the quantities of the material on hand.

But I went a step further. Using average monthly consumption in dollars as the denominator and average inventory on hand as the numerator, I discovered the startling fact that there was an average of eight months' supply of material on hand. Inquiry brought out the fact that material known as standard could be obtained in quantities desired within a period of two to three weeks; and further, that in the instance of the comparatively small number of special materials carried, one month was the maximum time needed to replenish. Obviously, the inventory was excessive.

I went a step further by bringing the matter down to certain individual items. Some showed as much as a three-year supply on hand.

This particular concern was carrying about $2,000,000 in cash, and their treasurer was getting a salary of $20,000 a year. The value of the inventory approximated $4,000,000, and the man responsible for that inventory (responsible as to its physical accountability only, for that was the only responsibility I could locate) was receiving a salary of $32.50 per week. Understand that the latter was meeting his responsibility in good shape, doing his work in an A-1 fashion; but the fact remains that from an *inventory control standpoint* there was no such thing. . . .

I answered the inquiry of one of the officials as to the reason for this condition with the following questions:

Have you one or more qualified employees in your organization constantly studying material movements:

a. To see if each item is getting sufficient turnover.

b. To see what items are overstocked.

c. To see what items are understocked.

d. To locate slow movers.

e. To determine if material is over at one location and short at another.

f. To set proper minimum, maximum and ordering quantities and to change these respective quantities up or down as the occasion demands, because these factors are variables, not constants.

g. To determine whether the factor of safety in setting minimum limits is too high.

h. To determine whether the replenishing periods may be shortened, thus allowing minimum points to be lowered.

i. To determine what overstocked material, if any, may be substituted for proposed new products and to see to it that the engineering department is advised of the overstocked items.

j. To receive advance copies of proposed sales, production or maintenance schedules so that demands for material will be met on time and without delay.

k. Does this representative know at what periods inventories should be built up and at what periods they should be scaled down?

l. Have you placed at the disposal of this employee the type of equipment and material record best suited for *control* purposes?

In other words, have you someone in your employ equipped with all the necessary facts regarding the procuring, maintaining, and disposal of inventory to permit him to regulate such inventory in accordance with present and future demands; and has he the necessary authority to take (and get) action when it is needed? His answers to the above questions were all in the negative. The particular organization mentioned here has an excellent stores department and a splendid material record system, but no semblance of inventory control. There is a difference and a big difference!

As with most concerns, they have been so busy making records and trying to keep them up to date that they have entirely overlooked the fact that such records are but a means to an end.[1]

Material-cost Control in the Processing Departments

The accounting functions in connection with the control of material cost in the processing departments are (1) to assist in the development of production control and inspection control, (2) to make sure that there are adequate reports of material consumption and of spoilage, (3) to prepare reports of departmental performance, and (4) to supply data to production engineers and foremen upon request and to cooperate with them in making special cost studies.

If material specifications are complete and definite, the problem of controlling material costs in the shop is mainly a problem of following the specifications. Where the production-control function is centralized, cost control is a by-product of production control. Material requisitions are released by the production planning department covering predetermined standard quantities of materials. The standard quantities are the quantities called for by the material specifications plus an allowance in some cases for unavoidable waste. To obtain material in excess of the standard quantity the shop foreman must prepare an excess-material requisition stating the reason for requiring excess material and submit it to a designated executive for review and approval. Material is counted when it passes from one processing department to the next, and each department must account for the material it has received. Spoiled pieces are tagged and reported by the inspection department. A form known as a rejected-material report is generally used for that purpose. The fore-

[1] Quoted by permission from an article by Frederic W. Kilduff entitled "Essentials of Inventory Control," *The Control and Valuation of Inventories*, pp. 16–18, National Association of Cost Accountants, New York, 1941.

man of the processing department is notified promptly by the inspector so that the cause of the spoilage can be determined and remedial action taken to prevent its recurrence. Performance reports analyzing the costs of spoiled material and excess material are prepared by the cost accounting department to aid management in controlling those costs.

There is likely to be some overlapping of excess-material requisitions and rejected-material reports. For example, a rejected-material report may be made covering spoiled pieces, and an excess-material requisition may be made for the replacement of the spoiled pieces. In the case of departments where it is feasible to obtain rejected-material reports to cover all spoiled work, the performance reports would be prepared from the rejected-material reports. The excess-material requisitions would be disregarded in such cases for purposes of measuring departmental performance.

Waste and Shrinkage

There are some types of spoilage and waste that cannot economically be reported on rejected-material reports. In an assembly operation, for example, small parts such as tacks and screws that are dropped on the floor and wasted may be of too little value to justify an exact accounting. In screw-machine operations, as another example, it is necessary to use up some bar stock, the raw material, in setting up the machines. The pieces of stock that are cut off in making the setup are thrown in the chip pan and not reported as spoiled pieces. In a painting operation the paint that adheres to the lining of the container must be wasted. A reasonable allowance for waste or shrinkage is generally made in determining the material-quantity standard. When the waste exceeds the standard allowance, the excess-material consumption may be reported on excess-material requisitions. Because rejected-material reports would not be available, performance reports would be based upon the data shown on excess-material requisitions.

When the raw materials are purchased in a natural or nearly natural state, the percentage of waste is likely to be high. Thus, in the case of ungraded lumber there are great variations in the number of flaws in a given quantity of rough lumber; even in the case of graded lumber there are some variations. Cuttings for use in woodwork and in the manufacture of furniture must be free of large knotholes and serious imperfections, and the quantity of good cuttings that can be obtained from a board of rough lumber depends upon the number of imperfections in the board, their location in the board, the size of the cuttings, and the skill of the workmen who operate the cutoff saws and ripsaws. A rough index of the effectiveness of the cutting department in controlling lumber costs can be

obtained by comparing the board feet of lumber consumed with the board feet of cuttings produced. The comparison is usually expressed in terms of a waste percentage. In some cases the waste percentage is based upon the quantity produced, whereas in other cases it is based upon the quantity consumed. The comparison could also be expressed in terms of a yield percentage. The three types of percentage are illustrated in Table 14.1. Waste percentages and yield percentages are frequently used by

TABLE 14.1
METHOD OF COMPUTING
WASTE AND YIELD PERCENTAGES

Data for a Given Period	
Board feet of rough lumber consumed	100,000
Board feet of good cuttings produced	66,667
Waste in board feet	33,333
Percentages	
Waste percentage, based on consumption, 33,333 ÷ 100,000	$33\frac{1}{3}$
Waste percentage, based on production, 33,333 ÷ 66,667	50
Yield percentage, 66,667 ÷ 100,000	$66\frac{2}{3}$

management in controlling material costs, particularly in process industries. Where the raw material is of uniform quality, the yield percentage is an accurate index of performance and it is possible to predetermine a standard yield ratio as a goal and a measure of performance.

General Shrinkage Allowance

Where material is costed to products on the basis of material specifications, as in standard cost systems, allowances for reasonable amounts of waste are generally included in figuring the quantities of individual items of material on cost sheets. Where material is costed to production orders on the basis of material requisitions, as in job-order cost systems, it is not necessary to make an allowance of that type, for the material actually issued from stores would be reported on requisitions and charged to cost sheets.

Under any cost system, however, a general shrinkage allowance may be provided to cover the cost of materials not otherwise accounted for. No system of inventory control is perfect. The storekeeper sometimes makes mistakes in counting stores issued, and if the stores control is weak, he may make it a practice to issue extra pieces for good measure. Spoilage is likely to be unreported in some cases, especially where the production control is faulty. Some workmen, for example, are inclined to throw spoiled pieces into waste pans if they can do so without discovery, and

foremen do not always discourage that practice. To compensate for these and other errors and to avoid an unfavorable inventory adjustment at the end of the year, it may be desirable to include a general shrinkage factor in the product costs.

The general shrinkage allowance as a rule would be set up at the time the goods are shipped. The pro forma monthly journal entry would be somewhat as follows:

Cost of Shipments—Material Shrinkage	xxx	
Reserve for Material Shrinkage		xxx

During the year a credit balance would be accumulated in the reserve account to offset an inventory adjustment debit at the year end. On the monthly balance sheets the reserve would be deducted from inventories. At the end of the year it would be closed to Inventory Adjustment account.

CHAPTER 15

MATERIALS AND SUPPLIES ACCOUNTING

The principal types of stores transactions are

1. Purchase orders
2. Material reservations
3. Stores receipts
4. Stores issues
5. Returns to stores

As previously explained purchase orders and material reservations are seldom given accounting recognition except in the balance-of-stores ledger; receipts of purchased goods into stores are recorded (1) in the stores ledger and (2) as debits to stores control accounts through the purchase-invoice distribution. Methods of accounting for issues and returns are discussed below.

Accounting for Stores Issues

Stores issues are reported on stores requisitions. In a perpetual-inventory system the stores requisitions are credited to the control accounts Material Stores and Supply Stores, to subsidiary stores-ledger records, and in some cases to subsidiary accounts for the various classes of stores. They are debited to the control accounts Goods in Process, Factory Overhead, Selling Expense, and Administrative Expense, and also to the appropriate subsidiary accounts. In job-order cost systems and in standard cost systems as a rule those materials and supplies which can be specifically allocated to products are debited to Goods in Process as direct costs. Those which although used by the factory cannot be tallied as a cost of a specific product are charged to Factory Overhead. Stores withdrawn for use by the sales department are charged to Selling Expense, and those withdrawn for use by the general office are charged to Administrative Expense. Where a factory ledger is kept, the last two types of withdrawals would be charged on the factory books to General Ledger Control, and copies of the stores requisitions would be furnished to the general office for use there in making the distribution to the selling and administrative expense accounts.

The departmental and the natural classifications of overhead are the subsidiary factory-overhead accounts. The order cost sheets are the subsidiary goods-in-process accounts in a job-order cost system. In

process cost systems and in standard cost systems as a rule there are no subsidiary goods-in-process accounts.

Stores requisitions are generally unit media. Entries to the stores ledger and to the job cost sheets may be made by the unit account method, that is, by making individual postings; but in some cases the unit-slip method is used in combination with the unit account method. The latter procedure of making the distribution to cost sheets is illustrated in Chapter 4, cases 6 and 8. For the distribution to control accounts and to subsidiary overhead accounts either the unit-slip method or a combination of the unit-slip method and the columnar method is usually most suitable.

A combination of these two methods is employed in the procedure described on pages 229 to 230. The distribution to subsidiary overhead accounts is obtained by the unit-slip method. So too is the daily distribution to control accounts. The daily control-account totals are then entered on a columnar analysis sheet called Summary of Materials Issued and Returned (see Fig. 15.1). Monthly totals of the Summary columns are journalized (see Table 9.3, entry 1-7f).

The Summary of Materials Issued and Returned is an example of a type of form called an analysis sheet, which has many uses in cost distribution work. Analysis-sheet forms as a rule are prepared on standard multicolumn paper. The title and headings are usually typewritten; the entries of data being distributed may be either typewritten or handwritten. Forms of this type can be readily adapted to changed requirements.

There are generally separate forms for material requisitions and supply requisitions, and usually the two types of stores requisition are handled separately by the accounting department. Entry 12-7 in Table 8.2 covers the distribution of material requisitions to control accounts. Entry 12-8 in the same table covers the distribution of supply requisitions.

Accounting for Returns to Stores

Returns to stores are the opposite of stores issues. The entry for stores returns is merely a reversal or a partial reversal of the entry for stores issues. Stores return slips are usually printed on paper of a distinctive color. They can be distributed either separately or along with the stores requisitions by deducting the amount of the returns from the amount of the requisitions.

Illustrative Procedure of Accounting for Materials Issued in a Job Cost System

The procedure of accounting for material requisitions and material return slips in a representative job-order cost system is described as follows:

Material requisitions and material return slips are received by the stores-ledger clerk from material storerooms twice daily. He sorts them by material class and by item number. The subsidiary stores records are filed in that sequence in a visible-index file. He then hand-posts the quantities issued in the Issued section of the stores records. Return slips are posted in red to indicate deduction. In the same operation he enters the unit costs upon the transaction reports; these are then forwarded to the factory accounting department.

Operations in the factory accounting department are

1. Extend requisitions and return slips, that is, multiply quantity by unit cost.
2. Add to obtain daily total, treating returns as deductions.
3. Verify the extensions and the total. (Key-driven calculators are used in making the calculations in the first three operations.)
4. Enter the daily total on Summary of Materials Issued and Returned as a credit to Material Stores (see Fig. 15.1).

Summary of Materials Issued and Returned — January 19___

Date	Credit	Debit		
	Material Stores	Goods in Process	Factory Overhead	General Ledger
Jan. 1			-	
2	$ 1,512.22	$ 1,512.22	-	
3	475.27	458.15	$ 17.12	
(Lines for 25 days, January 4 to January 28, omitted.)				
29	1,214.67	1,214.67	-	
30	1,680.90	1,680.90	-	
31	698.75	695.00	3.75	
Total	$26,150.00	$26,000.00	$150.00	-0-

FIG. 15.1. Summary of material requisitions less returns.

5. Hand-sort the direct-material requisitions and return slips according to job-order number, sorting out and setting aside the indirect-material requisitions and those chargeable to General Ledger Control.

6. Add the direct-material requisitions daily, deduct returns, and enter the net amount for the day on the Summary of Materials Issued and Returned as a debit to Goods in Process.

7. Add the indirect-material requisitions daily, and enter total on Summary of Materials Issued and Returned in the column headed Factory Overhead. Add the requisitions chargeable to General Ledger Control, and enter total on Summary of Stores Issued and Returned in column headed General Ledger Control. Hold these two groups of requisitions until the end of the month. There are so few of them that the remaining steps in their distribution can be scheduled for the end of the month without increasing unduly the peak load of work at that time.

8. Prove daily totals entered on Summary of Material Issued and Returned. The sum of the debit entries should equal the amount of the credit entry.

9. Hand-post the direct-material requisitions to cost sheets daily. Post returns in red to indicate deduction. Add postings and check total with total obtained in step 6. File direct-material reports.

10. At the end of the month total the columns on the Summary of Materials Issued and Returned and prove. Prepare journal entry (see Table 9.3, entry 1-7f). In case there are requisitions charged to General Ledger Control, forward them to the general office.

11. At the end of the month sort, according to department charged, the indirect material reports that have been charged to Factory Overhead. Add to obtain department totals. Key-punch totals in tabulating cards for use in preparing distribution to subsidiary overhead accounts.

12. Verify punched cards by tabulating and comparing the total with the total debit to Factory Overhead on the Summary of Material Issued and Returned.

Illustrative Procedure of Accounting for Materials Issued in Standard Cost Systems

Accounting for material requisitions in a standard cost system differs but slightly from the procedure in a job-order cost system. The principal differences are

1. Requisitions are costed at standard cost (and in some cases at actual cost also) in standard cost systems; they are costed at actual cost in job cost systems. The costing of material requisitions is discussed later on in this chapter.

2. Excess-material requisitions may be charged to Material Variance in standard cost systems; they are charged to Goods in Process in a job-order cost system.

3. In some standard cost systems the material-price variance is compiled from data on the requisitions; price variances are not recorded at all in job cost systems.

4. In standard cost systems the direct-material requisitions as a rule are not distributed to cost sheets, whereas this operation is required in job-order cost systems.

Under either type of cost system the entries on the balance-of-stores ledger are the same.

The steps in the work of the factory accounting department in a representative standard cost system are

1. Same as step 1 in previous section.
2. Same as step 2 in previous section.
3. Same as step 3 in previous section.
4. Same as step 4 in previous section.
5. Hand-sort daily the requisitions and return slips into four groups, those to be charged to
   - *a.* Goods in Process
   - *b.* Material-quantity Variance
   - *c.* Factory Overhead
   - *d.* General Ledger

Excess-material requisitions of those departments in which it is not feasible to obtain rejected-material reports are charged to Material-quantity Variance. Excess-material requisitions of those departments where spoiled pieces are tagged and reported on rejected-material reports are charged to Goods in Process. The rejected-material reports would be credited to Goods in Process and charged to Factory Overhead.

6. Add the first two groups of requisitions, deduct returns, and enter group totals on Summary of Materials Issued and Returned. In this case the debit columns of this form are Goods in Process, Material-quantity Variance, Factory Overhead, and General Ledger Control. (There would be an additional column for Material-price Variance in case the price variance were summarized from the requisitions.) File the requisitions that have been charged to Goods in Process.

7. Same as step 7 in previous section.

8. Same as step 8 in previous section.

9. Sort departmentally the requisitions charged to Material-quantity Variance as the basis for a report analyzing that variance.

10. Same as step 10 in previous section except that in this case reference should be made to Table 10.2, entry 7-5.

11. Same as step 11 in previous section.

12. Same as step 12 in previous section.

Illustrative Procedure of Accounting for Supplies Issued

A representative procedure of accounting for supply requisitions and supply-return slips is outlined below.

Supply requisitions and return slips are received by the stores-ledger clerk from the supply storeroom daily. He sorts them according to inventory classification and then hand-posts to stores records the quantities issued and the department numbers, entering unit costs and inventory classifications upon the requisitions in the same operation. The requisitions and return slips are then forwarded to the factory accounting department.

The operations in the factory accounting department are

1. Extend.
2. Add to obtain daily total.
3. Verify extensions and total.
4. Record daily total on the Summary of Supplies Issued and Returned as a credit to Supply Stores. This form would be the same as the one in Fig. 15.1 except that the credit column would be captioned Supply Stores instead of Material Stores.
5. Inspect the charge classifications appearing on supply reports, and make corrections where necessary. In the same operation sort out those requisitions which are to be charged to Goods in Process as direct cost as well as those which are to be charged to General Ledger Control. Examples of items that may be issued from supply stores for use on production orders are maintenance parts, such as pipe fittings, used on special jobs, and tool steel required in the manu-

facture of certain products but stored in the supply storeroom because the principal usage is by the toolroom.

6. Hand-sort according to job-order number the requisitions and return slips for direct supplies. Post daily to cost sheets.

7. Key-punch tabulating cards, one punched card for each requisition and one for each return slip. Punch date, inventory classification, department number, account number, and amount. In the case of a great majority of the requisitions, those charged to Factory Overhead, the account number would be the natural overhead classification. In the case of requisitions charged to Goods in Process and those charged to General Ledger Control, the account number would be the control account number. The latter two types of requisitions are punched primarily so as to get data by inventory classification, as explained later. For supply-return slips the punching is the same as for requisitions except that an extra hole must be punched in a certain position in order to actuate the subtraction mechanism of the tabulating machine.

8. Verify punching by the use of a verification punch. This step may be omitted if mistakes in punching are few. The punching of amounts is verified by operations 9 and 10.

9. Tabulate punched cards daily to obtain totals of charges to Factory Overhead, to Goods in Process, and to General Ledger Control. Enter totals on the Summary of Supplies Issued and Returned in the appropriate columns.

10. Prove daily totals entered on Summary of Supplies Issued and Returned. The sum of the debits should equal the credit to Supply Stores, a predetermined total obtained in steps 2 and 3.

11. At the end of the month add the columns on the Summary of Supplies Issued and Returned, and prepare journal entry covering the distribution to control accounts (see Table 9.3, entry 1-8f).

12. At the end of the month take the punched cards that have been charged to Factory Overhead and sort them by department and natural classification to obtain distribution to subsidiary overhead accounts. Summary cards are punched automatically as this tabulation is made and later are sorted and tabulated with the summary cards from other sources, such as the labor distribution and the purchase-invoice distribution, in order to obtain departmental overhead reports. (Reports could be prepared every week if that were desired. This procedure is used in many plants.) The monthly tabulation by subsidiary overhead accounts should agree in total with the total debit to Factory Overhead appearing on the Summary of Supplies Issued and Returned.

13. Sort and tabulate the punched cards by inventory classification. This tabulation is used by the purchasing agent. (If subsidiary inventory accounts were kept for the various classes of supplies, the credits to those accounts would be obtained from this tabulation.) The total of the monthly tabulation must agree with the total credit to Supply Stores.

14. Sort and tabulate the punched cards monthly by department and inventory classification to obtain analyses for use in connection with budgetary control. Copies of the analyses go to shop foremen and to the budget supervisor. The report is more detailed than the department overhead report that is prepared

in step 12. There, for example, there would be only one classification for Small Tools; here there are classifications for drills, reamers, taps, broaches, and numerous other classes of small tools.

Analysis Sheet Form for Distribution of Supply Charges

In step 12 the punched cards representing supply requisitions are sorted in with the punched cards from other sources to obtain departmental overhead reports. In many plants an intermediate tabulation or analysis sheet is made to summarize the distribution of supply requisitions to standing orders. This is likely to be done where hand methods pre-

Distribution of Supply Requisitions, January, 19__

Department	Total	Natural Classifications				
		Shop Supplies .21	Small Tools .22	Abrasives .23	Office Supplies .25	Fuel .27
21 Works Manager						
22 Building Occupancy						
24 Purchasing						
26 Employment						
32 Product Engineering						
34 Production Engineering						
36 Inspection						
41 Factory Superintenaent						
42 General Foreman						
43 Production Planning						
44 Stores						
47 Tool Room						
48 Maintenance						
52 Machine Shop Foreman						
54 Punch Press						
56 Automatics						
58 Light Machining & Bench						
60 Heavy Machining						
66 Assembly						
72 Shipping						
Total						

FIG. 15.2. Analysis-sheet form for distribution of supply requisitions to subsidiary factory overhead accounts.

dominate. Figure 15.2 is an illustration of an analysis-sheet form of this type. A similar sheet may be prepared for each of the other sources of overhead charges. Analysis sheets of this type are frequently used as posting media, the charges being posted from the analysis sheets to the subsidiary overhead accounts. The distribution of overhead is discussed more fully in Chapters 21 and 22.

Costing Stores Requisitions

Stores requisitions are priced at cost. There are various formulas, however, for computing costs for this purpose; different formulas may be employed in the same plant for different classes of materials and supplies. The questions to be considered are (1) What costs should be included? (2) What cost should be selected in case the inventory of a stores item consists of purchases made at different prices?

What Costs to Include

Theoretically a requisition for materials should be costed at a figure that covers all costs up to the time the material reaches the processing floor. This would include (1) invoice cost; (2) freight and cartage on incoming material; and (3) material overhead, that is, the costs of purchasing, receiving, and storing materials, keeping stores records, and moving material from receiving to stores and from stores to processing departments. Where the utmost accuracy is required, all three types of cost would be included in costing materials put into production. As a practical matter, however, the allocation of freight and material overhead to individual items frequently requires more clerical work than is justified by the results obtained. From the standpoint of cost control there is no object in making the allocation, and from the standpoint of product costing there are many instances where the gain in accuracy through making the allocation is too slight to justify the expense. In such cases the requisitions are costed at invoice cost, the freight and the material overhead being classified simply as process overhead. The subject of material overhead is discussed more fully in Chapter 23.

Where freight-in is treated as material cost, the freight cost per unit of material is added to the invoice cost per unit to obtain a total material cost per unit that is used in costing requisitions. Thus, if the invoice cost for a carload of coal containing 50 tons is $100 and the freight is $125, the material cost per ton would be computed as follows:

Invoice cost per ton	$2.00
Freight cost per ton	2.50
Material cost per ton	$4.50

If an entire shipment consists of a single kind of material, the unit freight cost is computed by dividing the amount of the freight bill by the number of units received. In the case of a mixed shipment, the total freight on the shipment is first allocated to the different items in the shipment; the freight allocated to each item is then divided by the number of units of the item to obtain the freight cost per unit.

Freight should be included in the material cost as a rule in the case of those materials for which the freight cost is substantial in comparison with the invoice price. In the case of bulk materials, such as lumber, coal, and steel, the freight cost is a significant factor and is generally counted as part of the material cost. In the case of purchased-finished parts, small castings and forgings, and finishing materials the freight cost is usually a relatively insignificant factor and is likely to be classified as factory overhead.

Cash Discounts

Cash discounts allowed for prompt payment of invoices may be treated by the purchaser either as a reduction of the invoice price or as financial income. The latter is perhaps the more common method of classification. It requires less clerical work, and it may in some cases be preferred by the management. For example, if the sales and factory executives are expected to produce the desired profit without the benefit of purchase discounts, the management may regard the purchase-discount credit as a safety margin to help ensure that the profits will be adequate and to cushion the impact of extraordinary expenses. A strong case can be presented, however, for treating purchase discount as a cost deduction rather than financial income, for the cash-discount rate on an annual basis is usually much higher than the interest rate on commercial loans. If the terms of payment are 1/10, n/30 the purchaser who has been paying invoices at the due date without discount would save 1 per cent by paying 20 days earlier and taking the discount. One per cent for 20 days is equivalent to 18 per cent a year. In the computation of costs of government cost-plus-fixed-fee contracts during the Second World War contractors were required as a general rule to treat purchase discount in excess of 1 per cent as a credit to contract costs.

What Cost to Select When the Inventory Consists of Purchases Made at Different Prices

If the purchases of a stores item were always made at one price, that price would be the figure to use as the invoice cost for the purpose of costing stores requisitions. Because prices fluctuate, however, the inventory frequently consists of purchases made at different prices, and it is impossible to state categorically the cost of materials issued. Assume the following stores transactions pertaining to a certain casting, a new item not previously purchased:

Jan. 10	Received	10 castings at $40 each
Mar. 10	Issued	5 castings at $40 each
Apr. 10	Received	10 castings at $43 each
Apr. 20	Issued	6 castings

What is the unit cost of the six castings issued April 20? Is it $40 or $43 or an intermediate figure? What cost should be assigned to the nine castings remaining in stores?

A plan or method should be adopted for the selection of representative costs under such circumstances, and the plan adopted should be consistently followed. The method of costing requisitions should be in keeping with the method of costing the inventory. The principal methods of cost selection are

Actual cost of specific items
First-in–first-out (Fifo)
Average cost
Last-in–first-out (Lifo)
Standard cost

On the annual balance sheet it is frequently the practice to state or "value" the inventory at the lower of cost or market, market being defined as replacement cost in the case of good usable stock and as net realizable value in the case of damaged and obsolete items. This practice of inventory valuation affects the costing of stores requisitions because the unit values adopted for the final inventory at the end of one fiscal year are treated as the unit costs at the beginning of the ensuing year for the quantities on hand in the inventory. Thus, if an item is valued in the final inventory at a replacement cost that is lower than the original cost, the replacement cost becomes the adjusted unit cost. The original cost would not be reinstated even though the market price of the item should subsequently increase.

Relative Popularity of Different Methods

In a study by the National Association of Cost Accountants published March 15, 1937, data were obtained in regard to the methods employed by

TABLE 15.1
METHODS USED IN CHARGING RAW MATERIAL INTO PROCESS*

Method	Number of companies	Per cent of total
Average cost basis	95	45.4
First-in–first-out basis	57	27.3
Standard cost basis	42	20.1
Actual cost basis	9	4.3
Last-in–first-out basis	5	2.4
Highest cost first	1	0 5
	209	100.0

* From *N.A.C.A. Bulletin*, Vol. 18, No. 14, Sec. I, p. 790.

representative companies in charging raw materials to goods in process. The data are summarized in Table 15.1, which is reproduced by permission. A later study by the same association published December 15, 1939, disclosed a noteworthy gain in the popularity of the last-in–first-out basis. Out of 264 companies, 25 were using the last-in–first-out method in 1939 for costing raw materials, and 14 additional companies expected to use it in 1940.[1]

[1] *N.A.C.A. Bulletin*, Vol. 21, No. 8, Sec. I, p. 500.

Actual Cost of Specific Items

In the case of materials purchased specifically for a certain production order, the actual cost of the materials can be charged to that order. In some cases the charge is made direct from the purchase invoice. In other cases the purchases are charged to Stores, and stores requisitions are prepared in order to charge Goods in Process. Less paper work is required under the former procedure. The latter procedure may be adopted, however, for the sake of uniformity in accounting for stores transactions and to facilitate the reporting of purchases and of material usage by class of material.

The actual-cost-of-specific-items method of pricing stores requisitions is applicable only in jobbing industries, and there it is applicable only for special purchases. Items that are regularly carried in stock and purchased in advance of the receipt of customer orders would be costed by some other method.

First-in–first-out Cost

Under the first-in–first-out method, sometimes referred to by the abbreviation Fifo, the stores requisitions are costed on the assumption that materials are issued from stores in the same order as they were received. It coincides with the usual storeskeeping practice of issuing the oldest materials first so as to avoid deterioration in storage. The effect of this method is to cost stores issues and, consequently, shipments, not at current replacement costs but at costs that were in effect at some earlier date. The cost assigned to the goods remaining on hand tends to approximate current replacement cost.

For the figures given on page 235, the first-in–first-out costs are shown in the accompanying table.

	In	Out	Balance
Jan. 10	10 @ $40		10 @ $40
Mar. 10		5 @ $40	5 @ $40
Apr. 10	10 @ $43		5 @ $40 10 @ $43
Apr. 20		5 @ $40 1 @ $43	9 @ $43

The stores record in Fig. 14.1 illustrates an application of the first-in-first-out method. The unit cost of each lot of material received from suppliers is recorded in the "In" section. A notation of the unit cost figure used in pricing stores requisitions is made in the "Out" section.

The initial inventory of 200 pieces was valued at $2.34 per hundred. This unit value was used for costing the first six requisitions entered in the "Out" section and also for six of the 40 pieces covered by the seventh requisition (dated February 10, 1944). This makes a total of 200 pieces to which the $2.34 cost was applied. A line was then drawn under the figure 0.0234 in the Receipts column to indicate that no further use was to be made of that cost in costing requisitions. The remaining 34 pieces of the requisition of February 10 were costed at $2.64 a hundred ($0.0264 each), which is the unit cost of the 400 pieces received January 28. This unit cost would then continue in use until a total of 400 pieces had been issued at that figure.

Average Cost

When average unit costs are used for pricing stores requisitions, they are generally weighted averages. The formula most commonly adopted for computing the weighted average unit cost of a stores item is

> (Cost of goods on hand prior to receipt of purchased goods + cost of purchased goods received) ÷ (units on hand prior to receipt of purchased goods + purchased units received)

A new average unit cost may be computed for a stores item whenever goods are received from suppliers. This is the usual practice in case the stores requisitions are costed at frequent intervals. In the process industries, it is the practice in many cases to cost material requisitions only once a month. Under these circumstances the average unit costs would be computed monthly. The inventory at the beginning of the month and the purchases for the month would be included in the average. Under the average cost method the unit costs applied to production and carried through to the cost of shipments more nearly approach the current replacement cost than is the case when the first-in–first-out method is used, whereas the unit costs assigned to the final inventory are not so close to current costs.

For the figures given on page 235, the weighted average costs are shown in the following table:

	In	Out	Balance
Jan. 10	10 @ $40	.....	10 @ $40
Mar. 10	.....	5 @ $40	5 @ $40
Apr. 10	10 @ $43	.....	15 @ $42
Apr. 20	.....	6 @ $42	9 @ $42

The average cost of $42 is computed as follows:

April 10	Quantity	Unit cost	Amount
Inventory, prior to receipt of material	5	$40	$200
Material received	10	43	430
Total	15		$630
Average unit cost: $630 ÷ 15 = $42.			

According to the data in Table 15.1 the average cost method is by far the most popular of the various procedures of cost selection. There are probably two reasons for the popularity of this method: (1) The detailed work of stores-record keeping is somewhat less complicated than it is under the first-in–first-out method, for it is unnecessary under the average cost method to analyze the inventory so as to show the quantities of material received at different prices. (2) Changes in unit costs resulting from changes in purchase prices are less severe than under the first-in–first-out method. The averaging method has the effect of smoothing the trend of unit costs applied to cost sheets.

The stores record in Fig. 14.2 illustrates an application of the average cost method. The average unit cost that would be used for pricing a stores requisition is shown as a notation on the title insert, part 3 of the form. The average cost of the 43 pieces on hand is $7.42 a hundred. The cost of $7.25 a hundred, which has been crossed out, was the cost in effect prior to May 6 when 25 pieces were received at $7.57 a hundred. The latter price is shown in part 1 of the form. The calculation of the unit cost of $7.42 a hundred was made as follows:

On hand, May 6, prior to receipt of goods purchased	22 pieces @ $7.25C	$1.5950
Received, May 6, on Purchase Order 33-913	25 pieces @ $7.57C	1.8925
Total	47 pieces	$3.4875

Average unit cost of 47 pieces: $3.4875 ÷ 47 = $0.0742 each, or $7.42 a hundred.

Last-in–first-out Cost

The last-in–first-out method, sometimes referred to by the abbreviation Lifo, is just the opposite of the first-in–first-out method. Stores requisitions are costed on the assumption that the most recent purchases are used first. Cost of sales therefore approximates current reproduction costs. Unless the quantity has increased, the inventory at the end of the year is costed at the same unit cost as the beginning inventory. The quantity in excess of the initial quantity is costed at unit costs in effect during the year. Table 15.2 is designed to present for a limited range of transactions

a comparison of the results that would be obtained under three methods of costing—Fifo, average cost, and Lifo.

Over a series of years representing a complete price cycle the total profit would be the same under any one of these three methods, provided that there is the same inventory quantity at the end of the price cycle as at the beginning. Under Lifo, however, the profits are spread more evenly among the years in the price cycle; when the price trend is upward,

TABLE 15.2
THREE METHODS OF COSTING STORES REQUISITIONS AND INVENTORIES ON AN ANNUAL BASIS

	Quantity	Fifo	Average cost	Lifo
First Year, Price Trend Upward				
Initial inventory, 100 @ $2.00	100	$ 200.00	$ 200.00	$ 200.00
Purchases, one lot of 500 @ $2.30	500	1,150.00	1,150 00	1,150.00
Total debits to stores	600	$1,350.00	$1,350.00	$1,350.00
Stores issued	400			
Fifo: 100 @ $2.00				
300 @ $2.30	...	890.00		
Average cost: 400 @ $2.25	...		900.00	
Lifo: 400 @ $2.30	...			920.00
Final inventory, at cost	200	$ 460.00	$ 450.00	$ 430.00
Second Year, Price Trend Downward				
Initial inventory	200			
Fifo: 200 @ $2.30	...	$ 460.00		
Average cost: 200 @ $2.25	...		$ 450.00	
Lifo: 100 @ $2.00				
100 @ $2.30	...			$ 430.00
Purchases, one lot of 500 @ $2 10	500	1,050.00	1,050.00	1,050.00
Total debits to stores	700	$1,510.00	$1,500.00	$1,480.00
Stores issued	600			
Fifo: 200 @ $2.30				
400 @ $2.10	...	1,300.00		
Average cost: 600 @ $2.143	...		1,285.80	
Lifo: 500 @ $2.10				
100 @ $2.30	...			1,280.00
Final inventory, at cost	100	$ 210.00	$ 214.20	$ 200.00

inventories are stated more conservatively than they are under the other methods.

Although the popularity of Lifo in recent years is undoubtedly due to its advantages in certain cases from the tax standpoint, a strong case can be presented in support of the claim that

it approximates more closely the true economic and business facts of inventory operations, particularly in lines of industry where selling prices respond most quickly to replacement or reproductive cost. The proponents claim that the method comes closer to determining profits on the basis of realization, measuring profits by matching current sales against current costs.[1]

Where stores issues are costed only once a month and where there are relatively few stores items—a situation frequently found in the process

TABLE 15.3

LAST-IN–FIRST-OUT METHOD APPLIED ON A YEAR-TO-DATE BASIS*

Data given:

Initial inventory, Jan. 1, 100 units at 10 cents.

Month	Purchases		Units sold
	Units	Cost	
Jan	200	$18.00	150
Feb	200	16.00	175
Mar	175	12.25	275
Apr	225	16.88	175

Required:

Cost of sales for each month.
Cost of inventory on hand at the end of each month.

Solution:

The first step is to cumulate the purchase data obtaining year-to-date totals monthly and then to compute for each month the average unit costs on a year-to-date basis. The results of these calculations are shown in the following schedule:

Month	Purchases, year-to-date		
	Units	Cost	Ave. unit cost
Jan	200	$18.00	$0.09
Feb	400	34.00	0.085
Mar	575	46.25	0.0804
Apr	800	63.13	0.0789

* Adapted from "Example of the Last-in–First-out Uniform Method of Valuing Petroleum Inventories," approved by the American Petroleum Institute, Nov. 12, 1934, reported in *N.A.C.A. Bulletin*, Vol. 18, No. 13, Sec. I, p. 766.

[1] Committee on Cooperation with Bankers of the New York State Society of Certified Public Accountants, "Answers to Questions Presented by the New York Chapter of the Robert Morris Associates," *The New York Certified Public Accountant*, Vol. 12, No. 7, p. 420.

TABLE 15.3. (*Continued*)

The second step is to cumulate units sold obtaining year-to-date totals monthly, then cost by last-in–first-out method to obtain year-to-date cost of sales at the end of each month. Sales for year-to-date are costed at unit cost of purchases for year-to-date except that an excess of units sold over units purchased is costed at 10 cents, the unit cost of the initial inventory. The results of these calculations are shown in the following schedule:

Month	Cost of sales, year-to-date		
	Units sold	Unit cost	Cost of sales
Jan	150	$0 09	$13 50
Feb	325	0.085	27 63
Mar	600	*	48 75
Apr	775	0.0789	61.15

* 575 units @ $0.0804, and 25 units @ 10 cents.

The third step is to compute the cost of sales for each month by subtracting the year-to-date cost of sales at the beginning of the month from the year-to-date cost of sales at the end of the month. The results of these calculations as well as the unit costs of sales for each month are shown in the following schedule:

Month	Cost of sales, year-to-date		Cost of sales for the month	
	First of month	End of month	Amount	Unit cost
Jan	0	$13.50	$13.50	$0 09
Feb	$13 50	27.63	14 13	0 0807
Mar	27.63	48.75	21.12	0 0768
Apr	48 75	61 15	12.40	0.0709

The final step is to compute the cost of the goods on hand at the end of each month. The results of the inventory calculations are shown in the following schedule, the units on hand and the unit costs being shown also:

Date	Inventory account			Units on hand	Unit cost
	Debits	Credits	Balance		
Jan. 1	$10.00	.....	$10.00	100	$0.10
Jan. 31	18.00	$13.50	14.50	100	0.10
				50	0.09
Feb. 28	16.00	14.13	16.37	100	0.10
				75	0.085
Mar. 31	12.25	21.12	7.50	75	0.10
April 30	16.88	12.40	11.98	100	0.10
				25	0.0789

industries—the Lifo principle can be applied without a great deal of difficulty. Table 15.3 illustrates its application on a year-to-date basis in the costing of petroleum sales. The method employed would also be applicable to the costing of materials issued from stores. The cost of sales is computed each month by applying Lifo on a year-to-date basis; then the cost of sales for the current month is determined by subtracting the year-to-date cost at the end of the previous month from the year-to-date cost at the end of the current month. The monthly cost of sales therefore includes whatever adjustment is necessary in order to bring the cumulative year-to-date cost of sales into accordance with the Lifo formula, and no extraordinary adjustment is needed at the end of the fiscal year. The calculations are somewhat complicated, but this is not a serious drawback when the number of inventory items is small.

In job-order cost systems it is usually difficult to make a satisfactory application of the last-in–first-out method, for as a rule there are numerous stores items, and the stores requisitions must be costed at frequent intervals.

The quantities of individual items ebb and flow even though the inventory as a whole represents a normal supply. The ebb and flow is not a daily occurrence nor even a monthly occurrence in most cases. The replenishment cycle varies, but except for the major items several months' requirements are generally received at one time.

For the purpose of computing the annual inventory on a last-in–first-out basis, the Lifo formula should be applied on an annual basis, but requisitions as a rule must be costed daily. When the Lifo formula is applied on a daily basis, there is a tendency to "use up" the old cost, for the supply of each item is likely to reach a low point prior to replenishment. The resulting book-inventory cost tends to approximate current cost, and the cost of shipments reported on monthly operating statements tends to approximate first-in–first-out cost. The monthly statements therefore do not furnish a reliable indication of the results for the year. At the end of the year the book inventory would require adjustment, for the Lifo formula would be applied on an annual basis in computing the final inventory. Table 15.4 illustrates an application of the last-in–first-out method both on a day-to-day basis and on an annual basis. In the illustration the initial inventory is entirely exhausted before replenishment is received.

Although it is not often the practice, it appears to the author that it would be feasible to use the last-in–first-out method of costing the annual inventory in connection with a standard cost system even where there are numerous stores items. Standard costs of the attainable-ideal type usually represent current replacement costs. The costs assigned to stores

issued and to goods shipped in a standard cost system of that type therefore are substantially the same as those which would be used for those purposes under Lifo applied on an annual basis. The monthly entries tracing the flow of costs would therefore be made according to the usual standard-cost procedure.

TABLE 15.4

VARIATION IN RESULTS UNDER LAST-IN–FIRST-OUT METHOD

When Applied (1) on a Day-to-day Basis and (2) on a Yearly Basis

Data for a certain stores item:

Inventory, Jan. 1	200 pieces @ $5
Received, June 5	300 pieces @ $6
Issued, Feb. 6	50 pieces
Mar. 11	50 pieces
Apr 15	50 pieces
May 25	50 pieces
Aug. 7	50 pieces
Nov. 12	50 pieces

Costing on a day-to-day basis:

	In	Out	Balance
Jan. 1, inventory			200 @ $5
Feb. 6, issued		50 @ $5	150 @ $5
Mar. 11, issued		50 @ $5	100 @ $5
Apr. 15, issued		50 @ $5	50 @ $5
May 25, issued		50 @ $5	0
June 5, received	300 @ $6		300 @ $6
Aug. 7, issued		50 @ $6	250 @ $6
Nov. 12, issued		50 @ $6	200 @ $6

Costing on a yearly basis:

	Quantity	Cost Each	Amount
Initial inventory	200	$5	$1,000
Received	300	6	1,800
	500		2,800
Issued	300	6	1,800
Final inventory	200	$5	$1,000

Inventory variation, December 31:

Book inventory, using day-to-day basis, 200 @ $6	$1,200
Final inventory, costed by applying Lifo on annual basis	1,000
Inventory variation	$ 200

Obviously the amount of the inventory at standard cost would differ from the amount at last-in–first-out cost, for inventory cost under Lifo is made up of costs that were in effect at previous times, whereas the standard costs would be current costs. The difference between the two amounts, in fact, is likely to be large. If the inventory at the begin-

ning of the year is booked at standard cost, the difference should be booked in a valuation account, which might be called Excess of Standard Cost of Inventory over Lifo Cost. This account in most cases would have a credit balance that would be subtracted from the balance of the inventory account to obtain the valuation of the inventory at Lifo cost.

Entries to inventory during the year would be at standard cost. Their total effect for the year would be nearly equivalent to that which would be obtained by applying Lifo on the annual basis. The balance of the valuation account Excess of Standard Cost of Inventory over Lifo Cost therefore would not require adjustment during the year. At the end of the fiscal year it would be adjusted to reflect the difference between the revised standard cost and the last-in–first-out cost of the final inventory. This year-end adjustment as a rule would be small in amount. After adjustment the valuation account may be closed to the inventory account if it is considered desirable that the balance of the latter account should agree with the inventory reported on the annual balance sheet. In case the valuation account is closed at the end of the year, it should be reopened at the beginning of the ensuing year and the inventory account should be restored to the standard cost basis.

The Elective Method of Inventorying

Under the Revenue Act of 1938 the use of the last-in–first-out method of inventorying was permitted for the first time for the purpose of computing taxable income. The permission applied only to certain specified industries. In later years, however, the law has been liberalized so that any taxpayer who takes inventories into account in determining taxable income may now elect to use Lifo for Federal income-tax purposes provided that he complies with certain requirements. The method permitted for tax purposes is specifically described in the Internal Revenue Code. It is not referred to as the last-in–first-out method, either in the Code or in the Income Tax Regulations, but is called the "elective method of inventorying." The requirements a taxpayer must meet in order to use the elective method are stated in the Regulations.

Lower of Cost or Market

Annual inventories are generally stated or "valued" either at cost or at the lower of cost or market. Supply inventories as a rule are stated at cost, material inventories at the lower of cost or market. The basis of valuation adopted should be followed consistently from year to year. As previously explained the principal methods of determining the costs of stores items are first-in–first-out, average cost, and last-in–first-out. Market is computed at current replacement cost in the case of good

usable items and at net realizable value in the case of damaged and obsolete stock. Replacement-cost data are compiled by obtaining price quotations from suppliers.

As a rule the lower of cost or market is computed for each item in the inventory. It may be done by comparing the actual cost per unit with the market per unit, selecting the lower of the two, and then extending and adding to obtain the inventory amount. That method is illustrated by the accompanying example.

Item	Inventory quantity	Per unit			Inventory amount
		Cost	Market	Lower of cost or market	
A	10	$1 00	$1 10	$1 00	$10
B	50	0.40	0 30	0 30	15
					$25

Under the foregoing procedure the amount of the inventory is computed properly in accordance with the lower-of-cost-or-market basis, but the inventory reduction caused by the valuation at market where market is lower than cost would be merged with other inventory adjustments. For managerial purposes it may be desirable to report the inventory reduction from this cause as a separate factor. In this case the amount of each inventory item would be computed at cost and also at the lower of cost or market. The total of the inventory at cost less the total at the lower of cost or market would represent the reduction in inventory due to price fluctuations. The method is illustrated by the following example:

Item	Inventory quantity	Per unit			Amount	
		Cost	Market	Lower of cost or market	At cost	At lower of cost or market
A	10	$1.00	$1.10	$1.00	$10	$10
B	50	0.40	0.30	0.30	20	15
					$30	$25

Inventory at cost	$30
Inventory at lower of cost or market	25
Reduction due to valuation at market where market is lower than cost	$ 5

To compute the amount of the entire inventory at cost and the amount at market and then to use the lower of the two amounts is not a proper

application of the lower-of-cost-or-market formula. If this method were used the reduction on those items for which market is less than cost would be nullified at least partially by the recognition of an unrealized profit on those items having a market value in excess of cost. This can be demonstrated as follows, using the data in the previous examples:

Item	Quantity	Amount	
		At cost	At market
A	10	$10	$11
B	50	20	15
		$30	$26

If the inventory were valued at $26, item A would be valued at more than cost.

Where the price trend is uniform for items in a given class of inventory, however, it is usually feasible and proper to treat the class as a unit for the application of the lower-of-cost-or-market formula, and it may be desirable to do so as a short cut. Thus, if it is known that cost is lower than market for all items in a certain class of material, it would be sufficient to compute the valuation of that class at cost only; if the market were lower than cost for all of a certain class of items, it would be sufficient to price and compute the inventory at market only unless it were necessary to determine the inventory reduction caused by application of the lower-of-cost-or-market formula.

For Federal income-tax purposes the lower-of-cost-or-market basis of inventory valuation is permitted if cost is computed by the first-in–first-out method. It is generally permitted when cost is computed by the average cost method. It is not permitted when cost is computed by the elective (last-in–first-out) method. The Regulations wisely permit the taxpayer, however, to value inventories at the lower of cost or market on published financial statements even though he is not allowed to do so for tax purposes.

From an accounting standpoint there is no reason why the lower-of-cost-or-market basis of inventory valuation should not be used in connection with the last-in–first-out method of costing. In a period of rising prices last-in–first-out cost is generally lower than market for all items. In a period of declining prices, however, there would be many items for which the Lifo cost would be in excess of replacement cost. It would not be sound business judgment to carry the inventory at a value materially in

excess of replacement cost, and this would be likely to happen if the inventory were valued at last-in–first-out cost. Even if Lifo were adopted at a time when prices were low, the introduction of new items due to changes in products and the ebb and flow in quantities of the older items would result during a period of rising prices in the introduction of materials into the inventory at higher price levels. Then when prices declined, the inventory would not be conservatively valued if it were valued at last-in–first-out cost. This objection would not hold, however, if the lower-of-cost-or-market basis of valuation were used in connection with Lifo.

Standard Cost—Material Stores Carried at Actual Cost

Standard material costs (in systems of the attainable-ideal type) are generally current replacement costs. The standards are revised at least once a year at the time of the annual inventory and generally at quarterly intervals during the year if there are marked changes in the purchase prices. The standard cost applied to production and to goods sold therefore tends to approximate the current reproduction cost. During the year the monthly inventories of worked materials are carried at standard cost; the monthly inventories of material in stores may be carried either at standard cost or at actual cost. Supply Stores are generally carried at actual cost, and supply requisitions are generally charged to Factory Overhead at actual cost.

If Material Stores is carried during the year at actual cost, variances are recognized at the time materials are issued from stores, and material requisitions must be costed both at actual cost and at standard cost. The difference between the amount of the requisitions at actual cost and the amount at standard cost is either debited or credited to a variance account through the Summary of Materials Issued and Returned. The pro forma monthly journal entry for materials issued less returns, assuming a debit variance, would be somewhat as follows:

Goods in Process (at standard)	xxx	
Material-price Variance	xxx	
Material Stores (at actual)		xxx

Where the stores requisitions are costed two ways, at actual cost and at standard cost, the costing operation is usually assigned to the stores-record department. The actual-cost data would be compiled on the stores-ledger cards by one of the methods previously explained; the predetermined standard unit costs would be written on the cards for reference in costing. Frequently a space is provided for this purpose in the heading of the stores-record form.

Material Stores Carried at Standard Cost

If Material Stores is carried during the year at standard cost, the material-price variances are recognized when materials are received. The monthly entry to the variance account comes from the purchase-invoice distribution (see Table 10.2, entry 7-1). Materials purchased are debited to Material Stores at standard cost, and material requisitions are then costed at standard cost only, being charged to Goods in Process and credited to Material Stores at standard cost.

Where the material requisitions are costed at standard cost only, the costing operation may be assigned to the factory cost accounting department. A file of standard unit costs of material is generally kept there for reference in costing standard cost sheets for parts and assemblies and for costing purchase invoices at standard cost. The file can be used also for the costing of stores requisitions.

There are two principal advantages of carrying Material Stores at standard rather than actual cost. In the first place, it is a simpler procedure requiring less clerical work. Costing the material requisitions only at standard cost is a faster operation than costing them both at standard and actual. Partly offsetting this gain is the additional work of costing the purchase invoices at standard, which must be done where Material Stores is carried at standard cost. The number of purchase transactions, however, is much smaller than the number of stores issues. The cost of the clerical work required to cost the purchase invoices at standard is small therefore relative to the saving made in the costing of requisitions.

In the second place, the purchase-price variances are more significant. They are reported as materials are received and thus indicate each month how current purchase prices compare with the standards. Price variances of this type can be easily analyzed so as to determine how much is caused by changes in price levels and how much is due to carelessness in buying. In some cases analysis of a price variance may disclose errors in suppliers' invoices. Such facts are significant, and if they are known to management, appropriate action can be taken.

Where materials in stores are carried during the year at actual cost, on the other hand, the price variances are reported as the materials are issued from stores. Because the average storage time is generally more than a month and frequently is 2 to 3 months, the price variances under this procedure do not indicate how current purchase prices compare with standards. There is a lag due to the time the materials are in storage. Furthermore, the storage time varies; hence the lag is not uniform for the various items. Price variances under this procedure therefore are not

significant. They tend to be merely a bookkeeping device and not a means of cost control.

It is sometimes contended that Material Stores should be carried at actual cost because standard cost is not a sound basis for inventory valuation. For the reasons given in the preceding two paragraphs, however, it is desirable to carry Material Stores at standard cost during the year. This can be done without deviating from sound principles of stating the inventory at the end of the fiscal year. Valuation of the annual stores inventory in a standard cost system is discussed in the next section.

Valuation of Annual Stores Inventory in Standard Cost Systems

The accounting principles or conventions governing the valuation of the annual inventory where the cost system is of the historical type apply also in a standard cost system. The annual stores inventory is therefore stated either at actual historical cost or at the lower of cost or market, and the practice adopted is followed consistently from year to year. The valuation should not be in excess of historical cost, for that would be tantamount to recognizing a gain before the goods are sold. Because of the risk attendant upon the conversion of inventories into cash, it is not good business judgment as a rule to count gains as realized until the sales have been booked.

Where Material Stores is carried during the year at actual cost, the historical costs needed to cost the final inventory would be obtained from the stores ledger. They would generally be either first-in–first-out costs or average costs. Where Material Stores is carried during the year at standard cost the historical costs needed for inventory costing are generally computed on the first-in–first-out basis.

To compute first-in–first-out cost for the purpose of costing the final inventory where a running record of such costs has not been maintained during the year, the inventory quantity of each item is compared with the purchase quantities, starting with the most recent purchase and working back until the quantity on hand is fully accounted for. The inventory quantity not in excess of the most recent purchase is costed at the price of the most recent purchase. Any excess quantity not in excess of the quantity received in the next most recent purchase is costed at the price of the next most recent purchase. Any excess quantity still remaining would be costed at the cost of the third most recent purchase to the extent that it did not exceed the quantity in that purchase, and so on, but seldom would the inventory quantity be greater than the total of the two most recent purchases. The procedure is illustrated by the following example:

	Item 1	Item 2
Quantity on hand, Dec. 31	150	50
Purchases:		
Dec. 15	100 @ $5.00	100 @ $2.00
Nov. 15	100 @ $4.75	
Inventory at first-in–first-out cost	100 @ $5.00 50 @ $4.75	50 @ $2.00
Total	$737.50	$100.00

Although it may appear to be complicated, the foregoing procedure is not impractical. As a short cut, however, the most-recent-purchase price is frequently used for costing the final inventory. For the figures in the foregoing example the most-recent-purchase prices would be $5 for item 1 and $2 for item 2. The inventory amounts would be $750 for item 1 and $100 for item 2.

Unless there have been marked fluctuations in purchase prices in the two or three months preceding the close of the fiscal year, the inventory costs obtained by the most-recent-purchase method would in most cases be substantially the same as those obtained by the first-in–first-out method. Before approving the short-cut method, however, the controller or his representative should study the situation carefully. This should be done each year. If there have been pronounced price changes during a period of two or three months previous to the inventory date, particularly if prices are rising, the most-recent-purchase method cannot safely be used as a substitute for the first-in–first-out method.

To obtain purchase-price data reference may be made to the files of purchase invoices and purchase orders. This is generally not necessary, however, for there is usually a systematic record of prices in the purchasing department. This record may be designed so as to serve the needs of the cost accounting department. Purchase prices may be recorded in the stores ledger, although this is not customary except where stores are carried at actual cost. In some cases the cost accounting department makes a record of price changes in its file of standard material costs. This may be done at the time the purchase invoices are costed at standard and in the same operation.

Where the last-in–first-out method of costing the final inventory is used in conjunction with a standard cost system, there should be a record of the quantity and the Lifo cost of each item at the beginning and end of each year. Purchase quantities and prices should appear on the same record. The latter data are needed in order to determine the cost to be applied to quantities on hand at the end of the year in excess of the

quantities at the beginning of the year. The stores record would usually be the best place to compile the desired information.

To determine the valuation of a stores inventory at the lower of cost or market in a standard cost system the procedure is the same as in systems of the historical type once the historical unit costs have been determined.

The Material Stores account would as a rule be adjusted at the end of the year to the valuation basis adopted for the balance sheet. At the beginning of the ensuing period it should be adjusted to the standard cost basis if the new standard unit costs differ from the unit costs used for the inventory valuation. In case the price trend is level or downward the standard cost is likely to be the same as lower of cost or market. Only when the price trend is upward therefore is it necessary as a rule to recompute the inventory and to adjust the inventory accounts.

Variations in Procedure

A complete system of accounting for materials and supplies embraces two features: the perpetual-inventory system of stores control and the requisition system of charging goods in process and factory-overhead accounts. The two features are closely linked, for stores requisitions are usually required in the operation of the perpetual-inventory procedure. Although the expense of operating a complete system is considerable, there are many cases in which the expense is justified. Perpetual-inventory control is a means of regulating the flow of materials and avoiding material shortages as well as excessive inventories. Stores requisitions are an aid in product costing and in the proper distribution of overhead costs and cost variances.

If costs are figured by the job-order cost method, stores requisitions are usually the best means of obtaining accurate reports of the materials used on each job order. In case requisitions are not available, the reports of materials used are generally obtained from shop foremen, and as a rule they are not prepared and checked systematically. In standard cost systems, materials are costed to products by the specification method; nevertheless it is frequently desirable to obtain stores requisitions in order to determine and analyze material-quantity variances.

Wartime conditions have stimulated the introduction and the improvement of stores control systems. Without adequate and reliable stores records it was difficult if not impossible to comply with requirements established by the War Production Board for regulating the flow of scarce materials. Manufacturers working on government contracts found it necessary in many cases to install perpetual-inventory systems in order to obtain accurate contract costs. Where a contractor had government-

owned materials in his custody he was required to have a good system of inventory control.

There are, of course, variations in procedure, and in some cases short cuts can be made without sacrificing essential controls. In mass-production industries of the assembly type, for example, the flow of materials is controlled on the basis of schedules to such an extent that stores requisitions are not used at all for the major items of material. On the stores records the scheduled requirements, the quantities ordered from suppliers, and the quantities received are shown; but the issues from stores are not recorded. Stores, in fact, consists only of small banks of material in the processing departments; incoming shipments are delivered direct to the processing floor. Arrangements are made with suppliers and with transportation companies so that materials are received as they are needed in production. Purchase invoices for material are charged to Goods in Process. The balances of the factory inventory accounts—Material Stores, Goods in Process, and Finished Product—are merged except at the end of the fiscal year. Product costs are computed by the standard cost method. The system of production control and inspection is such that complete reports are made of spoiled pieces.

Where stores requisitions are used in order to have a perpetual-inventory control of stores items, it is sometimes feasible in standard cost systems to omit the costing of the direct-material requisitions. Materials are costed to products on the basis of material specifications, and in case excess material usage is all reported on rejected-material reports, the only object of costing the direct-material requisitions is to obtain a journal entry debiting Goods in Process and crediting Material Stores. In one case it was found that the dollar amount of the monthly inventory of material stores could be computed from the stores records in much less time than it took to cost and extend the material requisitions. By subtracting the sum of the material stores inventory at the end of the month and the amount of indirect material issued during the month from the sum of the initial inventory and the purchases for the month, the amount of the direct material issued is determined as the basis for the journal entry debiting Work in Process and crediting Stores. In other cases, although material requisitions are posted to the stores ledger, the general ledger balances of Material Stores and Goods in Process are merged except at the end of the fiscal year; hence it is unnecessary to cost the requisitions for standard direct material. Requisitions for indirect material would be costed, however, as would the requisitions for excess-material usage not covered by rejected-material reports.

In the process industries, raw materials frequently are not under perpetual-inventory control. If the materials are bulky and of small unit

value, there is little risk of loss through theft. Incoming materials are unloaded at points convenient to the processing departments and then used as needed. To obtain data for the computation of daily yield percentages the material put into process may be measured in the processing departments. The monthly consumption of materials is usually computed by the physical-inventory method. There are only a few items of raw material as a rule, and it is not difficult to count the quantity on hand. The count is generally made under the foreman's supervision subject to verification by the accounting department.

Even in jobbing industries exceptions must sometimes be made to the general practice of costing materials to orders on the basis of material requisitions. To save counting and measuring in the storeroom and to avoid loss of time in processing, it may be advantageous to issue certain materials from stores in package lots rather than in the quantities required for individual jobs. Paint may be issued, for example, in 5-gallon cans and then used in the paint shop as it is needed. A similar practice is often adopted in the case of nails, screws, small bolts, and washers. Optional procedures that may be used in job-order cost systems in such cases are (1) to charge the material requisitions to Factory Overhead as indirect material, (2) to charge the requisitions to Unapplied Materials in Process crediting that account later and charging Goods in Process on the basis of foremen's reports of quantities used on individual jobs, and (3) to charge the material requisitions to Unapplied Materials in Process the same as in the second procedure and then to credit that account and charge job cost sheets by the specification cost method. The nails required for a certain style and size of shipping crate, for example, might be listed and a standard cost determined for use in costing shipping orders calling for that crate.

In a furniture factory producing a great number of small orders, cuttings of various sizes for different orders are frequently made from one piece of rough lumber in order to avoid waste. It would be difficult if not impossible to determine the quantity of lumber actually used on each order. Requisitions covering rough lumber withdrawn from stores by the cutting department are charged to Cutting Department Inventory, an inventory of unapplied material in process. The job cost sheets are costed at an estimated cost computed as follows. On the basis of the dimensions and quantities of the good cuttings called for by a production order a computation is made of the board feet of lumber that would have been needed if there had been no waste in cutting. This quantity is referred to as the board feet of production. It is multiplied by a predetermined loss percentage to obtain an estimate of the loss or waste. The estimated loss is added to the board feet of production to obtain an

estimate of the board feet consumed on the order that is charged at an average cost to the cost sheet and to Goods in Process and credited to Cutting Department Inventory. The procedure of determining quantities used in this case is essentially a specification cost procedure. The manufacturing technique, which is an efficient one, makes it impractical to cost the production orders on the basis of stores requisitions.

CHAPTER 16

WAGES AND SALARIES—LABOR COST CONTROL

The earnings of employees who are hired by the day are called wages. The earnings of employees who are hired by the week, month, or year are called salaries. Costs incurred for wages are referred to as labor costs. That portion of labor cost which can be applied specifically to units of product is called direct labor cost or simply direct labor. The remainder of the labor cost is called indirect labor cost or indirect labor. Indirect labor cost is distributed to overhead accounts; it is applied to products only as a part of the factory overhead. Salary costs as a rule are indirect costs. In some cases salary costs are classified as indirect labor; in other cases a separate overhead classification is provided for salaries.

The major objectives in accounting for salaries and wages are cost control, payroll preparation, and cost distribution. Although the three cannot be disassociated, the discussion of labor cost control is concentrated as much as possible in the present chapter, that of timekeeping and payrolls in Chapter 18, and that of labor cost distribution in Chapter 19.

Control of Labor Cost

The principal service performed by a manufacturing organization is the conversion of material into finished product. The success of the organization is measured to a large extent by its effectiveness in performing this service. Except in the process industries, conversion costs are generally divided into two groups, direct labor and factory overhead, the indirect labor and the salary costs being included in the latter group. Although conversion costs in most cases amount to less than the material costs, they are more subject to control by the organization.

Direct labor cost is important not only of itself, but also because of its influence upon overhead costs. Indirect services are needed in connection with the direct operations, and an increase in direct man-hours therefore tends to increase the periodic overhead total. Furthermore, a high standard of performance must be maintained on direct operations in order to have efficient utilization of plant facilities. In two plants using the same type of machines and producing the same output, for example, the plant with a more efficient labor force would require fewer machines and hence a smaller investment in plant and equipment and would have a lower fixed overhead cost per unit of output.

The control of labor cost is closely related to production control. There must be dependable performance on the part of the direct workers if the flow of production is to be regulated satisfactorily. Production is scheduled to the various operations on the basis of standard performance. When the performance at any work point falls below standard, a "bottleneck" condition is likely to develop, with the result that assembly schedules and shipping schedules may have to be revised.

Labor cost control, like material cost control, begins with the design of the product. This point can scarcely be overemphasized. The accounting function in connection with cost control at the design stage is discussed in Chapter 14. The present chapter deals with the following elements of labor cost control: production standards, production planning, labor budget, employment, wage-payment plans, job classification, control in the shop.

Production Standards

A standard under modern scientific management is simply a carefully thought-out method of performing a function, or carefully drawn specifications covering an implement or some article of stores or of product. The idea of perfection is not involved in standardization. The standard method of doing anything is simply the best method that can be devised at the time the standard is drawn. Standard specifications for materials simply cover all the points of possible variation which it is possible to cover at the time the specifications are drawn. Improvements in standards are wanted and adopted whenever and wherever they are found. There is absolutely nothing in standardization to preclude innovation. But to protect standards from changes which are not in the direction of improvement, certain safeguards are erected. These safeguards protect standards from change for the sake of change. All that is demanded under modern scientific management is that a proposed change in a standard must be scrutinized as carefully as the standard was scrutinized prior to its adoption, and further that this work be done by experts as competent to do it as were those who originally framed the standard. Standards adopted and protected in this way produce the best that is known at any one time. Standardization practiced in this way is a constant invitation to experimentation and improvement.[1]

The establishment of production standards covering manufacturing methods, plant and equipment, and man-hours is a production engineering function. In plants where the operations are numerous and varied, it is generally desirable to centralize the responsibility for this function in a department that may be called, for example, the methods and standards department or the production engineering department. Manufacturing methods are planned by this department before production orders are

[1] Cooke, Morris L., "Academic and Industrial Efficiency," *Bulletin of the Carnegie Foundation for the Advancement of Teaching*, No. 5, p. 6, 1910.

released to the shop. The operations to be performed on each part are listed in their proper sequence. The type of machine to be used for each operation is designated. The layout or arrangement of machines in the plant is checked, and in some cases changes in layout are authorized. Jigs, fixtures, cutting tools, gauges, and material-handling devices are specified; where special ones are needed, they are either designed or requested by this department. Requests for the procurement of machines, tools, and other equipment are initiated and followed up. Production routings are prepared listing the operations to be performed, the standard equipment, and in most cases the standard time for each operation. Illustrations of production routings will be found in Figs. 5.3 and 16.1.

Time and Motion Study

Time and motion study or operation study is an important part of production engineering. It is a means of improving methods, a basis for equitable incentive wages, and a source of data for use in production control, cost control, cost estimating, and cost accounting. The object of a time and motion study is to develop the best method of performing an operation and to determine the standard time. The operation is analyzed into its elements. Waste motions are eliminated, and a rhythmic series of motions is developed. Modifications of the equipment are made in order to reduce fatigue and to secure economy of motion. For example, a hoist may be provided for lifting heavy parts; or a stand may be installed on which to place the container of pieces to be processed so that it will be convenient for the operator to reach without stooping. Conditions at the work point are studied, improvements are made where it is economical to do so. For example, if the lighting is inadequate, additional lighting may be provided.

Standard time is the time that an experienced workman working at a selected performance level would require for a given task including an allowance for rest and unavoidable delays. It may also be referred to as the allowed time or the task time. In an incentive-wage system, such as a piece-rate system, the standard time is the basis for the determination of the incentive-wage rate. It is a measure of performance. To determine performance efficiency or job efficiency the standard time for a given amount of work is divided by the actual time taken. This is equivalent to dividing actual output by standard output.

The performance level at which standards are set varies in different plants. Frederick W. Taylor, the originator of motion and time study, favored "fixing a task which required a first-class man to do his best, and then offering a good round premium. When this high standard is set it

takes longer to raise the men up to it. But it is surprising after all how rapidly they develop."[1] When the standard time is set at that level, the average job efficiency under an incentive-wage system should be approximately 100 per cent. Perhaps the more common practice is to set the standard at the performance level of a workman of average skill working with average effort. "That pace used by operators working without incentive (that is, paid by the day) with reasonably good supervision is what is meant by average effort."[2] Under an incentive-wage system in which the time standard is set at the latter level, the average performance efficiency should be considerably in excess of 100 per cent.

A description of the standard method of performing each operation should be recorded and kept on file. This description, which is known as a standard practice sheet, would include a description of the machine, the tools and other accessory equipment, and the surrounding conditions, as well as a detailed statement of the standard time computation showing the time of each element of the operation and the allowances for fatigue and unavoidable delays. In some plants a copy of the standard practice sheet is issued to the shop as an instruction card. In other cases oral instructions are given. In any event it is a responsibility of the department conducting the time and motion studies to explain the standard methods to foremen and workmen.

Standard Time for Product Costing Purposes

When labor and overhead costs are computed on the basis of time standards, as is frequently done in standard cost systems and in making cost estimates, it is generally necessary to adjust the standard time to the expected level of performance. Thus, if the standard time for a certain operation is 10 hours and the expected efficiency 125 per cent, the expected or attainable time would be 8 hours (10 hours divided by 1.25). For product costing purposes this would be the standard time for the operation.

Production Planning

In a broad sense production planning includes all supervisory work and all engineering relating to factory operation. In a more limited sense the term refers to the release of production orders and production routings to the processing departments, the scheduling of work, and the dispatching

[1] Taylor, Frederick W., *Shop Management*, p. 175, Harper & Brothers, New York, 1919. (First published in 1903 in the *Transactions of the American Society of Mechanical Engineers.*)

[2] Barnes, Ralph M., *Motion and Time Study*, p. 276, John Wiley & Sons, Inc., New York, 1940.

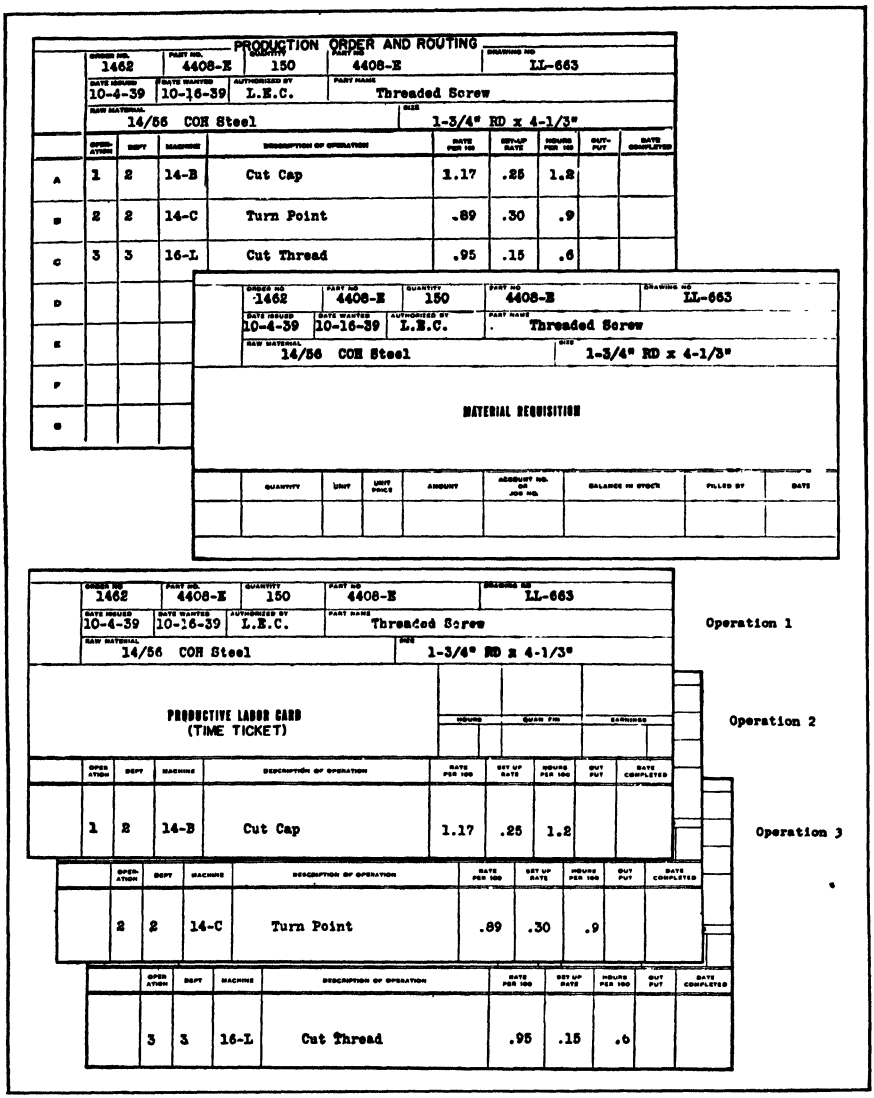


FIG. 16.1. Production order and routing, material requisition, and time tickets written in one operation by means of a spirit duplicator. (*Ditto, Inc.*)

of work in the shop. Where there are numerous operations and a variety of products, the responsibility for these functions is generally centralized in a production planning department. The stores ledger is likely to be kept in that department because of the importance of synchronizing the procurement of materials with production schedules.

It is the practice in many plants for the production planning depart-

ment to issue material requisitions and time tickets to the shop along with the production orders and routings. Either a spirit duplicator or a mimeograph machine can be used to prepare the various forms in one operation from a master copy of the production order and routing. The forms illustrated in Fig. 16.1 were prepared on a Ditto spirit duplicator.

Labor Budget

A labor budget indicates the total man-hours required in each department as well as the labor cost for a given production schedule. It is an over-all

TABLE 16.1

LABOR BUDGET—FINAL ASSEMBLY DEPARTMENT

Revised Budget for the Week Ending November 14, 19—

Issued November 7, 19—

Production Schedule

Model Number or Order Number	Units Scheduled	Direct Hours per Unit	Direct Hours Scheduled
M 41	20	100	2,000
M 42	40	60	2,400
			4,400

Labor Budget

	Fixed		Variable	
Direct Labor			4,400 hr. @ $0.80	$3,520
Indirect Labor:				
Supervision	320 hr.	$510		
Clerical	160 hr.	120		
Other (hours 12% of direct hours)	...	....	528 hr. @ $0.75	396
	480 hr.	$630	4,928 hr.	$3,916

Total Labor

5,408 hr., $4,546.00 (Direct $3,520, Indirect $1,026)

Labor force required working 40 hr. a week:

5,408 divided by 40	135.2
Add 3% for absence	4.1
	139.3 or 140

standard. It aids management to plan the size of the labor force and the schedule of working hours. In some plants the budget is prepared under the controller's supervision. In any event the controller should approve the budget procedure, and he should organize the accounting procedure so that data needed for budget purposes are readily available.

So far as possible the labor budget is based upon time-study standards for individual operations adjusted to the attainable level of performance. The long-term budget is generally prepared 3 months or more in advance and then revised at shorter intervals. In many plants the revised budget is issued every week, covering the requirements for the ensuing week. Table 16.1 is an example of a budget of the latter type. Reports

of performance are issued periodically, comparing actual hours and costs with budgets.

Personnel Management

Although every member of the supervisory staff has a share in the responsibility for personnel management, there are certain duties that are generally centralized in a personnel department. In general the function of this department is to "advise and assist in the solution of problems involving the application and control of human rather than mechanical forces. . . ."[1] More specifically its duties have to do with personnel procurement or employment, health and safety, education and training, recreation and personal welfare, job classification, and labor relations. All the work of the personnel department has a bearing on labor costs, but only those functions which are closely related to the accounting function can be discussed here.

Employment

The employment office of the personnel department is concerned with personnel procurement, placement, and records. From a control standpoint its functions are

1. To procure competent employees
2. To require that personnel changes be properly authorized in accordance with standards established by personnel budgets and job classifications
3. To furnish a means of internal check of payrolls

When there is a vacancy to be filled, the employment office is notified by means of a form called a hire requisition. Where there is a personnel budget showing the number of persons authorized for each department, it is usually the function of the employment department to make sure that the budget would not be exceeded by filling the requisition. By a screening process, on the basis of application forms, interviews, and tests, the employment office selects applicants who most nearly meet the qualifications for the position and arranges interviews for them with the foreman of the department where the vacancy exists. The final choice of the person to be hired generally rests with the foreman, but he must make his choice from among the applicants who have successfully passed through the screening in the employment office. When a person has been hired, a personnel change notice is prepared. When it has been signed by the department foreman and by the employment supervisor, the original copy of the notice is sent to the payroll department as authority to put the new

[1] Davis, Ralph C., *Industrial Organization and Management*, p. 470, Harper & Brothers, New York, 1940.

employee on the payroll. Transfers, rate changes, promotions, and terminations of employment also clear through the employment office for approval and for recording.

Figure 16.2 is a form known as a personnel-change notice. It is used as a hire slip, a transfer slip, a rate-change notice, and a termination notice. It would be prepared in each case by the employment office and signed by the employment supervisor and by the heads of the departments affected. The original copy of the completed form is sent to the payroll department in each case. In order to have a good system of internal check it should be required that all personnel changes made on the payroll records be authorized by personnel-change notices.

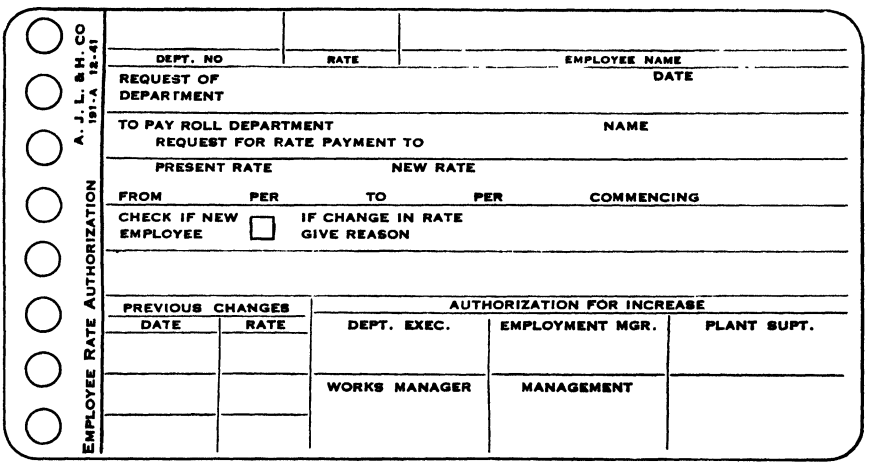


FIG. 16.2. Personnel-change notice. (*A. J. Lindemann & Hoverson Company.*)

The employment office keeps a personnel record card for each employee. This is usually a rather comprehensive record of his background and his progress with the company. It serves as a guide in the placement of employees. It may also be used as a check on the payroll, for the names and rates appearing on the payroll should agree with those on the personnel records.

Wage Policies

The pay envelope is the most important contact between the employer and the employee. In most plants therefore the formulation of wage policy as well as the negotiation of wage contracts with officials of labor unions representing the employees is a responsibility of top management. In American industry it is common practice to pay high wages in order to obtain a high level of performance. The results of that policy are low unit costs, effective utilization of plant and equipment, a good "take-

home" for the workers, and usually a vigorous, alert, and therefore a stable business organization. These conditions are generally brought about only through the efforts of management and the cooperation of workers over a period of years. In the administration of wage policy, the personnel department, the production engineering department, and the accounting department each has a part.

Wage Systems

Wage systems, broadly classified, are of two types: day-wage systems and incentive-wage systems.

Under a day-wage system the worker's earnings are proportional to time worked. Wages are paid at a specified rate per hour or day. This is the simplest procedure and requires less clerical work than any other wage system. However, it is not conducive to the improvement or the control of performance, and costs cannot be predicted accurately as a rule under this type of system. The day-wage system is widely used in small shops and in shops working chiefly on special orders where it is felt that the costs of standardizing conditions and administering an incentive-wage system are prohibitive. The production of new products, as when a plant is changing from peacetime products to wartime products or vice versa, is frequently paid at day rates until conditions can be standardized.

The day-wage system is also used, on the other hand, in shops where the operations are highly standardized and where the speed of the operation is controlled to a large extent by the flow of work through the process. Under such conditions the worker is held responsible for producing a given task. A system of the latter type is referred to as a measured day-work system.

Incentive-wage Systems

Under an incentive-wage system the worker's earnings are proportional (but not always directly proportional) to output. "The purpose of an industrial incentive scheme is to stimulate the worker to greater effort and cooperation by means of a direct appeal to his self-interest to improve his own status and, at the same time, reduce the costs of production to his employer."[1] The fundamentals of a good incentive-wage system are

1. The workman should be rewarded generously for increased production.

2. The wage formula should not be too difficult for the workman to understand. Other things being equal, the simpler the wage calculation, the better.

[1] Mitchell, W. N., *Organization and Management of Production*, p. 261, McGraw-Hill Book Company, Inc., New York, 1939.

3. The workman should not be penalized for unfavorable conditions beyond his control.

4. Performance standards should be established on the basis of careful time and motion studies.

5. Standards should be guaranteed.

To be fair and effective the incentive wages should be based on performance standards that are determined through careful time and motion study, and the standards should be guaranteed by the employer. The substance of the guarantee is generally that the standard time established for an operation will not be reduced unless the methods and equipment are improved by management. If performance standards are not carefully worked out, the employer cannot afford to guarantee the incentive-wage rate, and he is forced to cut the rate when individual earnings become unreasonably high. Consequently, workers learn in such circumstances to limit output.

The practice of rate cutting which has characterized many wage systems in operation has perhaps done more to wreck shop morale than any other factor in the relations of management and labor. As Taylor pointed out, it springs directly from the ill-advised adoption of some incentive plan without first determining what constitutes a reasonable standard of performance, and even after 45 years this warning is still sometimes ignored. Rates are determined by past performance (as if no improvement was to be expected!); and labor, accepting management's promises in good faith, responds to the offered incentive only to be disillusioned by a cut in rates and the prospect of expending more effort for less pay. No wonder, under the circumstances, that "the plan defeats itself" and that "men deliberately regulate output at the point where they think their employer will let them alone."[1]

Where the incentive-wage plan is fair to the workmen and honestly administered, many of the employees, probably a majority, would rather work under incentive than on day work. The men assigned to day-work operations, in fact, are likely to urge that their work be put on the incentive basis. Organized labor in the past was generally opposed to incentive wages, but the more realistic labor-union leaders nowadays accept the principle of incentive wages as beneficial to labor, provided that the labor union through qualified representatives is permitted to participate in the establishment of performance standards, thus preventing a management from taking unfair advantage of the workmen. In numerous instances today the performance standards are as much a matter of collective bargaining as the base rates.

The introduction of a wage-incentive system in place of an unstandardized day-rate system generally increases the output per man-hour at

[1] *Ibid.*, pp. 262–263.

least 100 per cent, owing partly to improvement in methods resulting from time and motion study and partly to increased effort on the part of workers stimulated by the wage incentive. How much of the time saved is due to improved methods and how much to the wage incentive is difficult to determine, for the incentive wage is usually necessary to induce the worker to learn the new methods and to improve his skill and efficiency.

Under all incentive-wage plans, the financial benefits resulting from increased productivity are shared by the employer and the employee. The employee receives additional pay. The employer generally benefits by a reduction in the direct labor cost per unit of output and by a reduction in overhead cost per unit as well owing to the fact that more output can be obtained from the same investment in plant facilities.

In most plants operating under wage-incentive plans there are some day-work operations, operations that cannot economically be standardized and are therefore paid at hourly rates. Because incentive wages are paid on the basis of output, while day work is paid on the basis of time, it is to the operator's advantage to understate the hours spent on incentive work and overstate the hours spent on day work. Care must therefore be taken by the timekeeping division of the accounting department to obtain an accurate report of the time on each type of work.

It is generally considered good practice to furnish each workman with daily statements of his earnings on incentive work in order to give him an opportunity to verify the payroll calculations and also to maintain his interest in the incentive. The daily statements are usually prepared by the payroll division of the accounting department.

A great many different wage-incentive plans are in successful operation in industry. Some of the more common types are described below. The cost accountant should familiarize himself thoroughly with the system in use in the plant where he is employed.

Piece Rates

The piece rate is the most widely used of the various wage incentives. The piece rate for an operation is computed by multiplying the standard time for the operation by a basic hourly piecework rate. Thus, if the standard time were $\frac{2}{10}$ of an hour and the basic hourly piecework rate 70 cents, then the piece rate would be 14 cents. To compute wages earned on piecework it is necessary first to tally the number of good pieces completed by the operator and then to multiply by the piece rate. Thus, if a worker completed 50 pieces in an 8-hour day at 14 cents per piece, his earnings for the day would be $7.

Because the output must be recorded as well as the time spent, the accounting work under a piece-rate system is somewhat more complicated than for a day-rate system. The piece rate, however, is a strong incentive to good performance, and labor costs can be accurately predicted under a system of this type.

Some plants use a modified piecework plan under which the work done is measured in points, 100 points being equivalent to one standard hour of work. The points per piece are determined by multiplying the standard time in hours by 100. Thus, if the standard time per piece is $\frac{2}{10}$ of an hour, the points per piece would be 20. To compute a worker's daily earnings the number of good pieces produced are multiplied by the points per piece to determine the number of points earned. Then the latter figure divided by 100 is multiplied by the employee's basic hourly rate to determine his earnings. Thus, if a worker produced 50 pieces having a value of 20 points each, he would earn 1,000 points. Dividing that by 100 and then multiplying by his hourly rate, 70 cents let us say, would give $7, the amount of his earnings for the day.

The piece-point system has at least two advantages over the straight piece-rate system. (1) It is better for measuring performance. The point is a measure that is common to all operations, and the number of points earned in a day is an indication therefore of the amount of work performed. The measure can be applied to the work of an individual, a department, a production center, or an entire plant. The number of hundred points earned divided by the actual hours worked gives the percentage of efficiency. (2) It is more flexible. Under a straight piecework system, when there is a general increase or decrease in basic hourly wage rates, it is necessary to refigure all piece rates. Under a piece-point system this is not necessary. The number of points per piece does not change except when there is a change in methods or equipment.

In piece-rate systems, and in other types of incentive-wage plans as well, the worker generally is guaranteed a minimum hourly earning rate. In case his earnings at piece rate are less than day-work earnings at his minimum hourly rate, he is paid at the latter rate. The guarantee protects the worker in case management fails to provide materials and equipment in accordance with the standards established for an operation. It is not the same as the standard-time guarantee previously discussed, but an additional guarantee. The guaranteed day rate is also a characteristic of incentive-bonus plans.

Incentive Bonus—Halsey Plan

Under the Halsey gain-sharing plan, originated by F. A. Halsey, a minimum hourly wage is paid, and in addition the worker is paid a premium or

bonus if his performance is better than the accepted standard. The premium is a fraction, usually one-fourth to one-half, of the value of the time saved. The standard time is usually set at a fairly low level of performance. In fact, when the plan was originally devised, past performance was accepted as the standard. Hence the incentive wage starts at a fairly low efficiency but is not so strong an incentive for high performance as the piece rate, because under the Halsey formula the worker receives only a portion of the gain or saving.

TABLE 16.2

CALCULATION OF EARNINGS UNDER THE HALSEY PLAN

Data given:		
Standard time per piece	0.24 hr.	
Worker's hourly rate	70¢	
Time worked	8.0 hr.	
Output	40 pieces	
Calculations:		
Earnings at hourly rate		
8 hr. @ 70¢		$5.60
Premium earnings		
Standard hours earned		
40 pieces @ 0.24	9.6 hr.	
Actual hours worked	8.0	
Time saved	1.6 hr.	
Multiply by gain-sharing ratio	0.50	
	0.8 hr.	
Multiply by hourly rate	0.70	
Premium earnings		0.56
Total earnings		$6.16
Performance efficiency:		
Standard hours (9.6) divided by actual hours (8.0), or		120%

If the gains are shared on a fifty-fifty basis, the workman's earnings are his regular hourly wages plus 50 per cent of the time saved multiplied by his hourly rate. Time saved is the excess of the standard hours over the actual hours. Table 16.2 illustrates the calculation of earnings under the Halsey plan.

Payroll calculations under this plan are more complicated than under either the day-rate or the piece-rate plan. Costs can be predicted with reasonable accuracy although not so well as under a piece-rate system, for actual performance is generally more consistent under the piece-rate plan. Standard hours earned is a good measure of performance provided that the standards are based on time and motion studies.

The Halsey plan

> is suited to all tasks which are estimated, roughly timed, or well standardized in themselves but uncertain in accomplishment from external deficiencies. . . .

Plan should only be applied to work which for any reason is uncertain in possibilities. For all such work it provides a safe and, at the same time, a generous incentive through the intermediate range of efficiencies. It cannot be expected to draw average response beyond 90 per cent of high task, although it might do so in cases where high piece rates had never been experienced. For these reasons the (50-50) sharing is usually restricted to jobbing type of work, maintenance, etc., and to employees formerly on ordinary time wages.[1]

Incentive Bonus—Bedeaux Plan

Under the Bedeaux system (devised by Charles E. Bedeaux) a standard minute of work including an allowance for rest is called a "B." A

TABLE 16.3

CALCULATION OF EARNINGS UNDER THE BEDEAUX PLAN

Data given:		
Standard time per piece	0.2 hr.	
B's per piece (0.2 × 60)	12 B's	
Basic hourly rate	70¢	
Rate per B ($0.70 ÷ 60)	$0.01167	
Time worked	8 0 hr.	
Output	50 pieces	
Calculations:		
Earnings at hourly rate		
8 hr. @ 70¢		$5.60
Bonus earnings:		
B's earned (50 pieces @ 12 B's each)	600 B's	
B's at standard performance for actual time worked (8 hr. @ 60 B's per hour)	480 B's	
Excess	120 B's	
Total bonus		
120 B's @ $0.01167	$1.40	
Proportion to worker	100%	
Worker's bonus		1.40
Total earnings		$7.00
Performance efficiency:		
B's earned (600) divided by hours worked (8), or	75 B's per hour	
Equivalent to	125% efficiency	

standard hour of work is therefore 60 B's. The worker is paid a guaranteed hourly wage, and if he produces at a rate in excess of 60 B's per hour worked, that is, better than standard performance, he is paid a premium or bonus. As in the Halsey plan the bonus is a proportion of the value of the time saved, but the standard time or task is usually set at a higher level of performance under the Bedeaux plan. Formerly in most

[1] Alford, L. P., ed., *Cost and Production Handbook*, pp. 633–634, The Ronald Press Company, New York, 1934.

installations using this plan the bonus for time saved was divided between the workers and the supervisors, 75 per cent going to the workers and the remaining 25 per cent going to the supervisors for their efforts in improving control and performance. Because the latter feature of the plan proved to be unpopular with labor, the system has been modified in many plants so that the workers are paid the entire bonus and the supervisors are compensated by separate incentive plans. When the worker is paid at his hourly rate for all the time saved, his earnings at and above the standard level of performance are equivalent to piece-rate earnings. Table 16.3 illustrates the method of calculating earnings under the Bedeaux plan.

Incentive Bonus—Efficiency Bonus

Efficiency-bonus systems represent a type of incentive bonus that is frequently favored in shops where wage incentives are being introduced for the first time and the workers are therefore not in the habit of working at high efficiency. The standard time or task is set at a high level of performance, but the bonus starts at a fairly low level only moderately above the day-work level. The worker's pay consists of a guaranteed hourly wage and a bonus.

The Emerson plan (developed by Harrington Emerson) is the forerunner of most systems of the efficiency bonus type. Under the Emerson plan the bonus is figured as a percentage of the hourly pay and starts at $66\frac{2}{3}$ per cent efficiency and then increases gradually to 20 per cent of the hourly wage when 100 per cent efficiency is reached. Above 100 per cent efficiency the bonus increases 1 per cent for each 1 per cent gain in efficiency. The effect of the latter provision is to pay the worker the entire value of time saved through bettering the standard performance in addition to his pay at the hourly rate and the 20 per cent bonus for reaching 100 per cent efficiency.

Because of the 20 per cent bonus the worker's earnings are greater under the Emerson plan than under piece rate, provided that (1) the standard is set at the same level of performance and (2) the basic hourly rate is the same. However, the earnings under the two plans can be equalized at the desired output level either by using a lower basic hourly wage or a higher task level in the application of the Emerson plan. In the Emerson plan, as in the Halsey plan, the pay per piece decreases as efficiency increases. There is not so strong an incentive for high performance therefore as there is in a piece-rate system. This defect has been remedied in some of the later efficiency-bonus plans by stepping up the bonus rate for performance above standard.

To compute the bonus under the Emerson plan the output in good pieces is multiplied by the standard time per piece to determine the standard hours earned. The latter figure is divided by the actual hours worked to determine the job efficiency. Then by reference to a table the

TABLE 16.4

EMERSON BONUS RATES AT CERTAIN EFFICIENCIES

Job Efficiency, Per Cent	Bonus Rate, Per Cent of Hourly Wages
67	0.01
68	0 04
80	3.27
90	9.91
100	20.00
101	21.00
110	30 00
125	45 00

bonus percentage at that efficiency is determined. The amount of bonus is computed by multiplying the hours worked by the hourly rate and then multiplying the product by the bonus percentage.

TABLE 16.5

CALCULATION OF EARNINGS UNDER THE EMERSON PLAN

Data given:		
Standard time per piece	0.16 hr.	
Hourly rate	70 ¢	
Time worked	8 0 hr.	
Output	50 pieces	
Calculations:		
Earnings at hourly rate, 8 hr. @ 70¢		$5.60
Bonus:		
Standard hours earned, 50 pieces @ 0.16	8 0 hr.	
Actual hours worked	8.0 hr.	
Job efficiency:		
Standard hours (8.0) divided by actual hours (8.0)	100%	
Bonus rate at 100% job efficiency, from table	20%	
Bonus, 20% of wages at hourly rate (0.20 × 8 × 70¢)		1 12
Total earnings		$6.72
Performance efficiency, computed above		100%

The bonus percentages shown in Table 16.4 were selected from a table of Emerson bonus rates. In the complete table a bonus rate is shown for each percentage of efficiency from 67 per cent to 140 per cent. For each increase of 1 per cent efficiency there is an increase in the bonus percentage. The computation of a workman's earnings for a day under the Emerson plan is illustrated in Table 16.5.

Originally under the Emerson plan the bonus was computed only once each pay period. The incentive value of the bonus is greater, however, if it is computed daily.

In any of the efficiency-bonus systems the standard hour is a measure of work done. It is a common denominator applicable to all jobs in all departments. Summaries of standard hours earned in comparison with actual hours worked are therefore useful to indicate trends of departmental performance and for comparison of one department with another. If the standard times are carefully set, performance is likely to be fairly consistent and labor costs can therefore be accurately predicted. Because the earnings formula is complex, however, the calculations of costs and payrolls are expensive under this type of plan. From the worker's standpoint a plan in which the method of computing earnings can be easily explained and understood is generally more acceptable.

Group Incentives

Where a number of employees work collectively, as for example, on progressive assembly operations, at machines requiring more than one operator, and on maintenance work, it is impractical to tally the output of each individual. Under such circumstances incentive wages are frequently paid on a group basis. Standards are established for group operations, and all members of a group are paid according to group performance. The group incentive may be either a piece-rate or an incentive bonus. The group-incentive wage is apportioned to the members of the group according to the value assigned to the occupational classifications represented. Thus, if a battery of machines is operated by a group consisting of two operators and two helpers, the operators would receive a larger share of the group earnings than the helpers.

Job Classification

Under either a day-rate or an incentive-wage system it is necessary to establish a scale of hourly wage rates. To have a rate scale that is fair both to the employer and the employee it is generally desirable to classify the various jobs or occupations in a plant and to determine their relative values. There are numerous techniques of doing this objectively in all of which the factors pertaining to the occupation are studied, for job classification is a rating of occupations, not a rating of men. As a rule consideration is given to such factors as[1]

Training and experience required

Physical resistance to be overcome

[1] Adapted from John W. Riegel, *Wage Determination*, Chap. IV, Bureau of Industrial Relations, University of Michigan, 1937.

Mental application
Seriousness of errors
Degree to which work is supervised
Hazards and disagreeable conditions
Personal characteristics required, for example, originality, judgment, and ability to work well with other people

The work of preparing the job classification and keeping it up to date may be assigned either to the personnel department or to the production engineering department. It affects the work of both departments.

TABLE 16.6
STANDARD JOB CLASSIFICATION
Factory Occupations

Job or occupation	Grade 3		Grade 2		Grade 1	
	Job code	Job class	Job code	Job class	Job code	Job class
Armature winders	1013	7	1012	8	1011	9
Ash men	1033	2	1032	3	1031	4
Assemblers:						
Minor assemblies—light	1043	3	1042	4	1041	5
Minor assemblies—heavy	1063	4	1062	5	1061	6
Subassemblies—light	1083	4	1082	5	1081	6
Subassemblies—heavy	1103	5	1102	6	1101	7
Major assemblies—light	1123	5	1122	6	1121	7
Major assemblies—heavy	1143	6	1142	7	1141	8
Balancing	1303	5	1302	6	1301	7
Bearing scrapers	1323	6	1322	7	1321	8
Blacksmiths:						
General	1343	6	1342	7	1341	8
Helpers	1363	3	1362	4	1361	5

A section of a table of occupational classifications which was developed in a plant using an efficiency-bonus-incentive system, is reproduced in Table 16.6. Although there are 250 factory occupations in the complete table with three grades for each occupation, there are only 12 job classes.

Wage rates for each of the 12 job classes would be established by collective bargaining. Table 16.7 is a schedule of class rates.

The hourly wage rate of each employee is established according to the job classification of the work to which he is ordinarily assigned. A new employee is hired at the rate of the lowest grade in his occupational classification, and his hourly wage is paid at that rate during a probationary period of 4 weeks. Then if his work is satisfactory, he is promoted to the second grade at the beginning of the next pay period. Thus, a black-

smith helper would be hired at 70 cents an hour and after successfully completing his probationary period would be raised to 75 cents an hour. The top rate for an occupation (Grade 1) would be paid as a means of recognizing individual merit. The efficiency bonus, however, is the principal provision for compensating individual effort and ability. Length of service is rewarded by seniority rights, vacation privileges, and a special bonus paid annually.

For incentive-wage purposes the operations in the plant are classified according to the job classification. Efficiency bonuses are paid at the job-class rates of the operations performed, even though the workmen may in

TABLE 16.7
SCHEDULE OF HOURLY WAGE RATES
BY JOB CLASS
Effective May 1, 19—

Job Class	Hourly Wage Rate
1	$0 60
2	0.65
3	0.70
4	0 75
5	0 82
6	0.90
7	1 00
8	1 10
9	1.20
10	1.30
11	1.40
12	1.50

some cases be classified differently. Thus, a man who is classified as a general blacksmith, grade 1, would draw hourly wages at the rate of job class 8, but if he were assigned to an operation that was rated as a job-class 7 operation, his efficiency bonus would be computed at the hourly base rate of job class 7. Because standard labor costs are computed at operation job-class rates, the difference between the man's hourly wages at his job-class rate and the hourly wages at the operation job-class rate is reported as a labor cost variance.

Control in the Shop

The shop foreman is a key man in labor cost control. Although he works under instructions from the office, he is the coordinator at the "firing line" of the materials, the tools of production, and the human resources that are put at his disposal. The attitudes and the working habits of the shop personnel depend to a large extent upon the quality of his supervision. It is usually his duty to plan the assignment of work to individual employees under his supervision and to train the employees in their work.

When materials, tools, or working conditions are off standard, it is his duty to obtain corrections.

The factory cost accountant can aid the foreman by designing the timekeeping procedure so that off-standard conditions are called to his attention as they arise. Thus, it is frequently the practice to provide time tickets of distinctive colors for day work and indirect labor. In the timekeeper's rack of current time tickets, which is near the foreman's station, the distinctive colored cards are visible signals of off-standard

DAILY PERFORMANCE REPORT

Date _____ Department _____

Total Hours (a) _____ Percent on Bonus _____ * _____ % Bonus Earned _____

Hours on Bonus (h) _____ Average Job Efficiency _____ * _____ % Corrections _____

Standard Hours (s) _____ Department Efficiency _____ * _____ % Net _____

Man No.	Part No.	Op. No.	Mach. No.	Actual Hours (h)	Standard Hours (s)	Job Efficiency	Bonus

* Formulas for computation of percentages:

Per cent on bonus: $(h \div a) \times 100$

Average job efficiency: $(s \div h) \times 100$

Department efficiency: $\dfrac{s + .50(a - h) \times 100}{a}$

FIG. 16.3. Daily departmental report of labor performance.

conditions. In some plants the timekeepers are instructed to obtain the foreman's approval before "ringing in" a direct worker on either day work or indirect work.

The cost accountant can also aid the foreman and his superiors by furnishing them reports showing the performance of individual workers. If these reports are prepared frequently, and in many plants they are prepared daily, they enable the supervisors to trace the progress of individual workers and to direct attention promptly to situations where there are variations from standard performance. Figure 16.3 is an example of a form of departmental daily report of labor performance.

CHAPTER 17

GOVERNMENT REQUIREMENTS AFFECTING PAYROLL ACCOUNTING

Preparing a payroll is a much more complex operation today then it was 15 years ago. Social-security legislation enacted in 1935 made it necessary for many employers to redesign their payroll procedures in order to make an efficient accounting for payroll deductions. This was followed by wage-hour legislation and later, during the Second World War, by Federal income-tax withholding, both of which imposed additional requirements upon employers affecting the accounting for wages and salaries.

It is the purpose of this chapter to state only in a general way the principal government requirements affecting payroll accounting according to the laws in effect at the time of writing. A corporation controller or his representative who is in charge of this branch of the accounting work should keep himself thoroughly informed as to particular requirements affecting the type of business with which he is associated and should keep abreast of changes in the laws and regulations. This can generally be done by studying circulars and instructions issued to employers by the Federal and state governments.

Old-age and Survivors' Insurance

The Federal Social Security Act of 1935 provides among other things a Federal system of old-age benefits for workers in employment covered by the act. Amendments adopted in 1939 extend the coverage to members of the workers' families. To provide a fund out of which the benefits are paid, two taxes of equal amounts are levied. One is an income tax on the employee that the employer is required to deduct from the employee's wages and pay to a collector of internal revenue. The other is an excise tax on the employer. Both taxes are payable quarterly. The employee's tax is based on the wages received; the employer's tax is based on the wages paid. Only the first $3,000 of an employee's earnings from one employer in any calendar year is taxable. At present each tax is at the rate of 1 per cent.

On his quarterly tax return (Treasury Department Form SS-1a) the employer reports the total taxable wages paid, the amount of the employer's tax, and the amount of the employee's tax. He also submits

(Schedule A) a list of the employees covered and the taxable wages paid to each. Employers are identified by identification numbers, and employees by account numbers that are issued by the Social Security Board.

The employer is required to furnish each employee a statement of his earnings and of the amount deducted for old-age and survivors' insurance tax. This statement may be furnished each payday or at quarterly, semiannual, or annual intervals, but a statement must be furnished with the final wage payment upon the termination of employment. The employer must keep a record of each employee's earnings, showing the amount of each wage payment, the amount subject to tax, the amounts of the deductions for employee's tax, and the reason for exemption in the case of earnings that are not subject to tax. No set form is prescribed by the government for either the earnings statement or the earnings record.

Unemployment Compensation Insurance

One of the principal objects of the Federal Social Security Act of 1935 was to promote the adoption of state unemployment insurance programs meeting standards established by the Federal government. By June 30, 1937, all the states had enacted unemployment compensation laws. Although not uniform, the laws of the various states have many points of similarity.

The Federal Unemployment Tax Act levies an excise tax at the rate of 3 per cent of taxable wages on employers of eight or more workers in employments covered by the Act. Salaries and wages in excess of $3,000 in one calendar year are exempt from the tax, the same as in the case of the old-age and survivors' insurance tax. A credit not exceeding 90 per cent of the tax is allowed to employers for contributions made to state unemployment insurance funds. The net cost of the Federal unemployment insurance tax is therefore 0.3 of 1 per cent of the taxable wages as a rule. The taxes collected by the Federal government are used solely to defray administrative costs, and Federal grants are made to the states for that purpose.

The Federal unemployment insurance tax is payable annually. The tax return (Treasury Department Form 940) shows the total salaries, wages, and other remuneration paid during the year, the amount of nontaxable remuneration paid, the amount of taxable wages, the amount of the tax at 3 per cent, the credit for contributions to state unemployment funds, and the balance of the tax. On a schedule submitted with the tax return the employer submits details of the nontaxable remuneration and on another schedule the details of his state contributions.

Unemployment benefits to individuals are paid by the states. To provide funds for this purpose all the states levy taxes (or contributions)

on employers and a few states tax employees also. The basic tax rate or contribution rate for employers in most states is 2.7 per cent of the taxable wages. In many of the states a merit-rating plan is provided under which an employer who stabilizes employment is taxed at a rate lower than the basic rate. The employer who has obtained a reduction in his state tax by earning a merit rating is permitted by the Federal law to take as a credit against his Federal tax the full amount of credit to which he would have been entitled if he had not received the benefit of the merit rating. In addition to filing tax returns or contribution reports with the appropriate state officials, employers are required to report such information about individual employees as may be needed in order to administer the payment of unemployment benefits. In those states having an employees' unemployment insurance tax, the employer is required to withhold that tax from the wages earned.

Workmen's Compensation Insurance

Workmen's compensation laws, under which workers or their survivors are compensated for losses caused by accidents and occupational diseases suffered in the course of employment, have been in force in almost all states for many years, the first law of this type in the United States having been passed by New York in 1910. The cost of the insurance is borne by the employer. Depending upon the law of the state, the employer may have the option of insuring either with an approved private insurance company or through a state insurance fund, or of carrying the risk himself provided that he has sufficient financial resources to qualify as a self-insurer under the laws of the state. Under either of the first two optional plans the employer pays an insurance premium. The premium is based upon the amount of payroll. The premium rates vary for different occupational classifications. The payroll records must therefore be arranged so that an analysis can readily be prepared according to the occupational classifications adopted for this purpose.

Premiums for workmen's compensation insurance are invoiced by the insurer, in most cases either annually or semiannually. An employer is required to pay in advance an estimated premium or premium deposit, the amount of which is determined by estimating the premium for the ensuing period. At the end of the annual or semiannual period, an auditor employed by the insurer examines the payroll records, and the insurer then issues his invoice for the exact amount of the premium less the premium paid in advance (see Fig. 17.1).

In the purchase-invoice distribution the premium invoices are charged as a rule to Unexpired Insurance. Each month the cost of the insurance expired may be computed by multiplying the actual payroll for each

occupational classification by the premium rate. The monthly cost may be credited to Unexpired Insurance and distributed to Factory Overhead and Selling and Administrative Expense.

An employer who is a self-insurer may either charge to overhead and expense accounts the amount of benefits actually paid as workmen's compensation, or he may use the reserve method. Under the latter method he would determine each month the amount of premiums that would have expired if he had been insured with an insurance company or with a state insurance fund less any allowance for selling expense which is included by the insurer in the premium rate. The resulting estimated

INVOICE FOR WORKMEN'S COMPENSATION INSURANCE

THE_____INSURANCE COMPANY

To: Brumm Baking Company
Madison, Wisconsin

Payroll Audit Adjustment
Invoice No X81420

Invoice Date	Risk No	Policy No.	From	To
5/21/48	18671	WC179688D	4/1/47	4/1/48

Occupational Class No	Description	Payroll	Rate	Earned	Balance
2003	Madison bakeries	$220,140	$1.636	$3,601.49	
2003	Madison bakeries OD	—	None	—	
8810	Madison clerical	16,214	.114	18.48	
	Earned premium			$3,619.97	
	Estimated premium			$3,486.20	
	Due us				$133.77

FIG. 17.1. Invoice for workmen's compensation insurance.

amount would be charged to overhead and expense accounts and credited to a Reserve for Self Insurance. Benefits paid to workers would then be charged to the Reserve. For purposes of determining costs under cost-plus-fixed-fee government contracts, as a general rule, a self-insurer is permitted to use the reserve method of accounting for workmen's compensation and for unemployment insurance but not for other types of self-insured risks.[1]

Wage-hour Legislation

The Walsh-Healey Act (Public Law 846) adopted in 1936 requires that a stipulation be made in all Federal contracts for materials, supplies, or equipment amounting to more than $10,000, whereby the employer must pay time and a half for all hours worked in excess of 8 hours a day or 40

[1] Explanation of Principles for Determination of Costs under Government Contracts, paragraph 47, War Department-Navy Department, U. S. Government Printing Office, Washington, April, 1942.

hours a week, whichever is greater, to all persons employed during any week on the contract.

The Federal Fair Labor Standards Act adopted in 1938 prescribes minimum hourly wage standards and maximum weekly working hour standards for employees of business concerns engaged in interstate commerce with certain exceptions. The standard working week is 40 hours. If an employee who is subject to the provisions of the act works more than 40 hours in any week, he is entitled to be paid time and a half, that is, 1½ times his regular earning rate, for the hours in excess of 40. Although no set form is required, an employer is required to maintain records showing the following information for each employee who is subject to the minimum wage and 40-hour week overtime provisions:

Name and address

Date of birth if under 19

Occupation in which employed

Time of day and name of day on which the employee's work week begins

Regular hourly rate of pay, and basis on which wages are paid

Hours worked each workday and total hours worked each work week

Total daily or weekly straight-time earnings or wages

Total weekly overtime excess compensation

Remuneration other than cash

Date of payment and pay period covered by payment

Income Taxes on Individuals

The employer's duties in connection with Federal income taxes on individuals are (1) to furnish information and (2) to withhold taxes from salary and wage payments.

For many years employers have been required to report to the employee and to the Treasury Department annually the earnings of each employee whose remuneration exceeded a specified amount. These reports, called information returns, are used by the Treasury Department in auditing the income-tax returns of individuals. In those states which levy income taxes on individuals, information in regard to employee earnings must be furnished to state authorities also. In order to prepare the required information returns it is necessary for employers to compile records of the annual earnings of individual employees.

Tax-withholding legislation is a more recent development adopted during the Second World War by the Federal government as a means of collecting income taxes of individuals on a current or pay-as-you-earn basis. Employers' duties are explained in Circular WT issued by the Commissioner of Internal Revenue.

The employer is expected to obtain from each new employee a withholding exemption certificate (Treasury Department Form W-4). This is a statement of the number of exemptions claimed by the employee. Once filed with the employer a withholding exemption certificate remains in effect until an amended certificate is furnished. It is the responsibility of the employee to file an amended certificate in the event the number of his exemptions decreases to less than the number shown by the certificate last furnished by him to his employer.

The employer is required to withhold income tax from each wage payment in accordance with the amount of the employee's earnings and the exemptions claimed on the withholding exemption certificate. In the Revenue Act of 1948 there are wage-withholding tables that the employer may use to determine the tax he is required to withhold. These tables show, for various payroll periods (weekly, monthly, etc.) and for various wage brackets, the tax amounts applicable according to the number of exemptions claimed. Although the table method is generally more convenient, the employer has the option of using instead the percentage method which is provided in the Act. Both the table method and the percentage method give the employee the benefit of the exemptions claimed by him as well as the 10 per cent standard deduction.

In case the amount withheld during a month is more than $100, the employer is required to pay it to an authorized depositary within 15 days after the close of the month. Quarterly returns (Treasury Department Form W-1) must be filed with the appropriate collector of internal revenue on or before the last day of the month following the close of each quarter. Each return must be accompanied by payment of the full amount of the tax. The payment may be partly or wholly in the form of depositary receipts.

The amount of taxes withheld from his wages must be reported to the employee annually in duplicate on Treasury Department Form W-2, Statement of Income Tax Withheld on Wages. The annual earnings are also reported on this form, and usually the amount withheld for old-age and survivors' insurance as well. A triplicate copy (Form W-2a) is filed with the collector as the Federal information return of the employee's annual earnings. In those states which require employers to furnish information returns showing employee earnings, employers are generally permitted to use for the state return a form that is similar in arrangement to Form W-2. The state return can then be written by means of carbon at the same time as the Federal return.

CHAPTER 18

TIMEKEEPING AND PAYROLLS

The principal divisions of the work of accounting for factory wages are timekeeping, payroll, and labor distribution. This chapter deals chiefly with timekeeping and payrolls.

The timekeeping function is to record hours worked, operations performed, and pieces produced by each employee. The timekeepers' reports are the original documents on which wage calculations and labor cost distributions are based. In some plants the timekeeping is done either by shop foremen or under their supervision. The controller then exercises functional control of this work. Better control is obtained, however, when timekeeping is organized as a department of the accounting group coming under the controller's direct authority.

The primary function of the payroll department is to prepare a payroll each pay period, that is, a list of employees showing the amount of wages earned by each employee, the wage deductions, and the net amount to be paid. Usually the payroll department is responsible also for the calculation of earnings; the preparation of an earnings statement for each employee; writing either payroll checks or pay envelopes; keeping an earnings record, that is, a cumulative record of the wages earned by each employee and the wage deductions; preparing reports of payroll data that are required by governmental units; and preparing reports of performance for the shop executives. The payment of wages to employees, however, should be assigned to the treasurer's department. It is a fundamental requirement of a good system of internal check that the person who prepares the payrolls should not also be responsible for making the payments.

The labor-distribution function is to allocate the labor cost for each accounting period to control accounts and subsidiary accounts in accordance with the account classification. Labor distribution is a cost accounting function. It is usually assigned to the cost accounting department, although in some cases for practical reasons it is assigned to the payroll department.

Pay Period and Accounting Period

The pay period is the period of time covered in the wage payment. It is usually either a week, two weeks, or a half month.

The accounting period is the period of time covered by the operating statements. Monthly operating statements are generally prepared for industrial concerns in addition to annual statements. The accounting months are usually (1) the 12 calendar months, (2) 13 periods of 4 weeks each, or (3) 12 periods of which 8 are of 4 weeks and 4 are of 5 weeks. Under the third arrangement each quarter-year consists of two periods of 4 weeks and one period of 5 weeks.

If the pay period and the accounting period end at different dates, provision must be made for accruing the wages for a portion of the pay period in order to indicate accurately in the financial statements the costs incurred during the accounting period and the liability for accrued wages at the end of the period. The accounting procedure is much simpler if the pay period and the accounting period always end on the same day. If the accounting period is the calendar month therefore it is advantageous to pay semimonthly; if the 4-week month is used as the accounting period, it is advantageous to pay either weekly or biweekly.

Clock Numbers

In most plants each employee except the major executives is assigned a clock number as a convenient means of identification for payroll purposes. The clock number or man number is shown on clock cards, time tickets, and payrolls. It might also be called a payroll account number.

Usually there is a separate series of clock numbers for each department. Frequently the department number is a part of the clock number, a prefix. Thus, clock number 56-126 would be the number of a man in department 56. Separate blocks of numbers in each departmental series may be reserved for workers normally engaged on direct operations and for those whose work is normally indirect. Clock numbers are usually assigned by the payroll department.

A change in clock number may be made in case a man is transferred from one department to another or from one occupation to another; as a rule such changes should be made only at the beginning of a pay period. Otherwise, a man's name might appear twice on the same payroll, thus making it necessary to establish a procedure to guard against duplicate payment besides complicating the work of making payroll deductions and compiling earnings records.

In addition to a clock number each employee has a social-security account number that is assigned by the Federal Social Security Board. Some companies also assign their own serial numbers. The social-security account numbers and the company serial numbers do not change.

Payroll Plates

Employees' names and numbers must be printed or written on numerous occasions on clock cards, payrolls, and other forms. It is usually economical to use some type of addressing equipment for this purpose. In this case the payroll department maintains a file of payroll plates or stencils, one for each employee. Upon receiving a hire slip from the employment department, the payroll department assigns a clock number to the new employee and then prepares a payroll plate. Where Addressograph equipment is used, the plate is made of soft pliable type metal. The new employee's name, clock number, social-security account number, and hourly rate are embossed on it, and the plate is then inserted in a metal frame and filed in a tray according to clock number. The plates are changed when transfers, rate changes, and terminations occur. The file of payroll plates is the payroll department's file of names of men on the payroll.

Accounting Forms

The principal accounting forms that are used in connection with factory payrolls are

Attendance card
Time ticket
Time checking sheet
Payroll control sheet
Wage cumulation record (for the pay period)
Payroll
A pay check, a payroll draft, or a pay envelope
Earnings statement
Earnings record (for the year)

Attendance Card

The attendance card is a form on which the time of an employee's arrival at the plant each day and the time of his departure are recorded, usually by means of a time-recording clock. As a rule each attendance card covers one pay period. The form reproduced in Fig. 18.1 is designed for use in connection with a weekly pay period. Other names for the attendance card are clock card and in-and-out card.

"In-and-out" clocks are generally placed either at the plant entrance or, in the case of large plants, at the department entrances. At each clock there are two racks for holding the attendance cards, an "out" rack for the cards of men who are not at work and an "in" rack for the cards of those who are at work. Each rack is numbered, and the cards are filed in the racks according to clock number. The racks are constructed so

that the top part of each card showing the clock number is visible when the cards are in the rack.

At the start of each pay period a new set of clock cards is prepared by the payroll department and then placed in the out racks by timekeepers. Each employee upon arrival for work "rings in" by removing his card from the out rack, inserting it in a slot in the time-recording mechanism which prints the time "in," and then placing the card in the proper position in the in rack. To ring out he reverses the process. At the end of the pay period the timekeepers remove the attendance cards from the racks for delivery to the payroll department.

Each employee should be held responsible for ringing his own card properly. Ringing of friends' cards should not be permitted. This practice is likely to result in covering up absence and tardiness and may result in overpayment of wages. In order to maintain the prescribed procedure either a foreman, a watchman, or a timekeeper is customarily stationed at each in-and-out clock when a shift is arriving or leaving.

At the starting time of each shift or soon afterward the timekeeper prepares an absentee report by listing the numbers of the cards for that shift which are in the out rack. A copy of the report is given to the foreman.

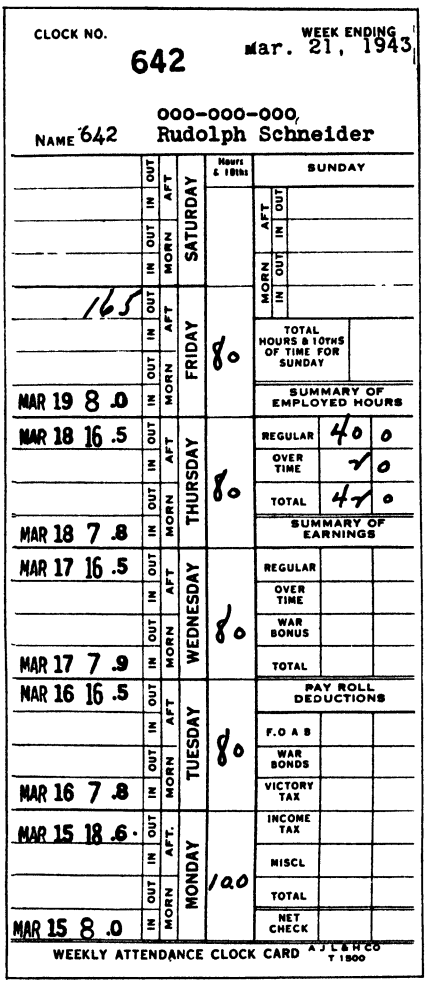

CLOCK NO. 642
WEEK ENDING Mar. 21, 1943
000-000-000
NAME 642 Rudolph Schneider
SATURDAY
FRIDAY 8.0
THURSDAY 8.0
WEDNESDAY 8.0
TUESDAY 8.0
MONDAY 10.0
MAR 19 8.0
MAR 18 16.5
MAR 18 7.8
MAR 17 16.5
MAR 17 7.9
MAR 16 16.5
MAR 16 7.8
MAR 15 18.6
MAR 15 8.0
SUNDAY
TOTAL HOURS & 10THS OF TIME FOR SUNDAY
SUMMARY OF EMPLOYED HOURS
REGULAR 40 0
OVER TIME 7 0
TOTAL 47 0
SUMMARY OF EARNINGS
REGULAR
OVER TIME
WAR BONUS
TOTAL
PAY ROLL DEDUCTIONS
F.O.A.B.
WAR BONDS
VICTORY TAX
INCOME TAX
MISCL
TOTAL
NET CHECK
WEEKLY ATTENDANCE CLOCK CARD A.J.L.&H.CO T 1500

FIG. 18.1. Attendance card. (*A. J. Lindemann & Hoverson Company.*)

The attendance card is an attendance record and a source of statistics of hours worked. Under day-wage systems and incentive-bonus systems it is usually the basis for the calculation of the hourly wages. Where time tickets are used, it is a means of auditing the time reported on time tickets.

Time Ticket

The time ticket is an operation time report. Whereas the clock card is an over-all record of time worked, the time ticket shows how the time was spent and what work was accomplished. A time-ticket record is generally made of each operation performed. The operation number, the order number, the workman's clock number, the elapsed time, and the number of good pieces produced are recorded as well as other data that may be wanted. Elapsed time is usually shown in hours and tenths of hours. Machine numbers and machine hours are frequently recorded on time tickets in the case of machining operations. Other names for the time ticket are job card, tally card, and operation ticket.

Under an incentive-wage system the time ticket is the basis for the calculation of incentive wages. In day-wage systems it is a means of auditing the clock-card record of time worked. Except in noncost systems and process cost systems, where time tickets are usually not required, it is the basis for the labor distribution.

It is generally desirable to have the time tickets prepared by timekeepers rather than by the workmen or the foremen. Not only are the results more accurate, but the shop men are relieved of onerous clerical duties. Where the work is widely dispersed, as in a shipyard, the timekeeper may travel to the various work points to get the data needed for the time tickets. In most factories, however, timekeepers are stationed at central points where the employees go to report upon changing from one operation to another. The timekeeper's equipment generally consists of a desk and chair, a small time-recording clock, and either trays or racks for filing the current time tickets. In some plants each timekeeper also maintains a file of piece rates or incentive-bonus standards for the operations in his department. In some cases he is furnished either a calculating machine or a slide rule for use in calculating earnings.

The timekeeping procedure should be planned so that the shop employees do not lose an unreasonable amount of time in traveling to the timekeeper's desk or in waiting at his desk. Frequently the timekeeper and the dispatch clerk are stationed adjacent to each other and near the foreman's desk and the tool crib. Upon completing an operation the workman travels from his work point to the timekeeping-dispatch station, obtains his next assignment from the dispatch clerk, reports to the timekeeper, and then obtains the necessary tools from the tool crib—all in one trip. In the smaller departments an arrangement of this kind may make it possible for one clerk to look after both the timekeeping and the dispatching.

In some cases time tickets are prepared in duplicate, one copy for payroll purposes, the other for use in making the labor distribution. In other

cases only a single copy is prepared to serve both purposes. In wage-incentive systems an additional copy of the time ticket is prepared in some cases for the workman. After the pay is computed this copy is delivered to him to inform him how much he earned on the operation and to enable him to verify the computation.

A portion of the information required on time tickets is frequently prewritten in the office. In some cases, for example, timekeepers are furnished a supply of the forms on which employees' names and clock numbers have been Addressographed. If the time ticket is a tabulating card, the department numbers and clock numbers may be prepunched by means of a gang punch. If Keysort cards are used, the department numbers and clock numbers may be pregrooved.

Under some systems of production control the time tickets are partly prewritten from the master copy of the production routing, as illustrated in Fig. 16.1. The prewritten data are the order number, part symbol, operation number, piece rate, and other data pertaining to the operation. In a procedure of this type the names and clock numbers cannot be prewritten, for it is impossible to determine in advance the operator who will be assigned to each operation.

When a workman reports to the timekeeper that he is starting an operation, the timekeeper rings the starting time on the time ticket. He then fills in all the required information pertaining to the man and to the job except that which has been prewritten. When the workman reports the completion of the operation, the timekeeper rings the stopping time and records the number of good pieces completed. He verifies the workman's count by reference to inspection reports or to production records. The timekeeper computes the elapsed time and in some cases the earnings.

There are two types of time-ticket forms. One can be called a job time ticket, the other a daily time ticket.

Job Time Ticket

In job-order cost systems a job time ticket is a form designed to record work done on only one job or order. A separate job time ticket is required for each man each day for each order that he works on. Usually there is a separate time ticket for each operation performed, but in some cases the form provides lines for recording a series of operations. In a standard cost system, even though job numbers are not recorded, a time ticket designed to record the data for only one operation is commonly referred to as a job time ticket, although the title "operation time ticket" would be more appropriate.

The job time ticket is a unit slip. This characteristic distinguishes it from the daily time ticket. Job time tickets can therefore be sorted and

tabulated according to the various classifications appearing on them, such as man number, order number, part number, operation number, machine number, department charged, and natural classification. The sorting may be a hand operation, a Keysort operation, or a machine operation, depending upon the design of the form. The job time ticket in Fig. 16.1 is designed for hand sorting. The form illustrated in Fig. 18.2 is a Keysort form. Incidentally, although it is a job time ticket, it is not an operation

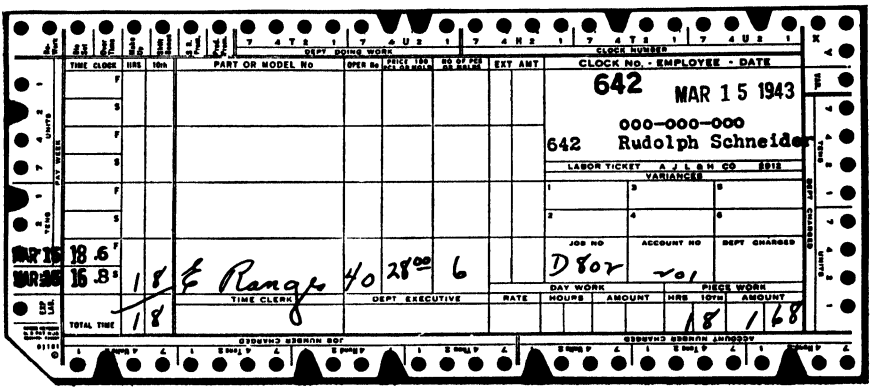


FIG. 18.2. Job time ticket. (*A. J. Lindemann & Hoverson Company.*)

time ticket; successive operations on the same job can be recorded on one ticket.

Daily Time Ticket

The daily time ticket has sections for as many different jobs and operations as a workman ordinarily performs during the course of a day. The sections of the daily time tickets illustrated in Figs. 4.4 and 18.3 are perforated. Unit slips are obtained for labor-distribution purposes by tearing the time ticket into strips at the perforations. Unit slips may also be developed from daily time tickets by means of punched cards. The distribution card in Fig. 4.12, for example, is a tabulating card form in which would be punched the data appearing on the tally card, a form of daily time ticket, in the same illustration. The daily time ticket may be designed to serve as an attendance card as well as a time ticket. The one in Fig. 4.4 is a form of this type.

Time Checking Sheet

Shop timekeepers are required as a rule to check the time tickets against the attendance cards. The principle of exceptions is frequently applied in planning the checking procedure. Employees are instructed to report to the timekeeper upon arriving late, departing early, or working over-

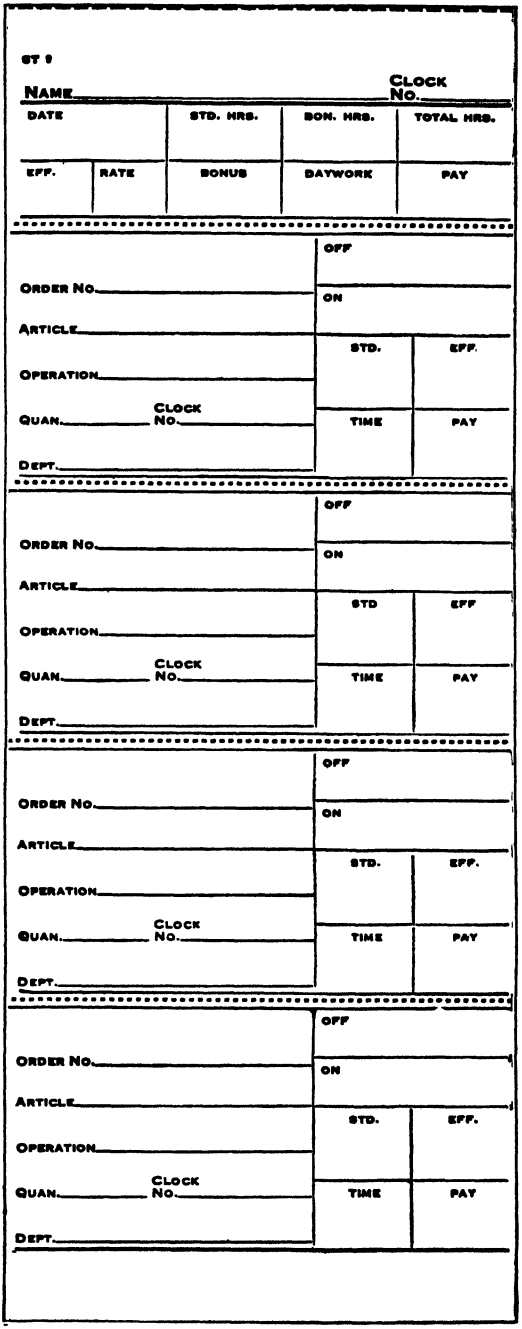


FIG. 18.3. Daily time ticket.

time. To make sure that all exceptions are reported to him, the time-keeper examines the out rack just after the start of a shift, again shortly before the end of the shift, and once more during the overtime period. At the end of the shift he views the clock cards of the men who he knows

TIME CHECKING SHEET Week Ending Mar. 21, 1943 Department 44

Man No.	Name	M	T	W	T	F	S	S	Total	Remarks
621	000-000-0000 John Smith	8.0	8.0	8.0	8.0	8.0	-	-	40.0	(Hours worked)
										(Hours overtime)
642	000-000-0000 Rudolph Schneider	10.0	8.0	8.0	8.0	8.0	-	-	42.0	
		2.0							2.0	(See Fig. 18.1)
644	000-000-0000 Harry James	8.0	8.0	8.0	8.0	8.0	8.0	-	48.0	
							8.0	-	8.0	
		26.0	24.0	24.0	24.0	24.0	8.0	-	130.0	
	Total	2.0					8.0		10.0	

FIG. 18.4. Time checking sheet.

have worked irregular hours. In the case of the others it is usually safe to assume that the regular hours were worked.

In the office the departmental totals of hours reported on time tickets should be compared with the corresponding totals of hours reported on attendance cards. To obtain the latter figure a time checking sheet may be used, such as the form illustrated in Fig. 18.4. In some cases the payroll sheet is designed to serve as a time checking sheet as well as a payroll form.

Under a procedure that is fairly representative, a time checking sheet is prepared at the beginning of each pay period for each shift in each department. The names and clock numbers of the department employees are Addressographed on the forms. Shop timekeepers deliver the time tickets and the attendance cards each day to the head timekeeper's office, which operates two shifts daily. On the basis of the data appearing on the attendance cards a timekeeper in this office computes the hours worked by each man and the overtime hours, records these figures on the attendance cards, and posts them to the time checking sheet. By footing the entries on the latter form he obtains a daily total for each department for use as a control figure. The hours reported on time tickets are then added. The total must agree with the control figure. If there should be a discrepancy, the time tickets for each man are checked against his attendance card. Errors are referred to the shop timekeeper for correction.

The attendance cards are returned to the out racks before the next starting time of the shift except at the end of the pay period when new cards are put in the racks, the completed cards being delivered to the payroll department. Time tickets are delivered to the payroll department daily with a slip showing the daily total of hours worked attached to each departmental bundle of time tickets. At the end of the pay period the time checking sheets are sent to the payroll department where the figures are added across to obtain man totals and department totals for the pay period which are used to verify the corresponding totals on the payroll.

Payroll Control Sheet

After the time tickets have been received by the payroll department, the first operation as a rule is the checking of the piece rates or the standard piece times. The earnings are then calculated unless that has already been done by the timekeeper. The calculations are checked; then the wages are totaled. The departmental daily totals of hours and wages are entered on a payroll control sheet.

A separate control sheet may be set up each pay period for each department with a line on the form for each day. Figure 18.5 is a form of that type. Departmental control totals for the pay period, obtained by adding the columns, would be used to check the payroll and the labor distribution for the period. The daily entries on the control sheets would be used to check the posting to wage-cumulation cards in case that is a daily operation.

From the department control sheets a daily summary of payroll data and a pay-period summary may be obtained for purposes of managerial control. The column headings on the summary form would be similar to

those in Fig. 18.5, but the line headings would be different. There would be a line for each department and one for the plant total. As a short cut, where plant summaries are made, the departmental control sheet is frequently omitted. In this case the summaries are used as payroll control sheets. The daily departmental totals are posted direct to the

FACTORY PAYROLL CONTROL SHEET

Week Ending _____ Dep't _____

Day	Department Payroll		Transfers (Amount)		Labor Distribution (Amount)		
	Hours	Amount	Out (Minus)	In (Plus)	Total	Direct	Indirect
Mon							
Tues							
Wed							
Thur							
Fri.							
Sat							
Sun							
Total							

FIG. 18.5. Payroll control sheet. The two columns captioned "Department Payroll" are used to obtain control totals for payroll purposes, the remaining columns to obtain control figures for cost-distribution purposes.

daily summary, and the pay-period summary is obtained by adding the appropriate entries appearing on the daily summaries.

Performance Reports

Where daily reports of labor performance are made, the data for them come from time tickets. The reports are usually prepared by the payroll department as a part of its daily routine. The totals appearing on the daily performance reports should be reconciled with those on the payroll control sheets.

Incentive-wage Notices

Under some incentive-wage plans, the workman is furnished a daily notice of his incentive earnings. This is intended to stimulate his interest and to enable him to verify the computations. The incentive-wage notice may be a copy of the time ticket, a perforated section of a copy of the performance report, or a separate form. The notices as a rule are released by the payroll department and delivered to the workmen by timekeepers.

Wage Cumulation—Piece-rate Systems

In piece-rate systems the time tickets are the media for the cumulation of the earnings of individual workers for the pay period. The more common methods of cumulating the earnings from time tickets are

1. Unit-slip hand-sort method with periodical cumulation. The time tickets, which are unit slips, are sorted daily and then filed by clock number until the end of the pay period when they are added to obtain totals for individual employees. The totals are entered on the payroll. Wage deductions and in some cases overtime calculations are made on the payroll itself. Under this method there is a heavy peak load of work at the end of the pay period and the labor distribution must usually wait until after the payroll is completed. The method is most frequently used in small plants where the volume of time tickets is relatively small.

2. Unit-slip punched-card method. The earnings data are punched daily on tabulating cards. The labor-distribution data is punched either on the same cards or on separate cards. The punching is verified daily. One step in the verification is to run the punched cards through the tabulating machine and thus obtain totals to check with those appearing on the payroll control sheet. The daily tabulation may be made in the form of a daily performance report if a report of that type is desired.

At the end of the pay period the punched cards are sorted by clock number and tabulated. The sorting and tabulating are rapid mechanized operations. The total hours and the total earnings of each man may be printed by the tabulating machine on the payroll sheet. The wage deductions and the net pay in this case would be computed by means of calculating machines. As an alternative a summary punch may be connected to the tabulating machine so as to punch automatically a summary card for each man. The summary cards together with cards for wage deductions may then be mechanically tabulated by man number on the payroll sheets.

After they have been tabulated for payroll purposes, the cards on which the time-ticket data are punched may be re-sorted to obtain the labor distribution. Or in case a daily labor distribution is wanted, the cards may be sorted daily for that purpose after the punching has been verified and then re-sorted to man number at the end of the pay period for payroll purposes.

3. Unit-slip–unit-account method with daily posting of wages. The time ticket, which is the unit slip, may be either a hand-sort or a Keysort form. A form called a wage-cumulation card or wage-accrual card is the unit account. A wage-cumulation card for each employee is Addressographed at the beginning of each pay period. To it are posted the daily

CLOCK NO. 642

WORK WEEK ENDING DATE: Mar. 21, 1943

EMPLOYEE SOC SEC NO: 000-000-000

NAME: Rudolph Schneider

Work week and earnings accrual begins with first shift on Monday ends with last shift on Sunday

PRODUCTIVE LABOR		EXPENSE LABOR		DATE WORK PERFORMED	OVERTIME (WAR BONUS INCLUDED)	TOTAL EARNINGS	
Hrs.-10ths	AMOUNT	Hrs.-10ths	AMOUNT	Day No.		Hrs.-10ths	AMOUNT
				Mon. 1			
8,2	7.9 8	1,8	1.6 2	MAR 15	.9 6	1 0,	1 0.5 6
				Tues. 2			
8,	7.0 0			MAR 16		8,	7.0 0
				Wed. 3			
7,1	6.4 8	9	.5 4	MAR 17		8,	7.0 2
				Thur. 4			
7,6	6.5 5	4	.2 0	MAR 18		8,	6.7 5
				Fri. 5			
		8,	6.0 0	MAR 19		8,	6.0 0
				Sat. 6			
				Sun. 7			
				Plus Adjustments			
				Minus Adjustments			
				Premium			
50.9	28.0 1	11.1	8.3 6	Total For Week	.96	40.0	37.33
	5%	.05		Bonus Basis			
	1.40		.55	Bonus Amount			1.95
				Total Weekly Earnings			39.28

WEEKLY RECORD OF EMPLOYEE'S EARNINGS AND DEDUCTIONS

RETAIN THIS REPORT FOR YOUR PERSONAL RECORD IT IS A STATEMENT OF YOUR EARNINGS COMPUTATION AND DEDUCTIONS THEREFROM FOR THE WORK WEEK STATED ABOVE. PLEASE REPORT ANY DIFFERENCES IMMEDIATELY TO THE TIME CLERK IN THE DEPARTMENT IN WHICH YOU WORK.

EMPLOYEE SHALL RETAIN CLOCK NUMBER IDENTIFICATION CARD ON PERSON WHILE IN PLANT, AND MUST PRESENT TO PAYMASTER TO RECEIVE PAYROLL CHECK.

A. J. LINDEMANN & HOVERSON CO.
MILWAUKEE, WISCONSIN

WEEKLY SUMMARY

EARNINGS	Hrs.-10ths	AMOUNT
Productive and Expense Labor		36.37
Premium		
War Bonus	—	1.95
Overtime	—	.96
Total Earnings	40.0	39.28
DEDUCTIONS FROM EARNINGS:		
Federal Social Security Tax		.39
War Bond		3.92
Victory Tax		1.30
Income Tax (Withholding)		
Miscellaneous		
Total Deductions		5.61
Net Payment		33.67

COMMENTS

FIG. 18.6. Wage-cumulation record. (*A. J. Lindemann & Hoverson Company.*)

totals of hours and wages. The posting is usually done by machine. It is verified by obtaining departmental totals of the posted figures which must agree with the totals shown on the payroll control sheets. The labor distribution may be made either before the operation of posting to the wage-cumulation cards or afterward. The earnings of each man are computed at the end of the pay period by adding the daily postings.

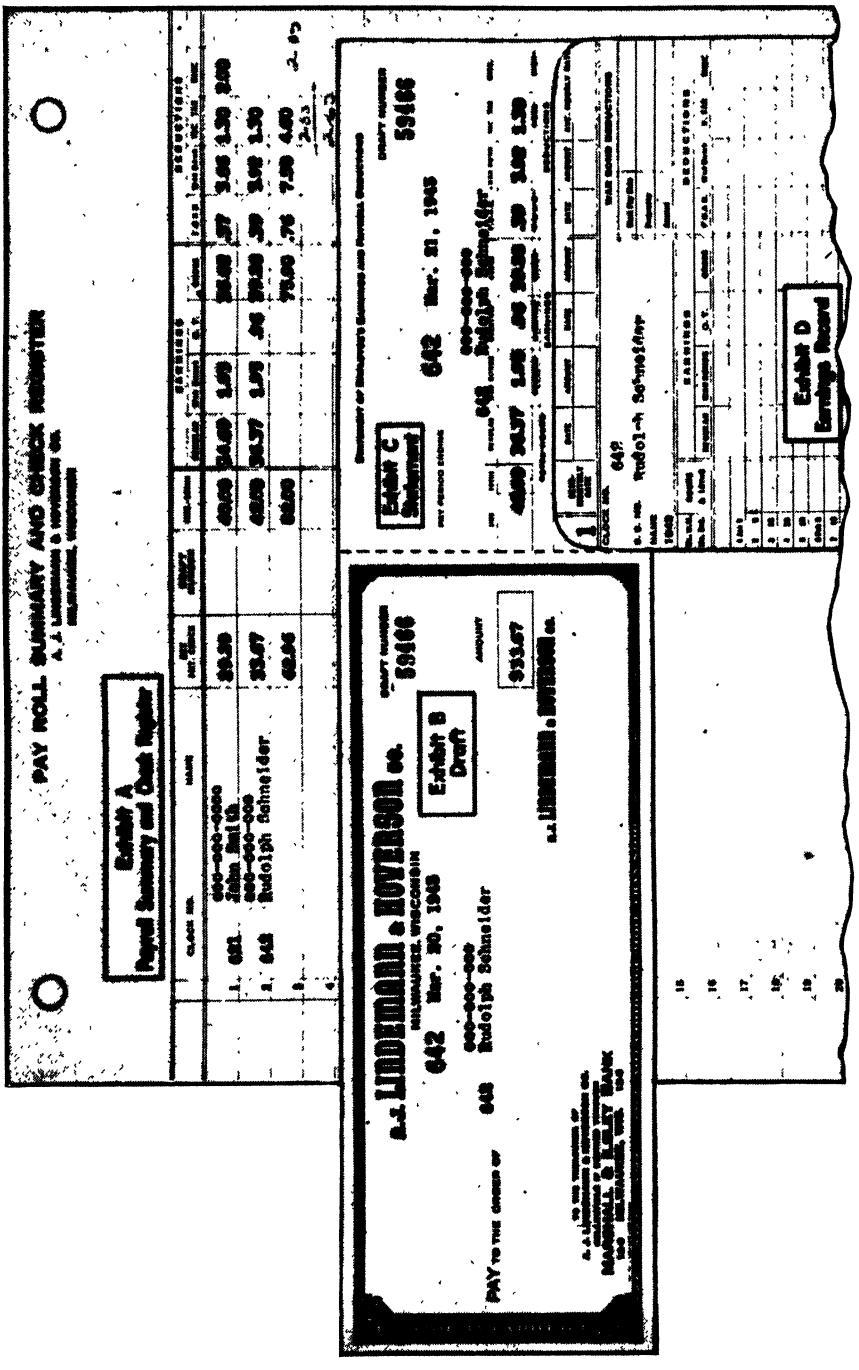
The wage-cumulation card is primarily a means of cumulating the daily earnings from time tickets so as to obtain a total for the pay period. In addition, however, it frequently has other functions. Overtime premium pay may be calculated and recorded on this form without being first shown on time tickets. If the payroll is prepared on a form-writing machine, the wage-cumulation cards are used as the media from which to write the payroll. In this case payroll deductions and the net pay should appear on the wage-cumulation form. Finally, a duplicate of the wage-accrual card may be prepared to be handed to the employees as an earnings statement. The form illustrated in Fig. 18.6 is designed to serve all the purposes that have been mentioned.

Both in the punched-card method and in the unit-slip–unit-account method much of the detail work of cumulating piece-rate earnings is done daily, and many of the operations are mechanized. As a result the time tickets can be made available daily for labor cost distribution and analysis, and the work at the end of the pay period can be completed promptly without an excessive peak load. These two methods of cumulating piece-rate earnings are therefore widely used in plants where there is a large volume of time tickets.

Wage Cumulation—Hourly Wage and Bonus

Under an hourly wage system the hours worked, straight-time earnings, extra pay for overtime, total earnings, wage deductions, and net pay are generally recorded on the attendance card at the end of the pay period. A space is blocked off on the form for this information. Then the attendance card is the source of data for the payroll, and no other form of wage-cumulation record is needed.

Under an incentive-bonus system the regular hourly wages may be recorded on the attendance cards the same as in an hourly wage system; the incentive wages would be computed on time tickets and then cumulated as in a piece-rate system. The two amounts, hourly wage and bonus, may then be brought together in one of several ways. (1) Both amounts may be entered by hand on the payroll. The total regular earnings, the overtime excess pay, the wage deductions, and the net pay would then be computed on the payroll itself. (2) The total of the incentive wages for the pay period may be entered on the attendance card.


PAY ROLL SUMMARY AND CHECK REGISTER
Exhibit A
Payroll Summary and Check Register
A. J. LINDEMANN & HOVERSON CO.
MILWAUKEE, WISCONSIN
642 Mar. 20, 1943
59166
Exhibit B
Draft
PAY TO THE ORDER OF
Rudolph Schneider
$13.67
Exhibit C
Statement
642 Mar. 31, 1943
59166
Rudolph Schneider
Exhibit D
Earnings Record

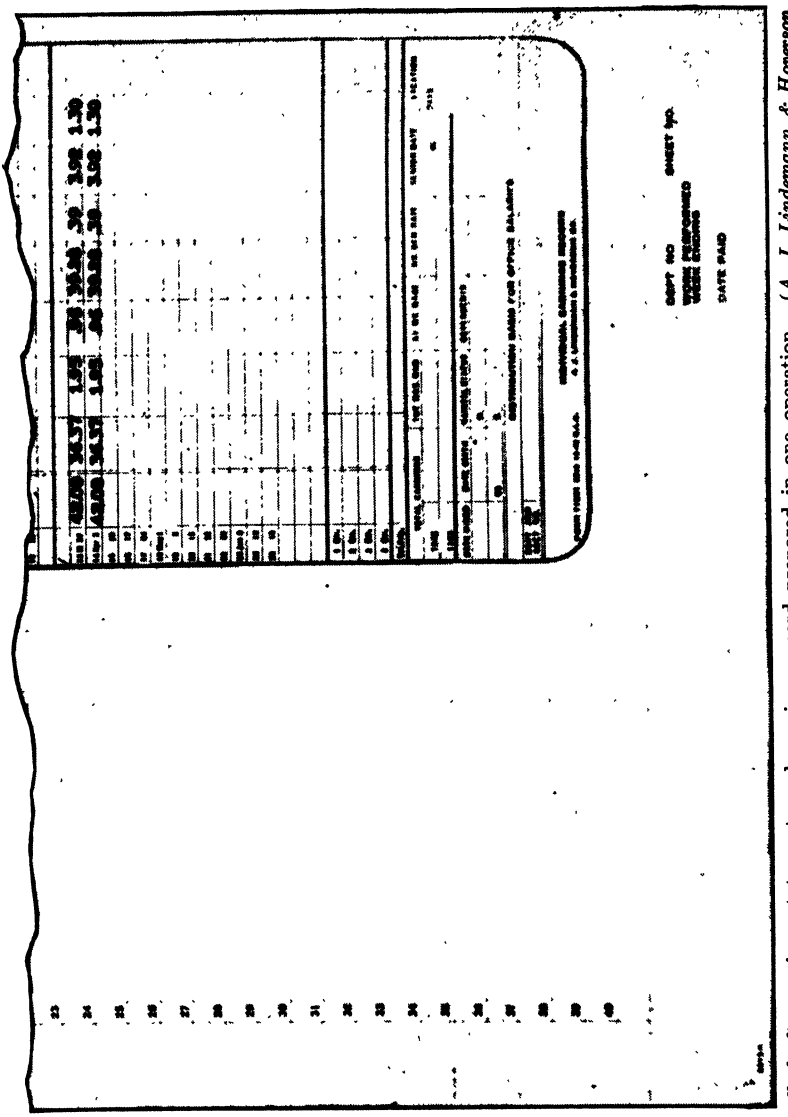


FIG. 18.7. Payroll, payroll draft, earnings statement, and earnings record prepared in one operation. (*A. J. Lindemann & Hoverson Company.*)

Total regular earnings, overtime premium, total earnings, wage deductions, and net pay may then be computed on the attendance card, which would then be used as the medium from which to write the payroll. (3) A separate form of wage-cumulation record may be used, both the hourly wages and the bonus earnings being posted to it.

Payroll

The payroll is a list of employees showing the net amount of pay due each employee for the pay period and usually the number of hours worked, the total regular earnings, the overtime excess pay, the total earnings, and the payroll deductions as well. If the employees are paid by check, the payroll is also a check register, the check numbers being written on the payroll. Exhibit A in Fig. 18.7 is an example of a payroll form. Methods of journalizing the payroll totals are discussed in Chapter 19.

Pay Check, Payroll Draft, Pay Envelope

Employees may be paid by check, by draft, or in cash. Exhibit B of Fig. 18.7 is an illustration of a payroll draft. A pay check would be similar in form but would be drawn on a bank instead of on the treasurer of the issuing corporation. When payment is to be made in cash, a pay envelope is provided for each employee to contain the cash. The payroll department writes the men's names and numbers and the amounts to be paid on the pay checks, drafts, or envelopes and then delivers them to the paymaster in the treasurer's office for payment. In case payment is to be made in cash a change sheet is also furnished to the paymaster, showing the quantity of each denomination of currency and coin required to fill the pay envelopes.

Earnings Statement

From the standpoint of maintaining good industrial relations, it is desirable each payday to furnish earnings statements to employees showing wages earned, payroll deductions, and net pay. A statement of this type satisfies the government requirement of a statement to employees in connection with old-age and survivors' insurance, provided that it shows the amount deducted for this purpose. It does not, however, take the place of the annual statement of income tax withheld. Exhibit C of Fig. 18.7 is an illustration of a form of earnings statement that is attached to a payroll draft. The employee would detach the earnings statement before presenting the draft for payment.

Earnings Record (for the Year)

The earnings record is a form on which an employee's quarterly and annual earnings are summarized. This information is needed in order to

prepare reports to the Federal government which are required in connection with social-security taxes and income taxes. Exhibit D of Fig. 18.7 is an illustration of a form of earnings record.

Preparation of Payroll and Related Forms in One Operation

The four forms in Fig. 18.7 are written in one operation on a form-writing machine. Column totals are obtained in the same operation. The payroll draft and the earnings record are original copies. The earnings statement and the payroll are carbon copies. In the illustration the forms are arranged horizontally as they would be positioned in the machine for writing. The vertical arrangement in the illustration is designed to give the readers a view of the various copies, but in the machine the material would be positioned vertically so that the writing would register on the proper line on each form. There are a number of makes of form-writing machines that are suitable for the writing of the payroll and the related forms in one operation. In many offices the equipment that is used for writing the purchase register and the check register is also used to write the payroll.

Where a suitable form-writing machine is either not obtainable or not justified by the volume of work to be handled, it is possible to write the payroll, the earnings statement, and the earnings record in one operation using hand methods. Figure 18.8 illustrates a procedure of this type. The forms in the illustration are standard (Pathfinder) forms. The following description of the procedure is quoted by permission.

> A group of compensation records [or earnings records] is spread or shingled on the peg strip at the right. A payroll journal is placed on the peg strip at the left. Pay checks corresponding to the compensation records are spread or shingled on the peg strip at the left (on top of the payroll journal). Two carbons are placed between the groups of forms. After the forms are arranged as illustrated, the operator makes the necessary entries [from wage cumulation records].
>
> As each entry is completed, the pay check is torn off on the perforated line at the left and placed face down. The corresponding compensation record is removed and also placed face down in a separate group. After all the checks on the board have been completed, the various columns of the journal are footed. Obviously, a cross-footing of the "Deductions" columns and the "Net Pay" column should exactly equal the total of the "Earnings" column. This substantiates the accuracy of individual additions and subtractions. The proof of the payroll journal furnishes also an *automatic proof* of the accuracy of the employees' remittance statements and the postings to the compensation records.
>
> It should be noted that both peg strips are removable. This makes it possible for an assistant to spread or shingle additional sets of compensation records and checks while the regular operator is making entries on the board. If an Addressograph is available, the names and employee numbers may be printed in advance

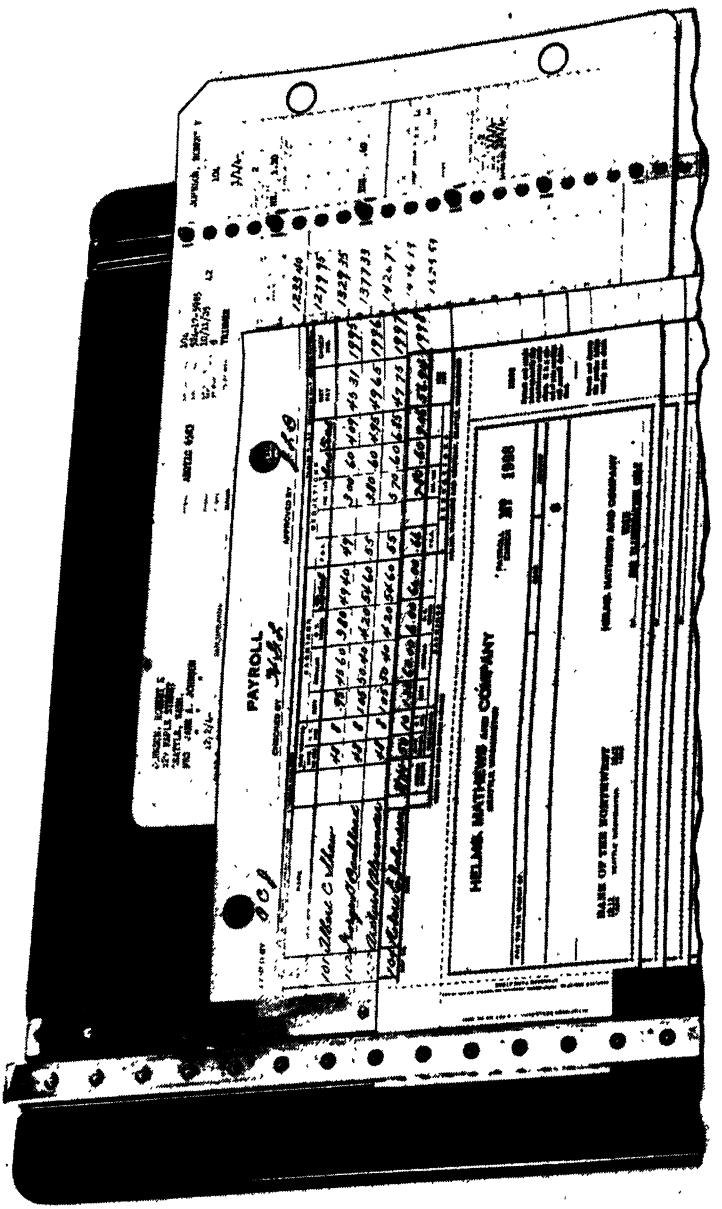


FIG. 18.8. Payroll, earnings statement, and earnings record written by hand in one operation. (*Charles R. Hadley Company.*)

on the payroll journals and the checks. The checks themselves, aside from the employees' remittance statements, may be prepared on the typewriter or on a check writer.[1]

Salary Payroll

The preparation of salary payrolls presents no unusual problems, and in fact is a much shorter process than the preparation of factory payrolls; for the basic rate of the salaried employee is a rate for the entire pay period. An Addressograph plate is generally prepared for each salaried employee. His name, department number, clock number, social-security number, and salary rate are embossed on the plate. The authorization for changes comes from personnel change notices.

Where it is considered desirable to treat the salary payrolls as confidential records, their preparation is likely to be assigned to a clerk in the controller's office. In a representative case the confidential clerk stores the payroll records, including the file of Addressograph plates, in a locked cabinet. Each pay period he personally imprints the department numbers, names, and rates on payroll sheets. In the case of those employees who are eligible for overtime premium, he refers to the clock cards, computes the premium, and records it on the payroll sheets. He then proceeds to compute on the payroll the total earnings, the payroll deductions, and the net pay, after which he prepares the payroll checks and earnings statements and delivers them to the treasurer for signature and issuance. The confidential clerk also posts the earnings records.

Overtime Pay Authorization

Authority for the payment of overtime comes from (1) attendance-card and time-ticket reports of overtime worked and (2) authorization of the overtime by an executive of the department in which the work is performed. In many of the larger plants a form known as a Request for Overtime is used as a means of showing executive approval. This form would be prepared and signed by the department foreman and then approved by the superintendent. The original copy would be sent to the head timekeeper. In smaller plants it is usually the practice to have the foreman indicate his approval merely by initialing the clock card adjacent to the overtime clock registration. Where overtime operation is regularly scheduled, a blanket authorization of overtime is generally given.

Overtime Premium—Calculation

In the development of a formula for overtime calculations consideration must be given to

[1] *Pathfinder Service Bulletin* 171, 1943, Courtesy of Charles R. Hadley Company.

1. The Fair Labor Standards Act, applying to employers in interstate commerce
2. The Walsh-Healey Act, applying to work performed on government contracts
3. Contracts with labor unions
4. The policy or custom of the employer

Where the Fair Labor Standards Act applies, time and a half must be paid for hours worked in excess of 40 hours in any work week. Where the Walsh-Healey Act applies, time and a half must be paid for hours in excess of 8 in one day or 40 in one week. The provisions of the union contract may govern where they differ from and do not conflict with government requirements. In the same manner, in case there is no union contract, the policy of the employer may govern.

The steps in the calculation of overtime are

1. Determine the amount of regular earnings, exclusive of overtime premium.
2. Determine the number of hours of overtime work.
3. Ascertain what percentage of the regular hourly rate is to be paid as overtime premium. Where time and a half is paid, for example, the overtime premium is 50 per cent.
4. Compute the regular hourly rate, an average rate. The regular earnings for the week (or the day) including piecework earnings and production bonuses as well as day-rate earnings are divided by the hours worked to determine the regular hourly rate. A weekly average is generally used, but in some plants union contracts require the use of a daily average.
5. Compute the overtime rate, that is, the regular hourly rate times the overtime premium percentage. Where time and a half is paid, the overtime rate is 50 per cent of the regular hourly rate.
6. Multiply overtime hours by overtime rate. The result is the overtime premium.

Two cases are presented in Table 18.1 to illustrate the calculation of overtime premium. In both it may be assumed that the regularly scheduled work week begins at 7 A.M. Sunday, that time and a half is paid for hours in excess of 8 in one day or 40 in one week, and that double time is paid for work on the seventh day of work in the work week.

Use of Tables as a Short Cut

Where the same calculations can be expected to be repeated a number of times, it may be desirable as a short cut to use a table of factors and answers. When an answer can be obtained by reference to a table, that is usually quicker and easier than making the calculations. For many

purposes standard tables are available, for example, tables of decimal equivalents of the more common fractions, tables of reciprocals, and the wage-withholding tables referred to in Chapter 17. In some cases the tables must be specially designed. A little thought on the part of the

TABLE 18.1
CALCULATION OF OVERTIME PREMIUM PAY
(At 50% of regular earning rate except as noted)

Day	Hours worked	Overtime hours	Regular earnings	Regular hourly rate	Overtime rate	Overtime premium
Case 1. Regular hourly rate computed on basis of earnings for the week						
Sunday	8					
Monday	9	1*	.....	.....	$0.375	$0.38
Tuesday	8					
Wednesday	8					
Thursday	8					
Friday	8	8†	.....	.....	0.375	3.00
Saturday	4 6	4.6‡	.....	.....	0.75	3.45
	53.6	13 6	$40.12	$0.75§	....	$6.83
Case 2. Regular hourly rate computed each day on basis of earnings for the day						
Sunday	9	1*	$ 6.52	$0 72¶	$0 36	$0.36
Monday	9	1*	5.80	0.64**	0 32	0.32
Tuesday	9	1*	6.70	0.74	0.37	0.37
Wednesday	0‖					
Thursday	9	1*	5.94	0.66	0.33	0.33
Friday	9	1*	6.80	0.76	0.38	0.38
Saturday	9	9†	7.25	0.81	0.405	3.65
	54		$39.01	.. ..	.....	$5.41

* In excess of 8 hours in one day.
† In excess of 40 hours in one week less excess previously allowed on daily basis.
‡ Seventh day, at double time.
§ $40.12 ÷ 53.6.
‖ Absent.
¶ $6.52 ÷ 9.
** $5.80 ÷ 9.

accountant in designing a table frequently saves many hours of clerical work.

Tables of factors and answers are widely used in payroll work. In a day-wage system a table with columns for rates (factor 1) and lines for number of hours worked (factor 2) is likely to be employed, the straight-time earnings (the answers) being shown in the body of the table. Incen-

40		45		50		55		60	
40.0		45.0	.05556	50.0	.10000	55.0	.13636	60.0	.16667
40.1	.00125	45.1	.05654	50.1	.10080	55.1	.13702	60.1	.16722
40.2	.00249	45.2	.05752	50.2	.10159	55.2	.13768	60.2	.16777
40.3	.00372	45.3	.05850	50.3	.10239	55.3	.13834	60.3	.16833
40.4	.00495	45.4	.05947	50.4	.10317	55.4	.13899	60.4	.16887
40.5	.00617	45.5	.06044	50.5	.10396	55.5	.13964	60.5	.16942
40.6	.00739	45.6	.06140	50.6	.10474	55.6	.14029	60.6	.16997
40.7	.00860	45.7	.06236	50.7	.10552	55.7	.14093	60.7	.17051
40.8	.00980	45.8	.06332	50.8	.10630	55.8	.14158	60.8	.17105
40.9	.01100	45.9	.06427	50.9	.10707	55.9	.14222	60.9	.17159
41		46		51		56		61	
41.0	.01220	46.0	.06522	51.0	.10784	56.0	.14286	61.0	.17213
41.1	.01338	46.1	.06616	51.1	.10861	56.1	.14349	61.1	.17267
41.2	.01456	46.2	.06710	51.2	.10938	56.2	.14413	61.2	.17320
41.3	.01574	46.3	.06803	51.3	.11014	56.3	.14476	61.3	.17374
41.4	.01691	46.4	.06897	51.4	.11089	56.4	.14539	61.4	.17427
41.5	.01807	46.5	.06989	51.5	.11165	56.5	.14602	61.5	.17480
41.6	.01923	46.6	.07082	51.6	.11240	56.6	.14664	61.6	.17532
41.7	.02038	46.7	.07173	51.7	.11315	56.7	.14727	61.7	.17585
41.8	.02153	46.8	.07265	51.8	.11390	56.8	.14789	61.8	.17638
41.9	.02267	46.9	.07356	51.9	.11464	56.9	.14851	61.9	.17690
42		47		52		57		62	
42.0	.02381	47.0	.07447	52.0	.11538	57.0	.14912	62.0	.17742
42.1	.02494	47.1	.07537	52.1	.11612	57.1	.14974	62.1	.17794
42.2	.02607	47.2	.07627	52.2	.11686	57.2	.15035	62.2	.17846
42.3	.02719	47.3	.07717	52.3	.11759	57.3	.15096	62.3	.17897
42.4	.02830	47.4	.07806	52.4	.11832	57.4	.15157	62.4	.17949
42.5	.02941	47.5	.07895	52.5	.11905	57.5	.15217	62.5	.18000
42.6	.03052	47.6	.07983	52.6	.11977	57.6	.15278	62.6	.18051
42.7	.03162	47.7	.08071	52.7	.12049	57.7	.15338	62.7	.18102
42.8	.03271	47.8	.08159	52.8	.12121	57.8	.15398	62.8	.18153
42.9	.03380	47.9	.08246	52.9	.12193	57.9	.15458	62.9	.18203
43		48		53		58		63	
43.0	.03488	48.0	.08333	53.0	.12264	58.0	.15517	63.0	.18254
43.1	.03596	48.1	.08420	53.1	.12335	58.1	.15577	63.1	.18304
43.2	.03704	48.2	.08506	53.2	.12406	58.2	.15636	63.2	.18354
43.3	.03811	48.3	.08592	53.3	.12477	58.3	.15695	63.3	.18404
43.4	.03917	48.4	.08678	53.4	.12547	58.4	.15753	63.4	.18454
43.5	.04023	48.5	.08763	53.5	.12617	58.5	.15812	63.5	.18504
43.6	.04128	48.6	.08848	53.6	.12687	58.6	.15870	63.6	.18553
43.7	.04233	48.7	.08932	53.7	.12756	58.7	.15928	63.7	.18603
43.8	.04338	48.8	.09016	53.8	.12825	58.8	.15986	63.8	.18652
43.9	.04442	48.9	.09100	53.9	.12894	58.9	.16044	63.9	.18701
44		49		54		59		64	
44.0	.04545	49.0	.09184	54.0	.12963	59.0	.16102	64.0	.18750
44.1	.04649	49.1	.09267	54.1	.13031	59.1	.16159	64.1	.18799
44.2	.04751	49.2	.09350	54.2	.13100	59.2	.16216	64.2	.18847
44.3	.04853	49.3	.09432	54.3	.13168	59.3	.16273	64.3	.18896
44.4	.04955	49.4	.09514	54.4	.13235	59.4	.16330	64.4	.18944
44.5	.05056	49.5	.09596	54.5	.13303	59.5	.16387	64.5	.18992
44.6	.05157	49.6	.09677	54.6	.13370	59.6	.16443	64.6	.19040
44.7	.05257	49.7	.09759	54.7	.13437	59.7	.16499	64.7	.19088
44.8	.05357	49.8	.09839	54.8	.13504	59.8	.16555	64.8	.19136
44.9	.05457	49.9	.09920	54.9	.13570	59.9	.16611	64.9	.19183

FIG. 18.9. Overtime-earnings table. For calculating overtime earnings at *one-half the average hourly rate* for time in *tenths of hours* over 40 hours. EXAMPLE: Employee works 45.3 hours and earns $32.76. Multiply .05850 by $32.76. Answer = $1.92. See 45.3 on table. $.05850 = \frac{45.3 - 40.0}{45.3} \times \frac{1}{2}$. (*Burroughs Adding Machine Company.*)

tive-bonus calculations can usually be expedited by using tables of bonus earnings per hour with columns for job classifications and lines for efficiency percentages. Tables are also helpful in determining the amount of overtime premium.

Figure 18.9 is a reproduction of a part of a standard table that is designed for use in the calculation of overtime premium at one half the average hourly rate for time in tenths of hours in excess of 40 hours a week. The table is divided into sections, each section consisting of two columns. Hours and tenths of hours (factors) are shown in the first of the two columns and ratios of overtime premium to regular earnings, in the second or answer column.

By employing this table the steps in the calculation of overtime would be

1. Determine the amount of regular earnings.
2. Determine the number of hours worked.
3. Refer to the table, and multiply regular earnings by the appropriate ratio shown in the table. The step of determining the average earning rate is entirely eliminated through the ingenuity of the person who designed the table.

To illustrate:

Assume that a man worked 52.4 hours during a certain week, that his regular earnings for the week amount to $42.10, and that he is entitled to time and a half for time in excess of 40 hours. Referring to the table in Fig. 18.9 the ratio of overtime premium to regular earnings for a week of 52.4 hours is found to be 0.11832. Multiplying $42.10 by 0.11832 gives $4.98, the overtime premium.

A table of factors and answers need not be applicable in every possible case in order to be a timesaver. Rather than make the table unwieldy, it is usually wise to limit its range to calculations that are often repeated. Cases not covered by the table would then be calculated without the use of the table. Thus, the table in Fig. 18.9 covers a range from 40.1 hours a week to 64.9 hours, and it applies only to overtime that is paid at time and a half. In case a man either worked more than 64.9 hours in a week or was entitled to double time, the table would not apply. If such cases occurred frequently it would probably pay to expand the table to cover them, but if they were rare, it would probably be better to use for the exceptional cases the long method of calculation outlined on pages 302 and 303.

Payment of Wages

As explained in Chapter 17 employers are required by the Federal government (and in some states by the state government as well) to withhold

certain employee taxes from wages and either to pay them direct to government collectors or to deposit them in a bank to the credit of the government. In addition an employer with employee authorization may make deductions from wages for war bonds, group insurance, and pension trust payments, to mention only a few examples, and for payroll advances. Amounts withheld for war bonds are used to buy bonds that are delivered to employees. Amounts withheld for group insurance and for pension trust payments are transmitted to an insurance company for credit to the employees' accounts. Amounts withheld for payroll advances are to reimburse the employer for payments to employees prior to the regular payday.

To prepare a payroll it is necessary first to compute the gross earnings of each employee and then to deduct the amounts to be withheld. The remainder, known as the net pay, is the amount to be paid to the employee on payday. Payments of withheld wages to government collectors and to insurance companies are generally made by check from funds on deposit in a regular commercial account. Wage payments to employees are generally made from a special payroll bank account. Payroll advances may be reimbursed in any one of several ways.

Payroll Advances

A payroll advance is a payment to an employee prior to the regular payday on account of wages that either have been earned or are expected to be earned in the future. The advance may be made either

1. From cash on deposit in the employer's commercial checking account, in which case the advance would be charged to Accounts Receivable—Employees
2. From petty cash, in which case either
   a. A charge would be made to Accounts Receivable—Employees, or
   b. No charge would be made for the advance but the petty cashier would present the employee's receipt to the paymaster on payday and receive reimbursement from the paymaster in cash
3. From a payroll fund.

Collection of payroll advances from employees is generally made by deduction from the employee earnings. If the advances have been charged to Accounts Receivable—Employees, a check for the amount of the advances would be drawn (by the employer) on payday and made payable to the employer. The check would be deposited in the commercial account and credited to Accounts Receivable—Employees. In case employees' receipts for advances are held by the petty cashier in lieu of cash, a check for the amount of the advances would be drawn (by the

employer) on payday and made payable to the order of the cashier, who would cash the check to reimburse his fund. The procedure followed when advances have been made from a special payroll fund is explained in the following section.

Payroll Fund

Wage payments are made in many plants from special deposit accounts that are operated as imprest funds. To establish a payroll fund of this type an amount sufficient to cover probable payroll advances is deposited in it. The entry for the establishment of the fund would be somewhat as follows:

Cash on Deposit—Factory Payroll Account	$1,000	
Cash on Deposit—Commercial Account		$1,000

If the paymaster who has charge of the fund makes advances to employees from the payroll fund, he simply holds the employees' receipts for the advances until the end of the pay period. At that time he furnishes the payroll department a list of the advances. The advances are deducted on the payroll in computing net pay. Pay checks for the net pay are drawn against the payroll fund. Each payday a check is drawn on the commercial account to reimburse the payroll fund for the sum of the advances and the net pay. The paymaster deposits this check in the payroll fund. Thus, the fund is automatically reimbursed for payroll advances.

To illustrate, assume that

1. The factory paymaster has an imprest payroll fund of $1,000
2. He has made payroll advances amounting to $250 during a certain pay period
3. Employees' earnings for the period amount to $12,800
4. Deductions from earnings for social security taxes are $120, for income tax $1,270, and for group insurance $110.

Then,

1. The wage cost for the period is $12,800
2. The amount to be paid to employees on payday is $11,050, computed as follows:

Earnings		$12,800
Less: Deductions		
Social-security tax	$ 120	
Income tax	1,270	
Group insurance	110	
Payroll advances	250	1,750
Net pay		$11,050

3. The amount that is required to reimburse the payroll fund on payday is $11,300, computed as follows:

Checks for net pay to be drawn on payroll fund	$11,050
Advances made from payroll fund prior to payday	250
Total reimbursement	$11,300

4. The balance on hand in the payroll fund after the foregoing transactions would be $1,000, computed as follows:

Balance on hand, beginning of period	$ 1,000
Less: Payroll advances	250
	$ 750
Plus: Reimbursement check	11,300
	$12,050
Less: Payroll checks to employees	11,050
Balance on hand, end of period	$ 1,000

Journal Entries for Payrolls

In the illustration in Chapter 8 the checks drawn to reimburse the payroll fund are credited to Cash on Deposit—Commercial Account and debited to Cash on Deposit—Payroll Fund (see Table 8.2, entry 12-23). In the same illustration the journal entry covering the payrolls credits Cash on Deposit—Payroll Fund for the sum of the net pay and the advances, credits Employee Deposits for the amount of wages withheld, and debits the amount of the gross earnings to Accrued Wages (see Table 8.2, entry 12-25). Other methods of journalizing the payroll data are described in Chapter 19.

CHAPTER 19

LABOR DISTRIBUTION

Labor distribution is the allocation of periodic labor cost in accordance with the account classification. A reliable distribution of labor cost is required in order to have adequate labor cost control and accurate product cost data.

In job-order cost systems and in standard cost systems the labor distribution furnishes the data for the application of direct labor cost to Goods in Process as well as the data for the periodic cost distribution. Separate journal entries may be made for the distribution and the direct-labor application. That procedure is illustrated in Fig. 7.2, entries 2*c* and 3*c*. Frequently, however, a compound entry is prepared to cover both steps in the flow of costs as illustrated in Fig. 7.3, entry 1*b*.

A monthly labor distribution report is generally prepared showing the labor cost by department and by class of labor for comparison with the labor budget for the period. In many plants for managerial purposes a labor distribution and budget comparison is prepared each pay period in addition to the monthly reports, and in some cases a daily distribution is prepared. Except in process cost systems the detail work of making the distribution is usually organized to a large extent as a daily routine in order to avoid a peak load of work at the end of the month.

Labor Distribution in Job-order Cost Systems

In job-order cost systems the labor distribution is made from time tickets. It consists of two parts, namely,

1. Distribution by department and natural classification
2. Distribution of direct labor by job-order number

As a rule the distribution of direct labor by order number consists of sorting time tickets by order number, adding, and then posting totals to cost sheets. This phase of the labor distribution is discussed in Chapter 4. Here we are concerned with the distribution by department and natural classification.

The department and the natural classification are recorded on each time ticket by the timekeeper in the shop. The major natural classifications are direct labor and indirect labor, both of which may be subdivided, the former according to types of direct operations performed, the latter according to subordinate natural classifications, such as, supervision,

clerical, trucking, and cleanup. In Table 6.8, for example, there are eight natural classifications in the indirect-labor group.

Nonproductive Labor

The natural classification registered on the time ticket should be determined according to the operation or work performed and not according to the man's usual occupation. Thus, if a machine operator who normally does direct work is assigned for part of a day to an indirect operation, such as repairing belts, that part of his day should be reported as indirect labor. Idle time due to material shortages, machine breakdowns, and other causes should also be reported as indirect labor.

The cost of direct workers' time not spent on direct operations is called nonproductive labor.[1] When indirect work is assigned to a direct worker, it is generally "busy" work—intended primarily to keep the worker occupied when he would otherwise be idle. As a rule it is either work that would not need to be done at all or work that could be done more economically by other means. In a well-managed shop the direct workers are kept supplied with materials and equipment so that there is little nonproductive labor. If the direct workers spend a large part of their time nonproductively, it is generally an indication of faulty management.

It is difficult to obtain complete reports of nonproductive time, however, under day-wage systems where performance standards have not been established. These conditions are frequently found in jobbing shops. If the workman is paid at his hourly rate both for direct work and for nonproductive time, it makes no difference to him from a pecuniary standpoint whether his time is recorded as direct labor or as indirect labor. As a rule under these circumstances workmen are reluctant to report nonproductive time to timekeepers, and foremen do not encourage them to do so. The cost of the nonproductive labor, if it is not reported as such, is included in the labor cost of the production order on which the workman is rung in at the time. In many job cost systems therefore the labor distribution is not extremely reliable. When this is the case, the control of labor cost is likely to be meager, and the "actual" product costs are likely to deviate considerably from cost estimates. Improvement in the labor distribution usually goes hand in hand with the development of

[1] The term "nonproductive labor" is sometimes used as the equivalent of indirect labor. In this text, however, it is defined as that part of the indirect labor which represents direct workers' time not spent directly on production. To refer to all indirect labor as nonproductive is, in the author's opinion, objectionable. The trucker, the inspector, the foreman, and the timekeeper, for example, contribute indirectly to production. It is misleading to call their time nonproductive.

performance standards and production control and with the introduction of incentive wages.

Labor Distribution Routine in Job-order Cost Systems

In the office the principal steps in making the labor distribution in a job-order cost system are

1. Establish departmental control figures for direct labor and indirect labor, taking into consideration interdepartmental transfers. The subject of labor transfers is discussed more fully later on. The payroll control sheet illustrated in Fig. 18.5 has columns for recording labor transfers and distribution control totals.

2. Distribute direct labor to cost sheets. This subject is discussed in Chapter 4.

3. Distribute indirect labor (and in some cases direct labor also) according to natural classifications. One of the unit-slip methods of distribution is usually employed, the time tickets being sorted and added to obtain class totals. This distribution is usually made each pay period but in some cases is made daily.

4. Prepare monthly labor distribution summaries and journal entries. Entry 12-2 of Table 8.2 and entry 1-2*bf* of Table 9.3 are examples of journal entries covering labor distribution in order cost systems.

5. Prepare labor distribution reports as required. Labor distribution summaries are frequently prepared in the form of reports.

Where two copies of time tickets are prepared, one for payroll purposes and one for distribution purposes, the payroll department would generally deliver the latter copies to the cost accounting department daily after earnings calculations have been verified. The work of distribution from that point on would be done by the cost accounting department. Where only one copy of each time ticket is prepared, it is frequently the practice to have the payroll department prepare the distribution as well as the payroll.

Labor Distribution Summary

The labor distribution summary may be, and frequently is, merely a columnar analysis sheet with typewritten or hectographed headings to which the totals of time tickets are posted periodically. Figure 19.1 is a form of columnar summary that would be suitable for use in a plant where the end of the accounting month always coincides with the end of a pay period.

Figure 19.2 shows the column headings of a form that would be suitable in case the end of the accounting month does not come at the end of a pay period. In such cases in order to obtain the monthly distribution it is necessary to make two split-pay-period distributions for each overlapping

LABOR DISTRIBUTION

Four Weeks Ending _____ Period No _____ Dep't No _____

Classification	Regular Earnings Pay Period Ending 9-19-47	Regular Earnings Pay Period Ending 10-3-47	Overtime Excess Pay	Vacation Pay	Total
Department Payroll					
Hours Worked					
Regular Earnings					
Overtime Excess Pay					
Vacation Pay					
Total Wages					
Labor Distribution					
Direct Labor					
Hours					
Amount (Straight Time)					
Indirect Labor					
Hours					
Amount (Straight Time)					
Overtime Excess Pay					
Vacation Pay					
Totals					
Hours					
Amount					
Indirect Labor					
01 Supervision					
02 Technical and Clerical					
03 Inspection					
04 Clean Up					
05 Trucking					
06 Idle Time					
07 Overtime Excess Pay					
09 Other Indirect Labor					
Total					

FIG. 19.1. Departmental labor distribution summary.

pay period. Thus, in Fig. 19.2 the first column would be used to show a split-pay-period distribution covering the last five days of the biweekly pay period ending September 5, 19—. A split-pay-period distribution for the first nine days of that pay period would appear on the labor distribution summary for the month of August. The third column of the September summary (Fig. 19.2) would show a split-pay-period distribution for the first eleven days of the pay period ending October 3, 19—.

Line headings are not illustrated in Fig. 19.2 for they would be the same as in the previous illustration.

The monthly departmental totals are summarized to obtain totals for the plant as a whole. A columnar form may be used for the plant summary, with a column for each department. The line headings would be similar to those on the departmental summary (Fig. 19.1).

When multicolumn forms or analysis sheets, such as those just described, are used to summarize the labor distribution, the procedure is somewhat laborious because it is necessary to copy columns of figures from

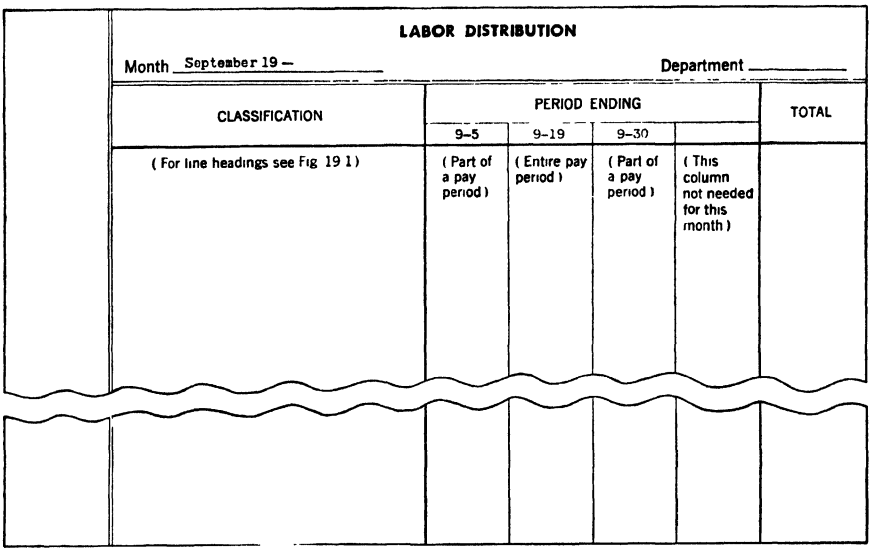


FIG. 19.2. Column headings for departmental labor distribution summary where end of accounting month does not coincide with end of pay period.

one form to another and then to check the copying. This is particularly true when the labor distribution is prepared daily. Two methods of avoiding the laborious work of copying the columns of figures are discussed below. One is the summary-strip method, the other the punched-card method.

Summary-strip or Pegboard Method

The summary-strip or pegboard method is an application of the columnar method of distribution. Summary strips are "shingled" on a mounting device known as a pegboard so that only one column of each form is exposed, thus giving a multicolumn array of figures that can be cross-added the same as a multicolumn sheet. Figure 19.3 illustrates the operation of adding a set of summary strips mounted on a pegboard. The

equipment required with this method is inexpensive. Equipment that is suitable for adding multicolumn analysis sheets is also suitable for adding summary strips. Nonlisting calculating machines are generally used for this purpose.

A summary-strip form consists of a column of classifications and one or more columns for numerical data. The classifications, which are the line headings, are usually printed on the form. Holes are punched along one

FIG. 19.3. Addition of summary strips mounted on pegboard. (*Felt and Farrant Manufacturing Company.*)

edge of the form, usually the top, to fit the pegs, hooks, or rings of the mounting device. The forms must be carefully designed and made so as to obtain the proper alignment and the proper column exposure when the forms are shingled. Figure 19.4 is an illustration of a summary-strip form.

When summary strips are shingled on a pegboard, the desired columns of numerical data are exposed, but the line headings are concealed except for those appearing upon that summary strip which is in the top position. A blank summary strip or "recap" strip on which to write the line totals is placed on the board, usually in the bottom position.

The shingling may run either from left to right or from right to left, depending on the position on the summary strip of the column to be exposed.

In the adding operation each line is added across and the total is entered on the recap strip. The addition of the strips on the pegboard is self-balancing the same as that of a multicolumn sheet, for the total of the recap strip adding down must agree with the total of the column totals added across.

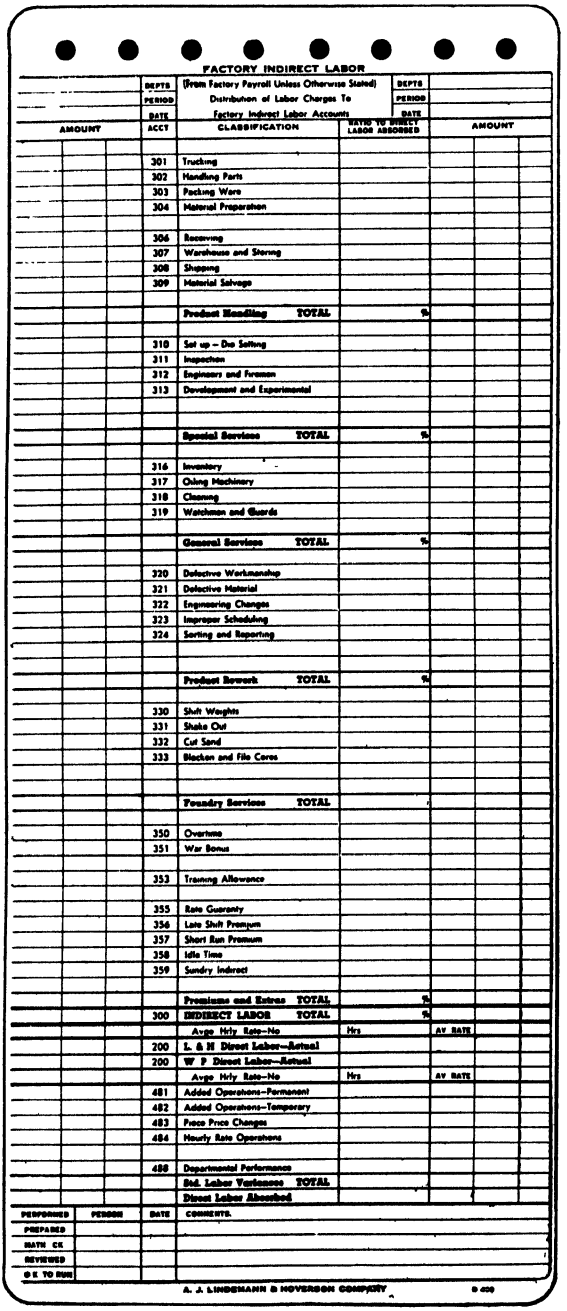
When the recap strip is completed, all the strips are removed from the pegboard. The individual summary strips may be re-sorted and recapped according to other classifications, and the recap strip may be sorted with other recap strips to obtain grand totals. Numerous distributions may therefore be obtained from a set of summary strips without recopying.

Labor Distribution by the Summary-strip Method

The summary-strip form reproduced in Fig. 19.4 is used in connection with a daily labor distribution. The indirect-labor classifications take up most of the lines on the form starting at the top. Direct labor and labor variances appear near the bottom of the form. The amount column at the left is for period totals—day, week, or month, as the case may be. The amount column at the right is for cumulative totals, which are shown on the weekly and monthly recaps but not on the daily strips.

Time tickets are sorted daily by department and by class of labor and then totaled. The totals are entered on daily summary strips, one strip being made for each department. The summary strips for the day are arranged on a pegboard and added to obtain the labor distribution for the entire plant for the day. At the end of the weekly pay period the daily strips are sorted departmentally, and the strips for each department are shingled on a pegboard. The figures are added across, and the line totals are entered on a recap summary strip which represents the departmental distribution for the week. By assembling the latter strip with the corresponding strips for the other departments and adding, the weekly totals for the plant are determined.

For the purpose of obtaining monthly data on the calendar-month basis, split-week distributions are made for those weekly periods which fall partly in one month and partly in another month. At the end of the month the weekly recap strips for each department including the appropriate split-week recaps are assembled and added to obtain the monthly distribution for the department. The recap strips showing the monthly departmental distributions are then assembled to obtain monthly totals for the entire plant.



FACTORY INDIRECT LABOR

(From Factory Payroll Unless Otherwise Stated)
Distribution of Labor Charges To
Factory Indirect Labor Accounts

DEPTS | PERIOD | DATE

AMOUNT	ACCT	CLASSIFICATION	RATIO TO DIRECT LABOR ABSORBED	AMOUNT
	301	Trucking		
	302	Handling Parts		
	303	Packing Ware		
	304	Material Preparation		
	306	Receiving		
	307	Warehouse and Storing		
	308	Shipping		
	309	Material Salvage		
		Product Handling TOTAL	%	
	310	Set up – Doo Setting		
	311	Inspection		
	312	Engineers and Foremen		
	313	Development and Experimental		
		Special Services TOTAL	%	
	316	Inventory		
	317	Oiling Machinery		
	318	Cleaning		
	319	Watchmen and Guards		
		General Services TOTAL	%	
	320	Defective Workmanship		
	321	Defective Material		
	322	Engineering Changes		
	323	Improper Scheduling		
	324	Sorting and Reporting		
		Product Rework TOTAL	%	
	330	Shot Weights		
	331	Shake Out		
	332	Cut Sand		
	333	Blacken and File Cores		
		Foundry Services TOTAL		
	350	Overtime		
	351	War Bonus		
	353	Training Allowance		
	355	Rate Guaranty		
	356	Late Shift Premium		
	357	Short Run Premium		
	358	Idle Time		
	359	Sundry Indirect		
		Premiums and Extras TOTAL	%	
	300	**INDIRECT LABOR TOTAL**	%	
		Avge Hrly Rate–No	Hrs	AV RATE
	200	L. & H Direct Labor–Actual		
	200	W P Direct Labor–Actual		
		Avge Hrly Rate–No	Hrs	AV RATE
	481	Added Operations–Permanent		
	482	Added Operations–Temporary		
	483	Piece Price Changes		
	484	Hourly Rate Operations		
	486	Departmental Performance		
		Ind. Labor Variances TOTAL		
		Direct Labor Absorbed		

PERFORMED | PERIOD | DATE | COMMENTS.
PREPARED
MATH CK
REVIEWED
O K TO RUN

A. J. LINDEMANN & HOVERSON COMPANY D 400

FIG. 19.4. Labor distribution, summary-strip form. (*A. J. Lindemann & Hoverson Company.*)

The practical application of the summary-strip method of labor distribution is not limited to cases where a daily distribution is wanted. It is frequently applied where the distribution is summarized only at the end of the pay period and at the end of the month. In this case time tickets for pay periods and for split periods would be sorted and added and the totals would be entered on summary strips. From this point on the procedure would be the same as that described above.

Daily Labor Distribution by Punched-card Method

When the punched-card method is used in connection with a daily labor distribution, tabulating cards are punched daily from time-ticket data. The punched cards may be used for payroll purposes as well as for the labor distribution. For the latter purpose the cards for each department are sorted daily by class of labor and tabulated. The daily totals are printed on report forms and also punched on summary cards. The latter operation is usually done automatically by means of a summary punch. There would be one summary card each day for each standing order affected. At the end of the pay period and again at the end of the month the summary cards are sorted by department and class of labor and tabulated. The labor distributions for the plant as a whole are obtained by re-sorting the summary cards and tabulating.

The practical application of the punched-card method of labor distribution is not limited to cases where a daily labor distribution is wanted. It is frequently applied where distribution summaries are made only at the end of the pay period and at the end of the month. In such cases the tabulating cards would be punched daily, but they would not be sorted and tabulated for distribution purposes except at the end of a pay period or a split period. Summary cards would be punched at that time for use in obtaining the monthly distribution.

Labor Distribution in Standard Cost Systems

The labor distribution in standard cost systems is similar in many respects to that in job-order cost systems. The distribution by order number is generally omitted, however, except for special jobs and pilot runs. In its place there is frequently a distribution by operation number to obtain data for use in compiling standard operation costs and variances. In some cases a distribution of labor cost according to class of product is made as a means of making an over-all verification of the labor costed at standard to each line of product. The labor distribution is likely to be more reliable in a standard cost system than in an order cost system because conditions in the shop as a rule are more fully standardized.

Entry 7-3 of Table 10.2 is an example of a journal entry for a monthly labor distribution in a standard cost system.

Labor Distribution in Process Cost Systems

In process cost systems the labor distribution is generally made from the payroll. Time tickets are not usually required. The distribution is principally an allocation to processes or departments. The names are arranged departmentally on the payroll. In case a man is assigned to work for a department other than his regular department, his foreman would notify the office, usually by making a notation of the facts on the man's attendance card.

To a limited extent in process cost systems the labor cost is classified according to natural classifications. The classifications are usually broad, and the men are not often shifted from one class of work to another. The distribution by natural classifications can therefore be made as a rule from the payroll if the names of the men in each department are grouped according to class of work performed. The foreman may be instructed to inform the payroll department in case a man is assigned part of the time to a class of work that is different from his payroll classification. It would not be worth while as a rule to provide for an absolutely accurate tally of labor cost by natural classifications if that required the installation of an elaborate timekeeping system.

Labor distribution summaries are prepared to combine the pay-period figures so as to obtain monthly totals. Forms of the type illustrated by Figs. 19.1 and 19.2 are suitable for this purpose. Entry 6-2 of Table 11.2 illustrates a method of journalizing the monthly labor distribution in a process cost system.

Interdepartment Transfers

When a man is transferred from one department to another for an entire pay period, no particular problem arises. A payroll transfer is made, the man is assigned a new clock number, and his time and earnings are recorded in the regular way in the payroll and in the labor distribution of the department to which he is transferred.

When a man is transferred or loaned by one department to another department for a part of a pay period, however, a special routine must ordinarily be established to charge the proper department in the labor distribution. The earnings should appear on the payroll of the first department, known as the home department, but the cost should be distributed to the second department, known as the foreign department.

In case the labor distribution is obtained from time tickets, the time tickets for labor transferred would be prepared either by the timekeeper

in the home department or by the one in the foreign department. The latter arrangement is usually more convenient in case the workman is working throughout the day in the foreign department. The man's clock number and the number of his home department are written at the top of the form in the usual way. There is usually a space in the body of the form for "department charged." The number of the foreign department is written in that space. The time tickets are marked "Transfer." In the head timekeeper's office at the end of the shift the transfer time tickets are assembled with the other time tickets of the home department for checking against the attendance cards. For payroll purposes the transfer time tickets are processed along with the other time tickets of the home department, and the earnings covered by them are included in the payroll of that department.

At some point in the office routine the transfer time tickets are separated from the other time tickets for distribution purposes. This would be done daily if a daily labor distribution is made. The subsequent steps in a representative daily routine are described briefly as follows:

After separation from the other time tickets the transfer time tickets are grouped and added according to home departments. Each departmental total is entered on the payroll control sheet in a column headed "Transfer Out" (see Fig. 18.5). The transfer tickets are then sorted and added according to departments charged, and the resulting totals are entered on the payroll control sheets in a column headed "Transfer In." The transfer time tickets are then assembled with the other time tickets of the foreign departments. From that point on they go through the regular procedure of labor distribution.

The payroll control sheet is a means of reconciling the departmental payroll totals with the departmental labor distribution totals. The total of the daily entries in the distribution columns must be equal to the daily payroll total plus transfers in minus transfers out. For the plant as a whole the amount of the labor distribution for any period must equal the earnings for the period, but for an individual department the two would not be equal if there were labor transfers affecting the department.

The foregoing procedure can be readily adapted for use at pay-period intervals instead of daily. Where labor distribution reports are prepared only once a month, however, it may be more practical to make the adjustment for labor transfers a monthly routine especially if the transfers are not numerous. In a representative procedure of this type the time tickets are first distributed each pay period with the tickets of the home departments but are charged to a subsidiary clearing account called Interdepartment Labor Transfers. At the end of the month the transfer time reports are separated from the other time tickets and sorted and added according to department charged and class of labor. A separate

analysis sheet is prepared to show the distribution of the labor transfers. From it the amounts are posted to the analysis sheets which summarize the monthly departmental labor distribution. On this form there would be a column for transfers and a line for the subsidiary clearing account Interdepartment Labor Transfers. Otherwise it would be the same as the form illustrated in Fig. 19.1.

The form of departmental summary just described would be suitable for use in process cost systems. There, however, the source of information about labor transfers would be the attendance cards.

Usually in job-order cost systems and in standard cost systems the Goods in Process account is not departmentized. The direct-labor cost is applied to Goods in Process as a total for the entire plant. As a short cut under these circumstances it is frequently the practice to disregard interdepartment transfers of direct labor in making the labor distribution. Only the indirect-labor transfers would be recorded in that case. Although the correct amount of direct-labor cost is applied to production under this short-cut procedure, a slight error is introduced in the application of overhead costs to production in case the overhead is applied at departmental rates based on direct labor. Also the departmental overhead budgets are somewhat distorted in case the budget allowances are based on direct labor. These errors may not be of sufficient consequence, however, to justify the work of making a complete accounting for interdepartment transfers.

Overtime Premium—Classification

Should overtime premium be considered a cost of production or should it be treated as a variance chargeable to Profit and Loss? If it is classed as a cost of production, should it be applied as a direct cost or as an indirect cost? Should overtime costs be included in the inventory valuation at the end of the fiscal period?

Under peacetime conditions overtime premium is usually not a large factor, and it is generally classified in the way that is the most convenient. In process cost systems it would generally be charged to production as a part of the payroll. In standard cost systems no allowance would usually be made for it in the standard costs; overtime premium costs incurred would be charged either to Labor Variance or to Factory Overhead. In the latter case the charge for overtime premium would tend to create a debit balance in the Burden Variance account. In job-order cost systems the overtime premium would be included either in the direct-labor cost or in the factory overhead. In the latter case, if overhead cost is applied to production at predetermined rates, the net result is about the same as in a standard cost system.

During the Second World War, overtime excess pay was a large factor, and cost accountants have given it much thought. On May 1, 1942, the Research and Technical Service Department of the National Association of Cost Accountants published a Tentative Statement on Accounting for Excess Labor Costs[1] in which it is recommended that

1. In the case of stock items abnormal overtime costs and other abnormal labor costs should be absorbed in current profit and loss.

. . . If these costs are included in inventory values during the war period instead of being absorbed against current income, the war period will reveal larger profits due to the excess labor costs carried forward in inventories, while the period following the war will be charged with write-downs to eliminate these costs which cannot be recovered. Any statement of what will happen to prices after the war would be pure speculation, but the ending of hostilities will undoubtedly mean the elimination of excessive overtime, most night shifts, and the need for training programs. It is unlikely that selling prices of products will long remain sufficiently high to provide for the reimbursement of these excess costs incurred in a prior period.[2]

2. In the case of production on government contracts, where the contractor is to be reimbursed for it, the overtime premium should be treated as a production cost. There is no objection to including this factor in the inventory value in this case.

3. Where a plant is working both on government work and on non-government work, excess labor cost should be prorated to production (1) by including it in the overhead, (2) by making allowance for it in the labor standards, or (3) as a separate factor.

It is difficult to make a case for direct application. How can it be said that the job which happens to be worked on during overtime at the end of the week or during a night shift is responsible for the added labor cost resulting? Today overtime and night shifts are necessary because the productive facilities and manpower available, working the 40 hours before overtime applies or working only one shift, cannot produce the goods demanded by both government and commercial customers. These costs do not arise because of any one contract or class of contracts, but are necessary because of the ratio between present demand for goods and the capacity available. If they are to be applied to jobs and contracts it would appear that all production should be charged for its proportionate share. This can be handled through inclusion in overhead, inclusion in labor standards or by separate application.[3]

In the classification of accounts in Chapter 8 the overtime premium is classified as factory overhead (see Table 6.8, account .07). If it were to

[1] *N.A.C.A. Bulletin*, Vol. 23, No. 17, Sec. III, pp. 1205-1213.
[2] *Ibid.*, p. 1210.
[3] *Ibid.*, p. 1212.

be applied to production as a direct cost, there would be an account for it in the 820 series in Table 6.7.

Overtime-premium Distribution

The computation of overtime hours may be made on the basis of the attendance-card record of time worked. The computation of overtime premium may be made on the wage cumulation record or in some cases on the payroll itself. In any event it usually is shown in a separate column on the payroll. It is not necessary for payroll purposes to record the overtime premium on time tickets, and as a rule it is not necessary to do so for distribution purposes. If the premium is to be charged to overhead or to a variance account, the distribution can usually be made from the payroll.

If the overtime premium is treated as a direct cost, however, in job-order cost systems it must be recorded on time tickets in order to obtain the distribution to cost sheets. It is somewhat difficult to do this in case the overtime is computed weekly while the time tickets are processed daily. The usual way of dealing with this difficulty is to have the time-keeper prepare an extra time ticket for overtime work. A distinctive colored form may be provided for this purpose. The regular straight-time earnings for the overtime hours are computed on the regular time ticket and then cumulated and distributed daily if desired. The over-time-premium time tickets are held until the end of the week when the premium is calculated. The premium earnings would then be cumulated and distributed.

Even where the extra pay for overtime is charged to overhead, it is the practice in some cases to have an extra time ticket prepared for overtime work. This may be done in order to have a uniform routine in the office or in order to make the proper departmental distribution of overtime premium in case interdepartmental transfers are numerous. Once the overtime premium is recorded on time tickets, the subsequent steps of earnings cumulation and labor cost distribution would follow the routine established for the regular time tickets.

If the overtime premium is distributed from the payroll (or from wage cumulation records), the method of incorporating it in the monthly labor distribution should be in keeping with the method adopted for the summarization of the labor distribution. Where multicolumn analysis sheets are used for the latter purpose, a column for overtime premium may be provided on the departmental summary form, as illustrated in Fig. 19.1. Where the summary-strip method of distribution is used, a summary strip may be made for the overtime premium of each department;

and where the punched-card method is used, a card may be punched for the overtime premium of each department.

Distribution of Vacation Pay

When vacation pay is distributed from the payroll (or from wage cumulation records), the method of incorporating it in the labor distribution should be in keeping with the method adopted for the summarization of the labor distribution. The remarks in regard to overtime premium in the previous paragraph apply also with respect to vacation pay. If the cost of vacation pay is spread over the year by the cumulation of a liability reserve, the amounts paid to employees as vacation pay are charged in the labor distribution to the liability account. The subject of vacation pay is discussed further in Chapter 21.

Setup

For many factory operations the tools and accessory equipment must be set up preparatory to processing the material. In job-order cost systems as a rule the time spent for setup or make-ready is treated as direct labor. Unlike most of the direct costs, however, setup does not vary with the number of pieces produced. It is somewhat in the nature of a fixed cost. The amount of setup cost would be the same, for example, whether 10 pieces or 100 pieces were processed on an order. As a result the setup cost per unit fluctuates widely if there are wide variations in the quantities of different runs of the same part.

In standard cost systems it is frequently the practice to adopt standard lot sizes and to include an allowance for setup in the standard direct-labor cost per unit by averaging the setup labor for each operation over the quantity in the standard lot. Then in case the quantity on a particular order differs from the standard lot size, a labor variance should be reported in the labor distribution. As a short cut in some standard cost systems the setup is simply included in the overhead, thus saving the work of computing standard setup costs and variances for the individual operations. In this case setup is reported as indirect labor in the labor distribution.

Accrued Wages

There are two methods of keeping the account for accrued wages: (1) the perpetual-adjustment method and (2) the periodic-adjustment method.

Under the perpetual-adjustment method Accrued Wages is credited with wage costs incurred (or accrued) during the accounting period. It is debited with wages paid. At the end of the accounting period the balance of the account is the amount of the liability for unpaid wages.

Under the periodic-adjustment method Accrued Wages is credited at the end of the accounting period with the amount of wages unpaid at that date, and cost accounts are debited. At the beginning of the ensuing accounting period a reversal entry is made to close the Accrued Wages account. During the period the payrolls are debited to cost accounts.

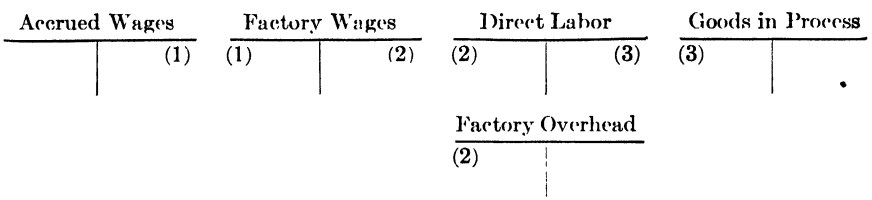
The perpetual-adjustment method is used in most cost systems because it is the better method for monthly adjustment, especially where the cost must be distributed departmentally. It is the method illustrated in the journal entries in this book.

Journal Entries for Labor Distribution

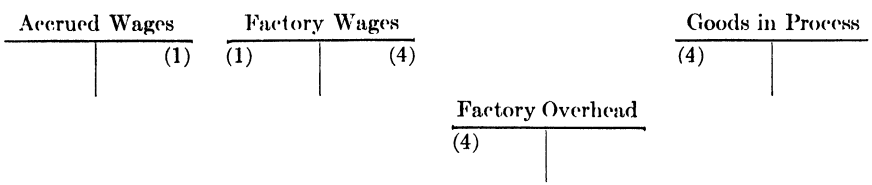
Accounting students are likely to find it difficult to understand the journal entries for wages, owing in part to lack of familiarity with the perpetual-adjustment method and in part to the fact that there are so many different methods of journalizing wage transactions. Upon analysis, however, the entries in a particular case will generally be found to fall into two main groups. In one group are the entries pertaining to the labor cost distribution; in the other are those pertaining to wage payments.

Three of the more common methods of journalizing the labor distribution in job-order cost systems are diagrammed below.

Case 1*a*. Separate entries for cost incurred (entry 1), cost distributed (entry 2), and direct-labor cost applied (entry 3).



Case 1*b*. Entries for cost incurred (entry 1) and cost distributed and applied (entry 4). The clearing account Direct Labor is omitted.



Case 1*c*. A single journal entry (entry 5) to cover the three steps in the flow of costs. The clearing accounts Factory Wages and Direct Labor are omitted.

Accrued Wages	
	(5)

Goods in Process	
(5)	

Factory Overhead	
(5)	

Journal Entries for Payroll

The payroll is the principal source of data for entries relating to wage payments. Four methods of journalizing payrolls are outlined below. It is assumed in each case that payments to employees are made from an imprest payroll fund.

Case 2*a*. Amount of wage payments recorded in Payroll Fund account. Wage deductions and net pay journalized from payroll (entry 6). Reimbursement of payroll fund recorded from check register (entry 7).

Cash in Bank—Commercial	
	(7)

Cash in Bank—Payroll Fund	
(7)	(6)

Accrued Wages	
(6)	

Employee Deposits	
	(6)

Case 2*b*. Same as Case 2*a* except that reimbursement of the payroll fund is recorded first in the voucher register (entry 8). Entry 9 is the check register entry in this case.

Cash in Bank—Commercial	
	(9)

Cash in Bank—Payroll Fund	
(8)	(6)

Accrued Wages	
(6)	

Employee Deposits	
	(6)

Vouchers Payable	
(9)	(8)

Case 2*c*. Amount of wage payments *not* recorded in Payroll Fund account. Wage deductions journalized from payroll (entry 10). Net pay debited to Accrued Wages in voucher register (entry 11). Check register entry same as in Case 2*b* (entry 9 in both cases).

Cash in Bank—Commercial	
	(9)

Accrued Wages	
(10)	
(11)	

Cash in Bank—Payroll Fund	

The amount of the imprest payroll fund would appear in this account as a debit balance, but there would be no other entries.

Employee Deposits	
	(10)

Vouchers Payable	
(9)	(11)

Case 2*d*. Same as Case 2*c* except that voucher register is not used. Net pay is charged to Accrued Wages from check register (entry 12).

Cash in Bank—Commercial	
	(12)

Accrued Wages	
(10)	
(12)	

Cash in Bank—Payroll Fund	
Same as Case 2*c*	

Employee Deposits	
	(10)

Journal Entries in Combination

Any of the three illustrated methods of journalizing labor cost (cases 1*a*, 1*b*, and 1*c*) may be combined with any of the four methods of journalizing wage payments (cases 2*a* to 2*d*). Thus, the 7 cases represent in combination 12 representative procedures of journalizing wage transactions in job-order cost systems.

In Table 8.2, for example, the labor distribution entry follows the pattern of Case 1*c*, and the wage payment entries are like those in Case 2*a* (see Table 8.2, entries 12-2, 12-23, and 12-25).

As a second example, the labor distribution entries of Case 1*c* are combined with the payroll entries of Case 2*d* in the following series of pro forma journal entries:

(1)

Goods in Process	xxx	
Factory Overhead	xxx	
Accrued Wages		xxx

Labor cost distribution, wages earned during the month.

(2)

Accrued Wages	xxx	
Employee Deposits		xxx

Payroll deductions for employee taxes on payrolls paid during the month.

(3)

Accrued Wages xxx
Cash in Bank—Commercial xxx
Net pay plus amount of advances deducted on payrolls paid during the month.

Journal Entries in Standard Cost and Process Cost Systems

The journal entries for wage transactions in standard cost systems are similar to those in job-order cost systems except that direct-labor variances are generally recorded in the labor-distribution entry (see Table 10.2, entry 7-3). In both systems the direct labor is applied to Goods in Process either in the entry for the labor distribution or in an entry for direct-labor-cost application. In process cost systems the direct labor is merged with the other conversion costs and applied to production as a part of the conversion cost (see Table 11.2, entry 6-8).

Subsidiary Accounts

Although the labor distribution summaries are not subsidiary accounts, they do furnish a detailed analysis of the monthly credits to Factory Wages account or to Accrued Wages account. The labor distribution summary as a rule is the final bookkeeping record of the cost of direct labor by departments. In the case of indirect labor, however, the cost distribution must be carried forward into the subsidiary factory overhead accounts. Methods of doing this are discussed in Chapter 22.

Salary Distribution

The distribution of salary cost is usually made from the salary payroll. The names are arranged departmentally on the payroll, and as a rule the entire earnings of each salaried employee are charged to his home department. Occasionally the salary of an employee who divides his time between two or more departments is apportioned. In this case one of the departments would be treated as his home department for payroll purposes, and the portions of his salary chargeable to other departments would be recorded as a transfer in the salary distribution. The salary distribution procedure ordinarily is similar to the labor distribution procedure in a process cost system.

In some instances a part of the salary cost is treated as direct cost. In construction work and in jobbing industries, for example, the compensation of engineers and draftsmen may be allocated at times directly to orders. The salaried worker or his supervisor in such cases generally prepares time tickets for salary distribution purposes.

CHAPTER 20

FACTORY OVERHEAD—CONTROL

That portion of conversion cost which is not allocated directly to products is called indirect manufacturing cost, factory overhead, or burden.[1] It consists of many different kinds of cost, such as, shop supervision, utility services, repairs, taxes, insurance, and depreciation. Minor items of material in some cases are charged to Factory Overhead where it is considered impractical to allocate their cost directly to jobs or products. In the aggregate the factory overhead frequently amounts to more than the direct-labor cost.

The stages in accounting for factory overhead are (1) classification, (2) control, (3) distribution, and (4) application. Overhead classification is discussed in Chapter 6, control of overhead costs in the present chapter, overhead distribution in Chapters 21 and 22, and burden application in Chapters 23 and 24. In process cost systems no distinction is generally made between direct and indirect conversion cost, but the accounting treatment of conversion costs is similar to the treatment of overhead in other types of cost systems except at the cost-application stage.

The costs of material and direct labor can generally be regarded as entirely variable, increasing and decreasing in direct proportion to increases and decreases in the volume of production. Factory overhead, on the other hand, consists of fixed costs as well as variable costs. In modern industry the fixed overhead as a rule is a large factor of cost. It is especially significant in connection with many of the problems of top management, such as, pricing the product, planning sales promotion, expansion and contraction of plant facilities. To measure and interpret the significance of fixed overhead is a central problem throughout the process of accounting for overhead.

The Variable Budget

The variable or flexible budget is the principal tool of management for the control of factory overhead. The essential features of variable budgets are

[1] *Factory overhead* is the term generally used in this text to refer to indirect manufacturing cost at the cost control and cost distribution stages. The term *burden* is generally used at the cost application stage.

1. Executive responsibility is established for each overhead classification. Department foremen are made responsible for the costs that they can control. As an incentive a bonus may be offered for success in controlling costs, and in any event weight would be given to this factor when promotions and salary increases are under consideration.

2. Factory-overhead costs are analyzed into fixed and variable elements, and budget allowances at various volumes are predetermined. Schedules of the budget allowances called master budgets are distributed to department heads.

3. Production schedules are issued in advance. On the basis of the production schedule each foreman can forecast what the production in his department will be for the ensuing period. Then by means of the master budget he can predict with reasonable accuracy what the department overhead budget for the period will be.

4. Budget reports comparing actual and budgeted overhead are issued periodically, the budget allowances being figured from the master budgets according to the volume actually attained.

Under older types of budget procedure the periodic budgets represent a standard for a predetermined volume of work. No means is provided to alter the budget in accordance with variations in production volume. Unless the production rate is unusually stable, a budget of this type is not a satisfactory measure for control purposes; for when the volume exceeds the predetermined volume, the actual overhead can be expected to exceed the budget; and vice versa, when the volume turns out to be less than the predetermined volume, the actual overhead should be less than the budget. In the latter case a foreman is not necessarily entitled to credit if the actual overhead of his department is less than the budget, for the budget is not a measure of what the cost should have been under the circumstances.

Under variable budget procedure, on the other hand, the periodic budget represents a fair standard of departmental overhead cost for the volume of production actually achieved. A comparison of the actual overhead with the budget is therefore a fair measure of the foreman's performance in the control of overhead costs.

Measures of Volume

Where the output is all of one kind, its volume can be measured in terms of physical units, such as pounds, gallons, or pieces. Usually, however, this is not the case, and some other basis of measurement must be adopted. For the processing departments it is generally satisfactory to use direct labor, in terms either of direct hours or of direct labor cost, as the measure of volume and the basis of controlling overhead, for it is a

factor that is common to all production. It should be noted, however, that to serve as a satisfactory basis for controlling overhead the direct labor itself must be under adequate control. A foreman should not be able to increase his overhead budget merely by adding direct labor operations or by encouraging an overstatement of the direct labor in time reports. Vice versa, a foreman should not be penalized in his overhead budget when he devises methods of reducing the direct labor required to perform the work of the department. Because it is not affected by variations in performance, the standard direct hours of work done is superior to actual direct hours (or actual direct labor cost) as the measure of volume.

In establishing the budget for a service department, since there is no direct labor in the department, it is necessary to adopt some other measure of volume. Frequently it is satisfactory to use the total direct labor of the entire plant. In some cases a more accurate measure may be found. The output of a power-generating department, for example, may be measured by the kilowatt-hours of energy produced.

Volume is sometimes stated in terms of percentage of capacity. If the capacity of a department is 2,500 direct hours a week, for example, and the volume in a given week is 1,500 direct hours, then the production volume is said to be 60 per cent of capacity.

Formula for Periodic Plant Overhead

For purposes of forecasting and budgeting, the overhead of an entire plant can be assumed to consist of a fixed portion, which is uniform in amount each period, and a variable portion, the amount of which varies directly with the volume of production. A formula for periodic plant overhead may therefore be stated as a linear or straight-line equation of the form

$$T = F + vn$$

where T = total plant overhead for a stated period
F = periodic fixed overhead
v = variable overhead cost per unit
n = number of units to be produced.

If the values of the constants F and v are known, the periodic plant overhead at a given volume can be predicted. Thus, if F = \$40,000 per month and v = \$0.45 per unit, the equation for the monthly plant overhead would be

$$T = 40{,}000 + 0.45n$$

This equation would represent the average relationship between the independent variable n and the dependent variable T for a given set of circumstances.

When plotted on rectangular coordinate paper, the curve of the equation is a straight line. T, the dependent variable, would be plotted on the vertical or y axis; and n, the independent variable, would be plotted on the horizontal or x axis. The point at which the line crosses the vertical axis, the y intercept, represents the amount of periodic fixed cost F. The variable cost per unit v is the slope of the line, that is, the amount of the increase in the dependent variable T for each unit of increase in the independent variable n. Figure 20.1 is a graph of the foregoing equation.

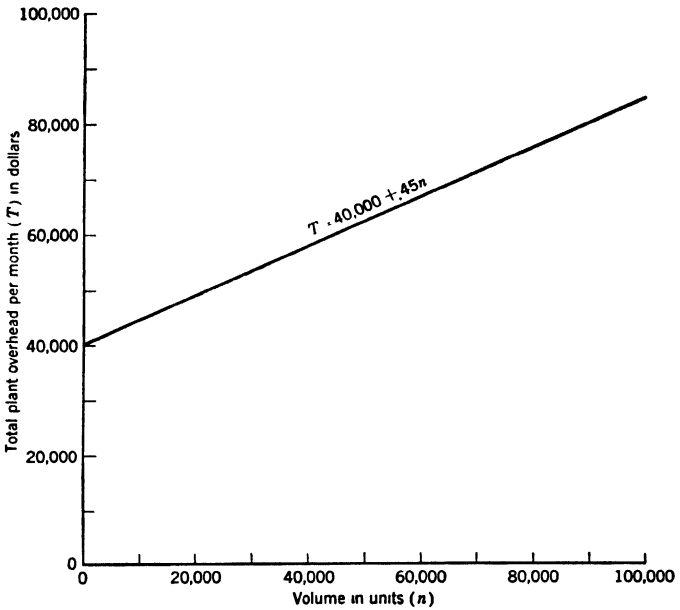


FIG. 20.1. Graph of the equation $T = 40{,}000 + 0.45n$.

It should be noted that the values of the constants F and v are valid only for a given set of circumstances. The value of F, the fixed cost factor, would apply only for the range of volume that the plant is equipped to produce economically. If the capacity of the plant were to be altered, the periodic fixed cost F would change. Likewise, the value of v, the variable cost factor, would be changed if there were a substantial change in manufacturing methods. The introduction of budgetary control may, for example, reduce the variable cost per unit v. Changing circumstances may therefore require changes in the values of F and v.

It should be noted also that the equation states merely the *average* relationship of plant overhead to volume. In dealing with economic problems it is frequently necessary to make use of averages, but the cost accountant should appreciate their limitations. A speaker at a meeting

of one of the chapters of the National Association of Cost Accountants once illustrated this point by the story of a man who wanted to cross a river. He could not swim and he had no boat, but when he was informed that the average depth of the river was only 4 feet he tried to wade across. He did not succeed. The river depths deviated so much from the average that the water was over his head before he reached midstream. So too do the actual monthly amounts of plant overhead deviate from the line of average relationship. On the basis of the formula of average relationship $T = F + vn$, one can predict the periodic plant overhead for a given volume, but the prediction cannot be expected to be 100 per cent accurate. It is an estimate of the most probable value of T for a given value of n. In plants where conditions are reasonably well controlled, such estimates are satisfactory for purposes of forecasting and budgeting. Good judgment must be exercised in using them, however, and they should not be relied upon where it is found that the actual overhead deviates too widely from the line of average relationship.[1]

Methods of Evaluating Fixed and Variable Factors of Periodic Plant Overhead

The basis for the evaluation of periodic fixed cost F and the variable cost per unit v may be (1) past experience, (2) future estimates, or (3) a combination of the two. In the case of a newly formed enterprise the second basis would be the only one available. In the case of an established enterprise either the first or the third basis might be used, depending upon the purpose for which the figures are wanted. If a formula is to be developed for forecasting purposes on the assumption that there will be no material change in circumstances, values of F and v based on past experience would be suitable. For budget purposes, where improvement is expected, values would generally be computed on the basis of past experience and then modified according to estimates of the improvement that is considered to be attainable.

To compute values of F and v for the plant as a whole on the basis of past experience, three methods are available. They are explained and illustrated below. In each case it should be noted that the values obtained are valid only for the range of volume covered by the data on

[1] There are statistical techniques for appraising the accuracy of such estimates. The appraisal would generally be stated in terms of probability somewhat as follows: The chances are even that the actual result will not deviate from the estimate by more than (PE). Or, the chances are slightly less than 1 in 3 that the actual result will deviate from the estimate by more than (S). Methods of determining the values of S, the standard error of estimate, and PE, the probable error, are described in textbooks on statistical methods.

which the calculations are based. In graphing the equation for periodic plant overhead it is customary to extend the curve of the equation to the vertical axis, where the production volume is zero, so as to indicate on the graph the amount of the fixed cost factor. Nevertheless, it should not be assumed that the equation is a reliable means of prediction at zero volume or at any volume beyond the range covered by the data used in developing the values of the constants F and v.

First Method—Analysis by Natural Classification

Under the first method, each natural classification is treated as if it were either entirely a fixed cost or entirely variable. From the accounting rec-

TABLE 20.1

EVALUATION OF FIXED AND VARIABLE FACTORS OF PLANT OVERHEAD THROUGH ANALYSIS BY NATURAL CLASSIFICATION

Natural classification	Annual cost	Treated as fixed	Treated as variable
Shop supervision	$144,000	$144,000	
Janitors and watchmen	60,000	60,000	
Other indirect labor	192,000	.....	$192,000
Payroll taxes and insurance	21,000	.....	21,000
Shop supplies	50,400	.....	50,400
Purchased electricity	18,000	.....	18,000
Maintenance of buildings	36,000	36,000	
Maintenance of equipment	57,600	.....	57,600
Defective work	15,000	.....	15,000
Research	60,000	60,000	
Property taxes	72,000	72,000	
Fire and casualty insurance	12,000	12,000	
Depreciation	96,000	96,000	
Other factory overhead	24,000	.....	24,000
Annual total	$858,000	$480,000	$378,000

Annual production volume: 840,000 units.
Variable cost per unit, v: $378,000 ÷ 840,000 units = $0.45.
Equation for annual plant overhead (where n = number of units): T = $480,000 + 0.45n$.
Equation for monthly plant overhead: T = $40,000 + 0.45n$.

ords a tabulation is prepared showing the amount charged to each natural classification during a representative interval not less than a year. The annual totals may be used in this method, or they may be converted to monthly or weekly average amounts if desired.

The natural classification amounts are then classified as either fixed or variable. The total of the amounts classed as fixed is considered to be the periodic fixed cost F. The total of the amounts classed as variable is

considered to be the variable cost for the period. It is divided by the number of units produced to determine the variable cost per unit v.

If annual figures are used throughout the foregoing calculations, the resulting equation is the equation for annual plant overhead. From it a formula for monthly plant overhead can be readily derived by dividing the annual fixed cost by 12 (or by 13 in cases where the year is divided into 13 accounting months) to obtain the value of F on a monthly basis. The variable cost per unit v would be the same for either period.

Table 20.1 illustrates the application of the first method. The equation for monthly plant overhead obtained there is $T = \$40{,}000 + \$0.45n$.

Treating each natural classification as either fixed or variable, as is done in the first method, is not in accord with the facts, for many of the classifications are semivariable, containing both fixed and variable elements. Shop supervision, for example, although treated as a fixed cost in Table 20.1, is generally semivariable. The number of executives at the upper levels of the plant organization is likely to be fairly constant over a considerable range of volume, but relatively minor changes in volume are likely to cause some fluctuations in the number of shop foremen.

The errors resulting from treating each natural classification as either fixed or variable are usually compensating errors. The variable elements in those classifications counted as fixed tend to offset or compensate for the fixed elements in the classifications that are regarded as variable. The net amount of error in the plant totals therefore may be not great. The chances of error are less, however, in the second and third methods.

Second or Graphical Method

The second and third methods are methods commonly employed in statistical work to measure the average relationship between two variables when the relationship is one that can be stated in the form of a linear or straight-line equation. Pairs of values of the two variables, in this case the periodic overhead for the entire plant (T) and the units produced (n), are tabulated and then plotted to form a scatter diagram. Inasmuch as a number of pairs of values are needed, either monthly or weekly data must generally be used rather than annual data. Table 20.2 is a table of monthly data which are used for illustrative purposes. The data are plotted on the scatter diagram illustrated in Fig. 20.2.

The scatter diagram is prepared on rectangular coordinate paper. The horizontal or x axis is scaled for values of the independent variable, n. The vertical or y axis is scaled for values of the dependent variable, T. A point is plotted on the scatter diagram for each pair of values. Thus, the first pair of values in Table 20.2 is $n = 70{,}000$, $T = 74{,}000$. The point

on the diagram representing this pair or combination of values is directly above the value 70,000 on the n scale and directly across from the value 74,000 on the T scale.

A scatter diagram indicates whether a straight line or some other form of line is the best to show the average relationship between the two variables. If the pattern of the points that have been plotted is approximately the pattern of a straight line, it can be assumed that there is a linear relationship. The average relationship of periodic plant overhead

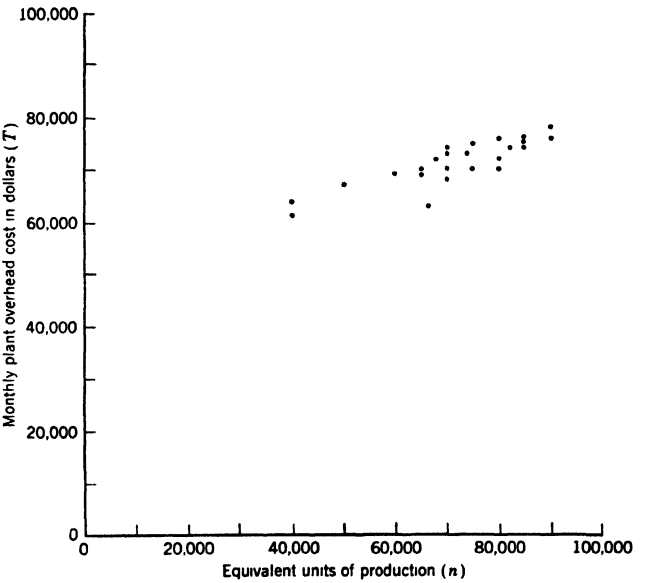


FIG. 20.2. Scatter diagram of cost and volume data of Table 20.2. (The scatter diagram is prepared in order to determine whether or not the relationship between the two variables can be fairly represented by a straight line and by a linear equation of the form $T = F + vn$.)

to production volume is almost always found to be a linear or straight-line relationship.

Assuming this is the case, the next step is to locate the straight line that best conforms to the pattern of the points in the scatter diagram. In the second or graphical method this is done by inspection. By means of either a piece of thread or a transparent ruler a straight line is located that passes through the diagram in such a way that the points above the line and those below appear to balance, taking into consideration their distances from the line as well as the number of points. Considerable practice is required to develop the ability to do this operation satisfactorily, but one who is experienced in it can obtain remarkably accurate results.

The line thus located is then drawn on the scatter diagram. It is the curve of the equation for periodic plant overhead cost at various volumes of production. By reading the cost and the volume at any two points on the curve, the cost increment for a given volume increment can be found. Dividing the cost increment by the volume increment expressed in units

TABLE 20.2

COST AND VOLUME DATA FOR ILLUSTRATIONS OF GRAPHICAL METHOD AND LEAST-SQUARES METHOD OF EVALUATING FIXED AND VARIABLE FACTORS

Month	Equivalent units of production	Plant overhead cost
1945:		
January	70,000	$74,000
February	65,000	70,000
March	68,000	72,000
April	65,000	69,000
May	74,000	73,000
June	75,000	75,000
July	66,000	63,000
August	70,000	68,000
September	80,000	70,000
October	85,000	74,000
November	82,000	74,000
December	75,000	70,000
1946:		
January	70,000	$73,000
February	60,000	69,000
March	40,000	64,000
April	40,000	61,000
May	50,000	67,000
June	70,000	70,000
July	80,000	76,000
August	85,000	75,000
September	90,000	78,000
October	90,000	76,000
November	85,000	76,000
December	80,000	72,000

gives the variable cost per unit v. This is the slope of the cost curve. By extending the curve to the vertical axis, the y intercept can be located. This is the amount of the periodic fixed overhead F. The equation for periodic plant overhead can then be written in the form $T = F + vn$.

Figure 20.3 shows the location of the periodic plant overhead curve on the scatter diagram. The steps in calculating the values of the constants

F and v are also illustrated. The equation obtained for the monthly overhead of the plant as a whole is $T = 50{,}000 + 0.30n$.

Third Method or Method of Least Squares

Where the average relationship between two variables is linear, the line that best fits the data is one computed by the method of least squares.

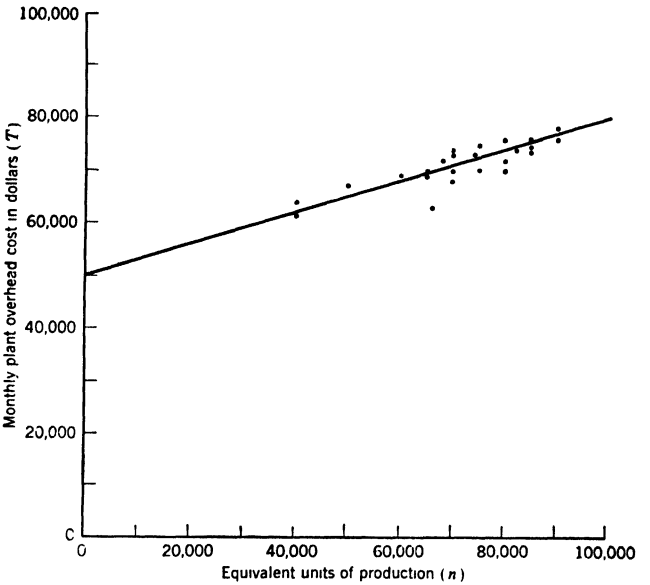


FIG. 20.3. Straight line fitted by inspection on scatter diagram of FIG. 20.2.

The equation of the fitted line in the form $T = F + vn$ is computed as follows:

Reading the graph, the y intercept is found to be \$50,000. That is the fixed cost F, the cost at zero volume.

Reading the graph, the cost is found to be \$80,000 at a volume of 100,000 units. The increase in cost is therefore \$80,000 minus \$50,000, or \$30,000, for a volume increase of 100,000 units; and the cost increase per unit is \$30,000 divided by 100,000, or \$0.30 per unit. That is the slope of the line or the variable cost per unit v.

The equation is therefore $T = \$50{,}000 + 0.30n$.

Pairs of values are tabulated as in the graphical method, and a scatter diagram may be prepared in order to determine whether a straight-line relationship exists. The line measuring the average relationship between the variables, however, is not located by reference to the scatter diagram but by means of two simultaneous linear equations. It is here that the method of least squares differs from the graphical method.

The general symbols and terms used in describing the method of least squares are listed on the left in the accompanying table. Opposite each general term is shown the term that is applicable in the study of the relationship of periodic plant overhead cost to production volume and the symbol that is used for it in this text.

General symbol	General term	Terms applicable in studying relationship of overhead cost to volume
a	y intercept	Periodic fixed cost, F
b	Slope	Variable cost per unit, v
x	Independent variable	Production volume, n
y	Dependent variable	Periodic plant overhead cost, T
n	Number of cases	Number of cases (no symbol)
Σ	The Greek letter sigma meaning summation	Summation, Σ

If the general symbols shown are used, the two simultaneous linear equations that are employed in the method of least squares are

$$\Sigma y = na + b\Sigma x$$
$$\Sigma xy = a\Sigma x + b\Sigma x^2$$

From the tabulated data values are determined for all the terms in the two equations except a and b. The equations are then solved to obtain the values of the constants a and b. The line of best fit may then be stated in the form $y = a + bx$.

The application of the method of least squares is illustrated in Table 20.3. The data used for the illustration are those given in Table 20.2. The symbols used in the illustration are the general symbols listed above. The equation obtained is $y = 51{,}673 + 0.2734x$. Using the symbols that have been adopted in this text the equation would be written $T = 51{,}673 + 0.2734n$.

The method of least squares is more accurate than the graphical method but has not been widely used in practice. The graphical method is certainly quicker and easier, and industrial engineers generally consider that it gives reliable results when carefully applied.

Departmental Budget Allowances

For budget purposes the overhead accounts are grouped according to the responsibility for control. The overhead budget of each department covers only those standing orders which are considered to be controllable by the department head. Budgets of the processing departments would cover indirect labor, shop supplies, and repairs; but not taxes, property insurance, or depreciation as a rule. According to a practice followed in many plants the foreman's own salary is excluded from the budget of his department.

For product costing purposes, where burden is applied at departmental rates, all factory overhead costs must be distributed in the end to the

TABLE 20.3

COMPUTATION OF EQUATION FOR PERIODIC PLANT OVERHEAD COST BY THE METHOD OF LEAST SQUARES

(Number of cases, $n = 24$)

	Production units, thousands x	Periodic plant overhead, thousands y	xy	x^2
	70	74	5,180	4,900
	65	70	4,550	4,225
	68	72	4,896	4,624
	65	69	4,485	4,225
	74	73	5,402	5,476
	75	75	5,625	5,625
	66	63	4,158	4,356
	70	68	4,760	4,900
	80	70	5,600	6,400
	85	74	6,290	7,225
	82	74	6,068	6,724
	75	70	5,250	5,625
	70	73	5,110	4,900
	60	69	4,140	3,600
	40	64	2,560	1,600
	40	61	2,440	1,600
	50	67	3,350	2,500
	70	70	4,900	4,900
	80	76	6,080	6,400
	85	75	6,375	7,225
	90	78	7,020	8,100
	90	76	6,840	8,100
	85	76	6,460	7,225
	80	72	5,760	6,400
Σ	1,715	1,709	123,299	126,855

By formula,

$$\Sigma y = na + b\Sigma x$$
$$\Sigma xy = a\Sigma x + b\Sigma x^2$$

Substituting known values,

$$1{,}709 = 24a + 1{,}715b$$
$$123{,}299 = 1{,}715a + 126{,}855b$$

Solving the two simultaneous linear equations for the two unknowns, a and b,

$$a = 51{,}673$$
$$b = 0.2734$$

Substituting the known values of a and b, in the straight-line equation $y = a + bx$,

$$y = 51{,}673 + 0.2734x$$

processing departments. For purposes of budgetary control this is not necessary. Budgets are prepared for the service departments, and the supervisors of those departments are made responsible for the service-department standing orders that are subject to their control.

The works manager's office is one of the service departments. Costs that are considered to be directly subject to his control are covered by the budget of this department. Property taxes, fire and casualty insurance, and depreciation for the entire plant would be considered his responsibility, and these items would therefore appear on his budget. In case the compensation of the other department heads is excluded from their budgets, it would be covered by the works manager's budget. All the overhead accounts are therefore brought under budgetary control.

Budget allowances or standards are established for each department after a study of past experience and probable future requirements. The foreman of the department should be consulted. His cooperation is essential to the successful operation of budgetary controls, and every reasonable attempt should be made to satisfy him that the budget standards are fair. Foremen generally welcome the opportunity to join in the planning of the budgets and frequently present worth-while suggestions for cost reduction. A budget standard is established for each standing order. The foreman's performance is generally measured, however, according to the total budget for his department. Budget allowances are usually revised once a year and may be revised oftener if changes in conditions require it.

The control of fixed overhead is a responsibility of top management and a very important one. It calls for careful long-term planning of the procurement of plant facilities and the employment of salaried personnel. Overexpansion of plant at a time when construction costs are high is a mistake that has been made frequently in the past. When paid for with borrowed money, such overexpansion may prove to be disastrous for the enterprise. In any event it saddles the enterprise with excessively high fixed costs for a long term of years. When the budget allowances are revised, the fixed overhead costs are reviewed and steps are taken to regulate the fixed overhead as far as possible according to the anticipated volume for the ensuing year.

In setting standards for the variable and semivariable classifications, standing-order costs for previous periods are tabulated. The production volume is also tabulated.

Detailed analyses may then be made of many of the standing-order costs. The indirect labor cost of a department, for example, may be detailed to show who the indirect workers are and their duties and how much time of direct workers is spent on nonproductive work. With the

aid of the foreman, estimates would then be made of the indirect-labor requirements at different levels of volume. Assume, for example, that two clerical workers are required in a certain department when production is at 70 per cent of capacity. An estimate might then be made by those familiar with the work that two clerks would be able to do it for volumes ranging from 60 to 80 per cent of capacity; for volumes below 60 per cent and down to 40 per cent of capacity, one clerk would be sufficient; and above 80 per cent and up to 100 per cent of capacity, three clerks would be required.

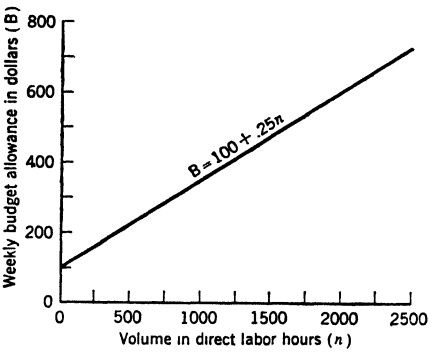


FIG. 20.4. Graph of weekly budget allowances for assembly department indirect labor. The graph is applicable for budget purposes only for volumes ranging from 1,000 direct man-hours to 2,500 direct man-hours per week.

In some cases a scatter diagram is made of standing-order costs in relation to volume, and a straight line is fitted to the plotted data either by inspection or by the method of least squares. For a great many of the standing orders the average relationship of periodic cost to volume is a straight-line relationship or so nearly so that the budget standard can be stated in the form

$$B = F + vn$$

where B = standing-order budget for a given period
F = periodic fixed cost element
v = variable cost per unit
n = production volume in units.

It can also be stated in graphic form as in Fig. 20.4. In practice standards of this type are usually presented in tabular form, as in Table 20.4. For those costs which are treated as wholly variable the fixed cost factor is zero and the formula for the budget allowance becomes

$$B = 0 + vn = vn$$

If a standing-order cost is considered to be wholly fixed, the variable cost factor is zero, and the budget formula becomes

$$B = F + 0n = F$$

In some plants it is found that a straight-line equation is not sufficiently accurate for all the budget allowances. Although it is almost always a reliable formula for predicting periodic plant overhead in the aggregate,

TABLE 20.4
MASTER OVERHEAD BUDGET—FINISHING DEPARTMENT
Effective January 1, 19—
(Covering overhead that is controllable by the department foreman)
Budget Allowances

Classification	Fixed or stand-by cost per week	Variable cost per direct hour
Indirect labor (exclusive of supervision)	$100	$0 250
Shop supplies	. . .	0.084
Purchased electricity	. . . .	0.010
Maintenance of equipment	25	0 022
Defective work	. . .	0.005
Miscellaneous	15	0 015
Taxes, insurance, and depreciation (equipment only)	48	
Total	$188	$0 386

Fixed-cost allowances are for period of 1 week.
Measure of volume: Direct labor hours in this department.
Range of volume covered: from 1,000 direct hours per week, 40% of capacity, to 2,500 direct hours per week, 100% of capacity.
100% capacity defined as the practical capacity working one 40-hr. shift.

there are some classes of overhead that do not follow the straight-line pattern. In some cases the cost curve upon close analysis is found to be an irregular curve consisting of a series of steps, as illustrated in Fig. 20.5. In other cases it is a convex curve, as illustrated in Fig. 20.6.

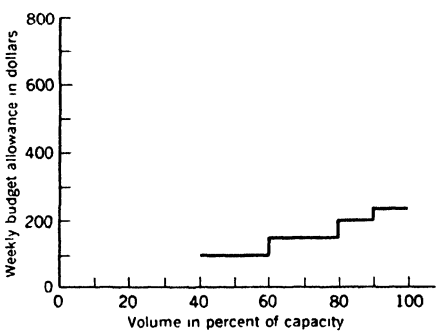


FIG. 20.5. Weekly budget allowances for clerical work in shop superintendent's office.

Whether to use the straight-line formula for all budget allowances or other types of budget formulas as well is a question that must be settled on practical grounds. The latter procedure is more flexible; the former procedure requires less clerical work. The procedure that works better in a given situation should be selected.

Master Budgets

A table of departmental budget allowances is called a master budget. From it the periodic budget can be figured for any volume within the range covered by the table. Each department head is furnished a copy of the master budget for his department, usually at the beginning of the

year. In case any revisions are made in the budget allowances during the year, he is notified at the time they take effect.

Table 20.4 is a suitable form of master budget where a straight-line formula is used for all the budget allowances. One column of the table shows the allowances for periodic fixed cost F; a second column shows the allowances per unit for variable costs v. Computation of the periodic departmental budget is a simple matter that foremen readily comprehend even though they have had no mathematical training beyond grade-school arithmetic. To compute the budget allowance for a given volume

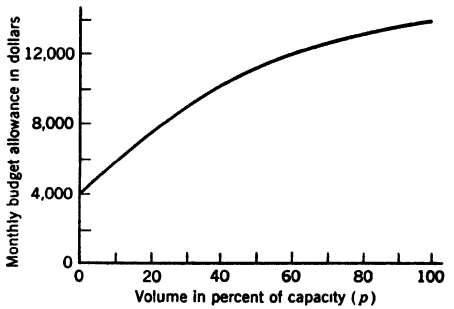


FIG. 20.6. Monthly budget allowances for trucking labor. (*Adapted from Schlatter, C. F., Advanced Cost Accounting, John Wiley & Sons, Inc., New York, 1939, p. 87, Illustration 8.*)

the variable cost per direct hour is multiplied by the volume measured in direct hours. The fixed cost allowance is then added to the product. Thus, at a volume of 2,000 direct-labor hours per week the weekly budget allowance for indirect labor would be calculated as follows:

Variable cost, 2,000 × $0.250	$500
Fixed cost	100
Total	$600

Figure 20.7 is a suitable form of master budget to use where other patterns of cost variation are recognized as well as the straight-line pattern. There are columns showing the budget allowances at 75 per cent of capacity, at 80 per cent, at 85 per cent, and so forth. For a volume other than those shown by the master budget but falling within the range of volume covered by it, the budget allowances are computed by a process of interpolation. Thus, the allowance for semidurable tools and instruments at 92 per cent of capacity would be computed as follows:

Allowance at 95% of capacity	$68
Allowance at 90% of capacity	64
Difference 5%	$ 4
Increase in allowance for each 1% increase in volume (⅕ of $4)	$ 0.80
Allowance at 90% of capacity	$64.00
Add 2 × $0.80	1.60
Allowance at 92% of capacity	$65.60

WK-70 245-5M Revised

NEW YORK WORKS

WORKS INDIRECT EXPENSE BUDGETS PER WEEK FOR VARIOUS OPERATING CAPACITIES

Machine Shop #5 DEPT.

REVISED 1 WEEKS R. Brown FOREMAN

	DIRECT HOURS	1,778	1,896	2,015	2,133	2,252	2,370	2,489	2,607	2,726	2,844	2,963
NO.	PER CENT CAPACITY	75	80	85	90	95	100	105	110	115	120	125
01	Executive Staff											
02	Foremen	58	58	58	109	109	109	109	109	109	109	109
03	Inspectors											
04	Clerical	84	84	84	84	84	84	84	84	84	84	84
	Total Superv & Cler.	142	142	142	193	193	193	193	193	193	193	193
10	Guards & Gatemen											
11	Oilers, Sweep. and Clean.	24	24	24	24	24	30	30	30	30	30	30
12	Internal Transportation	40	56	56	56	56	56	84	84	84	84	84
13	Personnel Adjustments	2	2	3	3	5	5	6	6	7	7	7
14	Idle or Lost Time											
15	Other Indirect Labor	20	20	21	21	23	29	33	35	37	39	43
16	Overtime Bonus	70	76	82	88	94	100	106	112	118	124	130
17	Vacation Allowances											
18	Student Training											
	Total Indirect Labor	156	178	186	192	202	220	259	267	276	284	294
20	Fuel											
21	Sand											
22	Nails, Rods and Wires											
23	Binders and Facings											
24	Grinding & Polishing Wheels	12	12	13	14	14	15	16	17	18	19	20
25	Paints, Lubricants & Waste	11	12	12	12	13	13	13	14	14	14	16
26	Stationery & Office Supplies											
27	Miscellaneous Supplies	5	5	5	6	6	6	6	6	6	7	7
28	Purchased Electricity											
	Total Operating Supplies	28	29	30	32	33	34	35	37	38	40	43
40	Real Estate											
41	Buildings											
42	Machinery	40	43	43	46	46	49	52	54	57	60	64
43	Motors	12	13	14	15	16	17	18	19	20	21	22
44	Semi-durable Tools & Inst.	60	60	64	64	68	68	72	77	82	86	92
45	Internal Transp Equip't	2	2	3	3	3	3	4	4	4	4	5
46	Carting Equipment											
47	Furniture and Office Appl											
48	Flask Equipment											
49	Patterns											
50	Miscellaneous Equipment	1	1	1	1	2	2	2	2	2	2	2
	Total Maintenance	115	119	125	129	135	139	148	156	165	173	185
60	Re-arrangement of Equip't.											
61	Postage											
62	Telephone											
63	Telegraph and Cable											
64	Inventory Adjustment											
65	Employees' Welfare	2	2	2	3	3	3	3	3	3	3	3
66	Liability Insurance											
67	Dues and Subscriptions											
71	Miscellaneous Expense	4	4	4	4	4	6	6	6	6	6	6
	Total Sundries	6	6	6	7	7	9	9	9	9	9	9
	Total Above Charges	447	458	489	553	570	595	644	662	681	699	724
80	Depreciation											
80A	Amortization											
81	Insurance											
82	Taxes											
83	Social Security Taxes											
84	Rentals - U.S Facilities											
	Total Fixed Charges											
	Total all Charges											

FIG. 20.7. Master budget of departmental overhead.

Production Schedules

Advance scheduling of production is an essential feature of variable budget procedure. In many plants preliminary schedules are issued quarterly and final schedules weekly. Each department head is given copies of the production schedules for his department. From the production schedule he can forecast the production volume of his department.

Then from the master budget he can compute the periodic departmental budget at that volume. Although the final determination of the periodic budget is not made until the end of the budget period, it should differ but little from the budget computed in advance by the foreman. The only cause for a difference would be a variation of the actual volume from the scheduled volume, and in a well-managed plant such variations would be slight.

Budget Reports

Budget reports are prepared periodically comparing the actual overhead with the budget. Each department head is furnished a copy of the

TABLE 20.5
OVERHEAD BUDGET REPORT—FINISHING DEPARTMENT
Week Ending February 21, 19—

	Current week		Year to date	
	Budget	Actual	Budget	Actual
Direct hours	.....	2,100	.....	15,400
Per cent of capacity	.....	84%	.....	88%
Controllable overhead:				
Indirect labor	$625.00	$ 648.12	$4,550.00	$4,658.28
Shop supplies	176 40	198 75	1,363.60	1,402.62
Purchased electricity	21.00	20.25	154.00	152.10
Maintenance of equipment	71.20	105 12	513 80	496.90
Defective work	10 50	24 18	77 00	95 41
Miscellaneous	46 50	41.50	336.00	360.57
Taxes, insurance, and depreciation (equipment)	48 00	48 00	336 00	336.00
Total	$998 60	$1,085 92	$7,330 40	$7,501.88
Under budget		—		—
Over budget	.	$ 87 32	. . .	$ 171 48

Issued: Feb. 24, 19—
Copies to
Department Foreman
Works Manager
File

budget report for his department. The works manager is furnished a complete set of the departmental budget reports for the entire plant. Table 20.5 is an illustration of a weekly budget report. In addition to the figures for the current week this report shows the actual overhead and the budget for the year to date. It is usually desirable to report the year-to-date cumulation, for in the case of some standing orders, such as main-

tenance of equipment, the actual cost fluctuates so much from week to week that the cumulative figures are more significant than the figures for a single week.

Preparation of the budget reports is a statistical operation which in many plants is assigned to the factory accounting department. The budget figures shown on the reports are the standard allowances for the volume actually attained. In order to compute them a record of the actual production volume of each department during the budget period is obtained, and then by reference to the file of master budgets the periodic budget allowances for that volume are determined. The actual overhead figures shown on the budget reports are obtained from the overhead distribution. Methods of overhead distribution should be developed so as to provide the data required for the budget reports. Overhead distribution is the subject discussed in the next two chapters.

CHAPTER 21

DISTRIBUTION OF FACTORY OVERHEAD

The periodic debits to Factory Overhead must be allocated in accordance with the account classification. That process is called the distribution of factory overhead.

This process is complex for two reasons. In the first place, the debits come from numerous sources. In a representative case, Table 7.2, there are charges to Factory Overhead from 10 transaction summaries. In the second place, the subsidiary overhead accounts are numerous. Where there are departmental accounts, the overhead classifications run into the hundreds and frequently exceed a thousand. In a plant with 30 departments and 40 natural classifications, for example, there are 1,200 combination overhead accounts or standing orders.

Table 21.1 illustrates a type of monthly financial report that is prepared in some plants to summarize the distribution of overhead as well as the burden applied. A study of the first nineteen lines and the last three lines of the table will help the student to appreciate the nature of the problem of making a departmental overhead distribution. The illustration, however, is only a small-scale representation of the usual situation. There are only six departments, and the natural classification is highly condensed. Where there are too many departments to summarize on one sheet, departments may be grouped, a summary made for each group, and the group totals then summarized in the form illustrated by the table.

Some of the charges to overhead are distributed to departments by a specific or direct allocation, others by proration. The first method is preferable where it can be used.

With some exceptions the charges from purchase invoices, time tickets, supply requisitions, maintenance orders, and rejected-material reports are allocated specifically, the department to be charged being written on each transaction report. The distribution of purchase invoices, time tickets, supply requisitions, and rejected material reports has been covered in previous chapters. The distribution of charges to maintenance orders is discussed in the next section of this chapter.

Costs that cannot be specifically allocated are prorated to departments. Purchased utility services, payroll taxes and insurance, property taxes, fire insurance, and depreciation are usually distributed in this way. A

TABLE 21.1

CAMPBELL TOOL AND DIE COMPANY†

FACTORY OVERHEAD SUMMARY

Month of September, 19—

Production Volume: 35,424 Direct Man-hours

Line	Distribution	Service departments			Processing departments			Total
		Maintenance	Building occupancy	Shop administration	Machine shop	Heat treat	Assembly	
1	Indirect Labor	$ 390	$ 962	$2,250	$ 4,861	$ 360	$1,023	$ 9,846
2	Shop Supplies	639	705	241	3,538	1,381	387	6,891
3	Maintenance	123	1,592	169	4,002	802	322	7,010
4	Purchased Electricity	130	300	24	1,813	556	220	3,043
5	Fuel		106			414		520
6	Payroll Taxes and Insurance	209	47	217	1,270	122	309	2,174
7	Provision for Vacation Pay (hourly force)	104	19	45	605	51	140	964
8	Defective Work			87	257	119	58	521
9	Miscellaneous	110	19	522	16		5	672
10	Property Taxes	33	750	250	570	100	88	1,791
11	Property Insurance	8	83	75	110	15	10	301
12	Depreciation	150	625	300	2,250	500	350	4,175
13	Supervision and Technical Services	715	225	3,962	1,750	567	960	8,179
14	Total Factory Overhead for the Month	$2,611	$5,433	$8,142	$21,042	$4,987	$3,872	$46,087
15	Redistribution of Service Department Costs							
16	Maintenance Department	$2,611	522	52	1,567	261	209	
17	Building Occupancy		$5,955	596	3,573	595	1,191	
18	Shop Administration			$8,790	6 259	668	1,863	
19	Total Allocated to Processing Departments				$32 441	$6,511	$7,135	$46,087
	Application							
20	Burden Applied at Predetermined Rates per Direct Man-hour				32,544	6,360	6,076	44,980
	Variance							
21	Burden variance, Dr. or Cr.*				$ 103*	$ 151	$1,059	$ 1,107
	Activity							
22	Direct Man-hours for the Month				25,228	2,695	7,501	35,424
23	Per Cent of Predetermined Volume				102%	101%	70%	93%
	Burden Rates per Direct Hour							
24	Actual, this month				$1 29	$2 42	$0 95	$1 30
25	Predetermined				1 29	2 36	0 81	1 23
	Percentages Used in Redistribution of Service Department Costs							
26	Maintenance Department, based on maintenance service, current month	100%	20%	2%	60%	10%	8%	
27	Building Occupancy, based on floor-space units		100%	10	60	10	20	
28	Shop Administration, based on direct man-hours, current month			100%	71 2%	7 6%	21 2%	

* Red.

† An imaginary enterprise.

process of proration is used also to redistribute the overhead of service departments to the processing departments.

Maintenance Orders

Charges to maintenance orders for material and labor are reported on stores requisitions, time tickets, and purchase invoices. The charges must be distributed to factory overhead accounts and usually by maintenance-order numbers as well. The number of the department to be charged is written on each maintenance order, and the distribution to departments is a specific allocation. There are, however, at least three methods of making the allocation.

Under one method the charges for material and labor are first distributed to the maintenance-job-order cost sheets, the totals being charged to the control account, Goods in Process. Each month a summary is made of the maintenance orders completed, showing the distribution of the cost of completed orders by department and natural classification. The total cost of the completed orders is credited to Goods in Process (see Table 8.2, entry 12-17). A slight variation of the foregoing procedure is found in some plants where an account Maintenance Orders in Process is provided, the maintenance costs being cleared through that account instead of Goods in Process.

The principal objection to the first method is that the closing of maintenance orders is likely to be delayed. The foreman of a maintenance department is prone to keep an order open until he is sure that the work is satisfactory, for in case he should have to send his men back to a job after he has reported the order as completed, it would be necessary for him to obtain a new order. The cost accumulated on maintenance orders in process is not generally considered a good asset to be carried on the balance sheet. It is frequently the practice therefore to close out all maintenance orders at the end of the accounting year and then to reopen the uncompleted orders at the beginning of the following year. When this practice is followed, the charges to maintenance are overstated in the last month of each accounting year and understated in the first month.

A second method corrects the defects that have been noted in the first method. Material and labor are charged to maintenance-order cost sheets and to Goods in Process account the same as in the first method. At the end of each month, however, all charges to maintenance orders for the month are summarized and distributed to the subsidiary overhead accounts. The total is debited to Factory Overhead Control and credited to Goods in Process, thus clearing the latter account of all maintenance-order costs each month.

A third method gives substantially the same results as the second

method but by a different sequence of operations. Material and labor used are first distributed to the overhead accounts from the summary of stores requisitions, the labor distribution, and the purchase invoice distribution. Subsequently, the charges are distributed by maintenance-order number and posted to the job-order cost sheets. The cost sheets under this procedure are memorandum records not under the control of the double-entry books. A distinct advantage of the procedure, however, is that it speeds up the completion of weekly budget reports and monthly operating statements. The distribution by job-order number may be done after the operating statements are completed; and the summary of costs by job number, which must be prepared under either of the first two methods, can be eliminated.

It is the practice in some plants to charge maintenance orders with a portion of the overhead of the department doing the work. The credit in such cases should be treated as a reduction in the periodic overhead cost of the department (see account .83 in Table 6.8). To credit Factory Overhead Applied would be incorrect, for then the periodic factory overhead cost would be overstated; the overhead charged to maintenance orders would be included twice—both in the overhead of the department charged and in the overhead of the department doing the work.

From the standpoint of obtaining complete costs of maintenance jobs it is desirable to make a charge for overhead. From the standpoint of cost control, however, there is usually no advantage. On the contrary, if the overhead charge is considered to be excessive by the foremen of the various departments in the shop, it is likely to cast discredit upon the budget system and to provoke pointless arguments. From the standpoint of product costing it generally makes but little difference whether overhead is costed to maintenance orders or not. If it is not costed to orders, it must be charged to processing departments in the redistribution of service department overhead. The latter topic is discussed on pages 358 to 367.

Arithmetic of Proration

Many of the periodic overhead costs can be distributed to departments only by proration. There are two ways of performing the arithmetic of proration. One can be referred to as the *percent of total* method, the other as the *rate* method.

To illustrate:

Assume that (1) the monthly cost of taxes on personal property, $72, is to be prorated to departments, (2) the basis of proration (or base factor) is the sound value of inventories and equipment, and (3) the total sound value of these assets

is \$80,000, of which Department A has \$12,000, Department B, \$50,000, and Department C, \$18,000.

Solution:

Proration by *per cent of total* method:

Department	Sound value (base factor)	Per cent of total	Monthly cost prorated
A	\$12,000	15 0*	\$10.80†
B	50,000	62.5	45.00
C	18,000	22.5	16.20
Total.	\$80,000	100.0	\$72.00

* (\$12,000 ÷ 80,000) × 100 = 15.0%.
† 15% of \$72 = \$10.80.

Proration by *rate* method:

Department	Sound value (base factor)	Rate*	Monthly cost prorated
A	\$12,000	\$0.0009	\$10.80
B	50,000	0.0009	45.00
C	18,000	0.0009	16.20
	\$80,000	0.0009	\$72.00

* \$72 ÷ \$80,000 = \$0.0009.

Algebraically, if

b = amount of the base factor for a given department
Σb = total of the base factor for all departments
Σc = total monthly cost to be prorated
c = monthly cost for the given department

then,

$$\frac{c}{\Sigma c} = \frac{b}{\Sigma b}$$

$$c = \frac{b}{\Sigma b} \times \Sigma c, \text{ the formula for the } \textit{per cent of total} \text{ method}$$

$$c = \frac{\Sigma c}{\Sigma b} \times b, \text{ the formula for the } \textit{rate} \text{ method, } \frac{\Sigma c}{\Sigma b} \text{ being the rate}$$

Obviously the results should be the same under both methods.

Planning the Proration Procedure

To make prorations, once the base factors are known, is a clerical operation requiring only ordinary arithmetical ability. To plan the procedure,

however, requires analytical ability of a higher order coupled with good judgment. It should be remembered that proration is at best an approximation, and reasonably accurate results are all that can be expected. Furthermore, the purpose of the proration should be kept in mind. If it is merely a step in the calculation of product costs, and this is frequently the case, the proration need not be extremely complicated except perhaps in plants where the products are dissimilar and where there are large inventories of work in process at different stages of completion. In case all the products of a plant pass through the same operations, any scheme of proration would give practically the same results in so far as the cost of finished product is concerned.

Although hard and fast rules obviously cannot be laid down, the following points would generally be observed in planning the proration of overhead to departments:

1. A list would be prepared of the departments benefited by each service the cost of which is to be prorated.

2. For each proration a base factor would be selected which is a fair measure of the departmental benefits. The base factor itself should be one that can be tallied accurately and economically. Preferably the base factor should be one that is regularly recorded for other purposes. The tally of the base factor is then obtained without extra work, and it is checked by being used repeatedly.

3. In some cases, where the same base factor applies, a number of related cost classifications may be combined for proration purposes.

4. The procedure should be no more elaborate than is justified by the circumstances.

Purchased Utility Services

Costs of services purchased from public utilities, such as gas, water, and electricity, are prorated in some cases on the basis of metered consumption, in some cases on the basis of estimated normal consumption, and in some cases partly on the basis of meter readings and partly on the basis of estimated consumption. Under the first type of procedure the departmental proportions of the costs to be prorated are determined each month from meter readings, a meter being permanently installed where the service enters each department. Metered consumption is the most accurate basis for the proration of purchased utilities, but the investment required in meters is usually prohibitive.

Under the second type of procedure the production engineer and the cost accountant collaborate in estimating the consumption by departments at a normal volume of production. The estimates are revised only when there are substantial changes in relative department loads, usually

not oftener than once a year. The departmental proportions of the estimated consumption may be expressed as percentages of the total, the same schedule of percentages being used month after month to prorate the monthly cost. Table 21.2 is an outline of the steps taken in estimating normal consumption of electricity by departments in an illustrative case.

TABLE 21.2

OUTLINE OF STEPS TAKEN IN ESTIMATING NORMAL MONTHLY CONSUMPTION OF ELECTRICITY BY DEPARTMENTS IN AN ILLUSTRATIVE CASE

1. Total monthly consumption at normal volume, estimated on the basis of past experience ..... 70,000 kwh
2. Estimated consumption for lighting, based on wattage of light bulbs and estimated hours in use. Distributed to Building Occupancy Department ..... 4,000 kwh
3. Estimated consumption for heat-treat furnaces, based on meter readings during test periods. Distributed to Heat Treat Department ... 10,000 kwh
4. Estimated consumption for electric welding, based on number of each type of weld in a normal month and manufacturers' data on electricity required per weld of each type. Distributed to Welding Department 6,000 kwh
5. Estimated consumption for driving motors, the remainder. Distributed to departments on the basis of rated capacity of motors and estimated load and hours in use ..... 50,000 kwh

   Total normal monthly consumption ..... 70,000 kwh

6. Summary of estimated departmental consumption and percentages of total:

Department	Consumption, kwh			Per cent of total
	Motors	Other	Total	
Building Occupancy	500	4,000	4,500	6.43
Toolroom	3,000	.....	3,000	4 29
Receiving and Shipping	800	.....	800	1.14
Screw Machine	12,000	.....	12,000	17.14
Gear Cutting	10,000	.....	10,000	14.29
Punch Press	8,000	.....	8,000	11.43
Welding	500	6,000	6,500	9.29
Heavy Machining	12,200	.....	12,200	17.42
Heat Treat	1,000	10,000	11,000	15.71
Assembly	2,000	.....	2,000	2.86
Total	50,000	20,000	70,000	100 00

Under the third type of procedure meters are provided for the major divisions of the plant. The monthly cost is first prorated to the major divisions on the basis of monthly meter readings. Each divisional cost is then prorated to the departments in the division on the basis of estimated normal consumption by departments.

In the illustration of general ledger procedure in Chapter 8 the total monthly cost of electricity used is charged to Factory Overhead and credited to Accrued Electricity Cost (see Table 8.2, entry 12-6). The distribution by departments would be shown on a schedule similar to the

TABLE 21.3
PURCHASED ELECTRICITY
Proration by Departments
January, 19—

Department	Per cent of total	January
Building Occupancy	6.43	$ 228.98
Toolroom	4.29	152 77
Receiving and Shipping	1 14	40 60
Screw Machine	17.14	610 37
Gear Cutting	14.29	508 88
Punch Press	11.43	407 03
Welding	9 29	330 83
Heavy Machining	17 42	620 34
Heat Treat	15 71	559 45
Assembly	2 86	101.85
Total	100 00	$3,561 10

one illustrated in Table 21.3. From the schedule, postings would be made to the departmental accounts.

Employee Security Costs

Employee security costs include taxes on the employer for old-age and survivors' insurance, unemployment compensation, workmen's compensation insurance, and provision for shop vacations, all of which are computed and distributed on the basis of payroll data. Monthly accruals of old-age benefit taxes and unemployment taxes are generally computed by first determining the monthly departmental costs and then adding. The monthly departmental costs are determined on the basis of department payrolls less the amount of payments for work in employment not covered and payments in excess of $3,000 in any year to an individual employee. The departmental costs are scheduled, and the distribution to departments is made from the schedule. The total applicable to the factory is debited to Factory Overhead as a rule and credited to Accrued Social Security Taxes (see Table 8.2, entry 12-4). The old-age and unemployment taxes on direct labor, however, are in some cases treated as direct costs

instead of overhead. There is a study of alternative methods of accounting for payroll taxes in the *N.A.C.A. Bulletin* of August 15, 1937.[1]

The total periodic costs of workmen's compensation insurance may likewise be computed by first computing the departmental costs and then adding. To obtain the most accurate results each departmental payroll would be analyzed by occupational classification and the appropriate premium rate applied to each classification. In some cases, however, the total is first estimated and then prorated to departments, the estimate being made not in detail according to occupational classification but only according to broad classifications adopted for the purpose. The periodic cost of insurance on office occupations and shop occupations may be estimated, for example, by using average premium rates for each of these two broad classifications. The amount for office occupations would then be prorated to departments on the basis of office payrolls and that for shop occupations on the basis of shop payrolls. There is usually a slight saving in clerical work under the latter procedure, and in some circumstances the results are sufficiently accurate for practical purposes. In the illustration of general ledger procedure in Chapter 8 the total periodic cost of workmen's compensation insurance is recorded, along with other insurance expirations, in journal entry 12-10, Table 8.2.

When shop employees are given vacations with pay, the vacation pay is a cost not of the month in which the vacation occurs, but of the time when the employees are working. The estimated annual cost is usually spread over the months preceding the vacation, being distributed to departments on the basis of payrolls. In the general ledger the pro forma journal entry to record the monthly provision for vacation pay would be

Factory Overhead	xxx	
Selling Expense	xxx	
Administrative Expense	xxx	
Cumulated Provision for Vacation Pay		xxx

Cumulated Provision for Vacation Pay is a current liability account. It is debited from the labor distribution in the month when the vacations are taken.

Salaried workers usually are given vacations with pay. If the vacations are staggered, the vacation pay is frequently considered a cost of the period in which the vacation occurs, for the effect of the salaried employee's work continues to a large extent during his absence. However, if the entire plant and most of the office is closed down for vacation, it is usually desirable to spread the cost of vacations for salaried workers over the

[1] Vol. 18, No. 24, Sec. I, pp. 1365–1391.

year. In this case the accounting treatment would be similar to that for shop vacations.

Fixed Charges

Depreciation, fire insurance, and property taxes are referred to as fixed charges because the monthly amounts as a rule are uniform for fairly long intervals. They make up a large portion of the fixed costs. At the beginning of the accounting year the monthly fixed charges are estimated, and a fixed-charge schedule is prepared to be used month after month without change until the middle or latter part of the year when a revision

TABLE 21.4
CAMPBELL TOOL AND DIE COMPANY
SCHEDULE OF MONTHLY FIXED CHARGES
Effective July 1, 19—

Department	Property taxes	Property insurance	Depreciation
Maintenance	$ 33	$ 8	$ 150
Building Occupancy	750	83	625
Shop Administration	250	75	300
Machine Shop	570	110	2,250
Heat Treat	100	15	500
Assembly	88	10	350
Factory total	$1,791	$301	$4,175
Sales Office	50	8	190
General Office	36	20	75
Grand total	$1,877	$329	$4,440

may be required. The schedule should be revised at least once a year to take cognizance of increases and decreases in property accounts and assessments, changes in tax rates, insurance rates, and depreciation rates, and shifts in departmental proportions. Table 21.4 is an illustration of a fixed-charge schedule. There would be supporting schedules showing in detail the data used in working out the distribution. In the case of depreciation, for example, a schedule would generally be prepared for each class of depreciable property; then a summary schedule might be used to obtain department totals, which would be entered on the fixed-charge schedule.

When depreciation is computed by the unit method, a property ledger must be kept with an account for each fixed-asset unit, that is, for each building, for each machine, and so on. The accounts are arranged in the ledger according to class of depreciable property. Depreciation is computed separately on each unit. The department to which the unit is assigned is indicated in the property ledger. The distribution by depart-

ments is made by totaling the depreciation provisions for the fixed-asset units in each department. Class totals are first obtained and then summarized to obtain the department totals which are entered on the fixed-charge schedule.

Under the group method of computing depreciation, the fixed assets are grouped or classified, each group consisting of similar assets having approximately the same life expectancy. A depreciation rate is established for each group or class representing an average or composite rate for the assets in the group. Depreciation is computed at the group rates on the group totals. The depreciation on each fixed-asset group is prorated to departments on the basis of the cost of the assets assigned to each department. The department locations would be shown in the property ledger, if one were kept, or on fixed-asset schedules. Department totals, which are obtained by summarizing the departmental proportions of the various group totals, are entered on the fixed-charge schedule.

In the illustration of general ledger procedure in Chapter 8, the journal entry for the monthly depreciation is recorded in Table 8.2, entry 12-9.

Fire insurance is distributed or prorated to departments on the basis of the sound value of insured property if that value is known, otherwise on the basis of carrying value. Sound value is the current replacement cost less the estimated depreciation based on replacement cost. To obtain reliable estimates of sound values it is necessary to employ an appraisal company. Some companies make it a practice to have appraisals prepared at regular intervals as an aid in planning insurance programs and in obtaining favorable settlements when fire losses occur. Carrying value is the balance-sheet value or the net book value. The carrying value of fixed assets is usually the cost less cumulated depreciation. Departmental totals may be obtained from the property ledger or from itemized fixed-asset schedules. In the case of inventories, the carrying value is usually the lower of cost or market. The departmental distribution of inventories may be obtained from inventory sheets and perpetual inventory records.

In the illustration of general ledger procedure in Chapter 8 the monthly expiration of fire insurance is included in entry 12-10 of Table 8.2.

The monthly cost of property taxes is prorated to departments either on the basis of the sound value of taxable property or on the basis of carrying value. In the illustration of general ledger procedure in Chapter 8 the monthly accrual of property taxes is recorded in entry 12-5, Table 8.2.

In addition to depreciation, fire insurance, and property taxes, the fixed-charge schedule may include public liability insurance, motor vehicle taxes, and general administrative overhead charged to factory.

Public liability insurance applicable to the factory and the factory's share of general administrative overhead as a rule are charged to the works manager's department. Taxes on motor vehicles can usually be allocated specifically to the departments to which the equipment is assigned.

Redistribution of Service Department Costs

Overhead costs are distributed to the service departments so that the cost of performing each service function may be known and controlled. The service department costs are in turn redistributed to the processing departments served in order to determine the total cost of operating each processing department. The redistribution is made primarily for product-costing purposes. Where departmental overhead rates are used to apply overhead to cost sheets, for example, a redistribution of service department costs must be made as a step in the calculation of the departmental rates, and each month a redistribution is made in order to analyze departmentally the overhead variance. In Table 21.1 the redistribution of service department costs is shown on lines 16 to 18.

In the illustration of general ledger procedure in Chapter 8 no journal entry is required for the redistribution of service department costs because the department accounts are merely subsidiary accounts. The Factory Overhead Control account is not affected. In case the department overhead accounts were kept in the general ledger, the redistribution would be recorded by journal entries somewhat as follows, using the data in Table 21.1 for purpose of illustration.

(1)

Building Occupancy Department	522	
Shop Administration	52	
Machine Shop	1,567	
Heat Treat Department	261	
Assembly Department	209	
Maintenance Department		2,611

Redistribution of Maintenance Department Overhead.

(2)

Shop Administration	596	
Machine Shop	3,573	
Heat Treat Department	595	
Assembly Department	1,191	
Building Occupancy Department		5,955

Redistribution of Overhead of Building Occupancy Department.

(3)

Machine Shop	6,259	
Heat Treat Department	668	
Assembly Department	1,863	
Shop Administration		8,790

Redistribution of Shop Administration.

Separate Redistribution of Fixed and Variable Costs

Service department facilities are planned to take care of the normal requirements of the processing departments at the expected plant volume. If the most accurate results are wanted, the fixed costs and the variable costs of service departments should be redistributed separately, the fixed costs or stand-by costs on the basis of normal requirements and the variable costs on the basis of the services furnished in the current month. This is especially true where there are differences in the percentages of capacity utilized in different departments. Under these circumstances, if service department costs are redistributed solely in accordance with the current usage of services, a processing department that is relatively busy is charged with more than its share and a department that is operating at less than the expected volume is charged with less than its share of the fixed overhead of the service departments. To use the words of Fred V. Gardner, industrial management consultant, "keeping the stand-by and variable expenses separate throughout our distribution will not only give more accurate costs and better current control to departments charged and to lines [of product] but make Management more conscious of its responsibility to carry through a program of long-time control of stand-by, or fixed, costs."[1]

In Table 21.5 the fixed costs and the variable costs of the service departments are redistributed separately. In the case of the maintenance department the predetermined amount of fixed overhead is first redistributed in accordance with the normal proportions of maintenance service furnished to other departments. The remainder of the maintenance department overhead is then redistributed on the basis of service furnished during the current month. The cost of shop administration is disposed of in a similar manner. The overhead of the building occupancy department, however, is treated wholly as a fixed cost. The actual overhead for the month is apportioned on the basis of space occupied.

The data in Table 21.5 are the same as the corresponding data in Table 21.1 except for differences due to the method of redistribution. In the month covered by the tables the plant volume was 93 per cent of the predetermined volume, the assembly department operated at only 70 per cent of its predetermined volume, while the other two processing departments operated at slightly more than predetermined volume.

In Table 21.1 the assembly department because it operated at less than the average rate for the plant is charged less than its normal share of the stand-by cost of the service departments, whereas the other two processing departments are charged more than their normal shares.

[1] Gardner, Fred V., *Variable Budget Control*, p. 189, McGraw-Hill Book Company, Inc., New York, 1940.

TABLE 21.5
CAMPBELL TOOL AND DIE COMPANY
FACTORY OVERHEAD SUMMARY
Fixed Costs and Variable Costs of Service Departments Redistributed Separately
Month of September, 19—; Production Volume: 35,424 Direct Man-hours

Distribution	Service departments			Processing departments			Total
	Maintenance	Building occupancy	Shop administration	Machine shop	Heat treat	Assembly	
Total Factory Overhead for the Month, from Table 21 1, line 14	$2,611	$5,433	$8,142	$21,042	$4,987	$3,872	$46,087
Redistribution of Service Department Costs:							
Maintenance Department							
Fixed (predetermined amount)	1,600*	240	32	1,040	128	160	
Variable (remainder)	1,011*	202	20	607	101	81	
	0						
Building Occupancy (all fixed)		$5,875*	588	3,525	587	1,175	
			$8,782				
Shop Administration							
Fixed (predetermined amount)			5,290*	3,439	370	1,481	
Variable (remainder)			3,492*	2,487	265	740	
			0				
Total Allocated to Processing Departments				$32,140	$6,438	$7,509	$46,087
Application							
Burden Applied at Predetermined Rates, from Table 21 1, line 20				32,544	6,360	6,076	44,980
Variance							
Burden Variance, Dr. or Cr.*				$ 404*	$ 78	$1,433	$ 1,107
Percentages Used in Redistribution of Service Department Costs							
Maintenance Department:							
Fixed Cost, based on normal maintenance service	100%	15%	2%	65%	8%	10%	
Variable Cost, based on maintenance service, current month	100%	20	2	60	10	8	
Building Occupancy:							
All Fixed Cost, based on floor-space units		100%	10	60	10	20	
Shop Administration:							
Fixed Cost, based on predetermined direct hours			100%	65	7	28	
Variable Cost, based on direct hours, current month			100%	71.2%	7.6%	21.2%	

*Red.

The variances reported in the two tables are summarized as follows:

	Machine shop	Heat treat	Assembly	Entire plant
Rate of operation (per cent of predetermined volume)	102%	101%	70%	93%
Burden Variance, Dr. or Cr.*				
Table 21.5	$404*	$ 78	$1,433	$1,107
Table 21.1	103*	151	1,059	1,107
Difference	$301*	$ 73*	$ 374	0

Under the procedure illustrated in Tables 21.1 and 21.5 the entire cost of the service departments for the month is allocated to the processing departments. An alternative procedure would be to allocate both the fixed and variable costs in accordance with predetermined standards. In this case a portion of the service department costs would be undistributed. The undistributed portion would be treated as service-department burden variance.

Maintenance Department and Tool Room

Services performed by the maintenance department for other departments are authorized by written orders. The material and labor used on maintenance orders is charged to the departments for which the work is done. The overhead of the maintenance department therefore includes only the costs of operating the department such as supervision, small tools and supplies, and floor space rental. As has been explained on page 350 it may be applied to maintenance orders and charged as a maintenance cost to the departments receiving the services. A more practical procedure as a rule is to redistribute it as a service department overhead. This procedure is illustrated in Tables 21.1 and 21.5. In the latter illustration the fixed overhead of the maintenance department is redistributed on the basis of the normal requirements for maintenance service, and the variable overhead is redistributed on the basis of service given in the current month.

The foregoing discussion of maintenance department overhead applies also to toolroom overhead. Both departments work on written orders, and the major costs of the work, the material and labor, are allocated specifically to orders. The overhead of each department is then charged to the departments served either as a maintenance cost or as a service-department cost redistributed.

Building Occupancy Department

The provision of suitable space and housing for industrial operations may be referred to as the building occupancy function. Whether the factory buildings are owned or rented by the enterprise, it is good practice to have an account that summarizes the periodic costs of this function. The account, which may be called Building Occupancy Department, is a service-department account. To it are charged the real estate taxes, depreciation and insurance on buildings, building repairs, heating, lighting, air-conditioning, janitor and watchman service. The total is redistributed to the other departments as a rental charge on the basis of space occupied.

Where the functional service-department account is not used, the various costs of building occupancy are distributed separately to the departments that use floor space. In the department accounts they are scattered through the various natural classifications. The total cost of building occupancy is not reported as such in the overhead distribution.

Each procedure requires about the same amount of clerical work, but from the control standpoint the first procedure is better. It brings the periodic cost of building occupancy together in one place for study as a basis for long-term planning and control. Executive responsibility for the over-all costs of this function can then be assigned. Furthermore, it is helpful in gaining the cooperation of the foremen in utilizing floor space economically; for if the entire charge for building space is expressed in terms of a rate per square foot, a foreman can readily estimate the saving that would result from a reduction in the floor-space requirements of his department.

For the purpose of distributing building occupancy costs, floor space may be measured in square feet, cubic feet, or floor-space units. The choice would depend upon circumstances. In a plant where there are different types of floor space, some of which are more desirable than others, a floor-space unit is likely to be adopted. Weights are assigned to the different types of space. In one plant, for example, ground-floor space is given a weight of one, whereas the basement space is given a weight of one-half. The floor-space unit in this case is 1 square foot of ground-floor space, and a square foot of basement space is equivalent to one-half of a floor-space unit.

Power Plant

If a factory has its own power plant generating steam, electricity, and compressed air, three separate service-department accounts may be opened, one for each type of power. Steam would be used for the gener-

ation of electricity, for heating, and in manufacturing processes, such as steam-hammer and pickling processes. The cost of the steam department would be redistributed to the departments using steam on the basis of estimated consumption. Steam used for space heating would be charged to building occupancy department. The cost of the electric power department would be redistributed in much the same way as purchased electricity (see pages 352 and 353). The cost of the compressed air department would be redistributed on the basis of engineer's estimates of the departmental proportions of compressed air used.

If the departmental proportions of power used are the same each month or nearly so, it makes little difference whether the normal power consumption by departments or the current month's consumption is used as the basis for the proration of power plant overhead. But where departmental proportions vary from month to month, it is likely to be desirable to redistribute the fixed costs of the power plant on the basis of normal requirements and the variable costs on the basis of the actual consumption during the current month.

Factory Administration Departments

Costs of factory administrative departments such as the works manager's office, the personnel department, the shop engineering department, the factory accounting department, and the production planning department are usually redistributed to the processing departments on the basis of direct man-hours. For budget purposes separate accounts would be provided for each administrative department. In making the redistribution to the processing departments, however, the administrative costs can usually be combined and prorated as one item. In Table 21.1 the costs of the various shop administrative departments are combined in the column headed "Shop Administration."

Purchasing, Receiving, and Stores Departments

Theoretically the cost of purchasing, receiving, and storing materials is a material cost. The major part of the cost of the departments performing these functions may therefore be redistributed to a material overhead account and then be applied to products as material overhead. As a practical matter, however, the cost of the purchasing, receiving, and stores departments is generally redistributed to the processing departments as a shop administrative cost.

Services of Service Departments to One Another

The service departments not only furnish services to the processing departments, but also serve one another. The maintenance department,

for example, does work for the building occupancy department; at the same time, because it occupies floor space, it receives service from the building occupancy department. To know the total amount of maintenance department overhead to be distributed to other departments one must know how much of the cost of the building occupancy department is to be charged to the maintenance department; this cannot be determined until the amount of the maintenance department overhead to be redistributed to the building occupancy department is known. Five cases are presented to illustrate alternative ways of dealing with this problem. The illustrations are based upon the following assumed data:

DATA FOR ILLUSTRATIVE CASES

	Service departments		Processing departments		Total
	A	B	R	S	
Overhead cost before redistribution of service department costs	$1,000	$2,000	$ 4,000	$ 5,000	$12,000
Proportions of services furnished:					
By Department A	.....	4%	64%	32%	100%
By Department B	10%	.....	40%	50%	100%
Direct labor hours	.....	.....	2,000	8,000	10,000
Floor-space units	2,500	.....	10,000	12,500	25,000

Case 1

Pool the costs of the service departments that serve one another, and distribute the totals. This is the simplest procedure and may be sufficiently accurate where the products pass through about the same series of operations. In the illustration the pooled costs are prorated on the basis of direct labor hours.

	Service departments		Processing departments		Total
	A	B	R	S	
Overhead costs before redistribution of service department costs.	$1,000	$2,000	$4,000	$5,000	$12,000
Total cost of service departments ($3,000) redistributed on basis of direct hours	$1,000	$2,000	600	2,400	
Total overhead of processing departments	.....	.....	$4,600	$7,400	$12,000
Overhead per direct hour	.....	.....	$ 2.30	$0.925	$ 1.20

Case 2

Redistribute the service department costs to processing departments only. Ignore for cost purposes the services furnished by service departments to one another. This is a practical procedure that is frequently used. It is more accurate than the first procedure because it permits the selection of different base factors for the different prorations.

	Service departments		Processing departments		Total
	A	B	R	S	
Overhead costs before redistribution of service department costs.	$1,000	$2,000	$4,000	$5,000	$12,000
Redistribution of service departments					
A ($\frac{64}{96}$, $\frac{32}{96}$)	$1,000	.....	667	333	
B ($\frac{40}{90}$, $\frac{50}{90}$)	.....	$2,000	889	1,111	
Total overhead of processing departments.	.....	.....	$5,556	$6,444	$12,000
Overhead per direct hour . . .	...	.....	$2 778	$0.806	$ 1 20

Case 3

Select a sequence of redistribution, proceeding from the most significant to the least significant. This too is a practical procedure. The cost of the first service department in the sequence would be distributed to all the other departments receiving its service. The cost of the second department in the sequence would be distributed to the remaining departments receiving its service but not to the first department. The cost of the last department in the sequence would be redistributed only to the processing departments. Once the cost of a service department had been redistributed, that department would not be charged through any subsequent distribution of service department costs. The fact that it received services from the remaining departments would be ignored.

In the example it can be seen that the redistribution of the cost of service Department B is more significant than the redistribution of Department A. The cost of Department B aside from service department costs redistributed is $2,000, and 10 per cent of the service of Department B is used by Department A. Ten per cent of $2,000 is $200, whereas 4 per cent (Department B's proportion of the services of Department A) times $1,000 (the cost of Department A before redistribution of service department) is only $40. Department B is therefore redistributed first and Department A second. No charge is made to Department B for the services furnished by Department A.

	Service departments		Processing departments		Total
	B	A	R	S	
Overhead costs before redistribution of service department costs	$2,000	$1,000	$4,000	$5,000	$12,000
Redistribution of service departments					
B (10%, 40%, 50%)	$2,000	200	800	1,000	
A ($\frac{6}{96}$, $\frac{32}{96}$)	.....	$1,200	800	400	
Total overhead of processing departments	.....	.	$5,600	$6,400	$12,000
Overhead per direct hour	. ....	.. .	$2.80	$0 80	$1 20

Case 4

Compute algebraically the true cost of each service department, and then redistribute the true cost. This treatment is the most accurate. It is not impractical provided that only two or three service departments are involved. The calculations become increasingly complex, however, as the number of departments increases.

Let A = true cost of Department A
B = true cost of Department B

then,

$$A = \$1{,}000 + 0.10B$$
$$B = \$2{,}000 + 0.04A$$

Solving,

$$A = \$1{,}204.82$$
$$B = \$2{,}048.19$$

	Service departments		Processing departments		Total*
	A	B	R	S	
Overhead costs before redistribution of service department costs	$1,000.00	$2,000.00	$4,000.00	$5,000.00	$12,000.00
Redistribution of service department costs					
A (1,204.82; 4%, 64%, 32%)	1,204.82*	48.19	771.09	385.54	
B (2,048.19; 10%, 40%, 50%)	204.82	2,048.19*	819.28	1,024.09	
Total overhead of processing departments	.....	. ....	$5,590.37	$6,409.63	$12,000.00
Overhead per direct hour	. . .. ..	..	$2.795	$0.801	$1.20

* Red.

Case 5

Use predetermined rates. Treat as a variance the difference between the actual periodic overhead cost of a service department and the amount redistributed at standard rates. When this procedure is employed, a more complete departmental analysis of the overhead variance can be made than would otherwise be possible.

	Service departments		Processing departments		Total
	A	B	R	S	
Overhead cost before redistribution of service departments.	$1,000	$2,000	$4,000	$5,000	$12,000
Redistribution of service departments					
A (at flat monthly rate)...	1,300*	50	830	420	
B (at 8¢ per square foot).	200	2,000*	800	1,000	
Overhead variance, service departments	$100*	$50			$50*
Total overhead of processing departments			$5,630	$6,420	12,050
Total overhead					$12,000
Overhead per direct hour			$2.815	$0.803	$1.20

* Red.

CHAPTER 22

DISTRIBUTION OF FACTORY OVERHEAD (*Continued*)

Methods of Distribution

The discussion of overhead distribution thus far has dealt principally with the *basis* of distribution, that is, how to determine the amount to charge to each department. The next phase of the discussion deals with the *method* of distribution, that is, how to bring together or assemble the charges from various sources so as to compile periodic totals by department and natural classification.

The subsidiary overhead accounts are usually so numerous that it is impractical to keep them in conventional unit-account form. Instead, they are likely to be represented by spaces on multicolumn sheets or on summary strips or by punched cards. Four representative methods of making the distribution by department and natural classification are described in this chapter. They are referred to as

1. Analysis-sheet method
2. Summary-strip methods
   a. Strips prepared for transaction summaries as well as for department summaries
   b. Strips prepared for department summaries but not for transaction summaries
3. Punched-card method

Analysis-sheet Method

An analysis sheet is a multicolumn form or schedule. The analysis-sheet method is an application of the columnar method of distribution to the latter stages of the overhead distribution. Any of the distribution methods explained in Chapter 13 may be used in the earlier stages of the distribution.

The essential features of this method are

1. Transaction-summary analysis sheets are prepared each month to show the charges to each standing order. A separate sheet is prepared for each transaction summary affecting factory overhead. Figure 15.2, a distribution of charges to factory overhead from supply requisitions, is an illustration of a transaction-summary analysis sheet. The data in this case are obtained from supply requi-

sitions by one of the unit-slip methods. The fixed-charge schedule, Table 21.4, is another illustration. The data in this case are obtained from proration schedules.

2. A natural-classification control sheet is made each month. This is a multicolumn sheet with columns for the various transaction summaries and a total column. The lines are for the natural classifications. The total charges to each natural classification from each transaction summary are posted to the natural-classification control sheet. From the distribution of supply requisitions illustrated in Fig. 15.2, for example, the column totals would be posted. The control sheet is then added to obtain monthly totals by natural classification for comparison later on with the corresponding totals on the overhead distribution summary (Table 21.1).

3. Department-overhead analysis sheets are provided to summarize the overhead of each department by natural classification. The charges to department-overhead analysis sheets are posted from the transaction-summary analysis sheets. Figure 22.1 is a form of department-overhead analysis sheet that is designed to summarize the charges for a single month. There is a column for each posting source and a line for each natural classification. A new set of forms is prepared each month, one form for each department. After a departmental sheet has been completely posted, the postings are added across and the line totals are entered in the total column.

As an alternative it is feasible in some cases to use a form of department-overhead analysis sheet that is designed to provide a cumulative record of standing-order costs. Figure 22.2 is a form of this type. The cumulative feature is in its favor, but the fact that a column is required for each natural classification frequently precludes its use, for 16 columns is about the most that can be used efficiently.

4. From the department-overhead analysis sheets the monthly totals are posted to budget reports and to the overhead distribution summary. Where a form of the type illustrated by Fig. 22.1 is used to summarize the monthly departmental overhead, cumulative totals for quarterly and annual reports are obtained by posting the monthly totals to analysis sheets and adding.

In the analysis-sheet method most of the operations are hand operations. A key-driven calculator is the only mechanical equipment needed. Because the analysis sheets are self-balancing, a partial proof of the posting and adding of each sheet can be obtained. Where daily or weekly budget reports are wanted, however, the analysis-sheet method, because it requires so much hand posting, is not usually satisfactory. One of the three methods discussed below is more suitable.

Summary-strip Method *a*

In the method designated as Summary-strip method *a*, transaction summary strips are prepared in place of transaction-summary analysis sheets, and department summary strips take the place of the department-over-

DEPARTMENTAL OVERHEAD ANALYSIS SHEET Month of_____ 19____ Department_____

Natural Classification	Acc't No.	Dep't Total	TRANSACTION SUMMARY										Acc't No
			Purchase Invoices	Labor Distribution	Salary Distribution	Material Requisitions	Supply Requisitions	Rejected Material	Maintenance Orders	Purchased Utilities	Employee Security Costs	Fixed Charges	Miscell	
Supervision	01													01
Technical and Clerical	02													02
Inspection	03													03
Cleanup	04													04
Trucking	05													05
Idle Time	06													06
Overtime Excess Pay	07													07
Other Indirect Labor	09													09
State Unemployment Tax	11													.11
Federal Unemployment Tax	.12													.12
Federal Old-Age Benefit Tax	.13													.13
Workmen's Compens Insur	14													.14
Provision for Vacation Pay	15													15
Shop Supplies	21													.21
Small Tools	22													.22
Abrasives	23													.23
Office Supplies	25													25
Fuel	27													.27
Purchased Electricity	28													.28
Other Purchased Utilities	29													.29
Maintenance-Buildings	31													.31
-Machinery	32													.32
-Auto Trucks & Tract's	.33													.33
-Other Mt'l Handlg Eq	.34													.34
-Patterns & Forge Dies	.35													.35

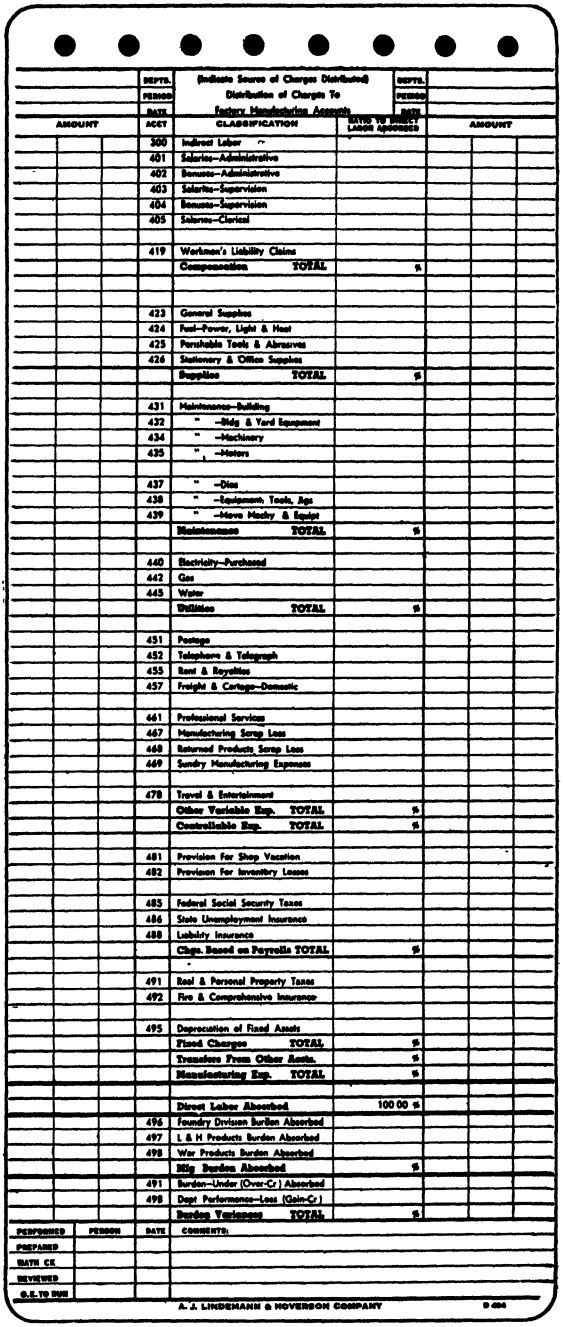
| | | |

DEPARTMENT OVERHEAD ANALYSIS SHEET

Finishing Dep't

1943	Source	Total	Indirect Labor	Shop Supplies	Purchased Electricity	Maintenance	Defective Work	Employee Security Costs	Fixed Charges	Miscellaneous
Jan 31	Fixed charge schedule	208 -							T 39 - I 13 - D 156 -	
	Salary distribution	250 -	(Supervision) 250 -							
	Labor distribution	2,834 -	2,782 10				51 90			
	Workmens compensation	33 -						33 -		
	Supply requisitions	652 26		642 26						10 -
	Rejected mat'l reports	8 20					8 20			
	OAB & unemploymt ins	417 25						417 25		
	Purchased utilities	107 50			85 -					22 50
	Maintenance orders	326 59				312 42				14 17
	Purchase invoice distr	378 68		177 50		75 -				126 18
	Subtotal	5,215 48	3,032 10	819 76	85 -	387 42	60 10	450 25	208 -	172 85
Feb 28	Fixed charge schedule	208 -							T 39 - I 13 - D 156 -	
	Supply requisitions	587 81		577 81						10 -
	Salary distribution	250 -	(Supervision) 250 -							

FIG. 22.2. Department overhead analysis sheet—cumulative record.



DEPTS.	(Indicate Source of Charges Distributed)	DEPTS.
PERIOD	Distribution of Charges To	PERIOD
DATE	Factory Manufacturing Accounts	DATE

AMOUNT	ACCT	CLASSIFICATION	RATIO TO DIRECT LABOR ABSORBED	AMOUNT
	400	Indirect Labor		
	401	Salaries—Administrative		
	402	Bonuses—Administrative		
	403	Salaries—Supervision		
	404	Bonuses—Supervision		
	405	Salaries—Clerical		
	419	Workmen's Liability Claims		
		Compensation TOTAL	%	
	423	General Supplies		
	424	Fuel—Power, Light & Heat		
	425	Perishable Tools & Abrasives		
	426	Stationery & Office Supplies		
		Supplies TOTAL	%	
	431	Maintenance—Building		
	432	" —Bldg & Yard Equipment		
	434	" —Machinery		
	435	" —Motors		
	437	" —Dies		
	438	" —Equipment Tools, Jigs		
	439	" —Move Machy & Equipt		
		Maintenance TOTAL	%	
	440	Electricity—Purchased		
	442	Gas		
	445	Water		
		Utilities TOTAL	%	
	451	Postage		
	452	Telephone & Telegraph		
	455	Rent & Royalties		
	457	Freight & Cartage—Domestic		
	461	Professional Services		
	467	Manufacturing Scrap Loss		
	468	Returned Products Scrap Loss		
	469	Sundry Manufacturing Expenses		
	478	Travel & Entertainment		
		Other Variable Exp. TOTAL	%	
		Controllable Exp. TOTAL	%	
	481	Provision For Shop Vacation		
	482	Provision For Inventory Losses		
	485	Federal Social Security Taxes		
	486	State Unemployment Insurance		
	488	Liability Insurance		
		Chgs. Based on Payrolls TOTAL	%	
	491	Real & Personal Property Taxes		
	492	Fire & Comprehensive Insurance		
	495	Depreciation of Fixed Assets		
		Fixed Charges TOTAL	%	
		Transfers From Other Accts.	%	
		Manufacturing Exp. TOTAL	%	
		Direct Labor Absorbed	100 00 %	
	496	Foundry Division Burden Absorbed		
	497	L & H Products Burden Absorbed		
	498	War Products Burden Absorbed		
		Mfg. Burden Absorbed	%	
	491	Burden—Under (Over-Cr.) Absorbed		
	498	Dept Performance—Loss (Gain-Cr.)		
		Burden Variance TOTAL	%	

PERFORMED	PERSON	DATE	COMMENTS:
PREPARED			
DATA CK			
REVIEWED			
O.K. TO PAY			

A. J. LINDEMANN & HOVERSON COMPANY

FIG. 22.3. Transaction summary strip. (*A. J. Lindemann & Hoverson Company.*)

head analysis sheets. The essential features of a representative application of this method are

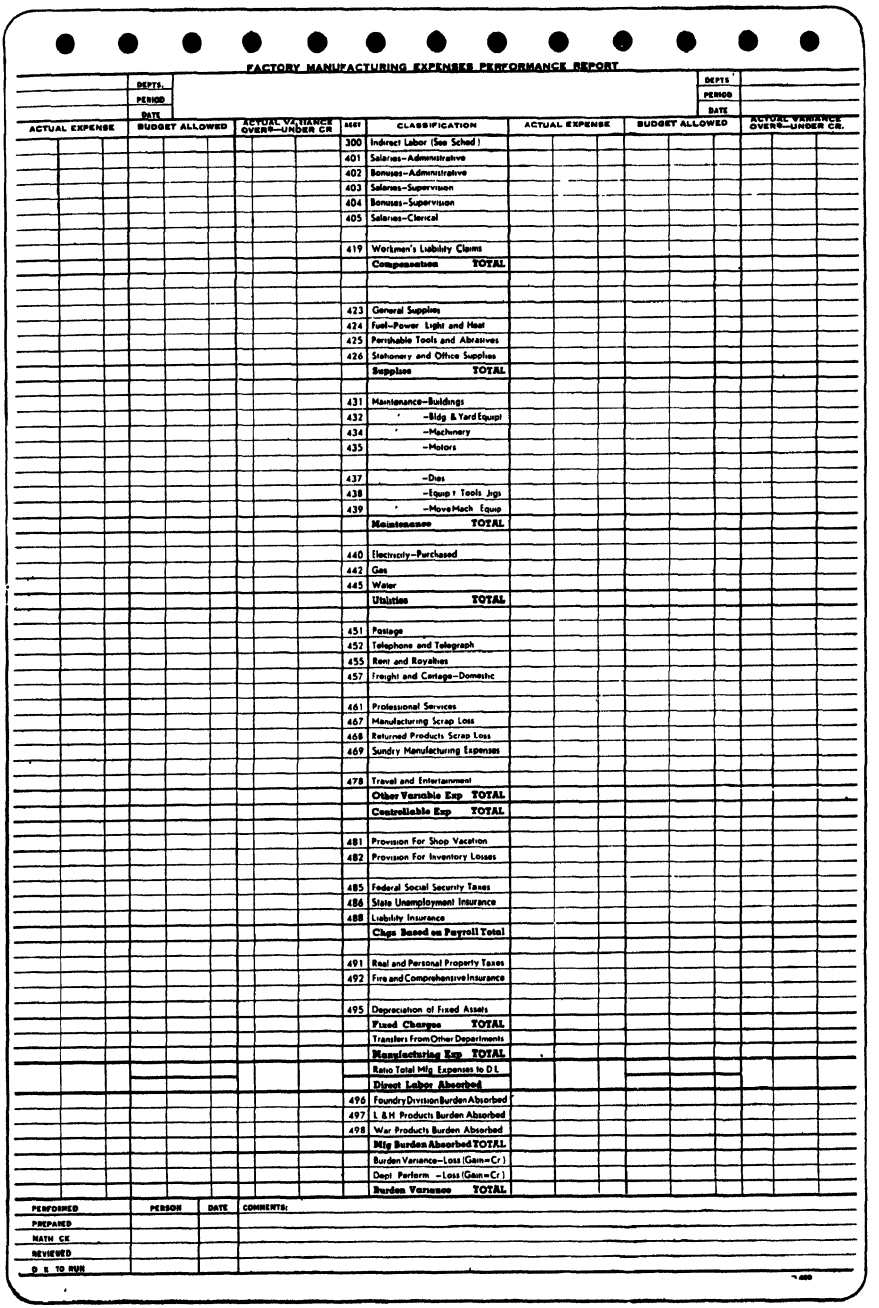
1. A transaction summary strip is prepared periodically for each department to show the charges from each source. In the description that follows it is assumed that budget reports are wanted each week and that the transaction summary strips would therefore be prepared at weekly intervals. A set of strips, one strip for each department, is prepared for the labor distribution, another set for the purchase invoice distribution, another set for fixed charges, and so on. The fixed-charge strips are used over and over; a new set is needed only when the fixed-charge schedule is revised. Figure 22.3 is an illustration of a transaction summary-strip form. The amounts for the current week are entered in the column at the left. The column at the right can be used to show cumulative amounts for the year to date. There is a line for each natural classification. For each transaction type there is a separate form printed in a distinctive color. The arrangement of lines, however, is uniform on all the transaction summary strip forms.

2. In lieu of the natural-classification control sheet which is prepared in the analysis-sheet method, summary strips may be prepared weekly from the original media, a strip for each type of transaction, listing by natural classification the total charges for the week from each source. These summary strips may be used to obtain weekly recaps, and the weekly recaps may be used in turn to obtain monthly recaps showing periodic totals by natural classification for the plant as a whole for comparison with the corresponding totals on the overhead distribution summary.

It may be unnecessary, however, to establish control totals for the natural classifications if the transaction summary strips for the individual departments are carefully checked against the original media at the time they are prepared. About the only chance of error in the subsequent operations is that a line total may be written on the wrong line on a recap strip. If an error of this type were made, and it is not likely to be, it would almost certainly be detected when the periodic overhead for the department is compared with the budget. The adding of summary strips on the pegboard is self-balancing, and the grand total would be checked against a control figure.

3. Each week the transaction summary strips are sorted departmentally. The strips for each department are positioned on a pegboard, a department recap strip being placed in the total position. The lines are then added across, and the totals are entered on the department recap strip. This recap strip has the same function as the department total column on the department-overhead analysis sheet (Fig. 22.1). The arrangement of summary strips on the pegboard is in effect an analysis sheet obtained without posting.

The department recap-strip form may be identical with the transaction summary-strip form except for the heading. In this case the weekly totals would be copied from the recap strip to the departmental budget report. More often the department recap summary strip is designed in the form of a budget report, as illustrated by Fig. 22.4. On this form the columns at the left are



FACTORY MANUFACTURING EXPENSES PERFORMANCE REPORT

DEPTS. | PERIOD | DATE

ACTUAL EXPENSE	BUDGET ALLOWED	ACTUAL VARIANCE OVER—UNDER CR	ACCT	CLASSIFICATION	ACTUAL EXPENSE	BUDGET ALLOWED	ACTUAL VARIANCE OVER—UNDER CR.
			300	Indirect Labor (See Sched.)			
			401	Salaries—Administrative			
			402	Bonuses—Administrative			
			403	Salaries—Supervision			
			404	Bonuses—Supervision			
			405	Salaries—Clerical			
			419	Workmen's Liability Claims			
				Compensation TOTAL			
			423	General Supplies			
			424	Fuel—Power Light and Heat			
			425	Perishable Tools and Abrasives			
			426	Stationery and Office Supplies			
				Supplies TOTAL			
			431	Maintenance—Buildings			
			432	" —Bldg. & Yard Equipt			
			434	" —Machinery			
			435	—Motors			
			437	—Dies			
			438	—Equip't Tools Jigs			
			439	" —Move Mach. Equip			
				Maintenance TOTAL			
			440	Electricity—Purchased			
			442	Gas			
			445	Water			
				Utilities TOTAL			
			451	Postage			
			452	Telephone and Telegraph			
			455	Rent and Royalties			
			457	Freight and Cartage—Domestic			
			461	Professional Services			
			467	Manufacturing Scrap Loss			
			468	Returned Products Scrap Loss			
			469	Sundry Manufacturing Expenses			
			478	Travel and Entertainment			
				Other Variable Exp. TOTAL			
				Controllable Exp. TOTAL			
			481	Provision For Shop Vacation			
			482	Provision For Inventory Losses			
			485	Federal Social Security Taxes			
			486	State Unemployment Insurance			
			488	Liability Insurance			
				Chgs. Based on Payroll Total			
			491	Real and Personal Property Taxes			
			492	Fire and Comprehensive Insurance			
			495	Depreciation of Fixed Assets			
				Fixed Charges TOTAL			
				Transfers From Other Departments			
				Manufacturing Exp. TOTAL			
				Ratio Total Mfg. Expenses to D.L.			
				Direct Labor Absorbed			
			496	Foundry Division Burden Absorbed			
			497	L & H Products Burden Absorbed			
			498	War Products Burden Absorbed			
				Mfg. Burden Absorbed TOTAL			
				Burden Variance—Loss (Gain=Cr.)			
				Dept. Perform. —Loss (Gain=Cr.)			
				Burden Variance TOTAL			

PERFORMED	PERSON	DATE	COMMENTS:
PREPARED			
MATH CK			
REVIEWED			
O K TO RUN			

FIG. 22.4. Department-overhead budget report—summary-strip form. (*A. J. Lindemann & Hoverson Company.*)

for the current period, and those at the right are for cumulative year-to-date amounts. The periodic budget allowances can as a rule be determined and entered on the form as soon as the production volume for the period is known. This is usually in advance of the tabulation of the actual expenses. When the department summary strips are removed from the pegboard therefore, the pencil copy of the budget report is complete except for the computation of variations of actual costs from budget. After this operation has been done, the report can be typed and distributed.

In order to obtain the monthly distribution on a calendar-month basis, split-week recap strips are made for those weeks which overlap 2 months. For budget purposes the regular weekly recaps would be prepared for the overlapping weeks in addition to the split-week recaps. If the accounting month were a 4-week period, it would be unnecessary to prepare split-week recap strips.

4. At the end of the month the weekly departmental recap strips and the appropriate split-week recaps are sorted by department. The strips for each department are shingled on a pegboard together with a blank recap strip on which to record the totals for the month. The monthly recap strips for all departments are then assembled on a pegboard in the form of an overhead distribution summary similar to the one illustrated in Table 21.1. The lines are added across, and the plant totals are entered on a recap strip. A permanent copy of the overhead distribution may then be made either by typing or by photographing.

5. At the end of 3 months the monthly departmental strips may be reassembled by departments to obtain quarterly departmental totals. At the end of a year the quarterly strips may be reassembled to obtain annual departmental totals.

Summary-strip Method *b*

In the method designated as Summary-strip method *b*, the data for department summary strips are obtained by the unit-slip method. The transaction summary strip is therefore eliminated. After the department summary strips have been prepared, the procedure is the same as under the previous method. The essential features of a representative application of this method are

1. All overhead charges that are specifically allocated to departments are reported on unit slips. The various unit-slip forms, such as supply requisitions, time tickets, and purchase invoice memorandums, must be uniform in size, and the spaces for data which are needed in the overhead distribution must be arranged uniformly. The tabulating card size, $3\frac{1}{4}$ by $7\frac{3}{8}$ inches, is most frequently used. It is a convenient size to handle, and it fits a standard filing cabinet. The various unit-slip forms may be designed either for hand sorting, key sorting, or punched-card machine sorting. Inasmuch as most of the transactions affecting overhead are recorded on unit slips under any procedure, little additional work is caused by the requirement that all specific charges be reported on unit slips. It is mainly a matter of designing the forms so that they are uniform in size and in the arrangement of the data needed in the overhead distribution.

2. To obtain natural-classification control totals the unit slips of each type are sorted and added each week by natural classification. The resulting totals are written on summary strips, a strip for each transaction type. A summary strip is also prepared for the prorated charges. The summary strips are assembled on a pegboard and added to obtain natural-classification totals for comparison later on with the corresponding totals on the overhead distribution summary.

3. After the control totals have been obtained the unit slips affecting overhead are all brought together, sorted by department and natural classification, and added. The totals are entered on department summary strips. The prorated charges may be either reported on unit slips or posted direct from proration schedules to the departmental summary strips.

4. Same as step 4 under Summary-strip method *a*.

5. Same as step 5 under Summary-strip method *a*.

In order to make a successful application of summary-strip accounting it is essential that the account classification be standardized and that the summary-strip forms be carefully designed and printed. As in the analysis-sheet method the operations are chiefly manual operations, but there is very little hand posting in the summary-strip method. When a set of summary strips has been prepared and checked against control figures, the strips may be sorted and assembled in various combinations and used, without rechecking, to obtain totals. The application of summary-strip methods of overhead distribution is not limited to cases where weekly budget reports are wanted. It is also suitable in many cases where the overhead distribution is made only once a month.

Punched-card Method

Punched tabulating cards may be used in the earlier stages of distribution under any of the three methods just described. When the punched-card procedure is used throughout, it is similar in many respects to Summary-strip method *b* except that punched summary cards take the place of the departmental summary strips. The essential features of a representative application of the punched-card method for the distribution of overhead to standing orders are

On the basis of the transaction reports

1. A tabulating card is punched for each item charged to Factory Overhead. Cards are prepared for prorated charges as well as for charges specifically allocated to departments. Cards covering fixed charges may be used over and over. It is not necessary to prepare a new set each week.

2. The punched cards are carefully checked against the original media, and control figures are established.

3. Each week the punched cards are sorted and tabulated by department and natural classification. The tabulations may be printed directly on the departmental budget reports. The weekly totals are punched on summary cards.

4. The weekly summary cards are sorted at the end of the month and tabulated by department and natural classification to obtain the data for monthly reports. The monthly totals may be punched on summary cards for use later in obtaining quarterly and annual totals.

The punched-card method is a highly mechanized procedure in which hand posting is almost entirely eliminated. Once the punched cards have been checked against control figures, the results obtained through sorting and tabulating them in various combinations are almost certain to agree with the controls. The application of the punched-card method of overhead distribution is not limited to cases where weekly budget reports are wanted. It is also suitable in many cases where the overhead distribution is made only once a month.

Subsidiary Overhead Accounts

Under the foregoing methods of overhead distribution the subsidiary overhead accounts appear on analysis sheets, summary strips, or punched cards, as the case may be. In many accounting systems there are no other subsidiary accounts supporting the Factory Overhead control in the general ledger (or the factory ledger).

In some cases, however, it is thought that a more formal book record should be kept of the distribution by natural classification. This distribution is reported on corporate income tax returns and in some cases on reports to shareholders, whereas the departmental distribution is an internal matter that is reported in most cases only for managerial purposes.

The formal ledger record of the distribution by natural classification may be a subsidiary ledger with accounts in conventional ledger form. In this case there would also be a Factory Overhead Control as well as the analysis sheets or other forms for the departmental distribution. The distribution to the subsidiary ledger would be obtained from transaction summaries. Thus, the column totals of the distribution of supply requisitions, Fig. 15.2, would be debits to account .21 Shop Supplies, account .22 Small Tools, etc. The column totals may either be posted direct to the subsidiary ledger or be copied first to the detail column of the journal entry (see Fig. 7.1) and be posted from there if a formal journal record of the distribution is wanted.

As an alternative to having them in a subsidiary ledger the accounts for the natural classifications may be put in the general ledger (or the factory ledger) in place of the Factory Overhead Control. The journal entries for

the various transaction summaries in this case would list the debits to the natural-classification accounts in the Debit column of the journal. The analysis sheets or other forms for the departmental distribution detailed by natural classification would be prepared, but the Factory Overhead Control account would be omitted.

Where formal ledger accounts are kept for the natural classifications the natural-classification control sheet may be omitted. Control totals for checking the natural-classification totals appearing on the overhead distribution summary would be obtained from the ledger accounts. Otherwise, the procedure of obtaining the two-way distribution of overhead by department *and* natural classification would not be altered by the opening of ledger accounts for the natural classifications.

Ledger Accounts for Departmental Overhead

Departmental overhead control accounts are sometimes kept in the general ledger where the departments are not numerous. In this case, if the natural-classification accounts are also kept in the ledger, the periodic debits to the latter accounts are generally made first and then the totals are distributed to departments. The entries debiting the departmental accounts may be credited either to the natural-classification accounts, thus closing those accounts each month, or to a credit-balance account Overhead Distributed to Departments. In the latter case the balances of the natural-classification accounts as well as the balance of the departmental accounts would represent year-to-date costs. The accounts would be closed only at the end of the year. The credit balance in the account Overhead Distributed to Departments would be equal to the sum of the balances in the department overhead accounts, thus keeping the ledger in balance.

By using a form of the type illustrated in Fig. 22.2 as the departmental ledger account, it is possible to summarize in the ledger not only the department total but also the analysis of the department overhead by natural classification. This is a practical procedure in case there are not too many natural classifications. Although the form is not a conventional ledger form, it can be prepared on multicolumn paper of ledger size and filed in the ledger.

Procedures similar to those described in this section are frequently used in process cost systems in the distribution of conversion costs. They are not usually found in order cost and standard cost systems except in small plants where there are only a few departments.

CHAPTER 23

BURDEN APPLICATION

The allocation of factory overhead cost to the products manufactured is called factory overhead application, or burden application. Burden is applied as the material passes through the conversion processes. The total of the burden applied is debited to Goods in Process. It may be credited to Factory Overhead. The difference between the actual periodic overhead and the amount applied is known as factory overhead

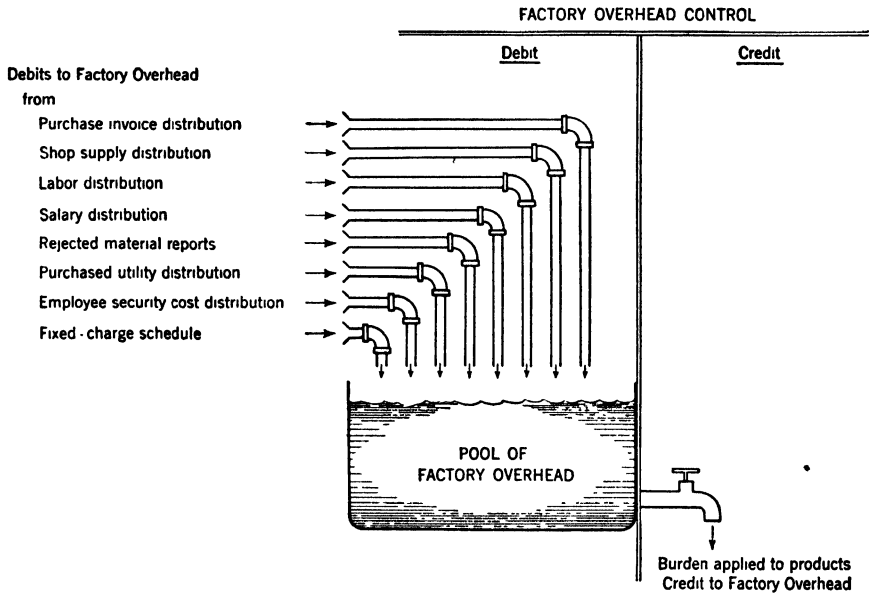


FIG. 23.1. Factory overhead pool.

variance, or burden variance. The subject of burden variance is discussed in Chapter 25.

The Factory Overhead account of a burden center may be thought of as a pool. The streams feeding the pool are the debits from the overhead distribution representing the various kinds of overhead costs. Flowing out of the pool is a single credit stream of applied burden representing a composite of all the different kinds of overhead costs that have been collected in the pool. The concept of overhead as a pool of indirect cost is diagrammed in Fig. 23.1.

Because it cannot be specifically allocated to products, burden must be applied more or less arbitrarily, usually by prorating on the basis of a factor that can be specifically identified with products. The average relationship between the total overhead and the total of the base factor is determined, and this average relationship is assumed to hold true for each operation.

The general formula for the proration of overhead to products is

$$pc = \frac{\Sigma c}{\Sigma b} \times pb$$

where pc = overhead cost applied to a given product
pb = quantity of the base factor on that product
Σc = total overhead cost to be applied at a given volume of production
Σb = total quantity of the base factor at that volume and
$\frac{\Sigma c}{\Sigma b}$ = burden rate

As a simple illustration, assume (1) that the actual monthly overhead of a certain plant is to be applied to orders at an over-all rate based on direct-labor cost, (2) that the total overhead for a certain month (Σc) equals \$4,240, (3) that the total direct-labor cost for the same month (Σb) equals \$8,000, and (4) that the direct-labor cost on order 86 during the month (pb) was \$500.

The burden rate $\Sigma c/\Sigma b$ equals \$4,240/\$8,000, or \$0.53. That is, for every dollar of direct labor there was on the average 53 cents of factory overhead. Stated as a percentage, the overhead was 53 per cent of the direct-labor cost. The burden applied to order 86 [$(\Sigma c/\Sigma b)pb$] would be 53 per cent of \$500, or \$265.

Planning the Development of Burden Rates

The principal questions faced by the cost accountant in planning the development of burden rates are

1. How many different rates are needed? In answering this question consideration should be given to

   a. Variation in types of overhead with relation to products
   b. Variations in overhead requirements at different work points

2. What base factor is the most suitable for each rate?
3. Should actual rates or predetermined rates be used? If Σb represents the actual volume and Σc the actual overhead cost for a given period, then the burden rate $\Sigma c/\Sigma b$ is referred to as an actual rate.

Where Σb represents a predetermined volume and Σc the estimated overhead cost at that volume, then the burden rate is referred to as a predetermined rate.

4. In case predetermined rates are used, and that is the usual practice both in job-order cost and standard cost systems, what volume of production should be selected as the predetermined volume? The variable-overhead cost per unit is constant over a wide range of volume, but the unit cost of fixed overhead varies inversely with the production volume. The rate at which fixed overhead is applied to products therefore depends upon the volume selected as the predetermined volume.

The answers to the foregoing questions should be governed by the circumstances in each case—the nature of the product, the characteristics of the manufacturing processes, and the purpose for which the cost data are wanted. Frequently, different costs are needed for different purposes. The costing procedure is generally designed to provide as a matter of routine the type of data that is needed for costing shipments and inventories. Then special studies are made when necessary to obtain data for other purposes.

Classification of Overhead with Relation to Products

Factory overhead is a grouping of many diverse costs. In their relation to the products manufactured these costs may be classified as

Material overhead
Process overhead
  Work-point overhead
  Process-personnel overhead

Material Overhead

Material overhead consists of the indirect costs of procuring and handling material up to the time it is delivered to processing departments. A major part of the costs of operating the purchasing, receiving, receiving inspection, and stores departments would fall in this category. The cost of patterns and dies used by suppliers of material, although theoretically a direct cost, is frequently treated as overhead and would in this case be classed as material overhead. Those defective material costs that cannot be recovered from the supplier would also belong here.

Where material overhead is to be applied as a separate factor, a Material Overhead account would be kept either as an adjunct to the Factory Overhead Control or subsidiary to it. In the redistribution of service-department costs this account would be charged with a portion of the cost of the purchasing, receiving, inspection, and stores departments.

Pattern and die costs applicable to material overhead and defective-material costs would either be charged direct to Material Overhead or would first be classified functionally as a charge to the Purchasing Department and then redistributed to Material Overhead as a part of the cost of that department. Material burden would be applied when material is put into process, the Material Overhead account being credited.

Either material cost or material weight is likely to be selected as the application base. In a certain spring-manufacturing plant the weight basis is preferred "because it would cost no more to purchase, store, record, and deliver to production a pound of material valued at one dollar than it would a pound of material valued at six cents."[1] As a matter of fact it is usually impossible to select any factor that is entirely satisfactory as a base for the application of material burden. A special item purchased in small quantities, for example, is likely to cause as much work in the purchasing department as a standard item purchased in large quantities; bulky articles require more trucking time and more storage space than compact articles of equal weight and value.

Where the proportions of material and labor are about the same in all the products of a plant, little is gained through making a separate application of material overhead. It can be merged with the process overhead without materially changing the results. In fact this is the usual practice. Separate application is most likely to be advantageous where there are substantial differences in the proportions of material and labor on different jobs. Thus, in a ship repair yard on an order calling for extensive replacement of equipment the proportion of material cost would be high, and on an order for repairing minor damage to decks and hull the material-cost proportion would be relatively low. In recognition of this situation Navy contracts for ship repairs that are placed on a time and material basis permit the contractor as a rule to include a material handling charge in computing the invoice amount.

Burden Centers

A burden center or cost center is a segment of a plant, or in some cases an entire plant, which is treated as a functional unit for the purpose of applying process overhead. It may be a single work point, such as a machine, a group of work points smaller than a department, a processing department, or an entire plant. A burden rate is computed for each burden center to use in applying overhead to work processed in that center.

[1] Seeber, Carl A., "Material Burden and Its Application," pp. 155–163, *N.A.C.A. Year Book, 1937.*

A machine center is a burden center consisting of a single machine or a group of similiar machines. A machine-center overhead rate is called a machine rate. An assembly center is a burden center consisting of equipment, such as benches, fixtures, and conveyers, used for assembly operations. A bench center is a burden center consisting of equipment for bench operations. If the bench operations are assembly operations, the center may be called either a bench center or an assembly center. Overhead rates for assembly centers and bench centers are referred to, respectively, as assembly-center rates and bench-center rates. The term *work-point rate* is a general term covering the three types of rates just described, namely, machine rates, assembly-center rates, and bench-center rates. Where a department is treated as a burden center, the overhead rate is known as a departmental rate. Where the entire plant is treated as the burden center, the burden rate is termed an over-all rate.

Work-point Overhead

Work-point overhead is the cost of the services of plant, equipment, and supplies used in processing. It includes building occupancy cost of the space required for processing; maintenance, taxes, depreciation, and insurance on machinery and shop equipment; and the cost of small tools, shop supplies, fuel, and power used in the processing operations. The costs of dies, jigs, and fixtures used in processing operations, in case they are not treated as direct costs, would be classed as work-point overhead. In a highly mechanized industry the work-point overhead is a substantial factor, and usually there are substantial differences in the hourly overhead costs at different work-points. A large multispindle milling machine, for example, is a much more expensive piece of equipment than an ordinary assembly bench. It requires more floor space and, when in use, more supplies and power. The work-point overhead for an hour of work on the milling machine is much more than for an hour of assembly work.

It is in connection with the costing of work-point overhead that the most careful attention should be given to the selection of burden centers. The choice depends as a rule upon how accurate the operation costs must be.

When the costs of individual operations must be extremely accurate, the burden centers for the application of work-point overhead should be homogeneous plant segments, each center consisting of a single work point or a group of similar work points. For machine operations, machine rates would be used. A departmental rate would be satisfactory only where all the machines in a department are similar. In this case the department would be a machine center, and the depart-

mental rate would be in effect a machine rate. For assembly operations, departmental rates would generally be satisfactory. Assembly departments are likely to be homogeneous plant segments; furthermore on assembly work the work-point overhead is not a large factor as a rule. Where there are both machine operations and assembly operations in the same department, it may be necessary to apply work-point overhead to machine operations at machine rates and to assembly operations at an assembly-center rate. An over-all rate is seldom suitable for the costing of work-point overhead in case accurate costs of individual operations are wanted.

Circumstances Determine How Accurate the Operation Costs Need to Be

In some circumstances it is impossible to determine the cost of finished products accurately unless the operation costs have been accurately computed. This is likely to be true in a jobbing shop where a large part of the work is to special order and also in a plant producing two or more lines of standardized products if the plant is not departmentized according to line of product.

In many cases, however, it is possible to obtain accurate finished-product costs even though the operation costs are not extremely accurate. Where the various products of a plant all pass through about the same series of operations, an over-all rate may in fact be satisfactory for product-costing purposes because the errors in the costing of individual operations would tend to offset one another in the cost of the finished product. Thus, a factory producing Chevrolet automobile bodies uses enormous presses to blank and form the body panels. Even though the work-point overhead per hour is much greater for press operations than for assembly and finishing operations, it is practical to use an over-all rate because the proportions of time in the different processes are about the same for each body model.

In many cases where an over-all rate is unsatisfactory owing to variety in the processing of the different products of a plant, departmental rates are found to be satisfactory. Processing departments are usually organized either according to the type of operation performed or according to the products manufactured. In the first case the department is likely to be a homogeneous unit, the work points being similar. Under these conditions a departmental rate gives very nearly the same results as work-point rates. In the second case the series of operations for the different articles passing through a department are likely to be similar even though there is a variety of equipment in the department. Under these conditions the errors in costing individual operations would be compensating errors; the total burden applied to any article passing

through a department using departmental rates would deviate but little from the total that would be applied if work-point rates were used.

For product costing purposes a departmental rate is usually satisfactory for the application of work-point overhead provided that any one of three conditions are met. That is, (1) if the work-point overhead of the department is a small factor, (2) if all the work points in the department are similar, or (3) if all the articles processed in the department pass through about the same series of operations and require about the same proportion of time at each work point. Where two or more of the foregoing conditions are found, the departmental rate is almost certain to be satisfactory. Where none of these conditions prevails, a departmental rate should not be used; it is necessary to use work-point rates if accurate product costs are wanted.

For the purpose of costing a work-in-process inventory, cumulative costs are needed at the stages of manufacture where there are inventories. To obtain accurate cumulative costs at each operation it is necessary to have accurate operation costs. Some preference should therefore be given to the use of work-point rates from the standpoint of inventory costing in case departmental rates do not give accurate costs of individual operations. However, in case departmental rates are satisfactory for product costing, they are generally considered satisfactory for inventory costing. The cumulative cost of work as it leaves each department would be accurately computed in such cases. Only the work that is on hand partly finished would be incorrectly costed, and the deviations would generally be of little consequence, particularly if the same method of costing inventories were employed consistently each year.

Illustrative Case

A hypothetical case can be used to obtain comparisons of cumulative costs using (1) machine rates, (2) departmental rates, and (3) an over-all rate. Assume that there are four machines in a factory, two in Department X and two in Department Y, and that all products require equal proportions of time at each work point. Assume further that the work-point overhead applied at machine rates to a certain product is as follows:

Department	Machine	Work-point overhead applied at machine rates	
		By operations	Cumulative
X	1	$0.80	$0.80
	2	0.60	1.40
Y	3	0.40	1.80
	4	0.20	2.00
Total	.	$2.00	$2.00

If the work-point overhead were applied at departmental rates the results would be as follows:

Department	Machine	Work-point overhead applied at departmental rates	
		By operations	Cumulative
X	1	$0.70	$0.70
	2	0.70	1.40
Y	3	0.30	1.70
	4	0 30	2 00
Total. .	.	$2 00	$2.00

Although the operation costs differ, the cumulative costs at the end of the operations in each department are the same whether machine rates or departmental rates are used. If an over-all rate were used, the applied cost would be as follows:

Department	Machine	Work-point overhead applied at over-all rate	
		By operations	Cumulative
X	1	$0.50	$0.50
	2	0.50	1.00
Y	3	0.50	1.50
	4	0.50	2.00
Total..	..	$2 00	$2 00

In this case both the cumulative cost of the work leaving Department X and the costs of the individual operations deviate from the costs obtained by using machine rates. The deviations are greater when the over-all rate is used than when departmental rates are used. This is generally to be expected.

Throughout the foregoing illustration only the work-point burden is taken into consideration. In practice, when work-point overhead is applied either at departmental rates or at an over-all rate, it is merged with the process-personnel overhead. Even when burden is applied at work-point rates, it is generally satisfactory to combine the work-point burden and the process-personnel burden. In order to choose burden centers intelligently, however, the two types of overhead should be considered separately.

Process-personnel Overhead

The portion of the process overhead that cannot be identified with work points may be referred to as process-personnel overhead. It consists

chiefly of the cost of maintaining the force of direct workers and facilitating their work. More specifically, its principal components are the cost of (1) supervision in the processing departments, (2) shop administration, (3) shop trucking, except trucking from receiving to stores and from stores to process, (4) employee security provisions chargeable to processing departments, and (5) defective work. In addition the material overhead as previously explained is generally merged with the process-personnel overhead.

Where accurate costing of individual operations is desired, the process-personnel overhead should as a rule be applied at departmental rates, for the processing department is the organization unit for the supervision of direct workers. Because of differences in the character of work in different departments and in the type of supervision, the departmental rates of process-personnel overhead are likely to vary from the plant average. In some cases the variations are slight; then it may be satisfactory to use the over-all rate. Process-personnel overhead may in some cases be merged with work-point overhead and applied at machine rates by converting the process-personnel overhead rate for the department to an equivalent machine rate for each machine center and adding that to the work-point overhead rate.

Application Bases for Process Overhead

The burden application base in the case of process overhead is the means of connecting the overhead of a burden center with the products passing through the center. It must be a factor that can be identified with individual products. In job-order cost systems it must be one that can be tallied regularly according to order number. In standard cost systems the quantity of the base factor must be predetermined for each part number and operation number. It should be a fair measure of the overhead cost of the different products passing through the burden center. For the purpose of the present discussion it makes little difference whether the base factor measurements are at the level of standard performance as in standard cost systems or at the level of actual performance as in job cost systems.

Machine Rates—Application Bases

For machine rates the machine-hour is usually selected as the base factor. If the machine rate covers only work-point overhead, the machine-hour is the logical application base.

When the machine rate includes both work-point overhead and process-personnel overhead, the machine-hour is a satisfactory base unless the ratio of man-hours to machine-hours at the machine center fluctuates

from time to time; in that case the two types of overhead should be applied separately if the utmost accuracy is desired. Ordinarily, when the process-personnel overhead is to be included in the machine rates, the departmental rate of process-personnel overhead per direct man-hour is multiplied by the normal ratio of man-hours to machine-hours at each machine center to determine the process-personnel overhead rate per machine-hour. Thus, if a machine requires two operators, the rate per man-hour would be multiplied by two in order to convert it to a rate per machine-hour. The process-personnel overhead per machine-hour would then be added to the work-point overhead per machine-hour to obtain the machine rate. To apply burden to products, the machine-hours required on an operation are multiplied by the machine rate for the machine center at which the operation is performed. When the process-personnel overhead is included in the machine rate in the proper proportion according to the number of workers at the machine, it is applied accurately even though on the basis of machine-hours.

There are some types of operations where work-point rates are advisable, although it is not feasible to tally the machine-hours according to individual products. Thus, in heat-treating processes the work-point overhead is a large factor, but it is difficult if not impossible to tally the process hours by products because several different products (or parts) may be processed in one furnace at one time. The weight of the materials processed is, therefore, frequently adopted as the base factor for the application of heat-treat overhead as well as for pickling and in some cases for sandblasting. The overhead of electroplating and enameling processes are frequently costed in a similar manner but on the basis of the surface area of the materials processed. The machine rates (or process rates) in cases such as those mentioned in this paragraph generally cover direct labor as well as process overhead.

To use machine rates a great deal of clerical work is generally required. In the first place it is necessary to compute a rate for each machine center, and there are usually a great many of them. In the second place, if the machine-hour is the application base, and that is the usual practice, it is necessary to tally the machine-hours on time tickets and to record the machine-hours by operations either on cost sheets or on standard cost cards.

Overhead Distribution when Burden Is Applied at Machine Rates

The monthly distribution of factory overhead is generally a departmental distribution. Even though burden is applied at machine rates, it is not customary to distribute monthly overhead costs to machine centers.

Burden applied at machine rates is summarized monthly by depart-

ments, and the burden variance—the difference between actual overhead and the amount applied—is determined monthly for each department but not for machine centers within the department.

Machine rates almost invariably are predetermined rates which are revised not oftener than once or twice a year, for the machine centers are usually so numerous that it is impractical to compute actual rates each month. Records should be kept currently to compile the distribution by machine centers of those costs which can be specifically allocated to machine centers. When revision of the machine rate is made, a compilation of these costs is needed in order to predetermine satisfactorily the costs for each machine center. Machine repair costs as a rule can be specifically allocated to machine centers. In some cases the cost of jigs and fixtures, perishable tools, supplies, and power can be specifically allocated, but generally the departmental totals of the latter items must be prorated to machine centers on the basis of foremen's and engineers' estimates. The fixed charges on equipment and the building occupancy costs are prorated to machine centers. For purposes of computing machine rates those costs which are prorated to machine centers need not be distributed except when the rates are being revised; there is no advantage in a monthly distribution to machine centers.

For purposes of cost control, reports of the idle machine time and the machine repair costs at each machine center may be prepared for foremen and other executives at monthly intervals or more frequently. A complete distribution of the monthly overhead according to machine centers, however, would be of limited value from the standpoint of controlling the overhead.

Departmental Rates—Application Bases

For departmental burden rates either direct labor hours or direct labor cost is usually selected as the application base. When the rate includes only process-personnel overhead, it is logical to use one of these two factors as the base factor.

There is more clerical work when the direct hour basis is used, for then the direct hours must be detailed on job cost sheets or on standard cost cards. Direct labor cost must be detailed in any event, and when this factor is the application base, the direct hours need not be detailed.

Direct hours is generally considered the more accurate base. Although the employee security costs attributable to direct workers are proportional to direct labor costs, the principal components of process-personnel overhead such as the cost of supervision, personnel and payroll work, and other shop administrative work depend more upon the number of men employed and the hours worked than upon the wages paid. From the

standpoint of accuracy, however, it frequently makes little difference which base is used, for the two factors are closely related to each other. Where earning rates are uniform on all direct operations, identical amounts of burden would be applied, using either a rate per direct hour or a percentage of direct labor cost. It is only where there are substantial variations in earning rates that the direct hour basis is sufficiently superior to justify the additional clerical work required. Furthermore, where the articles processed in a department pass through about the same series of operations, errors in the costing of individual operations would tend to offset one another.

When the departmental rate is to cover work-point overhead as well as process-personnel overhead, the circumstances in each case would determine whether the direct hour or the direct labor dollar would be the more accurate application base. Of course if the earning rates on all direct operations are about the same, either base would give approximately the same results. Where there are variations in earning rates, it sometimes happens that there is a fairly close correlation between labor cost per machine-hour and process overhead per machine-hour. This condition would be found where the operators of the more expensive machines are paid higher wages than the operators of the less expensive machines in a department. Under such circumstances the direct labor dollar would be the more accurate base to use. On the other hand, where there is no correlation between labor cost per machine-hour and process overhead per machine-hour, the direct labor hour would be the more accurate base.

Method of Analysis to Determine Whether Direct Hours or Direct Labor Cost Is the More Accurate Base in a Given Case

Table 23.1 illustrates a method of determining in a given case whether the direct hour or the direct labor dollar would be the more accurate application base for a departmental burden rate covering both work-point overhead and process-personnel overhead. The steps in the method are

1. Estimate the machine rate, the process overhead per machine hour, for each type of machine in the department. The machine rate for a given machine would be equivalent to the burden that would be applied to 1 machine-hour of work on that machine if machine rates were used. It is used here as a standard of comparison.

2. Compute the burden that would be applied to 1 machine-hour of work using a departmental rate per direct man-hour. At machines that require one operator the burden for 1 machine-hour would be equivalent to the rate per direct man-hour. In the case of a machine requiring more than one operator the rate per direct man-hour would be multiplied by the number of men required. Conversely, in case one man operates more

TABLE 23.1

ILLUSTRATIONS OF METHOD OF DETERMINING IN A GIVEN CASE WHETHER DIRECT HOURS OR DIRECT LABOR COST IS THE MORE ACCURATE APPLICATION BASE FOR A DEPARTMENTAL BURDEN RATE COVERING BOTH WORK-POINT OVERHEAD AND PROCESS PERSONNEL OVERHEAD

	Type of machine			
	1	2	3	4
Data				
Investment in machine	$10,000	$2,000	$2,000	$10,000
Hours per week (two 40-hr. shifts less 10% for lost time):				
Machine-hours	72	72	72	72
Direct man-hours	72	72	24	72
Average earning rate of operator, per hour	$ 1 00	$ 0 80	$ 1 20	$ 0 60
Direct labor cost per week	72 00	57 60	28 80	43 20
Process overhead per week:				
Work-point overhead	$ 75 00	$20 00	$20 00	$ 75 00
Process-personnel overhead at $1.10 per direct man-hour	79 20	79 20	26 40	79 20
Total process overhead per week	$154 20	$99 20	$46 40	$154 20
Standard of Comparison				
Burden applied at machine rates per machine-hour to 1 machine-hour of work	$ 2 14	$ 1 38	$ 0 64	$ 2 14
Case I				
Burden applied at departmental rates to 1 machine-hour of work, if the department consists of 12 machines, three of each type:				
a. Rate per direct labor hour ($1.89)	$ 1.89	$ 1 89	$ 0 63	$ 1.89
b. Percentage of direct labor cost (225%)	2 25	1 80	0 90	1 35
Deviation from burden applied at machine rates:				
a. When rate per direct hour is used (ave. $0.26)	0 25	0 51	0 01	0 25
b. When percentage of direct labor is used (ave. $0.40)	0.11	0.42	0 26	0 79
Case II				
Burden applied at departmental rates to 1 machine-hour of work if the department consists of 9 machines, three each of types 1, 2, and 3:				
a. Rate per direct labor hour ($1.78)	$ 1 78	$ 1.78	$ 0 59	
b. Percentage of direct labor cost (189%)	1 89	1 51	0 76	
Deviation from burden applied at machine rates:				
a. When rate per direct hour is used (ave. $0.27)	0 36	0.40	0 05	
b. When percentage of direct labor is used (ave. $0.17)	0 25	0.13	0 12	
Case III				
Burden applied at departmental rates to one machine hour of work if the department consists of 6 machines, three each of types 1 and 2:				
a. Rate per direct labor hour ($1.76)	$ 1 76	$ 1.76		
b. Percentage of direct labor cost (196%)	1.96	1 57		
Deviation from burden applied at machine rates:				
a. When rate per direct hour is used (ave. $0.38)	0 38	0.38		
b. When percentage of direct labor is used (ave. $0.19)	0 18	0 19		

than one machine, the rate per man-hour would be divided by the number of machines in order to determine the burden applied to 1 machine-hour of work.

3. Compute the burden that would be applied to 1 machine-hour of work using a departmental percentage of direct labor cost.
4. Compute deviations from burden applied at machine rates.
   a. Deviations when departmental rate per direct labor hour is used
   b. Deviations when departmental percentage of direct labor cost is used
5. Compute average deviations.

Three cases are illustrated in Table 23.1. In the first case the average deviation would be 26 cents if a rate per direct labor hour were used, and 40 cents if a percentage of direct labor were used. The direct labor hour would be the more accurate application base in this case. In each of the other two cases the direct labor dollar would be the more accurate.

Machine Hours as the Base for a Departmental Rate

In a department where the machine overhead is a large factor, the use of a departmental rate per machine-hour is sometimes recommended. Only in unusual circumstances, however, is the machine-hour a suitable base for a departmental burden rate. It may be used satisfactorily where all the work points in a department are similar machines, but then the department is a machine center and the departmental rate would be in effect a machine rate.

A departmental rate per machine-hour is an average rate for a department. Unlike the machine rate it does not give cognizance to differences in work-point overhead at different work points.

Where the number of direct workers per machine differs at different machines in a department, the departmental rate per machine-hour is extremely inaccurate, for it applies the process-personnel overhead at a uniform rate per machine-hour.[1] Machine rates would give the most accurate results under those circumstances (where work-point overhead is a large factor and where the ratios of man-hours to machine-hours differ at

[1] Thus, an hour of work performed on a machine requiring only one-third of an operator's time would be charged the same amount of process-personnel overhead as an hour of work on a machine requiring the whole attention of one operator, whereas actually the cost of process-personnel overhead per machine-hour is only one-third as much in the former case as in the latter. The foregoing objection holds for departmental rates per machine-hour but not for machine rates. In the establishment of machine rates, when process-personnel overhead is to be included, it is apportioned to machine centers on the basis of the number of direct workers normally employed at each center.

different machines) with only slightly more clerical work, for in order to use a departmental rate per machine-hour, it is necessary to tally the machine-hours on time tickets the same as if a machine rate were used.

Where the ratio of man-hours to machine-hours is the same for all the machines in a department, for example, where one operator is needed for each machine, a departmental rate per direct labor hour gives exactly the same results in terms of overhead applied to operations as a departmental rate per machine-hour, and with less clerical work. A departmental rate per direct labor dollar would usually give approximately the same results with even less clerical work.

Illustration

Several representative methods of burden application are illustrated in Table 23.2 in order to clarify the foregoing discussion of burden centers and application bases. The first method, in which work-point overhead and process-personnel overhead are applied separately, is the ideal method from the standpoint of accuracy. In any given case the results obtained

TABLE 23.2

ILLUSTRATION OF REPRESENTATIVE METHODS OF BURDEN APPLICATION

100. *Data.*

110. Work points in a certain Gear Department

30 Semiautomatic gear-cutting machines. Ten operators are required. Each operator tends three machines and earns on the average 90¢ an hour.

4 Radial drill presses, each requiring one operator at an average earning rate of 60¢ an hour.

4 Broaching machines, each requiring one operator at an average earning rate of 80¢ an hour.

Total number of direct workers: 18 on each shift.

120. Predetermined volume per year

Practical capacity operating two 40-hr.-a-week shifts for 50 weeks with allowance of 10% for idle time due to absenteeism, machine breakdown, and material shortages. It is assumed that the capacities of the machines are in balance, that is, none of the machines have excess capacity in relation to the other machines.

Machine-hours per year at practical capacity

30 gear-cutting machines	108,000 hr.
4 drill presses	14,400 hr.
4 broaching machines	14,400 hr.
Total	136,800 hr.

Direct labor per year at practical capacity

Direct labor hours (36 men), 64,800 hr.

Direct labor cost, $52,560

Average earning rate (52,560 ÷ 64,800), $0.8111

TABLE 23.2 (*Continued*)

130. Predetermined overhead per year

Work-point overhead	Fixed	Variable	Total
30 gear-cutting machines	$17,400	$ 8,700	$26,100
4 drill presses	1,600	800	2,400
4 broaches	2,400	2,400	4,800
Total machine overhead	$21,400	$11,900	$33,300
Process-personnel overhead	24,000	30,000	54,000
Total process overhead	$45,400	$41,900	$87,300

200. *Calculation of rates.*

Burden rates are usually carried out to two decimal places. They could not be considered accurate to more than two decimal places because the underlying data to a large extent is estimated data

210. Method 1. Separate rates for work-point overhead and process-personnel overhead

211. Work-point overhead per machine hour

Machine Center	Work-point Overhead (Σc)	Machine-Hours (Σb)	Machine Rate (Σc) ÷ (Σb)
Gear cutter	$26,100	108,000	$0 24
Drill press	2,400	14,400	0 17
Broach	4,800	14,400	0 33

212. Process-personnel overhead per direct man-hour

Process-personnel overhead (Σc), $54,000

Direct labor hours (Σb), 64,800

Departmental rate per direct labor hour (Σc) ÷ (Σb), $0.83

220. Method 2. Machine rates for process overhead. (Process overhead includes both work-point overhead and process-personnel overhead.)

		Process-personnel Overhead		Work-point Overhead per Machine-hour (d) (see 211)	Total Process Overhead per Machine-hour (e) = (c) + (d)
Machine Center	Machines per Operator (a)	Per Man-hour (b) (see 212)	Per Machine-hour (c) = (b) ÷ (a)		
Gear cutter	3	$0.83	$0 28	$0.24	$0.52
Drill press	1	0 83	0.83	0.17	1.00
Broach	1	0.83	0.83	0.33	1.16

230. Method 3. Departmental rate per direct man-hour for process overhead

Total process overhead (Σc), $87,300

Total direct labor hours (Σb), 64,800

Departmental rate per direct labor hour (Σc) ÷ (Σb), $1.35

240. Method 4. Departmental rate per direct labor dollar for process overhead

Total process overhead (Σc), $87,300

Total direct labor cost (Σb), $52,560

TABLE 23.2 (*Continued*)

Departmental rate per direct labor dollar ($\Sigma c \div \Sigma b$), $1.66

Expressed as a percentage, the rate is 166% of direct labor cost.

250. Method 5. Departmental rate per machine-hour for process overhead

Total process overhead (Σc), $87,300

Total machine-hours (Σb), 136,800

Departmental rate per machine-hour ($\Sigma c \div \Sigma b$), $0.64

300. *Burden application.*

310. Data of work done in Gear Department on production order 310. Note that the proportion of time at each work point is the same on this order as the departmental average proportion.

Operation	Work Point	Machine-hours	Direct Labor Hours	Direct Labor Cost
7	Gear cutter	15	5	$4 50
8	Drill press	2	2	1.20
9	Broach	2	2	1.60
		19	9	$7 30

311. Method 1. Work-point overhead applied at machine rates and process-personnel overhead at departmental rate. (See 210 for rates.)

			Work-point Overhead			Process-personnel Overhead			
Dept.	Operation Number	Machine Center	Mach.-hr.	Rate	Amt.	Man-hr.	Rate	Am't	Total Overhead Applied
Gear....	7	Gear cutter	15	$0.24	$3 60	5	$0.83	$4.15	$ 7 75
Gear....	8	Drill press	2	0.17	0.34	2	0.83	1.66	2 00
Gear....	9	Broach	2	0.33	0.66	2	0.83	1.66	2.32
			19		$4.60	9		$7.47	$12.07

312. Method 2. Process overhead applied at machine rates. (See 220 for rates.)

Dept.	Operation Number	Machine Center	Machine-hours	Machine Rate	Overhead Applied
Gear....	7	Gear cutter	15	$0.52	$ 7.80
Gear....	8	Drill press	2	1.00	2.00
Gear...	9	Broach	2	1.16	2 32
			19		$12.12

313. Method 3. Process overhead applied at departmental rate per direct labor hour. (See 230 for rate.)

Dept.	Operation Number	Direct Man-hours	Dept. Rate	Overhead Applied
Gear.....	7	5	$1.35	$ 6.75
Gear....	8	2	1.35	2.70
Gear.	9	2	1.35	2.70
		9		$12.15

TABLE 23.2 (*Continued*)

314. Method 4. Process overhead applied at departmental rate per direct labor dollar (percentage of direct labor cost). (See 240 for rate.)

Dept.	Operation Number	Direct Labor Cost	Overhead Rate	Overhead Applied
Gear	7	$4 50	166%	$ 7.47
Gear	8	1.20	166%	1.99
Gear	9	1.60	166%	2.66
		$7.30		$12.12

315. Method 5. Process overhead applied at departmental rate per machine-hour. (See 250 for rate.)

Dept.	Operation Number	Machine-hours	Overhead Rate	Overhead Applied
Gear	7	15	$0.64	$ 9 60
Gear	8	2	0 64	1.28
Gear	9	2	0.64	1.28
		19		$12.16

320. Data of work done in Gear Department on production order 320. On this order the proportions of time at each work point deviate from the departmental average.

Operation	Work Point	Machine-hours	Direct Hours	Labor Cost
3	Gear cutter	18	6	$ 5.40
4	Broach	10	10	8 00
		28	16	$13.40

321. Method 1. Work-point overhead applied at machine rates and process-personnel overhead applied at departmental rate. (See 210 for rates and 311 for method of calculating burden applied.)

Operation	Overhead Applied
3	$ 9.30
4	11 60
	$20.90

322. Method 2. Process overhead applied at machine rates. (See 220 and 312.)

Operation	Overhead Applied
3	$ 9.36
4	11.60
	$20.96

TABLE 23.2 (*Continued*)

323. Method 3. Process overhead applied at departmental rate per direct labor hour. (See 230 and 313.)

Operation	Overhead Applied
3	$ 8 10
4	13.50
	$21 60

324. Method 4. Process overhead applied at departmental percentage of direct labor cost. (See 240 and 314.)

Operation	Overhead Applied
3	$ 8 96
4	13 28
	$22 24

325. Method 5. Process overhead applied at departmental rate per machine-hour. (See 250 and 315.)

Operation	Overhead Applied
3	$11 52
4	6 40
	$17 92

400. *Comparisons.*

410. Tabulation of burden applied by various methods

Production Order	Operation Number	Method 1	2	3	4	5
310	7	$ 7.75	$ 7 80	$ 6 75	$ 7.47	$ 9.60
	8	2.00	2.00	2.70	1.99	1.28
	9	2 32	2 32	2 70	2 66	1.28
	Total	$12 07	$12.12	$12 15	$12 12	$12 16
320	3	$ 9 30	$ 9.36	$ 8.10	$ 8 96	$11 52
	4	11 60	11 60	13 50	13 28	6 40
	Total	$20 90	$20 96	$21 60	$22 24	$17 92

420. Comments

For the circumstances covered by the illustration it can be seen that

421. Except for chance differences caused by adding and dropping fractions when computing rates, the first two methods give identical results. That would generally be true. It is only where the ratio of man-hours to machine-hours fluctuates from time to time that the first method would be superior to the second method, for example, where one-half of an operator's time is required for some operations on a machine, and his whole time is required for other operations.

422. The departmental rate per machine-hour (fifth method) is unreliable. This is generally true where the ratio of man-hours to machine-hours differs at different work points in the department. In case that ratio

TABLE 23.2 (*Continued*)

is uniform at all work points, the departmental rate per direct man-hour would give exactly the same results as the departmental rate per machine-hour, and with less clerical work.

423. The percentage of direct labor (fourth method) gives more accurate operation costs than the rate per direct hour. This happens to be true in this case because the earning rates of direct labor at the different operations are somewhat proportional to the machine rates. As previously explained, however, the circumstances in each case determine whether the direct labor cost or the direct labor hour would be the more accurate application base for a departmental rate covering both work-point overhead and process-personnel overhead.

by this method may be treated as a standard for comparison with the results obtained by other methods. The five methods that are illustrated are

1. Work-point overhead applied at machine rates per machine-hour, process-personnel overhead applied at departmental rate per direct hour
2. Process overhead (including both work-point overhead and process-personnel overhead) applied at machine rates per machine-hour
3. Process overhead applied at departmental rate per direct man-hour
4. Process overhead applied at departmental percentage of direct labor cost
5. Process overhead applied at departmental rate per machine-hour

The illustrations all deal with a single department, a gear machining department. Predetermined overhead rates are used throughout.

Types of Burden Rates and Application Bases Found in Practice

An N.A.C.A. research study published April 1, 1938,[1] made use of a questionnaire "to get a picture of the actual methods used by American industrial companies, and to discover which methods are most commonly used." Replies were received from 224 representative companies covering a wide range of industries. On the question as to whether an over-all rate, departmental rates, or cost-center rates were used, the replies indicated that

48 companies use an over-all rate.
98 companies have a separate rate for each productive department.
52 companies have a separate rate for each cost center. (In the study "cost center" refers to a burden center smaller than a department as, for example, a machine center within a department.)
20 companies use both departmental and cost-center rates.
5 companies have a separate rate for each class of product.
1 company failed to reply to this question.
224 companies

[1] *N.A.C.A. Bulletin*, Vol. 19, No. 15, Sec. III, pp. 917–934.

The replies from the same companies as to the types of burden application bases used are summarized in Table 23.3. Companies using more than one type of base were requested to indicate both the major base, the one most extensively used, and also the secondary bases, those used less extensively. Thus, if most of the burden of a factory was applied on the basis of actual direct labor cost, while material burden was applied on a weight basis, the actual direct labor cost would be considered the major base and the weight a secondary base. The published study does not report separately the application bases used for different types of rates, that is, the bases used for departmental rates, for machine rates, etc. From the study it is apparent that direct labor cost is the factor most frequently used in practice as the base for burden application, 101 companies reporting this as the major or the only base employed. The direct labor hour is the major or only base in 56 cases and the machine-hour in 43 cases.

TABLE 23.3

BASES USED IN APPLICATION OF OVERHEAD BY 224 REPRESENTATIVE COMPANIES*

Type of application base	Number of companies		
	Using as major or only base	Using as secondary base	Total
Direct labor cost:			
Actual	96	13	109
Standard	5	.	5
Number using direct labor cost	101	13	114
Direct labor hours:			
Actual	27	21	48
Standard	29	4	33
Number using direct labor hours	56	25	81
Machine-hours:			
Actual	30	13	43
Standard	13	22	35
Number using machine-hours	43	35	78
Weight basis	7	29	36
Unit of product	11	18	29
Material cost	...	11	11
Prime cost	5	5	10
Miscellaneous	1	2	3
Total	224		

* From N.A.C.A. Research Study, "Practice in Applying Overhead and Calculating Normal Capacity," *N.A.C.A. Bulletin*, Vol. 19, No. 15, Sec. III, p. 922 (adapted).

CHAPTER 24

BURDEN APPLICATION *(Continued)*

Fixed and Variable Overhead in Burden Rates

Factory overhead consists of variable elements and fixed elements. The amount of variable overhead varies almost directly with production volume. The variable-overhead rate per unit of production therefore tends to be constant. Fixed overhead on the other hand is a function of time. The monthly amount tends to be constant over a term of months. The fixed-overhead rate per unit of volume therefore varies inversely with the volume of production.

To illustrate:

The budget allowances for a certain department at volumes ranging from 6,000 to 10,000 direct man-hours per month are

Fixed overhead..... $3,200 per month
Variable overhead..... $0.60 per direct man-hour

The allowances cover all process overhead attributable to the department including a fair share of service-department costs.

The monthly budgets at three different levels of production would be

Production volume measured in direct man-hours	Monthly overhead budget		
	Variable	Fixed	Total
6,000	$3,600	$3,200	$6,800
8,000	4,800	3,200	8,000
10,000	6,000	3,200	9,200

The overhead rates per direct man-hour at the three levels of monthly production would be

Production volume measured in direct man-hours	Overhead rates per direct man-hour		
	Variable overhead	Fixed overhead	Total
6,000	$0.60	$0.53	$1.13
8,000	0.60	0.40	1.00
10,000	0.60	0.32	0.92

Actual or Predetermined Rates

For practical reasons it is almost always necessary, except in process cost systems, to use predetermined burden rates rather than actual rates. In many circumstances the use of predetermined rates is favored on theoretical grounds also.

Shipments must be costed monthly. If actual burden rates are used, they must therefore be actual monthly rates. But actual monthly burden rates are usually not satisfactory for costing purposes for the following reasons: (1) They are subject to fluctuations which are not significant for costing purposes. (2) The resulting product cost data are difficult to interpret. (3) Too long an interval is required after the end of a month for the completion of cost sheets and financial statements.

Of the 224 firms replying to the N.A.C.A. questionnaire referred to above,[1] 205, or 91.5 per cent, were using predetermined rates. The 18 firms using actual rates were chiefly in industries where the process cost method is applicable.

Fluctuations in Actual Monthly Burden Rates

There are two types of fluctuations in actual monthly burden rates that are of no significance from a product-costing standpoint. In the first place, a monthly overhead cost may deviate from budget allowances or norms. Where the budget control is weak, the monthly deviations are likely to be substantial. In one case, for example, a foreman requisitions small tools and shop supplies at irregular intervals. Although he usually does this once a week, he sometimes may let it go for two weeks or even longer in case he is busy, for the normal supply in the department is ample to take care of several weeks' requirements. The charges to his department, based on supply requisitions filled by the central storeroom, vary from month to month depending on when he happens to replenish the departmental supply, although over a term of months they would bear a normal relationship to the production volume. Even with good budget control there are some fluctuations in variable overhead from month to month which are not due to variations in volume. Machine repairs, for example, are made when machines are not producing, and it is good planning to schedule repair work for periods of low production. Over a term of months the repair costs tend to vary directly with production, but from month to month the repair cost per unit of production is likely to fluctuate. Variations in weather conditions cause fluctuations in monthly costs. On an annual basis the cost of heating and air

[1] N.A.C.A. Research Study, "Practice in Applying Overhead and Calculating Normal Capacity," *N.A.C.A. Bulletin*, Vol. 19, No. 15, Sec. III, pp. 917–934.

conditioning the factory space is a fixed cost. On a monthly basis it is an irregular cost; it fluctuates with the seasons of the year.

In the second place, there are usually fluctuations in the fixed-overhead rate from month to month owing to fluctuations in volume. Seasonal variations in production are found in many industries. In the manufacture of women's coats, for example, production for the spring trade starts in December on a small scale; through most of January, February, and March it is at peak volume; in April the volume tapers off; and in May it is negligible. If overhead were applied at actual monthly rates, the unit cost of coats produced in December and April would be overstated and the unit costs of those produced in the busy months would be understated. Either for costing inventories or for making a comparison of costs and selling prices it is better to apply the overhead at an average rate either for the 6-month season or for the year. There are very few industries that are not subject to some seasonal fluctuations in volume.

Calendar variations cause fluctuations in monthly volume particularly if the accounting month is the calendar month. For a factory operating 5 days a week and observing the six major holidays the working days per month in 1948 would be

January	21
February	20
March	23
April	22
May	20
June	22
July	21
August	22
September	21
October	21
November	21
December	23

It obviously distorts the product costs to apply overhead at different rates in different months merely because of variations in the working days available for production.

Shutdowns for inventory, for vacation, for rearrangement of machinery, and because of shortages of material also cause fluctuations in monthly volume that should not be reflected in the product costs of the month in which they happen to occur.

Difficulty in the Interpretation of Product Cost Data when Burden Is Applied at Actual Monthly Rates

It is difficult to interpret the product cost data when burden has been applied at actual monthly rates. The reported costs of two identical

orders produced in different months, for example, would not be comparable owing to differences in the burden rates. In the interpretation of product cost data under such circumstances it is generally necessary to know the production volume that was used in applying the overhead. Frequently the interpreter finds it necessary to adjust overhead costs to a desired level of production. This is a laborious task when actual monthly burden rates are used. An order requiring several months to process, for example, would be costed at several different overhead rates. A detailed analysis would be required in order to adjust the cost for purposes of interpretation.

Interval Required for Completion of Cost Reports

Actual monthly burden rates cannot be computed until after the various transaction summaries for the month as well as the overhead distribution have been completed. This usually takes 10 days or more. Then if the actual rates are used for the burden application, all the detail work of applying burden to cost sheets for the entire month and summarizing cost of production and cost of shipments remains to be done, and it is likely to be at least 20 days after the end of the month before the financial statements are ready.

Advantages of Predetermined Rates

When burden is applied at predetermined rates, the rates are usually not revised oftener than once a year. They are not subject to monthly fluctuations. There is not the difficulty in the interpretation of product cost data that is found when actual monthly rates are used. The work of applying burden to cost sheets can be spread over the month and completed within two or three days after the end of the month. The monthly financial statements can be available within 10 days after the close of the month. Costs of individual orders can be reported soon after the orders are completed. In job-order cost systems burden is almost always applied at predetermined rates in order to expedite the preparation of cost reports if for no other reason.

Predetermined rates are always used in standard cost systems. In fact the development of the technique of costing burden at predetermined rates in historical cost systems helped to lay the groundwork for the development of standard cost methods in which all the elements of product costs are predetermined. The standard-cost viewpoint is that predetermined rates are not only a means of obtaining cost reports promptly and smoothing month-to-month fluctuations, but also a device to regulate the fixed overhead applied to production and to segregate the cost of idle plant capacity from the cost of production. The latter

viewpoint is frequently adopted nowadays in job-order cost systems as well as in standard cost systems.

Predetermined Burden Rates

Predetermined burden rates are set with reference to a predetermined plant volume, which as a rule is either normal volume, expected actual volume, or practical plant capacity. Selection of the predetermined volume is a means of regulating the costing of fixed overhead to products, for the fixed-overhead rate varies inversely with volume. The costing of variable overhead is not affected, for the variable-overhead rate would be the same at any volume that might be selected.

The predetermined volume at each cost center corresponding to the predetermined plant volume must be estimated in terms of the burden-application base (Σb). The overhead of the cost center at that volume (Σc) is then estimated. The predetermined overhead rate is obtained by dividing ($\Sigma c \div \Sigma b$).

Predetermined rates are revised from time to time but in most cases not oftener than once or twice a year. Table 24.1 is a summary of the practices followed by 224 representative companies.

TABLE 24.1

FREQUENCY OF BURDEN RATE REVISION*

Frequency	Number of Companies
Monthly	7
Quarterly	8
Two to four times a year	3
Semiannually	22
Annually	101
Every two or three years	6
When necessary	37
Infrequent or rare revisions	19
Use actual rates	18
No answer	3
Total companies	224

* A tabulation of replies to the question "How often are your overhead rates revised?" From N.A.C.A. Research Study, "Practice in Applying Overhead and Calculating Normal Capacity," *N.A.C.A. Bulletin*, Vol. 19, No. 15, Sec. III, p. 922.

Monthly fluctuations in volume have no effect on the predetermined rates, and because burden is applied to production at the predetermined rates, the fixed overhead as well as the variable overhead is treated as a variable cost for cost-application purposes. The product costs thus obtained are uniformly representative of costs at a selected volume level. The periodic burden variances give management an indication of the effect of volume fluctuations on profits. If the volume variance is a debit variance, caused by operating at a volume below the predetermined

level, it is an index of the cost of having idle plant facilities. A credit variance indicates the favorable effect of utilizing the plant more fully than was contemplated in the predetermined rates.

Normal Volume

Normal volume or normal capacity is the expected average volume of a plant over a term of years, usually 5 to 10 years, a term long enough to take in periods of depression as well as periods of peak activity. Estimates of normal volume as a rule are based on averages for previous years modified to the extent necessary to give effect to anticipated changes in conditions. Ability to produce and ability to sell are both considered. Inasmuch as it is seldom possible to keep a plant fully occupied at all times over a term of years, the average sales expectancy is generally the determining factor.[1]

Predetermined burden rates based on normal volume are generally lower than the actual rates in periods of subnormal volume; they are likely to be higher than the actual rates in periods when production is above normal. Over a period of years they should be approximately the same on the average as the actual rates. The effect of using normal volume as the predetermined volume, therefore, is to spread the fixed overhead to product on a long-term basis. It is logical to do so, for the expenditures that give rise to fixed overhead are planned on a long-term basis.

The fixed overhead of a factory is attributable for the most part to (1) plant facilities and (2) supervisory and technical organization. In planning expenditures for plant and equipment the management takes into consideration the probable future demand for the products of the plant over a term of years. Because the demand cannot be expected in most cases to be uniform each year, facilities are generally provided to take care of peak demands to the extent that it is considered profitable to do so. Although they will not be fully utilized at all times, it is expected that the fixed overhead resulting from their purchase will be recovered during the useful life of the facilities through the sale of products. Supervisory and

[1] Confusion sometimes arises in discussions of cost accounting because the meaning of the term *normal volume* is not standardized. In this book the term is used to refer to the typical or average volume of a plant over a period of years. Many cost accountants follow this usage. It is the usage suggested in the *Cost and Production Handbook* from which the following definition is quoted:

"The number of standard productive hours which will produce at normal efficiency sufficient goods to meet average sales demand during an extended term of years, preferably a complete economic cycle, shall be termed normal capacity." Alford, L. P., ed., *Cost and Production Handbook*, p. 1118, The Ronald Press Company, New York, 1934.

technical staff is planned in accordance with the outlook for a year or more. It is not economical to shut off and turn on the expenditures for staff from month to month, and it is reasonable to expect to recover these expenditures on a long-term basis.

Expected Actual Volume

Expected actual volume is an advance estimate of the actual production of a plant for a period of a year (or in some cases a shorter period). The estimate is usually based on past performance adjusted according to the current outlook. As a rule the anticipated sales volume for the year under consideration is the governing factor, but ability to produce is a limiting factor, for the actual production volume cannot be more than the plant is equipped to produce.

Predetermined rates based on expected actual annual volume are likely to be used where the primary reasons for using predetermined rates are to expedite the reporting of costs and to avoid monthly fluctuations in burden-application rates. Although they would never be exactly the same as the actual rates except by coincidence, they should be approximately the same. Differences would be due to errors in forecasts. The approximate effect of using expected actual annual volume as the predetermined volume is to apply each year's overhead costs to the year's production. That principle is less abstract than the principle of spreading the fixed costs on a long-term basis, and it appears to many accountants to be consistent with the well-established practice of treating each year as a unit for the purpose of determining profit or loss. Furthermore, when economic conditions change as rapidly as they have in recent years, it is difficult if not impossible to make a reliable forecast of the trend of volume more than a year in advance.

Some cost accountants consider it advantageous from the standpoint of budgetary control to use expected actual volume as the predetermined volume, but in the author's opinion the advantage is slight especially where a flexible or variable budget has been developed. Selection of the predetermined volume has to do primarily with the costing of products, and product cost data have very little bearing on the control of periodic overhead costs. Product costs are end costs, whereas periodic overhead costs must be controlled at the source. Under variable budget procedure the weekly and monthly budgets are based on the actual volume regardless of what volume was selected as the predetermined volume.

Practical Plant Capacity

Practical plant capacity is the volume that a plant as a whole is equipped to produce in the regularly scheduled working hours. Where the regular

working schedule calls for one shift of 40 hours a week, the theoretical capacity of each machine would be 40 hours a week. The practical capacity, however, would be less than that. Allowances must be made for machine breakdowns, material shortages, absence of the operator, and unbalanced machine capacities. The practical capacity of a machine is seldom more than 90 per cent of its theoretical capacity, and in most cases it is less than that. The practical capacity of the plant as a whole is the sum of the practical capacities of the various units of processing equipment in service in the plant.

There are few plants where the capacities of the different types of equipment are perfectly balanced with relation to each other. It is necessary to make allowance for unbalanced conditions in order to determine the capacity of the plant as a whole and the capacities of individual machines in relation to the whole.

To illustrate:
Assume that a plant making a single product has two machines, A and B, and that each unit of product requires 1 hour of work on machine A and 2 hours of work on machine B. Unless other work could be found for machine A, it would operate only half as many hours as machine B. If the practical capacity of machine B were 36 hours a week, then the practical capacity of machine A would be 18 hours a week and the practical plant capacity in terms of machine-hours would be 54 hours a week.

Although ability to produce is generally regarded as the governing factor in the determination of practical plant capacity, ability to sell is a conditioning factor, for the regular schedule of working hours is established to conform to the sales expectancy over a term of months. Usually the schedule of working hours is planned to take care of maximum sales demand with some allowance for building up inventories of stock items during seasons of small demand and then drawing upon the inventories during seasons of peak sales. Temporary changes in working schedules are not usually reflected by changes in predetermined plant capacity and predetermined burden rates, but where a change in schedule is expected to be in effect for a long time, it is usually desirable to revise the predetermined volume and the predetermined rates. As an extreme case it would obviously be unsatisfactory to use burden rates based on one-shift operation in a plant operating 24 hours a day.

Ability to sell has an effect also upon the balance or lack of balance in machine capacities. Changes in demand for the different products of a plant frequently are a cause of unbalanced machine capacities. Intelligent direction of sales effort, on the other hand, may sometimes remedy an unbalanced condition. To refer to the first illustration in this section, if

it were possible to find an independent market for the work of machine A, its practical capacity might be increased to 36 hours a week, and in that case the practical plant capacity would be 72 machine-hours a week instead of 54.

In process industries and mass-production industries where the products are few in number and where each machine performs only a limited number of different operations, it is usually feasible to use engineering data in order to compute machine capacities and plant capacity for a given production schedule. From production routings the machine-hours required on each type of machine per unit of product would be summarized. If there were more than one product, it would be necessary to summarize the machine-hours per unit for each product. Machine loads for a given production schedule would be computed by multiplying the hours per unit by the number of units scheduled.

In industries where the products are numerous and where many of the machines perform a variety of operations, practical plant capacity represents a composite of so many factors that it must generally be estimated on the basis of past performance. The output actually attained during a period of peak production in the past would usually be selected as the practical plant capacity, provided that the schedule of working hours was the same as that contemplated in the determination of plant capacity. In case there is evidence to indicate that the plant has never operated at full practical capacity in the past or if plant facilities have been materially altered, the peak production of the past would be adjusted to obtain an estimate of the current plant capacity. Departmental capacities would also be set on the basis of past experience with adjustments where necessary to give effect to recent changes such as, for example, a change in plant layout whereby certain machines were transferred from one department to another.

Practical plant capacity is the maximum volume attainable by the plant as a whole working the full number of hours available in regularly scheduled shifts. As a rule it is a difficult standard to reach, for the capacity is usually planned not for the average sales expectancy but to take care of peak demands. Some provision would be made for building up inventories of stock items during seasons when sales are low and then drawing upon inventories during seasons of peak sales; nevertheless it would generally be the practice during dull seasons to taper off production either by temporarily shortening the hours or by reducing the force of workers. It is seldom possible to operate a plant continuously at full practical capacity. Predetermined burden rates based on practical plant capacity are therefore likely to be consistently lower than actual rates.

Practical-capacity rates are most often adopted in plants where operations are stabilized at or near practical plant capacity. Where there are substantial fluctuations in production volume, one of the other types of burden rates is likely to be more satisfactory for general costing purposes.

Types of Predetermined Volume Found in Practice

The relative popularity of the principal types of predetermined volume is indicated by the replies to the N.A.C.A. questionnaire previously referred to. The following tabulation is reprinted by permission.[1]

1. Those using estimated production based on ability to produce only	5 companies
2. Those using estimated production based on ability to produce and sell	44 companies
3. Those using normal capacity based on ability to produce only	34 companies
4. Those using normal capacity based on ability to produce and sell	89 companies
	172 companies

The foregoing data are regrouped below in accordance with the terminology adopted in this text.

172 COMPANIES

Type of Predetermined Volume Used	Number of Companies
Normal volume	89
Expected actual volume	49
Practical plant capacity	34
	172

It is pointed out in the N.A.C.A. study that

> . . . there are not a few distinct methods of measuring estimated production or normal capacity, but that one method tends to blend into another and that the best indication that we can get of the method followed is secured from a listing in order of importance of the factors given consideration. The terms "normal capacity," "estimated production," "ability to produce only," and "ability to produce and sell" are likely to have different meanings to different people.[2]

In some cases the actual rates of the previous year are used as the predetermined rates. In any event past performance is a guide in the setting of predetermined rates, and usually the current outlook is taken into consideration also.

Predetermined Cost-center Volume

In addition to predetermining the volume of the plant as a whole, it is necessary to predetermine the volume of each cost center in terms of its

[1] N.A.C.A. Research Study, "Practice in Applying Overhead and Calculating Normal Capacity," *N.A.C.A. Bulletin*, Vol. 19, No. 15, Sec. III, p. 928.

[2] *Ibid.*, p. 930.

burden-application base. Ordinarily this phase of the establishment of predetermined burden rates is not extremely difficult. In job-order cost systems and standard cost systems plant volume can usually be stated in terms of direct man-hours. Then if the burden is to be applied at departmental rates per direct man-hour, all that is necessary is to apportion the plant total departmentally. The departmental proportions, which should represent current conditions, are usually estimated on the basis of the past year's experience with adjustments where needed to reflect recent changes in departmental loads due, for example, to rearrangement of machines or to variations in the demand for the different products of the plant. In mass-production shops departmental proportions may in some cases be determined on the basis of engineering data, but where the products are numerous and the operations varied, it is generally necessary to rely to a large extent upon statistics of past performance.

Where there is a department or a division of a plant that is a self-contained processing unit with an independent market for its products, the predetermined departmental volume would be established independently. The predetermined plant volume in this case would be obtained by adding the predetermined volumes of the departments or divisions of the plant. Ordinarily, however, the departments are interrelated and the predetermined plant volume is first established by taking into consideration the productive capacity and the sales expectancy of the plant as a whole. The predetermined departmental volumes are then set by apportioning the plant totals among the departments.

In case burden is to be applied at departmental percentages of direct labor cost, the predetermined volume of each department in terms of direct man-hours would first be determined and then be multiplied by the current average earning rate on direct operations in the department. The resulting figure would be the predetermined volume of the department in terms of direct labor cost.

Predetermined Weight of Material

In case material burden is to be applied separately on the basis, let us say, of the weight of material put into production, it would be necessary to estimate the weight of the material that would be used at the predetermined plant volume. Inasmuch as material usage tends to vary with volume, a ratio of material weight to direct man-hours would be established on the basis of past experience. That ratio would be multiplied by the predetermined plant volume in direct man-hours. The resulting product as a rule would be the predetermined material weight. Inasmuch as the ratio of material weight to direct man-hours would differ for different products, however, adjustments might be needed in case a

shift was in prospect in the proportions of sales of different products. Engineering data on the weight of material used in each major product and the direct man-hours required would be referred to by the cost accountant in order to work out the necessary adjustments. In some cases the predetermined material weight would be computed entirely from engineering data and not on the basis of past experience.

Predetermined Machine-center Volume

In case burden is to be applied at machine rates, the predetermined volume of each machine center must be established and stated in terms of machine-hours. Generally, the department volume in direct man-hours would first be predetermined by one of the methods previously described. After this the procedure would depend upon circumstances. Where the capacities of the various machines in a department are not balanced, it would be necessary to apportion the departmental volume to individual machine centers on the basis of the work load of each machine center at the predetermined departmental volume. Where there is a balanced condition, it would generally be feasible to set the predetermined volume of all machine centers at a uniform percentage of

TABLE 24.2

CALCULATION OF PREDETERMINED MACHINE-CENTER VOLUMES WHEN MACHINE CAPACITIES ARE BALANCED

Data

1. Predetermined annual departmental volume: 64,000 direct man-hours. For the purpose of the illustrations it is immaterial whether this is normal volume, expected actual volume, or practical capacity.
2. Regular schedule of working hours: one shift of 40 hours a week for 50 weeks a year. Certain machines, however, are operated an extra shift at times.
3. Machines in department and theoretical capacities:

Type of machine	Number of machines	Number of operators per machine	Theoretical annual capacity	
			Machine-hours	Man-hours
A	1	1	2,000	2,000
B	6	1	12,000	12,000
C	6	1	12,000	12,000
D	8	1	16,000	16,000
E	2	1	4,000	4,000
F	3	1	6,000	6,000
G	10	½	20,000	10,000
H	9	⅓	18,000	6,000
I	2	2	4,000	8,000
J	1	2	2,000	4,000
Department total.	48		96,000	80,000

TABLE 24.2 (*Continued*)
Calculation

Type of machine	Actual running time, latest 12-month period			Theoretical capacity, machine-hours	Predetermined volume, machine-hours at 80% of theoretical capacity (4) × 80%
	Machine-hours	Man-hours	Per cent of theoretical machine capacity (1) ÷ (4)		
	(1)	(2)	(3)	(4)	(5)
A	1,350	1,350	68	2,000	1,600
B	8,000	8,000	67	12,000	9,600
C	8,400	8,400	70	12,000	9,600
D	11,000	11,000	69	16,000	12,800
E	2,850	2,850	71	4,000	3,200
F	4,350	4,350	73	6,000	4,800
G	14,000	7,000	70	20,000	16,000
H	12,900	4,300	72	18,000	14,400
I	2,750	5,500	69	4,000	3,200
J	1,400	2,800	70	2,000	1,600
Department total . . .	67,000	55,550	70	96,000	76,800

The percentages in column (3) indicate that machine capacities are in balance. The deviations from the norm (70%) are small.

The predetermined machine-center volumes are therefore set at the predetermined departmental average percentage of capacity, which is 80% (see calculations below).

Predetermined departmental volume in man-hours	64,000 man-hours
Multiply by: Ratio of machine-hours to man-hours at theoretical capacity (96,000 ÷ 80,000)	1.2
Predetermined departmental volume in machine-hours	76,800 machine-hours
Predetermined departmental average per cent of theoretical machine capacity (76,800 ÷ 96,000)	80%

full theoretical capacity. The percentage would be the departmental average percentage of full capacity at predetermined departmental volume. Where machine capacities are fairly well balanced except that certain special-purpose machines have excess capacity, the procedure would follow in general the pattern of procedure for a balanced condition, except that individual calculations would be made for the special-purpose machines. Under any circumstances it would be necessary at some stage in the computation to convert direct man-hours into machine-hours. The total of the predetermined machine-center volumes should

TABLE 24.3

CALCULATION OF PREDETERMINED MACHINE-CENTER VOLUMES WHEN MACHINE CAPACITIES ARE NOT BALANCED

Data

Same as for Table 24.2

Calculation

Type of machine	Actual running time—latest 12-month period			Percent of total man-hours based on (2)	Proration of predetermined departmental volume (4) × 64,000
	Machine-hours	Man-hours	Per cent of theoretical machine capacity		
	(1)	(2)	(3)	(4)	(5)
A	2,400	2,400	120*	4.29	2,746
B	7,200	7,200	60	12.86	8,230
C	8,400	8,400	70	15.00	9,600
D	11,200	11,200	70	20.00	12,800
E	4,000	4,000	100*	7.14	4,570
F	3,600	3,600	60	6.43	4,115
G	10,000	5,000	50	8.93	5,715
H	19,800	6,600	110*	11.78	7,539
I	3,200	6,400	80	11.43	7,315
J	600	1,200	30	2 14	1,370
Department total. . . .	70,400	56,000	73	100.00	64,000

Type of machine	Adjustments to reflect current trends	Predetermined volume, man-hours (5) + (6)	Number of operators per machine	Predetermined volume	
				Machine-hours (7) ÷ (8)	Per cent of theoretical machine capacity*
	(6)	(7)	(8)	(9)	(10)
A	+ 54	2,800	1	2,800	140%
B	.....	8,230	1	8,230	69
C	.....	9,600	1	9,600	80
D	.....	12,800	1	12,800	80
E	.....	4,570	1	4,570	114
F	.....	4,115	1	4,115	69
G	+585	6,300	½	12,600	63
H	−824	6,715	⅓	20,145	112
I	+185	7,500	2	3,750	94
J	.....	1,370	2	685	34
Department total.....	0	64,000		79,295	83%

* These machines operated an extra shift part of the year.

of course be equal to the predetermined departmental volume when both are expressed in the same unit of measure. Tables 24.2 and 24.3 illustrate procedures followed in setting predetermined machine-center volumes.

Estimate of Cost-center Overhead at Predetermined Volume

An estimate must be made of the overhead of each cost center at the predetermined volume. Where the processing departments are the cost centers, and where there is a variable budget, the variable budget allowances would be utilized in estimating departmental overhead costs at predetermined volume. For this purpose the budget allowances must cover all overhead applicable to the processing departments and not merely that which is considered to be controllable by the department foremen (see Table 24.4). A distribution of the estimated overhead at the predetermined volume may be made in a form similar to that illustrated by Table 24.5. The budget allowances in Table 24.4 were used in making the estimate of the Assembly Department overhead which appears in Table 24.5.

Where variable budget allowances have not been developed, the department overhead would be estimated on the basis of past experience with modifications for anticipated changes. As a guide in making the estimates an overhead distribution for the most recent 12-month period would generally be prepared, and similar summaries for previous years and for individual months would be assembled. A separate study would be made of each of the natural classifications. In the case of those classifications representing principally fixed costs, the monthly amounts usually change but slightly from year to year. The changes can be predicted reasonably well by the cost accountant if he is conversant with the plans of management. It might be possible to prepare the fixed-charge schedule for the ensuing year at the time of developing the estimates of department overhead. If so, those costs of depreciation, taxes, and insurance which are covered by it would be taken from the fixed-charge schedule. In the case of those classifications representing principally variable costs, the cost per direct man-hour would be estimated on the basis of past experience modified if necessary so as to reflect current developments. The resulting ratio would be multiplied by the number of direct man-hours at the predetermined departmental volume. In the case of those classifications, frequently referred to as semivariable, which cannot be characterized either as fixed or variable, analysis would be made to determine the fixed and the variable elements.

It can be seen that the procedure just described is similar to that which is followed when there are variable budget allowances. In fact

TABLE 24.4
CAMPBELL TOOL AND DIE COMPANY
ASSEMBLY DEPARTMENT
Variable Budget Allowances Covering All Overhead
Applicable to This Department for Product-costing Purposes

Natural classification	Fixed or stand-by cost		Variable cost per direct hour
	Per year	Per month	
Indirect labor (exclusive of supervision)	$ 2,400	$ 200	$0 1050
Shop supplies	600	50	0.0422
Maintenance	720	60	0.0312
Purchased electricity			0 0296
Fuel			
Payroll taxes and insurance	420	35	0 0360
Provision for vacation pay (hourly force)	48	4	0 0180
Defective work			0.0040
Miscellaneous			
Property taxes	1,060	88	
Property insurance	120	10	
Depreciation	4,200	350	
Supervision and technical services	9,600	800	0.0200
Subtotal	$19,168	$1,597	$0.2860
Maintenance department	1,920	160	0.0100*
Building occupancy	14,400	1,200	
Shop administration	17,774	1,481	0 1000
Total	$53,262	$4,438	$0 3960

Range of volume covered: 90,000 to 150,000 direct hours per year, or 7,500 to 12,500 direct hours per month.

Predetermined burden rate at volume of 128,000 direct hours per year, or 10,667 per month, 81¢ per direct hour, computed as follows:

	Per Year	Per Month
Fixed overhead	$ 53,262	$4,438
Variable overhead, 128,000 × $0.3960	50,688	4,225
Total overhead	$103,950	$8,663

Predetermined burden rate: $103,950 ÷ 128,000 = $0.8121

Fixed-overhead rate, 53,262 ÷ 128,000 =	$0.4161
Variable-overhead rate	0.3960
	$0.8121

* Maintenance department variable overhead is distributed on basis of service furnished; the charge to the Assembly Department normally averages 1 cent per direct hour.

TABLE 24.5

CAMPBELL TOOL AND DIE COMPANY

Estimated Monthly Overhead and Predetermined Burden Rates Effective July 1, 19—

Predetermined Volume: 38,100 Direct Man-hours per Month

Line	Natural classification	Service departments			Processing departments			Total
		Maintenance	Building occupancy	Shop administration	Machine shop	Heat treat	Assembly	
1	Indirect Labor	$ 400	$1,000	$2,333	$ 4,850	$ 354	$1,320	$10,257
2	Shop Supplies	651	700	257	3,425	1,362	500	6,835
3	Maintenance	126	1,062	170	3,833	815	393	6,399
4	Purchased Electricity	133	300	25	1,775	533	316	3,082
5	Fuel		767			417		1,184
6	Payroll Taxes and Insurance	216	49	223	1,251	120	419	2,278
7	Provision for Vacation Pay (Hourly Force)	108	20	47	597	50	196	1,018
8	Defective Work			100	200	80	43	423
9	Miscellaneous	133	19	500				652
10	Property Taxes	33	750	250	570	100	88	1,791
11	Property Insurance	8	83	75	110	15	10	301
12	Depreciation	150	625	300	2,250	500	350	4,175
13	Supervision and Technical Services	708	225	4,167	1,750	567	1,013	8,430
14	Total Factory Overhead Estimate	$2,666	$5,600	$8,447	$20,611	$4,853	$4,648	$46,825
15	Redistribution of Service Departments							
16	Maintenance Department—Fixed	1,600	240	32	1,040	28	160	
17	Variable	$1,066	160	21	693	85	107	
18	Building Occupancy—Fixed		$6,000	600	3,600	600	1,200	
19	Shop Administration—Total			$9,100				
20	Fixed			5,290	3,439	370	1,481	
21	Variable			$3,810	2,476	267	1,067	
22	Total allocated to processing departments (Σc)				$31,859	$6,303	$8,663	$46,825
23	Predetermined Direct Hours (Σb)				24,766	2,667	10,667	38,100
24	Predetermined Burden Rates ($\Sigma c \div \Sigma b$)				$1 29	$2 36	$0 81	$1 23
25	Percentages Used in Redistribution of Service Department Costs							
26	Maintenance Department—Fixed, based on normal maintenance service	100%	15%	2%	65%	8%	10%	
27	Variable, based on normal maintenance service	100%	15	2	65	8	10	
28	Building Occupancy—Fixed, floor-space units		100%	10	60	10	20	
29	Variable, based on floor-space units		None					
30	Shop Administration—Fixed, predetermined direct hours			100%	65	7	28	
31	Variable, based on predetermined direct hours			100%	65%	7%	28%	

the study of overhead costs for the purpose of establishing burden-application rates has helped to lay the groundwork in many plants for the development of variable budgets. Under variable budgeting, however, a more careful analysis is made with the object of determining what the cost should be.

Estimate of Machine-center Overhead

Where machine rates are wanted, it is necessary to estimate the overhead of each machine center at the predetermined volume. Departmental overheads would first be estimated and then apportioned to machine centers. The following outline indicates typical methods of making the apportionment. See also the section entitled "Overhead Distribution When Burden Is Applied at Machine Rates" in Chapter 23.

OUTLINE OF METHOD OF APPORTIONING OVERHEAD TO MACHINE CENTERS

Classification	Basis of Apportionment
Work-point Overhead	
Machine repair	Actual cost of repairs, previous year, from maintenance orders
Power	Engineer's estimates based either on test-meter readings or on horsepower of motors
Supplies and small tools	Engineer's and foreman's estimates. Cost accountant would prepare analysis of the supply requisitions for a month or longer for use as a guide
Machinery depreciation	Cost of machines from plant ledger
Taxes and insurance on machinery and interest on machinery investment	Either sound value of machines from appraisal record or net book value of machines from plant ledger
Building occupancy	Floor space at each work point, including space occupied by the machine and space adjacent to the machine which is required for its operation but excluding aisles and passageways used for general traffic
Process-personnel Overhead	
Department supervision, trucking and other indirect labor, defective work, building occupancy cost allocated to department office, to main aisles, etc., general department supplies, and other overhead of the department	If the process-personnel overhead is to be included in the machine rate, the departmental rate of process-personnel overhead per direct man-hour would first be determined and then be converted to a rate per machine-hour at each machine center by multiplying it by the number of operators required for one machine (see Table 23.2, paragraph 220). The effect of this procedure is to apportion the predetermined process-personnel overhead of the department on the basis of the direct man-hours at each machine center

Burden Application—Job-order Cost Systems

There are three phases of the application of burden at predetermined rates in job-order cost systems. They are (1) the application to job-order cost sheets, (2) the calculation of department totals each month, and (3) the debit of the monthly grand total to the control account Goods in Process. In case burden is applied to cost sheets only upon the completion of orders, a monthly total of burden to be applied would be obtained for each department by multiplying the quantity of the burden-application base, for example, the direct hours for the month, by the predetermined burden rate for the department. The plant total would be obtained by adding the departmental totals and would be charged to Goods in Process. The amount of overhead that would eventually be charged to cost sheets covering the work of that month should agree approximately with the totals thus obtained. Owing to the dropping and carrying of fractions on the cost sheets there is likely to be a slight discrepancy. As a matter of fact, however, it would be impractical to compare the two results, for the burden applied to cost sheets would not be segregated by months.

In case burden is applied to cost sheets monthly or oftener, the department totals of burden applied may be obtained each month by summarizing the charges made to cost sheets. This is the best procedure to follow in computing the debit to Goods in Process if the subsidiary cost sheets are to be kept in exact agreement with the Goods in Process control. The departmental totals thus obtained should be compared with the amounts obtained by multiplying the quantity of the burden-application base by the predetermined rate for each department. If there should be more than a slight difference between the two totals, it would indicate that a clerical error had been made.

The monthly journal entry for the application of burden is a debit to Goods in Process and a credit to Factory Overhead or to a related account. Illustrations will be found in entry 12-12 of Table 8.2 and entry 1-12f of Table 9.3. In Table 21.1 the departmental totals and the plant total of burden applied are shown on line 20.

Burden Application—Standard Cost Systems

In standard cost systems a standard cost card is prepared for each part and assembly that the plant is likely to manufacture. The standard cost card shows the unit cost. The file of standard cost cards is used in costing transfers of worked material. There is no subsidiary record showing in detail the composition of the Goods in Process balance.

On the standard cost cards the labor and burden costs are shown by operations. The standard quantity of the base factor on each operation

is multiplied by the predetermined burden rate. The standard unit cost of labor and burden is frequently summarized departmentally for use in statistical analyses of product costs and in the development of data for use in forecasts.

At the end of each month the department totals of burden applied are obtained by multiplying the monthly quantity of the base factor for each department by the predetermined burden rate. The plant total is the sum of the department totals.

The tally of the monthly quantity of the burden application base presents a problem in standard cost systems, for the base is a standard figure, such as, for example, the standard direct man-hour. The standard adopted for standard cost purposes generally represents the expected level of performance, a standard that is attainable if management and workmen both function effectively. The standard direct hour is a measure of the amount of work that a qualified worker can be expected to perform in 1 hour at the level of performance that has been adopted as the standard for product-costing purposes. The periodic tally of standard direct hours is therefore a tally of the work done in terms of standard direct hours.

TABLE 24.6

STANDARD DIRECT HOURS OF WORK PERFORMED BY A DEPARTMENT IN A GIVEN MONTH COMPUTED ON THE BASIS OF OUTPUT

Part No.	Output for the month (number of pieces)	Standard direct hours required in this department	
		Per 100 pieces	Total for the month
2010	100,000	10.0	10,000
2020	80,000	8.5	6,800
2021	5,000	11.2	560
2180	92,000	10.0	9,200
Total.	. .....	....	26,560

Where there is only a short interval between the receipt of material in a department and its completion and where the inventory of worked material in the department is approximately the same at all times, the standard direct hours of work done can be computed on the basis of the output of the department in terms of physical units. Table 24.6 illustrates the computation in a case of this type.

In case the departmental inventory fluctuates, it is sometimes feasible to compute the standard direct hours for the month by first determining the standard direct hours represented by the output, as in

the foregoing example, and then adjusting for inventory fluctuations somewhat as follows:

Output for the month in terms of standard direct hours (computed as illustrated in Table 24.6)			26,560 hours
Increase in inventory of work in process in terms of standard direct hours:			
Inventory at end of month: 20,000 pieces which are 50% completed on the average. Standard direct hours per hundred pieces in this department on the average: 10. The 20,000 pieces 50% completed therefore represent 1,000 standard direct hours in this department	1,000		
Inventory at beginning of month: 2,000 pieces 25% completed, equivalent to 50 standard direct hours in this department	50	950	
Standard direct hours of work for the month			27,510 hours

Where it is not feasible to take a monthly inventory, it is generally necessary to obtain a tally by operations of the work performed. In case a wage-incentive plan has been adopted, the tally recorded on the time tickets for earnings-computation purposes can generally be utilized in the computation of standard hours for burden-application purposes. Under an incentive bonus system, for example, the standard time for each operation performed would appear on the time tickets, and departmental totals would be obtained regularly in order to determine departmental labor efficiency.

Note, however, that the standard time for bonus-incentive purposes in many cases is not the same as the standard direct hours for cost purposes. As explained in the chapter on labor cost control the standard time for wage-incentive purposes is set at a somewhat arbitrary level. Where the standard represents a "high task," the normal performance is likely to average between 85 and 100 per cent of standard. Where it represents a "low task," the normal performance can be expected to average between 125 and 160 per cent of standard. For product-costing purposes, on the other hand, the standard adopted should be realistic. It should be an attainable standard. The performance at expected efficiency is generally adopted as the standard for standard cost purposes.

To convert wage-incentive standard time to standard-cost standard time, divide the former by the expected efficiency ratio. If the standard time allowed for wage-incentive purposes for a certain operation is 10 hours and if the expected efficiency is 125 per cent, then the standard time for standard cost purposes would be 10.0 ÷ 1.25, or 8.0 hours.

To compute standard direct hours for burden-application purposes,

the total of wage-incentive standard hours for each department would be divided by the average job efficiency that was used in computing the standard costs of operations in the department. Thus, if a summary of the time tickets covering a period of a month for a certain department showed a total of 12,000 wage-incentive standard hours and if a performance efficiency of 125 per cent was used in building up the standard cost of operations in this department, then the standard-cost standard direct hours for the month would be 12,000 ÷ 1.25, or 9,600 hours. That would be the quantity of the burden-application base for the month.

Under a piece-rate system the piece-rate earnings would be recorded on time tickets and summarized in the labor distribution. To compute the equivalent number of standard hours the piece-rate earnings would be divided by the basic piecework rate per hour. Frequently, however, when the pay is at piece rates, the burden is applied on the basis of standard direct labor cost, and in that case the total of the standard piece-rate earnings would be multiplied by the predetermined burden percentage in order to determine the applied burden. It would not be necessary for burden-application purposes to compute the standard hours.

Where burden is applied at machine rates, there are two alternative methods of obtaining a department total. In case the flow of work is such that each machine center's proportion of the work of the department is uniform from month to month, then it may be satisfactory to use a departmental average rate to compute the department total of burden applied even though machine rates are employed for the costing of individual operations. If the relative proportions of work at the different machine centers fluctuate from month to month, however, it would be necessary each month to compute the overhead applied or absorbed at each machine center. The latter method is generally preferable because the results are more certain to be accurate. The base factor quantity for the month at the machine center would be multiplied by the predetermined burden rate. The department total of burden absorbed would then be obtained by adding the machine-center amounts.

The journal entry for the application of burden in a standard cost system is similar to that in a job cost system. Goods in Process is debited, and either Factory Overhead or a related account is credited. An illustration will be found in entry 7-9 of Table 10.2. On the overhead distribution summary, the applied overhead may be shown as illustrated on line 20 of Table 21.1.

It should be noted that in some plants where standard cost procedures are only partly developed, the actual monthly totals of the base factor are used instead of a standard figure in the computation of burden applied. Thus, if burden is applied on the basis of direct hours, the

actual direct hours for a given month would be multiplied by the predetermined burden rate in order to compute the debit to Goods in Process. Under this procedure inventory variations are to be expected, for the debits to Goods in Process are based on the direct hours actually taken; whereas, the credits to Goods in Process, obtained by costing the output from the standard cost cards, are based on the standard hours of work in the products of the factory.

Conversion Cost Application—Process Cost Systems

In process cost systems conversion costs are applied or debited to departmental Goods in Process accounts, usually at monthly intervals. As a rule it is the actual conversion cost that is applied. This practice is followed in the illustration of ledger procedure in Chapter 11.

Conversion cost may be applied, however, at predetermined rates. Where there are marked fluctuations in volume from month to month, the latter practice is likely to be favored as a means of reporting more representative unit costs and of measuring the cost of idle capacity. Either process hours or physical units of production would generally be used as the base factor for the application of conversion cost at a predetermined rate.

CHAPTER 25

BURDEN VARIANCE

The difference between the actual factory overhead for an accounting period and the amount applied is called factory overhead variance or burden variance. The Burden Variance account, if one is used, is debited with the actual overhead and credited with the overhead applied. When the actual overhead is the greater, the account would have a debit balance and the variance would be a debit variance. In case the actual overhead is less than the amount applied, the variance account would have a credit balance, and the variance would be a credit variance.

Analysis of Burden Variance

Burden variance may be analyzed according to causes. A two-way analysis would show (1) volume variance and (2) budget variance or controllable variance. The budget variance may be analyzed further according to standing orders. The method to use for making the two-way analysis depends upon the data available. Two methods are explained and illustrated below.

First Method

This method can be employed where flexible budget allowances have been established.

Let A = actual overhead for the month
B = monthly budget at the volume actually attained
C = overhead applied at predetermined rates

Then $A - C$ = total burden variance
$B - C$ = volume variance
$A - B$ = overhead budget variance

In each case if the result of the subtraction is a positive figure, the variance is a debit variance; if the result is a negative figure, the variance is a credit variance.

Note that $(A - B) + (B - C) = (A - C)$.

To illustrate:

The flexible budget allowances of a certain assembly department are shown in Table 24.4. The predetermined departmental volume is 10,667 direct hours

per month. At this volume the monthly overhead budget would be \$4,438 plus (10,667 × \$0.3960), or \$8,663. The predetermined burden rate is therefore \$8,663 ÷ 10,667, or 81 cents per direct hour (see Table 24.5). In September, 19—, the actual overhead was \$7,509 and the production volume was 7,501 direct man-hours (see Table 21.5).

Then A = \$7,509

B = \$4,438 + (7,501 × \$0.3960) = \$7,408

C = 7,501 × \$0.81 = \$6,076

Total burden variance ($A - C$) =		\$1,433
Volume variance ($B - C$) =	\$1,332	
Overhead budget variance ($A - B$) =	101	
Total ($B - C$) + ($A - B$) =		\$1,433

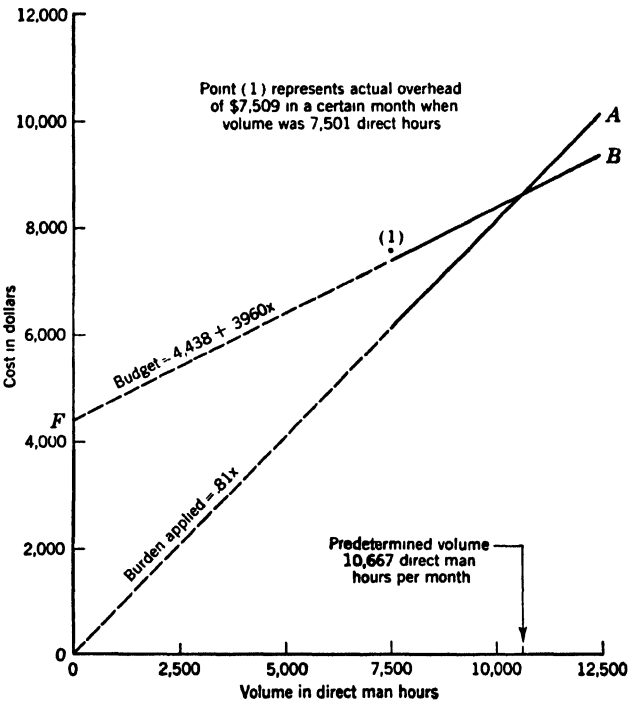


FIG. 25.1.—Overhead budget and burden applied at different monthly production volumes—assembly department. (Note that budget allowances apply only to monthly volumes ranging from 7,500 to 12,500 direct man hours.)

The analysis by causes can also be made graphically. In Fig. 25.1 the line FB represents budget allowances at various volumes, the line OA represents burden applied at various volumes, and the point (1) represents the actual overhead of \$7,509 in September, 19—, when the actual volume was 7,501 direct man-hours. The vertical distance

between that point and the line OA represents the total variance. The vertical distance between lines OA and FB represents the volume variance, and the vertical distance between line FB and the point (1) represents the budget variance. In this illustration all three variances are debit variances.

The first method of analysis may be employed with any type of cost system provided that there are flexible budget allowances. In a standard cost system, as a rule, the overhead would be applied on the basis of standard hours (or standard labor cost) and the budget allowances would also be based upon standard hours (or standard labor cost). B would equal the budget at the volume actually attained measured in standard hours of work completed; C would equal the burden applied at predetermined rates based on standard hours.

In a job-order cost system the actual direct hours (or the actual labor cost) would be used, instead of a standard figure, as the burden-application base and the measure of volume for budget purposes. B in this case would equal the budget at the volume actually attained measured in terms of actual man-hours, C would equal the burden applied at predetermined rates based on actual direct hours.

Second Method

This method may be used where variable budget allowances have not been established. The estimated overhead cost at predetermined volume is analyzed to obtain estimated totals of fixed overhead and variable overhead. For this purpose each of the natural overhead classifications is treated either as entirely fixed or as entirely variable. A predetermined fixed-overhead rate and a predetermined variable-overhead rate are computed. By means of these separate rates the overhead applied in any given month is analyzed to determine the amount of fixed and the amount of variable overhead applied. (The separate rates are employed only for the purpose of analyzing the burden variance and not to apply overhead cost to products. For the latter purpose a single burden rate covering both fixed and variable overhead would be used for each cost center.)

The actual overhead for the month is then analyzed to obtain totals of the fixed overhead and the variable overhead. Those classifications which were treated as fixed-overhead classifications in computing the fixed-overhead rate would be counted as fixed overhead in obtaining the actual total of fixed overhead for the month; those classifications which were treated as variable-overhead classifications would be counted as variable overhead for the purpose of obtaining the actual total of variable overhead for the month.

TABLE 25.1

ANALYSIS OF PLANT BURDEN VARIANCE FOR A GIVEN MONTH WHERE VARIABLE BUDGET ALLOWANCES ARE NOT AVAILABLE

Actual Volume: 24,782 Direct Man-hours

	Total	Fixed	Variable
Actual Overhead			
Indirect labor	$ 7,477		$ 7,477
Shop supplies	5,210		5,210
Maintenance	5,985		5,985
Purchased electricity	2,123		2,123
Employee security costs	2,176		2,176
Miscellaneous	706	$ 706	
Property taxes and insurance	1,550	1,550	
Depreciation	3,180	3,180	
Supervision and technical services	6,560	6,560	
Total overhead for the month	$34,967	$11,996	$22,971
Overhead Applied			
Total applied (24,782 hr. @ $1.36*)	33,704		
Fixed (24,782 hr. @ $0.44*)		10,904	
Variable (24,782 hr. @ $0.92*)			22,800
Burden Variance			
Total burden variance	$ 1,263		
Volume variance		$ 1,092	
Controllable variance			$ 171

* Calculation of Predetermined Burden Rates:

Predetermined Monthly Volume: 27,500 Direct Man-hours

Estimated monthly overhead at predetermined volume	Total	Fixed	Variable
Indirect labor	$ 8,230		$ 8,230
Shop supplies	5,700		5,700
Maintenance	6,550		6,550
Purchased electricity	2,350		2,350
Employee security costs	2,400		2,400
Miscellaneous	660	$ 660	
Property taxes and insurance	1,550	1,550	
Depreciation	3,180	3,180	
Supervision and technical services	6,730	6,730	
Total	$37,350	$12,120	$25,230
Predetermined burden rates per direct hour (totals divided by 27,500)	$1.36	$0.44	$0.92

The difference between the actual fixed overhead and the fixed overhead applied is a measure of the volume variance. The difference between the actual variable overhead and the variable overhead applied is an index of the amount of controllable variance. This method is practical for obtaining an analysis of the burden variance of a plant as a whole; but it is less accurate than the first method, for it does not recognize the fact that many of the natural classifications of overhead contain both a fixed element and a variable element. It cannot be used satisfactorily for the analysis of department variances unless the fixed and the variable costs of the service departments are apportioned separately in the monthly redistribution of service department costs. An illustration of the second method of analysis will be found in Table 25.1.

Volume Variance

Overhead volume variance represents the fixed cost that is unabsorbed or overabsorbed due to variations in volume from a predetermined norm. It is a measure of the cost of idle capacity, but a relative and not an absolute measure. It must be interpreted with reference to the volume that has been adopted as the predetermined volume. Other things being equal, the greater the predetermined volume, the greater will be the unabsorbed burden. The accompanying tabulation demonstrates this fact.

	Case 1	Case 2
Predetermined monthly volume in direct man-hours (Σb)	10,667	9,500
Overhead budget at predetermined volume		
Fixed overhead	$4,438	$4,438
Variable overhead at $0.3960 per direct hour	$4,225	$3,762
Total (Σc)	$8,663	$8,200
Predetermined burden rate (Σc) ÷ (Σb)	$ 0.81	$ 0.86
Actual volume in a given month	9,000 hr.	9,000 hr.
Burden applied at predetermined rate (C)	$7,290	$7,740
Budget for the month (B)	$8,002	$8,002
Volume variance ($B - C$)	$ 712	$ 262

In Case 1 the predetermined volume is 10,667 direct hours a month, the predetermined burden rate is 81 cents a direct hour, and the volume variance is $712. In Case 2 the predetermined monthly volume is set at 9,500 direct hours, the burden rate is 86 cents, and the volume variance is $262. The variable budget allowances, which are those shown in

Table 24.4, are the same in each case. The actual volume is the same in each case. The difference of $450 in the volume variance results solely from the difference in predetermined volume and not from any difference in the degree of utilization of plant facilities.

The volume variance therefore, if it is a debit variance, represents only the cost of idleness in excess of that for which an allowance has been made in the predetermined volume. It comes nearest to being an absolute measure of the cost of idle plant when practical plant capacity is used as the predetermined volume, but even then it covers only a portion of the idleness cost. The time when machines are idle between shifts, the idle machine time due to unbalanced conditions, and an irreducible minimum of idleness due to absenteeism, material shortages, and machine repairs—these are examples of idle capacity the cost of which is absorbed in production cost under any system of burden application. Nevertheless the volume variance is a useful measurement. If it is a debit variance, it indicates to management the cost of failure to attain the predetermined volume that the plant is organized and equipped to produce. If it is a credit variance, it represents an overabsorption of fixed costs, a saving, due to operating in excess of the predetermined volume.

When the predetermined volume is set at the level of practical plant capacity, the monthly volume variance is likely to be a debit variance. It could not be a credit variance unless there was overtime operation. The annual variance is almost certain to be a debit variance.

When normal volume has been selected as the predetermined volume, the monthly volume variance may be either a debit or a credit, for the normal is an average. At times the actual volume will be less than normal, at other times above normal. Over a term of years covering the economic cycle of the enterprise, the debit variance should theoretically be equal in amount to the credit variance. In practice, however, predetermined normal volume is frequently thought of as a goal for the sales department and is set at a point considerably above the long-term average of the past. Where this is the practice, the debit variances are likely to predominate.

When the expected actual volume for the year is the predetermined volume, the monthly volume variance may be either a debit variance or a credit variance, depending upon the rate of operation for the month. During the busy seasons the burden would be overabsorbed, and during the slack seasons it would be underabsorbed. Over the course of the year the fixed burden applied would approximate the actual fixed overhead, provided that the actual volume for the year turned out to be about the same as the expected volume.

Budget Variance

Overhead budget variance or controllable overhead variance may be defined as the difference between the actual overhead for an accounting period and the overhead budget for the volume actually attained. It represents mainly the deviation of variable overhead costs from standards or estimates. It is true that under the first method of analyzing burden variance described on pages 424 to 426 a variation in the amount of fixed overhead would be included in the budget variance as well as deviations in the variable overhead costs. However, the amount of fixed overhead seldom differs to any marked extent from the budget. The budget variance is therefore chiefly a variance in variable overhead costs.

Where the budget allowances have been carefully set, the departmental budget variances measure the effectiveness of department executives in controlling periodic overhead costs. A debit budget variance would indicate waste or inefficiency. A credit budget variance would indicate superior performance. Fluctuations are likely to occur from month to month, but over a term of months the budget variance is likely to be small if there is an adequate control of the periodic overhead costs.

The periodic budget reports analyze the overhead budget variance according to the natural classifications. The budget variance of $101 in the illustration on page 425, for example, is detailed in Table 25.2. Table 20.5 is a form of budget report in which the departmental budget variance is only partly analyzed. The report covers only those classifications which are considered to be subject to control of the department foreman.

In standard cost systems a supplementary analysis of the budget variance may be made according to (1) variations in the efficiency of direct labor, (2) variations in usage of supplies and indirect services, and (3) variations in the prices of supplies and the rate of indirect labor. Ideally the effect of the price and rate factors should be eliminated entirely from the budget variance, for they are not controllable. The elimination can be made by costing supplies and indirect labor to factory overhead at standard unit costs and then charging or crediting the difference between standard and actual costs to price variance and rate variance accounts. Ordinarily, however, this is not considered necessary for changes in supply prices and indirect labor rates are recognized when budget allowances are revised. This is usually done once a year but may be more often in the event of sharp and sudden changes in prices or rates. In the analysis of budget variance according to causal factors, therefore, the price and wage-rate variations are usually merged with the usage variations. The analysis then becomes a two-way analy-

TABLE 25.2
CAMPBELL TOOL AND DIE COMPANY
ASSEMBLY DEPARTMENT
Budget Report—September, 19—

Account	This month		Over or under* budget	
	Budget	Actual	This month	Year to date
Indirect Labor	$ 987	$1,023	$ 36	$312
Shop Supplies	367	387	20	75
Maintenance	294	322	28	40*
Purchased Electricity	222	220	2*	15
Fuel				
Payroll Taxes and Insurance	305	309	4	51
Provision for Vacation Pay (hourly force)	139	140	1	8
Defective Work	30	58	28	121
Miscellaneous		5	5	30
Property Taxes	88	88		
Property Insurance	10	10		
Depreciation	350	350		
Supervision and Technical Services	950	960	10	50*
Subtotal	$3,742	$3,872	$130	$522
Redistribution of Service Department Costs				
Maintenance Department:				
Fixed	160	160		
Variable	75	81	6	74
Building Occupancy:				
All Fixed	1,200	1,175	25*	154*
Shop Administration:				
Fixed	1,481	1,481		
Variable	750	740	10*	86*
Total	$7,408	$7,509	$101	$356
Activity:				
Direct man-hours		7,501		23,790
Per cent of predetermined volume		70%		74%

* Actual under budget.

sis. It is usually made by first measuring the effect on overhead of the variations in direct labor efficiency and then treating the remainder of the budget variance as a usage variance.

Labor-efficiency Overhead Variance

Variations in direct labor efficiency cause overhead budget variances owing to the fact that many of the variable overhead costs are proportional to the direct hours worked. When labor efficiency increases,

there is a decrease in the direct hours required for a given amount of work, consequently the variable overhead costs tend to decrease. Two ways of measuring labor-efficiency overhead variance are explained and illustrated. In both cases it is assumed that burden is applied on the basis of standard direct hours.

The more common method is simply to subtract the product of standard hours times the predetermined burden rate from the product of actual hours times the predetermined burden rate. The result would be the amount of burden unabsorbed which would have been absorbed if the actual hours had been at the standard efficiency. To illustrate: Assume that the predetermined burden rate of a certain department is 81¢ per direct hour and that in a given month there were 7,501 standard direct hours and 7,800 actual direct hours. The labor-efficiency overhead variation would be computed as follows:

Burden that would have been absorbed if actual hours had been at the standard efficiency:	
Actual hours at predetermined rate (7,800 × $0.81)	$6,318
Burden absorbed:	
Standard hours at predetermined rate (7,501 × $0.81)	6,076
Labor-efficiency overhead variation, debit	$ 242

Unless the department has sufficient work to utilize its full predetermined capacity, the foregoing method tends to overstate the effect on overhead of a variation in labor efficiency. It assumes that if the labor efficiency were increased, more burden would be absorbed; whereas the burden absorption is limited by the standard hours of work available. The predetermined rate covers both fixed and variable overhead, but a decrease in labor efficiency does not increase the monthly amount of fixed overhead unless it necessitates an increase in the department facilities in order to take care of work scheduled for the department.

A more exact method, which can be used where there are flexible budget allowances, is based on the concept that the labor-efficiency overhead variation is the difference between (1) the overhead budget for the month based on the standard hours of work done and (2) the overhead budget at the volume represented by the direct hours actually worked. It is an extension of the first method of analyzing burden variance described on pages 424 to 426.

Let A = actual overhead for the month

B = monthly budget at the attained volume measured in standard direct hours

B' = monthly budget for the number of direct hours actually required

C = overhead applied at predetermined rates on the basis of standard direct hours

Then $A - C$ = total burden variance
$B - C$ = overhead volume variance
$A - B$ = overhead budget variance
$B' - B$ = labor-efficiency overhead variance
$A - B'$ = usage variance

In each case if the result of the subtraction is a positive figure, the variance is a debit variance; if the result is a negative figure, the variance is a credit variance.

Note that budget variance $(A - B)$ + volume variance $(B - C)$ = total variance $(A - C)$.

Labor-efficiency overhead variance $(B' - B)$ + usage variance $(A - B')$ = budget variance $(A - B)$.

To illustrate:

Assuming that a certain assembly department had 7,501 standard direct hours of work in a given month which required 7,800 actual direct hours to complete and that the other data are the same as in the example on pages 424–425.

Then B = \$4,438 + (7,501 × \$0.3960) = \$7,408
B' = \$4,438 + (7,800 × \$0.3960) = \$7,527
A = \$7,509
C = 7,501 × \$0.81 = \$6,076

Labor-efficiency overhead variance	$(B' - B)$ =	\$ 119 Dr.
Overhead usage variance	$(A - B')$ =	−18 Cr.
Overhead budget variance	$(A - B)$ =	101 Dr.
Volume variance	$(B - C)$ =	1,332 Dr.
Total burden variance	$(A - C)$ =	\$1,433 Dr.

Disposition of Burden Variance

What disposition to make of the balance of the Burden Variance account is first a question of whether it is to be treated as a cost of production or not. In other words, are the inventories at the end of the period and the cost of shipments to be adjusted to an actual cost basis in so far as overhead is concerned? If so, should all the cost sheets for the period be adjusted, or is it sufficient to adjust the totals of the various classifications of inventory and shipments? If the burden variance is not to be treated as a cost of production, there is the question of how to classify it on the financial statements. Finally it must be decided whether to dispose of the variance monthly or annually.

Standard-cost Viewpoint

The standard-cost viewpoint is (1) that volume variance is not a cost of production but a cost of idle plant facilities (a cost of *not* producing) and (2) that budget variance is not a cost of production but a cost of

waste and inefficiency. Where this viewpoint is adopted, the entire amount of the burden variance would generally be reported as a separate item on the annual statement of profit.

Treatment on Annual Statement of Profit

On the annual statement of profit the burden variance may be reported

1. As a separate item under Cost of Goods Sold somewhat as follows:

Sales			xxx
Cost of Goods Sold:			
Standard Cost	xxx		
Cost Variances:			
Material Variance	xxx		
Labor Variance	xxx		
Burden Variance	xxx	xxx	
Total Cost of Goods Sold			xxx
Gross Margin			xxx

2. As an adjunct to Cost of Goods Sold somewhat as follows:

Sales			xxx
Factory Costs:			
Cost of Goods Sold, at Standard	xxx		
Cost Variances:			
Material Variance	xxx		
Labor Variance	xxx		
Burden Variance	xxx	xxx	
Total			xxx
Gross Margin			xxx

3. As a deduction from standard gross margin somewhat as follows:

Sales			xxx
Cost of Goods Sold, at standard			xxx
Standard Gross Margin			xxx
Cost Variances:			
Material Variance	xxx		
Labor Variance	xxx		
Burden Variance	xxx	xxx	
Actual Gross Margin			xxx

4. As extraordinary expense or income near the bottom of the statement of profit.

The standard-cost viewpoint may be adopted in job-order cost systems and in process cost systems as well as in standard cost systems. Adapting the second of the foregoing illustrations to the circumstances of a

job-order cost system, the burden variance would be shown somewhat as follows:

Sales		xxx
Factory Costs:		
Costs of Goods Sold, burden applied at predetermined rates	xxx	
Burden Variance	xxx	xxx
Gross Margin		xxx

Alternative Treatment Where Normal Rates Are Used

Where the burden rates are based upon normal volume it is sometimes contended, because the debit variances and the credit variances tend to be equal over a cycle of years, that the burden variance should be treated neither as a cost of production nor as an expense or income of the period in which it occurs, but as a balance sheet item. Under this theory the balance in the Burden Variance account, or at least that portion representing volume variance, would be carried forward from year to year. A debit balance would be treated as an asset, a deferred charge; a credit balance would be treated as a liability, a deferred credit.

Although it is logical, the foregoing theory runs counter to the practice of determining profits on an annual basis and is seldom followed. A debit variance would be a doubtful asset which a corporation controller would not be likely to countenance on the balance sheet at the end of the fiscal year. To carry a credit variance as a deferred credit is more justifiable but would be inconsistent with the treatment of debit variances as expense.

Treatment on Monthly Financial Statements

How to classify the burden variance on the monthly financial statements depends upon (1) what type of predetermined volume has been selected and (2) what seasonal fluctuations in production are expected.

Where the predetermined burden rates are based upon expected actual annual volume, it is generally desirable to treat the burden variance as a balance sheet item on the monthly statements. The debit variances in dull months would tend to offset the credit variances in busy months, leaving only a small balance in the burden variance account at the end of the year to be closed to Profit or Loss. If monthly variances were reported on the monthly operating statements as expense or income, the monthly statements would not give a reliable indication of the probable profit for the year.

Where the predetermined burden rates are based on normal volume, it is generally desirable to report the variances as expense or income each month except in industries subject to extreme seasonal fluctuations.

If the variances were cumulated during the year, the balance of the burden variance account being shown on the balance sheet at the end of each month, there would be a substantial balance as a rule to close to Profit or Loss at the end of the year even though over a cycle of years the unabsorbed and overabsorbed burden would tend to offset one another.

Where predetermined burden rates are based on practical plant capacity, the monthly burden variance is almost always a debit variance. It should be reported as an expense on the monthly statement of profit. Otherwise the monthly profit would be overstated regularly and the monthly statements would not give a reliable indication of the probable profit for the year.

Historical-cost Viewpoint

The historical-cost viewpoint is that all periodic costs charged to the factory should be absorbed in the cost of production either on a monthly or on an annual basis. When this viewpoint is adopted, predetermined rates would ordinarily be used merely as a matter of convenience in order to expedite the completion of cost sheets and to smooth the effect of monthly fluctuations. As a rule the predetermined rates would be based on expected actual volume, and the annual burden variance would be small.

As a practical matter, if it is a small factor, the entire amount of the burden variance for the year is likely to be treated as an adjustment of the cost of goods sold even where the historical viewpoint is adopted. Theoretically, however, it should be apportioned in part to inventories of worked materials and in part to cost of goods sold.

If the burden element of worked-material inventories at the end of the year is computed two ways, first at the predetermined rates that were in effect during the year, and then for the final inventory valuation at the actual rates for the year, the difference between the two totals would represent the amount of burden variance apportioned to the final inventories. The remainder of the burden variance would be apportioned to Cost of Goods Sold. The same results would be obtained by using a supplementary burden rate to determine the difference, a procedure that is explained in the next section.

Approximately the same results are obtained if the burden element of the final inventories is computed only one way, namely, at actual rates for the year. The allocation of cost to final inventories and to cost of goods sold would be the same as by the previous method, but there would be no measurement of the apportionment of the burden variance. The variance apportioned to inventories would be merged with other inven-

tory adjustments at the end of the year. The entire balance of the Burden Variance account as well as the balance of the Inventory Adjustment account would be closed to Cost of Goods Sold. The procedure just described is a practical one that is often followed. Actually it has the effect of apportioning a part of the burden variance to inventories, although to the casual observer it would appear that the entire amount of the variance is treated as an adjustment of the cost of goods sold.

As a matter of fact in any cost system using predetermined burden rates where the rates are revised yearly and where the final inventory is priced at the revised rates, there is a tendency to apportion a part of the burden variance for the year to the final inventories. This is because the revised burden rates reflect to some extent the current costs as indicated by the data for the most recent year. The amount of variance apportioned to inventories is not computed but is merged with the other end-of-the-year inventory adjustments.

Supplementary Burden Rates

In the following illustration the final inventory is adjusted by means of a supplementary burden rate.

1. Computation of Supplementary Burden Rate

Actual costs for the year:

Direct labor		$100,000
Factory Overhead		$156,000
Actual burden rate	156% of direct labor	
Predetermined burden rate	150% of direct labor	
Supplementary burden rate	6% of direct labor	

2. Inventory Adjustment

Final inventories of worked materials with burden at predetermined rates:

	Material	Labor	Burden	Total
Goods in Process	$15,000	$ 8,000	$12,000	$35,000
Finished Goods	10,000	10,000	15,000	35,000
	$25,000	$18,000	$27,000	$70,000
Inventory adjustment:				
Goods in Process (6% of $8,000)			$ 480	$ 480
Finished Goods (6% of $10,000)			600	600
Total			$1,080	$1,080

Final inventories of worked materials with burden at actual rates:

	Material	Labor	Burden	Total
Goods in Process	$15,000	$ 8,000	$12,480	$35,480
Finished Goods	10,000	10,000	15,600	35,600
	$25,000	$18,000	$28,080	$71,080

3. Apportionment of Burden Variance

Actual Burden for the year	$156,000
Burden Applied at predetermined rates	150,000
Burden Variance	6,000
Variance apportioned to final inventories	1,080
Variance apportioned to cost of goods sold	$ 4,920

The apportionment may be reflected on the books by journal entry, as follows:

Goods in Process	480	
Finished Goods	600	
Cost of Goods Sold	4,920	
Burden Variance		6,000

To adjust monthly inventories to an actual cost basis by the foregoing method is a simple matter if this is desired. Ordinarily, however, on the monthly financial statements, since the burden rates are based on expected actual volume, the burden variance is treated wholly as a balance sheet item.

Adjustment of Individual Cost Sheets

A supplementary rate may be used to adjust to an actual cost basis the cost of each production order worked on during an accounting period. As a rule, however, this is not done, for it would delay the completion of cost sheets and thus defeat the purpose for which predetermined rates are used. The cost sheets representing goods in process at the end of the year are frequently adjusted, but those closed out during the year are not.

An exception to the foregoing rule is sometimes found in the costing of government cost-plus-fixed-fee contracts. Thus, if a contract stipulates that overhead be costed at actual monthly burden rates, the government administrative agency, in order to expedite reimbursement, may permit the contractor to invoice first the overhead applied to the contract at predetermined rates and then later the difference between the overhead at predetermined rates and the overhead at actual rates. In such cases the contracts are first costed at predetermined rates, and an invoice on this basis is prepared soon after the end of the month. Then when the actual overhead is known, supplementary rates are computed to cover the difference between the overhead for the month and the amount applied at predetermined rates. The contracts are then costed

at the supplementary rates, and an invoice is prepared covering the overhead applied at the supplementary rates.

Bookkeeping Practice

As a matter of bookkeeping the Burden Variance account is usually closed to Profit or Loss only at the end of the year. Even though the variance is treated as expense or income on the monthly financial statements, it is not necessary or desirable to close the account monthly. It would be closed along with the other expense and income accounts at the end of the year.

There are numerous methods of booking the overhead transactions in the general ledger (or the factory ledger). Three accounts may be provided: (1) a Factory Overhead or a Factory Burden account to record the amount of the periodic overhead charges; (2) an account called Factory Overhead Applied, Factory Overhead Credit, or Burden Applied, which would be credited with the amount of burden applied; and (3) an account called Burden Variance, Factory Overhead Variance, or Unabsorbed and Overabsorbed Burden, in which the amount of the burden variance would be recorded. The entries for this method may be diagrammed as follows:

Factory Overhead	
Monthly debits for periodic overhead cost	Closed at end of year to Burden Variance

Burden Applied	
Closed at end of year to Burden Variance	Monthly credits for burden applied

Burden Variance	
Periodic overhead cost for the year from Factory Overhead	Total burden applied for the year from Burden Applied

Close to Profit or Loss at end of year

A slight variation of the foregoing procedure would be to close the first two accounts to Burden Variance each month instead of annually. In this event the balance of the latter account at the end of any month would represent the burden variance for the year to date.

The Burden Applied account may be omitted. In this case the monthly amount of burden applied would be credited either to Factory Overhead or to Burden Variance. The Factory Overhead account would be closed to Burden Variance either monthly or annually. The following diagram illustrates one of these possibilities (see also Table 10.1):

Factory Overhead	
Monthly debits for periodic overhead cost	Closed at end of year to Burden Variance

Burden Variance	
Periodic overhead cost for the year from Factory Overhead	Monthly credits for burden applied
Close to Profit or Loss at end of year	

In some cases only one account is provided in the general ledger to record all three types of overhead transactions. The account may be called Factory Overhead or Factory Burden. On the other hand, it may be called Factory Overhead Variance or Burden Variance.

The following diagram illustrates the procedure in the latter case:

Burden Variance	
Monthly debits for periodic overhead cost	Monthly credits for burden applied
Close to Profit or Loss at end of year	

In all the illustrations in this section the Burden Variance account is closed directly to Profit or Loss. If the variance were treated as a cost of production, the only difference in procedure would be that the variance would be closed either to Cost of Goods Sold or in part to Cost of Goods Sold and in part to Inventory Adjustment.

Practice in Regard to Disposition of Burden Variance

In a study made by the Research and Technical Service Department of the National Association of Cost Accountants the questionnaire method was used to ascertain the practices of representative companies in a wide range of industries in regard to the valuation of finished goods inventories. One section of the questionnaire related to the disposition of underabsorbed and overabsorbed burden. Table 25.3 is reproduced by permission from that study, which was published in the *N.A.C.A. Bulletin* of March 15, 1940.

TABLE 25.3

SUMMARY OF METHODS OF DISPOSING OF OVER- AND UNDERABSORBED BURDEN SHOWING NUMBER OF COMPANIES USING EACH METHOD*

Methods of disposing of over- and underabsorbed burden	Overabsorbed burden		Underabsorbed burden	
	End-of-year treatment	End-of-month treatment	End-of-year treatment	End-of-month treatment
1. Balance overabsorbed treated as a reserve; balance underabsorbed charged against reserve or carried forward	9	35	10	37
2. Balance overabsorbed credited to cost of goods sold; balance underabsorbed debited to cost of goods sold	65	38	72	39
3. Balance overabsorbed shown separately as deduction from cost of goods sold; balance underabsorbed shown separately as addition to cost of goods sold	59	46	62	46
4. Balance overabsorbed treated as other income below gross profit; balance underabsorbed charged to profit and loss below gross profit	57	52	58	53
5. Balance over- or underabsorbed divided prorata between inventories and cost of goods sold	19	7	8	1
6. Unclassified		3	.	3
Totals	209	181	210	179

* From N.A.C.A. Research Study, "Finished Goods Inventory Practice," *N.A.C.A. Bulletin*, Vol. 21, No. 14, Sec. III, p. 943.

QUESTIONS FOR DISCUSSION

CHAPTER 1

1.1. What is the distinction between a cost finding system and a cost accounting system?

1.2. What are the characteristics of cost accounting systems of the historical type?

1.3. What are the characteristics of cost accounting for control?

1.4. Give a formula for computing cost of goods sold by the physical-inventory method.

1.5. Under what circumstances is it impractical to use the physical-inventory method to determine cost of goods sold each month?

1.6. Describe the perpetual-inventory method of determining the cost of a final inventory of finished product.

1.7. Taking a physical inventory is a means of verifying the perpetual inventory balance. Is it also a means of verifying the product cost records? Explain your answer. Is it possible to make the foregoing verifications where the product cost records are not "tied in" with the books?

1.8. Why are monthly operating statements wanted by management?

1.9. Distinguish between line authority and functional authority. Give an example of functional authority other than those mentioned in the text.

1.10. What are the duties of a corporation controller? Is he responsible for the control of factory costs?

1.11. Give an example of the application of the principle of exceptions in managerial control.

1.12. Using the data in Table 1.1 make a revised estimate of the profit for the nine months ending September 30. Then make a revised estimate of the inventory on September 30.

CHAPTER 2

2.1. In a certain cost department it is the rule that requests from other departments for information in regard to product costs must be referred to the supervisor of the cost department for approval before releasing such information. What reasons might there be to justify this rule?

2.2. Why is fixed cost said to be a function of time?

2.3. Why does the fixed cost per unit decrease when the units of output increase?

2.4. Admissions to matinees at theaters are usually priced lower than admissions to evening performances. Why? To what extent are the operating costs of a theater affected by the size of the audience?

2.5. What are variable costs? Give examples.

2.6. Theoretically what costs should be counted as material costs?

2.7. What is conversion cost? Why is it desirable to determine conversion cost by operations?

2.8. Is cost estimating an accounting function?

2.9. Referring to Table 2.1, estimate the monthly cost at a volume of 1,200 units a month. Then estimate the average cost per unit at that volume.

2.10. Standard costs are similar to cost estimates in some respects. Enumerate points of similarity. Then enumerate points of dissimilarity.

CHAPTER 3

3.1. Give examples of industries, other than those mentioned in the text, where the process cost method would be suitable for determining product costs.

3.2. What unit to use as a measure of output depends upon the nature of the product. In the examples given in Chapter 3, cement output is measured in barrels, output of oxygen in cubic feet, output of dressed beef in pounds, output of lumber in board feet. Suggest units to use for measuring the output of the following products: gasoline, paint, hydrogen, coal, thread, canned peas, flour, cloth, sulphuric acid, face powder.

3.3. What is meant by the term *equivalent conversion units*? Describe a situation where the output units of a department would be the same as the equivalent conversion units. Under what circumstances would they differ?

3.4. Assume that a paint-mixing department had no work in process on October 1, 19—, that its output in October was 20,000 gallons, and that there were 500 gallons in process October 31, 19—, on which the work of mixing was 80 per cent finished. Compute the equivalent conversion units for the month.

3.5. You are given the following data for the molding department of a cement-block plant:

Product	Standard man-hours to mold 100 pieces	Output November, 19--
Standard building block	1.2	20,000 pieces
Silo block	2 0	2,000 pieces
Standard cinder block	1 4	5,000 pieces

Which product would you recommend using as the standard unit in this case? Compute equivalent output units. If the fluctuations of inventory in process are negligible, what is the number of equivalent conversion units?

3.6. Assume the same facts as in the previous problem except that the fluctuations of work in process within the department are to be taken into account and that the inventories were

Item	November 1	November 30
Standard building block	1,000 pieces 20% finished	2,000 pieces 50% finished
Silo block	None	None
Standard cinder block	None	500 pieces 20% finished

Compute equivalent conversion units for the month.

3.7. What are joint products? What are joint costs? What are by-products?

3.8. What is the basis of distinction between (*a*) by-product cost methods and (*b*) joint-product cost methods?

3.9. Why is it sound to allocate costs to joint products on the basis of market values? Where this basis of allocation is adopted, would you expect the ratio of gross margin to sales to be uniform for all joint products sold? If so, what do you think is the principal object of making the allocation at all?

3.10. Refer to Table 3.3. How are the unit costs computed?

3.11. How are the unit costs computed in Table 3.4 and in Table 3.5?

3.12. Refer to Table 3.7. Why is the unit cost of oxygen greater than the unit cost of nitrogen?

3.13. Refer to Table 3.9. Assume that sales of the major product amounted to $30,000 for the month. By-product sales amounted to $1,200. Compute the gross margin for the month assuming a constant inventory of finished major product.

3.14. In a process cost system what is the purpose of making a departmental allocation of conversion costs each month? Why are the material costs also allocated to departments?

3.15. In Table 3.5 the final inventory is costed at unit costs obtained by the weighted average method. Compute the cost of the final inventory using the first-in–first-out method.

CHAPTER 4

4.1. Give three examples of industries, other than those mentioned in the text, where the job-order cost method would be a suitable method of obtaining product costs.

4.2. Why is it necessary to number the production orders in a job-order cost system?

4.3. Give examples of costs that cannot be charged directly to job orders.

4.4. What purposes are served by production orders other than product costing purposes?

4.5. In a job-order cost system the factory superintendent's salary is classified as factory overhead. Would the job-order cost sheets show the amount of this salary charged to each order? Explain your answer.

4.6. What is meant by the term *burden center?*

4.7. Assume that the estimated annual overhead of a certain processing department is $30,000 when the volume of production measured in direct man-hours is 20,000 hours. Assume further that the operations performed in this department on a certain production order required 68 direct man-hours. (*a*) How much cost would be applied to the order to cover the various items of overhead in this department? (*b*) In working out your answer for part *a*, what did you use as the base factor for the application of burden? (*c*) What is the burden rate?

4.8. (*a*) Of the cost sheets illustrated in the chapter, which ones are designed to show labor cost by operations? (*b*) If the cost sheet covering a certain job is to be compared with the cost estimate for the job, is it desirable to have an analysis by operations of the labor charged to the cost sheet? Why?

4.9. Refer to Fig. 4.2. (*a*) How many pieces of the part covered by the order were produced by the pressroom on May 12? (*b*) What was the total quantity produced up to and including May 12? (*c*) How many pieces had been shipped on the order up to and including May 12?

4.10. Refer to Fig. 4.4. (*a*) Trace the posting of the material cost from the storeroom requisition to the job cost ledger. (*b*) Why is it impossible in the illustration to trace the posting of the labor cost from the time ticket to the cost sheet? (*c*) What is the total cost of the order?

4.11. Refer to Figs. 4.5 and 4.6. (*a*) How many pieces of material were cut on order 8716? (*b*) What was the average weight of material per piece? (*c*) How does this compare with the estimate? (*d*) How many hours were required to set up press 2500B? (*e*) What was the running time of this press? (*f*) How many pieces were processed on this press? (*g*) How does the unit cost on this operation compare with the estimate? (*h*) Trace the posting of labor cost from Fig. 4.6 to Fig. 4.5. (*i*) When would this posting be done?

4.12. Refer to Figs. 4.7 and 4.8. (*a*) What is the total cost of job order C-2033? (*b*) How much of that is material? (*c*) How much is labor and burden? (*d*) What is the actual labor cost per hundred pieces? (*e*) How does this compare with the estimate? (*f*) What are the burden centers in the illustration? (*g*) What is the base factor for the burden application?

CHAPTER 5

5.1. How are unit costs of products obtained in (*a*) the process cost method, (*b*) the standard cost method, (*c*) the job-order cost method?

5.2. How is the material cost of a product determined in a standard cost system?

5.3. In a standard cost system is it customary to determine the variances between the actual costs and the standard costs of the products manufactured?

5.4. What is a bill of material?

5.5. (*a*) What is a production routing? (*b*) What is its function in a standard cost system? (*c*) Is the form used primarily for product costing purposes?

5.6. Why would management want to know the variations between actual and standard costs by operations and by departments?

5.7. Does the claim that a standard cost system is a means of internal check appear to you to be plausible? Explain.

5.8. Refer to Fig. 5.4. (*a*) Verify the computation of the unit material cost of 53 cents. (*b*) What is the unit cost of labor for operation 1? (*c*) What is the unit in this case? (*d*) Assuming that there are 2,000 pieces of part 421-199 on hand on which only operation 1 had been completed, compute the cost of this inventory.

5.9. Refer to Figs. 5.3 and 5.5. (*a*) Trace the data in regard to the labor operations from Fig. 5.3 to Fig. 5.5. (*b*) Determine the labor cost per standard minute for job class 6 and for job class 4. (*c*) Verify the computation of the unit labor cost of $0.3396.

5.10. Which type of standard cost, the basic standard or the attainable-ideal standard, is the more realistic in the sense that it more nearly represents the current cost?

5.11. On January 17, 19—, a machine operator in department 56 worked 8 hours at operation 5 on assembly A13-244. His production for the day was 50 pieces. He was paid $6.75. What was the labor variance on this operation for the day? Refer to Fig. 5.5 for the standard cost per piece.

5.12. Give an example of an industry, other than those mentioned in the text, where it might be advantageous to have a standardized cost classification printed on the standard cost sheets.

CHAPTER 6

6.1. What is a standing order?

6.2. Refer to Table 6.8. State the standing order numbers for (*a*) repairing a machine in the toolroom, (*b*) replacing a broken window in a factory building, (*c*) factory superintendent's salary, (*d*) shop supplies used by assembly depart-

ment, (*e*) cost of reworking parts that were machined to the wrong dimensions by the heavy machining department, (*f*) depreciation of factory buildings, (*g*) wages of laborers working in the stores department.

6.3. Under what circumstances is there a need for a credit-balance account for burden applied?

6.4. What factors should be taken into consideration in making a classification of accounts?

6.5. Of what value is a detailed classification of stores such as the one illustrated in Table 6.3?

6.6. Of what value is a classification of sales such as the one illustrated in Table 6.5?

6.7. Refer to Table 6.6. Study the classification by causes of variance which is given in the column at the right of the table. Try to explain the nature of each causal classification. For example, a purchase-price variance is due to a difference between the invoice price of materials and the standard unit cost.

6.8. What is the product classification in Table 6.7?

6.9. Is classification 840, Goods in Process, in Table 6.7 intended to be used as the title of an account in the ledger? Explain.

6.10. In Table 6.7 there is a parenthetical statement referring to accounts 151, 152, 153, and 154 which indicates that these accounts are used at the end of the year only. What accounts are there in the classification to record the inventories from month to month during the year?

CHAPTER 7

7.1. Is it true that the general ledger of a large company is likely to have no more accounts in it than the general ledger of a small company? Explain.

7.2. What is meant by two "layers" of controlling accounts? Illustrate.

7.3. From the list of transaction summaries in Table 7.2 select two that you think could not be made economically by means of multicolumn journals. Give reasons for your selection.

7.4. What are the stages in the flow of costs in a manufacturing plant?

7.5. Give pro forma journal entries for (*a*) burden applied and (*b*) material cost applied. (In a pro forma journal entry the account titles are shown but amounts are omitted.)

7.6. Give a pro forma journal entry for wage cost incurred. How frequently would such an entry be made?

7.7. Name examples of cost-incurrence accounts.

7.8. What types of accounts may be credited for costs incurred?

7.9. What is meant by periodic cost distribution?

7.10. Would the following entries be classed as recording (1) cost incurrence, (2) periodic cost distribution, or (3) cost application?

(*a*) Direct Labor	xxx	
Factory Overhead	xxx	
Factory Wages		xxx
(*b*) Goods in Process	xxx	
Factory Overhead	xxx	
Accrued Wages		xxx

7.11. Give pro forma journal entries for (*a*) goods completed by the factory and put into a finished-stock warehouse and (*b*) manufactured products shipped to customers. Two pro forma journal entries are required for part *b*.

7.12. When the actual periodic cost is more than the cost applied to production, is the cost variance called a debit variance or a credit variance?

7.13. Is it possible to adjust a ledger without closing it?

7.14. What are cost-clearing accounts? Give examples.

7.15. (*a*) Make a list of the T accounts of Fig. 7.2 that are omitted in Fig. 7.3. (*b*) One of the accounts on your list should be the account Direct Labor. If there is no account in the ledger called Direct Labor, how can one find out from the accounts how much the direct labor amounted to in a given month?

CHAPTER 8

8.1. (*a*) In the illustration in Chapter 8 which of the accounts are clearing accounts? (*b*) Which are probably controlling accounts?

8.2. Account 150, Inventory, is used at the end of the year only. In your opinion what is the purpose of this account? Could it be dispensed with?

8.3. Study the accounts in the 800 series. Trace each entry back to the journal to determine the nature of the entry and its source. In the same way make a study of accounts 113, 114, 431, 432, 730, 741, and 742.

8.4. List the numbers of the journal entries that record the flow of material costs in Table 8.2. Indicate in each case what step or steps in the flow of costs it represents, that is, whether the entry records cost incurrence, periodic cost distribution, cost application, worked-material transfer, or cost expiration.

8.5. List the numbers of the journal entries in Table 8.2 that record the flow of direct labor cost through the cost-application stage. Indicate in each case what step or steps in the flow of costs the entry represents.

8.6. List the numbers of the journal entries in Table 8.2 that record the flow of overhead costs. Indicate in each case what step or steps in the flow of costs the entry represents.

8.7. The inventory adjustment closed to Profit or Loss in Table 8.4 is $3,050. Analyze this adjustment showing how much of it is for each class of inventory, that is, for material stores, for goods in process, and so on.

8.8. In Table 8.7 the factory cost of goods sold is reported as $59,650. Is this "actual" cost?

8.9. Are the inventory decreases in Table 8.7 based upon physical inventories?

8.10. According to Table 8.5, what is the amount of unapplied overhead for the 11 months ending November 30, 1947?

8.11. Compare the procedure of accounting for wages paid illustrated in Chapter 8 with the procedure illustrated in Chapter 7.

8.12. Where in the ledger do you find the detail needed for preparing the statement entitled Factory Cost of Goods Sold (Table 8.7)?

CHAPTER 9

9.1. (*a*) Under what circumstances is it likely to be desirable to have a factory ledger? (*b*) Why is it usually desirable to operate the factory ledger as a self-balancing ledger?

9.2. What are reciprocal control accounts?

9.3. (*a*) What types of accounts are usually kept in the factory ledger? (*b*) Would it be wrong to have the fixed-asset accounts for Factory Machinery and Factory Equipment in the factory ledger? Discuss.

9.4. Assume that an enterprise has a separate factory ledger. (*a*) What transactions are recorded only on the factory books? (*b*) What transactions are recorded only on the general books? (*c*) What transactions are recorded on both sets of books?

9.5. The Factory Ledger Control Account is a debit-balance account on the general books. Would it be proper to show the balance of this account as an asset on the balance sheet?

9.6. (*a*) Which accounts in Table 9.1 are clearing accounts? (*b*) Which are probably controlling accounts?

9.7. Compare the journal entries in Table 9.3 with the corresponding entries in Table 9.4. For example, compare journal entry 1-1f with journal entry 1-1, and so on.

9.8. In the case of entry 1-3f why is the amount only \$2,600 whereas the amount credited to Accrued Salaries in entry 1-3 is \$7,600?

9.9. Refer to Table 9.5. Trace representative entries in each account back to the journal shown in Table 9.3.

9.10. Is the use of a separate factory ledger limited to enterprises having job-order cost systems, or can it be used in other types of cost systems also?

CHAPTER 10

10.1. If the actual direct labor cost for a given month was \$8,000 and the standard cost of the direct operations completed was \$7,800, what is the total labor variance? What additional information is needed in order to analyze this variance so as to show how much is due to variations in wage rates and how much is due to variations in labor efficiency?

10.2. Describe the procedure of determining the cost of goods shipped in a standard cost system.

10.3. Describe the procedure of determining the cost of goods completed by the factory and placed in finished stock.

10.4. Describe the standard cost method of costing factory output. How does it differ from the procedure followed in job-order cost systems to determine the cost of factory output?

10.5. When the worked-material inventory accounts are merged in one account, why is it unnecessary to determine the cost of factory output each month?

10.6. Assume that a stores inventory is carried at actual cost. Prepare pro forma journal entries for (*a*) material purchased and (*b*) material issued from stores. Assume that the material variance is a debit variance.

10.7. Study entry 7-5 of Table 10.2. (*a*) What is the standard cost of the standard input? (*b*) What is the standard cost of the actual input? (*c*) Make a list of three or more occurrences that might have caused the quantity variance.

10.8. In the case of a plant where the standard input of material is computed on the basis of output with adjustment for inventory variation, do you think it would be practical to use the same method to compute the standard labor hours for the operations completed? Making up your own figures for the purpose of illustration, show how you would proceed to determine the standard direct labor hours for the work done.

10.9. In case the input of material and labor is determined on the basis of output, should there be a separate accounting for spoilage culminating in a journal entry in which Work in Process would be credited? Explain your answer.

10.10. State a formula for determining the total burden variance.

10.11. Explain why an excess of actual cost over standard cost is called a debit variance.

10.12. Give three or more examples of timely reporting of cost variances to management.

10.13. Review carefully the methods used in the illustration to analyze the cost variances. State the six causes of variance represented in the analysis.

10.14. Study Table 6.6. In your opinion is the classification in this table superior from a cost-control standpoint to the six-way classification illustrated in Chapter 10?

10.15. What is meant by the expression "standard gross margin"? If the operating statement is designed to show the standard gross margin, would it be possible to show cost variances in the Cost of Goods Sold section of the operating statement?

CHAPTER 11

11.1. Of the six characteristics of ledger procedure in process cost systems that are stated in the first paragraph of Chapter 11, which ones are also characteristics of a noncost system?

11.2. The O. M. Packing Company has branch factories in six cities in the Middle West. A process cost system is used. Should the cost accounts be kept in the general ledger, or should there be a factory ledger for each branch factory? What additional information do you need in order to discuss the foregoing question intelligently?

11.3. Refer to entry 6-4 of Table 11.2. If the 8,000 tons of limestone purchased had cost 55 cents a ton instead of 50 cents and otherwise the facts were the same as those shown in the explanatory schedule, how would you compute the cost of limestone put into production (*a*) using first-in–first-out cost? (*b*) using a weighted average cost?

11.4. Which of the entries in Table 11.2 record cost application?

11.5. Trace to Table 3.4 the amounts shown in entries 6-9, 6-10, 6-11, and 6-12 of Table 11.2.

11.6. Construct T accounts or an interim work sheet for the accounts used in the illustration in Chapter 11. Post the account balances of June 1 from Table 11.1 and the journal entries for the month of June, which are given in Table 11.2. Prepare a trial balance of the factory ledger, June 30.

11.7. What changes would you suggest in the chart of accounts shown in Table 11.1 in order to adapt it for use in a standard cost system of the process type?

11.8. Process cost sheets may have either a vertical arrangement or a horizontal arrangement. What is the distinction between the two forms?

11.9. Why is there no classification for direct labor in Table 11.1?

11.10. (*a*) Why is there no Finished Goods account in the classification shown in Table 11.1? (*b*) Why is there no account called Cost of Goods Sold?

11.11. Using the data in Table 11.5 prepare journal entries for cost application and for worked-material transfers. Open T accounts for Work in Process—Department 1 and Work in Process—Department 2. Enter the initial inventories and the transactions affecting these accounts.

11.12. In Table 11.5 why is it that in Department 1 the cost per unit of current month's production is the same as the unit cost of output, whereas in the case of Department 2 the two unit cost figures are different?

CHAPTER 12

12.1. What duties are likely to be assigned to the purchasing department?

12.2. From the standpoint of cost control what are the advantages in centralizing the work of purchasing? Why would it be uneconomical as a rule to permit each foreman to issue purchase orders?

12.3. Distinguish (*a*) purchase order from purchase requisition, (*b*) purchase order from purchase invoice, (*c*) purchase invoice from purchaser's debit memorandum.

12.4. In many plants account numbers are written on purchase requisitions. Why is this done?

12.5. What use is made of receiving records?

12.6. What are the steps in the audit of purchase invoices? Whose is the final responsibility for this audit?

12.7. What is the purpose of the invoice-verification stamp?

12.8. In what way would the costing of purchase invoices at standard contribute to the efficiency of the internal check?

12.9. What is meant by purchase-invoice distribution?

12.10. Under what circumstances would a voucher system be an efficient system of accounting for purchase liabilities? What other types of systems are used for this purpose?

CHAPTER 13

13.1. What are the five fundamental methods of distributing data?

13.2. (*a*) Can unit media be used in all five methods of distribution? (*b*) Can multiple media be used in all five methods?

13.3. In a plant using a purchase-voucher system four purchase invoices from one supplier have been assembled and are to be covered by one purchase voucher. The items appearing on the invoices and the accounts to be charged are shown below. You are asked to determine the voucher total and the distribution of the total according to control accounts. Then describe the method you used to obtain the distribution stating which of the five fundamental methods of distribution it is. Then name and describe an alternative method that could have been used.

Purchase invoices		Item amounts	Accounts to be charged	
Date	Amount		Control accounts	Subsidiary accounts
3/4/48	$169.62	$ 85.26	822	Job 48-82
		2.10	812	.91
		14.45	812	.95
		67.81	811	.12
3/8/48	354.77	18.50	831	60.22
		41.27	822	Job 47-712
		295.00	811	.10
3/8/48	31.80	27.25	812	.95
		4.55	831	60.22
3/10/48	221.27	112.70	811	.12
		27.25	812	.95
		81.32	811	.12

13.4. Three ways of sorting unit slips are hand-sort, Keysort, punched-card sort. (*a*) Would the unit slip forms have to be designed differently depending upon the type of sorting procedure? (*b*) Could Keysort forms be hand-sorted? (*c*) Could punched-card forms be hand-sorted? (*d*) Which type of sorting is likely to be favored where only one distribution of the same data is wanted? Why?

13.5. What are the advantages of having unit slips presorted in the shop so that they come to the office with the initial sorting operation completed?

13.6. When Keysort forms are used, how are classification totals obtained? How are they obtained when punched cards are employed?

13.7. Five cases are presented in Chapter 13 to illustrate the application of different methods of distribution in accounting for purchases. In each of these cases, state what combination of distribution methods is found.

13.8. Refer to Fig. 13.2. (*a*) The first item on the remittance advice is an item of $10. Where in the purchase journal should this item appear? (*b*) Where is the subsidiary account payable in the illustration? (*c*) What different title can you suggest for the form called "Purchase Distribution"?

13.9. Refer to Fig. 13.3. (*a*) What are the control account numbers appearing in the illustration? (*b*) How are the control account totals obtained? (*c*) What subsidiary account numbers appear? (*d*) How are the subsidiary account totals obtained? (*e*) How many control accounts could there be if the method of distribution illustrated here is used? (*f*) How many subsidiary accounts could there be?

13.10. Refer to Fig. 13.4. (*a*) Where is the remittance advice in this illustration? (*b*) What name is given to the purchase journal in this illustration? (*c*) Where is the distribution section of the purchase journal? (*d*) How many lines would be used in the purchase journal in order to record an invoice on which there were three items, each of them charged to a different account? (*e*) Can you figure out which holes of the Keysort form would be notched for account 132-17?

13.11. Refer to Fig. 13.5. (*a*) Where would the distribution of the debits appear on the forms illustrated? (*b*) How would the different copies of this form be filed? (*c*) Where would the purchase invoices covered by this voucher be filed? (*d*) How would purchase invoices be filed in accounts-payable systems?

13.12. Refer to Fig. 13.6. (*a*) What source of information would the key-punch operator have when punching this card? (*b*) How many cards would be punched for the data given in Question 13.3? (*c*) Assume that you were punching a tabulating card for a voucher amounting to $27.00, all of which is to be charged to Factory Overhead, Account 822; Standing Order 60.22. Where would this information be punched on the tabulating card shown in the illustration?

13.13. Refer to Fig. 13.7. (*a*) Where is the distribution section of this form? (*b*) How would totals be obtained to charge to control accounts? (*c*) How would subsidiary account totals be obtained?

13.14. Assume that departmental overhead costs are budgeted and that monthly reports are made for each department comparing budgeted and actual overhead. Departmental foremen may question the actual figures, and in some cases it may be necessary to furnish a foreman an analysis of certain charges to his department. Assume that it is necessary to make such an analysis covering items charged from purchase invoices; how would you proceed if the

purchase-distribution procedure were as illustrated (*a*) in Case 2? (*b*) in Case 3? (*c*) in Case 4? (*d*) in Case 5?

CHAPTER 14

14.1. Is it always possible to know when an article is purchased whether it will be used as material or as a supply?

14.2. What are the principal costs incurred in order to have a store of materials on hand? Are those costs generally costed to products as material cost or as overhead?

14.3. Why is the controller interested in seeing that there is a good system of inventory control? Should he be interested only in the inventory records? If not, what other aspects of inventory control should have his attention?

14.4. What is a balance-of-stores ledger?

14.5. (*a*) Why is it that unit costs are frequently recorded on the stores-ledger cards? (*b*) Why are the dollar amounts of stores on hand not usually recorded in stores ledgers?

14.6. (*a*) If certain materials are expected to rise in price, would it be wise to purchase those items in excess of normal quantities? (*b*) What other factors should be considered before deciding this question? (*c*) Who should make the decision?

14.7. (*a*) What is meant by minimum and maximum quantities of a stores item? (*b*) Who should determine these quantities? (*c*) What use is made of them?

14.8. What is meant by "quantity available" in the case of a stores item?

14.9. (*a*) What are material requisitions? (*b*) What are their functions in inventory control and in the work of recording the flow of costs through the accounts? (*c*) How may they be used to implement the system of production control?

14.10. What are the advantages of having the stores requisitions prewritten in the office?

14.11. What are the advantages of having a continuous audit of the stores inventory? Discuss from the standpoint of cost control as well as from the standpoint of financial accounting.

14.12. What type of errors disclosed by a continuous inventory audit call for adjustment of the control accounts?

14.13. What are some of the analyses that should be made of the stores-ledger data as a means of reducing costs and of preventing inventory losses?

14.14. (*a*) What is a rejected-material report? (*b*) Who prepares it? (*c*) How is it used in controlling costs?

14.15. Refer to Fig. 14.1. (*a*) What is the purchase-order quantity? (*b*) What unit cost should have been used in costing the 36 pieces issued on January 10? (*c*) Why were two lines of the form used to record the issuance of 40 pieces on February 10 for job 50816? (*d*) Why are there two "Out" columns and two "Balance" columns but only one "In" column?

14.16. Refer to Fig. 14.2. (*a*) What was the average monthly usage of item 423950 in 1941? (*b*) The colored visible tab for this item indicates that there is a 12-week supply. Can you check this? (*c*) In the Order Number column of Part 2 of the form the first number shown is 15171. What type of order is meant? What type of order is represented by the third order number in this column, order number 33-913? (*d*) Why is there no check mark on the line carrying the May 16 date? (*e*) Can this form be used for reference in costing material requisitions?

CHAPTER 15

15.1. You are called upon to substitute for the factory ledger bookkeeper who is ill. You find that he has prepared forms for the monthly journal entries, one of which reads as follows:

Work in Process	xx	
Factory Overhead	xx	
General Ledger Control	xx	
Stores		xx

(*a*) Write an explanation for the foregoing pro forma journal entry. (*b*) Where would you look for the amounts for completing the entry? (*c*) Why is a debit space provided for General Ledger Control?

15.2. What entries to subsidiary accounts must be made as a rule from material requisitions (*a*) in job-order cost systems? (*b*) in standard cost systems?

15.3. What is the purpose of the Summary of Materials Issued and Returned?

15.4. What is the accounting treatment of excess-material requisitions (*a*) in standard cost systems where spoiled work is accounted for by means of rejected-material reports? (*b*) in job-order cost systems?

15.5. Under what circumstances would excess-material requisitions be charged to Material Variance?

15.6. In the Summary of Supplies Issued and Returned that is described on page 231 there is a column for debits to Goods in Process. (*a*) Why is this column needed? (*b*) As an alternative procedure to the one described in the text, would it be practical in your opinion to have material requisitions for *all* items that are issued as direct material, even those which are stored in Supply Stores, and then to summarize all material requisitions on the Summary of Materials Issued and Returned? The Goods in Process column could then be eliminated on the Summary of Supplies Issued and Returned. If this alternative procedure were adopted, what change should be made in the form of the Summary of Materials Issued and Returned? (*c*) What are the advantages and disadvantages of the alternative procedure?

15.7. Refer to Fig. 15.2. (*a*) What is the source of the information that would be recorded on this form? (*b*) What is the purpose of the form? (*c*) Does it take the place of the Summary of Supplies Issued and Returned?

15.8. Theoretically how should the cost of freight on incoming material be classified, as material cost or as factory overhead?

15.9. There are accountants who strongly contend that a cash discount on materials purchased is a reduction in the material cost and that it should be treated as such in the accounts. Discuss.

15.10. On December 31, 1946, there were 100 pieces of a certain stores item on hand. These had been purchased during 1946 at a cost of $5 each. In the annual inventory December 31, 1946, they were valued at $4.50 each, the market price at that date. During 1947, 40 pieces of this item were used and 60 pieces were on hand at the end of the year. At that time the quoted price at which a supply of the item could be purchased was $5, the same as the original purchase price. If the inventory of December 31, 1947, is to be stated at lower of cost or market, what is the proper valuation of the 60 pieces?

15.11. Refer to Fig. 14.1. Compute the first-in–first-out cost of the inventory of 442 pieces on hand January 31, 1944.

15.12. Refer to Fig. 14.2. Assume that the next transaction to be recorded on this form is the receipt of 25 pieces May 16 at a purchase price of $7.57 a hundred. You are asked to compute the average cost of the pieces on hand after this transaction.

15.13. (*a*) With respect to the costing of materials issued, would the figures obtained by the last-in–first-out method be greatly at variance with those which would be obtained in a standard cost system? (*b*) Would the difference between the Lifo figures and the average cost be more or less than the difference between the Lifo figures and the first-in–first-out cost of materials issued?

15.14. To introduce the Lifo basis of inventory valuation at a time when prices are high is generally not favored by accountants and businessmen, for they contend that the inventory would be carried at too high a figure subsequently when prices decline. Would this objection hold if the Lifo formula were used merely to determine cost and the lower-of-cost-or-market formula were then used to determine the inventory valuation? Discuss.

15.15. In standard cost systems the stores inventory may be carried either at actual cost or at standard cost. Which in your opinion is the better procedure? Give reasons for your preference.

15.16. Under what circumstances can the use of material requisitions be entirely dispensed with?

15.17. Under what circumstances can the costing of material requisitions be dispensed with?

15.18. Give examples of the use of the specification cost method in job-order cost systems.

15.19. Make lists of the uses that may be made of material requisitions (*a*) for cost control purposes, (*b*) for product-costing purposes, and (*c*) for the purpose of obtaining data for the financial statements. Would the latter purpose alone justify the expense of operating a material requisition system?

15.20. Under what circumstances is the most recent purchase price likely to be used in costing the annual stores inventory?

CHAPTER 16

16.1. More time and effort is expended in most plants to control labor cost than is spent on the control of material cost. State reasons for this situation.

16.2. Illustrate how the control of labor cost is related to the control of the flow of production.

16.3. A certain manufacturer desired to introduce a wage-incentive system. He assigned a former timekeeper to establish standards. The timekeeper determined the average time for each operation on the basis of past experience and then treated the averages as standards which he used as a basis for piece rates. Criticize this procedure.

16.4. Are the standard operation times that are used to measure performance for wage-incentive purposes also suitable for product-costing purposes? Discuss.

16.5. (*a*) What is meant by a guaranteed task? (*b*) What is a guaranteed day rate?

16.6. What are the advantages and disadvantages of having time tickets partly prewritten by the production planning department?

16.7. Refer to Table 16.1. What labor force would be required if the weekly schedule called for 40 units of Model M41 and 20 units of Model M42?

16.8. Explain how employment office procedures may be a means of internal check.

16.9. The installation of a wage-incentive system in the shop in place of a day-rate system is bound to increase the accounting work. Explain why.

16.10. (*a*) What is a day-work operation in a piece-rate shop? (*b*) What type of errors must a timekeeper guard against when workmen have both day-work and piecework operations in the course of a day's work?

16.11. Using the data given below, compute the daily earnings assuming that the wage incentive is (*a*) Halsey 50 per cent gain-sharing bonus, (*b*) Bedeaux incentive bonus, (*c*) Emerson Efficiency Bonus.

Data:

Standard time per piece, 10 minutes
Basic wage rate per hour, $1
Time worked, 8 hours
Output, 60 pieces

16.12. In Question 16.11 the standard time per piece was the same for all three types of incentive. Would it be sound practice to set the standard at the same level of performance for all these three incentive plans? Discuss.

16.13. Refer to Fig. 16.2. (*a*) For what purposes would this form be used? (*b*) What departments would receive copies?

16.14. (*a*) How is indirect labor cost applied to products? (*b*) How is salary cost applied to products? (*c*) Is it possible to have a situation where a portion of the salaries would be treated as direct cost?

CHAPTER 17

17.1. What are the employer's duties in connection with Old-age and Survivors' Insurance?

17.2. Are all workers covered by Old-age and Survivors' Insurance?

17.3. What are the employer's duties in connection with the Federal laws governing unemployment insurance?

17.4. What are the usual duties of the employer in connection with state laws governing unemployment insurance?

17.5. What risks are insured by workmen's compensation insurance?

17.6. How do the requirements of the Walsh-Healey Act covering the payment of overtime excess pay differ from the requirements of the Fair Labor Standards Act?

17.7. What is the purpose of a payroll audit made by an insurance company in connection with workmen's compensation insurance?

17.8. Describe alternative methods that a self-insurer might use in accounting for the cost of workmen's compensation.

17.9. What are the duties of the employer in connection with Federal income tax withholding?

17.10. What is the purpose of the withholding exemption certificate?

17.11. Refer to Fig. 17.1. (*a*) What is the cost of workmen's compensation insurance for the year ending April 1, 1948? (*b*) On the balance sheet of the Brumm Baking Company March 31, 1948, what amount should have been included in Unexpired Insurance with respect to Policy WC 179688D?

17.12. On July 1, 19— the Edwards Manufacturing Company pays an advance premium of $750 on its workmen's compensation insurance policy. The premium is based on an estimated payroll of $50,000 for the ensuing 6 months. The actual payroll for the month of July was $7,000. Prepare journal entries to

record the premium payment and the workmen's compensation insurance cost for the month of July.

CHAPTER 18

18.1. In a manufacturing organization what are the functions of (*a*) the timekeeping department? (*b*) the payroll department?

18.2. Why is the labor distribution function assigned in some plants to the cost accounting department instead of the payroll department?

18.3. What is the advantage of planning pay periods and accounting periods so that the end of the accounting period will always be the end of a pay period?

18.4. Why is it undesirable to change a man's clock number in the middle of a pay period?

18.5. Distinguish between (*a*) clock card and time ticket, (*b*) job time ticket and daily time ticket, and (*c*) time checking sheet and payroll control sheet.

18.6. Where employees operate the time clocks that register time in and time out, how is it possible to check the registration?

18.7. Where timekeepers are employed it is often the practice to have each timekeeper prepare an absentee report each day. A copy of this report is given to the foreman. What value would it have to him?

18.8. What use would be made of time tickets (*a*) in a plant having a standard cost system and a piece-rate incentive system? (*b*) in a plant having a day-rate system and a job-order cost system? (*c*) in a plant having a day-rate system and a process cost system?

18.9. Make a list of a timekeeper's daily duties as they are described in the text.

18.10. What is the purpose of an incentive-wage notice?

18.11. Describe three methods of obtaining totals of incentive wages for payroll purposes.

18.12. The payroll summary illustrated in Fig. 18.7 has columns for net amount of check, hours, regular earnings, war bonus, overtime excess pay (O. T.), gross earnings, and four types of payroll deductions. (*a*) What is the source of the figures in these columns? (*b*) If the wage system were a day-rate system, what form would probably be the source of the figures that would be written in these columns?

18.13. (*a*) Trace the postings from Fig. 18.1 to Fig. 18.4. (*b*) What is the purpose of the time checking sheet illustrated in Fig. 18.4?

18.14. Refer to Fig. 18.5. (*a*) Is a form of this type needed in a day-rate system? (*b*) Where would the figures be obtained for the first two colums of this form? (*c*) Which of the column totals on the payroll sheet for the pay period should agree with control totals that would appear on the form illustrated in Fig. 18.5?

18.15. Refer to Fig. 18.6. (*a*) Check the calculation of the overtime excess pay of 96 cents. (*b*) In this case is the overtime figured on a daily basis or on a weekly basis? (*c*) What is the gross pay? (*d*) What is the net pay? (*e*) Trace the figures in this illustration to the forms in Fig. 18.7.

18.16. Can you trace the figures on the job time ticket of Fig. 18.2 into the wage-cumulation record of Fig. 18.6? If not, explain why it is impossible.

18.17. Refer to Fig. 18.8. (*a*) Identify the payroll, the earnings statement, the payroll check, and the earning record. (*b*) In the method of writing the payroll which is illustrated here, would it be necessary to have the overtime excess pay, the total earnings, and the deductions all figured out beforehand

or could they be figured as a part of the operation of writing the payroll? (*c*) Why is it that the amount of the net pay does not appear on the check form in the illustration?

18.18. What controls should be established to prevent unnecessary overtime?

18.19. Check the calculation of the overtime premium of $4.98 on page 305. Check it first by going through the steps described on that page. Then check it by the longer method of calculation that is outlined on pages 302 and 303.

18.20. Assume that payroll advances are made from a payroll fund and then deducted on the payroll. How would you compute the amount to be deposited in the payroll fund on payday?

CHAPTER 19

19.1. One of the objects of labor distribution is to obtain journal entries to allocate labor cost to the appropriate ledger accounts. What other objects are there (*a*) in job-order cost systems? (*b*) in standard cost systems?

19.2. (*a*) According to the explanation given on page 310 of the text, would "nonproductive labor" be the name of an account? (*b*) Why is it difficult to get accurate reports on nonproductive labor in a day-rate system? (*c*) In an incentive wage system?

19.3. (*a*) What is a labor distribution summary? (*b*) Does it have a purpose similar to that of the form illustrated in Fig. 15.2, which is called Distribution of Supply Requisitions?

19.4. (*a*) What are the advantages of the summary-strip method of distribution over the multicolumn analysis sheet method? (*b*) The disadvantages? (*c*) Under what circumstances is the summary-strip method likely to be superior?

19.5. In the procedure described on pages 315 and 316 of the text how many summary strips would be made for each department in the course of a month, assuming that there were five weekly periods in the month including split weeks?

19.6. (*a*) In the punched-card method of distribution what is the form called a summary card? (*b*) How may the punching of the summary card be done?

19.7. Why in process cost systems are time tickets not usually required for the labor distribution?

19.8. (*a*) What accounting problems arise when a man is loaned or transferred temporarily by one department to another? (*b*) How are such transfers reported in job-order cost systems? (*c*) In standard cost systems? (*d*) In process cost systems?

19.9. Refer to Fig. 18.5. (*a*) Explain how the figures needed to complete this form would be obtained. (*b*) What is the purpose of the last three columns?

19.10. Refer to Fig. 19.1. Explain how the figures needed to complete this form would be obtained (*a*) in job-order cost systems, (*b*) in standard cost systems, (*c*) in process cost systems.

19.11. What justification is there for charging to Factory Overhead the overtime premium paid for overtime spent on a direct operation?

19.12. (*a*) Should vacation pay for direct workers be classed as Factory Overhead? (*b*) Give pro forma journal entries for the cost of vacation pay and the payment of vacation pay, assuming that a Reserve for Vacation Pay is to be provided.

19.13. How is setup labor classified (*a*) in job-order cost systems? (*b*) in standard cost systems?

19.14. Prepare pro forma journal entries for labor distribution and wage payment by using in combination (*a*) the labor distribution entries of Case 1*c* (pages 324 and 325) and the wage payment entries of Case 2*b* (page 325), (*b*) the labor distribution entries of Case 1*a* and the wage payment entries of Case 2*a*.

19.15. (*a*) What is meant by a labor distribution for a split pay period? (*b*) Under what circumstances is it necessary to make one?

CHAPTER 20

20.1. What connection is there between the classification and the control of factory overhead?

20.2. From the standpoint of cost control is it desirable to have a departmental classification of factory overhead?

20.3. What is a standing order?

20.4. Define (*a*) fixed cost, (*b*) variable cost, (*c*) semivariable cost.

20.5. What are the essential features of variable budget procedure?

20.6. In a flexible budget system the exact amount of the budget is not known until the end of the budget period when the actual volume for the period can be determined. Is it fair then to expect a foreman to keep the actual overhead of his department within the budget? Discuss.

20.7. Whose responsibility is the control of fixed overhead?

20.8. Why is the standard direct hour a better measure of volume than the actual direct hour?

20.9. Under what circumstances is it possible to measure volume by (*a*) quantity of units produced? (*b*) equivalent conversion units?

20.10. Compute the expected monthly plant overhead for a volume of 80,000 units (*a*) by reading the graph given in Fig. 20.3; (*b*) by the equation of the line that was fitted by inspection, as shown in Fig. 20.3; (*c*) by means of the equation that was computed by the method of least squares, as shown in Table 20.3.

20.11. A formula for periodic overhead in the form $T = F + vn$ merely expresses an average relationship. The actual overhead almost always deviates from the amount obtained by applying the formula. Of what value then is the formula?

20.12. The controller of H. G. Products, Inc., made a study of the factory overhead costs and developed a formula to use for estimating what the monthly amount of overhead would be. The formula follows: Monthly factory overhead = \$15,000 + the number of standard direct hours × 50 cents. (*a*) In the formula what is the fixed cost? (*b*) What is the variable unit cost? (*c*) Give the formula for estimating the annual factory overhead of this company.

20.13. (*a*) Why is it that total plant overhead can in most cases be estimated reasonably well by means of a linear equation even though some of the component overhead classifications are semivariable? (*b*) Of the three methods of developing a linear equation for periodic plant overhead that are described in the text, which method gives the least weight to the fact that many of the natural-classification costs are semivariable?

20.14. In designing a form of departmental master budget, what form would you suggest if you found that the standing-order costs were in many cases semivariable?

20.15. Inasmuch as departmental budget performance is generally measured on the basis of the total budget of a department, why are budget allowances shown for the various natural classifications?

20.16. If you were a shop foreman, would you want to have your performance measured by means of a flexible budget?

20.17. Why are taxes, insurance, and depreciation frequently excluded from the overhead budgets of the processing departments?

20.18. From the standpoint of cost control is it necessary or desirable to redistribute to processing departments the overhead of the service departments? For example, to charge the overhead of the maintenance department to the processing departments?

20.19. On the basis of the data in Table 20.3, state an equation for weekly plant overhead.

20.20. Refer to Fig. 20.7. (*a*) Compute the budget allowance for Overtime Bonus at 108 per cent of capacity. (*b*) How is it possible for a department to operate at more than 100 per cent of capacity?

20.21. Refer to Table 20.4. Assume that there are 40 direct workers in the Finishing Department and that the production schedule calls for a 40-hour week. Allow 10 per cent for absenteeism and nonproductive labor. Estimate the overhead budget for the week.

CHAPTER 21

21.1. What is the connection between overhead classification and overhead distribution?

21.2. Give six examples of transaction summaries in which there may be charges to Factory Overhead.

21.3. What is meant by "direct departmental overhead"?

21.4. What objections are there to the practice of not charging the cost of maintenance material and labor to Factory Overhead until the maintenance orders are completed?

21.5. What alternative methods are available for charging toolroom overhead to the processing departments?

21.6. Give three examples of overhead costs that cannot be specifically allocated to departments.

21.7. Outline a procedure of allocating to departments the cost of purchased electricity.

21.8. What characteristics would you look for in selecting a base factor to use in prorating an overhead cost to departments?

21.9. Is the departmental allocation of employee security costs a specific allocation or a proration?

21.10. How are the departmental depreciation costs determined (*a*) when the unit method of computing depreciation is used? (*b*) when the group method is employed?

21.11. Suggest a suitable base factor to use in prorating fire insurance to departments.

21.12. For purposes of cost control is it necessary to make a redistribution of service department overhead to the processing departments? Explain your answer.

21.13. In order to establish predetermined burden rates is it necessary to redistribute the predetermined service department overheads to the processing departments? Discuss.

21.14. Under what circumstances would it be desirable to redistribute service department fixed overhead on a different basis than that used for the redistribution of the variable overhead of the service departments?

21.15. Refer to Table 21.1. (*a*) Verify the computation of the actual burden rate of the Assembly Department, which is shown as 95 cents. (*b*) With respect to each of the natural classifications, state the probable source of the charges. (*c*) Which of the natural-classification costs are probably allocated specifically to departments, and which are probably prorated? (*d*) Should the total burden applied be equal to the predetermined burden rate for the plant ($1.23) multiplied by the total direct hours (35,424)? (*e*) What was the predetermined volume for the entire plant in terms of direct man-hours?

CHAPTER 22

22.1. What are the "earlier stages of the distribution" that are referred to on page 368 of the text in the first paragraph of the section entitled Analysis Sheet Method?

22.2. Describe specifically the procedure of posting to the form of department-overhead analysis sheet illustrated in Fig. 22.1 from the form of transaction-summary analysis sheet illustrated in (*a*) Fig. 15.2, (*b*) Fig. 19.1, (*c*) Table 21.3, and (*d*) Table 21.4.

22.3. Describe three different procedures of obtaining monthly plant totals according to the natural classifications of overhead.

22.4. Under what circumstances would a summary-strip method of departmental overhead distribution be more efficient than the analysis-sheet method?

22.5. Under what circumstances is the punched-card method of departmental overhead distribution likely to be favored?

22.6. (*a*) What is the purpose of the natural-classification control sheet? (*b*) In what method of overhead distribution is it used? (*c*) Why is it practical to dispense with this form where the punched-card method is used? (*d*) If this form is not used, how are plant totals by natural classification obtained?

22.7. (*a*) Describe specifically the procedure of posting to the form of departmental overhead account illustrated by Fig. 22.2. (*b*) Under what circumstances is this form likely to be used? (*c*) If this form were used, would the form illustrated in Fig. 22.1 be used also?

22.8. Where monthly departmental overhead budget reports are prepared, how are the figures obtained for the "actual" column of the reports?

22.9. (*a*) If there were 10 departments in a plant and 10 transaction summaries affecting factory overhead and if Summary-strip Method *a* were used, what is the maximum number of transaction summary strips that might be required each period? (*b*) Why is it unlikely that the maximum possible number of transaction summary strips would ever be required?

22.10. Under what circumstances would split-week recap summary strips be needed?

22.11. In the punched-card method of departmental overhead distribution (*a*) what is the function of a weekly summary card? (*b*) How many weekly summary cards would be required for each department? (*c*) Could the weekly summary cards be dispensed with, and if so how would the end-of-month procedure be changed?

22.12. Refer to Fig. 22.4. (*a*) What period of time would be covered by the three columns at the left of the form illustrated? (*b*) By the three columns at the right? (*c*) In what respects is this form similar in function to the form illustrated in Table 21.1?

CHAPTER 23

23.1. How is indirect labor cost applied to job orders?

23.2. The Carr Engine Works uses an over-all burden rate of $2 per direct man-hour. For the month of May, 19—, the labor distribution shows 4,000 direct hours worked. Prepare journal entry for burden applied.

23.3. Define and give examples of (*a*) material overhead, (*b*) process overhead, (*c*) work-point overhead, (*d*) process-personnel overhead.

23.4. Under what circumstances is it likely to be desirable to apply material overhead as a separate factor?

23.5. (*a*) How is the term *cost center* defined in the text? (*b*) How is the term used in the N.A.C.A. Research Study published April 1, 1938, entitled "Practice in Applying Overhead and Calculating Normal Capacity"? (The student of cost accounting should be familiar with both of these definitions, for the expression *cost center* is used both ways in technical accounting discussions.)

23.6. Under what circumstances is it essential to determine operation costs with extreme accuracy?

23.7. In order to obtain the most accurate operation costs, what should be the cost centers for the application of work-point overhead?

23.8. Is it possible in many plants to have accurate costs of finished products even though the operation costs are not very accurate? Explain your answer.

23.9. What application bases are appropriate to use for (*a*) material overhead and (*b*) process overhead?

23.10. The following is a schedule of burden rates that are used in costing the operations performed on a large milling machine:

Number of Operators	Burden Rate per Machine-hour
1	$1 50
2	2 00

(*a*) Why is the higher rate used on operations requiring two operators? (*b*) Can you estimate the rate for machine overhead only? (*c*) Would the method of applying overhead used for this machine give different results than would be obtained by applying machine burden and process-personnel burden separately? (*d*) Would it require less clerical work?

23.11. Outline a procedure of predetermining burden rates for machine centers.

23.12. Where machine rates are used to apply burden, is it customary to compute the monthly burden variance for each machine? Discuss.

23.13. Under what circumstances would the burden applied to products be the same, regardless of whether the direct labor hour or the direct labor dollar is used as the base factor?

23.14. Under what circumstances may it be more accurate to use the direct labor dollar as the application base?

23.15. Niles and Carrell, furniture manufacturers, have made it a practice to charge to Factory Overhead the freight on lumber purchased and the cost of operating the kilns where the lumber is dried. The factory overhead is applied to the other processing operations on the basis of direct labor cost. Criticize the procedure.

23.16. Refer to Table 23.1. (*a*) Verify the figures shown as the burden which would be applied at machine rates to 1 machine-hour of work. These figures are

$2.14 for machines of type 1, $1.38 for machines of type 2, etc. (*b*) Verify in Case I the burden rates of $1.89 per direct labor hour and 225 per cent of direct labor cost. (*c*) In Case I how is the burden cost of 63 cents computed for an operation on machines of type 3? (*d*) In Case II verify the burden rates of $1.78 per direct hour and 189 per cent of direct labor cost. (*e*) Verify the computation of two or more of the deviations that are shown in the table. (*f*) In the circumstances covered by the table, would you consider that a departmental burden rate would be satisfactory if price quotations are to be based on cost figures?

23.17. Refer to Table 23.2. (*a*) In paragraph 120 verify the calculation of machine capacities. (*b*) In paragraph 220 trace the steps taken to arrive at the burden rates in column (*e*). (*c*) In paragraph 311 trace the steps taken to determine the overhead applied. (*d*) Is it merely a coincidence that the overhead applied in paragraph 312 is almost identically the same for each operation as in paragraph 311? (*e*) Would the results be the same by the two methods if there were some gear-cutting operations in which the operator must devote all his time to one machine, whereas on most of the gear-cutting operations one man operates three machines. (*f*) In paragraph 410 why is there so much deviation between the figures in column 5 and the figures in column 1?

23.18. What, if any, connection can you see between burden application and the control of overhead cost?

CHAPTER 24

24.1. The Bill Lee Art Works uses a form of labor performance report similar to Fig. 16.3. Would the information compiled on this report be useful in the application of burden if the burden rates are departmental rates based on standard direct hours? Would a monthly total of the standard hours reported on this form be the proper figure to multiply by the departmental burden rate in order to compute the burden to be applied? If not, what adjustment should be made?

24.2. (*a*) What are the practical objections to the use of actual monthly rates for burden application? (*b*) the theoretical objections?

24.3. Discuss the following statement: When burden is applied at predetermined rates, the amount applied varies directly with the volume of production. Hence, the burden applied in any month is almost certain to differ from the budgeted overhead, for the latter does not vary directly with volume. (*a*) Is it a true statement? (*b*) At what volume should the monthly applied burden be equal to the budgeted burden?

24.4. Refer to the figures that have been tabulated on page 401. Assume that 10,000 hours is selected as the predetermined monthly volume. (*a*) In a month in which there are 9,000 direct hours, how much burden would be applied? (*b*) What would the overhead budget be at 9,000 direct hours?

24.5. Interpret the following statement made by a factory accountant: "We base our burden rates on normal capacity which is figured each year according to what we expect to sell. Each year has to stand on its own feet, and we are not kidding ourselves as to what our costs are." (*a*) What is meant by "normal capacity"? (*b*) What is meant by "costs"? (*c*) How might the forecasts of profit be misleading if the burden rates were based on the volume at full productive capacity?

24.6. Under what circumstances would practical plant capacity be an unrealistic standard to use as the predetermined volume? Why?

24.7. What is the distinction between normal volume and expected actual volume?

24.8. Would the actual fixed-overhead rate be more or less than the predetermined fixed-overhead rate in case the actual monthly volume was less than the predetermined volume?

24.9. A foundry manager in a period of severe business depression complained that the product cost figures that were furnished him by the cost department were of little use because they indicated that the costs were higher than ever before, whereas he had to quote lower prices than before in order to get any business. (*a*) How was the burden applied in arriving at the cost figures? (*b*) How might the burden have been applied in order to make the cost data more useful to the manager in connection with making price quotations? (*c*) Would the product costs furnished by the cost department be satisfactory for the valuation of the annual inventory?

24.10. The Riley Manufacturing Company makes storage batteries and toys, two distinct lines of product requiring for the most part entirely different processing. The factory departments are therefore organized in two distinct divisions, one for each line of product. The predetermined volume is to be set at the expected actual volume. Outline a procedure of estimating the predetermined volume (*a*) for the plant as a whole, (*b*) for the two divisions of the plant, (*c*) for the departments in each division.

24.11. Refer to Table 24.4. (*a*) Estimate the overhead of the Assembly Department at a volume of 100,000 direct hours per year. (*b*) Compute the burden rate at that volume.

24.12. Verify the figures shown in Table 24.5 in the Assembly Department column.

24.13. How would you estimate departmental overhead at predetermined volume in a plant where variable budget allowances had not been established?

24.14. Outline a method of estimating the periodic overhead of a machine center at a predetermined volume.

24.15. In a standard cost system is it satisfactory to multiply actual direct hours by the predetermined burden rate per standard hour in order to compute the amount of burden to apply to Work in Process? Explain your answer.

24.16. Under what circumstances would the standard direct hours of input be the same as the standard direct hours of work represented in the output?

24.17. Where a variety of products are processed in a department and the inventory consists of a great many different items, would it be feasible to use output figures as the starting point in determining standard direct hours of work done?

24.18. In a standard cost system where the standard direct hours are tallied for the purpose of computing incentive wages (*a*) can that tally be used also in determining the standard hours of work done for the purpose of burden-application? (*b*) What adjustment would be needed in order to convert wage-incentive standard hours to standard-cost standard hours?

24.19. In job cost systems is it better to compute the monthly amount of burden to apply to Goods in Process (*a*) by adding the burden applied to cost sheets or (*b*) by multiplying the monthly total of the burden-application base by the burden rate? Why?

24.20. Refer to Table 24.2. (*a*) What is the method of determining whether machine capacities in the department are in balance? (*b*) Machines of type A operated at 68 per cent of theoretical capacity in the latest 12-month period. Why

then is the predetermined volume set at 80 per cent of capacity? (*c*) Verify the computation of the predetermined departmental volume in machine-hours.

24.21. Refer to Table 24.3. (*a*) Machines of type A operated at 120 per cent of theoretical capacity in the latest 12-month period. Why then is the predetermined volume set at 140 per cent of capacity? (*b*) Why is total predetermined machine-hours 83 per cent of theoretical capacity, whereas the predetermined volume in man-hours is only 80 per cent of theoretical annual capacity?

24.22. In an efficiency-bonus wage-incentive system (*a*) how is job efficiency computed? (*b*) Two standard hours are allowed for a certain operation for wage-incentive purposes and the expected job efficiency is 90 per cent. If standard costs are set at the expected level of performance how many hours will be used as the standard for this operation for standard-cost purposes? (*c*) How much burden would be applied to this operation on a standard cost sheet, assuming a burden rate of $1.50 per standard hour?

24.23. The following profit forecast was prepared by the manager of a manufacturing enterprise:

PROFIT FORECAST

Sales (15,000 units)	$150,000
Cost of Goods Sold (burden at predetermined rates)	110,000
Gross Margin	40,000
Selling and Administrative Expense	30,000
Operating Profit	$ 10,000

Would you consider the forecast sound if you learned that the predetermined burden rates were based on a normal volume of 20,000 units? Discuss.

24.24. Write an explanation for the following pro forma journal entry:

Goods in Process	xx
Factory Overhead	xx

CHAPTER 25

25.1. What is the object of analyzing burden variance according to cause?

25.2. If a monthly department budget shows what the overhead should have been for a given month, and if the overhead applied is more than the budget, does this indicate that the foreman of the department has failed to meet the budget standard? If not, then how would you explain the excess of overhead applied over the monthly budget?

25.3. Verify the calculations in the two-way analysis of budget variance on page 425.

25.4. Refer to Table 24.4. Assume that the actual overhead of the Assembly Department in October, 19—, was $7,400 and that the direct hours were 8,000. (*a*) Determine the amount of overhead applied in October if the predetermined burden rate is 81 cents per direct hour. (*b*) What is the burden variance for October? (*c*) Make a two-way analysis of the October variance. (*d*) What additional information would you need in order to analyze the controllable variance according to the natural classifications?

25.5. Is it possible to make an exact prediction of the amount of volume variance at a given volume even though the actual overhead is not known? Explain your answer.

25.6. Why is there a larger volume variance in Case 1 on page 428 than in Case 2, although the actual volume is the same in both cases?

25.7. Why is the volume variance almost always a debit variance in case predetermined rates are based on practical plant capacity?

25.8. Refer to Fig. 25.1. (*a*) At what monthly volume should the burden be fully absorbed and the burden variance zero? (*b*) Could the burden variance be a credit variance if the monthly volume was 10,000 direct hours?

25.9. Do you think the cost of idle machine time that is caused by unbalanced machine capacities should be treated as a cost of production? Why?

25.10. What is the significance of the overhead budget variance?

25.11. Is a variation in the purchase price of supplies a factor that should be reflected in the overhead budget variance?

25.12. On pages 431 to 433 are described two alternative methods of computing the amount of overhead variance that is ascribed to variation in labor efficiency. (*a*) Why do the two methods give different results? (*b*) When labor efficiency is below standard, would the first of the two methods always give a higher figure?

25.13. (*a*) What is the historical-cost viewpoint with reference to the disposition of a yearly accumulation of unabsorbed overhead? (*b*) Is this viewpoint always adopted in job-order cost systems?

25.14. Would it be logical to classify overhead budget variance as a cost-of-goods-sold adjustment and at the same time to treat volume variance as extraordinary expense or income?

25.15. What is a supplementary burden rate? For what purpose might it be used?

25.16. If expected actual volume is used as the predetermined volume, should the burden variance be closed to Profit or Loss each month?

25.17. Describe two alternative ways of adjusting the burden element in the end-of-year inventory to the historical-cost basis.

25.18. If practical plant capacity is used as the predetermined volume, how should the burden variance be treated (*a*) at the end of each month? (*b*) at the end of the year?

25.19. Under what circumstances would it be sound practice to show burden variance as a deferred charge (*a*) on a monthly balance sheet? (*b*) on an end-of-year balance sheet?

25.20. Write explanations of the following pro forma journal entries:

(*a*)	Burden Variance	xx
	Supply Stores	xx
(*b*)	Work in Process	xx
	Burden Variance	xx
(*c*)	Profit or Loss	xx
	Burden Variance	xx

PROBLEMS

PROBLEM 1.1

THE PARKER MANUFACTURING COMPANY
Trial Balance, December 31, 19—
(Adjusted except for final inventories)

Account	Dr.	Cr.
Cash	$ 61,000	
Notes Receivable	12,000	
Accrued Interest Income	200	
Accounts Receivable	75,000	
Reserve for Bad Debts		$ 6,000
Finished Goods Inventory, January 1	50,000	
Goods in Process Inventory, January 1	25,000	
Raw Material Inventory, January 1	28,000	
Factory Supplies Inventory, December 31	5,000	
Unexpired Insurance, December 31	3,000	
Plant Site	40,000	
Plant Buildings	300,000	
Reserve for Depreciation, Plant Buildings		55,000
Machinery and Factory Equipment	190,000	
Reserve for Depreciation, Machinery and Factory Equipment		90,000
Office Equipment	15,000	
Reserve for Depreciation, Office Equipment		1,000
Good will	150,000	
Accounts Payable		110,000
Accrued Taxes on Plant		9,000
Accrued Factory Payroll		8,000
Common Stock		500,000
Free Surplus		107,000
Sales		785,000
Purchase Discount		2,000
Interest on Notes Receivable		1,200
Raw Material Purchases	245,000	
Direct Labor	114,000	
Indirect Labor	17,000	
Taxes on Plant	10,000	
Factory Supplies Used	32,000	
Insurance	6,000	
Depreciation	36,000	
Other Factory Overhead	18,000	
Salesmen's Salaries	57,000	
Salesmen's Expense	49,000	
Other Selling Expense	58,000	
Office Salaries	8,000	
Officers' Salaries	32,000	
Other Administrative Expense	14,000	
Sale Discount	7,000	
Dividends Paid	20,000	
Totals	$1,677,200	$1,677,200

On the basis of a physical count, the inventories December 31, 19—, are computed at the following amounts:

Finished Goods	$25,000
Goods in Process	20,000
Raw Material	20,000

You are asked to prepare the following statements in good form:

1. Cost of Goods Manufactured
2. Profit or Loss
3. Balance Sheet

PROBLEM 1.2

The following quotation is from an address made November 24, 1947, by the director of finance of Ford Motor Company:[1]

"We can all, I think, take pride in the way cost accounting has kept pace with industrial development in this country. Tremendous strides have been made during the last quarter of a century, and I'm sure that much more progress will be made in the future. In fact, progress will *have* to be made if we are to keep the science of cost accounting abreast of the times. The whole of industry is now operating on a different level than we have known before—a higher plateau on which cost accounting appears in a new light, becomes more and more significant as a factor in business management.

"It is my experience that the function of cost determination is basic to every other function of a modern business. Cost factors thread their way through every phase of a business and to a large extent influence the make-up of the entire enterprise—its products, its markets, and its methods of operation.

"We must, of necessity, have rather complex and extensive costing organizations, but the principle according to which they work is the same—finding out what each of the operations costs before it is too late to avoid doing the wrong thing.

"I am sure you would be interested in knowing that the accounting office at Ford was formerly almost completely centralized and that we have begun to install a decentralized system. . . .

"It is planned that after the decentralized and the local organizations are prepared to assume the responsibilities involved, these accounting offices will be placed under the direct jurisdiction of the managers of the operations which they serve. . . .

"Under the decentralized system each division has its own complete accounting service. . . . Each separate activity, such as each assembly plant, has been provided with an accounting office to compile its own internal operating reports for its own use, and to forward the financial statements required by the central office."

You are asked to discuss the following questions:

1. Under the decentralized organization of the accounting work would it be better for the controller of the Ford Motor Company to have direct authority or functional authority over the branch and divisional accounting offices? Discuss.

2. Will the decentralized system, in your opinion, make the cost accounting activities more significant in business management? In other words, is the change to a decentralized system in keeping with the trend that is outlined in the first three quoted paragraphs? Explain your answer, stating and illustrating advantages and disadvantages of the decentralized system in this case.

[1] *N.A.C.A. Bulletin*, Vol. 29, No. 7, Sec. II.

PROBLEM 3.1

On January 1, 19—, the F. C. Manufacturing Company had 1,600 bicycles in finished stock inventoried at $20 each. During the year 19—, material put into production was costed at $64,000; direct labor, $53,000; and factory overhead, $48,600. Ten-thousand bicycles were sold, and there were 800 bicycles in finished stock on December 31, 19—. There were no goods in process either at the beginning or at the end of the year.

You are asked to compute the inventory of finished goods and to prepare a statement of cost of goods sold. Use first-in–first-out cost.

PROBLEM 3.2

1. The H. A. Wire Company operates a process cost system. There are three productive processes. On September 1, 19—, the inventory in process 2 consisted of 10,000 pounds of wire which on the average was three-quarters finished in process 2. This inventory was carried at $1,400. During September, 210,000 pounds of wire was received from process 1 at a cost of 11 cents a pound. Labor, supplies, power, repairs, and depreciation for process 2 were $2,400 during the month, and in addition $600 of service department overhead was allocated to process 2. Wire completed in process 2 and transferred to the next process weighed 200,000 pounds, and the inventory of 20,000 pounds on September 30 was estimated by the foreman to be on the average one-quarter finished in process 2.

Compute to four decimal places the unit cost of goods transferred from process 2 and the unit cost of the current month's production in that process. Estimate the cost of the final inventory on the first-in–first-out basis. Show your computations. Journalize the transfer of 200,000 pounds of wire from process 2 to process 3.

PROBLEM 3.3

2. The Star Leather Company produces a lot of oak-tanned sole leather weighing 20,000 pounds at a cost of $7,000. The leather is cut into what the trade terms bends, shoulders, bellies, and heads, the different products weighing as follows:

Bends	10,000 lb.
Shoulders	4,000 lb.
Bellies	5,000 lb.
Heads	1,000 lb.

At the time of cutting, the market prices per pound are bends, 60 cents; shoulders, 45 cents; bellies, 40 cents; heads, 22½ cents.

What portion of the total cost of production would you allocate to each product, and what is the resulting cost per pound for each product?

PROBLEM 3.4

Using aqua ammonia, a liquid, as raw material, the Kilbourn Chemical Company produces anhydrous ammonia, a gas, by a distillation process. A part of the gas is compressed in steel drums and sold. The remainder is used to produce ammonium nitrate, a solid. From the following data compute the cost per pound of each product. Show your calculations.

Aqua Ammonia

Used	15,000 gal.
Cost	6¢ per gal.

Anhydrous Ammonia

Produced	15,000 lb.
Compressed and sealed in drums	5,000 lb.
Put into nitrate process	10,000 lb.
Market price in drums (drums invoiced separately)	15¢ per lb.

Ammonium Nitrate

Produced	25,000 lb.
(Increased weight is accounted for by the addition of atmospheric nitrogen and oxygen.)	
Market price	5½¢ per lb.

Processing Costs (Labor and Overhead)

Distillation	$300
Compressing	200
Nitrate	600
	$1,100

Goods in Process

For the purpose of this problem it may be assumed that there was no inventory of goods in process either at the beginning or at the end of the period.

PROBLEM 3.5

From a single raw material the D. J. Chemical Company makes three products: X, Y, and Z. X is considered a by-product, Y and Z are treated as major joint products. In process 1, by-product X is obtained and the remaining output passes to process 2 where products Y and Z are obtained.

During a certain month, material costing $12,000 was used and conversion costs were $35,000 in process 1 and $25,000 in process 2. The inventory in process was negligible both at the beginning and at the end of the month.

Production and sales data for the month are

Product	Production	Sales
X	4,000 gal.	2,200 gal. @ $0.06
Y	6,000 tons	5,000 tons @ $10.00
Z	10,000 bbl.	8,000 bbl. @ $3.00

Initial inventories of finished products were

X	400 gal. @ $0.06
Y	500 tons @ $8.00
Z	200 bbl. @ $2.50

Required:

1. Inventory valuation, using weighted average cost basis for products Y and Z and market value for product X.
2. Statement of gross margin.

PROBLEM 4.1

Design a job-order cost sheet form that might be used by a large automobile repair shop. Provide space for entering at least 12 items of material. Provide five departmental columns on the back of the form for the daily posting of labor costs. On the face of the form provide spaces for summarizing the labor costs, for applying burden at departmental rates, and for summarizing the total cost of a job.

The five departments and their burden rates expressed as percentages of direct labor cost are

Chassis repair	50%
Engine repair	40
Electrical work	30
Body and fender repair	40
Inspection	20

Record on the form the costs applicable to job order 12-806, Overhaul Engine.

Material used, Dec. 9:
- 1 Set of piston rings @ $8.00
- 2 Exhaust valves @ $1.50
- 1 Main bearing assembly @ $12.00
- 8 Wrist pins with bushings @ $0.75
- 1 Set of engine gaskets @ $1.00
- 1 Set generator brushes @ $1.75

Labor Cost:

	Dec. 8	Dec. 9	Dec. 10
Engine repair	$12	$24	$6
Electrical work		8	
Inspection			3

Summarize the costs, and determine the total cost of the job.

PROBLEM 5.1

Draw a form of standard cost sheet like the one illustrated in Fig. 5.5. Then compile a standard cost of the water-pump assembly for which the bill of material is given in Fig. 5.2. Obtain the unit cost of the first item, the water-pump body assembly, part A13-244, from Fig. 5.5. Assume that the standard unit cost of the shaft, part 27-809, is 45 cents: 15 cents for material, 10 cents for labor, and 20 cents for burden. For the purpose of the problem assume that the *other* parts required are purchased ready for assembly at a cost of 5 cents each, which is the standard.

Assume that the standard quantity is 200 and that the following assembly operations are required, all of them in Department 66:

Operation number	Standard minutes		Job class
	Setup	Cycle	
5	20	5.0	5
6	10	2.5	5
10	10	8.5	5

The standard labor cost per standard minute in job class 5 is 1.2 cents. The burden rate for department 66 is 120 per cent of direct labor cost.

PROBLEM 6.1

Assume that a manufacturer of pressed-steel products, namely, automobile fenders, radiator grills, gasoline tanks, fuel-oil tanks, and metal stampings, has employed you to modernize his accounting system. He has also employed an industrial engineer to modernize the production management system. You find that the industrial engineer is preparing an organization chart for the factory. The processing departments that will be recognized in the organization chart are

Stamping
Forming
Machine Shop
Welding and Assembly
Finishing

The service departments that the engineer proposes to include in the organization chart are

Purchasing
Employment
Shop Engineering
Production Planning and Control
Receiving, Stores, and Shipping
Maintenance

He consults with you in regard to the proposed organization chart. You point out that it would be desirable, at least from an accounting standpoint, to have a separate classification for shipping expense. You suggest therefore that a Shipping Department be recognized on the organization chart, even though the department is supervised by the same executive as the receiving and stores department. You also suggest that the factory manager's office be recognized as a service department to which would be charged factory overhead items of a general nature as well as the salaries of the factory manager and his technical and clerical assistants. You also suggest that Building Occupancy be shown on the organization chart as a service department and that building repairs, janitors' wages, space heating, lighting, building depreciation, real property taxes, and other costs of housing the factory operations be charged each month to that account. The engineer sees the merit of your suggestions and adopts them.

You consult with the industrial engineer and the general manager to find out what natural classifications of overhead it will be desirable to have. The three of you agree that the classification need not be extremely detailed. Together you make a list of the accounts that seem to meet the requirements of the management. The accounts are small tools, oil and grease, fuel, other shop supplies, maintenance of dies and punches, machine repairs, other maintenance, supervision, overtime excess pay, other indirect labor, annual inventory cost, spoiled work, experimental work, social-security costs, property taxes, freight-in, fire and liability insurance, vacation pay, depreciation, other factory overhead.

You find that the accounts in the general ledger are accounts payable, accounts receivable, accrued expenses, advertising, automobiles, capital stock, cash, commissions, depreciation, discounts on purchases, discounts on sales, factory equipment,

factory insurance, freight-in, general insurance, good will, interest expense, inventory of finished goods, inventory of work in process, inventory of raw materials, light and heat for office, loans payable, machinery, notes receivable, office furniture, office salaries, patterns and templates, postage and express, power, punches and dies, purchases, repairs, reserve for bad debts, reserve for depreciation, returned sales and allowances, sales, salesmen's salaries, stationery and printing, sundry factory expense, sundry general expense, superintendence, surplus, taxes, small tools, travel expense, wages.

1. Prepare a numerical classification of general ledger accounts. Use a decimal numbering system. There should be control accounts in the general ledger for Factory Overhead, Selling Expense, and Administrative Expense. For the purpose of this problem the balance-sheet accounts in your classification may be substantially the same as those previously in use, but they should be arranged systematically in your classification.

2. Prepare a numerical classification of the factory overhead accounts that you and the industrial engineer have agreed should be used. Make this a two-way classification.

PROBLEM 7.1

Group the account types mentioned in Table 7.2 into eight groups, namely,

1. Cash
2. Liability
3. Cost incurrence
4. Periodic cost distribution
5. Worked material in process
6. Finished product
7. Expense
8. Income

Then draw T accounts for the various account types that you have listed, arranging the T accounts by groups. An arrangement similar to that in Fig. 7.3 is desired.

Write the transaction summary numbers and names appearing in Table 7.2 in the appropriate T accounts. Enter these numbers and names as debits or as credits, as indicated in Table 7.2. Thus, the T account for Stores should appear as follows:

Stores

1. Purchase-invoice distribution	4*a*. Material requisitions
7. Rejected material reports	4*b*. Supply requisitions

PROBLEM 7.2

Draw T accounts similar to those in Fig. 7.3, but add T accounts for Factory Wages, Manufactured Parts, and Factory Overhead Applied. Then prepare pro forma journal entries for the flow of factory cost from the cost-incurrence stage through the cost-expiration stage. Your entries should be designed to fit the T accounts in your diagram. Number the journal entries. Then write the journal entry numbers in the appropriate T accounts as debits or as credits, as indicated by your journal entries. Thus, if your second entry is for wages accrued, you would

number that as entry 2 and you would write the figure 2 on the credit side of the T account for Accrued Wages and on the debit side of the Factory Wages account.

PROBLEM 7.3*

In the plant of the Rainbow Manufacturing Company all materials and supplies entering the plant are checked through a central receiving department and entered in total in the Stores account. A record is kept of all material and supplies consumed, and at the end of the month a report is issued showing the accounts to be charged for stores issued.

On January 2, 19—, the balances of the inventory accounts are as follows:

Finished Product	$15,000
Stores	60,000
Work in Process	12,000

During the month of January, stores received amounted to $80,000 and the monthly report indicates that $50,000 of stores were put in process; $3,000 of office supplies, $5,000 of factory supplies, and $2,000 of shipping supplies were consumed. Factory labor for the month amounted to $52,000 and is divided into $40,000 of direct labor and $12,000 of indirect labor. Miscellaneous manufacturing expenses for the month total $13,000.

Finished articles completed and removed from the factory to the finished goods storeroom have a cost value of $110,000, and those actually sold and delivered to customers have a value of $114,000.

Required:

Prepare ledger accounts for Factory Overhead and for the inventories covering the month of January.

PROBLEM 8.1

THE BROWN MANUFACTURING COMPANY
Balance Sheet, January 1

Assets		Liabilities	
Cash	$ 38,000	Notes Payable	$ 25,000
Accounts Receivable	174,000	Accounts Payable	64,000
Notes Receivable	20,000		$ 89,000
Inventory	226,700	Capital Stock	350,000
Machinery and Equipment	35,000	Surplus	54,700
	$493,700		$493,700

Analysis of Inventory January 1:

Raw Material $65,200; Work in Process $32,200; Finished Stock $129,300; Total $226,700.

Purchase Transactions for the month: $65,000.

Purchase of Material	$ 59,000
Invoices Chargeable to Indirect Factory Cost	2,500
Invoices Chargeable to Selling Expense	1,500
Invoices Chargeable to Administrative Expense	2,000

*Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

Payroll Analysis: Total $28,300.

Direct Labor	$ 18,000
Indirect Labor	4,500
Salesmen's Salaries	4,300
Office Salaries	1,500

Sales Total: $85,000.
Cash Transactions:

Received from customers on accounts	$100,000
Received from customers on notes	5,000
Paid on Notes Payable	10,000
Paid to suppliers	65,000
Payroll payments	28,300

Based on the foregoing data two trial balances have been prepared, one being representative of the balances that would be found in the ledger at the end of the month if a noncost method of accounting were employed, the other representing the balances that one would find if a cost accounting system were used. These trial balances are as follows:

General Ledger Trial Balances, January 31

	A		B	
1. Cash	$ 39,700		$ 39,700	
2. Accounts Receivable	159,000		159,000	
3. Notes Receivable	15,000		15,000	
4. Machinery and Equipment	35,000		35,000	
5. Notes Payable		$ 15,000		$ 15,000
6. Accounts Payable		64,000		64,000
7. Capital Stock		350,000		350,000
8. Surplus		54,700		54,700
9. Sales		85,000		85,000
10. Raw Material	65,200		96,200	
11. Work in Process	32,200		45,200	
12. Finished Stock	129,300		109,300	
13. Material Purchases	59,000			
14. Direct Labor	18,000			
15. Factory Indirect Cost	7,000			
16. Selling Expense	5,800		5,800	
17. Administrative Expense	3,500		3,500	
18. Cost of Sales			60,000	
	$568,700	$568,700	$568,700	$568,700

You are asked

1. To state which trial balance is derived from cost accounting procedures and to describe briefly its characteristic features.

2. To prepare journal entries for the month's transactions using a noncost system. Check your work by posting to T accounts and comparing the resulting balances with those in the noncost trial balance.

3. To prepare journal entries for the month's transactions using the job-order cost method of tracing the flow of costs. Check your work by posting to T accounts and comparing the resulting balances with those in the cost-accounting trial balance.

4. To answer the following questions:

a. What are the January 31 inventories of Raw Material, Work in Process, and Finished Stock?

b. What was the cost of product completed by the factory in January?

c. In the trial balance illustrating the cost-accounting method, why is there no balance in the Factory Indirect Cost account? Was the burden applied at actual or at predetermined rates?

PROBLEM 8.2

The Graff Iron Works carries its cost accounts in a general ledger. On January 1, 19 –, the condition of the business is set forth by the following balance sheet:

Assets			Liabilities	
Cash		$ 38,000	Accrued Factory Wages	$ 11,000
Notes Receivable		20,000	Notes Payable	25,000
Accounts Receivable		174,000	Accounts Payable	64,000
Inventories:			Capital Stock	350,000
Raw Materials	$ 65,200		Surplus	43,700
Work in Process	32,200			
Finished Stock	129,300	226,700		
Machinery		35,000		
		$493,700		$493,700

The credit purchases for January amount to $65,000, chargeable as follows:

Raw Materials	$59,000
Factory Indirect Costs	2,500
Selling Expenses	1,500
Administrative Expenses	2,000

The sales for January, charged to Accounts Receivable, amount to $85,000.

The cash receipts for January amount to $105,000, the cash payments to $103,000, these totals being made up as follows:

Receipts:	
From Accounts Receivable	$100,000
From Notes Receivable	5,000
Payments:	
On Accounts Payable	65,000
On Notes Payable	10,000

On Payroll:	
Direct Factory Labor	18,000
Indirect Factory Labor	4,500
Salesmen's Salaries	4,300
Administrative Salaries	1,500

The requisitions covering raw materials issued to production orders during the month amount to $28,000.

The estimated depreciation of machinery for the month is $300.

The factory wages earned during the month amount to $20,000 for direct labor and $4,000 for indirect labor.

Burden is applied to production orders at the rate of 30 per cent of direct labor.

The goods manufactured during the month amount to $40,000.

The finished goods shipped during the month amount to $60,000 at cost.

On the basis of the foregoing data, give the journal entries to record the transactions for the month using job-order cost procedure. Then post to T accounts and take a trial balance, January 31, 19—. Prepare an operating statement and a balance sheet. For the purpose of this problem you may ignore payroll taxes and income tax withholding.

PROBLEM 8.3

On January 1, 19—, the ledger of S. F. Industries, Inc., showed the following balances: cash, $20,000; accounts receivable, $50,000; finished goods, $10,000; goods in process, $16,000; stores, $8,000; machinery, $30,000; reserve for depreciation, $12,000; accounts payable, $18,000; accrued wages, $1,000; other accrued expenses, $1,000; stock, $80,000; surplus, $22,000.

During the month of January, 19—, purchase invoices were vouchered amounting to $43,000, of which $25,000 was for raw material, $8,000 for factory overhead, and $10,000 for selling and administrative expenses. Checks drawn on commercial account amounted to $54,000, of which $40,000 was to pay invoices and $14,000 was for payrolls and was deposited in a payroll account. (Debit the latter amount to Accrued Wages.) The sales to customers were $80,000 all on account, and $70,000 cash was received from customers.

Factory wages earned was $11,000 on direct operations and $5,350 on indirect work. (Credit Accrued Wages.) Factory payrolls showed gross wages of $14,140 and deductions for old-age benefits of $140. (Debit the latter amount to Accrued Wages. Credit Other Accrued Expenses. No other entry is needed, for the net amount of the payroll, $14,000, was debited to Accrued Wages from the record of cash disbursements.)

Requisitions for material and supplies amounted to $23,000, of which $20,000 is chargeable to production orders and $3,000 to factory overhead. Depreciation of factory equipment is $150 for the month. Factory overhead is to be applied to production at 150 per cent of direct labor cost.

The material, labor, and overhead costs of completed production orders are summarized from job cost sheets and amount to $55,000. Goods sold, at factory cost, as shown by cost records were $60,000.

Required:

1. Journal entries and ledger T accounts to record the opening balances and the transactions for the month
2. Trial balance, January 31, 19—
3. Condensed statement of income and expense

PROBLEM 8.4*

OLDTOWN MANUFACTURING COMPANY

I. Trial Balance, January 1, 1949

Cash on Deposit—Payroll Fund	$ 500	
Cash on Deposit—Commercial Account	12,050	
Accounts Receivable	9,000	
Work in Process	1,720	
Raw Materials	2,500	
Shop Supplies	150	
Machinery and Equipment	15,000	
Office Equipment	1,000	
Accounts Payable		$ 1,200
Accrued Wages and Salaries		600
Accrued Taxes		500
Employee Deposits for Old-age and Survivors' Insurance		80
Employee Deposits for Federal Income Tax Withheld		280
Reserve for Depreciation of Machinery and Equipment		6,000
Reserve for Depreciation of Office Equipment		250
Capital Stock		30,000
Surplus		3,010
	$41,920	$41,920

II. Inventory Detail, January 1, 1949

Raw Materials:

Item number	Quantity	Unit cost	Amount
1	100 pieces	$0.75	$ 75.00
2	280 pieces	2.50	700.00
3	80 gal.	1.75	140 00
4	330 gal.	0.25	82 50
5	1,000 pieces	0.60	600 00
6	90 pieces	3.00	270 00
7	450 pieces	0.15	67 50
8	565 pieces	1.00	565 00
			$2,500 00

Work in Process:

Job-order number	Material	Labor	Burden
101	$250	$100	$125
102	500	60	75
103	430	80	100

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

III. Information about the Transactions for the Month of January, 1949

1. Purchase invoices received and audited:

Supplier	For	Amount
American Supply Co.	Raw material	$2,875
Smith Brothers.	Factory supplies	460
Columbus Dispatch.	Classified advertising for factory help wanted	90
E. W. Sells Co.	Office supplies	60
Columbus Power and Light Co.	Electricity	420
Federal Gas Co.	Gas for heating (90% factory)	130
George Jones, Agent .	Fire insurance for 1 year from Jan. 1	240
Rogers Chemical Works .	Raw Material	910
James Walker.	January rent (90% factory)	400
American Machine Co. . .	New part for milling machine	30

2. Cash payments:

a. Invoices paid: Those invoices listed above covering advertising, rent, insurance, heat, and electricity; also invoices of $1,200 for purchases of the previous month.

b. The amount of income tax withheld on December, 1948, payrolls, $280, was deposited in a bank to the credit of the Federal government.

c. Office salaries for the month were $400. One per cent was deducted for Old-age and Survivors' Insurance. Federal income tax withheld was $50. The remainder was paid.

d. Factory wages paid: $3,200 less 1 per cent for Old-age and Survivors' Insurance and less $320 for Federal income tax withheld.

e. Old-age and Survivors' Insurance taxes paid: Employees' tax $80, employer's tax $80. Debit the latter to Accrued Taxes.

f. Federal Unemployment-insurance Excise tax for the year 1948 paid: $100; state unemployment-insurance contribution for last three months of 1948 paid: $150. Debit Accrued Taxes.

3. Cash received on account: $8,000.

4. Detail of materials received:

American Supply Company
500 pieces item 1 @ $0.75
500 pieces item 6 @ 3.00
1,000 pieces item 8 @ 1.00
Roger Chemical Company
520 gallons item 3 @ $1.75

5. Materials requisitioned from stores:

Item Number	Job-order Number	Quantity
1	101	12
	102	12
	103	24
	104	24
	105	24
2	104	60
3	104	20 gal.
	105	20 gal.
4	104	60 gal.
	105	60 gal.
5	102	10
	103	50
6	104	500
8	104	500

6. Wage cost distribution:

Order Number	Direct Labor Cost
101	$400
102	400
103	800
104	400
105	400
Indirect	900
	$3,300

7. Burden rate: 125 per cent of direct labor cost.
8. Job orders completed and shipped:

Order Number	Invoice Amount
101	$2,000
102	2,000
103	3,200

9. Depreciation:
   Machinery and equipment: 12 per cent a year.
   Office equipment: 6 per cent a year.
10. Shop supplies requisitioned: $500.
11. Tax accruals for the month:
    Property taxes: $30.
    Employers' social-security taxes: 4 per cent of employee earnings.
12. Insurance expired: As determined from the facts given elsewhere in the problem.

IV. Required

1. Stores ledger.
2. Job cost sheets.

3. Ledger T accounts.
4. Journal entries.
5. Trial balance, January 31, 1949.
6. Proof schedules of stores ledger and cost sheets.
7. Statement of Cost of Goods Sold.
8. Statement of Profit or Loss.

V. Hints

Use 12-column paper for the stores ledger. Allow 10 lines for each stores item. Provide columns for

In: Quantity
Unit Cost
Out: Quantity
Unit Cost
Balance: Quantity
Unit Cost
Amount

Use four-column paper for job cost sheets. Allow 10 lines for each job-order number. Provide columns for

Material Cost
Direct Labor
Burden

Include in the purchase-invoice distribution not only the purchase invoices received in January, but also the items of payroll taxes and employee deposits that were paid during the month. Then include the latter items also in cash payments as debits to Accounts Payable.

Do not include wages or salaries in the purchase-invoice distribution. Credit the amount of wages and salaries earned to Accrued Wages and Salaries; and debit Work in Process, Factory Overhead, Selling and Administrative Expense as in entries 12-2 and 12-3 in Table 8.2. Then make an entry for the payrolls paid in January similar to entries 12–24 and 12–25, debiting Accrued Wages and Salaries and crediting Payroll Fund and employee-deposit accounts. In the entry for cash payments credit Cash for the net amount paid to employees and debit Payroll Fund as in entry 12-23.

Determine the cost of goods shipped by summarizing the appropriate cost sheets Credit Work in Process and debit Cost of Goods Sold. There is no account for Finished Goods in this problem. Presumably the product is shipped as soon as completed by the factory.

In addition to the accounts shown in the trial balance, provide T accounts for Factory Overhead, Factory Overhead Applied, Sales, Cost of Goods Sold, Selling and Administrative Expense, and Unexpired Insurance.

PROBLEM 9.1

On January 1, 19—, the ledger of the Adams Manufacturing Company showed the following balances: cash, $20,000; accounts receivable, $50,000; finished goods, $10,000; goods in process, $15,000; stores, $8,000; machinery, $30,000; reserve for depreciation, $12,000; accounts payable, $18,000; accrued wages, $1,000; capital stock, $80,000; surplus, $22,000.

Transactions for the months of January and February, 19—, were

	January	February
1. Purchase invoices audited		
Raw material purchases	$25,000	$15,000
Factory overhead	8,000	7,500
Selling and administrative expense	10,000	10,000
	$43,000	$32,500
2. Wages earned in factory		
Direct operations	$11,000	$ 7,500
Indirect operations	5,350	4,850
	$16,350	$12,350
3. Checks issued		
In payment of invoices	$41,000	$36,500
For payrolls	14,000	13,000
	$55,000	$49,500
4. Sales invoiced to customers	$80,000	$60,000
5. Cash received from customers	$70,000	$55,000
6. Depreciation	$ 150	$ 150
7. Raw material issued from stores		
Chargeable to production orders	$20,000	$17,500
Chargeable to factory overhead	3,000	2,500
	$23,000	$20,000
8. Factory overhead absorbed on production orders as a percentage of direct labor	150%	200%
9. Production orders completed at costs as shown by cost sheets; material, labor, and overhead	$55,000	$42,500
10. Goods sold, at manufacturing cost, as shown by cost records	$60,000	$46,000

On February 1, 19—, a factory ledger was opened with the following accounts: Finished Goods, Goods in Process, Stores, Accrued Wages, Factory Overhead, General Ledger Control.

Required:

1. Journal entries to record the transactions for both months including the entries needed to open the factory ledger on February 1, 19—.
2. Interim work sheets for the two months.
3. Condensed statement of income and expense for each month and balance sheet February 28, 19—.

PROBLEM 9.2

Using the data in Problem 8.2 but assuming that a separate factory ledger was to be opened on January 1, 19—, prepare the factory journal entries required to open the factory ledger and to record the transactions for the month of January, 19—. Assume that the Accrued Factory Wages account is to remain in the general ledger. Post the journal entries to factory ledger T accounts. Prepare a trial balance of the factory ledger January 31, 19—.

PROBLEM 9.3

The January 1, 1949, trial balance of the Oldtown Manufacturing Company is given in Problem 8.4 as well as a summary of the January, 1949, transactions. Assume that a separate factory ledger is to be opened January 1, 1949, containing the following accounts: Raw Materials, Shop Supplies, Factory Overhead Control, Factory Overhead Applied, Factory Wages, Work in Process, Cost of Shipments, Unabsorbed Factory Overhead, and General Ledger Control. Prepare two interim work sheets for the month of January, one representing the factory ledger, the other representing the general ledger.

PROBLEM 9.4

Given the trial balance of a manufacturing company's factory ledger on January 31, 1948, as follows:

Stores	$ 8,000	
Goods in Process	20,125	
Finished Goods	21,200	
Over- and Underapplied Overhead	400	
Accrued Payroll		$ 3,400
General Ledger		46,325
	$49,725	$49,725

and the following information:

Actual manufacturing overhead for the month:

Indirect labor	$ 2,700
Indirect material	1,200
Other overhead, including depreciation	4,000
	$ 7,900

Factory Payroll

Vouchered and paid	$40,800
Earned	44,200

Debits to Stores for purchases, $20,000.
General Ledger account balance January 1, 1948, (Cr.) $37,000.
Material returned to stores, none.
Returned sales, none.
Underapplied manufacturing overhead for the month, $400.
Total debits to Goods in Process for the month, $69,800.
Cost of goods completed, transferred to Finished Goods, $64,675.

You are asked to prepare

1. Factory ledger trial balance, January 1, 1948.
2. Statement of cost of goods manufactured for the month.

PROBLEM 9.5*

The McKinley Manufacturing Company of Manitowoc, Wisconsin, decided to install a cost system. At their request you install a job-order system of the controlling account type with a self-balancing factory ledger. The balance sheet on January 1 was as follows:

* Wisconsin C.P.A. Examination.

Balance Sheet, January 1, 19—

Assets			
Cash		$ 16,000	
Notes Receivable		10,000	
Accounts Receivable	$ 76,000		
Reserve for Bad Debts	8,000	68,000	
Inventories:			
Raw Material	$130,000		
Goods in Process	76,000		
Finished Goods	92,000	298,000	
Land		12,000	
Building	$106,000		
Reserve for Depreciation	4,240	101,760	
Machinery and Equipment	$169,500		
Reserve for Depreciation	16,260	153,240	
Office Furniture	$ 14,750		
Reserve for Depreciation	2,650	12,100	
Unexpired Insurance		3,120	
Fuel and Supplies Inventories		3,580	
Total Assets			$677,800
Liabilities			
Notes Payable		$ 20,000	
Accounts Payable		165,060	
Accrued Wages—(Direct $2,400)		2,740	
Accrued Salaries—Office		700	
Total Liabilities			$188,500
Proprietorship			
Capital Stock		$400,000	
Surplus		89,300	
Total Proprietary Interest			$489,300

As of January 1, the factory management was charged with $500 in cash turned over to it, as well as all inventories, accruals, and prepaid items affecting the manufacturing operations. The main office is to honor all purchase orders and payroll requests of the factory. It is also to reimburse the Factory Imprest Cash Fund but only upon the presentation of a properly prepared petty cash voucher. The burden rate to be used by the factory is 25 cents per direct labor hour.

January transactions are summarized as follows:

Invoice Register

Raw Material	$41,510
Fuel and Supplies	1,350
Insurance	160
Factory Repairs	720
Sundry Factory Expense	830
Sales Office Expense	2,250
Power, Heat, and Light	1,727
Main Office Expense	614
Office Stationery and Supplies	271
	$49,432

Sales Register

	Cost Price	Selling Price
Finished Goods Sold	$55,180	$85,310
Sales Return Book	$3,920	$6,240

Cash Received Journal

Notes Payable Issued (to Bank for Loan)	$11,000
Accounts Receivable Collected	71,418
Interest Income	25
Total	$82,443

Cash Paid Journal

Accounts Payable Paid	$61,302
Interest Expense	55
Factory Payroll	19,788
Salesmen's Salaries and Expenses	6,329
Office Salaries Paid	5,368
Postage	95
Total	$92,937

Payroll Record

Direct Labor	$17,354
Indirect Labor	2,301
Office Salaries	5,679
	$25,334

Additional Adjustment Data for January

Reserve ½ of 1% of Net Sales for Bad Debts	
Depreciation at following annual rates:	
Building	2%
Machinery and Equipment	5%
Office Furniture	10%
Unexpired Insurance, January 31	$ 2,816
Fuel and Supplies Inventory, January 31	2,681
Accrued Property Taxes	1,200

Factory Data

Material Requisitions	$28,693
Direct Labor Hours—34,800 hr.	
Completed job records show the following costs of manufactured stock transferred to the finished goods stockroom:	
Productive Labor	$18,924
Material	30,817
Burden	13,560
	$63,301

The factory has disbursed $97.10 for Sundry Factory Expense during January but has not yet prepared the voucher to be submitted to the main office. In addition

a purchase of $12.15 chargeable to the same account was made on January 20 but was unpaid on January 31.

From the above data submit

1. Journal entry to be made on the books of the main office to record the transfer to the factory upon opening the factory books.
2. Operating Statement for January.
3. Balance Sheet, January 31, 19—.
4. Itemized Factory Ledger Accounts for January.

PROBLEM 10.1

THE J. L. MANUFACTURING CO.
Factory Ledger Trial Balance, March 1, 19—

	Dr.	Cr.
Raw Material, at standard cost	$3,000	
Goods in Process, at standard cost	1,500	
Finished Goods, at standard cost	2,000	
Factory Overhead		
Cost of Goods Sold		
Material Variance		
Labor Variance		
Burden Variance		
General Ledger		$6,500
	$6,500	$6,500

The transactions for the month of March are summarized as follows:

Raw material purchases	
At standard cost	$18,500
At actual cost	19,000
Raw material requisitioned, at standard cost	
Actual quantity	$20,000
Standard quantity	19,800
Direct labor	
Actual (4,800 hr.)	$ 5,000
Standard (4,900 hr.)	4,900
Manufacturing Burden	
Actual	$ 4,000
Applied	3,750
Standard cost of product	
Completed by factory	$24,000
Shipped to customers	23,000

The factory overhead budget for a volume of 4,900 standard direct hours is $3,900.

Required:

1. Journalize the transactions for the month; close the expense accounts.
2. Prepare trial balance, March 31, 19—.
3. Prepare a report showing the analysis of variances according to causes.

PROBLEM 10.2

From the following data compute variances by causes (assuming that a standard cost system and a flexible budget are being used):

Material put into process		
Actual quantity	1,050 units	
Standard quantity	1,000 units	
Actual cost per unit	20¢	
Standard cost per unit	22¢	
Direct Labor		
Actual hours	10,000 hr.	
Standard hours	10,400 hr.	
Actual rate per hour	94¢	
Standard rate per hour	90¢	
Factory Overhead		
Actual overhead for the month		$15,000
Predetermined overhead rate, $1.20 per standard hour, based upon a normal volume of 15,000 hr.		
Budget for 10,400 hr.		$14,500

PROBLEM 10.3*

The John William Manufacturing Company uses standard costs throughout its plant. There are inventory accounts for materials, work in process and finished goods.

The following data pertains to the month of August, 19—:

	Actual	Standard
Raw Material Balance, August 1	$ 3,000	
Work in Process Balance, August 1		$ 1,500
Finished Goods Balance, August 1		2,000
Raw Material Purchased	19,000	
Raw Material Processed	20,000	19,500
Direct Labor	5,000	4,800
Manufacturing Expense	4,000	4,100
Product Finished		24,000
Product Sold		23,000

Required:

1. Assuming that all items are charged into and out of Work in Process at standard costs, set up the inventory and variance accounts to show entries for the month.
2. Assuming that all items are charged into Work in Process at actual costs and out at standard costs, set up the accounts to show entries for the month and indicate where the variance is located.

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* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

PROBLEM 10.4*

The Dickerson Show Case Company has established standard material requirements for the different sizes of stock cases. They have selected No. 1 oak and after numerous tests have established lumber standards, based on a cost of $90 per thousand feet, as follows:

Style	Quantity, ft.	Cost
A	230	$20.70
B	190	17.10
C	310	27.90

During September the plant is scheduled to operate at 60 per cent of capacity and to produce 400 style A, 200 style B, and 600 style C cases. Lumber carried at the standard cost of $90 a thousand is available for this production.

After production is started, orders are received for 700 style B cases, and it is necessary to increase production immediately and to purchase more No. 1 oak lumber for immediate delivery. Five cars (150,000 feet) of No. 1 oak are purchased at $92.50 per thousand feet. When it is delivered it is found that it is slightly off-grade, but as the seller decides to make an allowance of $7.50 per thousand feet, the lumber is used.

At the end of the month all scheduled production as well as the new order have cleared through the cutting division, and it is found that the actual lumber used amounted to 453,000 feet.

Required:

Calculate the material variance. Analyze the variance showing quantity and purchase-price variances. State the probable effect of the off-grade lumber on the costs.

PROBLEM 10.5*

The Hilley Mattress Company uses a standard cost system.

The company manufactures mattresses in a single standard size but in six different styles, resulting from combination of two grades of cover material, or "ticking," with three grades of filler material. For the first half of 19— the cost estimates are based on the anticipated requirements shown below as to material and labor for each style.

On January 1, 19—, material prices were as follows: grade A ticking, 20 cents per yard; grade B ticking, 30 cents per yard; felted cotton, 11 cents per pound; silk floss, 40 cents per pound; findings, tags, and trimming materials, 40 cents per mattress. Labor rates were as follows: cutting department, 80 cents per hour; stuffing and sewing department, 70 cents per hour; tying and trimming departments, 60 cents per hour. Burden is estimated as 200 per cent of direct labor in the cutting department; 100 per cent in the stuffing and sewing department; 200 per cent in the tying and

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

trimming department. Shipping department expense is estimated at 10 cents per mattress for labor and 5 cents per mattress for expense.

Bill of Material

Style	Ticking, yards		Filler, pounds	
	Grade A	Grade B	Felted cotton	Silk floss
1	6		50	
2	6		25	15
3	6			30
4		6	50	
5		6	25	15
6		6		30

Labor Operations
(For all styles)

	Standard Time, Hours
Cutting cover	0 1
Stuffing and sewing	2 0
Tying and trimming	0 4

Balance Sheet January 1, 19—

Assets		Liabilities	
Cash	$ 40,300	Accounts Payable	$ 4,300
Accounts Receivable	31,400	Capital Stock	100,000
Work in Process (none)		Surplus	33,512
Finished Product	9,022		
Raw Materials	15,890		
Plant and Equipment less Reserve for Depreciation	41,200		
	$137,812		$137,812

Production Record—First 6 months, 19—

Style	Raw material issued	Ticking cut	Stuffed and sewed	Tied and trimmed	Shipped	Sale price per unit
1	1,000	1,000	900	800	700	$13.00
2	3,000	3,000	3,000	2,800	2,400	16.50
3	500	500	500	400	300	20.00
4	2,200	2,000	2,000	1,600	1,400	14.00
5	4,800	4,500	4,200	4,000	3,500	17.50
6	2,000	2,000	2,000	1,600	1,200	21.00

Other Transactions

Material Purchases (on account). Grade A ticking, 24,500 yards at 20 cents; grade B, 45,000 yards at 30 cents; felted cotton, 350,000 pounds at 12 cents; silk floss, 200,000 pounds at 41 cents; trimmings, findings, etc., $5,500.

Expenses Incurred (on account). Factory, $20,600 (cutting, $1,200; stuffing and sewing, $16,000; tying and trimming, $3,400); shipping, $500; selling, $4,100; administrative, $2,000.

Wages and Salaries (paid in cash). Direct labor, $20,970 (cutting, 1,400 hours; stuffing and sewing, 24,500 hours; tying and trimming, 4,500 hours); indirect labor, $5,200 (cutting, $400; stuffing and sewing, $3,600; tying and trimming, $1,200); shipping, $900; selling, $10,000; administrative, $6,900.

Depreciation. Total, $1,500 (cutting, $400; stuffing and sewing, $700; tying and trimming, $400).

Cash Items. Collected on account, $155,600; paid on account (in addition to wages and salaries), $140,400.

Inventory Details
(By actual count)

Raw materials	Jan. 1, 19—	June 30, 19—
Ticking—A, yards	6,700	4,100
Ticking—B, yards	11,600	2,500
Felted cotton, pounds	50,000	46,000
Silk floss, pounds	12,000	18,000
Findings, etc.	$770	$750

Work in Process. As indicated by production record.

Finished Product

Style	Jan. 1, 19—	June 30, 19—
1	200	300
2	300	700
3	. .	100
4	100	300
5	100	600
6	. .	400

Required:

1. Detailed statement of standard cost of each style of mattress.
2. Journal entries recording transactions for the 6 months ending June 30, 19—, on the basis of standard cost calculations. Submit schedules in good form to support your journal entries.
3. Balance sheet at June 30.
4. Operating statement for the 6 months ending June 30.

Suggestions:

1. Assume that all materials including cover, filler, and findings are issued at the start of the first operation.
2. Apply burden on the basis of the standard direct labor cost of the hours actually worked.
3. Assume that the difference between the book inventory of raw materials on June 30 and the physical inventory is a quantity variance.

4. The balance of the Work in Process account in the ledger after the output has been credited at standard should differ from the amount obtained by costing the final quantities at standard. Assume that the difference in the case of the labor element is a labor-efficiency variance. In the case of the burden element the difference may be transferred to the Burden Variance account as a correction of the entry for burden applied.

5. Charge shipping expense at standard to Cost of Goods Sold.

PROBLEM 10.6*

The following problem illustrates the accounting procedure for basic or measurement standard costs.

Purchases of raw materials, supplies, and labor are entered at actual cost. Requisitions for raw material are priced at standard as well as at actual. The standard cost of material is debited to the standard-cost section of Materials in Process account and credited to Standard Cost Control account. The actual cost of material requisitioned is debited to the actual-cost section of Materials in Process account and credited to Stores.

Actual direct labor is debited to the actual-cost section of Labor and Burden in Process account. Normal burden is absorbed on the basis of hours run; unabsorbed burden is allowed to accumulate in the burden or overhead accounts. Department production reports are priced at standard labor and burden which is debited to the standard-cost section of the Labor and Burden in Process account, with contra credits to Standard Cost Control account.

Finished production reports are priced at actual and at standard, credited to the goods in process accounts and debited to Finished Goods account. Billings to customers are priced at standard cost and converted to actual by applying the current cost ratios. These ratios are computed each month by adding the current production to the initial inventory and then dividing actual by standard. The standard cost is credited to the standard-cost section of the Finished Goods account and debited to Standard Cost Control account. The actual cost is credited to the actual-cost section of Finished Goods account and debited to General Ledger account.

THE BASIC MANUFACTURING COMPANY
TRIAL BALANCE OF FACTORY LEDGER
March 1, 1948

Stores, at actual cost	$ 6,000	
Material in Process		
Actual cost	5,000	
Standard cost	4,400	
Labor and Burden in Process		
Actual cost	1,000	
Standard cost	1,100	
Finished Goods		
Factory Burden (Unabsorbed since January 1, 1948)	500	
General Ledger Control		$12,500
Standard Cost Control		5,500
	$18,000	$18,000

* Adapted from Eric A. Camman, *Basic Standard Costs*, Chart V, American Institute Publishing Company, Inc., New York, 1932.

Transactions for the month of March:

1. Raw material purchases	$ 9,000
2. Actual direct labor	2,000
3. Burden incurred, actual, (credit General Ledger Control)	2,500
4. Burden absorbed at rate of 110% of direct labor	
5. Requisitions for direct material	
a. Actual cost	5,000
b. Standard cost	4,200
6. Standard cost of operations performed:	
a. Direct labor	2,100
b. Burden	2,310
7. Standard cost of product completed:	
a. Material	6,000
b. Labor and Burden	4,500
8. Actual cost of product completed:	
a. Material	7,000
b. Labor and Burden	4,250
9. Standard cost of product shipped	10,000
10. Actual cost of product shipped (to be computed).	

Required:

1. On a 12-column sheet set down the trial balance, March 1, 1948. Allow two lines for each account.
2. In the second pair of columns record the transactions for the month. Number the entries.
3. In the third pair of columns show the trial balance, March 31, 1948.

PROBLEM 10.7*

The trial balances shown on page 492 are taken from the records of the Alton Products Company. The records are accumulated on the basis of standard costs.

During the month of February material costing $20,000 was purchased. The direct labor charged into Work in Process at standard costs amounted to $8,000. Salaries of $2,000 were charged to Selling Expense, and salaries of $4,000 to Administrative Expense.

Required:

Prepare journal entries summarizing the transactions for the month of February. Prepare also comparative financial statements for the 2 months.

PROBLEM 11.1

The A. G. Chemical Company manufactures one product by passing the material through two processes. The material passes directly from process 1 to process 2 without inventory between the processes. The inventories of work within the processes must be considered because the cost of the material is relatively high and the amount of material within each process varies greatly from time to time.

January:

Process 1. There was no inventory in this process on January 1. During the

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

Alton Products Company, Trial Balances

	Jan. 31, 1948		Feb. 29, 1948	
Cash	$ 9,000		$ 10,150	
Accounts Receivable	30,000		40,000	
Raw Material (actual)	12,000		13,930	
Work in Process (standard)	4,000		8,000	
Finished Goods (standard)	9,000		5,000	
Manufacturing Supplies	900		700	
Prepaid Fire Insurance	300		180	
Prepaid Compensation Insurance	700		588	
Land	10,000		10,000	
Buildings	60,000		60,000	
Machinery and Equipment	30,000		30,000	
Reserve for Depreciation		$ 12,000		$ 15,500
Accounts Payable		6,250		13,800
Accrued Property Taxes		1,200		200
Accrued Wages		840		1,040
Accrued Payroll Taxes		600		1,280
Employee Deposits for Old-age and Survivors' Insurance		150		320
Employee Deposits for Income Tax Withheld		1,500		3,100
Capital Stock		125,000		125,000
Surplus		20,210		20,210
Sales		35,000		83,230
Cost of Sales	24,000		60,000	
Indirect Labor	3,000		6,100	
Depreciation	3,500		7,000	
Heat and Light	800		1,700	
Property Taxes	200		400	
Fire Insurance	120		240	
Payroll Taxes	600		1,280	
Compensation Insurance	90		202	
Manufacturing Supplies Expense	140		340	
Power	1,200		2,600	
Selling Expense	3,000		6,500	
Administrative Expense	8,000		16,400	
Material Variance	90		160	
Labor Variance	110		210	
Burden Absorbed (standard)		8,000		18,000
	$210,750	$210,750	$281,680	$281,680

month, 900 units of material costing $9,000 were put into the process; on this material operations were performed at a cost of $2,800. During the month, 600 units were finished and passed on to process 2. On January 31, 300 units remained in process 1, one-half finished.

Process 2. Process 2 had no work in process on January 1. During the month

of January, it received the work finished by process 1. The costs of operations of process 2 were $2,000. During the month process 2 completed 300 units. At January 31, 300 units remained within the process, one-third finished.

February:

Process 1. Material put into process, 650 units, $6,750. Operation costs $2,550. On February 28, there were 450 units still within the process, two-thirds finished. The units that were unfinished on February 1 were all completed during the month.

Process 2. Cost of operations during the month, $2,640. On February 28, there were 300 units still within the process, one-half finished. The units that were unfinished on February 1 were all completed during the month.

Required:

1. Construct accounts for process 1 and process 2 for January. Enter therein the material cost and the operation costs. Transfer from each the work finished and passed on to the next process or to Finished Goods. Enter the inventory of January 31 in each, rule off, and bring down the inventories as of February 1.
2. Continue the accounts for February.
3. Prepare a cost sheet for each month using a form similar to that shown in Table 11.5.

PROBLEM 11.2

1. From the data in the T accounts below prepare journal entries covering cost application and worked-material transfers for the month of January.
2. Prepare a process cost sheet showing for each process the unit cost of manufacturing during the month as well as the unit cost of goods completed.

Process 1

Jan. 1	Inventory, 600 gal. two-thirds finished in this process	$ 630	
Jan. 31	Material, 5,000 gal	4,500	
Jan. 31	Conversion cost	1,500	
Jan. 31	Completed and transferred to Process 2, 5,200 gal		(?)
Jan. 31	Inventory, 400 gal. one-third finished in this process		(?)

Process 2

Jan. 1	Inventory	None	
Jan. 31	Worked material from process 1	(?)	
Jan. 31	Conversion cost	$1,800	
Jan. 31	Completed and sent to finished stock, 4,500 gal		(?)
Jan. 31	Inventory, 400 gal. one-half finished in this process		(?)
	(Shrinkage discovered when processing is completed, 300 gal.)		

PROBLEM 11.3

Refer to Problem 3.5. Using the data given there, prepare T accounts for the two processing departments and for the three items of finished product, and enter the initial inventories and the transactions for the month. Carry the by-product at market price, the other products at weighted average cost.

PROBLEM 11.4*

The Shadey Valley Milk Association operates a milk condensory at Shadey Valley, Ohio. The company buys whole milk from local producers and manufactures condensed milk which is sold in cans. On January 31, 19—, after 1 month's operation, the following trial balance was prepared after all adjustments had been made except for inventories.

Trial Balance
January 31, 19—

Cash	$ 8,000.00	
Accounts Receivable	3,450.00	
Manufacturing Supplies on Hand	2,680.12	
Prepaid Expenses	650.00	
Land	5,000.00	
Buildings	20,000.00	
Machinery and Equipment	24,000.00	
Accounts Payable		$ 2,514 12
Accrued Taxes		70 00
Accrued Wages		380 00
Capital Stock		60,000 00
Reserve for Depreciation—Buildings		50 00
Reserve for Depreciation—Machinery		200 00
Purchases—Whole Milk	16,000.00	
Receiving Department Labor and Expense	1,700 00	
Condensing Department Labor and Expense	1,000 00	
Canning Department Labor and Expense	5,000.00	
Administrative Expenses	603 15	
Selling Expense	130 85	
Sales		28,000.00
	$91,214 12	$91,214 12

During the month 500,000 pounds of whole milk was purchased. The capacity of the condensing pan is 1,000 gallons, and during the month 56 complete runs were made. A gallon of whole milk weighs approximately 8.6 pounds, and the milk is condensed in a 4:1 ratio (4 gallons of milk produce 1 gallon of condensed milk). A total of 207,400 cans of milk was put up during the period, each can containing one-half pint of condensed milk.

On January 31, 19—, the inventories were as follows:

2,100 gallons of whole milk
1,000 gallons of condensed but uncanned milk
7,400 cans of condensed milk

Required:

1. Prepare operating statements for the month, together with details of costs by processes (receiving, condensing, and canning) indicating clearly the shrinkage. Submit supporting schedules showing the calculation of the cost of the January 31 inventories.
2. Prepare journal entries to close the books.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

PROBLEM 11.5*

The following information is taken from the records of the Aksarben Packing Company for the month of October, 19—.

Cattle slaughtered were 200 head weighing an average of 800 pounds each and costing $45,000. Yields were as follows: dressed beef, 55 per cent; hides (green), 6½ per cent; oleo fats, 4 per cent; other by-products worth $1,300. Sales, inventories, and conversion costs were as follows:

Department	Inventory, Oct. 1		Inventory, Oct. 31		Sales		Conversion costs, amount
	Pounds	Value	Pounds	Value	Pounds	Value	
Killing	None	.	None	...	None	...	$1,600
Beef	12,000	44¢	18,000	(?)	79,000	50¢	1,800
Hides	30,000	16¢	28,000	17¢	11,000	18¢	300
Oleo	1,000	20¢	1,400	18¢	4,000	20¢	300
By-products	None	...	1,000	14¢	13,000	15¢	600

Set up five departmental accounts for the company, namely, Killing, Dressing Beef, Hide Processing, Oleo Processing, By-product Processing. Record the transactions for the month, and present the results in a form that will give the management all necessary information. Make such assumptions as are necessary to arrive at a complete solution. Transfer hides and oleo fats from Killing process at October 31 inventory values less shrinkage cost and other conversion cost for these items subsequent to the split-off point. Assume that all products in the October 31 inventory are fully processed and ready for sale.

PROBLEM 11.6

The following problem is patterned after the first illustration in Chapter 11, and purposely so, for the ledger procedure in the illustration is a typical procedure and is not too easy for a student to master. In order to solve the problem the student must go through the full cycle of developing the data required for the various journal entries. For the more difficult parts of the solution he will be able to use the illustration in the chapter as a guide.

There are some steps in the solution the principles of which are not covered in Chapter 11 or earlier chapters because they are usually studied in courses in accounting fundamentals. There are other steps in the solution, particularly the departmental distribution of conversion costs, the principles of which are not discussed until later in the text. Very specific instructions are therefore given in the problem on those parts of the solution.

The time required by most students for the solution of this problem has been found to range from 12 to 20 hours. Six assignments approximately equal in length are indicated to aid the instructor in making the assignments where it is desired to spread the classroom discussion of the problem over several class sessions.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

ORWELL PORTLAND CEMENT COMPANY

Assignment I

Portland cement is made by crushing and mixing materials containing silica, lime, and alumina in proper proportions, firing the mixture in a kiln, and then grinding the clinker thus obtained, with gypsum added to retard setting, into a fine powder. In the wet process water is added in the crushing operation to obtain a soupy mixture, which is called slurry. After the grinding operation the cement is stored in silos or bins. It may be shipped in bulk or in bags. In the latter case an additional operation is required, prior to shipment, to place the cement in bags.

The Orwell Portland Cement Company operates a cement plant using the wet process of manufacture. All cement is shipped in bags.

The chart of factory ledger accounts follows.

Chart of Accounts
Factory Ledger

10. Stores
    11. Limestone
    12. Shale
    13. Gypsum
    15. Coal
    16. Cloth Bags (at standard cost)
    17. Paper Bags (at standard cost)
    18. Factory Supplies
20. Work in Process
    21. Crushing and Mixing process
    22. Kiln (and clinker storage)
    24. Clinker Grinding Process
30. Finished Product
    31. Cement in Bins
    32. Cement in Bags
40. Conversion Costs—Primary Classification
    40.01 Wages
    40.05 Payroll Taxes and Insurance
    40.10 Coal Used
    40.11 Factory Supplies
    40.14 Repairs
    40.16 Power
    40.18 Miscellaneous
    40.21 Salaries
    40.25 Property Taxes
    40.26 Fire and Liability Insurance
    40.27 Depreciation
    40.99 Conversion Cost Distributed to Departments (*credit-balance account*)
50. Conversion Costs—Departmental Classification
    51. Building Occupancy
    52. Laboratory
    53. General Mill Overhead
    61. Crushing and Mixing
    62. Kiln

64. Clinker Grinding
67. Bagging and Shipping
70. Conversion Costs Applied
71. Crushing and Mixing
72. Kiln
74. Clinker Grinding
77. Bagging and Shipping
80. Expense
81. Bin Cost of Cement Shipped
82. Bagging and Shipping
83. Bags Used
84. Bag Cost Variance
99. General Ledger Control

A trial balance of the factory ledger on January 1, 19—, follows:

ORWELL PORTLAND CEMENT COMPANY
Trial Balance of Factory Ledger
January 1, 19—

	Dr.	Cr.
11. Limestone (5,000 tons @ 80¢)	$ 4,000	
12. Shale (2,000 tons @ $1)	2,000	
13. Gypsum (120 tons @ $15)	1,800	
15. Coal	4,500	
16. Cloth Bags (40,000 @ 15¢)	6,000	
17. Paper Bags (100,000 @ 5¢)	5,000	
18. Factory Supplies	5,800	
21. Work in Process—Crushing and Mixing		
22. Work in Process—Kiln (3,000 bbl. @ $1.25)	3,750	
24. Work in Process—Clinker Grinding		
31. Cement in Bins (5,000 bbl. @ $1.60)	8,000	
99. General Ledger Control		$40,850
	$40,850	$40,850

Open ledger accounts for the accounts shown in the chart. Allow ten lines for each account. Enter the balances of January 1, 19—. In cases where the data are given, write the quantity and unit cost in the explanation column.

A summary of charges to the factory from purchase invoices follows. Prepare journal entry and post to ledger.

Limestone (8,000 tons @ 85¢)	$ 6,800
Shale (5,200 tons @ $1.10)	5,720
Gypsum (180 tons @ $15)	2,700
Coal	7,000
Factory Supplies	3,000
Cloth Bags (30,000 @ 15¢)	4,500
Paper Bags (152,000 @ 5¢)	7,600
Bag Cost Variance	1,500
Repairs	506
Miscellaneous Conversion Cost	1,500
Total	$40,826

Assignment II

The last two items of the purchase distribution must be further distributed to departmental accounts. As preparation for that distribution the department numbers were written on the purchase invoices when they were being audited. In the purchase journal a column was provided for department numbers. The appropriate department numbers were written in this column when the distribution according to primary classifications was made. A summary of the departmental distribution of the purchases of repairs and miscellaneous conversion costs follows:

Department	Repairs (.14)	Miscellaneous conversion cost (.18)
51	$241	
52	.	$ 790
53	.	520
61	84	
62	160	70
64	21	
67	....	120
	$506	$1,500

Prepare on 12-column paper an analysis sheet for each department. As a heading for the first amount column write "Total." Then provide an amount column for each of the primary classifications, .01 Wages, .05 Payroll Taxes and Insurance, and so on, but omitting 40.99 Conversion Cost Distributed to Departments. The departmental analysis sheets are a means of distributing the current month's conversion costs to departments. They are also subsidiary accounts. In totaling the columns at the end of a month, the totals for the month are to be shown and ruled off. Then cumulative totals are to be written on the next line. The cumulative total for each department will agree with the balance of the departmental accounts in the 50 series in the ledger. Enter on the departmental analysis sheets the distribution of January purchase invoices for repairs and miscellaneous conversion costs. Indicate in the explanation column of the departmental analysis sheet the source of each entry. In this case the source is "Purchase Distribution."

The distribution of employee earnings for the month is summarized below:

Department	Wages	Salaries
51	$ 500	
52	. . . . .	$ 800
53	. . .	1,500
61	17,000	
62	15,000	
64	10,000	
67	2,200	
Total. . . .	$44,700	$2,300

Prepare journal entry, and post to the factory ledger. Enter the departmental amounts on the departmental analysis sheets. The Accrued Wages account is on the general ledger.

Payroll taxes and insurance are to be accrued at the rate of 4 per cent of wages earned. Power cost accrued for the month is $2,400, of which 25 per cent is to be charged to Department 61, 40 per cent to Department 62, 20 per cent to Department 64, and 15 per cent to Department 67. The estimate of property tax accrued for the month is $1,800, of which 40 per cent is to be charged to Department 51, 5 per cent to Department 52, 5 per cent to Department 53, 10 per cent to Department 61, 20 per cent to Department 62, 10 per cent to Department 64, and 10 per cent to Department 67. Prepare journal entries for the accruals referred to in this paragraph, and make the departmental distribution.

The January charge to the plant for fire and liability insurance is $600. This is to be distributed as follows:

Department	Amount
51	$200
52	140
61	60
62	100
64	60
67	40
	$600

Assignment III

A memorandum is received from the general office stating that the monthly depreciation charges to the factory in 19— will be $600 on buildings, $300 on office equipment, $800 on kiln, and $1,500 on miscellaneous factory equipment. Charge the first item to Department 51, one-fourth of the second item to Department 52 and the remainder to Department 53, the third item to Department 62, and the last item in proportion to the cost of miscellaneous factory equipment in service as tabulated below.

Department	Cost of Miscellaneous Factory Equipment in Service
51	$ 2,000
52	10,000
53	20,000
61	60,000
62	10,000
64	70,000
67	28,000
Total	$200,000

The quantities of raw materials put into process in January were

Limestone	7,500 tons
Shale	5,000 tons
Gypsum	150 tons

Using the first-in–first-out method of costing, apply the costs of materials used to the appropriate work-in-process accounts. Study carefully the description of the processing in the first paragraph of the problem.

The cost of coal used in January was $6,400, of which $6,000 was used to fire the kiln and the remainder for space heating.

The distribution of supplies requisitioned from stores in January is shown below.

Department charged	Primary classification	
	11	14
51	$ 50	$ 100
52	90	
53	200	
61	300	150
62	400	800
64	300	40
67	160	110
Total.....	$1,500	$1,200

After the foregoing transactions have been journalized and posted and appropriate entries have been made on the departmental analysis sheets, the latter sheets should be added down and across. The column totals on each sheet should be verified by cross-footing. The next step is to make a journal entry to distribute the conversion costs to the departmental accounts in the factory ledger. Debit the accounts in the 50 series; credit account 40.99.

Assignment IV

In order to determine the amount of conversion cost to apply to the work-in-process accounts, it is necessary to redistribute the cost of service departments to the processing departments. This redistribution is to be done on a schedule but not in the ledger. This schedule should be prepared on 12-column paper. Prepare it in good form, for it will be used also as a report. Give it a suitable title. Provide one amount column for each department and one for totals. Allow one line for each primary classification, writing the name of the primary classification in the explanation space. Enter the appropriate amounts in the departmental columns and the total columns, and add. Check primary classification totals with the ledger accounts in the 40 series. Check the grand total with account 40.99. Then on the schedule redistribute the cost of Department 51, Building Occupancy, on the basis of floor-space units. Carry out your answers only to the nearest dollar. The floor-space units are computed as follows:

Department	Square feet floor area	Unit equivalent	Floor-space units
52	5,000	3	15,000
53	5,000	3	15,000
61	30,000	1	30,000
62	20,000	1	20,000
64	20,000	1	20,000
67	25,000	2	50,000
Total . . .	105,000		150,000

On the schedule redistribute the cost of Departments 52 and 53 according to the following predetermined percentages, carrying out your answers to the nearest dollar.

Department	Percentage
61	30
62	25
64	25
67	20
Total	100

After redistributing the service-department costs, obtain totals of the processing department columns. These are the amounts to apply to work-in-process accounts. Prepare journal entry for conversion cost applied. Charge Bagging and Shipping Cost to account 82. Credit the accounts in the 70 series (Conversion Costs Applied). Post.

Assignment V

At the close of the last shift on January 31, 19--, the clinker in storage and the cement in bins were inventoried by physical inspection. A summary of the inventories follows.

Location	Quantity
Bins	10,000 bbl.
Clinker Storage, Dept. 62	1,000 bbl.

The inventories in the crushing and mixing process, in the kiln, and in the grinding process are to be ignored.

Shipments for the month were 57,000 barrels. 70,000 cloth bags and 158,000 paper bags were used. 35,000 cloth bags were returned by customers for credit.

Departmental output in terms of barrels of finished cement are compiled as follows:

Clinker Grinding, Department 64:		
	Cement bagged and shipped	57,000 bbl.
Add:	Cement in bins, Jan. 31	10,000 bbl.
		67,000 bbl.
Deduct:	Cement in bins, Jan. 1	5,000 bbl.
	Output, Dept. 64	62,000 bbl.
Kiln, Department 62:		
	Output of clinker grinding department	62,000 bbl.
Add:	Inventory of clinker, Jan. 31	1,000 bbl.
		63,000 bbl.
Deduct:	Inventory of clinker, Jan. 1	3,000 bbl.
	Output of kiln to clinker storage	60,000 bbl.

Crushing and Mixing Process, Department 61:

Inasmuch as the inventory in the kiln is to be ignored, the output of the crushing and mixing process is assumed to be the same as the output of the kiln, that is, 60,000 barrels.

The input of the crushing and mixing process in terms of barrels of finished cement is assumed to be the same as the output, namely, 60,000 barrels, for the inventory of worked material in the crushing and mixing process is to be ignored.

Prepare journal entries to record the transfer of slurry to kiln, the transfer of clinker to the grinding process, and the transfer of cement to bins. The inventory of clinker in storage is to be valued at weighted average cost. Post the journal entries.

Journalize the cost of cement shipped using a weighted average cost, the cost of bags used at the standard cost, and the standard cost of bags returned by customers. Post.

Prepare journal entry to charge General Ledger Control for the cost of cement shipped, bagging and shipping cost, bags used, and bag cost variance. Post.

Assignment VI

Prepare trial balance of factory ledger, January 31, 19—.

Prepare cost report for the month of January, 19—. Provide columns for Description, Barrels, Cost for the Month, Unit Cost. Following a vertical arrangement, show the cost at four stages, namely, Slurry, Clinker, Cement in Bins, Cement Shipped. At each stage show the input, the conversion cost, and the inventory adjustment if there is any.

PROBLEM 12.1

Make a report on one of the following topics:

1. Audit of purchase invoices.
2. Application of principles of internal check in connection with procurement.

In your report give specific illustrations of procedures found in practice. If it is possible for you to do so, visit a manufacturing plant to obtain material for your illustrations.

PROBLEM 13.1

The following is a list of audited purchase invoices of the Horsch Manufacturing Company for the month of December, 19—.

Vendor's Name	Date Audited	For	Amount
Bell Telephone Co.	Dec. 6	Telephone service	$ 88
Tawney Art Co.	Dec. 10	Advertising novelties	900
American Mfg. Co.	Dec. 10	Raw materials	1,250
Fred Construction Co.	Dec. 10	Repair factory roof	500
West Power Co.	Dec. 10	Electricity	200
Valentine & Co.	Dec. 10	Shop supplies	50
Burke Forging Co.	Dec. 10	Raw materials	1,082
Burke Forging Co.	Dec. 10	Raw materials	798
Burke Forging Co.	Dec. 10	Forging for machine repair	80
Burke Forging Co.	Dec. 10	Raw materials	910
American Mfg. Co.	Dec. 15	Raw materials	1,860
Die Castings, Inc.	Dec. 15	Raw materials	750
Ace Advertising Co.	Dec. 15	Magazine advertisements	5,000
Hiram Brown	Dec. 15	Legal services	500
Briggs Hardware Co.	Dec. 20	Shop supplies	246

Doan Machine Co.	Dec. 20	6 drill presses		6,000
K-M Electric Co.	Dec. 20	Repair motors		300
Burke Forging Co.	Dec. 20	Raw materials		941
Burke Forging Co.	Dec. 20	Raw materials		510
American Mfg. Co.	Dec. 20	Raw materials		1,210
Valentine & Co.	Dec. 31	Shop supplies		50
American Mfg. Co.	Dec. 31	Shop supplies		75
Wheeler Office Supply	Dec. 31	10 chairs for office		300
Wheeler Office Supply	Dec. 31	Office supplies		150
Briggs Hardware Co.	Dec. 31	Shop supplies		240
Petty Cash	Dec. 31	Postage due	$ 2	
		Car passes for shop messenger	5	
		Express collect on advertising material	8	
		Newspapers for office	2	
		Lunches for office overtime	25	
		Lunches for customers	12	54
				$24,044

From the company's chart of accounts the following list was prepared of the accounts needed for the solution of this problem:

Account Number	Name
1120	Bank
1171	Raw Materials
1210	Factory Supplies Inventory
1550	Machinery
1580	Office Furniture
2123	Accounts Payable
2142	Accrued Wages
5320	Machinery Repairs
5321	Building Repairs
5331	Utilities
5349	Other Factory Overhead
6230	Advertising
6249	Other Selling Expense
6340	Telephone, Telegraph, and Postage
6341	Office Supplies
6349	Other Administrative Expense
7810	Purchase Discount

The following credit invoices were received:

Date	From	For	Amount
Dec. 18	Burke Forging Co.	Return of 10 defective forgings from shipment of Dec. 2	$20
Dec. 28	Briggs Hardware Co.	Adjustment of price on shop supplies	3
			$23

The following is a summary of checks issued in December.

Date	Check No.	Payee	Amount of Check	Purchase Discount
Dec. 1–10	9461-79	Various, for November purchases	$ 9,810	$ 40
Dec. 10	9480	Payroll	2,409	
Dec. 10	9481	Bell Telephone Co.	88	
Dec. 15	9482-91	Various, for invoices audited Dec. 10 and 15. (1% discount on invoices for materials and shop supplies)	13,813	67
Dec. 24	9492	Payroll	2,882	
Dec. 31	9493	Cashier	54	
			$29,056	$107

1. Assume that a voucher register is used to show the distribution of all expenditures except payrolls. Assume that purchase vouchers are prepared twice a month—on the 15th and the 31st—and that December vouchers are numbered 12-1, 12-2, etc. Prepare voucher register and check register.

The column headings suggested for the voucher register are Date; Vendor, Voucher Number; Payment (2 columns—one for Date and one for Check Number); Cr. Accounts Payable, Account 2123; Debits (10 columns): Raw Materials, Account 1171; Factory Supplies Inventory, Account 1210; Factory Overhead (2 columns—one for Account Number and one for Amount); Selling Expense (2 columns); General Administrative Expense (2 columns); Other Debits (2 columns).

The column headings suggested for the check register are Date; Payee; Voucher Number; Check Number; Credit Bank, Account 1120; Credit Purchase Discount, Account 7810; Dr. Accounts Payable, Account 2123; Dr. Accrued Wages, Account 2142.

Prepare list of vouchers unpaid December 31, 19—. Describe the filing of invoices and vouchers.

Prepare summary journal entries covering the transactions recorded in the voucher register and the check register.

2. State how the procedure would differ if the distribution of costs incurred were made by means of unit slips. Assume that the other features of the procedure would be the same as in 1.

3. Assume that the purchase invoices are distributed in a purchase journal, remittance advices being prepared in the same operation. How would the purchase journal differ from the voucher register prepared in 1? From what file or record would the analysis of unpaid invoices at the end of the month be prepared?

PROBLEM 13.2

Assume that the Horsch Manufacturing Company has no purchase journal and no voucher register but uses the check register to make the distribution of purchase costs incurred. Using the facts in regard to December transactions which are given in Problem 13.1, prepare check register for the month of December. Charge payments of November invoices to Accounts Payable. Prepare summary journal entry.

Prepare schedule showing the distribution of invoices that were unpaid on December 31. Prepare adjusting journal entry to record this liability.

PROBLEM 13.3

Assume that the Horsch Manufacturing Company operated a factory ledger containing the following accounts: Raw Materials, Factory Supplies Inventory, Factory Overhead, and General Ledger Control. Assume that an accounts-payable system is used. Design a suitable form of purchase journal, and record in it the purchase transactions for the month of December which are described in Problem 13.1. Prepare summary journal entry for the general books.

Design a columnar analysis sheet to be used in the factory office to record the distribution of purchase invoices. Enter the December charges on the schedule. Prepare summary journal entry for the factory books.

PROBLEM 13.4

Make a report on one of the following topics:

1. General principles of punched-card accounting.
2. General principles of McBee Keysorting.
3. Methods of accounting for purchases in a manufacturing organization.

If the last topic is selected, it would be desirable for the student to visit a manufacturing plant to obtain material for specific illustrations.

If one of the first two topics is selected, material should be obtained from the manufacturers of the equipment who have sales offices in the larger cities. Users of the equipment are another source of information to which some students may have access. On the subject of punched-card accounting published material is available in many business libraries.

PROBLEM 14.1*

The Jones-Montana Company carries the details of their raw material inventory in stock cards divided into five sections, namely:(1) ordered, (2) received, (3) reserved, (4) issued, (5) balance. The reserved section shows only the order number and quantity; the received and issued sections show date, order number, quantity, and unit price; the ordered section shows date, order number, and quantity; and the balance section shows quantity available and quantity on hand.

The following transactions for part 19 occurred during the month of July. Rule up stores-ledger card, and make the necessary entries.

July 1. Balance 1,100 units, value $550.
July 3. Required for order 1005—1,000 units.
July 5. Ordered on purchase order 696—1,500 units.
July 6. Issued on order 950—100 units.
July 10. Reserved for order 1005—1,000 units.
July 12. Required for order 1006—500 units.
July 15. Received on order 696—1,500 units, at cost of $735.
July 20. Required for order 1007—2,000 units.
July 21. Issued for order 1005—1,000 units.
July 22. Reserved for order 1006—500 units.
July 29. Issued on order 1006—500 units.

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* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

PROBLEM 15.1

Using the facts given in Fig. 14.1 but using the weighted average cost method, determine the cost of the February 10 inventory of 366 pieces. Explain how you arrive at your answer.

PROBLEM 15.2

Using the facts given in Fig. 14.2 but using first-in–first-out cost, determine the cost of the May 16 inventory. Explain how you arrive at your answer.

PROBLEM 15.3*

The New-way Harvester Company purchases from the Harold-Jones Hardware Company bolts (½ by 3 inch), which are used in assembling their harvesting machines. These bolts are put up in boxes containing two dozen each; this is convenient since each machine assembled requires exactly 24 bolts of this size. During the month of March, one shipment of these bolts is received along with other items as shown by the following invoice.

SALES INVOICE

HAROLD-JONES HARDWARE COMPANY

Cleveland, Ohio

Sold to New-way Harvester Company — Our order 16921

Address: Columbus, Ohio — Your order 976

Terms: 1/10, n/60

Quantity	Unit	Description	Amount
14	Gross	½ by 3 in. bolt	$127 71
10	Gross	½ by 7 in. bolt	162.45
5	Gross	½ by 8 in. bolt	90.00
Gross amount			$380.16
Less discount 20 per cent and 10 per cent			106.45
Net amount			$273 71

Discount of $2.74 to be allowed if paid before April 10.

The freight and cartage on the shipment amounted to $5.47. The company pays all their invoices within the discount period and carries the inventories at the net cash price so far as this is possible.

Required:

Draw a form of stores-ledger card, and enter on it the appropriate data for the 3-inch bolt. Show the unit cost, and in a separate statement explain how you compute the unit cost.

PROBLEM 15.4*

The following table contains the details of receipts and disbursements of a particular item of raw material used by the Gibson Products Company during a certain month.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

Date	Receipts		Amount	Disbursements	
	Quantity	Unit price		Date	Quantity
2	100	$1.25	$ 125	4	60
8	200	1.30	260	9	75
15	500	1.20	600	12	125
20	300	1.25	375	17	100
26	900	1.15	1,035	21	400
				24	260
				29	600

Required:

1. Compute the cost of the material used and of the ending inventory under the following methods of costing:

   a. First-in–first-out cost.
   b. Weighted average cost.

2. What is the effect of the different methods on the inventory and cost of sales?

PROBLEM 15.5

Using the data given in problem 15.4 but assuming that a standard cost system is used and that the standard unit cost of the raw material item is $1.20, compute the cost of material issued, the material price variance, and the valuation of the ending inventory

1. If the stores inventory is carried at actual cost.
2. If the stores inventory is carried at standard cost.

PROBLEM 15.6*

The Krane Manufacturing Company maintains a perpetual inventory of all raw materials. It employs a staff of inventory checkers who continually take physical inventory and compare quantities on hand with stores-ledger balances. Discrepancies are written off currently. The following data cover transactions affecting stores-ledger card 67 which refers to a 2-inch valve. Set up on a stores-ledger card the details given below, and indicate what disposition would be made of inventory shortages and price variances. Carry all unit prices to nearest even cent.

Feb. 1. Balance 100 units, $15 (at standard).
Feb. 2. Received 300 on purchase order 910, $43.69.
Feb. 3. Issued 120 on production order 80.
Feb. 6. Issued 160 on production order 91.
Feb. 10. Received 400 on purchase order 938, $54.05.
Feb. 12. Issued 420 on production order 103.
Feb. 18. Physical inventory shows 95 units on hand.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

Feb. 21. Issued 60 on production order 109.
Feb. 28. Issued 35 on production order 111.
Mar. 1. Physical inventory shows no articles on hand.

PROBLEM 15.7

The Hanna Shipbuilding Company operates a job cost system. Sheet steel is requisitioned from stores for use on jobs, the job number appearing on each stores requisition. Scrap pieces from the stamping process are sorted and those which are large enough for later use are returned to stores at 50 per cent of the original cost per pound. Smaller pieces are carted to the scrap pile and sold as junk.

Outline a procedure of accounting for the scrap pieces. State and discuss how the procedure would differ if a standard cost system were used.

PROBLEM 15.8

This problem illustrates the operation of subsidiary records for raw materials, goods in process, and finished goods under job-order-cost procedure where dollar amounts as well as quantities are recorded in the stores ledger and the finished-stock ledger.

The stores ledger of the Adams Manufacturing Company showed the following items and balances on January 1:

Part No.	Quantity	Unit cost	Amount
101a	6,000	$0.25	$1,500
102a	200	1.50	300
124a	500	0.10	50
140a	2,000	1.00	2,000
152a	1,700	0.05	85
153a	1,700	2.00	3,400
154a	400	1.25	500
160a	3,300	0.05	165
Total.	. . .	. . .	$8,000

At the same date the orders in process showed the following accumulations of cost:

Order No.	Assembly No.	Quantity	Material	Labor	Overhead
211B	x70	400	$1,600	$1,000	$2,000
215B	x12	100	500	200	400
216B	x41	250	1,200	500	1,000
221B	x99	40	400	300	600
225B	x84	300	1,800	600	1,200
226B	x6	160	800	300	600
			$6,300	$2,900	$5,800

The finished-stock ledger showed the following balances:

Assembly No.	Quantity	Unit cost	Amount
x6	12	$25	$ 300
x12	100	20	2,000
x15	200	15	3,000
x70	100	17	1,700
x80	150	20	3,000
Total .	..	...	$10,000

During the month of January, the material purchases consisted of the following:

Part No.	Quantity	Unit cost	Amount
102a	1,000	$1.75	$ 1,750
103a	1,000	0.50	500
140a	2,000	1.00	2,000
141a	4,000	2.00	8,000
153a	2,000	2 00	4,000
160a	5,000	0.05	250
161a	500	1.00	500
165a	5,000	1 60	8,000
Total			$25,000

A summary of material requisitions for the month follows:

Order No.	Part No.	Quantity	Unit cost	Amount
211B	102a	200	$1.50	$ 300
	102a	200	1.75	350
	160a	1,200	0.05	60
215B	101a	400	0 25	100
	103a	100	0 50	50
221B	102a	200	1.75	350
	160a	200	0.05	10
227B	165a	2,000	1.60	3,200
	160a	4,000	0.05	200
	153a	2,000	2 00	4,000
228B	140a	1,500	1.00	1,500
	165a	1,500	1.60	2,400
229B	153a	1,200	2.00	2,400
	152a	1,600	0 05	80
	101a	4,800	0.25	1,200
	140a	2,400	1.00	2,400
	160a	2,000	0.05	100
230B	141a	600	2.00	1,200
	103a	200	0.50	100
Subtotal.....	....	.....	.....	$20,000
Overhead	141a	1,500	2.00	3,000
Total .. .	..	. .	. .	$23,000

Production orders issued during the month were:

Order No.	Assembly No.	Quantity
227B	x41	2,000
228B	x84	1,500
229B	x99	600
230B	x6	200

Production orders completed were:

Order No.	Date completed	Assembly No.	Quantity
211B	Jan. 15	x70	400
215B	Jan. 15	x12	100
216B	Jan. 15	x41	250
221B	Jan. 15	x99	40
226B	Jan. 15	x6	160
227B	Jan. 25	x41	2,000
229B	Jan. 25	x99	600
230B	Jan. 25	x6	200

Wages earned on direct operations are summarized below:

Order No.	Amount
211B	$ 1,200
215B	800
216B	1,000
221B	2,000
226B	600
227B	2,400
229B	2,000
230B	1,000
	$11,000

Overhead for the month of January is to be applied to job costs at the rate of 150 per cent of the direct labor cost.

Shipping records show that the following assemblies were shipped to customers during the month:

Assembly No.	Quantity
x6	322
x12	180
x15	100
x41	2,250
x70	500
x80	55
x99	640

Required:

1. Stores ledger.
2. Cost sheets.
3. Finished-stock ledger.
4. Summary of Materials Issued and Returned.
5. Cost of goods completed itemized by order number.
6. Cost of goods sold itemized by assembly number.
7. Proof schedules of subsidiary ledgers.

Use the first-in-first-out method in costing material requisitions and shipments.

PROBLEM 15.9*

The Flanagan Heating Company is in the business of installing small heating plants in residences. A cost accounting system is used, with cost sheets for each job and detailed stock records on each item, the latter being subsidiary for four control accounts entitled, respectively, (1) Pipe, (2) Fittings, (3) Radiators, (4) Heaters. Particulars as to the transactions involving materials are given below for the month of September, 19—.

Inventory at September 1: Pipe—200 feet at 10 cents per foot. Pipe Fittings—100 elbows at 15 cents each, 10 unions at 20 cents each, 10 tees at 15 cents each, 40 valves at $1 each. Radiators—10 four-section at $10 each, 20 six-section at $14 each, 1 eight-section at $18 each, 2 ten-section at $22 each. Heaters—5 at $50 each.

Purchases: September 4—50 elbows, total cost $7.25; 25 unions, total cost $5. September 11—30 radiators (four-section), cost $307.50; 10 radiators (eight-section), cost $185. September 18— 200 feet of pipe, cost $19. September 25—25 unions, cost $4.75; 10 tees, cost $1.40; 50 valves, cost $55. September 30—5 heaters, cost $250.

Items used on jobs: September 2 (on Job 111)—1 heater, 8 four-section radiators, 2 six-section radiators. September 6 (on Job 112)—heater. September 9 (on Job 111)—60 feet of pipe, 10 valves, 4 elbows, 1 tee. September 13 (on Job 113)—1 heater, 4 six-section radiators. September 14 (on Job 112)—4 four-section radiators, 4 six-section radiators, 4 eight-section radiators. September 16 (on Job 111)—2 unions, 1 elbow. September 20 (on Job 114)—1 heater, 6 six-section radiators. September 23 (on Job 115)—10 four-section radiators, 10 valves, 20 elbows, 4 unions,

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

and 2 tees. September 27 (on Job 112)—100 feet of pipe, 12 valves, 10 elbows, 4 unions. September 30 (on Job 114)—50 feet of pipe, 6 elbows, 4 valves.

Required:

Set up the inventory cards, cost sheets, and control accounts necessary to express the above transactions; enter the inventories and purchases; recapitulate in a material-distribution summary the items used on jobs; post totals and individual items as required; and show final agreement of control and subsidiary records, with such comments as are appropriate. Use weighted average cost.

PROBLEM 16.1

The following data is summarized from illustrations in the text:

	Piece-rate plan	Halsey plan	Bedeaux plan	Emerson plan
Standard hours per piece	0.2	0.24	0 2	0 16
Basic hourly rate	70¢	70¢	70¢	70¢
Hours worked	8 0	8.0	8 0	8.0
Output . . .	50	40	50	50
Direct labor cost	$7.00	$6.16	$7.00	$6 72

Assuming that all four illustrations have reference to the same identical operation, (1) compute the direct labor cost per piece in each of the four cases. (2) Compute what the labor cost per piece would be in each case if the daily output increased 10 per cent. Comment on the results. (3) State the probable reason for the output being lower under the Halsey plan than it is under the other three plans. (4) Which of the four types of incentive is best suited for a plant where standardization cannot be highly developed and conditions at the work point cannot be closely controlled? Discuss.

PROBLEM 17.1

John Brown was hired by the Fixit Corporation to work as an outside repairman. Henry Smith, the payroll clerk, asked him to furnish a withholding exemption certificate, which Brown said he would do. However, Brown was immediately assigned to work out of town; and when Smith made up the next payroll, he realized that he had not received the withholding exemption certificate from Brown and that it would be impossible to get it before the time when the payroll checks should be issued. Knowing that Brown was married and had two children in grade school, Smith figured that Brown had four exemptions and on that basis computed the tax to be withheld from his pay.

Comment on Smith's action. Suggest changes in the procedure which would make a similar situation unlikely to occur in the future.

PROBLEM 17.2

On the books of the Nu Corporation, which was organized in 1947, the balance of the Unexpired Workmen's Compensation Insurance account was $3,740 on December 31, 1947. Upon analysis you find entries in the account for the following items:

Date	Description		Amount
	Debits		
3/31/47	Advance premium, 3/1/47 to 6/1/47		
	Factory $90,000 @ 0.70	$ 630.00	
	Office 15,000 @ 0.05	7.50	$ 637.50
6/30/47	Premium adjustment, 3/1/47 to 6/1/47		
	Premium earned		
	Factory $100,000 @ 0.70	$ 700.00	
	Office 16,000 @ 0.05	8.00	
	Total earned	708.00	
	Less: Advance premium	637.50	70.50
6/30/47	Advance premium, 6/1/47 to 12/1/47		
	Factory $240,000 @ 0.70	$1,680.00	
	Office 36,000 @ 0.05	18.00	1,698.00
12/31/47	Advance premium, 12/1/47 to 6/1/48		
	Factory $210,000 @ 0.70	$1,470.00	
	Office 36,000 @ 0.05	18.00	1,488.00
	Total Debits		$3,894.00
	Credits		
12/31/47	Premium adjustment, 6/1/47 to 12/1/47		
	Premium earned		
	Factory $218,000 @ 0.70	$1,526.00	
	Office 36,000 @ 0.05	18.00	
	Total earned	1,544.00	
	Advance premium	1,698.00	154.00
	Balance		$3,740.00

A summary of payrolls for the year 1947 follows:

	Factory payroll	Office payroll
March	$ 25,000	$ 5,000
April	35,000	5,000
May	40,000	6,000
June	42,000	6,000
July	36,000	6,000
August	38,000	6,000
September	32,000	6,000
October	36,000	6,000
November	34,000	6,000
December	35,000	6,400
	$353,000	$58,400

Required:

1. Journal entry to adjust the Unexpired Workmen's Compensation Insurance Account, December 31, 1947.

2. Starting January 1, 1948, the Nu Corporation is installing a job-order cost system and a factory ledger. Monthly adjustments of the Unexpired Workmen's Compensation Insurance account will therefore be made. You are to prepare the adjustment in journal form for the month of January, 1948. The wages for the month were Factory, $30,000; Office, $6,000.

PROBLEM 18.1

The J. G. Manufacturing Company has a standard cost system and a piece-point system of wage incentives of the type described in the text on page 267. Overtime excess pay is figured according to the provisions of the Fair Labor Standards Act. The company has a payroll fund from which payroll advances are made when properly authorized. You are given an abstract of the time tickets for department 54 for the weekly pay period ending May 15, 19—. The time tickets have already been checked with the attendance cards. You are also given a statement of withholding exemptions claimed and a statement of payroll advances for the week.

You are asked to prepare:

1. Work sheet showing completion of time ticket calculations. Use columnar paper. Provide columns for date, man number, elasped time, piece points earned, regular earnings. Use one line for each time ticket. Determine the daily totals for each man.

2. Payroll control sheet showing payroll hours and amount.

3. Wage cumulation records for the pay period. Hours and regular earnings are to be summarized on these records. As a timesaver you may use columnar paper with columns for Man Number, Day, Hours Worked, Regular Earnings. Allow 10 lines for each employee. Refer to the work sheet prepared in 1 for the data. Obtain totals for each employee for the week.

4. Payroll for the week, payable on May 19. Use a wide sheet of paper. Provide 15 columns as follows.

Column No.	Column Heading
1.	Man Number
2.	Name
3.	Number of Exemptions
4.	Base Rate
5.	Regular Earnings Rate
	Hours:
6.	Worked
7.	Overtime
	Earnings:
8.	Regular
9.	Overtime Excess Pay
10.	Gross
	Deductions:
11.	Old-age and Survivors' Insurance (OASI)
12.	Income Tax Withheld
13.	Payroll Advances
14.	Total
15.	Net Pay

Post to the appropriate columns on the payroll the data shown by the wage cumulation records which you have prepared. Compute the figures for the remaining

columns and write them on the payroll. Deduct 1 per cent of wages for Old-age and Survivors' Insurance. If you have access to wage withholding tables, determine the amount of Federal income tax to be withheld by the table method. Otherwise use the percentage method which, beginning May 1, 1948, would be as follows where the payroll period is a weekly period:

Multiply $13 by the number of exemptions claimed by the employee. Subtract the resulting product from the employee's gross earnings. The remainder is subject to withholding at the rate of 15 per cent.

Total the payroll columns.

5. Journal entries for the month of May, 19—, assuming for the purpose of this problem that there are five identical payrolls that cover the five payroll periods ending in that month. Journal entries are needed for:

   a. Payroll summary.
   b. Reimbursement of payroll fund.
   c. Accrual of employer's payroll taxes. Assume that the J. G. Manufacturing Company enjoys a merit rating for state unemployment tax purposes that entitles it to a tax rate of 2 per cent instead of 2.7 per cent.

6. Answer the following questions:
   a. Is a work sheet of the type called for in part 1 of the problem a form that would be used in actual practice? What is its function in the solution of this problem?
   b. How can you verify certain of the totals on the payroll?
   c. If the overtime were computed on a daily basis instead of a weekly basis, what changes would be necessary in the form of wage cumulation record?
   d. Even though a separate payroll fund is maintained it is not necessary to debit it for replenishments or to credit it for payments. What then would the journal entries be for these transactions for the month of May?

Abstract of Time Tickets

Time is recorded in hours and tenths. The hour scale runs from 0.0 at midnight to 23.9 at 11:54 P.M. Time tickets are not rung out and in for the lunch period, which is from 11:30 A.M. to noon. The lunch period, however, is not considered as time worked. In the "charge" space the timekeeper writes D. W. for direct labor paid at the day rate, the standing order number in the case of indirect labor, and nothing if the operation is a direct operation paid on the incentive-wage basis.

Man number	Time stop	Time start	Part number	Operation number	Charge	Piece points each	Good pieces produced	Base rate
Department 54, May 10, 19—								
54-101	15.5	7.0	.....	..	54.01	....	.....	$1.20
54-126	9 5	7.0	B17X	12	.....	1.10	200	1.00
	14 5	9.5	A242X	5	.....	0.16	3,000	
	15 5	14.5	B904X	10	D.W.	....	None	
54-127	15 5	7 0	B271X	10	.....	0.07	11,500	0.90
Department 54, May 11, 19—								
54-101	16.5	7 0	..	..	54.01	....	.....	1.20
54-126	12 0	7.0	B904X	10	D.W.	....	6,000	1.00
	17 5	12 0	A242X	5	.....	0.16	4,000	
54-127	17 5	7.0	B271X	10	.....	0.07	14,500	0.90
Department 54, May 12, 19—								
54-101	15.5	7.0	....	..	54.01	....	.....	1.20
54-126	10 5	7 0	A242X	5	.....	0.16	3,000	1.00
	14.0	10 5	A94X	10	.....	0.06	5,000	
	15 5	14 0	. ..	..	54.06			
54-127	8.5	7 3	B271X	10	.....	0.07	1,500	0.90
	9 0	8 5	....	..	54.04			
	15 5	9.0	B57X	6	.....	0.20	3,200	
Department 54, May 13, 19—								
54-101	15.5	7.0	. ...	..	54.01	....	.....	1.20
54-126	11.0	7 0	B32X	11	.....	1.50	300	1.00
	15.5	11.0	A700X	5	.....	0.10	4,500	
54-127	15.5	7.0	B57X	6	.....	0.20	4,200	0.90
Department 54, May 14, 19—								
54-101	15 5	7.0	...	..	54.01	....	.....	1.20
54-126	8 8	7.0	A700X	5	.....	0.10	1,500	1.00
	9 5	8.8	. ....	..	54.06			
	15.5	9 5	A242X	5	.....	0.16	4,000	
54-127	16.0	7.0	B57X	6	.....	0.20	4,600	0 90

Withholding Exemptions Claimed

Man number	Name	Number of exemptions claimed
54-101	Henry Marquardt	4
54-126	John Salzer	2
54-127	Herman Lucht	1

Payroll Advances

May 15, Herman Lucht $25

PROBLEM 18.2

Prepare a report on one of the following topics:

1. Application of punched-card methods in accounting for factory payrolls.
2. Description of the payroll procedure in a specific factory.

PROBLEM 18.3

The Jones Chemical Company has employed you to design a complete system of payroll accounting. Assume that a form-writing machine will be used to write the payroll, the pay check, the earnings statement, and the earnings record in one operation. There are 200 factory employees. The cost system is a process cost system. The wage system is a day-rate system. There are three processing departments and four service departments

Submit an outline of the procedure you would recommend and drawings of the forms you would use. Submit also a set of instructions explaining the duties of the various departments in connection with the payroll procedure. For the purpose of solving the problem you may make your own assumptions covering data that are not given in the problem.

PROBLEM 19.1

1. Using the data given in Problem 18.1 you are asked to prepare a labor distribution report for the week ending May 15, 19— for Department 54 of the J. G. Manufacturing Company. Use a form similar to that illustrated in Fig. 19.1 but with only two columns, namely, Classification and Total for the Week.

2. Determine the amount of labor variance and how much is due to wage-rate variation and how much to efficiency variation

One hundred piece points is equivalent to one standard hour of work. The standard hours of work done on piece rate can therefore be computed by dividing piece points earned by 100. The average job efficiency is determined by dividing standard hours by actual hours. As a short cut the job efficiency can be computed by dividing piece points earned by actual hours worked.

Assume that the standard costs of operations in Department 54 are based on an average job efficiency of 101 per cent and an average standard labor rate of 95 cents an hour. Day work can be assumed to be 50 per cent efficient.

The following form of work sheet is suggested for the calculation of labor variance:

Direct Labor Variance

	Piecework	Day Work	Total	
Direct hours				
Piece points earned or equivalent				
(Use 50% efficiency for day work)				
Job efficiency				
Straight-time wages				
Actual Hours at Actual Rate (Total straight-time wages)				A
Actual Hours at Standard Rate (Total direct hours @ 95¢)				B

Standard Hours at Standard Rate (Piece points earned divided by 101 equals standard hours. Standard rate is 95¢)	C
Total Direct Labor Variance:	A-C
Efficiency Variance:	B-C
Wage-rate Variance:	A-B

3. Prepare journal entry for the labor distribution for Department 54 for the month of May assuming for the purpose of this problem that there are 4⅓ weeks in the month and that the weekly figures are identical throughout.

4. Design a form of department efficiency report for the J. G. Manufacturing Company. Use as a guide the form illustrated in Fig. 16.3, but adapt it to the incentive-wage system of the company. On the form you design prepare a report for Department 54 for May 10, 19—.

PROBLEM 19.2*

On June 30, 19—, the Accrued Wages account of the American Hardware Company showed a credit balance of $1,015. An analysis of the labor charges is made monthly, and the proper distribution for all amounts earned is made. Payroll payments are made weekly on Wednesdays, covering the period from Monday to Saturday of the previous week. During the month of July the following transactions affecting the payroll occurred:

1. July 7.	Paid payroll (June 28 to July 3)		$1,875
2. July 14.	Paid payroll (July 5 to July 10)		1,639
3. July 21.	Paid payroll (July 12 to July 17)		1,754
4. July 28.	Paid payroll (July 19 to July 24)		1,838
5. July 31.	Analysis of labor records for the month shows the following distribution of all amounts earned by employees from July 1 to July 31:		
	Direct Labor	$4,874	
	Indirect Labor	3,107	
		$7,981	

During August the following transactions occurred:

1. Aug. 4.	Paid payroll (July 26 to July 31)		$1,890
2. Aug. 11.	Paid payroll (Aug. 2 to Aug. 7)		2,014
3. Aug. 18.	Paid payroll (Aug. 9 to Aug. 14)		1,984
4. Aug. 25.	Paid payroll (Aug. 16 to Aug. 21)		1,796
5. Aug. 31.	Analysis of labor records for month shows the following distribution of all amounts earned by employees from Aug. 1 to Aug. 31:		
	Direct Labor	$5,680	
	Indirect Labor	2,733	
		$8,413	

Required:

Record the foregoing facts in ledger T accounts.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

PROBLEM 19.3

The labor distribution of the Dunne Desk Company is made from its payroll, all the wages of its 20 shop employees, except the foreman's, being treated as direct labor. The company pays for idle time of workmen caused by material shortages, and this amounts to a substantial portion of the payroll.

For the year 1946 the direct labor, according to the ledger, was $20,000, and the overhead $16,000. Accordingly an overhead rate of 80 per cent was used in 1947 for the purpose of estimating costs of new products. The manager thinks that the estimates are wrong, for his profit and loss statement shows a gross margin of only $1 a desk, whereas his prices are at least $5 a desk above the estimated costs. He suspects that the idle-time factor is not being included in the cost estimates, and he asks you to investigate the situation.

1. How would you proceed to determine whether the manager's suspicions are correct?
2. Recompute the overhead rate for 1946 on the assumption that $2,000 was paid for idle time which should be treated as overhead instead of direct labor.
3. Suggest a change in the method of labor distribution that would result in a more accurate accounting for idle time.

PROBLEM 19.4

The balance of the Accrued Wages account of Kem Industries, Inc., was $12,120 on October 31, 19—. The company has a job-order cost system. The cost accounts are in the general ledger. Time tickets for pay periods falling wholly or partly in November are summarized as follows:

Pay period	Direct labor	Factory overhead	Total
Nov. 1–7	$8,250	$4,510	$12,760
Nov. 8–14	8,450	4,490	12,940
Nov. 15–21	8,570	4,570	13,140
Nov. 22–28	7,920	4,060	11,980
Nov. 29–Dec. 5	8,430	4,470	12,900

Of the wages earned in the pay period ending December 5, one-third is applicable to November.

Payrolls for pay periods ending in November are summarized as follows:

Pay period ending	Gross earnings	Deductions		Net pay
		O.A.B.	Inc. Tax	
Oct. 31	$12,120	$110	$1,200	$10,810
Nov. 7	12,760	108	1,250	11,402
Nov. 14	12,940	112	1,280	11,548
Nov. 21	13,140	102	1,300	11,738
Nov. 28	11,980	95	1,200	10,685

The payroll for the period ending November 28 was paid December 2. The O.A.B. deductions are for Old-age and Survivors' Insurance. Prior to its amendment in 1939 the Social Security Act made provision for old-age benefits but not for survivors.

Required:

1. Journal entry for labor distribution.
2. Journal entry for payrolls paid in November.
3. Abstract of the Accrued Wages account.
4. Journal entry for accrual of employers' payroll taxes for the month of November at 4 per cent of the wages subject to these taxes.
5. Answer the following questions:
   - *a.* Theoretically should the accrual of employers' payroll taxes be based on wages earned or on wages paid during the month?
   - *b.* Why is the amount of O.A.B. deductions less than 1 per cent of the gross earnings?
   - *c.* What does the balance of Accrued Wages represent?

Journal explanations in all cases should state clearly how you arrived at your amounts.

PROBLEM 19.5

Given: The following data regarding a certain factory department:

Payroll Data—Finishing Department
Week Ending October 27, 19—

Clock number	Total hours worked	Overtime hours worked	Pay at straight time	Income tax withholding exemptions
101	40	..	$ 80 00	5
102	48	8	50 27	3
103	48	8	38 12	2
104	48	8	47 50	1
105	32	4	37 75	6
108	48	8	44 26	2
	264		$297 90	

Summary of Payrolls Paid in October, 19—

Week ending	Total hours worked	Overtime excess pay	Pay at straight time	Gross earnings	Deductions	
					O.A.B.	Inc. Tax
Oct. 6....	320	$25.75	$ 355.00	$380.75	$3.01	$37
Oct. 13....	288	23.42	318.20	341.62	2.54	32
Oct. 20.. .	252	21.50	288 82	310.32	2.30	30
Oct. 27....	264	.....	297.90			
	1,124		$1,259.92			

Labor Distribution Summary, October, 19—

Period	Total hours worked	Direct hours	Direct labor	Foreman and clerks	Other indirect	Overtime excess pay
Oct. 1–6	316	266	$ 267.00	$ 80.00	$ 8.00	$25.75
Week ending						
Oct. 13	288	218	214.20	80 00	24.00	23.42
Oct. 20	252	210	206 82	80.00	2 00	21 50
Oct. 27	264	220	213 90	80 00	4 00	
Oct. 28–31	130	104	102 50	48 00	2 00	0
	1,250	1,018	$1,004.42	$368 00	$40 00	

Required:

1. Prepare payroll for week ending October 27, 19—. Overtime hours are to be paid at time and a half. In the case of clock number 101, there is no deduction for Old-age and Survivors' Insurance. In all other cases deduct 1 per cent. Deduct for Federal income tax withholding. (For method of computing tax to be withheld see Problem 18.1.)

2. Complete the summary of payrolls paid in October, 19—. Prepare journal entry.

3. Complete labor distribution summary for the month of October, 19—. Prepare journal entry. Credit wages earned to Accrued Wages. Debit Overtime Excess Pay to Factory Overhead.

4. Prepare abstract of Accrued Wages account.

5 Prepare journal entry for accrual of employers' tax for Old-age and Survivors' Insurance.

6 Assuming that a job cost system is used, state what additional distribution must be made of the direct labor. If a standard cost system were to be installed, state what additional data would be required in regard to direct labor.

PROBLEM 19.6*

The plant of the Crowfoot Manufacturing Company opened on June 25, 19—. Individual time tickets are prepared for each employee for each job, and each employee has an in- and out-card from which his total time is transferred daily to the payroll register. A payroll bank account is established with a balance of $150, and a check is to be deposited weekly to cover the payments made on Thursdays covering the earnings from Monday to Saturday of the previous week.

Overtime at time and a half is to be paid on hours in excess of either 8 hours in one day or 40 hours in one week. For the purpose of computing the Federal income tax to be withheld assume that the employees Anderson, Beard, and Cline have each claimed two withholding exemptions; while Stone, Tare, and Wood have each claimed three exemptions. Assume that the deduction for Old-age and Survivors' Insurance is 1 per cent.

From the following particulars prepare (1) payroll, (2) labor distribution summary, and (3) journal entries. Write a brief outline of a suitable plan of accounting for labor in this case.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

Payroll Register
Week Ending Saturday, June 30

Employee	Number	M.	T.	W.	T.	F.	S.	Total	Rate	Amount
Claude Anderson	1	8 hr.	8 hr.	8 hr.	8 hr.	8 hr.	4 hr.	44	$0 60	$26.40
Fred Beard	2		8	8	4	8	4	32	0.80	25 60
George Cline	3	8	8	8	8	8		40	0 50	20 00
Avery Stone	4			Salary basis						35 00
Albert Tare	5			Salary basis						50 00
John Wood	6	8	8	8	8	8	4	44	0 70	30.80

Individual Time Tickets

Date	Employee's number	Job	Hours	Amount	Date	Employee's number	Job	Hours	Amount
June 25	4	Indirect labor	8		June 28	4	Indirect labor	8	
June 25	5	Indirect labor	8		June 28	5	Indirect labor	8	
June 25	1	601	8	$4 80	June 28	1	604	8	$4 80
June 25	3	601	6	3.00	June 28	2	605	4	3 20
June 25	3	Idle	2	1 00	June 28	3	604	2	1 00
June 25	6	602	8	5 60	June 28	3	605	6	3 00
June 26	4	Indirect labor	8		June 28	6	604	7	4 90
					June 28	6	605	1	0 70
June 26	5	Indirect labor	8		June 29	4	Indirect labor	8	
June 26	1	601	4	2.40	June 29	5	Indirect labor	8	
June 26	1	602	4	2.40					
June 26	2	603	8	6 40	June 29	1	601	8	4.80
June 26	3	603	7	3 50	June 29	2	605	8	6 40
June 26	3	604	1	0 50	June 29	3	606	8	4.00
June 26	6	602	3	2 10	June 29	6	605	8	5 60
June 26	6	604	5	3.50	June 30	4	Indirect labor	4	
June 27	4	Indirect labor	8		June 30	5	Indirect labor	4	
June 27	5	Indirect labor	8		June 30	1	601	4	2 40
June 27	1	602	3	1.80	June 30	2	606	4	3 20
June 27	1	603	4	2.40	June 30	6	606	4	2 80
June 27	1	Idle	1	0.60					
June 27	2	604	8	6.40					
June 27	3	604	8	4.00					
June 27	6	604	8	5.60					

PROBLEM 19.7*

In a given department of the plant of the Miami Products Company six men are employed at a uniform rate of $1 per hour, and the full-time number of hours for the month of September for each man is 184. Standard rates have been fixed for labor output on each product. The data of operations for the two payroll periods are given below.

Employee number	Sept. 1–15			Sept. 16–30		
	Actual hours	Rate	Standard hours	Actual hours	Rate	Standard hours
1	80	$1 00	84	104	$1.10	103
2	76	1 00	70	104	1.00	95
3	80	1 00	75	104	1.00	97
4	72	1 00	70	104	1.10	102
5	64	1.00	65	100	1.00	91
6	80	1.00	79	96	1.10	96
	452		443	612		584

At September 15 certain employees in this department were given a pay increase of 10 cents per hour. The total hours operated for the month amount to 1,064 out of a possible 1,104 and the value of the work completed at standard costs is $1,027. Determine the labor variance, and indicate that portion of it which is due to rate increases and also the amount due to decrease in efficiency.

PROBLEM 20.1

Assume that you are the factory accountant of Rex Products, Inc., and that you are a member of the plant budget committee. The other members are the works manager, the methods and standards engineer, and the plant superintendent. The committee is engaged in establishing departmental budget allowances for the coming year. One of the problems of the committee is to establish budget standards for in-plant trucking. Formerly the cost of this service was borne by the various processing departments, but in the future it will be charged to a newly formed department to be called Internal Transportation Department. You have volunteered to make a study of the labor cost which has in the past been charged to the natural classification Trucking Labor, and you have tabulated plant totals of this cost and of direct hours and direct labor cost, as follows:

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

		Trucking labor	Direct man-hours	Direct labor cost
1944	Nov.	$4,800	200,000	$160,000
	Dec.	5,000	200,000	160,000
1945	Jan.	5,000	210,000	168,000
	Feb	4,800	190,000	152,000
	Mar.	4,900	210,000	168,000
	Apr.	5,000	220,000	176,000
	May	5,200	220,000	176,000
	June	5,500	230,000	184,000
	July	5,500	240,000	192,000
	Aug	5,400	230,000	184,000
	Sept	5,500	200,000	160,000
	Oct	5,600	210,000	189,000
	Nov.	5,000	190,000	171,000
	Dec.	4,500	150,000	135,000
1946	Jan	4,600	160,000	144,000
	Feb	4,200	140,000	126,000
	Mar.	4,300	150,000	135,000
	Apr	4,100	140,000	126,000
	May	4,400	150,000	135,000
	June	4,200	150,000	135,000
	July.	3,200	100,000	90,000
	Aug	3,800	130,000	117,000
	Sept.	3,800	120,000	108,000
	Oct.	3,900	120,000	120,000
	Nov.	3,800	110,000	110,000
	Dec.	3,700	100,000	100,000
1947	Jan.	4,100	120,000	120,000
	Feb.	4,000	120,000	120,000
	Mar.	4,200	130,000	131,000
	Apr.	4,300	130,000	131,000
	May	4,500	140,000	141,000
	June	4,600	140,000	141,000
	July.	3,600	100,000	100,000
	Aug.	4,200	120,000	121,000
	Sept.	4,400	130,000	131,000
	Oct.	4,300	140,000	142,000

Required:

1. Prepare a scatter diagram to show the relationship of in-plant trucking labor and direct man-hours.

2. Prepare a scatter diagram to show the relationship of in-plant trucking labor and direct labor cost.

3. Inspect the two scatter diagrams and select the one that comes the closer to a straight-line pattern. By inspection fit a straight line to the plotted points on the scatter diagram that you have selected. Determine the equation of the line.
4. Answer the following questions:

a. When wage rates have been subject to marked fluctuation, would you expect the monthly variations in trucking labor cost to conform more closely to variations in direct hours or to variations in direct labor dollars?
b. Which of the two variables (direct hours or direct labor cost) would be a better measure of the physical volume of internal trucking?
c. What adjustment should be made in the budgets of the processing departments due to the establishment of the Internal Transportation Department?
d. In your opinion is it an accounting function to determine the budget allowances? Discuss.

PROBLEM 20.2

By the method of least squares compute the equation of linear relationship between the trucking cost and the direct labor cost of Rex Products, Inc., on the basis of the data given in Problem 20.1.

PROBLEM 21.1

The Hanley Tool and Die Company has six factory departments:

Service Departments
  Maintenance
  Building Occupancy
  General Factory Service
Production Departments
  Machine Shop
  Heat-treating
  Assembly

For the year 1947 the predetermined rates of overhead per direct labor hour are

Machine shop	$1.36
Heat-treating	1.57
Assembly	0.81

The departments are charged with the costs of completed maintenance orders including labor and material costs and an overhead cost at 15 per cent of labor. The 15 per cent rate, it is estimated, covers the out-of-pocket costs applicable to the orders worked on. The remaining cost of the maintenance department is treated as a readiness-to-serve or stand-by cost, which is redistributed to the other departments as follows:

Building occupancy	$ 50 a month
Machine shop	150 a month
Heat-treating	17 a month
Assembly	17 a month
General factory service	Remainder

Building occupancy costs are redistributed to the other departments on the basis of floor-space units, except that no charge for building occupancy is made to the maintenance department. Floor-space units by departments are

Maintenance	50
Building occupancy	50
General factory	100
Machine shop	600
Heat-treating	100
Assembly	200
Total	1,100

General factory service cost is redistributed to production departments on the basis of the actual number of employees. For the month of January, 1947, the average number of employees by departments was

Maintenance	4
Building occupancy	2
General factory	5
Machine shop	20
Heat-treating	2
Assembly	10
Total	43

The following data are obtained from the labor distribution for the month of January, 1947:

Man-hours

Department	Production	Maintenance	Other
Maintenance		540	180
Building occupancy			360
General factory service			900
Machine shop	2,700		540
Heat-treating	360		15
Assembly	1,260		420
Total	4,320	540	2,415

Amount

Department	Production	Maintenance	Other
Maintenance		$540	$ 220
Building occupancy			200
General factory service			830
Machine shop	$2,646		520
Heat-treating	288		12
Assembly	1,036		380
Total	$3,970	$540	$2,162

Costs of maintenance orders completed in January are summarized below:

Department Charged	Material	Labor	Overhead
Building occupancy	$100	$ 80	$12
General factory			
Machine shop	400	360	54
Heat-treating	50	12	2
Assembly	137	68	10
Total	$687	$520	$78

Department charges for factory supplies for January are

Department	Stores requisitions	Invoices
Maintenance	$100	
Building occupancy	25	$100
General factory service	5	10
Machine shop	320	30
Heat-treating	100	
Assembly	40	10
Total	$590	$150

Distribution of the cost of electricity, coal, and gas should be made as follows:

Department	Light	Power	Coal	Gas
Maintenance	...	$ 5		
Building occupancy	$55	...	$200	
General factory				
Machine shop	...	225		
Heat-treating	...	50	14	$36
Assembly	...	35		
Total	$55	$315	$214	$36

Payroll taxes and insurance for January are estimated to come to 4 per cent of the payroll and are classified as factory overhead.

Other overhead costs for the month are tabulated below.

Department	Property taxes	Property insurance	Depreciation
Maintenance	$ 3		$ 8
Building occupancy	50	$ 8	83
General factory	35	5	33
Machine shop	75	11	250
Heat-treating	10	2	50
Assembly	10	2	33
Total	$183	$28	$457

Required:

1. Prepare a table to show the distribution of factory overhead by departments for the month of January, 1947. Arrange it with columns for departments and lines for the natural classifications. Show redistribution of service-department overhead
2. Compute the amount of overhead applied at predetermined rates and the amount of over- or under-applied overhead by departments. This data should be shown on the table previously prepared.
3. Journalize: burd n applied.
4. Compute the cost of production order 826, which was completed January 12. Material drawn from stores by the machine shop for use on this order cost $72.80. Labor hours and cost as reported on time tickets are

Department	Hours	Labor cost
Machine shop	86	$ 90
Heat-treating	5	4
Assembly	8	7
	99	$101

Overhead cost should be computed at predetermined departmental rates based on direct labor hours.

PROBLEM 21.2

There are two service departments X and Y and three processing departments R, S, and T in a certain plant. In June, 19—, the overhead charged to these departments prior to any redistribution of service-department cost was as follows:

R	$ 5,000
S	10,000
T	15,000
X	5,200
Y	10,000

The direct man-hours were

R	3,000
S	3,000
T	6,000

The proportions of services received from the service departments were

From Department X	
By Department	
R	25%
S	40%
T	30%
Y	5%
From Department Y	
By Department	
R	25%
S	25%
T	45%
X	5%

Prepare four schedules showing four different methods of redistributing the service-department costs. One of your schedules should illustrate the algebraic method.

PROBLEM 21.3*

1. Determine the actual departmental costs of the Kitchen and Laundry of a hotel in which you are employed as accountant. You find the following interrelationship:

The Laundry Department does the laundry for the Kitchen, and the Kitchen serves meals to the Laundry employees. State how you would proceed to determine the actual costs in these departments, using the facts given below to illustrate your method.

	Departments		
Kitchen		Laundry	
No. of meals served	300,000	No. of pounds washed	600,000
Total revenue	$210,000	Total revenue	$30,000
Total expense*	$180,000	Total expense†	$20,000

* Includes 40,000 pounds of laundry charged at 5 cents a pound.

† Includes 10,000 meals at average rate of 50 cents per meal. For purposes of this problem variations in meal costs (breakfast, lunch, dinner) may be ignored.

2. Upon further analysis it is found that the Kitchen Department employees who also receive their meals as part of compensation have been served 5,000 meals that were charged at an average rate of 50 cents per meal and included in the total Kitchen costs of $180,000.

State the proper treatment of this additional factor in the determination of departmental costs. Show corrected unit costs.

PROBLEM 21.4†

The Gopher State Packing Company operates a small pork-packing plant. Desiring to determine accurately its operating cost by departments, the management

* Adapted from Wisconsin C. P. A. Examination.

† Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

directs that the necessary analyses be made covering the month of January, 19—. The cost accountant obtains the following facts relative to operations:

EXPENSES FOR MONTH

Plant departments	Labor	Supplies	Repairs	Investment	
				Inventory	Equipment
Operating					
Hog Killing and Cutting	$2,000	$ 100	$ 200	. .	$ 45,000
Fresh Pork	400	250	25	$ 4,000	3,000
Sweet Pickle	300	150	50	38,000	14,000
Dry Salt	200	100	25	18,000	7,000
Smoke House	500	100	100	9,000	16,000
Sausage	1,800	300	50	6,000	11,000
Lard	800	100	150	15,000	15,000
Tankage and Grease	600	100	150	8,000	16,000
Casings	300	50	50	2,000	3,000
Auxiliary					
Wells, Pumps, and Piping	100	25	75	.	8,000
Boilers	400	200	100		25,000
Electric Generation	300	50	150		20,000
Refrigeration and Ice	300	125	125	.	15,000
Superintendence and General	600	150	50		2,000
	$8,600	$1,800	$1,300	$100,000	$200,000

Additional expenses for the month were as follows: insurance, $700; taxes, $1,700; depreciation, $2,000; purchased electric current, $400; employee security costs, $300.

Pump-house records showed that 100,000 gallons of water was used in the plant during the month, as follows: hog killing, 20,000 gallons; sweet pickle, 10,000 gallons; sausage, 3,000 gallons; lard, 2,000 gallons; tankage, 3,000 gallons; casings, 2,000 gallons; boilers, 35,000 gallons; refrigeration, 10,000 gallons; ice manfuacture, 15,000 gallons.

Boiler-room records show 50,000 pounds of live steam generated, for which heat, hot water, and pressure requirements of the departments were approximately as follows: hog killing, 5,000 pounds; sausage, 2,500 pounds; lard, 10,000 pounds; tankage, 7,500 pounds; casings, 2,500 pounds; electric generation, 22,500 pounds.

Electric-generation records show production of 40,000 kilowatt-hours of energy, including purchased current, the total being consumed as follows: hog killing and cutting, 8,000 kilowatt-hours; sausage, 2,000 kilowatt-hours; lard, 4,000 kilowatt-hours; tankage, 1,200 kilowatt-hours; casings, 800 kilowatt-hours; refrigeration, 24,000 kilowatt-hours.

Refrigeration calculations indicate the following distribution of freezing and cooling service: hog killing and cutting (cooler), 30 per cent; fresh pork, 20 per cent; sweet pickle, 10 per cent; dry salt, 10 per cent; sausage, 5 per cent; lard, 5 per cent; ice manufacture, 20 per cent. The ice produced is used in icing cars and trucks used for delivery service.

Superintendence and general expense may be considered proportionate to labor employed in operating and auxiliary departments.

Required:

Prepare schedules to indicate the total expense of each operating department for the period.

PROBLEM 21.5*

The plant of the Safe-Te Manufacturing Company is divided into six departments: A, B, and C, material handling, maintenance, and general factory. Manufacturing burden is distributed to orders by a predetermined labor cost rate of 50 per cent in Department A, 40 per cent in Department B, and 50 per cent in Department C. Material-handling costs are charged to orders by a predetermined rate of 10 cents per dollar of material used. Maintenance-department costs are distributed to departments receiving benefit as indicated by the standing orders.

During September, $12,000 of raw material was put in process and the labor summary showed direct labor of $16,000 ($4,000 Department A, $8,000 Department B, $4,000 Department C), and indirect labor of $3,500. The indirect labor is divided as follows: Department A, $500; Department B, $600; Department C, $400; material handling, $600; maintenance, $600; and general factory, $800. Supplies consumed amount to $450 of which Department A uses $50; Department B, $100; Department C, $60; material handling, $30; maintenance, $200; general factory, $10.

Building depreciation is estimated to be $1,500 and machinery depreciation $1,500. Property taxes for the month amount to $600, of which 50 per cent is on buildings. Payroll taxes of $600 accrued during the month. Fire insurance premiums expired amount to $300, and 50 per cent of the premium applies to the buildings. Heat and light amounts to $300 and power to $600. Compensation insurance premiums expired amount to $383.

Charges to maintenance orders for the month were:

Standing order	Labor	Supplies
Repairs to equipment, Department A	$100	$ 50
Repairs to equipment, Department B	300	100
Repairs to equipment, Department C.	200	50
	$600	$200

PLANT ORGANIZATION

	Floor space, sq. ft.	Value of machinery	Horse-power rating	Compensation insurance rate
Department A.....	5,000	$ 40,000	60	$2.00
Department B.....	10,000	60,000	50	2.00
Department C.....	4,000	30,000	30	2.00
Material Handling.	6,000	10,000	...	1 50
Maintenance... .	2,000	5,000	10	2.00
General Factory.	3,000	5,000	...	1.50
	30,000	$150,000	150	

Required:

1. Prepare T accounts for Manufacturing Burden Control, Material Burden Applied, Process Burden Applied, Work in Process—Material, Work in Process—Labor and Process Burden.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

Prepare journal entries for materials issued, labor distribution, supplies consumed, depreciation, taxes, insurance, heat and light, and power. Credit heat, light, and power to an accrued expense account.

Prepare journal entry for cost application. Charge material burden applied to Work in Process—Material. From the journal entries enter the appropriate debits and credits to the T accounts that you have prepared.

2. Prepare overhead distribution summary. Assume that labor and supplies charged to maintenance orders are distributed to departmental accounts through the labor distribution and the summary of supplies issued, whereas the overhead of the maintenance department is charged to the benefited departments in the redistribution of service-department costs.

Plan the departmental sequence on the summary as you think best, keeping in mind the fact that applied burden and burden variance must be shown in the material handling column as well as in the columns for the processing departments.

PROBLEM 22.1

Prepare a report describing the procedure followed in the distribution of factory overhead in a specific case. Obtain material for your report by visiting a manufacturing plant.

PROBLEM 22.2

Describe applications of one of the following makes of equipment in overhead distribution:

Burroughs
International Business Machines
McBee Keysort
National Cash Register
Remington-Rand
Underwood

Obtain material for your report from the manufacturer's nearest sales office.

PROBLEM 22.3

In the following tabulation each line represents one rejected-material tag and shows the account charged and the amount of the charge. The account numbers or standing order numbers are in accordance with the classification of accounts of Table 6.8. The 20 rejected-material tags that are tabulated are all the tags for the month of November, 19—.

Standing Order Number	Amount	Standing Order Number	Amount
24.43	$ 12.50	24 43	21 89
32.44	75 82	60 42	7.77
54.42	18.14	32.44	235.50
60.42	91.10	54.42	6.45
60 42	8.41	60.42	3.08
24 43	5.26	58.42	16.18
58.42	41.50	24.43	25.20
56.42	27.18	58.42	6.82
60.42	44.14	54.42	13.28
58.42	2.92	66.42	45.57

Required:

1. Prepare a transaction summary analysis sheet and an appropriate journal entry covering the November rejected-material tags.
2. Describe a practical method of making the distribution of the charges from rejected-material tags so as to obtain the data for the transaction summary analysis sheet, assuming that there were 100 to 150 tags a month.
3. Describe the postings that would be made from the transaction summary analysis sheet prepared by you in step 1.

PROBLEM 22.4

Draw a form of departmental overhead analysis sheet like the one illustrated in Fig. 22.1. Fill in November as the month and 54 as the department. Post the following charges to Department 54 which appear on transaction summary analysis sheets for the month of November:

Summary	Charges	
	Natural classification	Amount
Purchase-invoice distribution	36	$817.50
Labor distribution	01	364.52
	.02	206.10
	.04	212.94
	05	91.41
	06	27.74
	07	155.61
Summary of payroll taxes and insurance	11	120.24
	12	18.04
	13	60.12
	14	101.12
Fixed-charge schedule	71	224.50
	72	50.00
	73	850.25
Schedule of purchased utilities	29	215.18
Summary of supplies issued	.21	150.12
	22	261.10
Summary of rejected-material tags	42	37.87
Summary of maintenance order charges	.32	412.40

Post charges for service departments redistributed to Department 54 as follows:

Toolroom and Maintenance	$ 75
Building Occupancy	450
Shop Administration	500

Total the departmental overhead analysis sheet and prove by cross footing.

Answer the following questions:

1. How much of the work of preparing the departmental overhead analysis sheet could be done prior to the last day of the month covered by it?

2. Would you class the file of department overhead analysis sheets as a subsidiary ledger? Discuss.

3. On what reports and what analysis sheets would the totals obtained on the departmental analysis sheet be used?

4. If the departments in the plant were those shown in Table 6.8, would it be practical to have a form of overhead summary such as the one illustrated in Table 21.1? Discuss. Describe alternative forms that might be used to report the monthly plant overhead.

5. What use is made of the department distribution in cost control?

6. What use is made of the department distribution for product costing?

PROBLEM 23.1

Assume the same facts as those given in Table 23.2 except that the department is scheduled to work only one 40-hour-a-week shift instead of two. The predetermined volume is set according to that schedule of operation.

Required:

1. Burden rates
   a. Machine rates for process overhead covering both work-point overhead and process-personnel overhead.
   b. Departmental rate for process overhead with direct labor cost as the application base.
2. Burden applied on production orders 310 and 320
   a. Using machine rates.
   b. Using departmental rate based on direct labor cost.

PROBLEM 23.2*

In the valve assembly department of the Logan Pipe Company burden has been distributed on a labor cost basis, but some dissatisfaction exists with this method and it is proposed to use the labor hours method. For the month of January, 19—, the direct labor is estimated to be $1,500 and the labor hours to be 1,800. The manufacturing burden for the same period is estimated to be $900. During the month the following orders are completed in the department:

Order number	Units	Labor cost	Labor hours
1065	1,000	$ 400	400
1066	400	200	300
1067	50	100	60
1068	800	400	600
1069	600	500	450
		$1,600	1,810

Required:

Calculate the predetermined burden rate for January on both the direct labor cost and the direct labor hour methods. Calculate also the labor and burden cost of each order and the unit labor and burden costs, using each of the methods for distributing burden.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

PROBLEM 23.3*

The Seidel Manufacturing Company estimated the manufacturing expense of the machine department to be $4,200 and the direct labor hours to be 6,000 for the month of January, 19—. The actual expense was later found to amount to $3,750, and the direct labor hours amounted to 5,000.

The distribution of direct labor by order number follows:

Order number	Direct labor	Labor hours
1015	$ 800	900
1016	500	400
1017	600	300
1018	700	800
1019	1,000	1,200
1020	600	600
1021	400	300
1022	700	500
	$5,300	5,000

Required:

Using a predetermined labor hour rate for burden, determine the amount of manufacturing expense applied to each order, the amount of under- or overabsorbed burden, and indicate the probable causes.

PROBLEM 23.4*

The Kunze Corporation has in its machine department a wide variety of machines, although it is possible to combine some of them for purposes of determining rates per hour of operation. Details are given below regarding normal monthly expenses and operations.

Machines	Space occupied, sq. ft.	Value	Horse-power rating	Normal hours
5 Drill presses	700	$ 2,500	25	800
4 Milling machines	600	3,000	40	600
6 Punch presses	600	2,500	30	1,000
4 Lathes (large)	600	4,000	60	400
3 Lathes (small)	300	2,000	15	500
1 Shaper	100	800	5	100
1 Planer	200	2,200	20	100
4 Screw machines	400	3,000	15	600
	3,500	$20,000	210	4,100

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

Normal Overhead—Machine Department		
Depreciation—Buildings	$1,000	
Insurance and Taxes—Buildings	250	
Heat and Light	500	
		$1,750
Depreciation—Machinery	$ 200	
Insurance and Taxes—Machinery	400	
		600
Power		840
Other Work-point Overhead		1,050
Process-personnel Overhead		1,000
		$5,240

One operator is required for each machine except that the four screw machines require only two operators.

Required:

1. Machine rates per machine-hour covering work-point overhead.
2. Departmental rate per direct man-hour covering process-personnel overhead.
3. Machine rates per machine-hour covering both work-point overhead and process-personnel overhead.
4. Answer the following questions:

Would it be feasible in this case to use machine-center rates based on direct man-hours covering both work-point overhead and process-personnel overhead?

Explain your answer. What would these rates be for the punch-press center and the screw-machine center?

PROBLEM 23.5*

The management of Graff Art Company, job printers and engravers, decides to establish hourly machine rates for all presses located in the pressroom. Both the labor and the burden are to be covered in the machine rates. The pressroom operating cost for the past year together with other details about the department are given below.

PRESSROOM EXPENSE—PREVIOUS YEAR	
Supervision	$ 5,000
Labor	20,000
Taxes—Machinery	1,400
Taxes—Buildings	1,200
Fire Insurance—Buildings	240
Fire Insurance—Machinery	280
Compensation Insurance ($2 per $100)	500
Supplies	3,100
Power	830
Heat and Light	450
Depreciation—Machinery	7,000
Depreciation—Buildings	3,000
	$43,000

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

Press number	Value	Space occupied, sq. ft.	Horse-power hours	Labor	Esti-mated supplies	Hours operated
1	$ 3,000	100	7,500	$ 1,800	$ 200	1,500
2	6,000	300	8,000	2,100	250	1,600
3	4,000	200	10,000	2,000	350	2,000
4	30,000	1,000	24,000	7,500	1,400	1,200
5	20,000	800	22,500	4,000	600	1,500
6	7,000	600	11,000	2,600	300	2,200
	$70,000	3,000	83,000	$20,000	$3,100	10,000

Required:

1. Determine the hourly machine rate for each press, showing in detail how you arrive at the result.
2. Assuming that the company merely desired a rate for the department as a whole, show how the rate would be calculated. Give your opinion as to the best application base to use for the departmental rate.
3. For cost estimating purposes where price quotations are based on estimates, what objections would there be to using a departmental rate?

PROBLEM 24.1*

The New Type Manufacturing Company, manufacturers of the New Type Standing Grain Thresher, present you with the information shown below with the request that you calculate in detail the amount of manufacturing burden that must be absorbed by each of the producing departments in the next 12 months. The facts presented are determined as nearly as possible from the past year's operations, and it is assumed that they will approximate the costs for the coming year.

Distribute all expenses to production and service departments, and then prorate the heat and light department cost to all remaining departments. At this point the raw material storage and handling cost may be excluded since it can be applied on a separate rate. Prorate the remaining service department charges to the producing departments on some equitable basis.

Compute predetermined departmental burden rates using direct labor hours as the application base. Compute predetermined material burden rate as a percentage of material cost.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

PLANT ORGANIZATION

Department	Area, sq. ft.	Value of machinery	Value of inventory	Horse-power rate
Production				
Machine	4,000	$30,000	$ 3,000	200
Sheet Metal	2,000	5,000	400	20
Assembly	6,000		7,000	
Painting	4,000	2,000	4,000	5
Service				
Material Storage and Handling	3,000	1,000	5,600	
Patterns	2,000	5,000		25
Heat and Light	1,500	5,000		
Factory Office	1,500	2,000		
	24,000	$50,000	$20,000	250

Department	Direct labor, hr.	Direct labor, cost	Number of employees	Compensation insurance rate
Production				
Machine	55,000	$40,000	30	$2 00
Sheet Metal	11,000	11,000	6	1 50
Assembly	22,000	20,000	12	1 50
Painting	11,000	9,000	5	1 50
Service				
Material Storage and Handling			4	1 00
Patterns			3	1.50
Heat and Light			4	2 00
Factory Office			6	1 00
	99,000	$80,000	70	

ESTIMATED EXPENSES

Rent	$12,000
Depreciation of Machinery (10 per cent)	5,000
Repairs to Machinery	2,500
Insurance—Fire	280
Insurance—Compensation	1,908
Insurance—Group Life	350
Taxes	1,400
Power	6,000
Supplies Used	
Machine	150
Sheet Metal	90

Assembly	200
Painting	350
Patterns	800
Heat and Light	200
Indirect Labor	
Machine	5,000
Sheet Metal	1,500
Assembly	2,000
Material Storage and Handling	4,800
Patterns	4,500
Heat and Light	5,000
Factory Office Salaries	5,000
Factory Office Expense	2,100
Superintendence	5,000
Fuel (Heat and Light)	6,000

Estimated cost of material input, $200,000.

PROBLEM 24.2*

The Gem Engineering Company, manufacturer of gasoline engines, accumulates its manufacturing burden by departments, as follows: (1) machine department, (2) assembly department, (3) testing department, (4) paint department, (5) material-handling department, (6) maintenance department, (7) power department, (8) general factory department. The general factory department includes miscellaneous auxiliary departments whose costs do not justify a separate classification. The maintenance department is in charge of all repair orders, and the department total is distributed to all departments receiving benefit on the basis of these orders. The material-handling department includes all costs incidental to purchasing, receiving, storage, and handling of material and parts, and the cost is applied to all cost sheets by a separate material handling rate based on the value of the material used. Power department costs are divided into heat, light, and power.

From the information given below prepare a burden distribution sheet showing the amount of burden that must be absorbed by each department monthly at the predetermined normal volume.

FACTORY ORGANIZATION

Department	Floor space, sq. ft.	Value of machinery and equipment	Monthly direct labor at normal volume	Horsepower hours
1	5,000	$15,000	$ 7,000	3,000
2	2,500	2,000	3,000	
3	1,250	5,000	4,000	
4	1,250	2,000	1,000	700
5	2,000	1,000		
6				
7	2,000	4,000		
8	1,000	1,000		300
	15,000	$30,000	$15,000	4,000

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

Monthly expenses at normal volume are as follows: indirect labor, Department 1, $700; Department 2, $300; Department 3, $200; Department 4, $200; Department 5, $900, Department 6, $800; Department 7, $500; Department 8, $2,000. Depreciation on buildings, $300; depreciation on machinery and equipment, $150; taxes on building, $150; taxes on machinery and equipment, $60; insurance on machinery and equipment, $30. Supplies consumed: Department 1, $100; Department 2, $50; Department 3, $50; Department 4, $75; Department 6, $300; Department 7, $43; Department 8, $100. Compensation insurance, $206 ($1 per $100). Fuel consumed: power department, $1,650. Miscellaneous general factory expense, $41. Payroll taxes, $824 (4 per cent).

An analysis of the maintenance orders shows the following: order 11, repairs to buildings (general factory), labor, $100, and supplies, $50; order 12, repairs to machinery (power department), labor, $200, and supplies, $100; order 13, repairs to machinery (machinery department), labor, $300, and supplies, $100; order 14, repairs to machinery (testing department), labor, $200, and supplies, $50.

Power department costs are to be divided: 20 per cent to heat and light, and 80 per cent to power.

PROBLEM 24.3*

The Erie Drop Forge Company is desirous of securing some business from a new customer, a concern that is asking for bids on an order for 1,000 forgings of a given pattern. The Erie Company wishes to quote a price that will represent "actual factory cost of production," no profit included. You are called on to figure this cost.

The Erie Company has no cost system in effect, but on investigation you are able to obtain the information given below as to operating conditions. The plant consists of three buildings: a forge shop, a power plant, and a material storage building. In the forge shop are located five steam hammers, each with its own auxiliary equipment, such as heating furnaces, trimming presses, grinders, etc. Steam is consumed by the hammers in proportion to their rated capacity, all operating on a full-time schedule, about 2,500 hours per year. Steam generated in the power plant is estimated to be consumed 90 per cent by the hammers and 10 per cent in heating and lighting the plant. The material-handling costs are presumed to be proportionate to the weight of productive materials used on various orders, which in total is about 600,000 pounds per year.

Productive labor in the plant is on a piecework basis, the rates being dependent on the nature of the work. The job for which bids are asked will be run on the 5,000-pound hammer, and the combined rates for the hammer man and helpers are computed as 60 cents per piece produced. The material used will be steel bars weighing 20 pounds per piece and costing 4 cents per pound. It will require about 12 minutes per piece for the forging operation, complete.

PLANT DATA

Building	Floor space sq. ft.	Value of building	Annual repairs	Value of equipment	Annual repairs
Forge Shop.	10,000	$20,000	$1,000	$50,000	$1,800
Power Plant.	3,500	20,000	300	10,000	1,200
Material Handling. .	5,000	10,000	200	5,000	300

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

STEAM HAMMER DATA

Rated capacity, lb.	Floor space occupied, sq. ft.	Value of equipment	Annual repairs	Fuel used	Tools and supplies
5,000	4,000	$28,000	$800	$500	$200
2,000	2,250	10,000	400	400	190
1,000	1,250	4,000	200	340	180
1,000	1,250	4,000	200	340	180
1,000	1,250	4,000	200	340	180

Sundry Data:

Fuel used by the power plant costs $2,100 in a normal year; fuel used in the forge shop is for heating furnaces serving the hammers. Factory supplies and small tools used run about $100 per year in the power plant and a similar amount in the material-handling department. Nonproductive labor for 1 year is as follows: power plant, $3,500; material handling, $4,000; superintendence and general, $8,500. Real estate and personal property taxes are $2 per $100 per year; insurance on buildings, $1 per $100 (none on equipment); depreciation on buildings, 5 per cent per year, on equipment, 10 per cent per year.

Required:

Calculate the factory cost of the forgings in question, and work up the data necessary for making similar quotations on jobs to be run on the other hammers.

Suggestions:

Calculate burden rates according to the method, or methods, best suited to the conditions. In redistributing expenses of nonproductive departments carry charges to productive departments only. Assume personal property taxes apply on equipment only. Disregard spoilage, idle time, and other factors not specifically mentioned.

PROBLEM 25.1

1. Prepare a table of variable budget allowances for the Machine Shop Department of Campbell Tool and Die Company. The form of the table should be similar to that illustrated in Table 24.4. Assume that there are the following monthly fixed costs: Indirect Labor, $300; Shop Supplies, $100; Maintenance, $100; Payroll Taxes and Insurance, $55; Property Taxes, $570; Property Insurance, $110; Depreciation, $2,250; Supervision, $1,200; Service Departments Redistributed, $8,079 (Maintenance, $1,040; Building Occupancy, $3,600; Shop Administration, $3,439). Assume that the foregoing fixed cost allowances are exactly the same as those used in making the overhead estimate that is given in Table 24.5. Assume further that the remaining burden costs of the Machine Shop vary directly with the production volume measured in standard direct hours. Determine the variable costs per direct hour that were used in computing the Machine-shop estimate shown in Table 24.5, and use these unit costs as the variable costs per standard direct hour in the table of budget allowances that you prepare.

2. Compute the predetermined burden rate of the Machine Shop at a monthly volume of 22,000 standard direct hours. Explain how you arrive at your answer, and show what portions of the predetermined rate represent (*a*) fixed overhead and (*b*) variable overhead.

3. For the month of November, 1948, assume that the standard direct hours earned were 20,000 and that the actual overhead was $28,524. Prepare journal entry for

Machine-shop burden applied. Compute the total burden variance. Analyze the burden variance to show the amount caused by variation in volume and the amount caused by variation from budget.

4. Assume that 20,400 direct hours were actually worked in November. Calculate by two different methods the labor-efficiency burden variance for the month.

5. Prepare a budget report for the month of November covering all of the overhead of the Machine Shop. For the actual column make up your own figures that should be reasonably consistent with the data previously given in this problem. Outline a procedure that might be followed in practice to redistribute service-department overhead to the Machine Shop. The procedure should be in keeping with the data previously given in the problem.

Answer the following questions:

a. How does the form of budget report that you have prepared differ from the one illustrated in Table 20.5?

b. Where the form illustrated in Table 20.5 is used, how are the fixed charges covered in the system of budget control?

PROBLEM 25.2

You are given the following data:

	Predetermined for the year 1948	Actual for the month of May, 1948
Direct hours:		
Department A	13,680	1,300
Department B	9,120	700
Direct labor:		
Department A	$12,600	$1,210
Department B	11,400	1,050
Factory overhead:		
Department A	$ 4,976	$ 480
Department B	2,224	240
Service Department		
Fixed	$ 1,440	$ 120
Variable	4,400	500
Total factory overhead	$13,040	$1,340

The fixed overhead of the service department is to be redistributed 60 per cent to Department A and 40 per cent to Department B.

The variable overhead of the service department is to be redistributed on the basis of direct labor hours.

Material and labor used on production order 162:

Department	Material	Direct hours	Direct labor
A	$70	16	$18
B	0	32	42

You are asked for:

1. Four types of predetermined overhead rates.
   a. Departmental rates based on direct labor hours.
   b. Departmental rates based on direct labor cost.
   c. Over-all rate per direct labor hour.
   d. Over-all percentage of direct labor.
2. Overhead distribution for the month of May, 1948.
3. Four schedules, one for each type of rate computed in step 1, showing in each case the amount of burden applied and the burden variance for the month of May.
4. Four calculations of the cost of production order 162, one for each type of burden rate.
5. Journal entry for burden applied using departmental burden rates based on direct hours.
6. Answers to the following questions:
   a. Can you determine the amount of labor variance? Would the labor variance be recorded in the ledger as a variance? Discuss.
   b. What apparently is the basis of the 60:40 ratio for the distribution of the fixed overhead of the service department?
   c. If the entire amount of service department overhead for the month of May had been redistributed in the 60:40 ratio, how much would the variances have differed from those obtained in step 3?
   d. Why are the variances greater if the burden rates used are those based on direct hours than they are if percentages of direct labor cost are used? Would the variance always be greater using rates based on direct hours than if percentages of labor cost were used for burden application?
   e. What additional information would you need in order to determine how much of the burden variance for the month of May was caused by variation in volume?

PROBLEM 25.3*

On the basis of the data given in the following table determine the labor variance and the burden variance and make whatever analyses you can of these two variances.

	Budget at predetermined volume	Month of July	
		Actual	Standard
Production Units	1,000	1,100	
Direct Labor Hours	1,500	1,700	1,650
Direct Labor Cost	$1,125.00	$1,360.00	$1,237.50
Manufacturing Overhead			
Fixed Charges	$ 300.00	$ 300.00	
Variable Overhead	1,200.00	1,300.00	
Total Manufacturing Overhead	$1,500.00	$1,600.00	

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

PROBLEM 25.4*

The Albers Machine Company provides flexible budgets for each department based upon the per cent of capacity operated. Below are given details of the monthly budget for the machine department.

Monthly Budget for Machine Department

Items	50 per cent	60 per cent	70 per cent	100 per cent
Direct Labor Hours	5,000	6,000	7,000	10,000
Direct Labor Cost	$5,000	$6,000	$7,000	$10,000
Manufacturing Expense				
Depreciation, Taxes, and Insurance	$ 300	$ 300	$ 300	$ 300
Supervision	400	500	600	750
Inspection	200	250	300	400
Supplies	160	190	220	300
Heat and Light	100	110	130	150
Power	320	350	450	600
Truckers and Helpers	200	200	300	300
Other Expense including Repairs	220	300	400	700
Total Expense	$1,900	$2,200	$2,700	$ 3,500
Relation of Expense to Direct Labor (per cent)	38 0	36.7	38 6	35 0

From the above budget it is apparent that the best rate of production (except for 100 per cent capacity) is 60 per cent when relation of expense to direct labor is considered and thus 60 per cent is the rate at which the foreman attempts to operate. Furthermore it must be noted that manufacturing expense is only a small figure as compared to labor.

At the end of the month the following condition is found to exist in the department.

	Actual	Standard
Direct Labor Hours	5,500	5,200
Direct Labor Cost	$5,800	$5,200
Manufacturing Expense		
Depreciation, Taxes, and Insurance	$ 300	
Supervision	500	
Inspection	225	
Supplies	230	
Heat and Light	120	
Power	320	
Truckers and Helpers	180	
Other Expense including Repairs	325	
Total Expense	$2,200	

Required:

Write a brief report for the foreman of the department pointing out essential facts of operation in relation to budget, actual and standard performance, and calling attention to such variances between actual and standard as you can from the data available.

* Adapted from Greer and Willcox, *Problems in Cost Accounting*, McGraw-Hill Book Company, Inc., New York, 1931.

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