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COST ACCOUNTING FOR BRASS AND BRONZE FOUNDRIES

SCOPE OF ARTICLE.

Cost accounting literature on foundry cost systems has dealt particularly with iron foundries. Little has been written about the application of correct principles of cost accounting to brass and bronze foundries.

While there are similarities in practice between iron foundries and brass and bronze foundries, there are enough important differences between them to warrant separate consideration of the proper cost accounting requirements of the latter type of foundry. In iron foundries metal is melted in cupolas, the formulas or mixtures in the metals cast are few, and in many cases the castings produced are of a high average weight. In brass and bronze foundries metals are melted in crucibles in pit or other types of furnaces, and the weight of each melt is much less than in iron foundries. Many different formulas or mixtures of metals are melted; melting losses are greater; and in many cases castings average low in weight and are more intricate than iron castings.

Differences in practice also exist between brass and bronze foundries producing billets in iron moulds which are rolled into rods and bars and those producing castings from a variety of patterns in sand moulds. The following discussion pertains to the latter type of foundry.

INADEQUATE FOUNDRY COST SYSTEMS.

It seems almost unnecessary to assert that a reliable cost accounting system is just as important in foundries as in other divisions of industry, but many foundries are in operation in which a cost accounting system which yields proper cost information is conspicuous by its absence. This is true not only of job-

bing foundries, but also of foundries operated in conjunction with machine shops which finish the foundry output. There are instances of concerns which manufacture machines under the direction of managements who insist on having a well developed cost accounting system in the machine shops but give little consideration to such a system in the foundry. Inasmuch as the accumulation of value of the product originates in the foundry, the same care should be taken to ascertain accurate costs in the foundry as in the machine shops.

Some foundries have accounting systems which determine the average cost per pound of all product, regardless of size, form, or other characteristics of the castings; or of the formula or mixture of the metals cast. All expenditures in connection with the operation of the foundry are included in the total from which the average cost per pound is determined, with the result that each pound of product is charged with a portion of all expenses, yielding costs too high for some castings and too low for others. In fixing selling prices for castings which are manifestly difficult to make or are manufactured from special compositions, an adjustment of the average cost per pound is made by the addition of an amount supposedly sufficient to cover the extra cost, but the adjustment is usually an arbitrary figure. Obviously, as castings vary in size, shape, or composition of metals from which they are made the cost of their production must vary. An average cost per pound can never be equitable unless the product of the foundry is absolutely uniform as to the characteristics already enumerated. It would be difficult to find a foundry which has such a product.

AN ADEQUATE FOUNDRY COST SYSTEM.

The brass and bronze foundry which produces castings of a variety of weights and shapes, both cored and solid, made from a number of different compositions, should have a cost accounting system that shows individual job costs (i. e., costs by individual patterns) and includes all cost factors fairly distributed. These costs as completed are used in cost of shipment reports for comparison with selling prices and are best recorded finally in comparative form with supporting details readily accessible. In this form they are of great value in estimating new work and in planning improvements in operating and production methods. Daily, weekly, and monthly schedules, and reports recording and summarizing in classified form the costs and results of operation

and production should supplement the individual job cost records which provide the means of fully informing the management of the condition and progress of the affairs of the concern, thus aiding it in the administration of the business.

The job cost records, schedules, and reports will be reliable and the most useful only if accuracy and promptness in presentation are observed. The management must have correct and live information upon which to act most effectively. The fulfillment of these requirements depends upon a correct classification of accounts; correct interpretation and recording of charges for material, labor, and expenses; reconciliation of all cost data with controlling accounts in the general books and cooperation of the personnel of the business. The arrangement and orderliness of the foundry itself and the production routine also have a bearing on the accuracy and promptness of cost data. Loose methods of storage, and lack of dispatch in handling materials and product are hindrances to be avoided. These inefficiencies are indicated by an adequate cost system.

The following paragraphs deal with a plan and procedure for the operation of an adequate cost accounting system for the type of foundry under consideration. As every foundry has its own peculiar conditions, it is practicable to lay down only fundamental principles which may be adapted to the special needs of specific cases. The limitations of this article do not permit the presentation of a complete classification of accounts nor illustrations of necessary records and forms, but these will be referred to and described.

It is assumed that proper methods and records are used for commercial accounting; and that proper control accounts for all purchases and sales are established, leaving for discussion only those features of accounting directly connected with operating and product costs.

Classification of Accounts.

If a classification of accounts is to be of the most service, it should have a system of account numbers, and an arrangement of accounts that will permit the addition of new accounts at any point as the necessity arises without disturbing the general scheme or order. The Dewey system of numbering, or a combination of numbers and letters, permits the greatest flexibility, pro-

vided tabulating machinery is not used. The classification should contain only those accounts most essential for the proper interpretation of the affairs of the concern, and an effort should be made to avoid a multiplicity of accounts which will exhibit only petty items, particularly in departmental expense accounts, thus reducing clerical labor to some extent.

The majority of essential "balance sheet" accounts are not unlike those for other lines of business. The divisions of assets should be Current, Deferred Charges, Funds, Permanent, and Contingent; and the Liabilities and Capital accounts should be divided into Current Liabilities, Operating Reserves, Contingent Liabilities, Capital Stock, Surplus, Surplus Reserves, and Current Profit and Loss.

INVENTORIES.

The inventory accounts among the current assets should include Work in Progress, Purchased Metals, Foundry Scrap, Fuel, Crucibles, Moulding and Core Sand, and Other Supplies. These are the most important items which should appear in the monthly statements.

Many brass and bronze foundries add tin, lead, zinc, etc., to molten copper or scrap metals in the crucible in the form of ingots previously prepared. In such cases an inventory account for Alloys should be used and the cost of the alloys should include, in addition to metal cost, proper amounts for labor and overhead consumed in their preparation.

Since foundry product is usually shipped as fast as finished, no account is listed for finished castings. If castings are finished, however, and held for future delivery, an account for Finished Castings should be provided.

DEFERRED CHARGES.

This class of accounts includes prepaid items, such as Taxes, Insurance, Interest and Discount, Subscriptions and Memberships, and Miscellaneous Expenses. Experimental and Development costs are also deferred charges until disposed of.

Since the basis and apportionment of most of these items are rather generally known, they will not be discussed here.

A brief reference to experimental and development expenses might be made. These items are accounted for in several ways. When incurred for the benefit of a customer, they should be included as direct items in the cost of the customer's order. If incurred for the benefit of the company, they may be immediately charged to general administrative expenses, or to the account of the department which is to benefit; or accumulated as a deferred charge item until completion of the work, when they may be disposed of in the surplus account or transferred to a permanent asset account. When the work is done by company labor, the proper overhead should be charged to its cost.

PERMANENT ASSETS.

The permanent assets should be classified as Land; Buildings; Light, Heat, and Power Equipment; Machinery and Operating Equipment; Furniture and Fixtures; Flasks and Patterns (owned by the concern). This classification not only indicates the value of permanent assets by classes, but also segregates those items most similar in respect to depreciation, maintenance and repair charges. The fact that depreciation rates on foundry property of various kinds vary widely should be fully recognized.

ACCRUED LIABILITIES.

The Accrued Liability accounts should include Accrued Payroll, Taxes, Insurance, Interest, and Miscellaneous Expenses. The operation of these accounts is rather well known.

OPERATING RESERVES.

Operating Reserve accounts are Reserves for Depreciation, subdivided to agree with the classification of permanent assets; Reserve for Bad Debts; Reserve for Overhead; and Reserve for Inventory Adjustments.

A table of depreciation rates should not be used as a medium for setting rates without consideration of the factors that affect depreciation. The following condensed table shows a list of rates which are of the most interest to foundry operators. These rates are calculated by two of the most commonly used methods. They are here presented to give a general idea of the rates frequently used for various classes of assets.

DEPRECIATION FACTORS AND RATES

ASSETS	Probable Years of Life	Ratio of Scrap Value to Original Value	Rate % on Original Cost	Rate % on Declining Value
Brick or Steel Frame Buildings,				
Easy service	40	0.10	2.25	5.5
Severe service	20	0.10	4.5	11.
Good Wooden Buildings,				
Easy service	30	0.10	3.	7.5
Severe service	15	0.10	6.	14.
Sprinkler, Heating and Ventilating systems, Water and Sewer piping and Sanitary Fixtures	20	0.10	4.5	11.
Pavements, sidewalks, fences, retaining walls, roadways, tracks, yard drainage, general conduits, tunnels, vaults, etc.	20	0.10	4.5	11.
Boilers, pumps, feedwater, heaters, air compressors, engines and dynamos	15–30	0.10	6.–3.	14.–7.5
Power piping, valves and fittings, engine room instruments and gauges, electric switchboard, instruments and main wiring	10–15	0.05	9.5–6.3	26.–18.
Heavy machinery, motors, traveling cranes, elevators, etc.	20–30	0.10	4.5–3.	11.–7.5
Light machinery	15–20	0.10	6.–4.5	14.–11.
Shafting, hangers and pulleys	10–15	0.05	9.5–6.3	26.–18.
Melting furnaces, heating ovens and accessories	15–20	0.10	6.–4.5	14.–11.
Motor trucks	5	0.10	18.	37.
For items below a single write-off at the rates specified is made and the balance is carried as part of the inventory without further reduction, renewals to be charged to expense.				
Belting, hand tools, chains, ropes, foundry flasks, core-driers, etc., net additions			50.	
Patterns and core-boxes (standard),				
Metal, net additions			75.	
Wood, net additions			100.	
All patterns, flasks or special equipment required for a particular order or contract to be charged to the job.				
Miscellaneous furniture, fixtures, and equipment,				
Mechanical appliances, departmental wiring and electric fixtures, etc., net additions			60.	
Miscellaneous items (wood), net additions			70.	

RESERVE FOR OVERHEAD.

No cost accounting system can be justified unless it shows accurate costs. This means that, so far as is possible, the unit cost of each product should include not only an accurate division of material and labor charges but also its equitable share of expense charges; and that the sums of material, labor, and expense charges included in the aggregate of product unit costs for any period must prove up to the total expenditures for these items during such period. Reference to the accurate accounting for direct material and labor charges will be made later.

Accurate charges for expenses, or overhead, because they are indirect charges, cannot be ascertained with reference to unit costs as easily as direct material and labor charges, but must enter those costs on predetermined bases. These will be considered in connection with departmental expense accounts.

Overhead distributions as made to product costs in Work in Progress are to be credited to Reserve for Overhead account, and the totals of departmental expense accounts are to be periodically closed into the same account. Thus the Reserve for Overhead account becomes a collecting account, and its balance at the close of any period will indicate whether overhead is being under-absorbed or over-absorbed. Either one of these conditions may be corrected, if warranted, by changes in overhead distribution rates.

It should not be inferred that overhead distribution rates must be changed each time the Reserve for Overhead account shows a difference between overhead absorbed and actual overhead. The real value of the overhead reserve account is obtained when it serves as a stabilizer of costs. It should be the aim to establish overhead distribution rates so nearly correct that they may remain constant as long as possible. But in spite of the most careful work in predetermining rates it will be found that there will always be some difference between the amount of overhead taken into costs and actual overhead; and that when the rates are nearly correct, a debit balance in the reserve account at the close of a month may easily be offset by a credit balance at the close of some other month during the year. The causes of under- or over-absorption of overhead should be carefully watched, and if the factors responsible are likely to continue in the future, a change in distribution rates should be made. Some of these causes

may be varying volume and character of production; and an increase or decrease of operating economy and efficiency somewhere in the plant.

While a large credit balance in the Overhead Reserve account indicates that more than actual overhead is being charged into costs, it is better to err in this direction than conversely, as a reserve is then available to take care of slight increases in actual overhead which cannot be foreseen and provided for. Any balance in the Overhead Reserve account at the end of the year should be closed into the Profit and Loss account.

RESERVE FOR INVENTORY ADJUSTMENTS.

The inventory records should be maintained carefully in order that inventory valuations may represent actual facts, and that charges to costs may be correct. Nevertheless, discrepancies between actual and recorded quantities of stocks on hand of the several inventories, due to clerical errors or natural wastes, will occur.

Inventories should be checked and inventory records corrected as often as opportunity is presented during the year. When all necessary corrections which can be made by righting clerical errors are taken care of, any remaining differences should be carried to the Reserve for Inventory Adjustments account and left to accumulate there until the end of the year, when the balance in that account is closed into the Profit and Loss account. By following this practice the data in the Reserve for Inventory Adjustments account provide a valuable index of the efficiency of the inventory records.

REVENUE AND COST ACCOUNTS.

In the monthly revenue and cost accounts, which are similar to those of other industries, the profits on each month's sales are expressed. The revenue accounts consist of Sales account, which is credited with amounts charged to customers for goods sold; Returns and Allowances account, which is debited with values credited to customers for allowances and sales value of castings returned; Freight on Sales account, which is debited with prepaid transportation charges on sales, and credited with amounts charged to customers.

The cost accounts are Cost of Shipments account, which is debited with amounts credited to inventory accounts for castings sold; Returns and Allowances account, which is credited with cost values charged to inventory or departmental expense accounts for scrap values and losses on castings returned.

The remaining revenue and cost accounts, Interest Received, Cash Discounts on Purchases, Other Income, Interest Paid, Cash Discounts on Sales, and Other Charges, are treated exactly as in other businesses.

Revenue and cost accounts may be subdivided by product classification, if desired, to facilitate comparison of revenues and costs of each line of product.

To guard against intermingling of the transactions of one month with another, the revenue and cost accounts may well be repeated under the headings "Previous Months of Current Year" and "Prior Year." Any adjustments of costs previously taken into account or transactions covering returns of castings sold in previous periods should be recorded in these accounts. The balances in these accounts at the end of the year are treated as adjustments of profit and loss.

DEPARTMENTAL EXPENSE ACCOUNTS.

As departmental lines in a foundry are well defined, a departmental classification of operating expenses can be planned and used with practically no trouble, and with much advantage in collecting operating cost information in the best form for comparison and control. When proper allocations of expenses are made, each department is placed squarely on its own feet, and its efficiency can be measured by comparison of its operating expenses with the results produced.

Foundry productive departments are Melting, Coremaking, Moulding, and Cleaning; auxiliary departments are Inspection and Shipping, Pattern, Power, and General Maintenance, the latter including carpenters, masons, millwrights, painters, blacksmiths, janitors, watchmen, etc. If, however, the establishment is large enough to maintain carpenter and blacksmith shops, etc., as distinct departments, individual departmental expense accounts should be kept and separated from the General Maintenance department grouping.

General Administrative Expenses according to this classification includes selling, trucking and teaming, and receiving and stores expenses. If the organization and equipment of each of these several facilities are large enough to constitute separate departments, they should be represented by separate expense accounts. If auto trucks or teaming equipment are a part of the property of the concern, fixed asset and depreciation reserve accounts should be set up for them.

INTERDEPARTMENTAL CHARGES.

Any transfers of labor or materials from one department to another should be given full effect in the accounts, charging the department served and crediting that giving the service, thus tending to reduce the amounts of expenses which must be prorated on arbitrary bases.

Particular care should be taken to exclude from General Maintenance and General Administrative accounts all expenses which can be charged definitely to other departmental expense accounts or to costs of shipments, thus avoiding further arbitrary expense distributions.

EXPENSE ITEMIZATION.

Expenses in all departments can be basically grouped for comparative purposes under the headings Labor, Supplies, Tools and Miscellaneous, Maintenance and Repairs, and Apportioned Charges. In the subdivision of these groups, or itemization of expenses in the accounts and cost reports, the magnitude of the business and the wishes of the management should be considered. The itemization suitable and necessary for a large plant for purposes of comparison and control of expenses would be needless detail for a small plant. In general, individual items which "run into money" should be featured as separate items rather than included with other items in any one account. If further itemization is desired at any time after the classification of accounts has been established, new accounts may be inserted at any point without difficulty, if the proper system of account numbering and arrangement is used.

The itemization in the following departmental expense accounts emphasizes the expense factors of importance in each department of a brass and bronze foundry. Accounts are symbolized by a combination of numbers and letters. Reserving the numbers from one to fifteen for balance sheet, and revenue and

cost accounts, the numbers applied to the several departments will commence with sixteen.

16 MELTING DEPARTMENT.
- 161 LABOR
  - A Melters and helpers
  - P Foremen and clerks
  - R Allowances for overtime
  - S Special labor allowances
  - T Trucking, handling and miscellaneous labor
- 162 SUPPLIES, TOOLS AND MISCELLANEOUS EXPENSES
  - A Fuel
  - B Crucibles
  - C Charcoal and flux
  - D Skimmers shovels and small tools
  - E Water
  - N Testing and analyzing
  - P Sickness and accident expense
  - R Losses due to errors and defects
  - S Miscellaneous supplies and expenses
- 163 MAINTENANCE AND REPAIRS
  - A Buildings
  - B Furnaces
  - C Elevators, conveyors and cranes
  - D Blowers
  - E Cinder mill and metal recovery equipment
  - L Light, heat and power equipment
  - S Other equipment
- 164 APPORTIONED CHARGES
  - A Taxes
  - B Insurance
  - C Light, heat and power
  - D Depreciation
  - E General administrative expenses
  - F Other

17 ALLOY MELTING REPARTMENT. (A suitable itemization follows for this department when separated from above.)

18 COREMAKING DEPARTMENT
- 181 LABOR
  - C Trimming, inspecting and repairing cores
  - D Oven tenders
  - P Foremen and clerks
  - R Allowances for overtime
  - S Special labor allowances
  - T Trucking, handling and miscellaneous labor
- 182 SUPPLIES, TOOLS AND MISCELLANEOUS EXPENSES
  - A Fuel
  - B Core sand and binders
  - C Rods, wires, nails, etc.
  - D Mallets and small tools
  - E Water
  - P Sickness and accident expense
  - R Losses due to errors and defects
  - S Miscellaneous supplies and expenses
- 183 MAINTENANCE AND REPAIRS
  - A Buildings
  - B Sand mixers
  - D Core ovens
  - E Core box repairs and renewals
  - F Core formers and plates
  - L Light, heat and power equipment
  - S Other equipment
- 184 APPORTIONED CHARGES (Same as for Melting Department)

19 (Reserved for Machine Coremaking Department when above is used for hand coremaking only.)

20 MOULDING DEPARTMENT
- 201 LABOR
  - C Pouring and shaking out
  - D Idle time
  - P Foremen and clerks
  - R Allowances for overtime
  - S Special labor allowances
  - T Trucking, handling and miscellaneous labor
- 202 SUPPLIES, TOOLS AND MISCELLANEOUS EXPENSES
  - A *
  - B Moulding sand and binders
  - C Core chaplets, gaggers, nails, etc.
  - D Small tools and equipment
  - E Water
  - P Sickness and accident expense
  - R Losses due to errors and defects
  - S Miscellaneous supplies and expenses
- 203 MAINTENANCE AND REPAIRS
  - A Buildings
  - B Moulding machines
  - C Riddling machines
  - E Pattern repairs and renewals
  - F Flasks
  - L Light, heat and power equipment
  - S Other equipment
- 204 APPORTIONED CHARGES (Same as for Melting Department)

21 (Reserved for Machine Moulding Department when above is used for hand moulding only.)

22 CLEANING DEPARTMENT
- 221 LABOR
  - A Pulling cores
  - B Cutting off gates and sprues
  - C Grinding labor
  - D Rattler tenders
  - E Hand chipping and filing
  - F Sand blasting
  - P Foremen and clerks
  - R Allowances for overtime
  - S Special labor allowances
  - T Trucking, handling and miscellaneous labor
- 222 SUPPLIES, TOOLS AND MISCELLANEOUS EXPENSES
  - A Sand blast supplies
  - B Grinding wheels and supplies
  - C Metal saws and cutting supplies
  - D Brushes, files and small tools
  - E Water
  - P Sickness and accident expense
  - R Losses due to errors and defects
  - S Miscellaneous supplies and expenses
- 223 MAINTENANCE AND REPAIRS
  - A Buildings
  - B Sand blast equipment
  - C Grinding equipment
  - D Sawing and cutting machines
  - L Light, heat and power equipment
  - S Other equipment
- 224 APPORTIONED CHARGES (Same as for Melting Department)

23-24 (Reserved for any departments which may be divorced from above, such as Sand Blasting.)

* The blank spaces in this code are reserved for the insertion of new accounts that may be opened up in order to make the system elastic.

25 INSPECTION AND SHIPPING DEPARTMENT
- 251 LABOR
  - A Inspection labor
  - B *
  - C Shipping labor
  - P Foremen and clerks
  - R Allowances for overtime
  - S Special labor allowances
  - T Trucking, handling and miscellaneous labor
- 252 SUPPLIES, TOOLS AND MISCELLANEOUS EXPENSES
  - A Stationery and printing
  - B Packing materials
  - C *
  - D Small tools and equipment
  - E Water
  - P Sickness and accident expense
  - R Losses due to errors and defects
  - S Miscellaneous supplies and expenses
- 253 MAINTENANCE AND REPAIRS
  - A Buildings
  - L Light, heat and power equipment
  - S Other equipment
- 254 APPORTIONED CHARGES (Same as for Melting Department)

26 (Reserved for Shipping Department if separated from above.)

27 (Reserved for Trucking and Teaming expenses if auto trucks or teams are maintained.)

28 PATTERN DEPARTMENT (Including pattern storage).
- 281 LABOR
  - A Pattern shop labor
  - C Pattern storage labor
  - P Foremen and clerks
  - R Allowances for overtime
  - S Special labor allowances
  - T Trucking, handling and miscellaneous labor
- 282 SUPPLIES, TOOLS AND MISCELLANEOUS EXPENSES
  - A Miscellaneous lumber
  - B Screws, bolts and small supplies
  - D Small tools and equipment
  - E Water
  - N Pattern storage expense
  - P Sickness and accident expense
  - R Losses due to errors and defects
  - S Miscellaneous supplies and expenses
- 283 MAINTENANCE AND REPAIRS
  - A Buildings
  - B Woodworking machinery
  - C Metal working machinery
  - L Light, heat and power equipment
  - S Other equipment
- 284 APPORTIONED CHARGES (Same as for Melting Department)

29-30 (Reserved for Metal Pattern Department and Pattern Storage when above is used for Wood Pattern Department only.)

31 POWER DEPARTMENT
- 311 LABOR
  - A Boiler room labor
  - B Engine room labor
  - P Foremen and clerks
  - R Allowances for overtime
  - S Special labor allowances
  - T Trucking, handling and miscellaneous labor
- 312 SUPPLIES, TOOLS AND MISCELLANEOUS EXPENSES
  - A Fuel
  - C Oils, grease and waste
  - D Small tools and equipment
  - E Water
  - P Sickness and accident expense
  - S Miscellaneous supplies and expenses
- 313 MAINTENANCE AND REPAIRS
  - A Buildings
  - B Boilers and appurtenances
  - C Engines, air compressors, dynamos, etc.
  - L Light, heat and power equipment
  - S Other equipment
- 314 APPORTIONED CHARGES (Same as Melting Department, omitting C)

32-33-34 (Reserved for any departments growing out of above.)

35 GENERAL MAINTENANCE
- 351 LABOR
  - A Operating labor, carpenters, masons, millwrights, painters, blacksmiths, janitors, watchmen, belt, power-line and electrical repairmen.
  - P Foremen and clerks
  - R Allowances for overtime
  - S Special labor allowances
  - T Trucking, handling and miscellaneous labor
- 352 SUPPLIES, TOOLS AND MISCELLANEOUS EXPENSES
  - A Miscellaneous materials
  - C Oils, grease and waste
  - D Small tools and equipment
  - E Water
  - P Sickness and accident expense
  - R Losses due to errors and defects
  - S Miscellaneous supplies and expenses
- 353 MAINTENANCE AND REPAIRS
  - A Buildings
  - B Machinery
  - L Light, heat and power equipment
  - S Other equipment
- 354 APPORTIONED CHARGES (Same as for Melting Department.)

36-37-38 (Reserved for any departments growing out of above.)

40 GENERAL ADMINISTRATIVE
- 401 LABOR
  - A Salaries, executive
  - B Salaries, office
  - C Salaries, selling
  - D Selling commissions
  - R Allowances for overtime.
  - S Special labor allowances
  - T Miscellaneous labor
- 402 SUPPLIES AND MISCELLANEOUS EXPENSES
  - A Stationery and printing
  - B Telephone and telegraph and postage
  - C Special expenses, executive
  - D Traveling
  - E Water
  - F Subscriptions and memberships
  - G Legal expenses
  - H Advertising
  - J Experimental and development
  - K Trucking and teaming expenses
  - L Receiving and stores expenses
  - P Sickness and accident expenses
  - R Losses due to errors and defects
  - S Miscellaneous supplies and expenses
- 403 MAINTENANCE AND REPAIRS
  - A Buildings
  - B Office machinery
  - C Furniture and equipment
  - S Other equipment
- 404 APPORTIONED CHARGES (Same as for Melting Department excluding E)

41-42 (Reserved for Selling, and Receiving and Stores accounts if set aside from above.)

* The blank spaces in this code are reserved for the insertion of new accounts that may be opened up in order to make the system elastic.

While most of the items in the classification are self-explanatory, perhaps some may need explanation. "Special labor allowances" is intended to be charged with wages allowed for holidays or special events. Sickness and accident expense should be charged with wages or any other expense incurred for sick or injured employees in any of the departments other than that covered by liability insurance. Idle time is frequently an important factor in the moulding department when moulders are delayed because cores or equipment are not ready for them and the Idle Time account is provided for charges of that nature. Idle time is not usually a factor in the other departments, but if it is the account may be included in the accounts of these departments.

DISTRIBUTION OF DEPARTMENTAL EXPENSES.

An exhaustive presentation of overhead distribution methods and the cases to which they best apply cannot be undertaken in this article for lack of space. The methods given in the following paragraphs are mentioned only as illustrations which may be used as approximations until better methods suiting the needs of specific cases are evolved.

Melting department expenses are to be prorated to Work in Progress on the basis of pounds of metal poured. The weight of castings in the mould, which includes gates, risers, and sprues, for each pattern worked should be on record. Metal recoveries from foundry ashes, and melting and moulding floor sweepings should be cleaned up daily and reported for each day's melt. The total weight of metal poured each day can be easily calculated from data kept for the gross weight of castings, daily moulding reports, and metal recovery reports, and accumulated for the month. The quotient of each month's melting expenses divided by total pounds poured is the conversion cost per pound on all metal poured. This factor calculated in this way disregards separate conversion costs for various formulas, but it is not feasible to obtain an accurate melting cost per pound by formulas. For those mixtures known to require appreciably more time for melting than ordinary formulas, thus absorbing more melting expense, special observations can be taken and the melting cost per pound therefor can be increased over the flat rate in proportion to the extra time required.

Melting loss, or the difference between weights of metal charged and poured, while included in melting costs, should be

recorded as statistical information of which the management may make use in striving to lessen such expense.

In foundries where piece work is not the rule, coremaking expenses may be distributed on the basis of coremaking man-hours on each order requiring cores; moulding expenses on the basis of moulding man-hours on each order; and cleaning expenses on the basis of combined coremaking and moulding man-hours on each order. These bases will be found to be good approximations, resulting in the distribution of each class of expenses in greater proportion to cored castings than to plain castings, which is logical. In many foundries the results secured from distribution of these expenses in the manner mentioned may be found to vary little from the results obtained by other methods.

Piece work methods of wage payment would alter the efficacy of the man-hour basis of distribution. The direct-labor cost basis would perhaps serve better in this case.

The extensive use of coremaking and moulding machines should lead to the consideration of establishing separate expense accounts for the machine departments, and the machine-hour basis of expense distribution.

In most foundries of the class considered in this article, the varied character of production precludes the treatment of cleaning labor as direct labor accounted for by order numbers, owing to the difficulty in keeping time for the several operations and orders. In such cases the distribution method mentioned above will serve to charge each order with cleaning expenses and labor in greater proportion in the case of cored castings which need cleaning inside and out, than in the case of plain castings which need cleaning only on the outside surface. Where practicable, time-keeping for cleaning labor may be by order numbers and cleaning expenses can be prorated thereon more accurately.

Inspection and Shipping expenses may be distributed to coremaking and moulding departments on the basis of total direct-labor hours in each department. This basis in most cases is better than a weight basis, as the relation of time required to inspect and prepare for shipment specific lots of castings to coremaking and moulding time consumed is closer than the weight relation.

Pattern and General Maintenance expenses except pattern storage costs, should be prorated to the expense accounts of departments benefited on the basis of man-hours spent on work in each department. The time and labor cost spent on each job should be recorded under proper departmental expense account numbers, plant order numbers for new work to be added to capital accounts, or production order numbers for special rigging, equipment or work for specific customer's orders. At the end of the month the man-hours applicable to each job shown by the time records form the basis of distribution of the entire expense in pattern and general maintenance departments, except pattern storage labor and expenses, which should be charged to core-making and moulding expenses on the basis of service given.

Power department expenses are chargeable to the various departments served on bases of consumption. If the power department includes, besides an engine for driving machinery, an electric power plant, air compressor, or water pumping station, these several units should bear equitable shares of steam expense, and the expenses of operating and maintaining the several units should in turn be borne by the departments served. The bases of distribution are: measured consumption or estimated horsepower consumption of power, wattage of lamps for lighting, floor space for heating, measured or estimated consumption of air and metered or estimated consumption of water. If exhaust steam is used for heating or other purposes, the engine room should be credited therefor. Purchased services of the kinds mentioned above should be charged into departmental expenses directly from accounts payable vouchers, having no connection with the power department.

General administrative expenses may be distributed over departments on a basis of total man-hours in each department which basis results in greater charges to the larger departments. Trucking and teaming expenses are properly to be borne by the receiving and shipping departments on the basis of services rendered. Receiving and stores expenses are properly chargeable to the cost of the stores handled so far as practicable, as is the case with freight and express inward. Any parts of such expenses which cannot be added to the cost of purchased materials should be prorated to departments to which the goods will finally be delivered.

STATEMENTS AND EXHIBITS.

The monthly reports will, of course, include a trial balance, balance sheet, and profit and loss statement, which are so common as to need no description, unless mention should be made of the desirability of presenting them in comparative form, showing results as of "this month," "last month," "this year to date," and "last year to date."

Departmental expense exhibits are also in order in a well-regulated system. These should all be in the same comparative form as the trial balance with respect to the periods reviewed.

The melting cost report, summarizing daily heat and metal reports, and melting department expenses, is first in the list of these exhibits. Melting department expenses are listed in detail just as they appear in the classification of accounts, and the grand total of these expenses is shown and named "Total conversion cost." The metals used are then detailed in kind, weight, and value, and totalled, which, added to the total conversion cost, gives a final total named "Total melting cost." The summarized charges to work in progress orders are then shown in weight poured and value, and deducted from the total melting cost, resulting in a debit or credit balance shown in black or red respectively, and named "Balance to overhead reserve account."

Thus a complete detailed story of melting department activities and results produced is presented. Melting loss is shown in the difference between the weights and values of metals used and poured and may be shown also in percentage of metals used. Whether the department is paying its way is shown in the balance carried to overhead reserve account.

Exhibits for all the other departments are constructed in the same way as the one for the melting department, using, however, the terms applicable in each case for the distribution of the total expense, and showing the bases used for the distribution.

All balances to Overhead Reserve account are shown in black or red as the amount is a debit or credit balance and their total must agree with the total monthly change in the Overhead Reserve account. Other statistical information can be incorporated in these exhibits.

PRODUCTION ORDERS.

As customers' orders are received production orders should be issued for individual patterns of castings, numbered serially and providing for the record of date, order number, pattern number, quantity ordered, formula, description, and sales order number. Six copies can be used advantageously, one copy for the office or production manager having additional provision for record of castings made, shipped, and rejected, and the dates. Another copy for the pattern storage is the authority to deliver patterns and core boxes, and may have provision for description of patterns, core boxes, and other equipment delivered, and signatures of receipt of this equipment in coremaking and moulding departments. The signatures acknowledge the fact that patterns, etc., are ready for use. A third copy, which goes to the coremaking department, is a notification of the placing of the order and may provide for recording dates, cores made, delivered and rejected. The fourth copy, going to the cleaning department, notifies them of the order and may provide for record of dates, castings received, delivered, and rejected. These four copies can be of any convenient size, say 4" x 6", and can be arranged to be issued in one writing with the aid of carbon paper.

The fifth and sixth copies should be larger, say 8" x 10", or 9½" x 12", being expanded for more extensive use, and should preferably be arranged for use in loose-leaf binders. The fifth copy is for the moulding department. It is assumed that the foundry timekeeper's headquarters are located in this department, and the copy acts primarily as a notification of the placing of the order. This copy provides on its face, in addition to the descriptive heading, columns for dates, materials charged—detailed as to kind, weight, price, and value—castings delivered—detailed as to good, rejected, weight, price, and value. The reverse of this copy is ruled to record coremaking and moulding time of direct labor, provision being made for recording dates, worker's clock numbers and names, hours worked (on the order), rate, day work earnings, pieces made, rates, and piece work earnings. Machine numbers may also be shown. Helpers' as well as principals' time and earnings are here recorded.

The sixth copy goes to the cost department, where it is filed in binders which contain the detailed records supporting the work in progress inventory. In addition to the descriptive heading,

this copy has provision on its face for a ledger account for the order. Under the caption "Work in Progress Account" there are three vertically ruled sections headed "Debits, Credits, Balance." The debit columns provide for recording dates and amounts for materials—detailed as to quantity, kind and weight—coremaking and moulding hours and labor, coremaking and moulding expense, cleaning charges, and total charges. The credit columns provide for record of castings delivered—detailed as to quantity good, rejected—accounts charged showing cost of shipments of finished castings, scrap, and departmental defective accounts, and values. The balance columns are for values only.

As daily time reports come to the cost department they are verified with the time clock record for each worker, rated and extended, and sorted by order and account numbers. A duplicate of each slip is filed by worker's number or name to be later verified with an abstract of the payroll for accuracy of recorded earnings. From the set filed by order numbers all labor charges are carried to the cost department's copy of the production order, all relevant information being obtained from the time slips. Material charges to production orders are obtained in a similar manner from properly priced, extended, and filed material requisitions. Thus the necessary information is recorded on each order so as to permit the daily pricing of records of cost of shipments, and orders are credited accordingly, so that the balance in work in progress is always known. All information except rates, prices, and values are recorded on the copy of the order in the moulding department and when the order is completed it is then turned in to the cost department with all related papers for final verification of all entries and final recording of costs on comparative cost records. The fifth and sixth copies of each order, after checking and the insertion of values on the fifth copy, become the permanent record of the order and carry all the details supporting the comparative cost record.

COST AND PRODUCTION REPORTS.

A detailed description of all of the cost and production reports used in operating an adequate cost accounting system will not be attempted in this article, as the numerous references to the many requirements for the successful working of the system should be a guide to the nature of the necessary papers. In foun-

dries already operating an accounting system probably most of the forms in use can be continued, perhaps with some modifications. Whenever possible cost and production department requirements should be served by the same forms, several copies being written if necessary, as the source of information for both departments is the same and much clerical labor can be saved by cooperation of the departments.

CONCLUSION.

Description of much of the details necessary for the installation of an adequate cost system such as is described in this paper is omitted, and necessarily so, because the requirements of individual cases are all different. The main purpose of this discussion is to show that adequate cost accounting for brass and bronze foundries should and can be accomplished, and to indicate the application of correct accounting principles to serve the operators of such foundries.

As indicated before, a complete knowledge of cost details presented in all proper relations and at the proper times is essential to brass and bronze foundry operators if their business is to be conducted intelligently and profitably and with a full realization of benefits from their equipment and facilities.

The cost system described is planned and based on sound accounting principles and may be adapted to the needs of any brass and bronze foundry of the type considered, and it is capable of expansion and improvement in details as the demands upon it become greater.

With a few minor changes in the accounts classification the system described is suitable for foundries connected with machine manufacturing concerns, "customers" being replaced by the parent plant, and other changes being made to bring the system into the proper relation with the whole organization. A very careful consideration of expenses should be made in such cases in order to insure that the foundry shall bear its just proportion of expenses.