847

PLANT REQUIREMENTS FOR MANUFACTURE OF GALVANIZED STEEL PIPE

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, N. Y., for the technical aids program 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, D. C.

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

Code Number
PR 107

March 1962

ACKNOWLEDGMENT

The author gratefully acknowledges the cooperation, technical aid, and illustrations provided for this report by the Yoder Company, 5500 Walworth Avenue, Cleveland 2, Ohio, manufacturers of the slitting line and tube mill equipment.

Special thanks are extended to Mr. George L. Steffel of the Yoder Company for his helpful assistance in reviewing the report manuscript prior to publication.

CONTENTS

	Page
Introduction	1
General Assumptions	2
Product Specifications	3
Production Capacity	4
Manufacturing Unit	4
Manufacturing Operations	4
Plant Site	10
Building	10
Power	10
Water	12
Fuel	12
Direct Labor	12
Indirect Labor	13
Direct Materials	13
Supplies	14
Production Tools & Equipment	14
Other Tools & Equipment	15
Furniture & Fixtures	15
Depreciation	16
Manufacturing Overhead	16
Manufacturing Cost	16
Fixed Assets	17
Working Capital	17
Capital Requirements	17
Sales Revenue	18
Recapitulation of Costs, Sales and Profits	18
Budget Control	19
Budget Control Accounts	20
Purchase Requisition Form	21
Voucher Check	22
Engineers	23
Training	24
Safety	25
Summary	26
Other Considerations	27
Materials and Supplies	27
Market Factors	27
Export Markets	28
Marketing Problems	28
Financial Factors	29
Financial Requirements of the Project	29
Short-Term Bank Credit	29
Financial Plan	29
Economic Factors	30
Personnel	30
Laws & Regulations	30
Technical & Trade Associations	31
Bibliography	31

INTRODUCTION

The purpose of this report is to present basic information relative to the establishment in a foreign country of a factory designed to produce certain sizes of galvanized steel pipe.

This type of pipe is used for water, air, gas, oil, or other fluid lines, and for structural purposes such as fence posts, scaffolding, and railings.

The proposed plant is about the minimum feasible size and will require a substantial capital investment and a small number of skilled workers. Profitable operation in industrially developing countries will depend upon the following factors: (1) the availability of steel strip and slab zinc (spelter) from nearby mills, or the presence of a sufficiently large domestic market, in the absence of a local supply of steel and zinc, sufficiently large to overcome the expense of imported materials; and (2) the availability of accessories such as galvanized couplings, nipples, elbows, unions, plugs, tees, guards, reducers, and bushings. Association with a facility producing the fittings would be advantageous for the pipe manufacturer.

This report describes a plant manufacturing pipe threaded on both ends and not equipped with accessories. The pipe may be supplied unthreaded or it may be equipped with couplings or thread guards at an additional cost.

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 supervisor 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

Steel pipe is produced in three classes, based on wall thickness, to withstand varying internal pressures: (1) standard weight, (2) extra strong, and (3) double extra strong. The proposed plant is designed to fabricate only standard weight (approximately 1/16 inch wall thickness), and threaded pipe ranging in inside diameter from one-half to three inches in quarter-inch increments.

The American Standards Association (ASA) in conjunction with the American Society for Testing Materials (ASTM) provide the following specifications which are applicable to the materials and processes to be employed by this plant:

ASTM A425-58T	Hot-Rolled Carbon Steel Strip, Commercial Quality
ASA H24.1-1959	Slab Zinc (Spelter) Specifications for (ASTM B6-58)
ASA B36.5-1956	Electric-Resistance-Welded Steel Pipe, Specifications for (ASTM A135-58T)
ASA B36.10-1959	Wrought-Steel and Wrought-Iron Pipe, American Standard for (Schedule 40)
ASA B36.20-1960	Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses, Tentative Specifications for (ASTM A120-57T)
ASA G8.1-1960	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip, Specifications for (ASTM A123-59)

ASA G8. 12-1956	Test for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles, Methods of (ASTM A90-53)
ASA B2.1-1960	Pipe Threads (Except Dryseal) Partial Revision of B2.1-1945)

PRODUCTION CAPACITY

This plant has a production capacity of approximately 21 million pounds of galvanized steel pipe per year or 84,000 pounds per day.

The plant should reach full production in about three to four months, with all labor training being accomplished by the manager and/or the supervisor, assisted by other experienced workers. The designed production rate is about the minimum which will provide efficient and economical use of the equipment. When the market expands, production can be increased by raising equipment speeds, adding auxiliary machines, providing more and better materials handling equipment, investing in heavier slitters to handle larger and heavier coils, and, if feasible, by operating two or three shifts per day.

MANUFACTURING UNIT

The manufacturing unit for steel pipe is the pound.

MANUFACTURING OPERATIONS

This plant is designed to fabricate pipe from steel strip by cold-roll-forming and resistance-welding, rather than by piercing (swaging) or butt-welding, both of which would require a much greater capital investment and continuous production of large tonnages to be profitable. This process appears to be the most practicable for a small plant and the operations involved are described in the following paragraphs.

Slitter Line. Coils of unpickled, hot-rolled steel strip are delivered by crane or truck to the receiving area of the plant. The coils vary in size and weight depending on the coil width, and footage. Rotary gang slitters can be procured in five basic sizes, each size being available in several widths. Large slitters are available which are

capable of handling coils weighing up to 22, 500 pounds and having an output of 146 tons of coil strip per day. This report is based on a 36-inch wide slitting line, as illustrated in figure 1, which consists of a hydraulically-operated coil car (not shown); an uncoiler drum; a strip-flattener; a medium size coil-slitter, and a recoiler which unloads onto the coil car.

A typical slitting operation consists of handling coils weighing approximately 4 tons and making 7 simultaneous cuts at slow speed. Although the actual slitting time is very short - only 3 to 5 minutes - the complete cycle requires about 28 minutes, for most thicknesses of stock. The use of coil cars for efficient handling is the most economical means of reducing this total cycle time, and thus, the unit cost of slitting. For example, when a coil car is used instead of a hoist, forklift, or crane for both loading and unloading, this part of the work cycle is reduced from 16 to 2 or 3 minutes. Standard speed is about 150 feet per minute, though the equipment is capable of speeds ranging from 325 to 650 feet per minute. Factors such as the size and weight of coils, thickness of stock, number of cuts, slitter speed, materials handling and cycle time, etc., all determine the output rate. Therefore, slitters have high potential output and are often run part time, leaving the operators free for other work.

The cycle of operations consists of keeping several coils ready on a small ramp in front of a coil car, installed on rails in front of the uncoiler drum, enabling the coils to be loaded in a few seconds. The coil is rolled onto the coil car top, which is flush with the ramp, and is hydraulically raised to the proper height for loading on the uncoiler drum. The strip is then threaded into the flattener and slitter, which has been set for the requisite number of cuts. The line is run slowly until the slit ends can be attached to the recoiler drum along with the necessary number of separators, and then brought up to normal speed. After slitting, the coils are unloaded from the recoiler drum directly onto a floor mounted coil car, banded, and transferred to the shot blasting equipment. The two outside edges, that are trimmed off by the slitter, are automatically chopped up into small pieces in the scrap chopper, dropped into a container, and later sold for scrap.

Shot Blasting. The coil strip is conveyed into a shot blaster where it is bombarded by abrasive metal shot at high speed to remove the surface oxides and other foreign matter. It emerges clean and free from scale, and is conveyed to the tube mill for forming and welding.

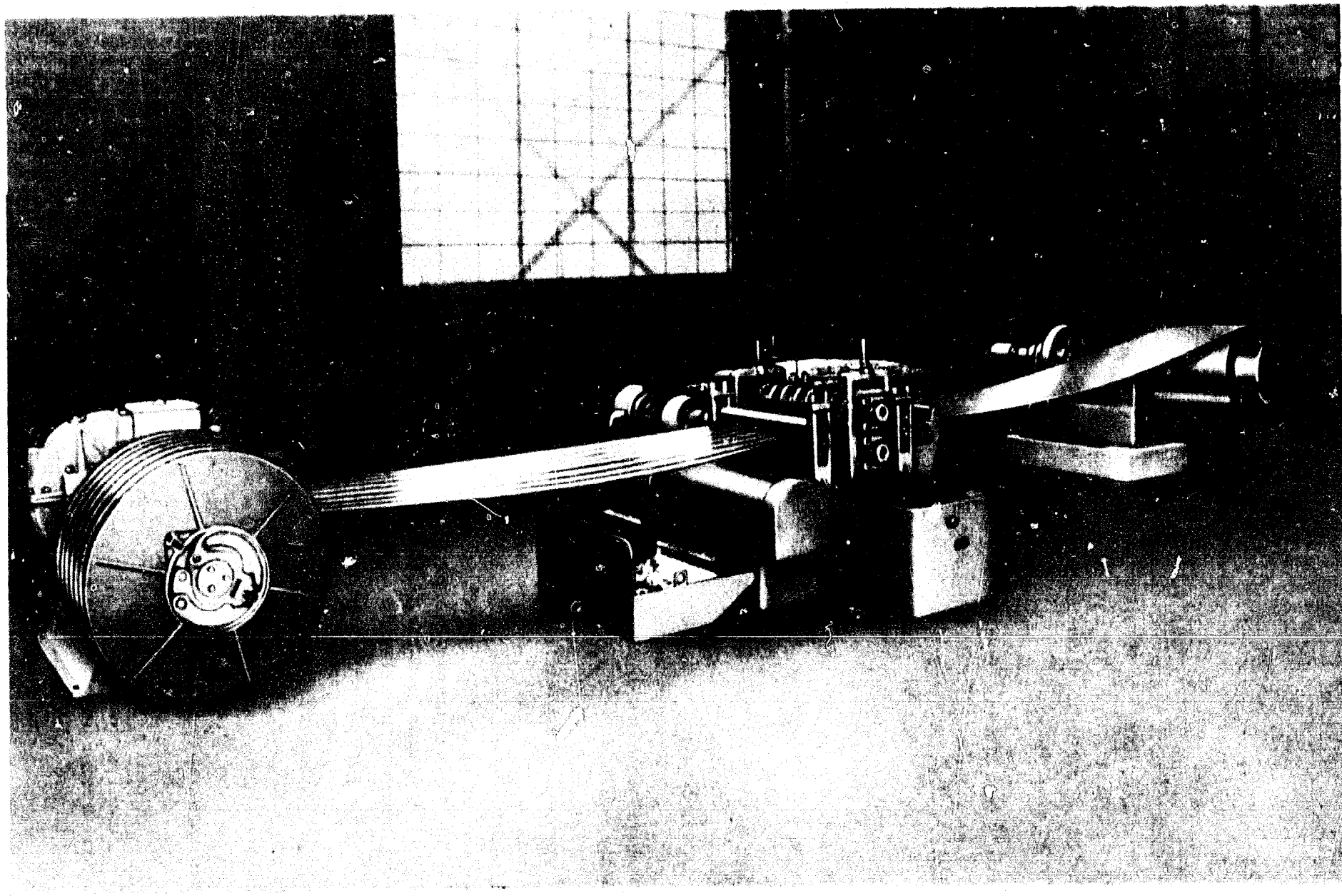


Figure 1. Typical Small Slitting Line Consisting of an Uncoiler at the Far Right, Flattener and Rotary Gang Slitter With Scrap Chopper, in the Center, and a Recoiler at the Left. (Coil Car Installations Are Not Shown.)

Shot blasting equipment can be omitted if steel previously cleaned by pickling is used; however, the initial costs are much higher, and it is considered more economical to shot blast the steel strip in the plant.

Tube Mill Line. The tube mill is the actual pipe fabrication assembly consisting of a coil box with flattener; a tube forming mill; a resistance-welder; a tube cooling system; sizing and straightening equipment; an automatic rotary cut-off; a run out table; and the associated electric equipment and controls. Figure 2 shows a similar tube mill assembly which employs a shear, rather than a rotary, cut-off. Figure 3 shows a typical workflow and mill floor plan.

The coil strip is loaded into an adjustable, driven coil box which continuously feeds it to the forming machine where a series of driven and idler rolls form the strip into a nearly circular shape prior to welding. The newly formed tube enters the welder where the open pipe seam is accurately aligned so as to pass directly underneath and between the two rotary electrodes where the seam is continuously welded. A pair of squeeze rolls, mounted beneath the electrodes, press the heated edges together and they are fused into a homogeneous mass of metal without the use of either welding rod or flux. Welding line speed varies from 30 to 115 feet per minute depending on the stock thickness. The slight bead or flash, formed on the outside of the pipe during welding, is removed by cutting tools mounted directly after the electrodes.

The welded pipe is water-cooled before entering the sizing and straightening mill. The slightly flattened pipe passes through successive sets of rollers, where it is reduced to the proper size and roundness. The speed of the sizing and straightening machine is synchronized with that of the forming mill through a common drive. Therefore, the drive rolls of these 2 units provide the necessary traction for the stock from flat strip to finished pipe. After sizing and straightening, the pipe is cut to the proper length and stacked for transfer to the pickling tanks.

An operator's control desk with push buttons, meters, and indicators allows one man to control the entire tube mill as a unit from a convenient position in front of the welder. Other emergency controls are mounted on the individual units.

Pickling, Washing. The pipe is pickled in a tank containing a dilute solution of sulphuric acid to remove any coolant and dirt that may have adhered to it during fabrication. It is then washed and scrubbed, partially dried, fluxed, and transferred to the galvanizing bath.

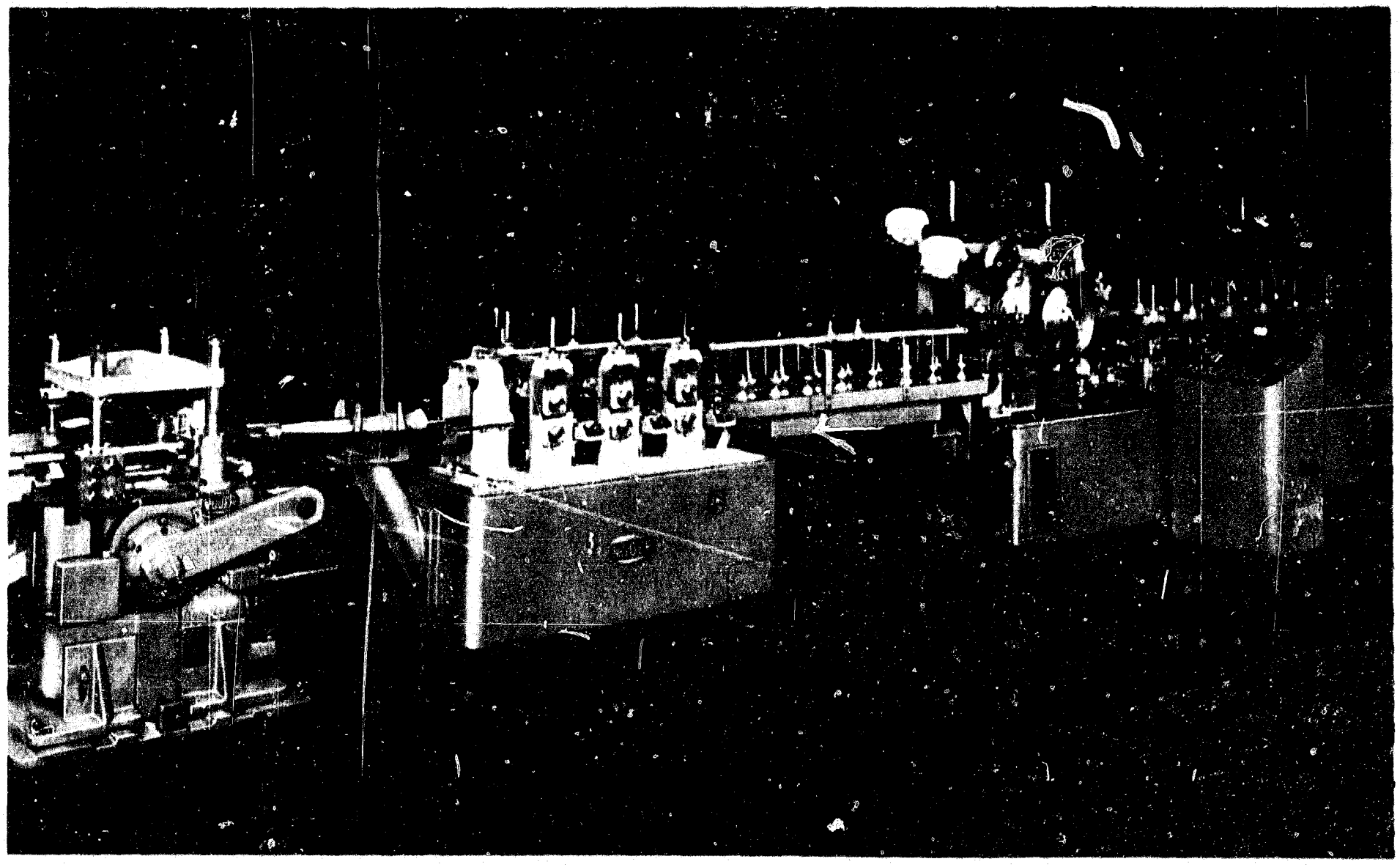
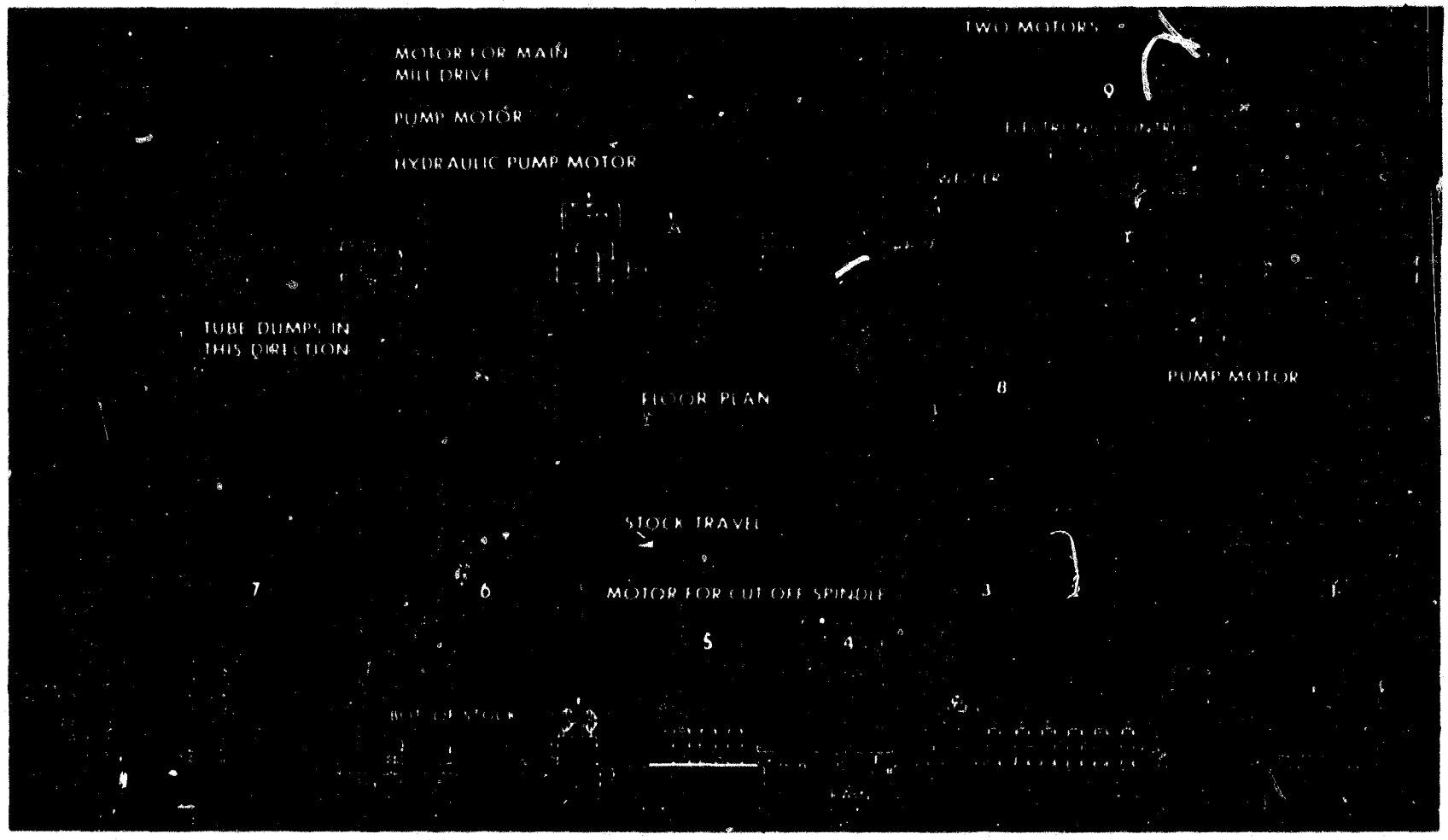


Figure 2. Typical Resistance Weld Tube Mill Showing, from Right to Left, the Forming Mill, Control Desk, Welder, Water Cooling Unit, Sizing and Straightening Unit, Shear Type Automatic Cut-off, and Runout Table.



KEY NUMBERS: 1. Coil Box. 2. Tube Forming Mill. 3. Welder. 4. Cooling. 5. Sizing and Straightening. 6. Rotary Cut-Off. 7. Run-Out Table. 8. Control Desk. 9. Mill Control Cabinets.

Figure 3. Typical Floor Plan and Workflow for a Complete Tube Mill

Galvanizing. The cleaned lengths of pipe are immersed in a bath of molten zinc where they are uniformly coated inside and out. They are then withdrawn with tongs or magnetic rollers, the excess zinc blown out by steam or compressed air, and the pipe cooled.

Threading. The galvanized pipe is threaded on both ends by an automatic threading machine. If desired, couplings or thread guards may be attached.

Quality Inspection and Test. The finished pipe is given a visual and dimensional inspection to determine compliance with requirements. It is then subjected to a water pressure test of 700 to 800 pounds per square inch, depending on the tube diameter, although the usual working pressure is below 150 pounds per square inch. Accepted pipe is then transferred to storage or to the shipping department.

PLANT SITE

About one acre of land will be required to accommodate 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 steel frame building with a concrete floor rated at 500 pounds per square foot will be required for this operation. Suggested dimensions are 70 feet wide and 200 feet long giving a floor area of 14,000 square feet. The cost of the building, including all utilities, is estimated at $70,000. The proposed plant layout is shown in figure 4.

POWER

The total connected power requirements for this plant are approximately 300 kilowatts per hour. The annual power cost is estimated at approximately $9,800 based on 1.3 cents per kilowatt hour. Even in the United States, power costs vary considerably with locality.

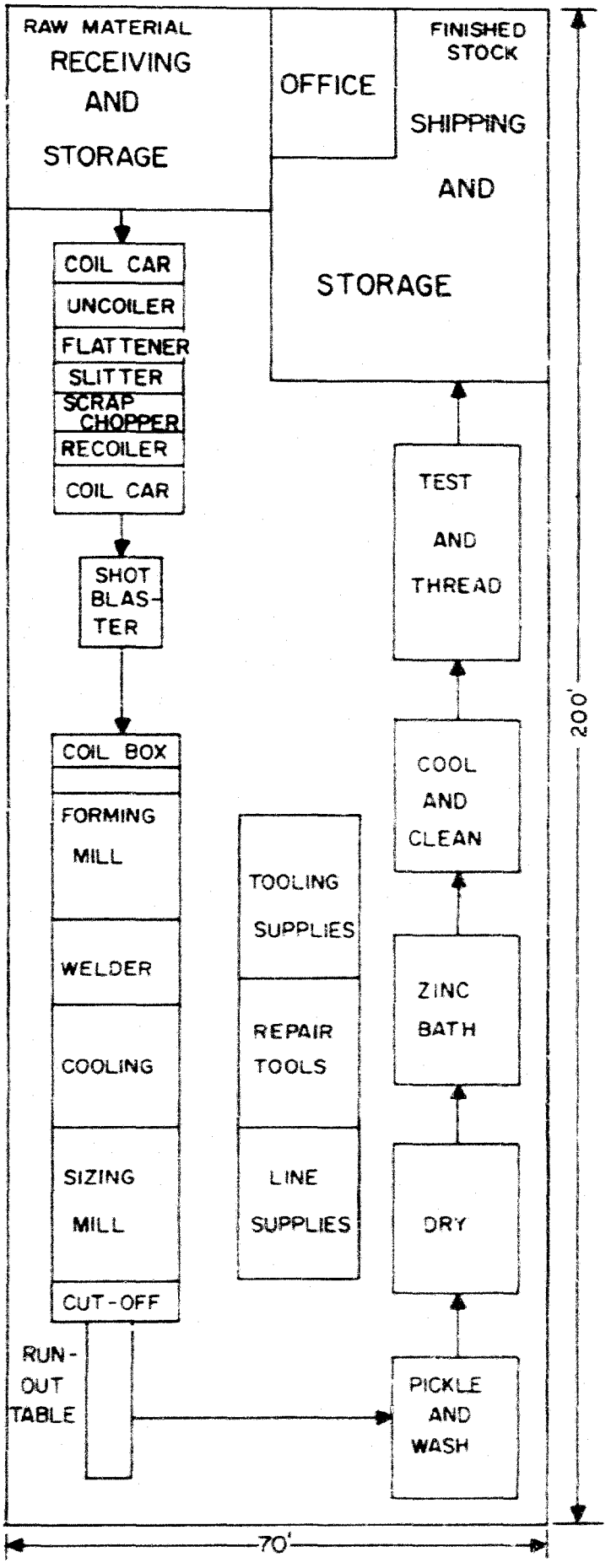


Figure 4. Typical Plant Layout and Workflow

WATER

The annual water requirements for production line, sanitation, and fire protection, are approximately 1.2 million gallons. On this basis, the annual water cost is estimated at $360.

FUEL

The annual fuel requirements for manufacturing and heating are about 30,000 gallons of oil at an estimated cost of $2,400.

DIRECT LABOR

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Annual Cost Actual
Slitter Line Operator	1	$2.50	$ 5,200	
Assistant	1	1.75	3,640	
Shot Blast Operator	1	2.50	5,200	
Tube Mill Operator	1	3.00	6,240	
Assistant	1	2.25	4,680	
Pickle-Wash Operator	1	2.75	5,720	
Assistant	2	1.75	7,280	
Zinc Bath Operator	1	2.85	5,928	
Assistant	2	1.75	7,280	
Threading Operator	2	2.50	10,400	
Assistant	2	1.75	7,280	
Supervising Foreman	1	3.75	7,800	
General Laborers	4	1.25	10,400	
Inspector	1	2.50	5,200	
Assistant	1	1.75	3,640	
Totals	22		$95,888	

INDIRECT LABOR

Occupation	Number Required	Hourly Rate	Annual Cost Estimated	Annual Cost Actual
Plant Manager	1	$	$11,000	
Production Engineer	1		8,000	
Maintenance Supervisor	1	3.75	7,800	
Mechanics	2	2.50	10,400	
Bookkeeper	1	3.00	6,240	
Typist-Clerk	1	1.75	3,640	
Stock Clerk	1	1.50	3,120	
Stock Handlers	4	1.25	10,400	
Lift Truck Operator	1	1.75	3,640	
Totals	13		$64,240	

DIRECT MATERIALS

Item	Unit	No. of Units	Unit Cost	Annual Cost Estimated	Annual Cost Actual
Hot-Rolled Carbon Steel Strip	ton	10,488	$120	$1,258,560	
Zinc Slab, (Spelter)	ton	840	270	226,800	
Totals		11,328		$1,485,360	

Note: In-freight and handling charges are included in the above prices.

SUPPLIES

Item	Unit	No. of Units	Unit Cost	Annual Cost Estimated	Annual Cost Actual
Sulfuric Acid	pound	180,000	$ .055	$ 9,900	
Zinc Bath Flux	pound	6,000	.09	540	
Cooling Compound	gallon	3,000	.08	240	
Cutting Compound	gallon	2,400	1.25	3,000	
Lubricants				1,000	
Maintenance and Repair Parts				5,000	
Shot	ton	30	300.00	9,000	
Office Supplies				500	
Total				$29,180	

PRODUCTION TOOLS AND EQUIPMENT

Description	Number Required	Estimated Cost Unit Cost	Estimated Cost Total Cost	Actual
Slitter Line, (complete, including two coil cars)			$ 80,000	
Slitter Tooling			7,000	
Tube Mill Line (complete, including shot blast unit)			320,000	
Tube Mill Tool Sets	8	$10,000	80,000	
Pickle-Wash Tanks			12,000	
Galvanizing Unit (complete)			45,000	
Threader	2	4,000	8,000	
Total			$552,000	

Note: Prices are approximate only.

OTHER TOOLS AND EQUIPMENT

Description	Cost Estimated	Cost Actual
Maintenance Tools	$21,500	
Air Compressor, Skids, Slings, Hand Tools, etc.	5,000	
Test Equipment	2,000	
Lift Truck	6,500	
Overhead Crane	10,000	
Total	$45,000	

FURNITURE AND FIXTURES

Description	Number Required	Unit Cost	Cost Estimated	Cost Actual
Executive Desk & Chair	1	$125	$ 125	
Standard Desk & Chair	4	100	400	
File Cabinet	4	50	200	
Typewriter & Table	2	110	220	
Adding Machine	1	100	100	
Clothes Locker	25	20	500	
Storage Cabinet	1	30	30	
Garment Rack	1	25	25	
Drinking Fountain	1	100	100	
Total			$1,700	

DEPRECIATION

Item	Estimated Cost	Years Life	Per Year Estimated	Per Year Actual
Building	$ 70,000	20	$ 3,500	
Production Tools and Equipment	552,000	10	55,200	
Other Tools and Equipment	45,000	10	4,500	
Furniture and Fixtures	1,700	10	170	
Total	$668,700		$ 63,370	

MANUFACTURING OVERHEAD

Item	Cost Estimated	Cost Actual
Depreciation	$ 63,370	
Indirect Labor	64,240	
Power	9,800	
Water	360	
Fuel	2,400	
Supplies	29,180	
Total	$169,350	

MANUFACTURING COST

Item	Cost Estimated	Cost Actual
Direct Materials	$1,485,360	
Direct Labor	95,888	
Manufacturing Overhead	169,350	
Total	$1,750,598	

FIXED ASSETS

Item	Cost Estimated	Cost Actual
Land	$ 2,000	
Building	70,000	
Production Tools and Equipment	552,000	
Other Tools and Equipment	45,000	
Furniture and Fixtures	1,700	
Total	$670,700	

WORKING CAPITAL

Item	Cost Estimated	Cost Actual
Direct Materials, 30 Days	$123,779	
Direct Labor, 30 Days	7,991	
Manufactu ing Overhead, 30 Days	14,113	
Reserve for Sales Collections, 30 Days	9,240	
Total	$155,123	

CAPITAL REQUIREMENTS

Item	Cost Estimated	Cost Actual
Fixed Assets	$670,700	
Working Capital	155,123	
Total	$825,823	

SALES REVENUE

The selling price of galvanized pipe is approximately 11-1/2c per pound. Thus, the annual production of 21 million pounds equals an estimated sales revenue of $2,415,000.

RECAPITULATION OF COSTS, SALES AND PROFITS

	ANNUAL COSTS		
Item	Estimated	Total	Actual
Direct Materials	$1,485,360		
Direct Labor	95,888		
Manufacturing Overhead	169,350		
Total Manufacturing Costs		$1,750,598	
Interest on Loans	11,000		
Insurance	8,000		
Legal	7,000		
Auditing	6,500		
Unforeseen Expense	20,000		
Total Administrative Cost		52,500	
*Total Sales Costs		108,186	
Profit Before Taxes		503,716	
Total Annual Gross Sales		$2,415,000	

* Includes Sales Commissions, Travel, Freight-out, Bad Debts, Discounts and Allowances.

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 21.

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 20) 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 22. 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 20. 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		$ 2,709	$ 32,500	
20 Sales		9,016	108,186	
30 Direct Materials		123,779	1,485,360	
40 Supplies		2,432	29,180	
51 Power*		817	9,800	
52 Water*		30	360	
53 Fuel		200	2,400	
60 Unforeseen Expense (Reserve Account)		1,667	20,000	
71 Direct Labor*		7,991	95,888	
72 Indirect Labor*		5,353	64,240	
80 Depreciation (Reserve Account)		5,281	63,370	
Totals		$159,275	$1,911,284	

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?

TECHNICAL AND TRADE ASSOCIATIONS

American Standards Association, Inc. (ASA), 10 East 40th Street, New York 16, New York

American Society for Testing Materials (ASTM), 1916 Race Street, Philadelphia 3, Pennsylvania

American Iron and Steel Institute (AISI), 150 East 42nd Street, New York, New York

Pipe Fabrication Institute, 1 Gateway Center, Pittsburgh 22, Pennsylvania

American Society for Metals (ASM), 7301 Euclid Avenue, Cleveland 3, Ohio

American Hot Dip Galvanizers Association, First National Bank Building, Pittsburgh 22, Pennsylvania

American Welding Society, 29 West 39th Street, New York, New York

American Zinc Institute, 292 Madison Avenue, New York, New York

BIBLIOGRAPHY

Metals Handbook, ASM (see address above)

Practical Metallurgy, 1940, George Sachs and Kent R. Van Horn, ASM (see address above)

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

Handbook of Fastening and Joining of Metal Parts, 1st Edition, 1956, V. H. Laughner and A. D. Hargan, McGraw-Hill Book Company, Inc., New York, New York

Modern Welding Practice, 1958, A. D. Althouse and C. H. Turnquist, The Goodheart Wilcox Company, Inc., Chicago, Illinois

Steel Products Manual, AISI (see address above)