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PLANT REQUIREMENTS FOR MANUFACTURE OF COPPER TUBING

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
COMMUNICATIONS RESOURCES DIVISION
Washington 25, D. C.

FOREWORD

This brochure is one of a series of reports resulting from overseas technical inquiries on factory or commercial establishments, operation, management, and engineering. The report is designed to provide only a general picture of the factors that must be considered in establishing and operating a factory of this type. In most cases, plans for actual installations will require expert engineering and financial advice in order to meet specific local conditions.

Mention of the name of any firm, product, or process in this report is not to be considered a recommendation or an endorsement by the Agency for International Development, but merely a citation that is typical in its field.

****

The original report was prepared by Morris and Van Wormer, Engineers, New York 4, N. Y. through the facilities of the Office of Technical Services, U. S. Department of Commerce.

****

This report has been revised and rewritten by Vitro Corporation of America, Washington Branch, 1025 Connecticut Avenue, N. W., Washington 6, D. C.

For further information and assistance, contact should be made with the local Productivity Center, Industrial Institute, Servicio or United States AID Mission.

Code Number
PR-94

March 1962

ACKNOWLEDGEMENT

The author gratefully acknowledges the cooperation of the following companies in providing technical information for use in this report:

Harnischfeger Corporation
1029 Vermont Avenue, N. W.
Washington, D. C.

Surface Combustion Corporation
2375 Dorr Street
Toledo 1, Ohio

Link-Belt Company
740 11th Street, N. W.
Washington, D. C.

Baldwin-Lima-Hamilton Corporation
Industrial Equipment Division
Philadelphia 42, Pennsylvania

The illustration of the Loewy Hydropress and Billet Heating Furnace was provided by Baldwin-Lima-Hamilton Corporation, manufacturers of the press.

Special thanks are extended to Mr. F. Klein of the Baldwin-Lima-Hamilton Corporation for his assistance in reviewing the report manuscript prior to publication.

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COPPER TUBING

INTRODUCTION

The purpose of this report is to present basic information relative to the establishment of a small copper tubing plant in a foreign country. This plant is designed to produce seamless, thin-walled, flexible, copper tubing by the extrusion method only. This tubing is generally used with solder type fittings, requiring no threads, and comes in two types: K (heavy duty), and L (light duty), the only difference being the wall thickness. This report is based on the manufacture of type K only, which is suitable for general plumbing and heating purposes, underground usage, and for gas, steam, and oil lines.

This plant, which is about the minimum feasible size, will require a substantial capital investment; however, it can be operated by a relatively small number of skilled workers. Profitable operation in industrially developing countries will depend upon two main factors: (1) the availability of locally mined and refined copper to provide low cost ingots thus enabling the plant to export its products; and (2) the presence of a sufficiently large domestic market, in the absence of domestic copper, to overcome the expense of imported ingots. Association of this tubing plant with a copper wire drawing facility would result in considerable savings and increased profits since the tubing extruder could produce the 5/16 inch copper rod required by the wire plant.

An increased future market might permit an increase in the range of tubing sizes produced; the manufacture of the lighter types of tubing; or the fabrication of other extruded shapes. The plant is also adaptable for the extrusion of other metals such as brass, bronze, and lead.

GENERAL ASSUMPTIONS

In order to make realistic cost estimates in this report, it is necessary to make the following assumptions:

1. The costs of the building and general facilities are based on United States prices.

2. Material and equipment costs are based on sizes and specifications current in the United States.

3. Labor costs are based on the average for the industry as recently published by the United States Bureau of Labor Statistics.

4. Adequate and suitable water, power, sewerage, and transportation facilities are available at the plant site.

5. This plant operates eight hours a day, five days a week, fifty weeks a year.

6. The plant manager and the supervisors are capable and experienced men able to do all the labor training necessary, with the aid of other experienced workmen. It is assumed that learner's rates will be paid in such cases and that the costs can be charged under unforeseen expenses.

7. The following items cannot be estimated realistically:

   a. Land value

   b. Distribution and selling costs

   c. In-freight and out-freight

   d. Administrative costs

   e. Taxes

   Approximate estimates are made for each of these items, with the exception of taxes, for the purpose

of completing cost estimates; however, adjustments should be made in accordance with actual local costs.

8. All cost estimates contained in this report are to be adjusted to conform to local conditions. Columns are provided in the tables included in this report to facilitate conversion of cost figures to those existing locally.

PRODUCT SPECIFICATIONS

All information and costs contained in this report are based on the production of 1/2-, 3/4-, and 1-inch outside diameter seamless, thin-walled, flexible, heavy duty, coiled copper tubing, type K, fabricated from copper ingots. The manufacturing process is based on the extrusion method rather than piercing and rolling or cold drawing.

The copper ingots must be oxygen free and are usually cast from electrolytic copper or a deoxidized or phosphorized copper obtained from high resistance lake copper or electrolytic copper. A commonly used type is a Deoxidized High-residual Phosphorus copper, usually referred to as DHP.

The American Standards Association (ASA) in conjunction with the American Society for Testing Materials (ASTM) provide the following applicable specifications:

ASA H17.1-1942	Lake Copper Wire Bars, Cakes, Slabs, Billets, Ingots, and Ingot Bars, Specifications for (ASTM B4-42)
ASA H17.2-1943	Electrolytic Copper Wire Bars, Cakes, Slabs, Billets, Ingots, and Ingot Bars, Specifications for (ASTM B5-43)
ASA H23.1-1959	Seamless Copper Water Tube, Specification for (ASTM B88-58)

other applicable ASTM specifications are:

ASTM B251-58T	General Requirements for Wrought Seamless Copper and Copper-Alloy Pipe and Tube, Tentative Specification for
ASTM B224-58	Standard Classification of Coppers

PRODUCTION CAPACITY

The proposed plant has an annual requirement of 1900 tons of copper to meet its designed production capacity of 15,000 pounds of extruded tubing per day or a total of 1875 tons per year. Annual scrap, due to butt end shell, etc., is estimated at approximately 15 per cent. This scrap can be remelted and cast into billets or sold to various foundries or other facilities which employ copper as their basic raw material.

The plant should reach full production in about two months, with all labor training being accomplished by the manager and the supervisors assisted by other experienced workers. The estimated production of 15,000 pounds of tubing per day is about the minimum rate for efficient and economical use of the equipment.

This report discusses only a small extrusion plant. However, as the plant grows, it could be converted to a high-speed, economical, and automatic operation capable of producing up to 15,000 pounds of tubing per hour. Current United States practice accomplishes this by extruding large tube blanks which are then annealed and drawn to the final size. This process would entail additional equipment such as another reverberatory furnace, more billet molds, a suitable drawing press, an annealing furnace, and an increase in floor area to at least 10,000 square feet. A proportionate increase in production output and profit would result.

MANUFACTURING UNIT

The manufacturing unit for copper tubing is the pound.

MANUFACTURING OPERATIONS

This plant manufactures copper tubing from ingots by the hot extrusion method. Properly controlled operations eliminate any need for annealing the tubing after extrusion.

Ingot Melting and Casting - The ingot is melted in an oil-fired, reverberatory furnace and then cast in a cylindrical mold to form a billet suitable for extrusion.

Billet Cutoff - After water cooling, the billet is cropped and cut to the required length by a rotary cutoff saw.

Billet Drilling - A center hole, large enough to accomodate the extrusion mandrel, is drilled lengthwise through the billet.

Billet Heating - The machined billet is heated to a plastic condition in a tunnel type furnace and then conveyed to the container of the extrusion press.

Tubing Extrusion - The extrusion press consists of three main parts: the hydraulic cylinder and ram fitted with an extrusion mandrel which controls the inside diameter of the hole in the tube; the container, a high pressure cylinder where the billet is squeezed; and the die holder containing the die which forms the outside diameter of the tube.

When the hot billet is in the container, the hydraulic ram moves forward and the mandrel passes through the center hole in the billet centering itself in the die. As the ram pressure continues, the billet is squeezed, and the metal flows between the die and the mandrel emerging as continuous tubing with uniform cross section.

The extrusion press and induction-heated billet furnace, pictured in figure 1, are included merely to give some idea of the type of equipment currently used in the United States for large production of copper tubing. This equipment is much larger and more expensive than the simple press and direct-fired furnace recommended for the proposed plant.

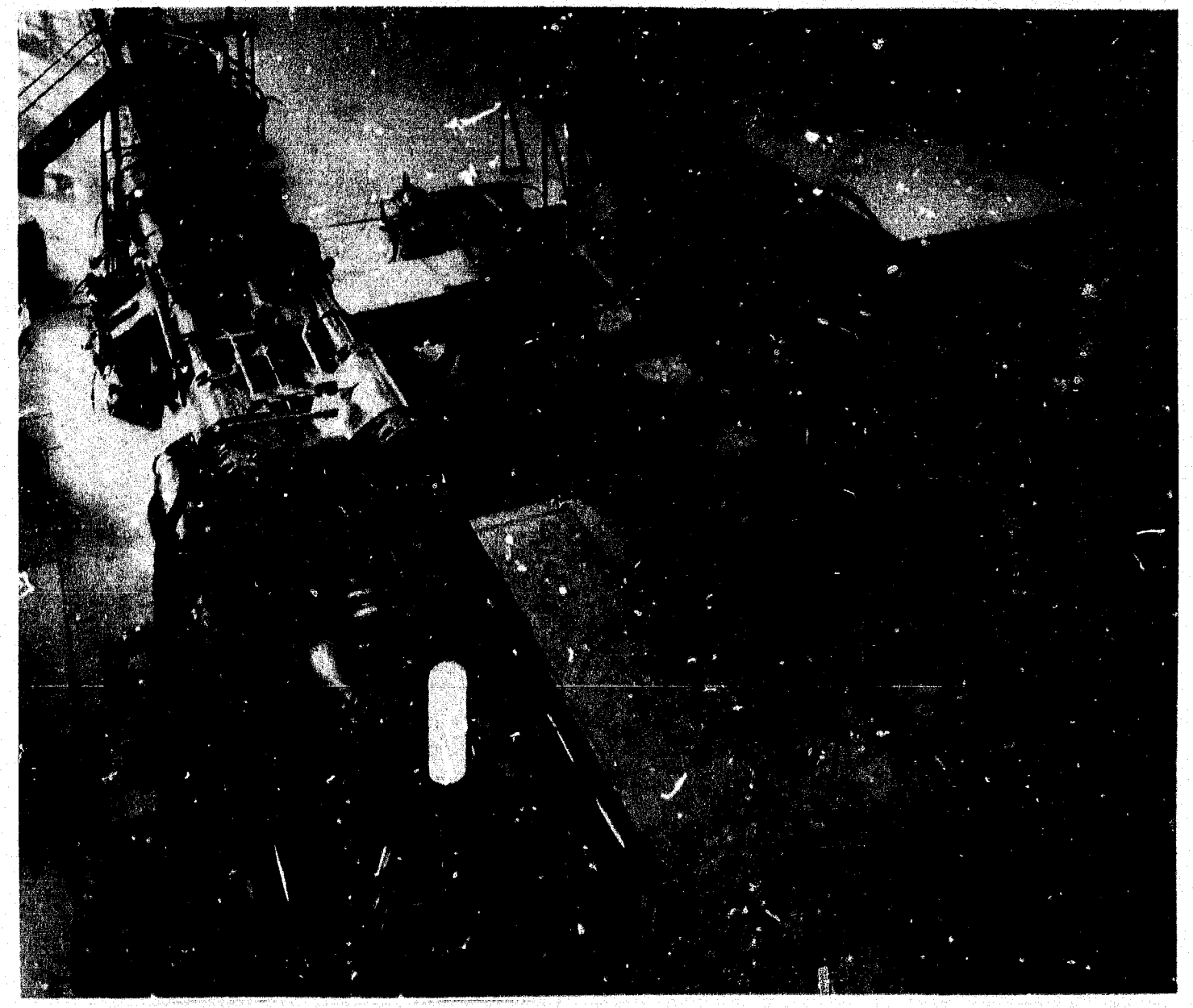

Figure 1. High Production Extrusion Press and Induction-Heated Billet Furnace

Lubrication - Lubricants such as oil and graphite may be used to facilitate ejection of the tubing from the die body.

Cooling and Coiling - After cooling, the tubing is cut into standard lengths, the ends are trimmed, and it is coiled prior to inspection and testing.

Inspection and Testing - The coils of tubing are submitted to visual and dimensional inspection to determine conformance with physical requirements, and to a hydrostatic test of not less than 60 pounds per square inch internal pressure while immersed in water, to insure against leakage.

PLANT SITE

About one acre of land will be required to accomodate the building and to allow for normal future expansion. It should be located as advantageously as possible with respect to transportation, power, water, fuel, sources of labor, and a substantial market for the finished goods. The cost of the land is estimated at $2,000.00.

BUILDING

A one story fireproof building of concrete block and steel truss construction, with no columns, will be required for this operation. It should contain a concrete floor rated at 500 pounds per square foot, and foundations for major equipment should be provided. Suggested dimensions are 60 feet wide and 100 feet long giving a floor area of 6,000 square feet. The cost of the building, including all utilities, is estimated at $33,000. A proposed plant layout is shown in figure 2.

POWER

The total connected power requirements for this plant are approximately 750 kilowatts per hour. The annual power cost is estimated at $20,300 based on 1.3 cents per kilowatt hour. Even in the United States, power costs vary considerably with locality.

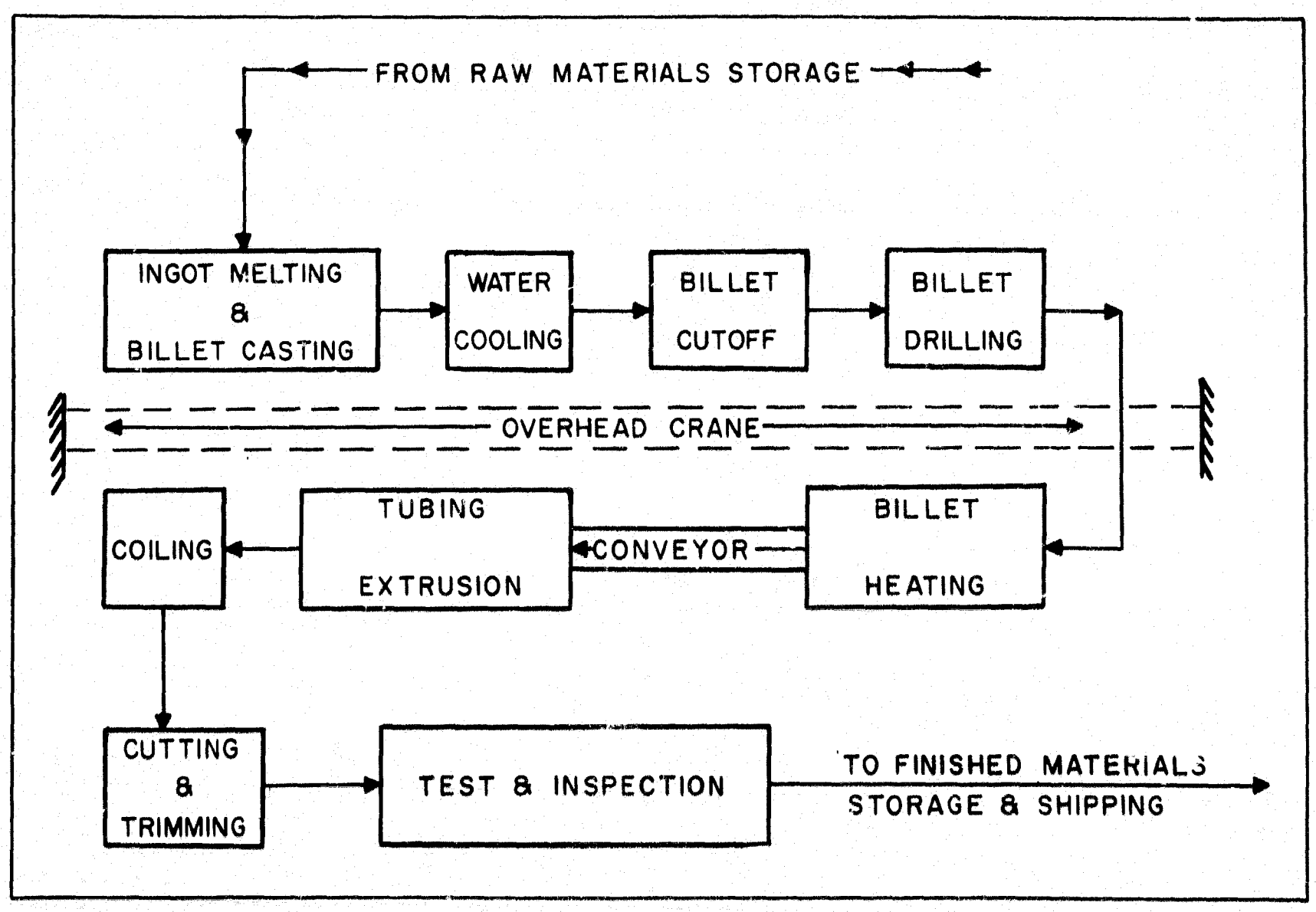

Figure 2. Proposed Plant Layout

WATER

Although water is reused in the manufacturing operations, the annual water requirements for make-up water, sanitation, and fire protection, are approximately seven million gallons. On this basis, the annual water cost is estimated at $2,100.

FUEL

The annual fuel requirements for heating and manufacturing are about 400,000 gallons of oil at an estimated cost of $32,000.

DIRECT LABOR

Fifteen workmen, as listed in the following table, are necessary to operate the manufacturing equipment.

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Annual Cost Actual
Melt Furnace Tender	1	$2.75	$ 5,720	
Billet Furnace Tender	1	2.75	5,720	
Extruder Operator	1	2.50	5,200	
Ingot Handlers	2	1.75	7,280	
Casters	3	2.15	13,416	
Mold Handler	2	1.75	7,280	
Saw Operator	1	2.15	4,472	
Drill Operator	1	2.15	4,472	
Extruder Operator's Helper	1	2.15	4,472	
Coil Operator	1	2.15	4,472	
Coil Operator's Helper	1	1.75	3,640	
Totals	15		$66,144	

INDIRECT LABOR

Thirteen people, as listed in the following table, are necessary to administer, manage, and maintain the plant.

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Annual Cost Actual
Plant Manager	1		$12,000	
Supervisor-Line	1	$4.00	8,320	
Supervisor-Maintenance	1	4.00	8,320	
Maintenance Mechanics	4	2.50	20,800	
Tester-Inspector	1	2.00	4,160	
Lift-Truck Operator	1	2.00	4,160	
Stock Handler	1	1.75	3,640	
Stock Clerk	1	1.75	3,640	
Typist-Clerk	1	1.50	3,120	
Bookkeeper	1	2.50	5,200	
Totals	13		$73,360	

DIRECT MATERIALS

Item	Unit	No. of Units	Unit Cost	Annual Costs Estimated	Annual Costs Actual
Copper Ingots	Ton	1900	$800	$1,520,000	
Total				$1,520,000	

SUPPLIES

Item	Annual Cost Estimated	Annual Cost Actual
Maintenance and repair parts, dies, tools, etc.	$15,000	
Lubricants	500	
Office Supplies	1,000	
Total	$16,500	

FURNITURE AND FIXTURES

Description	Number Required	Unit Cost	Cost Estimated	Cost Actual
Executive Desk and Chair Set	1	$130	$ 130	
Desk and Chair Set	5	100	500	
Typewriter and Table	2	110	220	
Adding Machine	2	110	220	
Drinking Fountain	2	100	200	
Clothing Locker	24	20	480	
File Cabinet	6	50	300	
Garment Rack	2	25	50	
Storage Cabinet	1	30	30	
Chairs	6	15	90	
Miscellaneous	---	---	80	
Total			$ 2,300	

PRODUCTION TOOLS AND EQUIPMENT

Usually, in ingot melting, billet casting, and billet heating, the type of furnace used determines the process system. This, in turn, determines the type of molds, special conveyors, and auxiliary equipment which will be required. All of this associated equipment is usually designed and supplied by the furnace manufacturer as an integral unit. The individual costs are estimated in the following table to arrive at a total estimated cost for production equipment.

Description	Number Required	Estimated Cost Unit Cost	Estimated Cost Total Cost	Actual Cost
Reverberatory Furnace-Oil Fired	1	$10,000	$ 10,000	
Ladles	3	500	1,500	
Billet Molds and Auxiliary Equipment			5,000	
Rotary Cutoff Saw	1	2,000	2,000	
Overhead Travelling Crane	1	10,000	10,000	
Billet Heating Furnace and Conveyor	1	4,000	4,000	
Extrusion Press	1	200,000	200,000	
Coiling Capstan	1	2,500	2,500	
Total			$ 235,000	

OTHER TOOLS AND EQUIPMENT

Description	Number Required	Unit Cost	Cost Estimated	Cost Actual
Maintenance Shop-Bench Lathe, Grinders, Trimmers, etc.			$ 4,500	
Hydrostatic Test Equipment			1,000	
Skids, Slings, Hand Tools, etc.			4,000	
Lift Truck	1	$6,500	6,500	
Total			$16,000	

DEPRECIATION

Description	Estimated Cost	Years Life	Per Year Estimated	Per Year Actual
Building	$ 33,000	20	$ 1,650	
Production Tools and Equipment	235,000	10	23,500	
Other Tools and Equipment	16,000	10	1,600	
Furniture and Fixtures	2,300	10	230	
Total	$286,300		$26,980	

MANUFACTURING OVERHEAD

Item	Cost Estimated	Cost Actual
Depreciation	$ 26,980	
Indirect Labor	73,360	
Power	20,300	
Water	2,100	
Fuel	32,000	
Supplies	16,500	
Total	$ 171,240	

MANUFACTURING COST

Item	Cost Estimated	Cost Actual
Direct Materials	$1,520,000	
Direct Labor	66,144	
Manufacturing Overhead	171,240	
Total	$1,757,384	

FIXED ASSETS

Item	Cost Estimated	Cost Actual
Land	$ 2,000	
Building	33,000	
Production Tools and Equipment	235,000	
Other Tools and Equipment	16,000	
Furniture and Fixtures	2,300	
Total	$ 288,300	

WORKING CAPITAL

Item	Cost Estimated	Cost Actual
Direct Materials, 30 Days	$ 126,666	
Direct Labor, 30 Days	5,512	
Manufacturing Overhead, 30 Days	14,270	
Reserve for Sales Collections, 30 Days	8,333	
Total	$ 154,781	

CAPITAL REQUIREMENTS

Item	Cost Estimated	Cost Actual
Fixed Assets	$ 288,300	
Working Capital	$ 154,781	
Total	$ 443,081	

SALES REVENUE

The annual production capacity of this plant is rated at 1875 tons or 3,750,000 pounds with an estimated selling price of $0.75 per pound, giving a total annual sales revenue of $2,812,500.

RECAPITULATION OF COSTS, SALES AND PROFITS

Item	ANNUAL COSTS Estimated	Total	Actual
Direct Materials	$1,520,000		
Direct Labor	66,144		
Manufacturing Overhead	171,240		
Total Manufacturing Costs		$1,757,384	
Interest on Loans	10,000		
Insurance	15,000		
Legal	15,000		
Auditing	10,000		
Unforeseen Expense, Bad Debts, etc.	20,000		
Total Administrative Cost		70,000	
Sales Commissions, Travel, Freight-out, Discounts and Allowances		100,000	
Total Business Cost		$1,927,384	
Profit Before Taxes		885,116	
Total Annual Gross Sales		$2,812,500	

BUDGET CONTROL

A requisition form designed to provide accurate records of procurement and indicate the purpose of procurement with the least amount of time and effort is shown on page 19.

This form has an account number for each type of the various expenditures which the manager will review in detail, monthly or oftener, in order to control his expenses. Some items, such as power and water, are usually under contract and are easily checked by reference to monthly bills. For simplification, items (marked with an asterisk in the table on page 18) are omitted from the purchase requisition. Variations in the labor costs are easily reviewed by examination of the payroll vouchers. The simplified type of control thus provided makes certain that the manager can control expenditures promptly.

In addition to the requisition form, a sample voucher check is shown on page 20. Voucher checks should be used for the payment of all expenditures and the appropriate book account number placed on each voucher.

At the end of each month the manager will receive a statement of all expenditures broken down by budget accounts, as shown on page 18. If the expenditures exceed the budgeted monthly allowances of any of the accounts, the bookkeeper will furnish the manager with a breakdown of all expenditures relative to the budgeted accounts exceeded. All these supporting data can be secured by reference to the purchase requisitions and the check vouchers. This reference will enable the manager to determine what caused the over-expenditure and take corrective action.

If at any time during each month it becomes apparent that expenditures will exceed any of the budget accounts, the bookkeeper will bring this to the attention of the manager for his information and action.

BUDGET CONTROL ACCOUNTS

Account Number		Monthly Expense	Monthly Budget	Annual Budget	Actual
10	Administrative		$ 4,166	$ 50,000	
20	Sales		8,333	100,000	
30	Direct Materials		126,667	1,520,000	
40	Supplies		1,375	16,500	
51	Power *		1,692	20,300	
52	Water *		175	2,100	
53	Fuel		2,666	32,000	
60	Unforeseen Expense (Reserve Account)		1,666	20,000	
71	Direct Labor *		5,512	66,144	
72	Indirect Labor *		6,114	73,360	
80	Depreciation (Reserve Account)		2,248	26,980	
	Total		$160,614	$1,927,384	

PURCHASE REQUISITION	COMPANY NAME	DATE

☐ 10 ADMINISTRATION ☐ 40 SUPPLIES

☐ 20 SALES ☐ 50 UTILITIES

☐ 30 MATERIALS ☐ 60 UNFORESEEN EXPENSE

INDICATE BELOW THE USE OF MATERIALS

☐ DIRECT MATERIALS ☐ MAINTENANCE SERVICES

☐ MAINTENANCE MATERIALS ☐ OPERATING SUPPLIES

	PLEASE ORDER THESE MATERIALS OR SERVICES	DELIVERY WANTED		
QUANTITY	DESCRIPTION	UNIT	TOTAL	

QUOTES FROM		REQUISITIONED BY	
QUOTES FROM		APPROVED BY	
QUOTES FROM		ORDER NO.	ORDER DATE

R. W. MITCHELL MANUFACTURING COMPANY

1422 BOSWORTH STREET, S. E.

65-22
514

ANYWHERE, U. S. A._____19____ No. 10000

PAY _____ DOLLARS $ _____

TO THE ORDER OF

R. W. MITCHELL MANUFACTURING COMPANY

TO FIRST NATIONAL BANK
ANYWHERE, U. S. A.

BY SAMPLE CHECK

VICE PRESIDENT

ACCOUNT NUMBER

Sample voucher check to be used for the payment of all expenditures in connection with Budget Control.

R. W. MITCHELL MANUFACTURING COMPANY

ENGINEERS

The services of professional engineers are desirable in the design of this plant, even though the proposed plant is small.

A correct design is one which provides the greatest economy in the investment of funds and establishes the basis of operation that will be most profitable in the beginning and will also be capable of expansion without expensive alteration.

The addresses of professional engineers who specialize in industrial design, some of whom may be willing to undertake such work on low cost projects overseas, can be secured by reference to the published cards in various engineering magazines. They may also be reached through their national organizations, one of which is the

National Society of Professional Engineers
2029 K Street, Northwest,
Washington 6, D.C.

Manufacturers of industrial equipment employ engineers familiar with the design and installation of their specialized products. These manufacturers are usually willing to give prospective customers the benefit of technical advice by those engineers in determining the suitability of their equipment in any proposed project.

The equipment manufacturers also know, and can recommend, professional engineers in private practice who are willing and able to provide appropriate consulting services.

TRAINING

Manufacturing an inferior quality of product during the training period could create sales resistance that might be difficult to cope with later. To avoid such possibilities, the quality of the product should be maintained at all times, including the training period.

In some areas skilled operators may be available locally. In other areas all the operators may have to be trained.

If skilled operators are not available, adequate training would be assured by using one or more of the following methods:

A. If the plant is designed and installed by a competent engineering firm, the contract should be negotiated, if possible, on a turn-key basis. On this basis the contractor agrees to operate the plant and produce the quality and quantity of the product stated in the contract for an agreed period of time. Such a contract would assure adequate personnel training, since full quantity and quality could not be produced with an untrained organization.

B. The engineering firm that designs and installs the plant can usually make training arrangements to have key personnel placed, for training purposes, in a foreign industry that produces the same type of product. This would provide training for the key personnel while the plant is being installed.

C. If neither of the above methods is possible, then qualified and experienced individuals should be employed for the key positions, either permanently or temporarily, to perform the key operations and assist in training the organization, even if they must be secured outside the country.

D. The manager should have years of successful experience in this type of business and be fully qualified in all phases of management, including the training of employees.

SAFETY

There is always danger of accident and injury in any industrial plant. Because of this, the manager should take specific action to bring to the attention of each employee the importance of safety precautions and intelligent first aid.

Practically all machines have safety appliances, and the manager should see that these are in good working condition and that the operators are making full use of them.

In addition to constant watchfulness to make sure that all practicable safety precautions are taken, first aid supplies should be readily available. One complete first aid kit should be maintained near the manager's office, and others at appropriate places throughout the plant. Some of the employees should be trained to provide first aid service.

The use of accident posters in the plant have proved to be of value in reducing accidents. It is recommended that such posters be used, and that some direct special action be taken by the manager, at least once each month, to bring to the attention of all personnel the importance of safety precautions.

A fire brigade should be established and each member trained as to his responsibility in case of fire. Fire drills should be conducted periodically.

It is recommended that the employees be encouraged to offer suggestions or recommendations relative to prevention of accidents, removal of fire hazards and maintaining general interest in all safety factors.

SUMMARY

A small plant, built and operated according to the assumptions made in this report would be a profitable undertaking.

Provision is made for inserting local cost in connection with all cost figures shown in this report. A careful analysis should be made of all cost figures to determine the local potential profits in any location where such a plant is being considered.

There are some determinations, however, that should be made before a decision is reached to build and operate such a plant.

For example, what are the possibilities of future expansion within the country for this industry?

What other products could be manufactured with the machinery and equipment specified in this report?

Is there a market for such additional products?

How does this industry compare with other industries that may be needed in the country relative to the following factors:

1. The economic value to the country.

2. The needs of the majority of the people.

3. The amount of investment capital required.

Consideration should also be given to such factors as :

The amount of power required and the availability of a dependable supply. If an adequate supply is not available the installation of power equipment may be required.

The water requirements for all purposes including fire protection and potable water for drinking purposes.

The fuel requirements and availability. If local fuel can be used the boiler should be adaptable to such fuel.

The transportation facilities to and from the plant. If they are not adequate an investment in trucks may be required.

OTHER CONSIDERATIONS

There are other important subjects, shown below, that should be fully investigated and considered. Information on these subjects is usually available from such sources as banks, government agencies, exporters and importers, wholesalers, retailers, transportation companies and manufacturers.

MATERIALS AND SUPPLIES

1. Are all materials and supplies available locally?
2. Is the local material market competitive?
3. Is satisfactory delivery of local materials assured at reasonable prices?
4. What materials and supplies must be imported?
5. Are they available in world markets at competitive prices?
6. Would prompt delivery of imported materials and supplies be assured so that large inventories would not be required?

MARKET FACTORS

1. Is there already a demand for the product?
   - A. Who are the principal consumers?
   - B. Who are possible new consumers?

2. How is demand for the product now satisfied?
   - A. By local production? If so, what is the volume of annual production?
   - B. What percentage of consumption is filled by local production?
   - C. By imports? If so, what is the volume of annual imports?
   - D. What percentage of consumption is met by imports?
   - E. From what areas are imports derived?

3. What is the estimated annual increase in local consumption over the next five years?
   - A. How were such estimates made?
   - B. By reference to official figures on population growth, family budgets, imports, etc.?
   - C. By consultation with trade or industry, ministries, associations, bankers, commercial houses, wholesalers, retailers, industrial consumers, etc.?

4. If the product is already being manufactured, can the existing and estimated future local market absorb production of the new plant without price-cutting or other dislocations?

5. Would the estimated sales price and quality of the new product make it competitive with an imported equivalent?
   A. After adjusting cost to local conditions, is the estimated sales price of the product so high that tariff protection is necessary to protect it from imports?

EXPORT MARKETS

1. Could the product compete in export markets on the basis of price, quality and dependability of supply?
2. Can export markets for the product be developed?
3. If so, in what areas and in what annual volume?
4. What procedures would be necessary to develop export markets?
5. What would it cost?

MARKETING PROBLEMS

1. In calculating costs of the product, has adequate allowance been made for the expense of a sales department, advertising and promotion that might be required?

2. Do consumer prejudices against locally manufactured products exist?
   A. If so, why?
   B. Would they apply to the new product?
   C. If so, how could they be overcome and what would it cost to do so?

3. Do marketing and distribution facilities for the product exist?
   A. If not, can they be set up?
   B. What would it cost to do so?

4. Will the product be sold to:
   A. Wholesalers?
   B. Retailers?
   C. Direct to consumer?
   D. Other industries?
   E. Government?

FINANCIAL FACTORS

1. Technical advice on selection of machinery and equipment.
   - A. In selecting the machinery and equipment for the new plant, have reputable and competent engineers and technicians been consulted?
   - B. Have they been asked for advice on the most suitable types of machinery and equipment for the process and locality?
   - C. Have they carefully compared costs of various suppliers?
   - D. Credit terms offered purchasers?

FINANCIAL REQUIREMENTS OF THE PROJECT

1. In estimating the cost of the project, has careful consideration been given to:
   - A. The effect on costs of delays in construction schedules?
   - B. In delivery and installation of machinery and equipment?
   - C. In import of essential raw materials and supplies?

2. In calculating cash flow and working capital requirements, has careful consideration been given to:
   - A. Maintaining adequate inventories of raw materials?
   - B. Supplies and spare parts?
   - C. Seasonal fluctuations in the business?
   - D. The time required to liquidate credit sales to customers and bad debts?
   - E. The period necessary to get the plant into production?
   - F. Cash required to amortize its principle loans?

3. If the economy is in a period of inflation, has full allowance been made for the influence of rising prices and wages on the cost of the project and on working capital requirements?

SHORT TERM BANK CREDITS

1. Has it been possible to make arrangements with local banks to finance short-time working capital requirements of the business?

FINANCIAL PLAN

1. Has a definite plan to finance the project been worked out?
   - A. Is sufficient capital available locally?
   - B. If not, what is the plan to obtain the required capital?

ECONOMIC FACTORS

1. How much foreign exchange (and in what currency) is required to import machinery, equipment and supplies:
   - A. How much foreign exchange (and in what currency) is required for annual interest payments and amortization of any loans contracted to import machinery and equipment, or for payment of royalties and technical services?
   - B. How much foreign exchange (and in what currency) is required for annual import of raw materials and supplies?
   - C. What are estimated annual foreign exchange earnings and in what currencies?
   - D. Has careful consideration been given to the possibility of depreciation in the foreign exchange value of the local currency?
   - E. Has careful consideration been given to the possibility of import controls, or restrictions on availabilities of foreign exchange necessary to operate the business?
   - F. What benefits would the new business bring to the economy in the use of local raw materials: in employment and in technology?
   - G. Do dependable facilities exist for transportation, power, fuel, water and sewage?
     - (1) If not, can existing deficiencies be eliminated satisfactorily?
     - (2) What would be the cost to do so?

PERSONNEL

1. Is there an adequate labor supply near the plant location?
   - A. If not, how can the problem be solved?

2. Can the problem of training competent management and supervisory personnel be solved?
   - A. Also, the training of skilled labor?
   - B. Is technical advice available in the locality?
   - C. If not, where can it be obtained and what will it cost?

LAWS AND REGULATIONS

1. Do existing labor laws, government regulations, laws and taxes favor establishment of new business?
   - A. If not, can existing obstacles be removed?
   - B. If so, how and when?

BIBLIOGRAPHY

Metals Handbook, 1948 Edition, American Society for Metals

Practical Metallurgy, 1940, Sachs & Van Horn, American Society for Metals

Mechanical Engineers Handbook, 5th Edition, Lionel S. Marks, McGraw-Hill Book Company, 330 West 42nd Street, New York 36, New York

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