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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

MANUFACTURING COST DETERMINATION

VOLUME 5

by

Mead Carney & Company, Inc.
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PREFACE

This volume presents a preliminary survey of cost factors applicable to electronic equipment of stacked wafer modular design as produced by mechanized or semi-mechanized techniques. Specifically, the volume is a reproduction of a report submitted to the National Bureau of Standards by Mead Carney and Co., Inc., management consultants. This manufacturing cost determination, although necessarily tentative, is based upon the best data on PROJECT TINKERTOY available at this time and is issued at the particular request of the Navy Bureau of Aeronautics, sponsors of the program.

Since the receipt of the Mead Carney Company's report, the Navy has announced that the name, PROJECT TINKERTOY, is no longer to be used to describe the program. Rather, modular design of electronics and mechanized production of electronics are to be used to designate the respective phases of the program. However, in order to make this volume immediately available to the electronics industry, it is being duplicated directly from the original manuscript. Consequently the name PROJECT TINKERTOY appears in some instances.

PROJECT TINKERTOY

MANUFACTURING COST DETERMINATION

TABLE OF CONTENTS

Part		Page
I	INTRODUCTION	1
	Description of Project Tinkertoy	
	Objectives	
	Limitations	
	Approach	
II	PROJECT TINKERTOY PROCESS FLOW	5
	Criteria	
	Item Selected	
III	SELECTION OF ITEM FOR COSTING PURPOSES	7
IV	ESTABLISHMENT OF COSTING BASIS	9
	Elements of Cost	
	Establishment of Costing Basis	
	Standard Costing Rates	
V	DETERMINATION OF MANUFACTURING COSTS	13
	Materials	
	Direct Labor	
	Manufacturing Overhead	
	Assembling Manufacturing Cost Data	
VI	PROJECT TINKERTOY PROCESS STEP COMPARATIVE COSTS	27
VII	I F AMPLIFIER MODULE COMPARATIVE COSTS	29
VIII	I F AMPLIFIER COMPARATIVE COSTS	30
IX	CONCLUSIONS	31

TABLE OF EXHIBITS

Exhibit	Page
1. Project Tinkertoy Concept	2
2. Project Tinkertoy Process Flow	6
3. Intermediate-Frequency (I F) Amplifier	8
4. Sales Price Components	10
5. Manufacturing Cost Standard Rates	12
6. Material Costs—I F Amplifier	14
7. Machine Process Equipment and Direct Labor Requirements	19
8. Hand Process Production and Equipment Data	22
9. Machine, Equipment and Tool Expense Data Sheet	24
10. Manufacturing Cost Data Sheet	26
11. Process Step Comparative Costs	28

I INTRODUCTION

I - INTRODUCTION

Description of Project Tinkertoy

Project Tinkertoy is the code name of a new system for manufacturing electronic circuits, which is illustrated on Exhibit I opposite. It was conceived and developed by the National Bureau of Standards and sponsored by the U. S. Navy Bureau of Aeronautics.

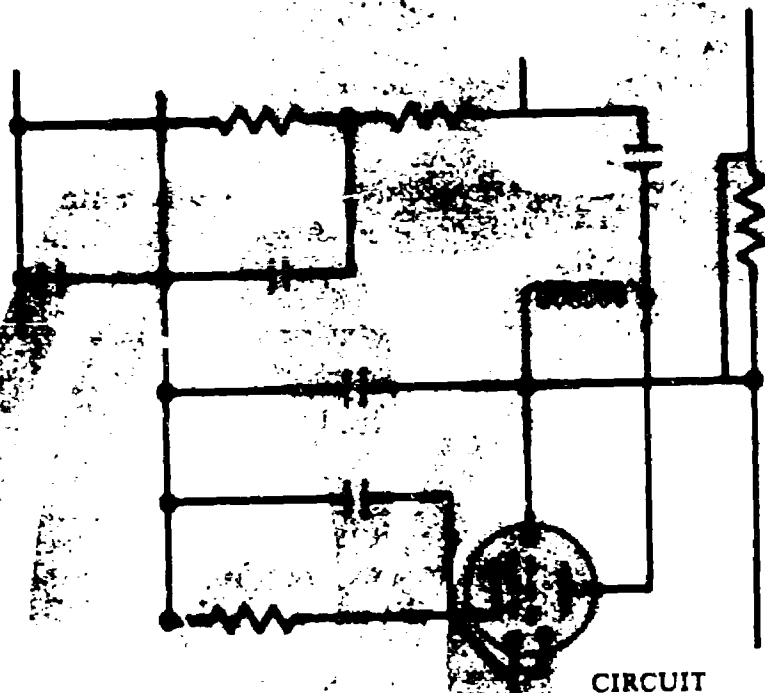
The unique basic component of Project Tinkertoy is the ceramic wafer. It provides the base onto which the major portion of the circuitry is printed. This silver paint base circuit is affixed by heat, which is a principal reason for the use of ceramics. The wafer rigidly supports, and has attached to it, a variety of electronic elements, such as resistors, capacitors, potentiometers, tube sockets, and tubes.

Tiers of up to six such wafers, each appropriately printed and electronically equipped, are assembled together into rigid module structures by 12 vertical riser wires (3 per edge) which, at the same time, provide structural strength and appropriately connect the circuitry of adjacent wafers. These module assemblies constitute the intrinsic core of the Tinkertoy concept.

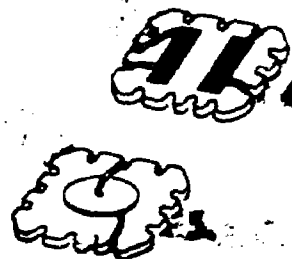
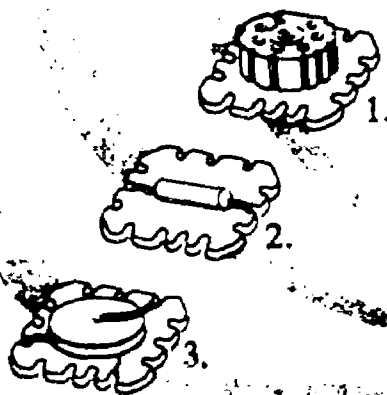
The Project Tinkertoy system of manufacture is applicable to hand or machine methods, and is particularly adaptable to automatic machine production.

EXHIBIT 1.

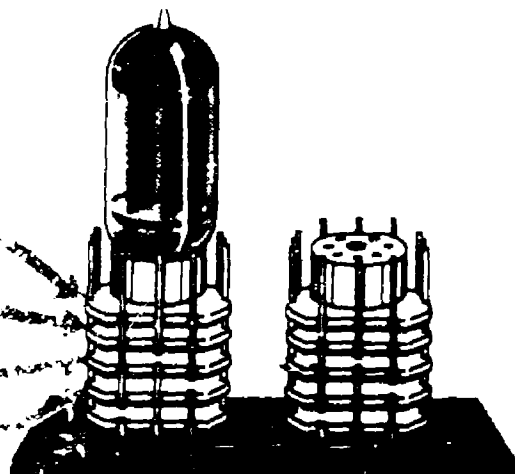
PROJECT
TINKERTOY
CONCEPT



CIRCUIT



WAFERS



MODULES

Objectives

Electronic equipment manufactured thus far by Tinkertoy methods has been processed largely on a pilot plant and model shop basis; and not on a conventional industrial production basis.

It became necessary to determine costs of manufacturing for the Tinkertoy system for comparison purposes. Consequently, the objectives of this survey are to:

1. Determine the cost of manufacturing a specific item of electronic equipment by Tinkertoy hand and Tinkertoy machine processes, as adapted and projected to conventional production practices.
2. Compare these costs with the cost of manufacturing a similar item by conventional methods and practices.

Limitations

The scope of this survey does not include technical evaluation of Project Tinkertoy processes.

As indicated previously, Project Tinkertoy manufacturing observed during this survey was of a pilot plant and/or model shop nature. There was little production experience and data to draw on; particularly in the machine processing operations. Consequently, the cost figures for machine processing were necessarily based largely on estimates for net machine yields, and are subject to revision as operating experience is gained.

The cost figures for hand processing are based to a large extent on time studies of operations. They are, therefore, less subject to revision with the accumulation of production experience, except as necessitated by methods improvements.

Approach

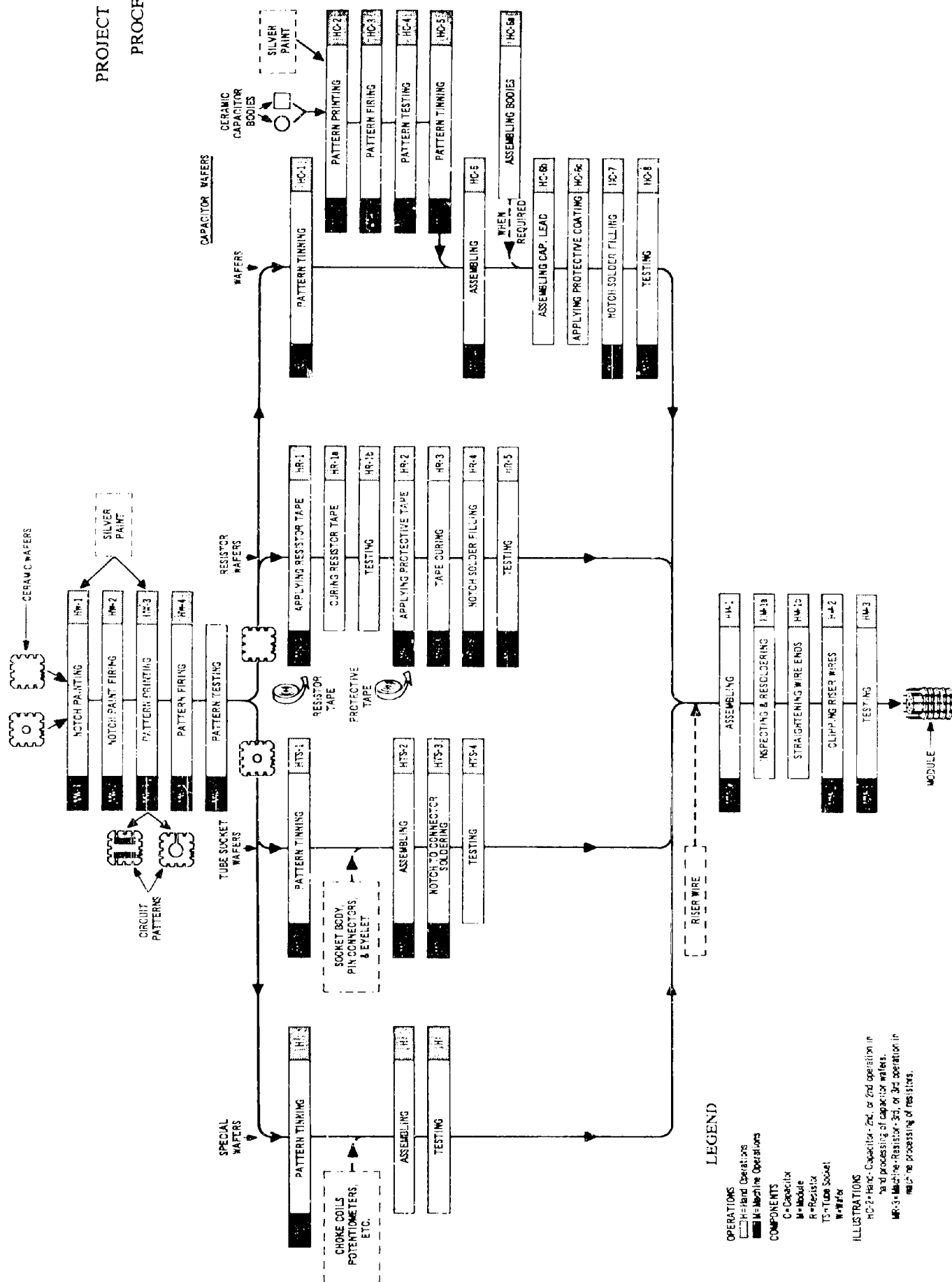
The objectives outlined previously have been accomplished by:

1. Analyzing the Project Tinkertoy hand and machine processes to determine process flow, and to delineate the individual process steps. This information was needed to facilitate comparison of each step of the hand and machine processes.
2. Selecting an appropriate item of electronic equipment on which to base the cost comparison.
3. Establishing a basis for developing cost data for this item, which would have a wide application in both government and industry.
4. Evaluating the state of development of the present hand and machine operations on the basis of available historical data, observations, and the estimates of those most familiar with the processes and equipment. This evaluation established sound bases and assumptions for the determination of cost data for a projected commercial operation.
5. Developing costs for:
 - a. hand and machine processes, step by step, and establishing breakeven points between the two processes.
 - b. individual hand and machine manufactured modules required for the item selected for the cost comparison,
 - c. the complete item of equipment selected as a vehicle for cost comparison as manufactured by the Project Tinkertoy hand and machine processes.
6. Obtaining costs for the selected item as manufactured by conventional methods, and comparing with the cost of manufacturing the item by Project Tinkertoy methods.

II

PROJECT TINKERTOY PROCESS FLOW

PROJECT TINKERTOY



III
SELECTION OF ITEM
FOR COSTING PURPOSES

III--SELECTION OF ITEM FOR COSTING PURPOSES

Criteria:

The following criteria were considered in selecting an item of electronic equipment for use as a vehicle for the cost comparison:

1. The item must have been produced by both conventional and Tinkertoy methods.
2. It should consist largely of Tinkertoy system components, so as not to mask the economic effects of the application of Tinkertoy to manufacture.
3. Manufacturing costs must be obtainable for the conventionally produced version of the item.

Item Selected

The item selected on the basis of the foregoing criteria was an Intermediate-Frequency Amplifier. This unit, illustrated on Exhibit 3 opposite, is similar to interchangeable subassemblies which are incorporated into a variety of complete electronic assemblies. It will be referred to as an I F Amplifier throughout the report.

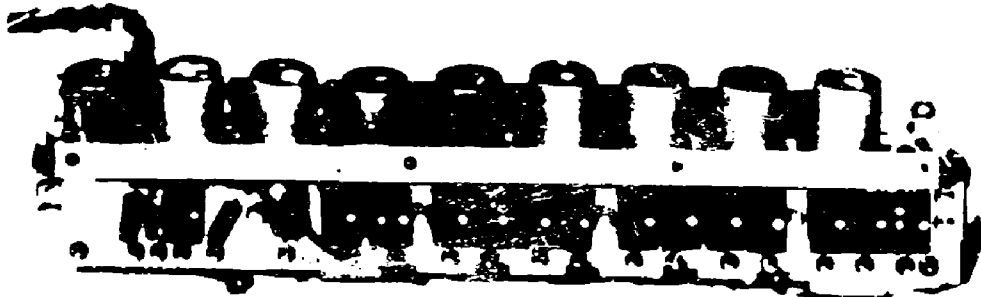
While the I F Amplifier satisfies the criteria referred to previously, its component modules have been produced by Tinkertoy processes only in a four-wafer design, and only by hand.

These particular four-wafer layouts were not adaptable to machine assembly. Five-wafer modules, adaptable to machine assembly, were therefore laid out for costing purposes. They were carefully checked for electrical correctness.

Though these module layouts have not been built, similar modules have been built and tested. It is considered, therefore, that no significant error will result from using these module layouts for cost comparison purposes.

INTERMEDIATE FREQUENCY (I F) AMPLIFIERS

CONVENTIONAL UNIT

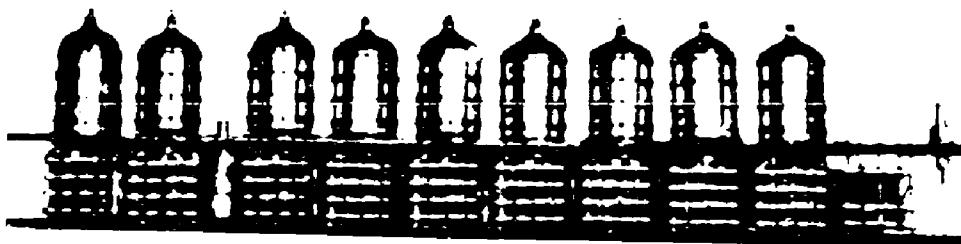


Side



Bottom

PROJECT TINKERTOY UNIT



IV

ESTABLISHMENT OF COSTING BASIS

IV—ESTABLISHMENT OF COSTING BASIS

Elements of Cost

The sales price of a product is normally composed of the following major cost elements, as illustrated on Exhibit 4, opposite.

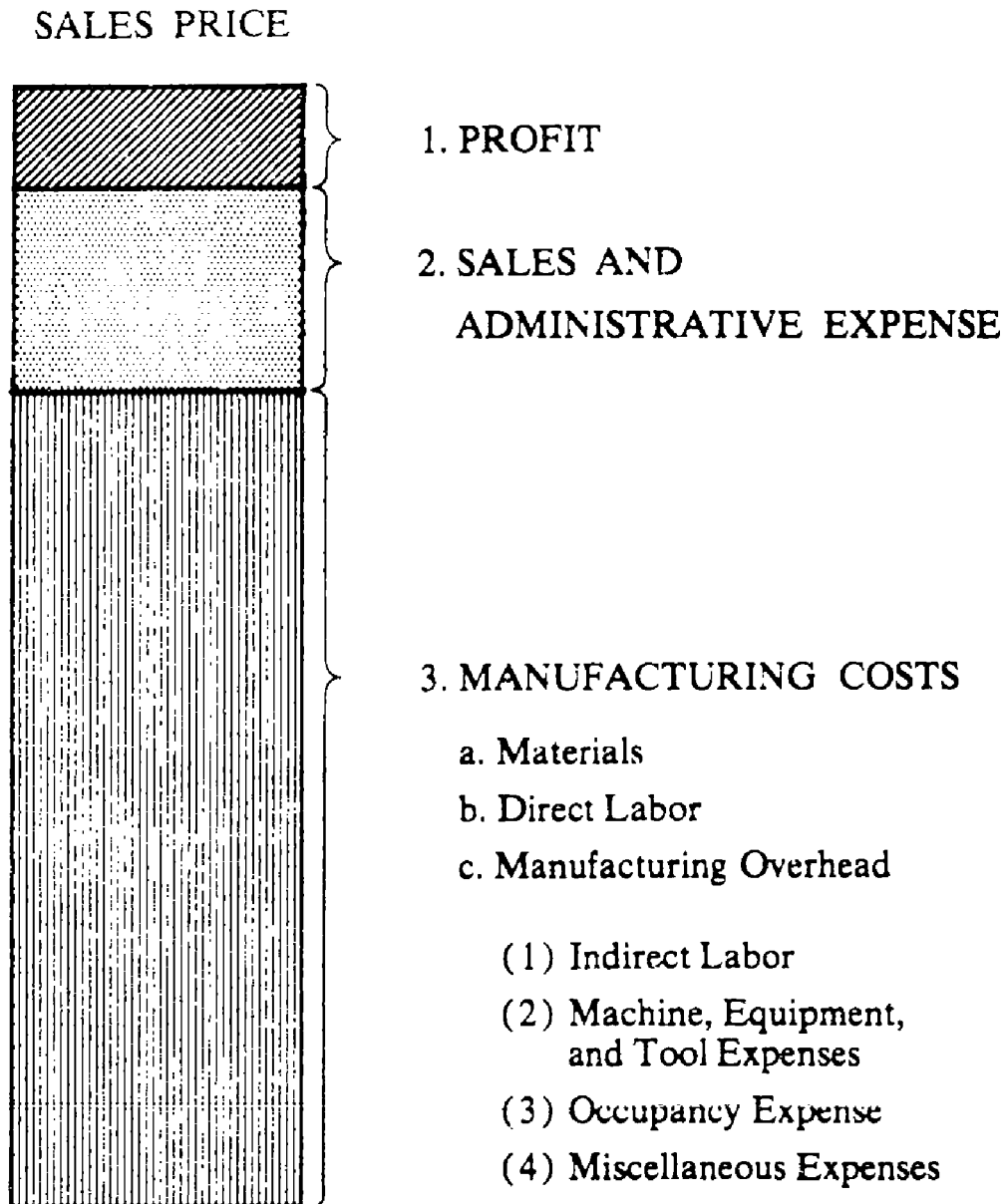
1. Profit
2. Sales and Administrative Expense
3. Manufacturing Costs

Establishment of Costing Basis

It was decided to use the Manufacturing Cost element of the sales price of a product as the basis for determining and comparing costs for Project Tinkertoy, for the following reasons:

1. Manufacturing Cost covers the basic manufacturing and processing expense, and is the element of cost on which the other cost elements are based. It is not particularly affected by extraneous factors such as sales policies, market demand, etc.
2. Manufacturing Cost figures can be compared readily with similar cost figures throughout industry, and can be adjusted for more exact comparison, if desired, for any specific set of operating conditions.

SALES PRICE OF A PRODUCT



STANDARD COSTING RATES

In determining the direct labor and manufacturing overhead costs, the representative rates and ratios shown on Exhibit 5 opposite were used.

The percentage of overhead expenses apportioned as fixed costs for use in determining breakeven points between hand and machine processes, are also shown on Exhibit 5.

PROJECT TINKERTOY
MANUFACTURING COST STANDARD RATES

ITEM	OPERATIONS		Distribution % Fixed Cost
	Machine	Hand	
1. WAGE RATES			
a. Highly skilled	\$2.40	\$2.40	—
b. Skilled	2.00	2.00	—
c. Semi-skilled	1.60	1.60	—
d. Unskilled	1.20	1.20	—
2. FACTORY OVERHEAD			
a. Indirect Labor (% of direct labor cost)	30%	30%	30%
b. Machine, equipment, tool cost			
1. Annual Depreciation	10%	10%	100%
2. Interest charged on capital required	4%	4%	100%
3. Annual taxes & insurance	1%	1%	100%
4. Maintenance (% of equip- ment cost)	Avg. 20%	5-15%	25%
5. Utilities			
a. Electricity	.02/KW HR.	.02/KW HR.	—
c. Occupancy expense			
1. Ratio of Total Space to process space	6/1	5/1	—
2. Annual Rental / sq. ft.	\$1.00	\$.80	100%
3. Annual Heat / sq. ft.	.10	.10	75%
4. Annual Light / sq. ft.	.30	.30	10%

V
DETERMINATION OF
MANUFACTURING COSTS

V—DETERMINATION OF MANUFACTURING COSTS

The projected Manufacturing Costs for Project Tinkertoy, consisting of the major cost elements—Material, Direct Labor, and Manufacturing Overhead—outlined in the previous section, were determined according to the following procedures:

Materials Costs

In order to develop manufacturing costs for the Tinkertoy I F Amplifier, it was necessary to establish proper costs for the materials used in its manufacture.

The development of costs for these materials was complicated by:

1. The relatively high cost of certain parts such as the ceramic wafers as now produced in small quantities at the pilot plant.
2. The necessarily small order quantities for some parts, resulting in comparatively high purchase prices for the items.
3. The fact that certain parts, such as base strips, have been handmade for this particular I F Amplifier, making it necessary to determine costs for such parts when manufactured in quantities.

All parts used in the Tinkertoy I F Amplifier are considered to be purchased parts, and the prices for these parts and materials as determined by appropriate appraisal, are shown in Exhibit 6, opposite.

MATERIAL COSTS

I F Amplifier.

Base strips	2 x \$.700	—	\$1.400
Brackets, tube shield	8 x .003	—	.024
*Cable, input coaxial	1 x 1.280	—	1.280
Capacitor bodies (regular)	32 x .014	—	.448
(small)	2 x .007	—	.014
Coil, tuning	1 x .950	—	.950
Coils, other	3 x .125	—	.375
*Cover assembly	1 x 2.170	—	2.170
Eyelets, tube socket	9 x .002	—	.018
Eyelets, other	150 x .005	—	.750
Plug, output	1 x .75	—	.750
Resistor strips	37 x .005	—	.185
Shield, inner stage	8 x .01	—	.080
Shield, input	1 x .02	—	.020
Shield, tube	9 x .0175	—	.158
Silver (at \$1.27/troy ounce)			
Capacitor body painting	33 x .001	—	.033
Notch painting	49 x .001	—	.049
Tube socket patterns	9 x .0003	—	.003
Other patterns	66 x .0005	—	.033
Transformer, input	1 x .10	—	.100
*Tube, 6AC5	1 x .48	—	.480
*Tube, 6AK5	8 x 1.21	—	9.680
Tube Socket bodies	9 x .055	—	.495
Tube socket connector pins	63 x .005	—	.315
Wafer, ceramic	49 x .01	—	.490
Wire, riser	18.75' x .014	—	.263
			<u>\$20.563</u>

*Same price as for conventional I F Amplifier

Direct Labor Costs—Tinkertoy Machine Process

To determine the operator or direct labor requirements for Tinkertoy machine processing, it was first necessary to determine machine and equipment requirements.

All of the Tinkertoy components manufactured to date by the machine process have been produced at a pilot plant established by the National Bureau of Standards, and now being operated by a commercial contractor.

Certain of the machines used have been adapted from standard machines with comparatively little modification. The majority, however, are relatively new designs, though they do contain some standard components.

Observations of the equipment during the survey indicated that the amount of machine delay, particularly from malfunctioning, was considerably higher than might be expected with comparable equipment in a more advanced state of development.

Some improvements have been developed, however, which have not yet been incorporated in the present equipment. Furthermore, experience indicates that development work on any piece of equipment can reduce malfunctioning delays to some extent. It was decided, therefore, that equipment and direct labor requirements based entirely on the current operations of the pilot plant would not provide a representative picture of the Project Tinkertoy machine process. Consequently, net machine production (or yield), and equipment requirements were based on the assumptions in the following section.

Assumptions for Projecting Equipment Yields. The projected machine process yields used in determining direct labor costs are based on:

1. Use of new equipment substantially like the present, operated at substantially the present cyclic rates, and incorporating improvements which have been developed during operations to date:
2. Machine delay time reflecting:
 - a. The present stage of development of the equipment.
 - b. General industrial practices and conditions with respect to time required for machine set-up, warm-up, clean-up, malfunctioning, maintenance, and operator's personal time.
3. Reasonable estimates of processed wafers or modules rendered unusable and therefore rejected due to equipment malfunctioning.

The projected yields are generally higher than current experience would indicate, but are considered to be reasonable expectations, based on the foregoing assumptions.

Equipment Requirements. As stated earlier, it was necessary to determine equipment requirements in order to establish operator, or direct labor requirements. The equipment requirements used in determining direct labor costs were based on:

1. Equipment yields based on the assumptions tabulated on the previous page.
2. The machine capacities necessary to process the required proportions of the various wafer components, such as resistors, capacitors, and tube sockets, comprising the ten modules for the I F Amplifier.

Note: A check of another naval electronic device, produced by both Tinkertoy and conventional methods, indicated the possibility that the I F Amplifier wafer component ratio is representative of such devices. It should be stressed, however, that the production of other items might require larger percentages of tube sockets, resistors, and capacitors, and consequently, additional requirements for certain machines.

3. The necessity for a fairly balanced production line, in order to reduce to a minimum the economic loss resulting from unused machine capacity.
4. Operation of the facility on a 2-8-5, or two-shift, 8-hour shift, and five-day week basis.

Production Line Balance and Facility Cost. The machine process yields developed from the foregoing are shown on Exhibit 7, together with the basic cyclic rates, machine delay times, and percentages of rejects on which these data are based.

After developing the equipment yields, the production line was balanced by adding to the present pilot plant operation the machines necessary to reduce to a minimum the total unused machine capacity consistent with a reasonable capital investment requirement. This resulted in a facility equipped to produce 405 five-wafer modules per hour, with an unused machine capacity equal to approximately 17% of the total investment. The number of pieces of equipment required for this facility are shown on Exhibit 7.

The replacement cost of the equipment required for this 405 module-per-hour facility is also shown on Exhibit 7. These costs were established by evaluation of purchase records and estimates of those most familiar with the development of the equipment.

Determining Direct Labor Costs. After establishing the equipment requirements, estimates were prepared of the number and skills of the operators needed, based on general industrial practice with similar equipments. These operator requirements are shown on Exhibit 7.

The number of operators, and the wage rates shown on the Standard Rate Sheet, Exhibit 5, were used to determine the machine process direct labor costs used in this survey.

PROJECT TINKERTOY MACHINE PROCESS-EQUIPMENT

1 Operation No.	2 Equipment Description	3 Basic cyclic rate (pcs./hr.)	4 Machine delay (hrs./8 hrs.)	5 % rejects	6 Net machine yield (pcs./hr.)	7 Factor for I F Amplifier
MW-1	Notch Painter	1,714	2.5	10%	1,060	4.9
MW-2	Notch Paint Filing ←					
MW-3	Pattern Printer	750	3.0	5%	445	4.9 + 5
MW-4	Pattern Firing Furnace	2,143	3.0	-	1,339	4.7 + 5
MW-5	Pattern Tester	3,000	1.5	10%	2,194	4.7
MR-1	Resistor Tape Applicator	1,500	2.0	5%	1,069	1.5
MR-2	Resistor Prot. Tape Applicator	1,500	2.0	5%	1,069	1.5
MR-3	Resistor Curing Oven	1,200	-	-	1,200	1.5
MR-4	Resistor Wafer Notch Tinner	579	1.75	10%	408	1.5
MR-5	Resistor Assembly Tester	632	1.5	5%	488	1.5
MC-1	Cap. Wafer Pattern Tinner	560	1.5	5%	432	3.2
MC-2	Cap. Body Pattern Printer	1,000	2.0	10%	675	3.2
MC-3	Cap. Body Pattern Oven	1,818	-	-	1,818	3.2
MC-4	Cap. Body Pattern Tester	2,143	1.5	5%	1,654	3.2
MC-5	Cap. Body Pattern Tinner	550	2.0	5%	392	3.2
MC-6	Cap. Assembler	359	2.5	5%	234	1.7
MC-7	Cap. Notch Tinner	579	1.75	10%	408	1.7
MC-8	Cap. Assembly Tester	632	1.5	5%	488	1.7
MTS-1	Tube Socket Pattern Tinning ←					
MTS-2	Tube Socket Assembler	240	2.5	5%	156	.9
MTS-3	Tube Socket Notch Tinner	579	1.75	10%	408	.9
MM-1	Module Assembler	125	2.0	10%	84	.9
MM-2	Module Riser Wire	270	2.0	5%	192	.9
MM-3	Module Tester	423	1.5	5%	327	.9

• HS - Highly Skilled
 S - Skilled
 SS - Semi-skilled
 U - Unskilled

•• Included
 in MW-1

••• Included
 in MW-3

AND DIRECT LABOR REQUIREMENTS

EXHIBIT 7.

8	9	10	11	12	13	14	15	16	17
1 F Modules per hr. (6-7)	Machines required (405 mod./hr.)	Machine replacement cost Per Mach. Total		Output items per hr. required per hr.		Unused Capacity % (12-13) 12	Mach. Cost (11 x 14)	Operator Requirements Number & *Skills	Composite rate
216	2	\$13,500	\$27,000	2,120	1,985	6.4%	\$1,722	2-S, 2-U	\$6.40
OPERATION PERFORMED IN CAP. BODY PATTERN OVEN (SEE MC-3) → **									
473	1	26,500	26,500	445	381	14.3%	3,812	1-S, 1-SS & 1-U	4.80
1,424	1	9,000	9,000	1,339	381	71.5%	6,439		-
467	1	17,000	17,000	2,194	1,904	13.2%	2,240	1-H.S.	2.40
713	1	12,000	12,000	1,069	608	43.1%	5,175	1-SS	1.60
713	1	12,000	12,000	1,069	608	43.1%	5,175	1-SS	1.60
800	1	9,000	9,000	1,200	608	49.3%	4,440	+	-
271	2	5,750	11,500	816	608	25.5%	2,931	2-U	2.40
325	2	11,000	22,000	976	608	37.7%	8,295	2-HS	4.80
135	3	7,500	22,800	1,296	1,296	0 %	-	3-SS	4.80
211	2	10,000	20,000	1,350	1,296	4 %	800	2-SS	3.20
284	2	9,000	18,000	1,818	1,296	28.7%	5,168	†	-
517	1	5,500	5,500	1,654	1,296	21.6%	1,190	1-HS	2.40
123	4	7,600	30,400	1,568	1,296	17.3%	5,273	4-SS	6.40
138	3	27,500	82,500	702	689	1.85%	1,528	6-SS	9.60
239	2	5,750	11,500	816	689	15.6%	1,790	2-U	2.40
287	2	12,000	24,000	976	689	29.4%	7,057	2-HS	4.80
OPERATION PERFORMED IN CAP. WAFER PATTERN TINNER (SEE MC-1) →									
173	3	32,000	96,000	468	365	22.0%	21,277	2-S, 2-SS	7.20
452	1	5,750	5,750	408	365	10.6%	606	1-U	1.20
93	5	31,500	157,500	420	365	13.1%	20,625	10-SS	16.00
213	2	14,500	29,000	384	365	4.9%	1,435	2-SS	3.20
363	2	8,000	16,000	654	365	44.2%	7,070	2-SS	4.80

\$664,950

\$114,049

† Included
in MR-2

‡ Included
in MC-2

Direct Labor Costs—Tinkertoy Hand Process

Most of the Tinkertoy components manufactured to date by the hand process have been produced in a model shop of the National Bureau of Standards. The major emphasis has been on development, rather than on production, and consequently the methods and worker pace are not equivalent to commercial practice. Direct labor requirements derived solely from current hand operations would not provide a sound basis for cost comparisons with conventional commercial manufacture.

Considering the present state of development of the Tinkertoy hand process, it was decided to time-study the individual manual process steps and to establish production rates per worker, based on general industrial conditions and practices with respect to worker pace, rest periods, personal time allowances, and delay factors.

The production rates per worker for the various hand process steps thus developed and shown on Exhibit 8 are considered to be applicable to the average industrial plant. While methods studies were not within the scope of this survey, specific methods improvements are reflected in several of the rates. It is apparent that production rates, in at least several process steps, may be further increased significantly by methods analysis and improvement.

In order to provide a direct comparison with the projected Tinkertoy machine processing operations, an equivalent Tinkertoy hand processing facility was projected with a capacity of 400 modules per hour. The equipment costs for this facility are also shown on Exhibit 8.

PROJECT TINKERTOY — HAND PROCESS PRODUCTION AND EQUIPMENT DATA

Operation No.	OPERATION DESCRIPTION	Standard Dec. Hrs. Per Operation	Output in Pieces Per Hour	No. Operators to Make 400 Mod. / Hr	No. Work Stations Req.	Equipment Cost For Work Stations
HW-1	Wafer Notch Painting	.00880	114	17.248	17	\$ 894.30
HW-2	Wafer Notch Paint Firing	.00044	2,273	.8624	(1)	224.40
HW-3	Wafer Pattern Printing (1 side)	.00091	1,099	.5460	1	9,902.20
HW-3	Wafer Pattern Printing (2 sides)	.00184	543	2.2080	2	—
HW-4	Wafer Pattern Firing	.00044	2,273	.8624	(1)	4,730.00
HC-1	Cap. Wafer Pattern Tinning	.00638	157	4.5936	5	937.75
HC-2	Cap. Body Pattern Printing	.00196	510	2.6656	3	7,422.80
HC-2a	Make Cap. Leads	.00055	1,820	.7480	1	100.10
HC-3	Cap. Body Pattern Firing	.00044	2,273	.5808	(1)	3,190.00
HC-4	Cap. Body Pattern Testing	.00176	568	2.3936	3	1,620.30
HC-5	Cap. Body Pattern Tinning	.00396	253	5.3856	5	937.75
HC-6	Cap. Body To Wafer Assembly (.02+.01)	.01320	76	2.1120	2	1,008.70
HC-6	Cap. Body To Wafer Assembly (Two .01)	.00715	140	2.2880	2	—
HC-6	Cap. Body To Wafer Assembly (One .02)	.00473	211	1.3240	2	—
HC-6a	Assemble Cap. Leads (1 side)	.00781	128	3.1244	3	474.93
HC-6a	Assemble Cap. Leads (2 sides)	.01408	71	6.7584	7	—
HC-6b	Sub-Assemble Cap. Bodies	.00974	103	1.9480	2	378.40
HC-6c	Apply Prot. Coating (1 side)	.00847	118	2.7104	3	334.40
HC-6c	Apply Prot. Coating (2 sides)	.01694	59	6.7760	7	—
HC-7	Cap. Wafer Notch Solder Filling	.00880	114	6.3360	6	315.49
HC-8	Cap Wafer Assembly Inspections	.00286	350	3.8896	4	2,160.40
HR-1	Res. Tape Application (1 side)	.00432	232	1.9008	2	135.30
HR-1	Res. Tape Application (2 sides)	.00620	161	1.2400	1	—
HR-1a	Dry Res. Tape	.00044	2,273	.2816	(1)	1,540.00
HR-1b	Inspect	.00550	182	3.3000	4	596.20
HR-2	Prot. Tape Application (1 side)	.00488	205	1.3664	2	246.40
HR-2	Prot. Tape Application (2 sides)	.00783	128	2.5056	2	—
HR-3	Dry Prot. Tape	.00044	2,273	.2816	(1)	1,540.00
HR-4	Res. Wafer Notch Solder Filling	.00792	126	4.7520	5	937.75
HR-5	Res. Testing	.00550	182	3.3000	4	477.40
HTS-1	Tube Socket Pattern Tinning	.00589	167	2.1204	2	375.10
HTS-2	T. S. Parts to Wafer Assembly	.01276	79	4.5936	5	1,353.00
HTS-3	T. S. Wafer Notch Solder Filling	.01716	58	6.1776	6	1,395.90
HTS-4	T. S. Inspection	.00524	191	1.8864	2	358.05
HM-1	Module Assembly	.04235	24	16.9400	17	17,576.90
HM-1a	Inspect & Resolder	.01749	57	6.9960	7	373.42
HM-1b	Straighten Wire Ends	.00880	114	3.5200	4	200.20
HM-2	Riser Wire Clipping	.01716	58	6.8640	7	508.20
HM-3	Module Testing	.00275	364	1.1000	2	18,123.00
	Special Items	.05500	18	2.2000	4	201.65
	Final Assembly	.38500	2.6	15.4000	16	1,249.60
TOTAL				182.0868	167	\$81,818.99

Manufacturing Overhead Costs

The manufacturing overhead costs for the various cost comparisons developed in this survey were determined in the following manner:

Indirect Labor includes plant supervision, clerical, shipping and receiving, quality control, material handling, janitor and watchman service, etc.

The indirect labor expense was developed by estimating the wages and salaries of the personnel required to service commercial facilities similar to those projected for Tinkertoy hand and Tinkertoy machine processing. This expense, compared to the estimated total expense for direct labor, provided the 30% ratio shown on the Standard Rate Sheet, and used in distributing indirect labor costs to the various process steps for both hand and machine manufacture.

Machine, Equipment, & Tool Expense covers depreciation, interest charges for capital requirements, taxes and insurance, power consumption, and maintenance labor, materials, and overhead for all machines, equipment, and tools used.

This expense was developed by using standard rates, as shown on the Standard Rate Sheet, for depreciation, interest, and taxes and insurance and applying them to the estimated replacement costs of equipment required. To this was added the estimated maintenance and power expenses for the equipment, to obtain the total. The work sheet used to develop this expense is shown as Exhibit 9.

PROJECT TINKERTOY - Machine, Equipment, & Tool Cost Data

	<u>Depreciation</u>	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
	Replacement Cost of Item _____	xx	xx	xx
	Annual Depreciation Rate <u>10%</u>	xx	xx	xx
	Annual Depreciation _____	_____	<u>100%</u>	xx
2.	<u>Interest charge for Capital required</u>			
	Replacement Cost _____ x Rate % <u>4%</u>	_____	<u>100%</u>	xx
3.	<u>Taxes & Insurance</u>	xx	xx	xx
	Replacement Cost _____ <u>1%</u>	_____	<u>100%</u>	xx
4.	<u>Maintenance</u> _____	_____	<u>25%</u>	<u>75%</u>
5.	<u>Utilities</u> KW Hrs. _____ x Rate <u>.02</u>	_____	xx	<u>100%</u>
6.	<u>Miscellaneous</u> _____	_____	_____	_____
	_____	_____	_____	_____
	_____	=====	=====	=====
	TOTAL COSTS	_____	_____	_____
		xx	xx	xx

[illegible]

Occupancy Expense was determined by estimating the space requirements of the facilities needed for the various operations, and multiplying the space by the average rates for rent, heat, and lights, shown on the Standard Rate Sheet. It will be noted that a lower rental rate was used for hand processing space than for machine processing space, based on the general practice of using more expensive space for automatic equipment installations.

Miscellaneous Expenses are numerous expenses incurred in connection with manufacturing facilities and operations, such as supplies, water and gas, employee benefits, loss and wastage, etc., for which it is difficult to establish general averages. However, it appeared reasonable to use a figure of 10% of the "Indirect Labor," "Machine, Equipment & Tool Expense," and "Occupancy Expense," to cover these miscellaneous expenses, and this 10% figure is used throughout this manufacturing cost determination.

Assembling Manufacturing Cost Data

The Manufacturing Cost Data for each step of the Project Tinkertoy machine and hand processes was developed as outlined in the preceding sections, and the data was assembled on work sheets illustrated on Exhibit 10, opposite.

The distribution between fixed and variable expenses was made according to the percentages shown on Exhibits 5 and 9.

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes _____ Mach. _____ No. _____
 Hand _____

Equipment _____ No. _____

Based on _____ shifts, _____ hrs., hourly prod. _____ and annual prod. _____

		<u>Annual Cost</u>		
<u>Item</u>		<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		=====	xx	_____
2. Direct Labor = Hrs. _____ x Rate _____ =		=====	xx	_____
3. Manufacturing Overhead				
a. Indirect Labor = <u>30%</u> of Direct _____ =		_____	_____	_____
b. Machine, Equipment & Tool _____		_____	_____	_____
c. Occupancy =				
Proc. Space _____ x Ratio _____ =		xx	xx	xx
Rent _____ =		_____	_____	_____
Light _____ =		_____	_____	_____
Heat _____ =		_____	_____	_____
Subtotal - a, b, and c.		_____	_____	_____
d. Miscellaneous = <u>10%</u> x Subtotal _____ =		_____	_____	_____
Total - a, b, c, and d.		=====	=====	=====
GRAND TOTALS		_____	_____	_____

Notes: _____

VI
PROJECT TINKERTOY
PROCESS STEP COMPARATIVE COSTS

VI—PROCESS STEP COMPARATIVE COSTS

Having developed complete manufacturing cost data, based on projected manufacturing facilities with capacities of 405 modules per hour for the Tinkertoy machine process and 400 modules an hour for the equivalent hand process, a comparison of the manufacturing costs for each step in the machine process was prepared.

These comparative process step costs per item processed are tabulated on Exhibit 11 opposite. The lower of the two costs is underlined to facilitate comparison at each step.

For each machine process step, a chart was also prepared depicting the variation between the manufacturing cost characteristics for the machine step and the comparable hand process step(s). These cost-volume charts involved utilization of the fixed cost overhead expense ratios referred to in Exhibit 5.

Wherever the cost characteristics for a machine process step and its equivalent hand process step(s) converged, and therefore, would intersect, a break-even volume was thereby determinable at which the manufacturing costs for both processes are identical. These break-even volumes were then determined by algebraic calculation, checked for correlation with the appropriate charts, and tabulated in Exhibit 11.

PROJECT TINKERTOY – PROCESS STEP COMPARATIVE COSTS
(Direct Labor and Manufacturing Overhead)

Oper. No.*	OPERATION DESCRIPTION	HAND		MACHINE		Break- even Volume**
		Unit Cost	Annual Volume**	Unit Cost	Annual Volume**	
Basic Wafer Preparation						
W-1, 2	Wafer Notch Painting & Firing	.0201	7,840	<u>.00663</u>	7,938	None
W-3, 4, 5	Wafer Pattern Printing, Firing, Testing	<u>.00498</u>	7,200	<u>.00342</u>	7,614	None
Resistor Wafer Preparation						
R-1	Resistor Tape Application	.0235	2,400	<u>.00477</u>	2,430	None
R-2	Protective Tape Application	.0141	2,400	<u>.00477</u>	2,430	67
R-3	Tape Curing	.00152	2,400	<u>.00141</u>	2,430	1,930
R-4	Wafer Notch Solder Filling	.0174	2,400	<u>.00707</u>	2,430	30
R-5	Inspection	<u>.0121</u>	2,400	<u>.0124</u>	2,430	2,915
Capacitor Wafer Preparation						
C-1	Wafer Pattern Tinning	.0140	2,880	<u>.00504</u>	3,390	140***
C-2, 3	Body Pattern Printing & Firing	.00717	5,440	<u>.00612</u>	5,184	2,179
C-4	Body Pattern Testing	.00392	5,440	<u>.0028</u>	5,184	219
C-5	Body Pattern Tinning	<u>.00866</u>	5,440	<u>.00917</u>	5,184	8,969
C-6	Body to Wafer Assembly	.082†	2,880	<u>.0327</u>	2,754	101†
C-7	Wafer Assem. Notch Solder Filling	.0192	2,880	<u>.00674</u>	2,754	None
C-8	Inspection	<u>.0120</u>	2,880	<u>.0121</u>	2,754	2,939
Tube Socket Wafer Preparation						
TS-1	Wafer Pattern Tinning	.0129	1,440	<u>.00584</u>	1,794	See C-1
TS-2	Parts to Wafer Assembly	<u>.028</u>	1,440	<u>.0546</u>	1,458	None
TS-3	Notch Solder Filling	.0375	1,440	<u>.0063</u>	1,458	None
Module Assembly						
M-1	Assembly	<u>.0958</u>	1,600	<u>.1096</u>	1,458	3,510
M-2	Riser Wire Clipping	.0375	1,600	<u>.0212</u>	1,458	204
M-3	Testing	<u>.00928</u>	1,600	<u>.01325</u>	1,458	None

*Preceded by "H" for hand processes, and "M" for machine processes.

**In thousands.

***For C-1 and TS-1 combined.

*Preceded by "H" for hand processes, and "M" for machine processes.

**In thousands.

***For C-1 and TS-1 combined.

†For H-6, 6a, 6b, 5c combined.

VII
I F AMPLIFIER MODULE
COMPARATIVE COSTS

VII — I F AMPLIFIER MODULE COMPARATIVE COSTS

The processing costs for the ten Tinkertoy I F Amplifier modules were determined according to the procedures previously outlined, and are shown in the following tabulation.

MODULE	Direct Labor		Manufacturing Overhead		TOTALS	
	Hand	Machine	Hand	Machine	Hand	Machine
M-1	.46514	.1483	.16823	.1392	.63337	.2875
M-2	.50031	.2209	.19535	.27464	.69566	.49544
M-3	.51031	.2209	.19815	.27464	.70846	.49554
M-4	.62458	.23886	.22821	.29286	.85279	.53172
M-5	.55956	.23977	.22746	.29850	.78702	.53827
M-6	.51961	.21342	.18702	.26786	.70663	.48128
M-7	.52111	.2209	.19435	.27464	.71546	.49554
M-8	.63576	.28313	.23481	.30701	.87057	.59014
M-9	.63468	.25118	.24730	.27139	.88198	.52257
M-10	<u>.40372</u>	<u>.18195</u>	<u>.16065</u>	<u>.23558</u>	<u>.56437</u>	<u>.41750</u>
	5.375	2.219	2.042	2.636	7.416	4.856

VIII
I F AMPLIFIER COMPARATIVE
COSTS

VIII—I F AMPLIFIER COMPARATIVE COSTS

The manufacturing costs of the complete I F Amplifier were determined for both Tinkertoy hand and machine operations, based on the processing and materials costs previously shown, and on the final assembly costs detailed in an appendix to this report.

Manufacturing costs for the conventional I F Amplifier were obtained from a Navy contractor who had produced a considerable quantity of the item. These costs, together with similar costs for Project Tinkertoy hand and machine processing, are tabulated below.

METHOD	MATERIALS	DIRECT LABOR	MFG. O. H.	TOTALS
Conventional	\$35.85	\$5.60	\$5.44	\$46.89
Tinkertoy Hand	20.56	5.99	2.27	28.82
Tinkertoy Machine	20.56	2.83	2.86	26.25

IX

CONCLUSIONS

IX – CONCLUSIONS

The significant conclusions of this survey are as follows:

- Substantial reductions in electronic manufacturing costs appear to be possible through the use of either Project Tinkertoy machine or hand processes, as compared with conventional manufacturing methods. Based on the survey projections, the manufacturing cost reductions amount to 44% for the Tinkertoy machine process, and 38.5% for the Tinkertoy hand process.
- Manufacturing costs are lower for the Project Tinkertoy machine processing operations than for the hand processes in 13 of the 20 process steps, or groups of steps, delineated for this survey and indicate a 8.9% lower manufacturing cost for a complete I F Amplifier manufactured by Tinkertoy machine processes as compared to Tinkertoy hand processes.
- The substitution of lower-cost hand process steps, where appropriate, would result in a lower total manufacturing cost for the I F Amplifier than the present projected machine process total cost.
- The \$665,000 investment required for the projected 405 module per hour machine process facility is approximately 8 times the \$82,000 investment for the 400 module per hour hand process facility, but the difference in investment would be repaid from manufacturing cost savings within less than one year and five months of operations at full capacity.

- The Tinkertoy machine process uses fewer labor hours per unit produced than does the hand process, but requires a larger proportion of higher skilled personnel.
- Little, if any, manufacturing cost reduction would result solely from an increase in size of the projected Tinkertoy hand or machine process facilities. (Some reduction in material costs might be expected from larger purchase order quantities.)
- Significant reductions may be achieved in the present Tinkertoy hand process costs through methods improvements in several of the process steps.
- Significant reductions in the present Tinkertoy machine process costs would result from:

Increases in equipment cyclic rates.

Reductions in machine delay time.

Reductions in percentages of rejects.

Reductions in equipment costs.

Reductions in numbers and skills of operators.

Reductions in equipment maintenance costs.

APPENDIXES

PROJECT TINKERTOY

Manufacturing Cost Determination

Appendixes

- A. Ceramic Wafer Manufacturing & Cost Data
- B. Project Tinkertoy Processing Cost Data Sheets & Cost
Volume Charts
- C. IF Amplifier Module Cost Data
- D. IF Amplifier Assembly & Test Cost Data

APPENDIX A

Ceramic Wafer Manufacturing & Cost Data

<u>Schedules</u>	<u>Description</u>
A-1	Ceramic Wafer Cost Determination
A-2	Wafer Manufacturing Process Flow
A-3	Wafer Manufacturing Equipment & Cost Data
A-4	Hand Process Wafer Manufacturing Cost Data
A-5	Hand Process Wafer Equipment Cost Data
A-6	Machine Process Wafer Manufacturing Cost Data
A-7	Machine Process Wafer Equipment Cost Data

CERAMIC WAFER COST DETERMINATION

Objective determination of the manufacturing cost for the ceramic module wafer was complicated by the fact that the present facility is largely developmental in nature, and that some of the equipment is used for both module wafers and experimental capacitor wafers. In addition, the facility had been transferred from operation by the National Bureau of Standards to operation by a private contractor but two weeks before the start of the cost determination study.

Wherever possible, production capacities were determined by actual count or time study, as in the cases of wafer pressing, firing and gaging. In the remaining cases, the necessary data was obtained through the medium of statistical sampling and the analysis of available production statistics.

The wafer manufacturing process sequence is shown on Schedule A-2. It was found that, with the present module firing kiln and drying oven fully loaded on a 24-hour basis, the remainder of the processing equipment was very much under-utilized. It was considered appropriate, therefore, in order to achieve better utilization of this equipment for costing purposes and to approximate therefor a more normal manufacturing facility, to quadruple the kiln and oven capacities. This resulted in a costing basis of 52,000 wafers per 24-hour day, based on a maximum practical capacity of 13,000 wafers per 24-hour day for each furnace at 85% of optimum kiln capacity.

With the quadrupled kiln capacity, the kilns would continue to be the limiting factor in determining production capacity. Since the kilns are essentially intended to run on a continuous (24-hour a day) basis, except for necessary time out for repairs, this provided the basis for determination of yearly production capacity.

Appraisal of maintenance requirements for the wafer processing equipment, through consultation with pertinent operating personnel, revealed the need for shutting down each kiln one day per week, on the average, for maintenance and repairs and two weeks per year for rebuilding of refractory linings. Hence, with four kilns producing 52,000 wafers per day, the maximum practical capacity of the costing basis production facility became 15,600,000 wafers per 300-day year.

Ceramic Wafer Cost Determination (cont'd)

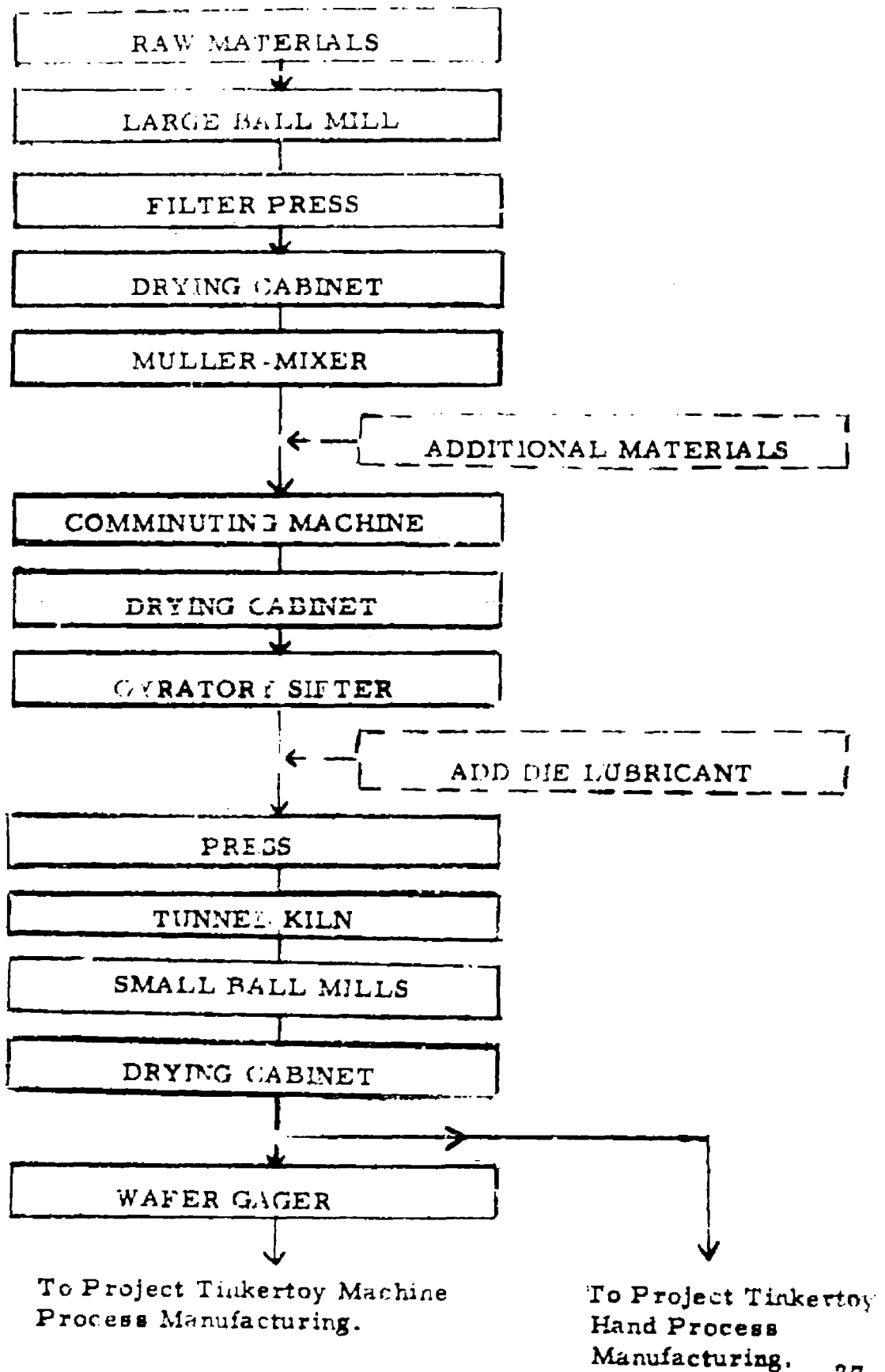
Analysis of some eight production batches completed during the period of the study indicated that an average yield of approximately 28,500 wafers per batch could be conservatively expected in normal production. This provided the basis for costing in the materials at the appraised cost of \$16.50 per batch.

The analysis also indicated that, in the case of wafers intended for use in machine wafer and module fabrication, approximately 20% of kiln production would be rejected at the wafer gager as not being acceptable therefor. These rejects could, however, be credited as being usable for hand module fabrication wherein a lower degree of dimensional precision in the wafer is acceptable.

These, then, were the bases upon which the module wafer cost determinations were predicated. Detailed costing data is tabulated on Schedule A-3 of this appendix. Schedules A-4 and A-5 contain the cost determination of the wafer for use in hand fabrication. Determination of the cost of the wafer for machine fabrication purposes is presented on Schedules A-6 and A-7.

PROJECT TINKERTOY

Wafer Manufacturing Process Flow



PRAWET JDAKEROY

Appendix A, Schedule A-2

ORRANTU WOVENS WATER MANUFACTURING EQUIPMENT AND COST DATA SHEET

(Based on plant producing 24 hours per day, 300 days per year)

With production rates of: (a) Wafers acceptable for Hand Fabrication - 52,000 per day = 15,600,000 per year

(With 20% rejected at Gager) (b) Wafers acceptable for Machine Fabrication-41,600 per days 12,480,000 per year

Pos. of Eqpt. Baud.	Column A Type of Equipment	Column B	Column C	Column D	Column E	Column F	Column G	Column H
		Estimated Replacement Cost \$	Hours used per 24 hr. day	Power Reqd. per 24 hr. day kw.	Space Occupied Sq. Feet	Maintenance Costs per year Labor, Supplies	Direct Labor Costs Per Day \$	Direct Labor Personnel Per Day
1	Large Ball Mill	1,627	22	44	48	116	100	
1	Filter Press	800	16	3	32	76	440	
4	Drying Cabinets	6,440	4 x 24	600	112	152	120	
1	Muller Mixer	2,830	20	24	25	76	60	Four semi-skilled men per shift
1	Comminuting Machine	1,837	8	30	30	76	60	
1	Gyrator Sifter	1,613	8	6	48	116	100	
1	Granular Blender	760	8	2	12	76	60	
2	Dual Pressure Presses	6,960	run 23 set-up 10	24	72	880 dies 8,480		(Two semi-skilled men on 1st and 2nd shifts, one on 3rd shift)
4	Tunnel Kilns	31,600	4 x 24	3,812	1,040	5,376	18,816	run 64.00
1	Small ball Mill	983	18	8	14	38	100	setup 48.00
	Misc. Auxiliary Equipment	1,569	As reqd.		629	76	60	(One skilled leading man per shift)
<u>Hard Fabrication Totals:</u>		\$58,019		4,553	2,062	7,058	28,396	265.60
1	Wafer Gager	3,500	23	9	36	1,444	2,000	28.80
<u>Machine Fabrication Totals:</u>		\$61,519		4,562	2,098	8,502	30,396	294.40
					plus 30% O.H.	2,550		
						11,052	11,052	
							41,448	

HAND PROCESS WAFER

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Module Wafer Manufacture Hand No. _____
Equipment See Schedule A-3, Column A
Based on 3 shifts, 7200 hrs., 24 hourly prod. 52,000 and /annua' prod. 15,600,000 300 day

<u>Item</u>	<u>Total Annual Costs</u>
1. Material - $\frac{\$16.50 \text{ per batch} \times 15,600,000}{28,500 \text{ per batch}}$	\$ <u>9,031.61</u>
2. Direct Labor - See Schedule A-3, Col. G	<u>79,680.00</u>
3. Manufacturing Overhead	
a. Ind. Lab. = 30% of Dir. <u>\$79,680</u> =	23,904.00
b. Mach., Equip. & Tool <u>(See Schedule A-5)</u>	73,592.25
c. Occupancy " (Per Schedule A-3, Col. E) Proc. Space 2062 x Ratio 6 = 12,372 sq. ft. @ \$1.40 sq. ft.	<u>17,320.80</u>
<u>Subtotal - a, b, and c</u>	<u>\$114,817.05</u>
d. Miscellaneous = 10% x Subtotal <u>114,817.05</u> =	<u>11,481.70</u>
<u>Total - a, b, c, and d</u>	<u>126,298.75</u>
GRAND TOTALS - Items 1, 2 & 3	<u>\$215,010.36</u>

Notes:

Manufacturing cost per Module Wafer for Hand Fabrication = $\frac{\$215,010.36}{15,600,000}$

= 1.378 cents

Add Sales and Administration Costs (15%) and Profit (10%)

Totalling 25% of Selling Price

= 0.460

Purchase Price

= 1.838 cents

HAND PROCESS WAFER

PROJECT TINKERTOY -- Machine, Equipment & Tool Cost Data

Annual Equipment Costs Based on 3 shifts and 7200 hrs.

	<u>Total</u>
1. <u>Depreciation</u>	
Replacement Cost of Item <u>\$58,019.00</u> (Per Schedule A-3, Col. B)	
Annual Depreciation Rate <u>10%</u>	
Annual Depreciation <u>\$5,801.90</u>	\$ 5,801.90
2. <u>Interest Charge for Capital Required</u>	
Replacement Cost <u>\$58,019.00</u> x Rate <u>4%</u> = (Per Schedule A-3, Col. B)	2,320.76
3. <u>Taxes & Insurance</u> <u>1%</u>	580.19
4. <u>Maintenance</u> (Per Schedule A-3, Col. F)	37,571.40
5. <u>Utilities</u> - KW Hrs. <u>4553 x 300</u> x Rate <u>.02</u> (Per Schedule A-3, Col. D)	<u>27,318.00</u>
<u>Total Costs</u>	<u>\$73,592.25</u>

MACHINE PROCESS WAFER

PROJECT TINKERTOY -- Total Manufacturing Cost Data

Process Module Wafer Manufacture Mach.

Equipment See Schedule A-3, Column A

Based on 3 shifts, 7200 hrs., 24 hourly prod./41,600 and/annual prod./12,480,000

<u>Item</u>	<u>Total Annual Costs</u>
1. Material - $\frac{\$16.50 \text{ per batch} \times 15,600,000}{28,500 \text{ per batch}}$	\$ <u>9,031.61</u>
2. Direct Labor - See Schedule A-3, Col. G	<u>88,320.00</u>
3. Manufacturing Overhead	
a. Ind. Lab. = 30% of Dir. <u>\$88,320</u> =	26,496.00
b. Mach., Equip. & Tool - See Schedule A-7	78,048.45
c. Occupancy =	
Proc. Space $\frac{2098 \times \text{Ratio } 6}{@ 1.40 \text{ sq. ft.}} = \frac{12,588 \text{ sq. ft.}}{1.40 \text{ sq. ft.}} =$	17,623.20
(Per Schedule A-3, Col. E)	
<u>Subtotal - a, b, and c</u>	122,167.65
d. Miscellaneous = Subtotal $\times 10\%$	12,216.76
<u>Total - 1, 2, 3</u>	<u>231,736.02</u>
Less credit for 3,120,000 rejected wafers salable for hand module fabrication @ 1.838¢ per wafer.	57,345.60
GRAND TOTAL	<u>\$174,390.42</u>

Notes: Price per Module Wafer for Machine Fabrication =

$$\frac{\$174,390.42}{12,480,000} = 1.397 \text{ cents}$$

Add Sales and Administration Costs (15%) and Profit (10%) Totalling 25%
of Selling Price = $\frac{0.466}{1.863 \text{ cents}}$

MACHINE PROCESS WAFER

PROJECT TINKERTOY -- Machine, Equipment & Tool Cost Data

Annual Equipment Costs Based on 3 shifts and 7200 hrs.

	<u>Total</u>
1. <u>Depreciation</u>	
Replacement Cost of Item <u>\$61,519</u> (Per Schedule A-3, Col. B)	
Annual Depreciation Rate <u>10%</u>	
Annual Depreciation <u>\$6,151.90</u>	\$6,151.90
2. <u>Interest Charge for Capital Required</u>	
Replacement Cost <u>\$61,519</u> x Rate <u>4%</u> = (Per Schedule A-3, Col. B)	2,460.76
3. <u>Taxes and Insurance</u> <u>1%</u>	615.19
4. <u>Maintenance</u> (Per Schedule A-3, Col. F)	41,448.60
5. Utilities - KW Hrs. <u>4562 x 300 x Rate .02</u> =	
Total Utilities	27,372.00
<u>Total Costs</u>	<u>\$78,048.45</u>

APPENDIX B

Project Tinkertoy Processing Cost Data

Schedules

Description

Basic Wafer Preparation

- B-1 (W1 & 2) Wafer Notch Painting & Firing
- B-2 (W3, 4, & 5) Wafer Pattern Printing, Firing & Testing

Resistor Wafer Preparation

- B-3 (R-1) Resistor Tape Application
- B-4 (R-2) Resistor Protective Tape Application
- B-5 (R-3) Resistor & Protective Tape Curing
- B-6 (R-4) Resistor Wafer Notch Solder Filling
- B-7 (R-5) Resistor Inspection

Capacitor Wafer Preparation

- B-8 (C-1) Capacitor Wafer Pattern Tinning
- B-9 (C-2 & 3) Capacitor Body Pattern Printing & Firing
- B-10 (C-4) Capacitor Body Pattern Testing
- B-11 (C-5) Capacitor Body Pattern Tinning
- B-12 (C-6) Capacitor Body to Wafer Assembly
- B-13 (C-7) Capacitor Wafer Notch Solder Filling
- B-14 (C-8) Capacitor Inspection

Tube Socket Wafer Preparation

- B-15 (TS-1) TS Wafer Pattern Tinning
- B-16 (TS-2) TS Parts to Wafer Assembly
- B-17 (TS-3) TS Wafer Notch Solder Filling
- B-18 (TS-4) TS Inspection

Module Assembly

- B-19 (M-1) Module Assembly
- B-20 (M-2) Module Riser Wire Clipping
- B-21 (M-3) Module Testing

Total Cost

- B-22 Total Projected Manufacturing Costs for Project Tinkertoy
Hand and Machine Processes

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Wafer Notch Painting & Firing Mach. No. MW-1 & 2

Equipment See MW-1 & 2 Data Sheets

Based on 2 shifts, 3,744 hrs., hourly prod. 2,120 and annual prod. 7,938,000

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
MW-1 =	\$47,394	\$ 9,507	\$37,887
MW-2 =	<u>5,224</u>	<u>2,724</u>	<u>2,500</u>
Totals --	<u>\$52,618</u>	<u>\$ 12,231</u>	<u>\$40,387</u>

Notes:

Cost per piece for MW-1 & 2 =

$$\frac{\$52,618}{7,938,000} = .00663$$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Wafer Notch Painting Mach. No. MW-1
Equipment 2-Notch Painters (A)
Based on 2 shifts, 3744 hrs., hourly prod. 2120 and annual prod. 7,938,000 wafers

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material	---	xx	---
2. Direct Labor = Hrs. <u>4,000</u> x Rate <u>6.40 (B)</u> =	<u>\$25,600</u>	xx	<u>\$25,600</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>25,600</u> =	7,680	\$2,304	5,376
b. Mach., Equip. & Tool	11,344	5,716	5,628
c. Occupancy = Proc. Space <u>94 x Ratio 6 = 564 sq. ft.</u>			
Rent <u>1.00 x 564 =</u>	564	564	---
Light <u>.30 x 564 =</u>	169	17	152
Heat <u>.10 x 564 =</u>	56	48	14
Subtotal - a, b, and c	\$19,813	\$8,643	\$11,170
d. Miscellaneous = 10% x Subtotal <u>19,813</u> =	1,981	864	1,117
Total - a, b, c, and d	---	---	---
GRAND TOTALS	<u>\$47,394</u>	<u>\$9,507</u>	<u>\$37,887</u>

Notes:

(A) 2-Notch Painters @ \$13,500 = \$27,000
(B) 2 Skilled @ \$2.00 = \$4.00
2 Unskilled @ \$1.20 = 2.40
\$6.40

Cost per piece for MW-1 = $\frac{\$47,394}{7,938,000} = .0059$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Wafer Notch Paint Firing Mach. No. MW-2
Equipment 1-Furnace (A)
Based on 2 shifts, 3744 hrs., hourly prod. 2,120 and annual prod. 7,938,000 wafers

Item	Total	Annual Costs	
		Fixed	Variable
1. Material	.	xx	
2. Direct Labor = Hrs. (B) x Rate		xx	
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir.			
b. Mach., Equip. & Tool	\$3,674	\$1,628	\$2,046
c. Occupancy = Proc. Space $128 \times \text{Ratio } 6 = 768 \text{ sq. ft.}$			
Rent 768×1.00	768	768	
Light $768 \times .30$	230	23	207
Heat $768 \times .10$	77	57	20
Subtotal - a, b, and c	\$4,749	\$2,476	\$2,273
d. Miscellaneous = 10% x Subtotal = 4,749	475	248	227
Total - a, b, c, and d	<u>5,224</u>	<u>2,724</u>	<u>2,500</u>
GRAND TOTALS	<u>\$5,224</u>	<u>\$2,724</u>	<u>\$2,500</u>

Notes:

- (A) 1-Furnace @ \$9,000
(B) Direct Labor Included in MW-1

MC-3 Operation includes balance of cost

$$\text{Cost per piece} = \frac{\$5,224}{7,938,000} = .00066$$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Wafer Notch Painting & Firing Hand No. HW-1 & 2

Based on 2 shifts, 4000 hrs., hourly prod. 1960 and annual prod. 7,840,000

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
HW-1 =	\$150,377.00	\$12,388.00	\$137,989.00
HW-2 =	<u>7,390.88</u>	<u>513.40</u>	<u>6,877.48</u>
Totals =	<u>\$157,767.88</u>	<u>\$12,901.40</u>	<u>\$144,866.48</u>

Notes: Cost per piece for HW-1 and 2 = $\frac{\$157,767.88}{7,840,000} = .0201$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Wafer Notch Painting Hand No. HW-1
Equipment (A)

Based on 2 shifts, 4000 hrs., hourly prod. 1960 and annual prod. 7,840,000

<u>Item</u>	<u>Total</u>	<u>Annual Costs</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material	---	xx	---
2. Direct Labor = Hrs. <u>68,992</u> x Rate <u>1.6</u> (B) =	<u>\$110,387.00</u>	xx	<u>\$110,387.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>110,387</u> =	33,116.00	\$ 9,935.00	23,181.00
b. Mach., Equip. & Tool	178.80	145.27	33.53
c. Occupancy = Proc. Space <u>510</u> (C) x Ratio <u>5</u> = <u>2550</u> sq. ft.			
Rent <u>.80 x 2550</u> =	2,040.00	2,040.00	
Light <u>.30 x 2550</u> =	765.00	76.50	688.50
Heat <u>.10 x 2550</u> =	255.00	191.25	63.75
Subtotal - a, b, and c	\$ 36,354.80	---	---
d. Miscellaneous = 10% x Subtotal <u>36,354.80</u> =	<u>3,635.48</u>		<u>3,635.48</u>
Total - a, b, c, and d	<u>39,990.28</u>	---	---
GRAND TOTALS	<u>\$150,377.00</u>	<u>\$12,388.00</u>	<u>\$137,989.00</u>

- Notes: (A) Notch Painting Tool, Bench & Stool. Cost for 17 station = \$894.30.
(B) Based on 17.24 men per hour per 40 modules per hour for 4,000 hours annually.
(C) Based on process space for 17 stations.

$$\text{Cost per piece} = \frac{\$150,377}{7,840,000} = .0192$$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Wafer Notch Paint Firing Hand No. HW-2

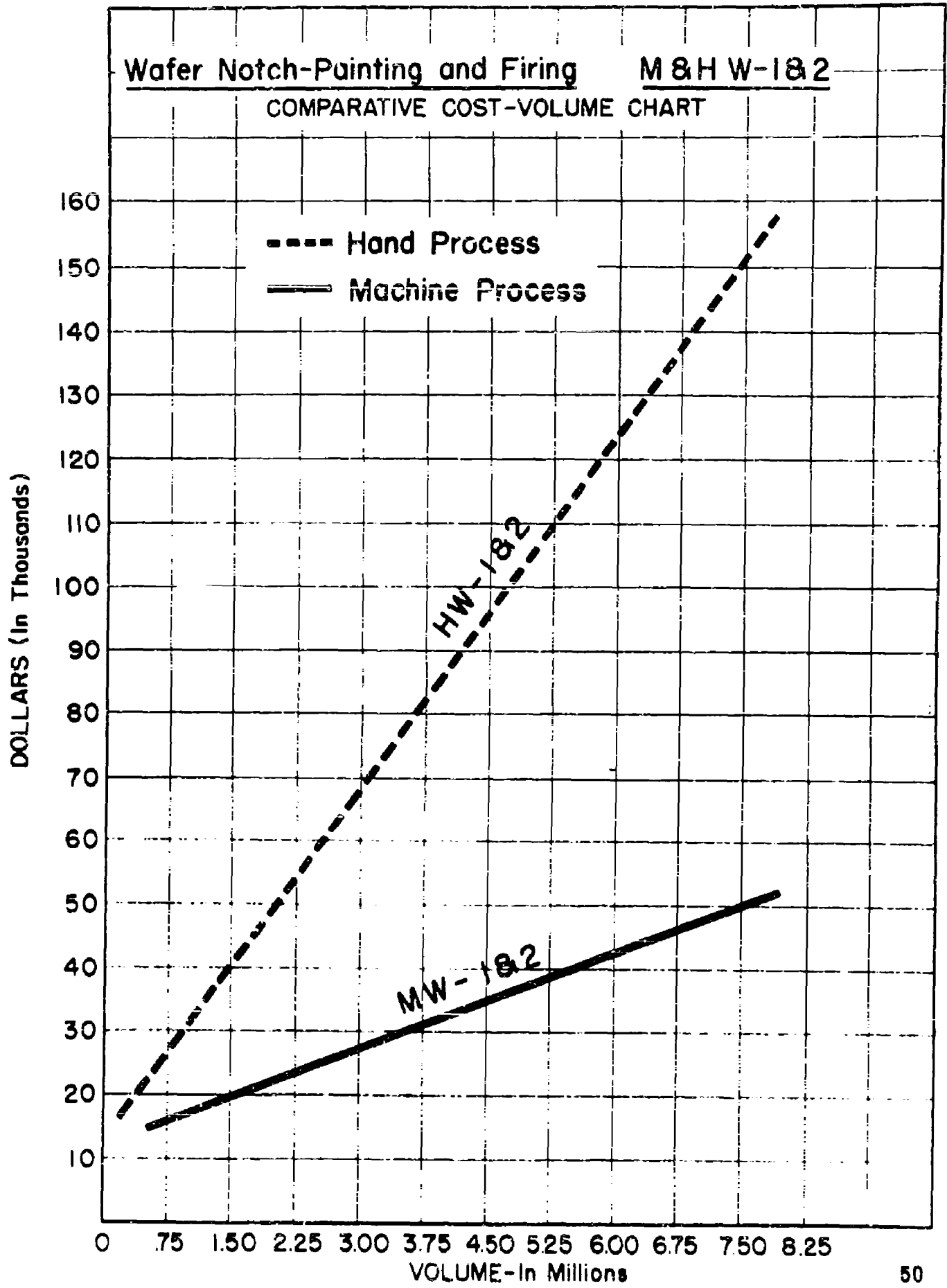
Equipment Benches, Stools and Infra-red Lamps

Based on 2 shifts, 4000 hrs., hourly prod. 1960 and annual prod. 7,840,000

<u>Item</u>	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material	---	xx	---
2. Direct Labor = Hrs. <u>3,450</u> x Rate <u>1.6</u> =	<u>\$5,520.00</u>	xx	<u>\$5,520.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30 % of Dir. <u>5,520</u> =	1,656.00	\$477.00	1,179.00
b. Mach., Equip. & Tool	44.80	36.40	8.40
c. Occupancy = Process Space (A) x Ratio _____ =			
Subtotal - a, b, and c	<u>\$1,700.80</u>	---	---
d. Miscellaneous = 10% x Subtotal <u>1,700.80</u> =	170.08		170.08
Total - a, b, c and d	<u>1,870.88</u>		
GRAND TOTAL	<u>\$7,390.88</u>	<u>\$513.40</u>	<u>\$6,877.48</u>

Notes: (A) Part of operation HW-1 space used.

$$\text{Cost per piece} = \frac{\$7,390.88}{7,840,000} = .0009427$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Wafer Pattern Printing, Firing, Test. Mach. No. MW-3, 4 & 5

Equipment See MW-3, 4 & 5 Data Sheet

Based on 2 shifts, 4,000 hrs., hourly prod. 2,225 and annual prod. 7,614,000

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
MW-3	\$38,809	\$ 9,014	\$29,795
MW-4	4,758	2,826	1,932
MW-5	<u>20,531</u>	<u>5,137</u>	<u>15,394</u>
Total	\$64,098	\$16,977	\$47,121

Notes:

Cost per piece for MW-3, 4 and 5 =

$$\frac{\$64,098}{7,614,000} = .00842$$

PROJECT TINKERTOY - - Manufacturing Cost Data

Processes Wafer Pattern Printing Mach. No. MW-3

Equipment 1 Wafer Pattern Printer (A)

Based on 2 shifts, 3,422 hrs., hrly. prod. 2,225 and annual prod. 7,614,000

		<u>Annual Cost</u>	
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>4,000</u> x Rate <u>4.80 (B)</u> =	<u>\$19,200</u>	xx	<u>\$19,200</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>19,200</u> =	5,760	\$1,728	4,032
b. Mach., Equip. & Tool	10,983	5,611	5,372
c. Occupancy =			
Proc. Space <u>129 x Ratio 6 = 774 sq. ft.</u>			
Rent <u>774 x 1.00 =</u>	774	774	---
Light <u>774 x .30 =</u>	232	23	209
Heat <u>774 x .10 =</u>	77	58	19
Subtotal - a, b, and c	<u>\$17,826</u>	<u>\$8,194</u>	<u>\$ 9,632</u>
d. Miscellaneous =			
10% x Subtotal <u>17,826</u> =	<u>1,783</u>	<u>820</u>	<u>963</u>
Total - a, b, c, and d	<u>19,609</u>	<u>9,014</u>	<u>10,595</u>
GRAND TOTALS	<u>\$38,809</u>	<u>\$9,014</u>	<u>\$29,795</u>

Notes:

(A) 1 Pattern printer @ \$26,500
 (B) 1 Skilled - \$2.00
 1 Semi-skilled - 1.60
 1 Unskilled - 1.20
 \$4.80

Cost per piece = $\frac{\$38,809}{7,614,000} = .0051$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Wafer Pattern Firing Mach. No. MW-4

Equipment 1 Furnace (A)

Based on 2 shifts, 3422 hrs., hourly prod. 2,225 and annual prod. 7,614,000

<u>Item</u>	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor = Hrs. (B) x Rate _____ =	---	xx	---
3. Manufacturing Overhead			
a. Ind. Lab.			
b. Mach., Equip. & Tool	\$3,132	\$1,628	\$1,504
c. Occupancy = Proc. Space $142 \times \text{Ratio } 6 = 852 \text{ sq. ft.}$			
Rent $852 \times 1.00 =$	852	852	---
Light $852 \times .30 =$	256	26	230
Heat $852 \times .10 =$	85	63	22
Subtotal - a, b, and c	\$4,325	\$2,569	\$1,756
d. Miscellaneous = 10% x Subtotal $4,325 =$	433	257	176
Total - a, b, c, and d	<u>\$4,758</u>	<u>\$2,826</u>	<u>\$1,932</u>
GRAND TOTALS	<u>\$4,758</u>	<u>\$2,826</u>	<u>\$1,932</u>

Notes:

(A) 1 Furnace @ \$9,000

(B) Direct Labor - Included in MW-3

Cost per piece = $\frac{\$4,758}{7,614,000} = .00062$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Wafer Pattern Testing Mach. No. MW-5

Equipment 1 Pattern Tester (A)

Based on 2 shifts, 3,470 hrs., hourly prod. 2,194 and annual prod. 7,614,000

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>4,000</u> x Rate <u>2.40 (B)</u> =	<u>\$9,600</u>	xx	<u>\$9,600</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. 9,600 =	2,880	\$ 864	2,016
b. Mach. Equipment & Tool	6,796	3,599	3,197
c. Occupancy =			
Proc. Space <u>31</u> x Ratio <u>6</u> = <u>186 sq. ft.</u>			
Rent <u>186</u> x <u>1.00</u> =	186	186	---
Light <u>186</u> x <u>.30</u> =	56	6	50
Heat <u>186</u> x <u>.10</u> =	19	15	4
Subtotal - a, b, and c	9,937	4,670	5,267
d. Miscellaneous =			
10% of Subtotal <u>9,937</u> =	<u>994</u>	<u>467</u>	<u>527</u>
Total - a, b, c, and d	<u>10,931</u>	<u>5,137</u>	<u>5,794</u>
GRAND TOTALS	<u>\$ 20,531</u>	<u>\$5,137</u>	<u>\$ 15,394</u>

Notes:

(A) 1 Tester @ \$17,000

(B) 1 Highly skilled @ \$2.40

Cost per piece = $\frac{\$20,531}{7,614,000} = .0027$

This operation is not performed separately in the hand process, but is included in steps HW 3 and 4.

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Wafer Pattern Printing & Firing Hand No. HW-3 & 4

Based on 2 shifts, 4000 hrs., hourly prod. 1800 and annual prod. 7,200,000

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
HW-3	\$26,214.40	\$3,602.63	\$22,611.77
HW-4	<u>9,688.29</u>	<u>1,439.60</u>	<u>8,248.69</u>
	<u>\$35,902.69</u>	<u>\$5,042.23</u>	<u>\$30,860.46</u>

Notes:

$$\text{Cost per piece for HW-3 and 4} = \frac{\$35,902.69}{7,200,000} = .00498$$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Wafer Pattern Printing Hand No. HW-3

Equipment (A)

Based on 2 shifts, 4000 hrs., hourly prod. (B) 1800 and annual prod. (B) 7,200,000

	<u>Total</u>	<u>Annual Cost</u> <u>Fixed</u> xx	<u>Variable</u>
1. Material			
2. Direct Labor *			
Hrs. (C) <u>11,016</u> x Rate <u>1.6</u>	<u>\$17,625.60</u>	xx	<u>\$17,625.60</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30%	5,287.60	\$1,586.30	3,701.30
b. Mach., Equip. & Tool	1,980.40	1,609.08	371.32
c. Occupancy			
Proc. Space (D) <u>90</u> x Ratio <u>5</u> = <u>450</u> sq. ft.	xx	xx	xx
Rent <u>450</u> x <u>.80</u> =	360.00	360.00	
Light <u>450</u> x <u>.30</u> =	135.00	13.50	121.50
Heat <u>450</u> x <u>.10</u> =	<u>45.00</u>	<u>33.75</u>	<u>11.25</u>
Subtotal - a, b, and c	\$ 7,808.00		
d. Miscellaneous =			
10% x Subtotal =	<u>780.80</u>		<u>780.80</u>
Total - a, b, c, and d	<u>8,588.80</u>		
GRAND TOTALS	<u>\$26,214.40</u>	<u>\$3,602.63</u>	<u>\$22,611.77</u>

Notes:

- (A) Printing press, screens, bench & stool; cost for 3 stations = \$9,902.20
- (B) 15 ops. on one side x 40 = 600 ops/hr x 4000 hrs. = 2,400,000 ops (pcs)
 30 ops. on two sides x 40 = 1200 ops/hr x 4000 hrs. = 4,800,000 ops (pcs)
1800 pcs/hr 7,200,000 pcs annual prod.
- (C) .546 (Men/hr to make 40 Mod/hr) x 4000 hrs = 2,184 Dir. Lab. Hrs.
 2.208 " x 4000 hrs = 8,832 "
11,016
- (D) Based on 30 sq. ft. x 3 Stations (for both Ops) = 90 sq. ft.

$$\text{Cost per piece} = \frac{\$26,214.40}{7,200,000} = .00364$$

This cost is based on printing six wafers at one time instead of one as at present.

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Wafer Pattern Firing Hand No. HW-4

Equipment Curing Oven (A)

Based on 2 shifts, 4000 hrs., hourly prod. 1800 and annual prod. 7,200,000 (B)

<u>Item</u>	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor = Hrs. <u>3168</u> (C) x Rate <u>1.6</u> *	<u>\$5,068.80</u>	xx	<u>\$5,068.80</u>
3. Manufacturing Overhead			
a. Indirect Labor	1,520.64	\$ 456.19	1,064.45
b. Mach., Equip. & Tool	2,472.50	827.75	1,644.75
c. Occupancy =			
Proc. Space <u>172</u> x Ratio <u>1</u> = <u>172 sq. ft.</u>	xx	xx	xx
Rent <u>172</u> x <u>.8</u> =	137.60	137.60	
Light <u>172</u> x <u>.3</u> =	51.60	5.16	46.44
Heat <u>172</u> x <u>.1</u> =	17.20	12.90	4.30
Subtotal - a, b, and c	\$4,199.54		
d. Miscellaneous = 10% x Subtotal	419.95		419.95
Total - a, b, c, and d	<u>4,619.49</u>		
GRAND TOTALS	\$9,688.29	\$1,439.60	\$8,248.69

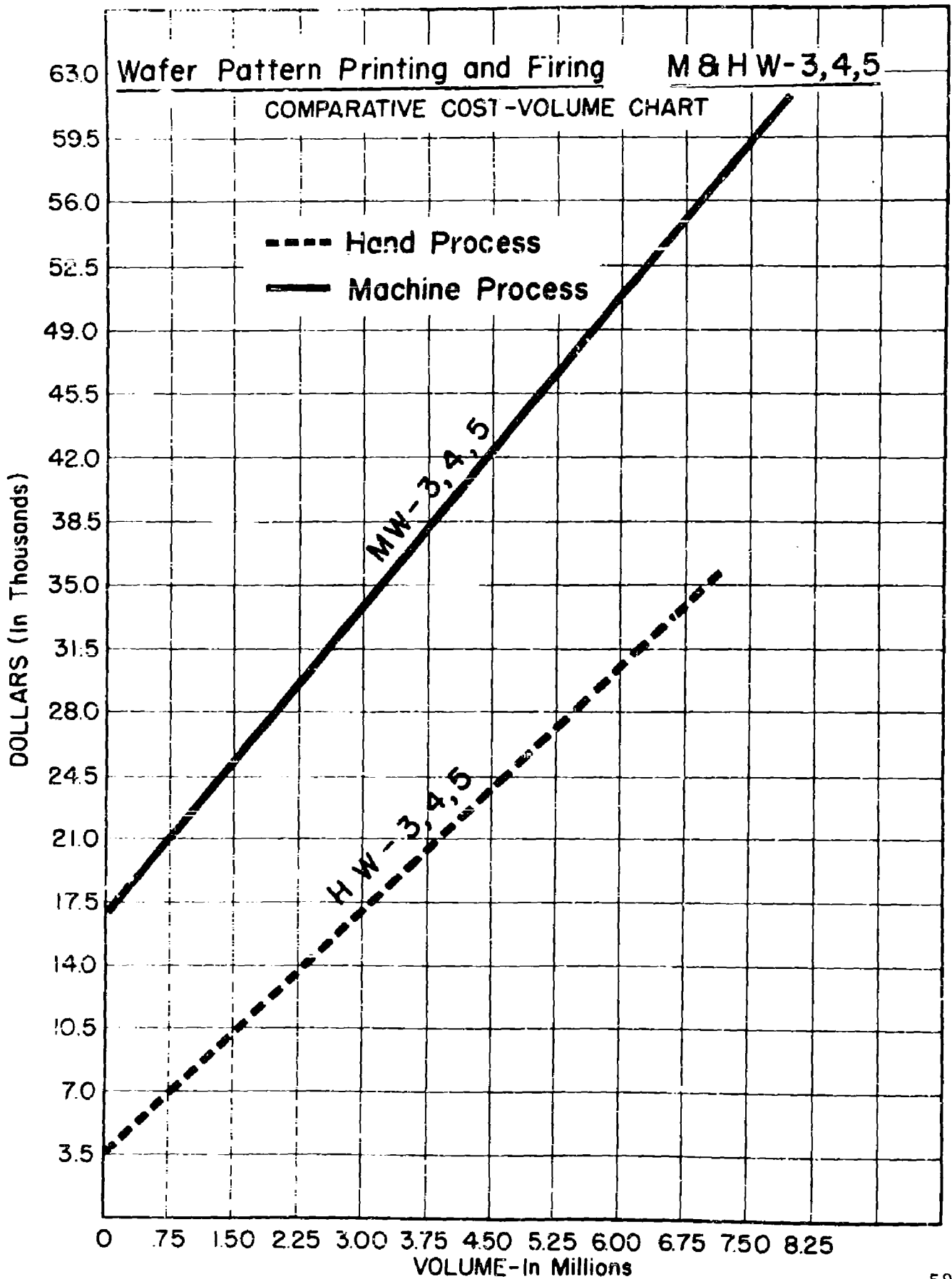
Notes:

(A) Cost of equipment = \$4,730

(B) 45 Wafers/module x 40 modules/hr = 1800 hrly prod. x 4,000 = annual prod.

(C) .7920 men per hr. per 40 strips x 4000 hrs. = 3,168

$$\text{Cost per piece} = \frac{\$9,688.29}{7,200,000} = .00134$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Process Resistor Tape Application Mach. No. MR-1

Equipment 1 Resistor Tape Applicator (A)

Based on 2 shifts, 2,273 hrs., hourly prod. 1,069 and annual prod. 2,430,000

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>2,880</u> x Rate <u>1.60 (B)</u> =	<u>\$ 4,608</u>	xx	<u>\$4,608</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. 4,608 =	1,382	\$ 415	967
b. Mach., Equip. & Tool	4,762	2,541	2,221
c. Occupancy =			
Proc. Space <u>24</u> x Ratio <u>6</u> = <u>144 sq. ft.</u>			
Rent <u>144</u> x <u>1.00</u> =	144	144	---
Light <u>144</u> x <u>.30</u> =	43	4	39
Heat <u>144</u> x <u>.10</u> =	14	12	2
Subtotal - a, b, and c	<u>\$ 6,345</u>	<u>\$3,116</u>	<u>\$3,229</u>
d. Miscellaneous =			
10% of Subtotal <u>6,345</u> =	<u>635</u>	<u>312</u>	<u>323</u>
Total - a, b, c, and d	<u>6,980</u>	<u>3,428</u>	<u>3,552</u>
GRAND TOTALS	<u>\$11,588</u>	<u>\$3,428</u>	<u>\$8,160</u>

Notes:

(A) 1 Tape Applicator @ \$12,000

(B) 1 Semi-skilled @ \$1.60

Cost per piece = $\frac{\$11,588}{2,430,000} = .00477$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Resistor Tape Application & Inspec. Hand No. HR-1 & 1b

Equipment

Based on 2 shifts, 4,000 hrs. , hourly prod. _____ and annual prod. 2,400,000 wafers

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
HR-1	\$27,358.19	\$2,238.29	\$25,119.90
HR-1b	<u>29,012.72</u>	<u>2,540.65</u>	<u>26,472.07</u>
Total	<u>\$56,370.91</u>	<u>\$4,778.94</u>	<u>\$51,591.97</u>

Notes:

Cost per piece = $\frac{\$56,370.91}{2,400,000 \text{ wafers}}$ = .0235

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Resistor Tape Application Hand No. HR-1

Equipment (A) _____

Based on 2 shifts, 4,000 hrs., hourly prod. (B) and annual prod. (C) 2,560,000

Item	Total	Annual Costs	
		Fixed	Variable
1. Material		xx	
2. Direct Labor = Hrs. <u>(D) 12,563.2</u> x Rate <u>1.6</u> =	<u>\$ 20,101.12</u>	xx	<u>\$ 20,101.12</u>
3. Manufacturing Overhead			
a. Ind. Lab. = <u>30% of Dir. 20,101.12</u> =	6,030.34	\$ 1,809.10	4,221.24
b. Mach., Equip. & Tool	27.00	21.94	5.06
c. Occupancy =			
Proc. Space <u>(E) 90</u> x Ratio <u>5</u> = <u>450</u> sq. ft.			
Rent <u>450 x .8</u> =	360.00	360.00	
Light <u>450 x .3</u> =	135.00	13.50	121.50
Heat <u>450 x .1</u> =	45.00	33.75	11.25
Subtotal - a, b, and c	6,597.34		
d. Miscellaneous =			
10% of Subtotal <u>6,597.34</u> =	659.73		659.73
Total - a, b, c, and d	<u>7,257.07</u>		
GRAND TOTALS	\$ 27,358.19	\$ 2,238.29	\$ 25,119.90

Notes:

(A) Bench, stool, cutting tools; cost for 3 stations - \$135.00

(B) Use net 600 for comparative costs.

(C) 11 op's. on one side x 40 = 440/hr. x 4,000 = 1,760,000
5 op's. on two sides x 40 = 200/hr. x 4,000 = 800,000
2,560,000 pcs. annual prod.

(D) 1.9008 (men/hr. to make 40 mod./hr. x 4,000 hrs. = 7,603.2 Dir. lab. hrs.
1.240 " " x 4,000 hrs. = 4,960.0 "
12,563.2

(E) Based on 30 sq. ft. per station x 3 stations = 90 sq. ft.

Cost per piece = $\frac{\$27,358.19}{2,560,000} = .0107$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process: Curing Resistor Tape Hand No. HR-1a

Equipment *

Based on 2 shifts, 4000 hrs., hourly prod. 600 and annual prod. 2,400,000

	Annual Costs		
	Total	Fixed	Variable
1. Material		xx	
2. Direct Labor =			
Hrs. <u>1,126.40</u> x Rate <u>1.6</u> =	<u>\$1,802.24</u>	xx	<u>\$1,802.24</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>1,802.24</u> =	540.67	\$162.20	378.47
b. Mach., Equip. & Tool	805.00	269.50	535.50
c. Occupancy =			
Proc. Space <u>56</u> x Ratio <u>5</u> = <u>280 sq. ft.</u>			
Rent <u>.8</u> x 280 =	224.00	224.00	---
Light <u>.3</u> x 280 =	84.00	8.40	75.60
Heat <u>.1</u> x 280 =	28.00	21.00	7.00
Subtotal - a, b, and c	<u>\$1,681.67</u>		
d. Miscellaneous =			
10% x Subtotal <u>1,681.67</u> =	<u>168.17</u>		<u>168.17</u>
Total - a, b, c, and d	<u>1,849.84</u>		
GRAND TOTALS	<u>\$3,652.08</u>	<u>\$685.10</u>	<u>\$2,966.98</u>

Notes:

* Curing oven (used for other curing ops.; cost distr. on basis of pieces)

15 ops x 40 = hrly prod x 4,000 = 2,400,000 annual prod.

.28160 x 4,000 = 1,126.40 Dir. Lab. Hrs.

Cost per piece = $\frac{\$3,652.08}{2,400,000 \text{ pcs.}}$ = .00152

This operation is being performed in current model shop manufacture, but is not included in the projected hand process manufacture. The protective tape curing operation (HR-3) is included.

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Inspecting Resistor Tape Hand No. HR-1b

Equipment Benches, stools, elect. testing instr.

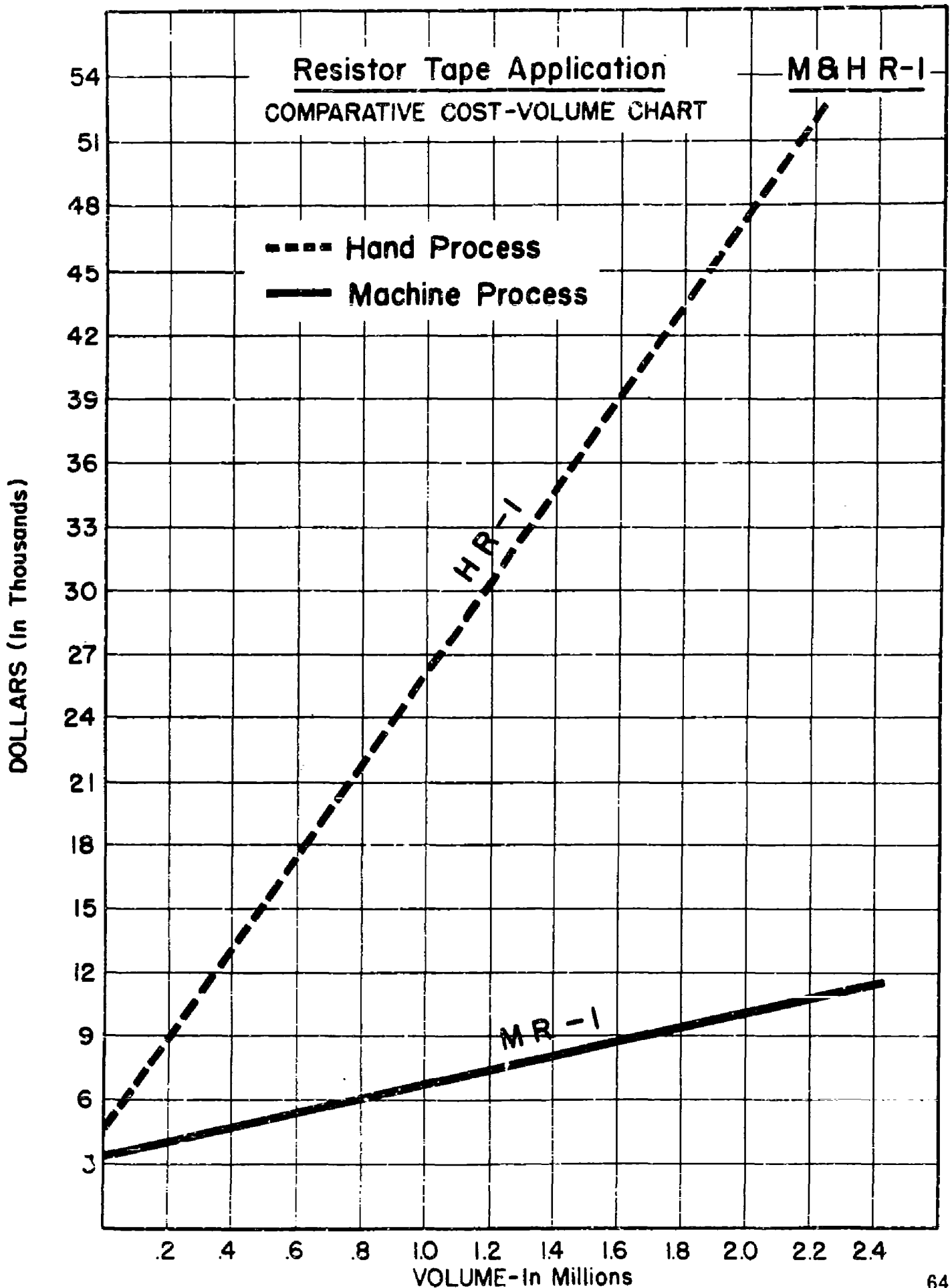
Based on 2 shifts, 4,000 hrs., hourly prod. 600 and annual prod. 2,400,000 (B)
(640 Inspections) (2,560,000 Inspections)

	Total	Annual Cost	
		Fixed	Variable
1. Material	---	xx	---
2. Direct Labor = Hrs. <u>13,200</u> (C) x Rate <u>1.6</u>	<u>\$21,120.00</u>	xx	<u>\$21,120.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>21,120.00</u> =	6,336.00	\$ 1,900.80	4,435.20
b. Mach., Equip. & Tool	119.20	96.85	22.35
c. Occupancy = Proc. Space <u>120</u> (D) x Ratio <u>5</u> = <u>600</u> Sq. ft.			
Rent <u>.8</u> x <u>600</u> =	480.00	480.00	---
Light <u>.3</u> x <u>600</u> =	180.00	18.00	162.00
Heat <u>.1</u> x <u>600</u> =	60.00	45.00	15.00
Subtotal - a, b, and c	7,175.20		
d. Miscellaneous = 10% x Subtotal <u>7,175.20</u> =	717.52		717.52
Total - a, b, c, and d	<u>7,892.72</u>		
GRAND TOTALS	<u>\$ 29,012.72</u>	<u>\$2,540.65</u>	<u>\$26,472.07</u>

Notes:

- (A) Cost of equipment for 4 stations = \$596.
 (B) 15 ops x 40 = 600 hrly prod x 4,000 = 2,400,000 annual prod.
 (C) 3.30 x 4,000 = 13,200 Dir. Lab. Hrs.
 (D) 4 stations x 30 sq. ft. = 120 sq. ft.

$$\text{Cost per piece} = \frac{\$29,012.72}{2,400,000} = .0121$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Process Protective Tape Application Mach. No. MR-2

Equipment 1-Protective Tape Applicator (A)

Based on 2 shifts, 2275 hrs., hourly prod. 1069 and annual prod. 2,430,000

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material	---	xx	---
2. Direct Labor =			
Hrs. <u>2,880</u> x Rate <u>1.60 (B)</u> =	\$ <u>4,608.00</u>	xx	<u>\$4,608.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>4,608</u> =	1,382.00	\$ 415.00	967.00
b. Mach., Equip. & Tool	4,762.00	2,541.00	2,221.00
c. Occupancy =			
Proc. Space <u>24 x Ratio 6 = 144 sq. ft.</u>			
Rent <u>1.00 x 144</u> =	144.00	144.00	---
Light <u>.30 x 144</u> =	43.00	4.00	39.00
Heat <u>.10 x 144</u> =	14.00	12.00	2.00
Subtotal - a, b, and c	\$ 6,345.00	\$3,116.00	\$3,229.00
d. Miscellaneous =			
10% x Subtotal <u>6,345</u> =	635.00	312.00	323.00
Total - a, b, c and d	<u>6,980.00</u>	<u>3,428.00</u>	<u>3,552.00</u>
GRAND TOTAL	<u>\$11,588.00</u>	<u>\$3,428.00</u>	<u>\$8,160.00</u>

Notes:

(A) 1 Tape applicator = \$12,000

(B) 1 Semi-skilled = \$1.60

Cost per piece = $\frac{\$11,588}{2,430,000}$ = .00477

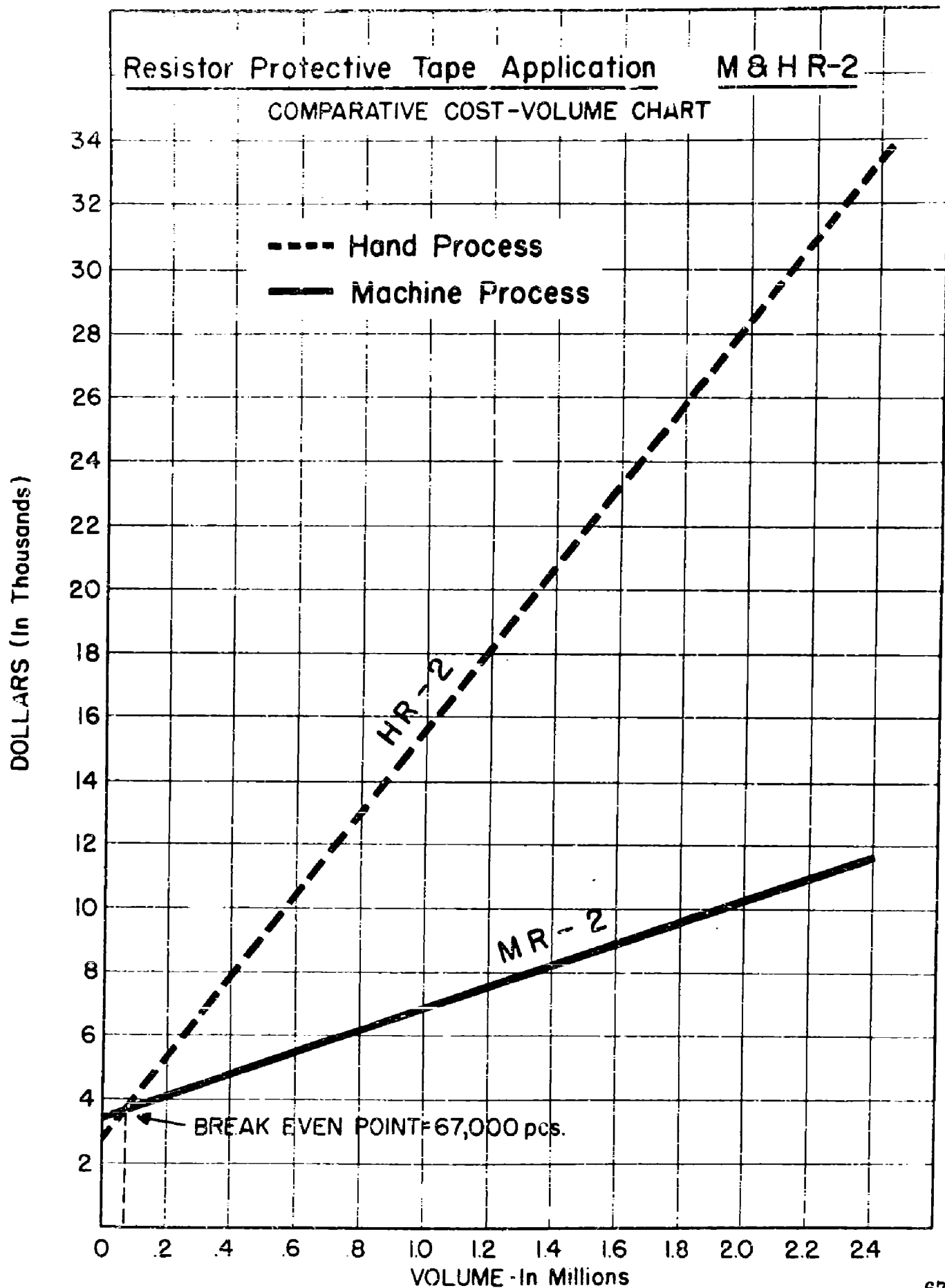
PROJECT TINKERTOY -- Manufacturing Cost Data

Process	Resistor Protective - Tape Application	Hand	No.	HR-2
Equipment	(A)			
Based on <u>2</u> shifts, <u>4000</u> hrs., hourly prod. (B) <u>600</u> and annual prod. <u>2,400,000</u> (B)				
	Total	Annual Costs		
	---	Fixed	Variable	
		xx	---	
1. Material				
2. Direct Labor =				
Hrs. (C) <u>15,488</u> x Rate <u>1.6</u> =	<u>\$24,780.80</u>	xx		<u>\$24,780.80</u>
3. Manufacturing Overhead				
a. Ind. Lab. = 30%	7,434.24	\$2,230.27		5,203.97
b. Mach., Equip. & Tool	49.20	39.98		9.22
c. Occupancy =				
Proc. Space (D) <u>120</u> x Ratio <u>5</u> = <u>600</u> sq. ft.				
Rent <u>.80</u> x <u>600</u> =	480.00	480.00		---
Light <u>.30</u> x <u>600</u> =	180.00	18.00		162.00
Heat <u>.10</u> x <u>600</u> =	60.00	45.00		15.00
Subtotal - a, b, and c	\$ 8,203.44	---		---
d. Miscellaneous = 10% x Subtotal	820.34	---		820.34
Total - a, b, c, and d	<u>9,023.78</u>	---		---
GRAND TOTAL	<u>\$33,804.58</u>	<u>\$2,813.25</u>		<u>\$30,991.33</u>

Notes: (A) Tape Press, Bench, Stool; cost for 4 stations = \$246.40
 (B) 7 operators on one side x 40 = 280 x 4000 = 1,120,000
 8 operators on two sides x 40 = 320 x 4000 = 1,280,000
 600 2,400,000 pcs. Annual Prod.
 (C) 1.3664 (men/hr to make 40 modules/hr) x 4000 hrs = 5,465.6) Direct
 10,022.4) Labor
 15,488.0) Hrs.

(D) Based on 30 sq. ft. per station x 4 stations = 120 sq. ft.

$$\text{Cost per piece} = \frac{\$33,804.58}{2,400,000} = .0141$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Process Resistor and Protective Tape Curing Mach. No. MR-3

Equipment 1 Oven (A)

Based on 2 shifts, 2,273 hrs., hourly prod. 1,069 and annual prod. 2,430,000

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor = Hrs. (B) x Rate =	---	xx	---
3. Manufacturing Overhead			
a. Ind. Lab. = _____ % of Dir. =	---	--	---
b. Mach., Equip. & Tool	\$2,588	\$1,628	\$ 960
c. Occupancy = Proc. Space $60 \times \text{Ratio } 6 = 360 \text{ sq. ft.}$			
Rent $360 \times 1.00 =$	360	360	---
Light $360 \times .30 =$	108	11	97
Heat $360 \times .10 =$	36	27	9
Subtotal - a, b, and c	\$3,092	\$2,026	\$1,066
d. Miscellaneous = 10% :: Subtotal <u>3,092</u> =	309	203	106
Total - a, b, c, and d	-----	-----	-----
GRAND TOTALS	<u>\$3,401</u>	<u>\$2,229</u>	<u>\$1,172</u>

Notes:

(A) 1 Oven = \$9,000

(B) Direct Labor included in MR-2

$$\text{Cost per piece} = \frac{\$3,401}{2,430,000} = .00141$$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Curing Protective Tape Hand No. HR-3

Equipment Oven (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 600 wafers and annual prod.
2,400,000 wafers (B)

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>1,126.40 (C)</u> x Rate <u>1.6</u> =	<u>\$1,802.24</u>	xx	<u>\$1,802.24</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. 1,802.24 =	540.67	\$ 162.20	378.47
b. Mach., Equip. & Tool	805.00	685.30	119.70
c. Occupancy =			
Proc. Space <u>56 * x Ratio 5 = 280 sq. ft.</u>			
Rent <u>280 x .8</u> =	224.00	224.00	---
Light <u>280 x .3</u> =	84.00	8.40	75.60
Heat <u>280 x .1</u> =	28.00	21.00	7.00
Subtotal - a, b, and c	\$1,681.67		
d. Miscellaneous =			
10% x Subtotal <u>1,681.67</u> =	168.17		168.17
Total - a, b, c, and d	<u>1,849.84</u>		
GRAND TOTALS	\$3,652.08	\$1,100.90	\$2,551.18

Notes:

* Pro Rata

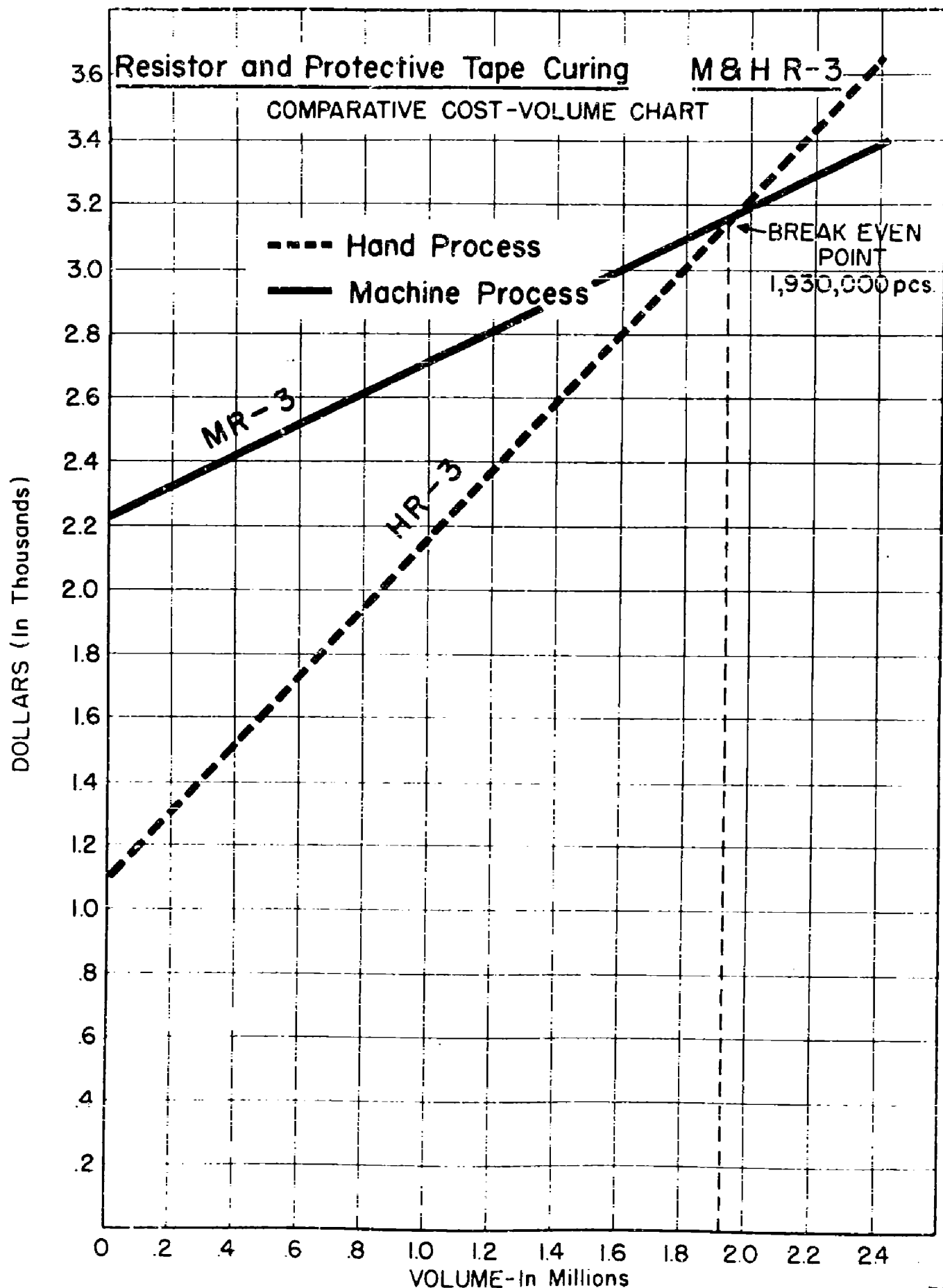
(A) Cost of Equipment = \$1,540

(B) 16 ops x 40 = 640 hrly. prod. x 4,000 = 2,560,000 annual prod. (ops.)

(C) .28160 x 4,000 = 1,126.40 Dir. Lab. Hrs.

Cost per operation = $\frac{\$3,652.08}{2,560,000 \text{ ops}} = .00143$

Cost per wafer = $\frac{\$3,652.08}{2,400,000 \text{ wafers}} = .00152$



PROJECT TINKERTOY -- Manufacturing Cost Data

Process Resistor Wafer Notch Solder Filling Mach. No. MR-4

Equipment 2 Notch Tanners (A)

Based on 2 shifts, 2,978 hrs., hourly prod. 816 and annual prod. 2,430,000

	<u>Total</u>	<u>Annual Costs</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>3,600</u> x Rate <u>2.40 (B)</u> =	<u>\$ 8,640</u>	xx	<u>\$ 8,640</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. 8,640 =	2,592	\$ 778	1,814
b. Mach., Equip. & Tool	4,743	2,435	2,308
c. Occupancy =			
Proc. Space <u>50</u> x Ratio <u>6</u> = <u>300 sq. ft.</u>			
Rent <u>300</u> x <u>1.00</u> =	300	300	---
Light <u>300</u> x <u>.30</u> =	90	9	81
Heat <u>300</u> x <u>.10</u> =	30	24	6
Subtotal - a, b, and c	<u>\$ 7,755</u>	<u>\$3,546</u>	<u>\$ 4,209</u>
d. Miscellaneous =			
10% x Subtotal <u>7,755</u> =	<u>776</u>	<u>355</u>	<u>421</u>
Total - a, b, c, and d	<u>8,531</u>	<u>3,901</u>	<u>4,630</u>
GRAND TOTALS	<u>\$17,171</u>	<u>\$3,901</u>	<u>\$13,270</u>

Notes:

(A) 2 Tanners @ \$5,750 = \$11,500
(B) 2 Unskilled @ \$1.20 = \$2.40

Cost per piece = $\frac{\$17,171}{2,430,000} = .00707$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Resistor-Wafer Notch Solder Filling Hand No. HR-4

Equipment (A)

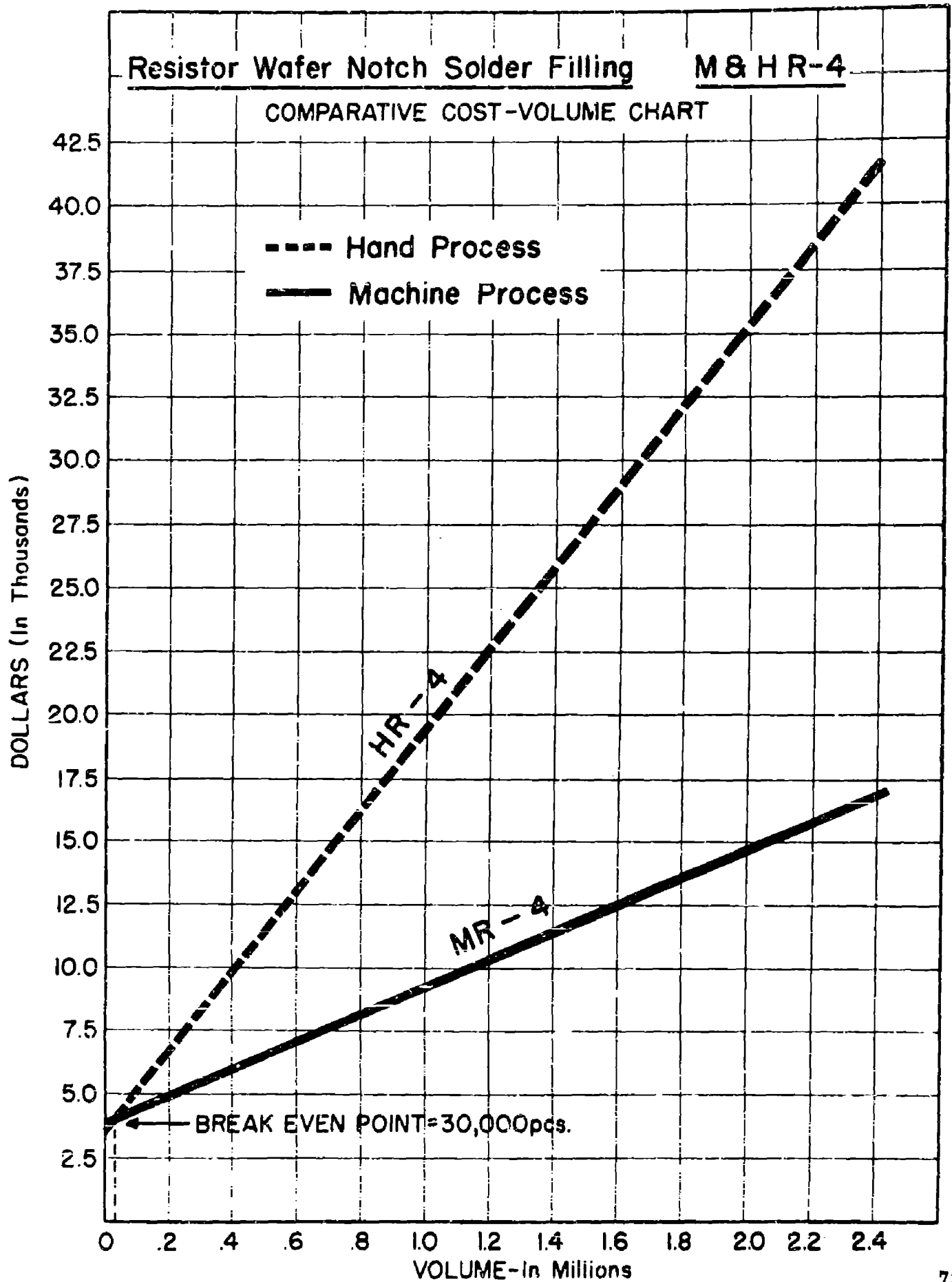
Based on 2 shifts, 4000 hrs., hourly prod. 600 and annual prod. 2,400,000 (B)

	Annual Costs		
	Total	Fixed	Variable
1. Material	---	xx	---
2. Direct Labor =			
Hrs. <u>19,008</u> (C) x Rate <u>1.6</u> =	<u>\$30,412.80</u>	xx	<u>\$30,412.80</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>30,412.80</u>	9,123.84	\$2,737.15	6,386.69
b. Mach., Equip. & Tool	187.60	152.43	35.17
c. Occupancy =			
Proc. Space <u>150</u> (D) x Ratio <u>5</u> = <u>750</u> sq. ft.			
Rent <u>.8 x 750</u> =	600.00	600.00	
Light <u>.3 x 750</u> =	225.00	25.00	200.00
Heat <u>.1 x 750</u> =	75.00	56.25	18.75
Subtotal - a, b, and c	\$10,211.44		
d. Miscellaneous =			
10% x Subtotal <u>10,211.44</u> =	<u>1,021.14</u>		
Total - a, b, c, and d	<u>11,232.58</u>		
GRAND TOTALS	<u>\$41,645.38</u>	<u>\$3,570.83</u>	<u>\$38,074.55</u>

Notes:

- (A) Solder pots, cleaning & rinsing pans, bench, stool, tweezers, hood. Cost of equipment - \$938.
- (B) 15 ops x 40 = 600/hr x 4,000 = 2,400,000
- (C) 4.752 x 4,000 = 19,008 Dir. Lab. Hrs.
- (D) 5 stations x 30 sq. ft. = 150 sq. ft.

$$\text{Cost per piece} = \frac{\$41,645.38}{2,400,000 \text{ pcs}} = .0174$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Process Resistor Inspection Mach. No. MR-5

Equipment 2 Resistor Assembly Testers (A)

Based on 2 shifts, 2,490 hrs., hourly prod. 976 and annual prod. 2,430,000

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor = Hrs. <u>3,086</u> x Rate <u>4.80 (B)</u> =	<u>\$14,784</u>	xx	<u>\$14,784</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. 14,784	4,435	\$1,331	3,104
b. Mach., Equip. & Tool	8,821	4,658	4,163
c. Occupancy = Proc. Space <u>82</u> x Ratio <u>6</u> = <u>492 sq. ft.</u>			
Rent <u>492</u> x <u>1.00</u> =	492	492	---
Light <u>492</u> x <u>.30</u> =	148	15	133
Heat <u>492</u> x <u>.10</u> =	49	36	13
Subtotal - a, b, and c	<u>\$13,945</u>	<u>\$6,532</u>	<u>\$ 7,413</u>
d. Miscellaneous = 10% x Subtotal <u>13,945</u> =	<u>1,395</u>	<u>653</u>	<u>742</u>
Total - a, b, c, and d	<u>15,340</u>	<u>7,185</u>	<u>8,155</u>
GRAND TOTALS	<u>\$30,124</u>	<u>\$7,185</u>	<u>\$22,939</u>

Notes:

- (A) 2 Testers @ \$11,000 = \$22,000
(B) 2 Highly Skilled @ \$2.40 = \$4.80

$$\text{Cost per piece} = \frac{\$30,124}{2,430,000} = .0124$$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Resistor Inspection Hand No. HR-5

Equipment Benches, stools, testing equipment

Based on 2 shifts, 4000 hrs., hourly prod. 600 and annual prod. 2,400,000

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor = Hrs. <u>13,200</u> x Rate <u>1.6</u> =	<u>\$21,120.00</u>	xx	<u>\$21,120.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. 21,120.00	6,336.00	\$1,900.80	4,435.20
b. Mach., Equip. & Tool	95.40	77.51	17.89
c. Occupancy = Proc. Space <u>120</u> x Ratio <u>5</u> = <u>600 sq. ft.</u>			
Rent <u>.8 x 600</u> =	480.00	480.00	
Light <u>.3 x 600</u> =	180.00	18.00	162.00
Heat <u>.1 x 600</u> =	60.00	45.00	15.00
Subtotal - a, b, and c	\$ 7,151.40		
d. Miscellaneous = 10% of Subtotal <u>7,151.40</u>	<u>715.14</u>		<u>715.14</u>
Total - a, b, c, and d	<u>7,866.54</u>		
GRAND TOTALS	<u>\$28,986.54</u>	<u>\$2,521.31</u>	<u>\$26,465.23</u>

Notes:

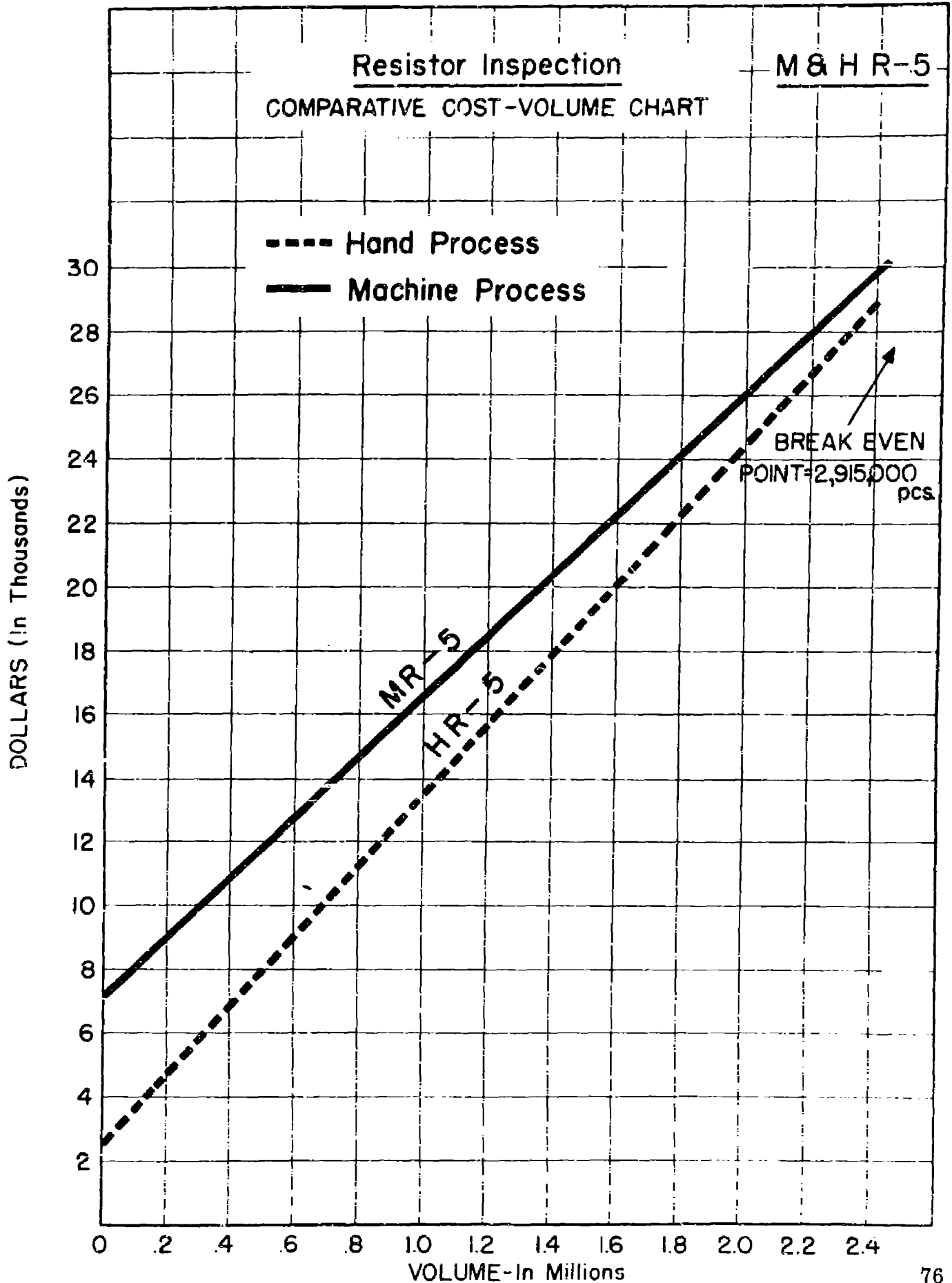
15 ops x 40 = 600 ops/m x 4,000 = 2,400,000 annual prod.

3.3 x 4,000 = 13,200 Dir. Lab. Hrs.

4 stations x 30 sq. ft. = 120

Cost of equipment = \$477

Cost per piece = $\frac{\$28,986.54}{2,400,000} = .0121$



PROJECT TINKERTOY -- Manufacturing Cost Data

Process	Capacitor Wafer Pattern Tinning	Mach.	No.	MC-1
Equipment	3-Surface Tanners (A)			
Based on <u>2</u> shifts, <u>4000</u> hrs. , hourly prod. <u>1276</u> and annual prod. <u>5,184,000</u> (B)				
			<u>Annual Cost</u>	
		<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		---	xx	---
2. Direct Labor =				
Hrs. <u>4000</u> x Rate <u>4.80</u> (C) =		<u>\$19,200</u>	xx	<u>\$19,200</u>
3. Manufacturing Overhead				
a. Ind. Lab. = 30% of Dir. 19,200 =		5,760	\$1,728	4,032
b. Mach. , Equip. & Tool		3,732	3,420	312
c. Occupancy =				
Proc. Space <u>66</u> x Ratio <u>6</u> = <u>396</u> sq. ft.				
Rent <u>396</u> x <u>1.00</u> =		396	396	---
Light <u>396</u> x <u>.30</u> =		119	12	107
Heat <u>396</u> x <u>.10</u> =		40	30	10
Subtotal - a, b, and c		\$10,047	\$5,586	\$ 4,461
d. Miscellaneous =				
10% x Subtotal <u>10,047</u> =		<u>1,005</u>	<u>559</u>	<u>446</u>
Total - a, b, c, and d		<u>11,052</u>	<u>6,145</u>	<u>4,907</u>
GRAND TOTALS		\$30,252	\$6,145	\$24,107

Notes:

- (A) 3-Surface Tanners @ \$7,600 for capacitor and tube socket pattern tinning.
- (B) This total is composed of:
Capacitor wafers = 3,390,000
Tube socket wafers = 1,794,000
- (C) 3 Semi-skilled @ \$1.60 = \$4.80

$$\text{Cost per piece} = \frac{\$30,252}{5,184,000} = .00584$$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Capacitor Wafer Pattern Tinning Hand No. HC-1

Equipment (A)

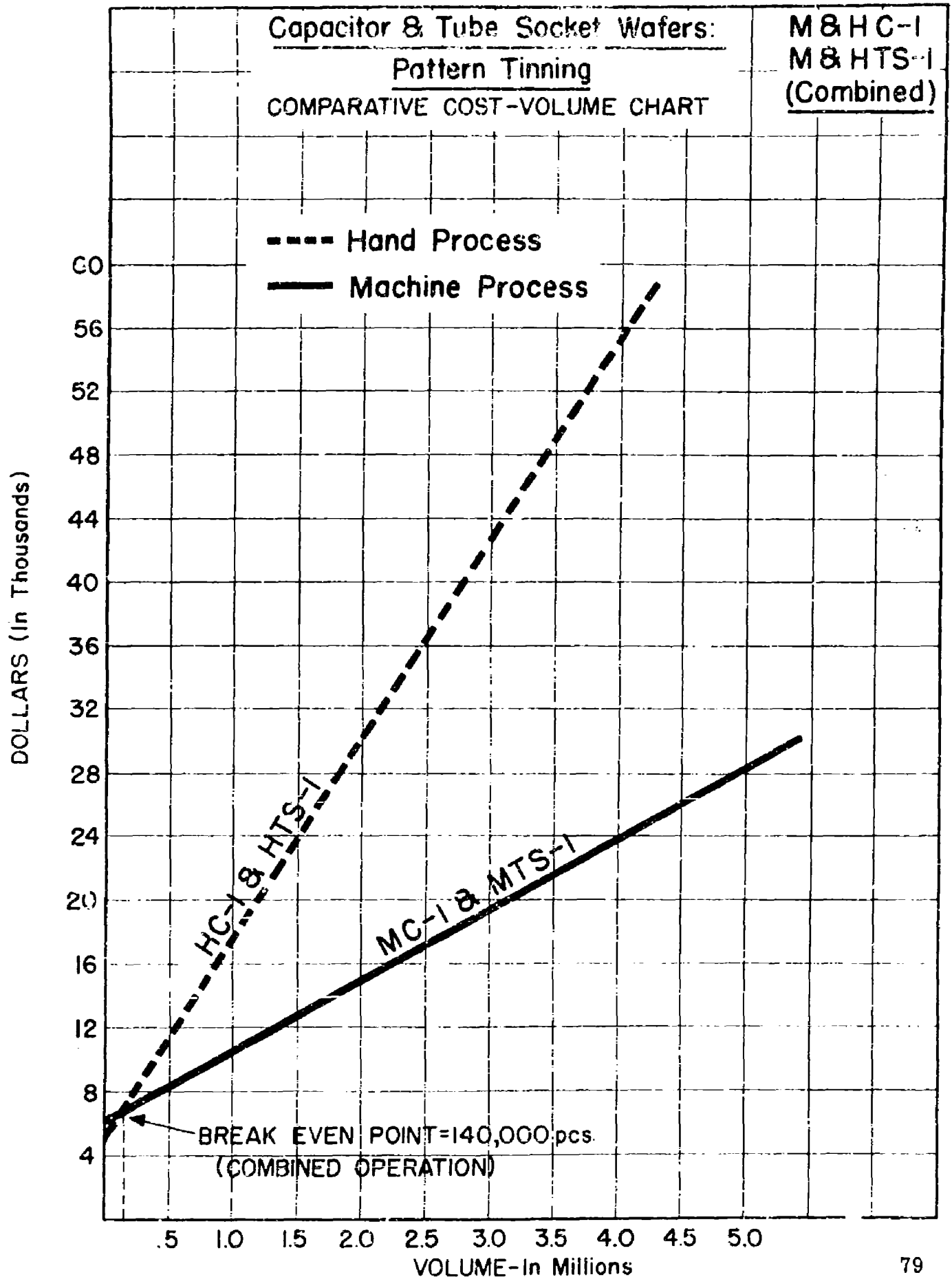
Based on 2 shifts, 4000 hrs., hourly prod. 720 (B) and annual prod. 2,880,000

	Annual Cost		
	Total	Fixed	Variable
1. Material	---	xx	---
2. Direct Labor = Hrs. <u>18,374</u> (C) x Rate <u>1.6</u> =	<u>\$29,399.00</u>	xx	<u>\$29,399.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>29,399</u> =	8,819.70	\$2,645.91	6,173.79
b. Mach., Equip. & Tool	187.60	152.43	35.17
c. Occupancy = Proc. Space <u>150</u> (D) x Ratio <u>5</u> = <u>750</u> sq. ft.			
Rent <u>.80 x 750</u> =	600.00	600.00	
Light <u>.30 x 750</u> =	225.00	22.50	202.50
Heat <u>.10 x 750</u> =	75.00	56.25	18.75
Subtotal - a, b, and c	\$ 9,907.30	---	---
d. Miscellaneous = 10% x Subtotal 9,907.30 =	990.73	---	990.73
Total - a, b, c and d	<u>10,898.03</u>		
GRAND TOTALS	<u>\$40,297.03</u>	<u>\$3,477.09</u>	<u>\$36,819.94</u>

- Notes: (A) Solder pots, tweezers, overhead hood, bench and stool.
Cost for 5 stations = \$938.
(B) 18 wafers/module x 40 modules/hr = 720/hr
(C) 4,5936 men/hr for 40 modules/hr x 4000 hrs = 18,374 hrs
(D) 5 stations required @ 30 sq. ft. each = 150 sq. ft.

$$\text{Cost per piece} = \frac{\$40,297.03}{2,880,000} = .014$$

The following chart, Schedule B-8c, reflects the combined capacitor and tube socket pattern tinning operations. (See B-8a, and B-15a)



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Painting and Firing Mach No. MC-2 & 3

Equipment See MC-2 & 3 Data Sheets

Based on 2 Shifts, 3840 Hrs., Hourly prod. 1350 and annual prod. 5,184,000 bodies

		<u>Annual Costs</u>		
		<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
	MC-2	\$26,493.00	\$6,348.00	\$20,145.00
	MC-3	<u>5,258.00</u>	<u>2,724.00</u>	<u>2,534.00</u>
	TOTAL	\$31,751.00	\$9,072.00	\$22,679.00

Notes:

Cost per piece for MC-2 and 3 = $\frac{\$31,751.00}{5,184,000} = .00612$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Painter Mach. No. MC-2
Equipment 2-Capacitor Body Pattern Painters (A)
Based on 2 Shifts, 3840 Hrs., Hourly Prod. 1350 and annual Prod. 5,184,000 Bodies

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =	<u>\$12,800</u>	xx	<u>\$12,800</u>
Hrs. <u>4000</u> x Rate <u>3.80 (B)</u> =			
3. Manufacturing Overhead			
a. Ind. Lab. = <u>30% of Direct \$12,800</u>	3,840	\$1,152	2,688
b. Mach., Equip. & Tool	8,121	4,234	3,887
c. Occupancy =			
Proc. space <u>58</u> x Ratio <u>6</u> = <u>348</u>			
Rent <u>348</u> x <u>\$1.00</u> =	348	348	
Light " x <u>.30</u> =	104	10	94
Heat " x <u>.10</u> =	35	27	8
<u>Subtotal - a, b, and c.</u>	<u>12,448</u>	<u>5,771</u>	<u>6,677</u>
d. Miscellaneous =			
10% x Subtotal <u>\$12,448</u>	1,245	577	668
<u>Total - a, b, c, and d</u>	<u>13,693</u>	<u>6,348</u>	<u>7,345</u>
GRAND TOTALS	<u>\$26,493</u>	<u>\$6,348</u>	<u>\$20,145</u>

Notes:

(A) 2 Printers at \$10,000 = \$20,000

(B) 2 Semi-skilled at \$1.60 = \$3.20

Cost per piece = $\frac{\$26,493}{5,184,000} = .00511$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Firing Mach. No. MC-3

Equipment 1-Furnace (A)

Based on 2 shifts, 3840 hrs., hourly prod. 1350 and annual prod. 5,184,000

<u>Item</u>	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material			
2. Direct Labor = (B)			
3. Manufacturing Overhead			
a. Ind. Lab.			
b. Machine, Equipment & Tool	\$ 1,705	\$ 1,628	\$ 2,077
c. Occupancy =			
Proc. Space <u>128 x Ratio 6 = 768 sq.ft</u>			
Rent <u>768 x 1.00 =</u>	768	768	
Light <u>768 x .30 =</u>	230	23	207
Heat <u>768 x .10 =</u>	77	57	20
Subtotal - a, b, and c	4,780	2,476	2,304
d. Miscellaneous =			
10% x Subtotal <u>4780 =</u>	478	248	230
Total - a, b, c, and	<u>5,258</u>	<u>2,724</u>	<u>2,534</u>
GRAND TOTALS	<u>\$ 5,258</u>	<u>\$2,724</u>	<u>\$2,534</u>

Notes: (A) Furnace @ \$9.00 (Also used for MW-2, Wafer Notch
Paint Firing.)

(B) Direct Labor in Operation MC-2.

Cost per piece = $\frac{\$5,258}{5,184,000} = .00101$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Printing & Firing Hand No. HC-2, 2a & 3

Equipment See HC-2, 2a & 3 Data Sheets

Based on 2 shifts, 4,000 hrs., hourly prod. 1,360 and annual prod. 5,440,000

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
HC-2	\$ 24,916.86	\$3,148.89	\$21,767.97
HC-2a	6,586.72	582.85	6,003.87
HC-3	<u>7,543.46</u>	<u>1,417.68</u>	<u>6,125.78</u>
GRAND TOTALS	<u>\$39,047.04</u>	<u>\$5,149.42</u>	<u>\$33,897.62</u>

Notes:

Cost per piece for HC2, 2a & 3 =

$$\frac{\$39,047.04}{5,440,000} = .00717$$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Printing Hand No. HC-2
Equipment (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 1,360 and annual prod. 5,440,000 (B)

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor = Hrs. <u>10,662</u> (C) x Rate <u>1.6</u> =	<u>\$ 17,060</u>	xx	<u>\$17,060</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Direct <u>17,060</u> =	5,118	\$1,535.40	3,582.60
b. Mach., Equip. & Tool	1,484.60	1,206.24	278.36
c. Occupancy = Proc. Space <u>90</u> (D) x Ratio <u>5</u> = <u>450 sq. ft.</u>			
Rent <u>450 x .80</u> =	360.00	360.00	---
Light <u>450 x .30</u> =	135.00	13.50	121.50
Heat <u>450 x .10</u> =	45.00	32.75	11.25
Subtotal - a, b, and c	\$ 7,142.60		
d. Miscellaneous = 10% of Subtotal <u>7,142.60</u> =	<u>714.26</u>	---	<u>714.26</u>
Total - a, b, c, and d	<u>7,856.86</u>		
GRAND TOTALS	<u>\$24,916.86</u>	<u>\$3,148.89</u>	<u>\$21,767.97</u>

Notes:

- (A) Capacitor Printing Press, Syntron, Rack, Bench & Stool
Cost for 3 stations = \$7,423.
(B) $34 \times 40 = 1,360$ hrly. prod. x 4,000
(C) $2.66560 \times 4,000 = 10,662$ Dir. Lab. Hrs.
(D) 3 stations x 30 sq. ft. = 90 sq. ft.

Cost per piece = $\frac{\$24,916.86}{5,440,000} = .00458$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Make Capacitor Leads Hand No. HC-2a

Equipment Benches, stools, fixture (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 1,360 and annual prod. 5,440,000 (B)

	<u>Total</u>	<u>Annual Costs</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>2,992 (C)</u> x Rate <u>1.6</u> =	<u>\$4,787.20</u>	xx	<u>\$4,787.20</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>4,787.20</u> =	1,436.16	\$430.85	1,005.31
b. Mach., Equip. & Tool	20.00	16.25	3.75
c. Occupancy =			
Proc. Space <u>30(D)</u> x Ratio <u>5</u> = <u>150 sq. ft.</u>			
Rent <u>150</u> x <u>.80</u> =	120.00	120.00	---
Light <u>150</u> x <u>.30</u> =	45.00	4.50	40.50
Heat <u>150</u> x <u>.10</u> =	15.00	11.25	3.75
Subtotal - a, b, and c	\$1,636.16		
d. Miscellaneous =			
10% of Subtotal <u>1,636.16</u> =	163.36		163.36
Total - a, b, c, and d	<u>1,799.52</u>		
GRAND TOTALS	<u>\$6,586.72</u>	<u>\$582.85</u>	<u>\$6,003.87</u>

Notes: (A) Equipment for one station = \$100.
(B) $34 \times 40 = 1,360$ hrly. prod. $\times 4,000$
(C) $.74800 \times 4,000 = 2,992$ Dir. Lab. Hrs.

Cost per piece = $\frac{\$6,586.72}{5,440,000} = .00121$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Firing Hand No. HC-3

Equipment 1 Oven (A)

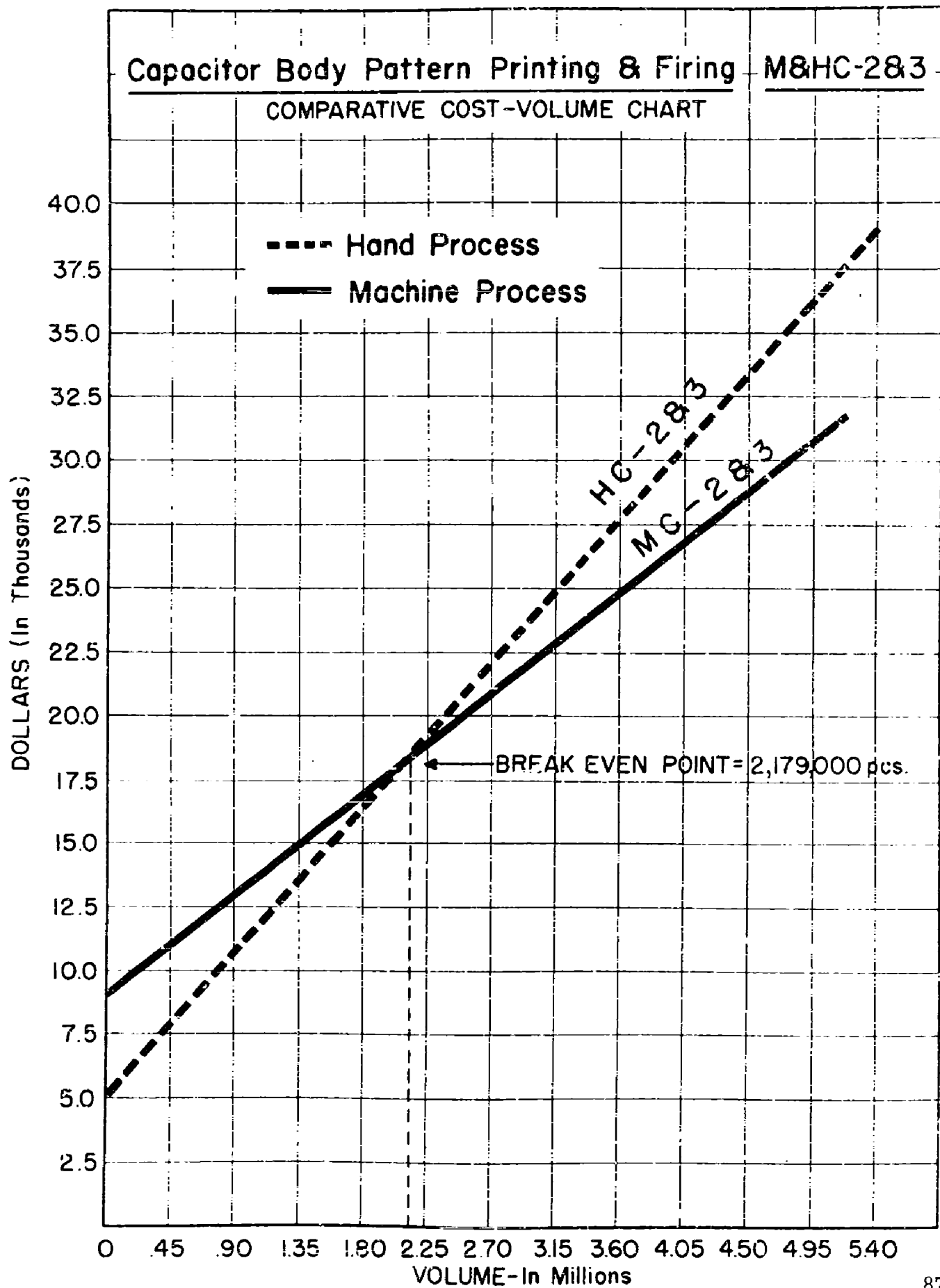
Based on 2 shifts, 4,000 hrs., hourly prod. 1,360 and annual prod. 5,440,000 (B)

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>2,323</u> (C) x Rate <u>1.6</u> =	<u>\$3,717.00</u>	xx	<u>\$3,717.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>3,717</u> =	1,115.10	\$ 334.53	780.57
b. Mach., Equip. & Tool	1,667.50	558.25	1,109.25
c. Occupancy =			
Proc. Space <u>116</u> (D) x Ratio <u>5</u> = <u>580</u> sq. ft.			
Rent <u>580</u> x .80 =	464.00	464.00	---
Light <u>580</u> x .30 =	174.00	17.40	156.60
Heat <u>580</u> x .10 =	58.00	43.50	14.50
Subtotal - a, b, and c	\$3,478.60		
d. Miscellaneous =			
10% x Subtotal <u>3,478.60</u> =	347.86	---	347.86
Total - a, b, c, and d	<u>3,826.46</u>		
GRAND TOTALS	<u>\$7,543.46</u>	<u>\$1,417.68</u>	<u>\$6,125.78</u>

Notes:

- (A) 1 oven @ \$3,190.
- (B) $34 \times 40 = 1,360 \times 4,000$
- (C) $.58080 \times 4,000 = 2,323$ Dir. Lab. Hrs.
- (D) This is oven area, in which is included all associated space requirements.

$$\text{Cost per piece} = \frac{\$7,543.46}{5,440,000} = .00138$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Testing Mach.

No. MC-4

Equipment 1 Capacitor Body Pattern Tester (A)

Based on 2 shifts, 3,134 hrs., hourly prod. 1,654 and annual prod. 5,184,000

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>3,720</u> x Rate <u>2.40 (B)</u>	<u>\$8,928</u>	xx	<u>\$8,928</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>8,928</u> =	2,678	\$ 803	1,875
b. Mach., Equip. & Tool	2,239	1,165	1,074
c. Occupancy =			
Proc. Space <u>17</u> x Ratio <u>6</u> = <u>102 sq. ft.</u>			
Rent <u>102</u> x <u>1.00</u> =	102	102	---
Light <u>102</u> x <u>.30</u> =	31	3	28
Heat <u>102</u> x <u>.10</u> =	10	9	1
Subtotal - a, b, and c	5,060	\$2,082	\$2,078
d. Miscellaneous =			
10% x Subtotal <u>5,060</u> =	506	208	298
Total - a, b, c and d	<u>5,566</u>	<u>2,290</u>	<u>3,276</u>
GRAND TOTALS	<u>\$14,494</u>	<u>\$2,290</u>	<u>\$12,204</u>

Notes: (A) 1 Tester @ \$5,500
(B) 1 Highly Skilled @ \$2.40

Cost per piece = $\frac{\$14,494}{5,184,000} = .0028$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Testing Hand No. HC-4

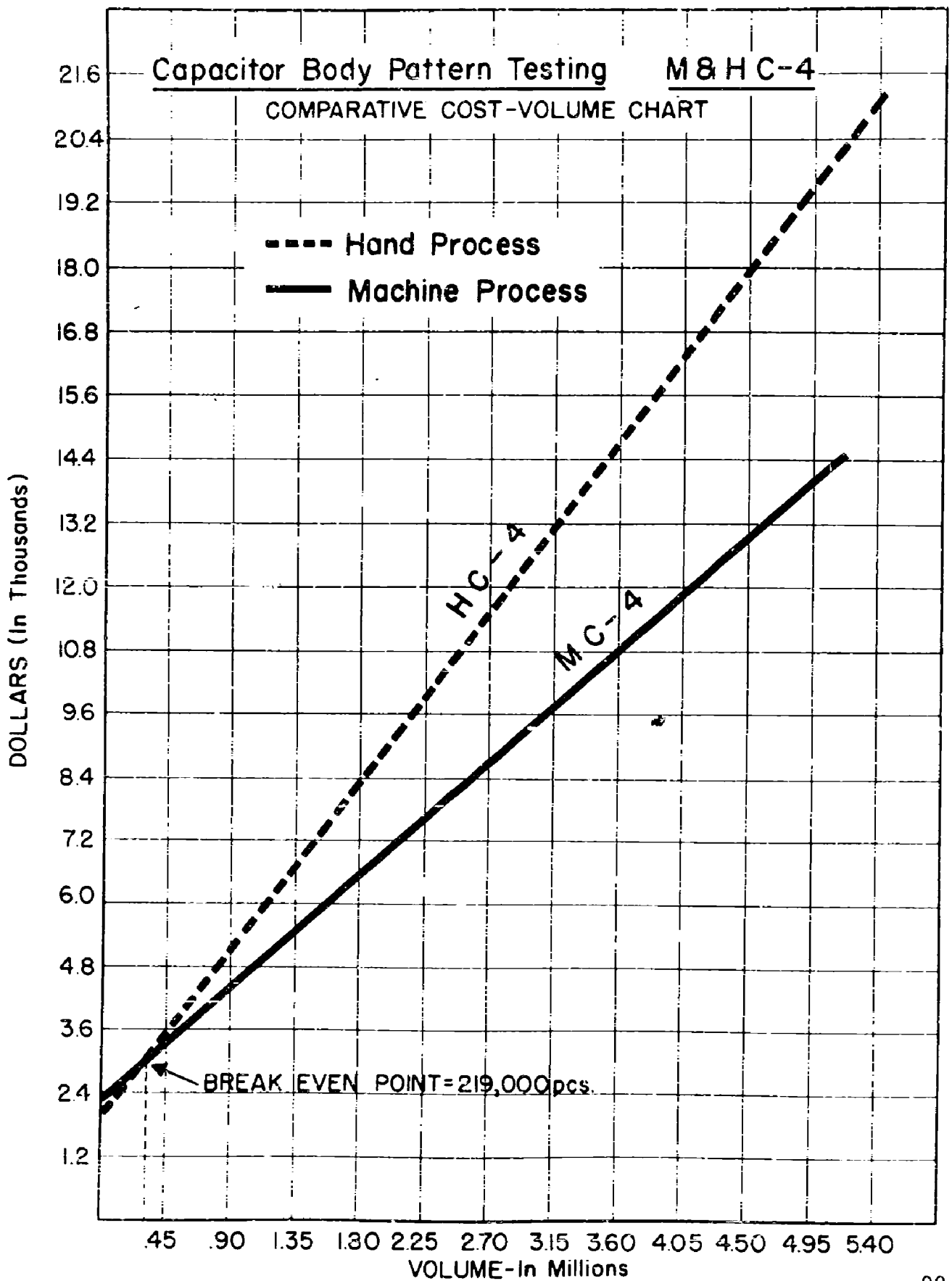
Equipment Benches, stools, electric tester (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 1,360 and annual prod. 5,440,000 (B)

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>9,574 (C)</u> x Rate <u>1.6</u> =	<u>\$15,319</u>	xx	<u>\$15,319</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>15,319</u> =	4,595.70	\$1,378.71	3,216.99
b. Mach., Equip. & Tool	324.00	263.25	60.75
c. Occupancy =			
Proc. Space <u>90 (D) x Ratio 5 = 450 sq. ft.</u>			
Rent <u>450 x .80</u> =	360.00	360.00	---
Light <u>450 x .30</u> =	135.00	13.50	121.50
Heat <u>450 x .10</u> =	45.00	33.75	11.25
Subtotal - a, b, and c	5,459.70		
d. Miscellaneous =			
10% x Subtotal <u>5,459.70</u> =	545.97		545.97
Total - a, b, c, and d	<u>6,005.67</u>		
GRAND TOTALS	<u>\$21,324.67</u>	<u>\$2,049.21</u>	<u>\$19,275.46</u>

Notes: (A) Equipment for 3 stations = \$1,620
 (B) $34 \times 40 = 1,360$ pcs./hr. $\times 4,000 = 5,440,000$
 (C) $2.39360 \times 4,000 = 9,574$
 (D) $3 \text{ stations} \times 30 \text{ sq. ft.} = 90 \text{ sq. ft.}$

Cost per piece = $\frac{\$21,324.67}{5,440,000 \text{ pcs.}} = .00392$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Tinning Mach. No. MC-5

Equipment 4 Capacitor Body Pattern Tanners (A)

Based on 2 shifts, 3,306 hrs., hourly prod. 1,568 and annual prod. 5,184,000

		<u>Annual Cost</u>	
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>3,880</u> x Rate <u>6.40 (B)</u> =	<u>\$24,832</u>	xx	<u>\$24,832</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>24,832</u> =	7,453	\$ 2,236	5,217
b. Mach., Equip. & Tool	12,409	6,436	5,973
c. Occupancy =			
Proc. Space <u>92 x Ratio 6 = 552 sq. ft.</u>			
Rent <u>552 x 1.00 =</u>	552	552	---
Light <u>552 x .30 =</u>	166	17	149
Heat <u>552 x .10 =</u>	55	42	13
Subtotal - a, b, and c	<u>\$20,635</u>	<u>\$ 9,283</u>	<u>\$11,352</u>
d. Miscellaneous =			
10% x Subtotal <u>20,635 =</u>	<u>2,064</u>	<u>928</u>	<u>1,136</u>
Total - a, b, c, and d	<u>22,699</u>	<u>10,211</u>	<u>12,488</u>
GRAND TOTALS	<u>\$47,531</u>	<u>\$10,211</u>	<u>\$37,320</u>

Notes:

(A) 4 Tanners @ \$7,600 = \$30,400

(B) 4 Semi-skilled @ \$1.60 = \$6.40

Cost per piece = $\frac{\$47,531}{5,184,000} = .00917$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body Pattern Tinning Hand No. HC-5

Equipment Benches, stools, solder pots, exhaust hood, & misc. (A)

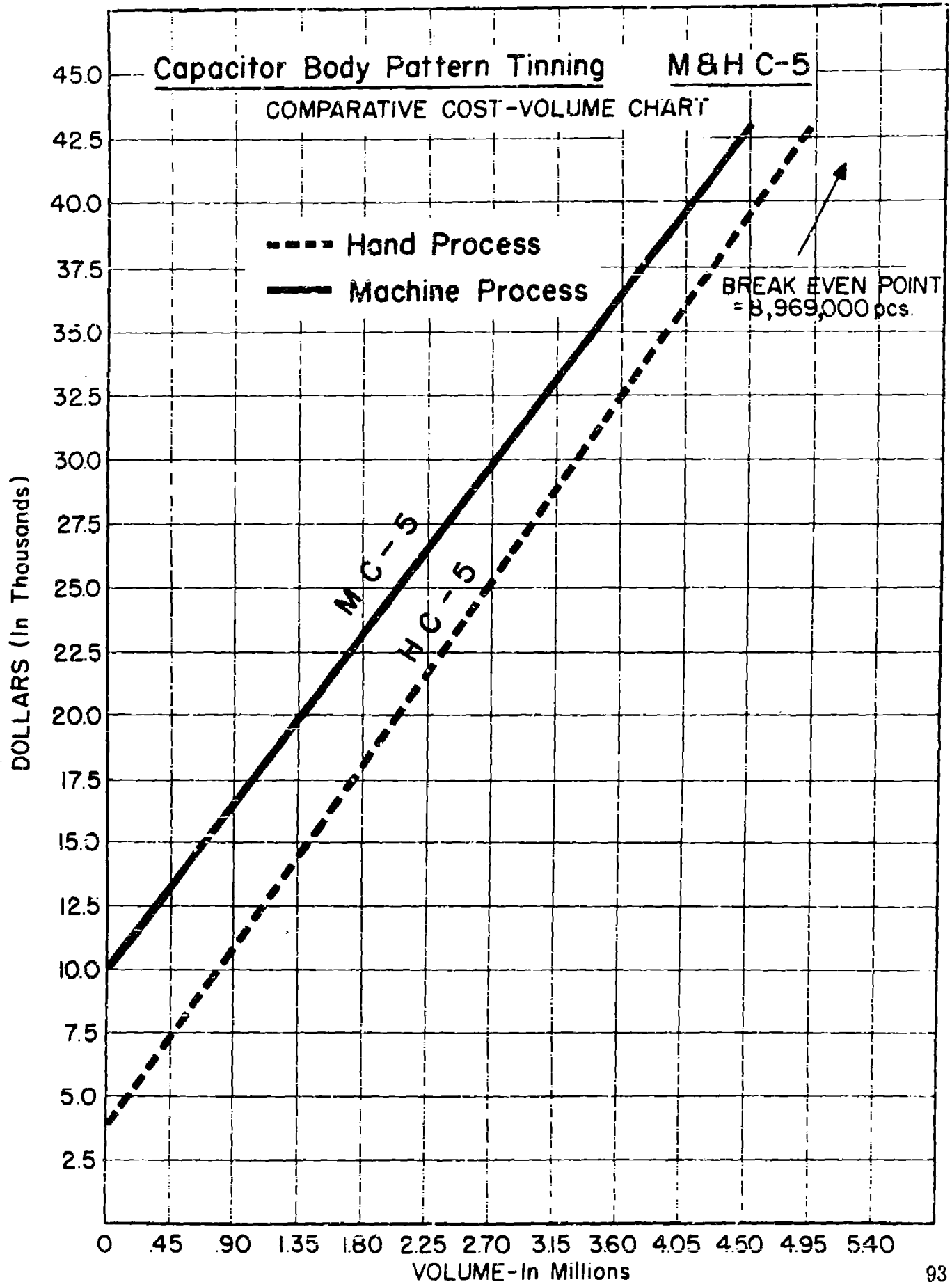
Based on 2 shifts, 4,000 hrs., hourly prod. 1,360 and annual prod. 5,440,000 (B)

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>21,524</u> (C) x Rate <u>1.6</u> =	<u>\$34,468.00</u>	xx	<u>\$34,468.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. 34,468.	10,340.40	\$3,102.12	7,238.28
b. Mach., Equip. & Tool	187.60	152.43	35.17
c. Occupancy =			
Proc. Space <u>150</u> (D) x Ratio <u>5</u> = <u>750</u> sq. ft.			
Rent <u>750 x .8</u> =	600.00	600.00	----
Light <u>750 x .3</u> =	225.00	22.50	202.50
Heat <u>750 x .1</u> =	75.00	56.25	18.75
Subtotal - a, b, and c	\$11,428.00		
d. Miscellaneous =			
10% x Subtotal <u>11,428</u> =	<u>1,142.80</u>		<u>1,142.80</u>
Total - a, b, c, and d	<u>12,570.80</u>	<u>3,933.30</u>	<u>8,637.50</u>
GRAND TOTALS	<u>\$47,038.80</u>	<u>\$3,933.30</u>	<u>\$43,105.50</u>

Notes:

- (A) Equipment for 5 stations = \$938
- (B) $34 \times 40 = 1,360$ hrly. prod. $\times 4,000 = 5,440,000$
- (C) $5.38560 \times 4,000 = 21,542$
- (D) $5 \text{ stations} \times 30 \text{ sq. ft.} = 150 \text{ sq. ft.}$

Cost per piece = $\frac{\$47,038.80}{5,440,000} = .00866$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body to Wafer Assembly Mach. No. MC-6

Equipment 3 Capacitor Assemblers (A)

Based on 2 shifts, 3,923 hrs., hourly prod. 702 and annual prod. 2,754,000

	Total	Annual Cost	
		Fixed	Variable
1. Material		xx	
2. Direct Labor =			
Hrs. 4,000 x Rate 9.60 (B) =	\$38,400	xx	\$38,400
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. \$38,000 =	11,520	\$ 3,456	8,064
b. Mach., Equip. & Tool	33,237	17,467	15,770
c. Occupancy =			
Proc. Space 264 x Ratio 6 = 1,584 sq. ft.			
Rent 1584 x 1.00 =	1,584	1,584	---
Light 1584 x .30 =	475	48	427
Heat 1584 x .10 =	158	120	38
Subtotal - a, b, and c	\$46,974	\$22,675	\$24,299
d. Miscellaneous =			
10% x Subtotal 46,074 =	4,697	2,268	2,429
Total - a, b, c, and d	51,671	24,943	26,728
GRAND TOTALS	\$90,071	\$24,943	\$65,128

Notes:

(A) 3 Assemblers @ \$27,000 = \$82,500

(B) 6 Semi-skilled @ \$1.60 = \$9.60

Cost per piece = $\frac{\$90,071}{2,754,000} = .0327$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Assem. Capacitor Body to Wafer, No. HC-6, 6a, 6b, 6c
 Assem. Leads, Subassem. Cap., and
 Apply Protective Coating Hand

Based on 2 shifts, 4,000 hours and annual production 2,880,000 wafers

	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
HC-6	\$50,136.08	\$4,275.72	\$45,860.36
HC-6a	86,203.49	7,126.95	79,076.54
HC-6b	17,060.54	1,454.98	15,605.56
HC-6c	<u>82,801.72</u>	<u>6,875.95</u>	<u>75,925.77</u>
GRAND TOTALS	<u>\$236,201.83</u>	<u>\$19,733.60</u>	<u>\$216,468.23</u>

Notes: Cost per piece = $\frac{\$236,201.83}{2,880,000 \text{ wafers}} = .082$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Body to Wafer Assembly Hand No. HC-6
Equipment (A)

Based on 2 shifts, 4,000 hrs., hourly prod. (B) 760 and annual prod. (B) 3,040,000

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor = <u>(C) 22,897 x Rate 1.6 =</u>	<u>\$36,636.16</u>	xx	<u>\$36,636.16</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>36,636.16 =</u>	10,990.85	\$3,297.26	7,693.59
b. Mach., Equip. & Tool	201.80	163.96	37.84
c. Occupancy =			
Proc. Space <u>(D) 180 x Ratio 5 = 900 sq. ft.</u>			
Rent <u>900 x .8 =</u>	720.00	720.00	---
Light <u>900 x .3 =</u>	270.00	27.00	243.00
Heat <u>900 x .1 =</u>	90.00	67.50	22.50
Subtotal - a, b, and c	12,272.65		
d. Miscellaneous =			
10% x Subtotal <u>12,272.65 =</u>	<u>1,227.27</u>		<u>1,227.27</u>
Total - a, b, c, and d	<u>13,499.92</u>		
GRAND TOTALS	<u>\$50,136.08</u>	<u>\$4,275.72</u>	<u>\$45,860.36</u>

Notes:

(A) Solder pots, cleaning and rinsing pots, tweezers, bench and stool; cost for 6 stations = \$1,008.70

(B) 4 (.02 & .01) cap's x 40 = 160 pcs/hr x 4,000 = 640,000
 8 (two .01) " x 40 = 320 " x 4,000 = 1,280,000
 7 (one .01) " x 40 = 280 " x 4,000 = 1,120,000
 760 3,040,000 annual prod.

(C) 2.112 (men/hr to make 40 mod/hr) x 4,000 hrs = 8,448.00 dir. lab. hrs.
 2.288 (") x 4,000 = 9,152.00 "
 1.3244 (") x 4,000 = 5,297.60 "
 22,897.60

(D) Based on 30 sq. ft. x 6 stations = 180 sq. ft.

Cost per piece = $\frac{\$50,136.08}{3,040,000} = .0165$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes	Assemble Capacitor Leads	Hand	No.	HC-6a
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Equipment (A)

Based on 2 shifts, 4,000 hrs., hrly. prod. (B) 880 and annual prod. (B) 3,520,000

	<u>Total</u>	<u>Annual Cost</u> <u>Fixed</u> xx	<u>Variable</u>
1. Material			
2. Direct Labor = hrs. (C) 39,529.6 x Rate 1.6	\$63,247.36	xx	\$63,247.36
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. 63,247.36 =	18,974.21	\$5,692.26	13,281.95
b. Mach., Equip. & Tool	95.00	77.19	17.81
c. Occupancy =			
Proc. Space (D) 300 x Ratio 5 = 1,500 sq. ft.			
Rent 1500 x .8 =	1,200.00	1,200.00	----
Light 1500 x .3 =	450.00	45.00	405.00
Heat 1500 x .1 =	150.00	112.50	37.50
Subtotal - a, b, and c	\$20,869.21		
d. Miscellaneous =			
10% x Subtotal 20,869.21 =	2,086.92		2,086.92
Total - a, b, c, and d	22,956.13		
GRAND TOTALS	\$86,203.49	\$7,126.95	\$79,076.54

Notes:

- (A) Hand soldering iron, bench, stool; cost for 10 stations = \$474.93
- (B) 10 ops one side x 40 ops/hr = 400 x 4,000 hrs = 1,600,000
12 ops two sides x 40 " = 480 x 4,000 hrs = 1,920,000
880 3,520,000 pcs annual prod
- (C) 3.124 (men/hr to make 40 mod/hr) x 4,000 = 12,496.00 dir lab hrs (1 side)
6.7584 (") x 4,000 = 27,033.60 " (2 sides)
39,529.60 "
- (D) Based on 30 sq. ft. x 10 stations = 300 sq. ft.

$$\text{Cost per piece} = \frac{\$86,203.49}{3,520,000} = .0245$$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Subassemble Capacitors Hand No. HC-6b
Equipment (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 200 and annual prod. 800,000 (B)

	<u>Total</u>	<u>Annual Costs</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. 7,792 (C) x Rate 1.6 =	<u>\$12,467.20</u>	xx	<u>\$12,467.20</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. 12,467.20 =	3,740.16	\$1,122.05	2,618.11
b. Mach., Equip., & Tool	75.60	61.43	14.17
c. Occupancy =			
Proc. Space 60 (D) x Ratio 5 = 300 sq. ft.			
Rent <u>300 x .8</u> =	240.00	240.00	----
Light <u>300 x .3</u> =	90.00	9.00	81.00
Heat <u>300 x .1</u> =	30.00	22.50	7.50
Subtotal - a, b, and c	\$ 4,175.76		
d. Miscellaneous =			
10% x Subtotal 4,175.76 =	<u>417.58</u>		<u>417.58</u>
Total - a, b, c, and d	<u>4,593.34</u>		
GRAND TOTALS	<u>\$17,060.54</u>	<u>\$1,454.98</u>	<u>\$15,605.56</u>

Notes:

- (A) Solder pot, cleaning & rinsing pot, overhead exhaust, bench, stool
(cost for 2 stations = \$378)
(B) 5 x 40 = 200 hrly. prod., 200 x 4,000 = 800,000 annual prod.
(C) 1.9480 x 4,000 = 7,792 dir. lab. hrs.
(D) 2 stations x 30 sq. ft. = 60 sq. ft.

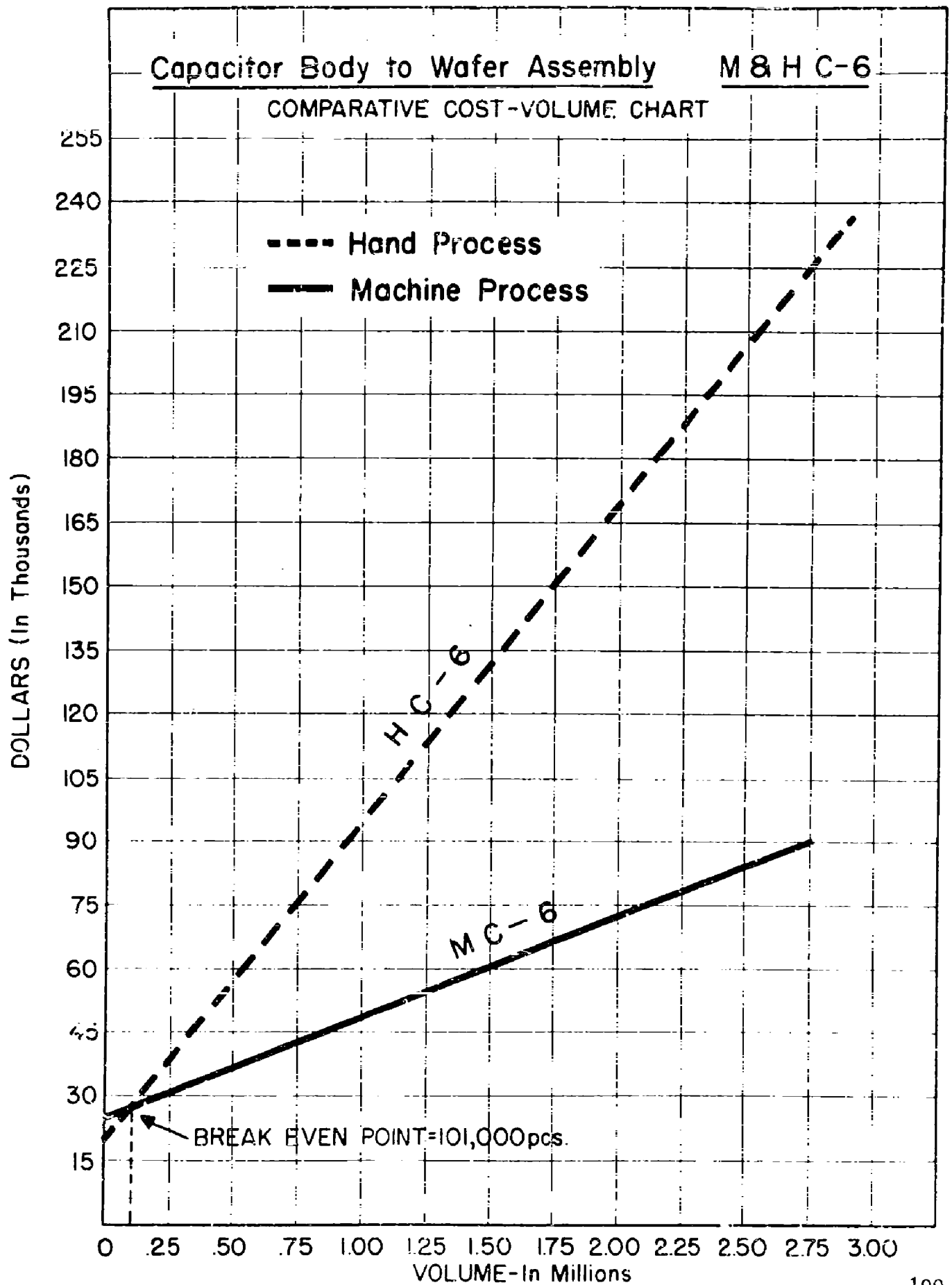
Cost per piece = $\frac{\$17,060.54}{800,000 \text{ pcs}}$ = .0213

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes	Apply Protective Coating	Hand	No.	HC-6c
Equipment	(A)			
Based on <u>2</u> shifts, <u>4,000</u> hrs., hrly. prod. (B) <u>720</u> and annual prod. (E) <u>2,880,000</u>				
		Annual Cost		
		Total	Fixed	Variable
1. Material			xx	
2. Dir. Lab. = hrs.(C) <u>37,945.6</u> x Rate <u>1.6</u> =		<u>\$60,712.96</u>	xx	<u>\$60,712.96</u>
3. Manufacturing Overhead				
a. Ind. Lab. = 30% of Dir. <u>60,712.96</u> =		18,213.89	\$5,464.17	12,749.72
b. Mach., Equip. & Tool		66.80	54.28	12.52
c. Occupancy =				
Proc. Space (D) <u>300</u> x Ratio <u>5</u> = <u>1,500</u> sq. ft.				
Rent <u>1,500</u> x <u>.8</u> =		1,200.00	1,200.00	---
Light <u>1,500</u> x <u>.3</u> =		450.00	45.00	405.00
Heat <u>1,500</u> x <u>.1</u> =		150.00	112.50	37.50
Subtotal - a, b, and c		20,080.69		
d. Miscellaneous =				
10% x Subtotal <u>20,080.69</u> =		2,008.07		2,008.07
Total - a, b, c, and d		<u>22,088.76</u>		
GRAND TOTALS		<u>\$82,801.72</u>	<u>\$6,875.95</u>	<u>\$75,925.77</u>

Notes:

- (A) Bench, stool, artists brushes, hysol containers; cost for 10 sta. = \$334.40
 (B) 8 ops on one side x 40 = 320 pcs/hr x 4,000 = 1,280,000
 10 ops on two sides x 40 = 400 pcs/hr x 4,000 = 1,600,000
 720 pcs/hr 2,880,000
 (C) 2.7104 (men/hr to make 40 mod/hr) x 4,000 hrs. = 10,841.6 Dir. Lab. Hrs.
 6.776 (") x 4,000 hrs. = 27,104.0 "
 37,945.6
 (D) Based on 30 sq. ft/sta , x 10 stations = 300 sq. ft.
 Cost per piece = $\frac{\$82,801.72}{2,880,000} = .0288$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Wafer Assembly Notch Solder Filling Mach. No. MC-7

Equipment 2-Notch Timmers (A)

Based on 2 shifts, 3,375 hrs., hourly prod. 816 and annual prod. 2,754,000

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>4,000</u> x Rate <u>2.40 (B)</u> =	<u>\$9,600</u>	xx	<u>\$9,600</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>9,600</u> =	2,880	\$ 864	2,016
b. Mach., Equip. & Tool	4,767	2,435	2,332
c. Occupancy =			
Proc. Space <u>60</u> x Ratio <u>6</u> = <u>360 sq. ft.</u>			
Rent <u>360</u> x <u>1.00</u> =	360	360	---
Light <u>360</u> x <u>.30</u> =	108	11	97
Heat <u>360</u> x <u>.10</u> =	36	27	9
Subtotal - a, b, and c	8,151	3,697	4,454
d. Miscellaneous =			
10% x Subtotal <u>8,151</u> =	815	370	445
Total - a, b, c, and d	<u>8,966</u>	<u>4,067</u>	<u>4,899</u>
GRAND TOTALS	<u>\$18,566</u>	<u>\$4,067</u>	<u>\$14,499</u>

Notes: (A) 2 Notch Timmers @ \$5,700 = \$11,500.

(B) 2 Unskilled @ \$1.20 = \$2.40

Cost per piece = $\frac{\$18,566}{2,754,000} = .00674$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Capacitor Wafer Assembly Notch Solder Filling Hand No. HC-7

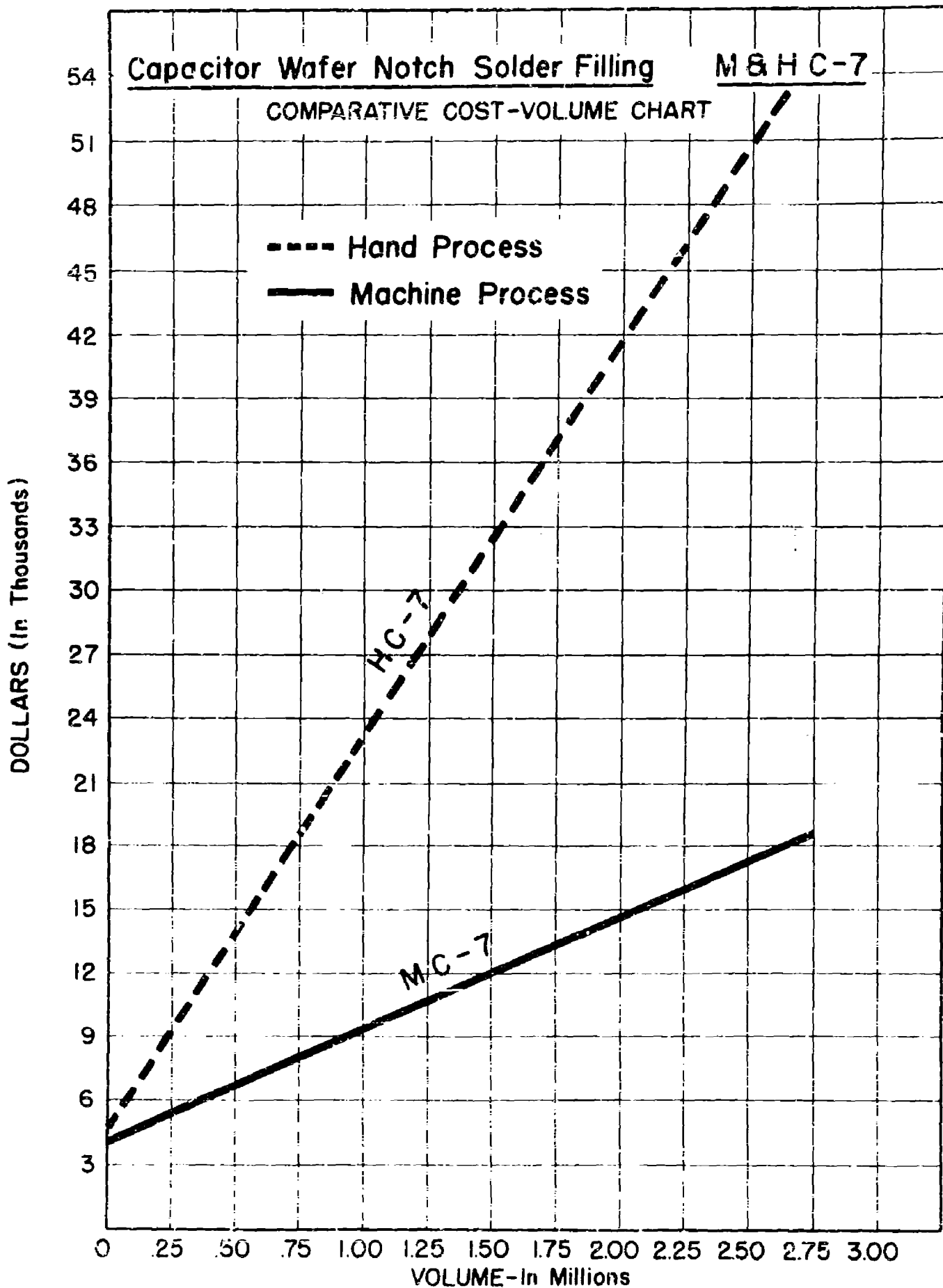
Equipment Benches, stools, soldering irons, and fixtures (A)

Based on 2 shifts, 4000 hrs., hourly prod. 720 and annual prod. 2,880,000 (B)

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>25,344.00</u> (C) x Rate <u>1.6</u> =	<u>\$40,550.40</u>	xx	<u>\$40,550.40</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>40,550.40</u> =	12,165.12	\$3,649.54	8,515.58
b. Mach., Equip. & Tool	63.00	51.19	11.81
c. Occupancy =			
Proc. Space <u>180</u> (D) x Ratio <u>5</u> = <u>900 sq. ft.</u>			
Rent <u>900</u> x <u>.8</u> =	720.00	720.00	
Light <u>900</u> x <u>.3</u> =	270.00	27.00	243.00
Heat <u>900</u> x <u>.1</u> =	90.00	67.50	22.50
Subtotal - a, b, and c	13,308.12		
d. Miscellaneous =			
10% x Subtotal <u>13,308.12</u> =	1,330.81		1,330.81
Total - a, b, c, and d	<u>14,638.93</u>		
GRAND TOTALS	<u>\$55,189.33</u>	<u>\$4,515.23</u>	<u>\$50,674.10</u>

Notes:

$$\text{Cost per piece} = \frac{\$55,189.33}{2,880,000} = .0192$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Wafer Assembly Inspection Mach. No. MC-8

Equipment 2 Capacitor Assembly Testers (A)

Based on 2 shifts, 2,822 hrs., hourly prod. 976 and annual prod. 2,754,000

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>3,440</u> x Rate <u>4.80 (B)</u> =	<u>\$16,512</u>	xx	<u>\$16,512</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>16,512</u> =	4,954	\$1,486	3,468
b. Mach., Equip. & Tool	9,627	5,081	4,546
c. Occupancy =			
Proc. Space <u>92</u> x Ratio <u>6</u> = <u>552 sq. ft.</u>			
Rent <u>552</u> x <u>1.00</u> =	552	552	---
Light <u>552</u> x <u>.30</u> =	166	17	149
Heat <u>552</u> x <u>.10</u> =	55	42	13
Subtotal - a, b, and c	\$15,354	\$7,178	\$ 8,176
d. Miscellaneous =			
10% x Subtotal <u>15,354</u> =	1,535	718	817
Total - a, b, c, and d	<u>16,889</u>	<u>7,896</u>	<u>8,993</u>
GRAND TOTALS	<u>\$33,401</u>	<u>\$7,896</u>	<u>\$25,505</u>

Notes: (A) 2 Testers @ \$12,000 = \$24,000
(B) 2 Highly Skilled @ \$2.40 = \$4.80

Cost per piece = $\frac{\$33,401}{2,754,000} = .0121$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Capacitor Wafer Assembly Inspection Hand No. HC-8

Equipment Benches, stools & electrical testers (A)

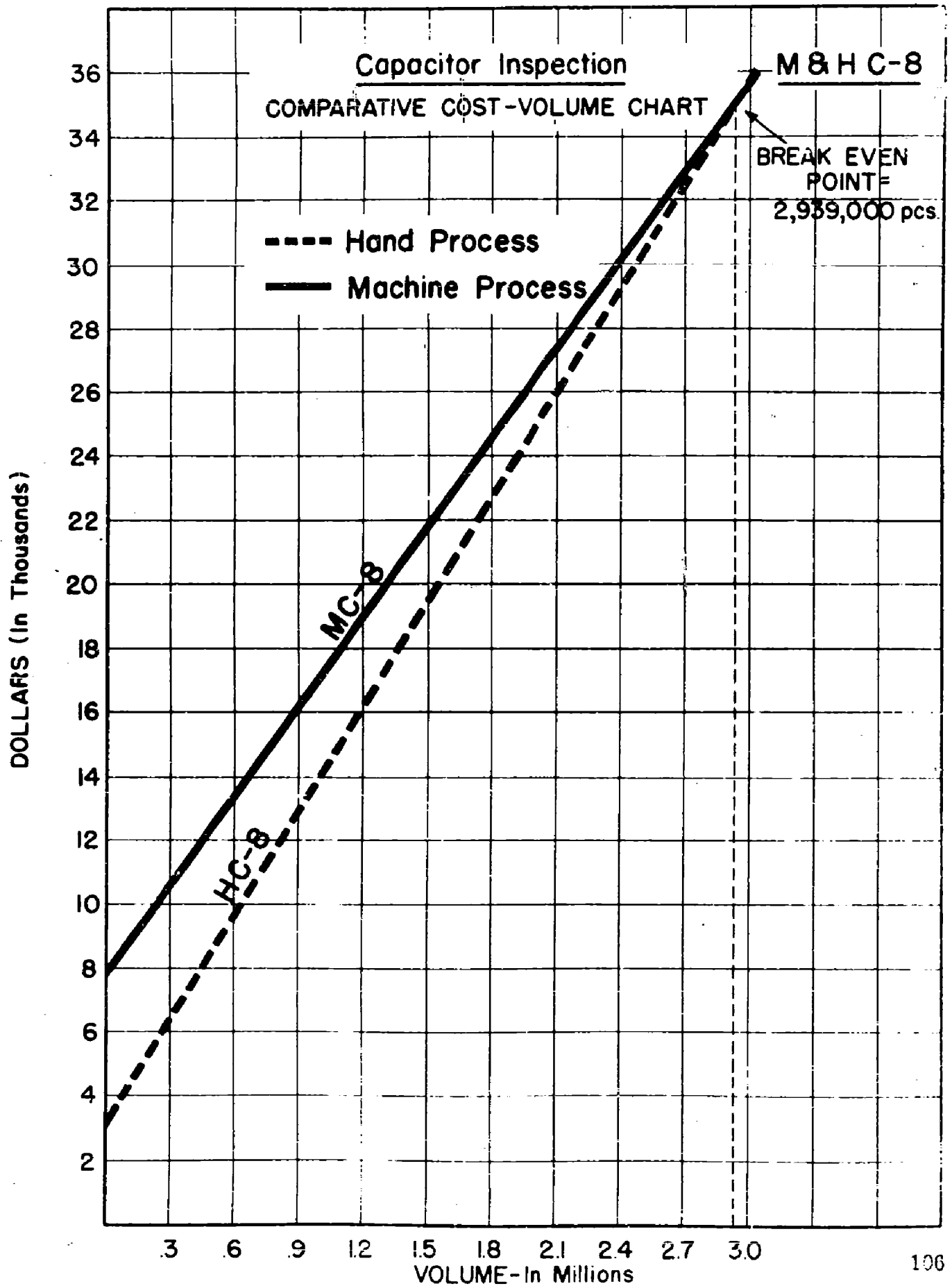
Based on 2 shifts, 4,000 hrs., hourly prod. 1,360 ops. and annual prod. 2,880,000 wafers

	Annual Cost		
	Total	Fixed	Variable
1. Material		xx	
2. Direct Labor =			
Hrs. <u>15,558.4 (B)</u> x Rate <u>1.6</u> =	<u>\$24,893.44</u>	xx	<u>\$24,893.44</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>24,893.44</u> =	7,668.03	\$2,300.41	5,367.62
b. Mach., Equip. & Tool	432.00	351.00	81.00
c. Occupancy =			
Proc. Space <u>120 (C)</u> x Ratio <u>5</u> = <u>600 sq. ft.</u>			
Heat <u>600 x .8</u> =	480.00	480.00	----
Light <u>600 x .3</u> =	180.00	18.00	162.00
Heat <u>600 x .1</u> =	60.00	45.00	15.00
Subtotal - a, b, and c	\$ 8,820.03		
d. Miscellaneous =			
10% x Subtotal <u>8,820.03</u> =	<u>882.00</u>	---	<u>882.00</u>
Total - a, b, c, and d	<u>9,702.03</u>		
GRAND TOTALS	<u>\$34,595.47</u>	<u>\$3,194.41</u>	<u>\$31,401.06</u>

Notes.

- (A) Cost for 4 stations = \$2,160
 (B) $3.88960 \times 4,000 = 15,558.40$ Dir. Lab. Hrs.
 (C) 4 stations x 30 sq. ft. = 120

$$\text{Cost per wafer} = \frac{\$34,595.47}{2,880,000} = .0120$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Tube Socket Wafer Pattern Tinning Mach. No. MTS-1
Equipment (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 1,296 and annual prod. 1,794,000 (B)

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>4,000</u> x Rate <u>4.80</u> =	<u>\$19,200.00</u>	xx	<u>\$19,200.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>19,200</u> =	5,760.00	\$1,728.00	4,032.00
b. Mach., Equip. & Tool	3,732.00	3,420.00	312.00
c. Occupancy =			
Proc. Space <u>66</u> x Ratio <u>6</u> = <u>396 sq. ft.</u>			
Rent <u>396</u> x <u>1.00</u> =	396.00	396.00	
Light <u>396</u> x <u>.30</u> =	119.00	12.00	107.00
Heat <u>396</u> x <u>.10</u> =	<u>40.00</u>	<u>30.00</u>	<u>10.00</u>
Subtotal - a, b, and c	<u>\$10,047.00</u>	<u>\$5,586.00</u>	<u>\$ 4,461.00</u>
d. Miscellaneous =			
10% x Subtotal <u>10,047.00</u> =	<u>1,005.00</u>	<u>559.00</u>	<u>446.00</u>
Total - a, b, c, and d	<u>11,052.00</u>	<u>6,145.00</u>	<u>4,907.00</u>
GRAND TOTALS	<u>\$30,252.00</u>	<u>\$6,145.00</u>	<u>\$24,107.00</u>

Notes: (A) Operation accomplished on pattern tinner used also for capacitor wafers (see C-1).

(B) Annual production of wafers as follows:

Capacitor wafers = 3,390,000
Tube socket wafers = 1,794,000
5,184,000

Cost per piece = $\frac{\$30,252}{5,184,000} = .00584$

An individual comparative cost-volume chart has not been prepared for MTS-1 and HTS-1 because of the combination of capacitor and tube socket wafer processing in the machine process manufacture. A combined chart has been prepared as Schedule 8c for MC-1 and MTS-1 vs. HC-1 and HTS-1.

PROJECT TINKERTOY -- Manufacturing Cos. Data

Process Tube Socket Wafer Pattern Tinning Hand No. HTS-1
Equipment (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 720 and annual prod. 1,440,000 (B)

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>8,481.60</u> (C) x Rate <u>1.6</u> =	<u>\$13,570.56</u>	xx	<u>\$13,570.56</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>13,570.56</u> =	4,071.17	\$1,221.35	2,849.82
b. Mach., Equip. & Tool	75.00	60.94	14.06
c. Occupancy =			
Proc. Space <u>60</u> (D) x Ratio <u>5</u> x <u>300</u> sq. ft.			
Rent <u>300</u> x <u>.8</u> =	240.00	240.00	
Light <u>300</u> x <u>.3</u> =	90.00	9.00	81.00
Heat <u>300</u> x <u>.1</u> =	30.00	22.50	7.50
Subtotal - a, b, and c	4,506.17		
d. Miscellaneous =			
10% x Subtotal <u>4,506.17</u>	450.62		450.62
Total - a, b, c, and d	<u>4,956.79</u>		
GRAND TOTALS	<u>\$18,527.35</u>	<u>\$1,553.79</u>	<u>\$16,973.56</u>

Notes: (A) Same as HC-1 but 2 stations, cost = \$375.
(B) 9 ops. x 40 = 360 x 4000 = 1,440,000 annual production
(C) 2.12040 x 4000 = 8,481.60 Direct Labor Hrs.
(D) 2 stations x 30 sq. ft. = 60

Cost per piece = $\frac{\$18,527.35}{1,440,000} = .0129$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Tube Socket Parts to Wafer Assembly Mach. No. MTS-2

Equipment 3-Tube Socket Assemblers (A)

Based on 2 shifts, 3,115 hrs., hourly prod. 468 and annual prod. 1,458,000

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>3,720</u> x Rate <u>7.20 (B)</u> =	<u>\$26,784</u>	xx	<u>\$26,784</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>26,784</u> =	8,035	\$ 2,411	5,624
b. Mach., Equip. & Tool	38,475	20,325	18,150
c. Occupancy =			
Proc. Space <u>180 x Ratio 6 = 1,080 sq. ft.</u>			
Rent <u>1080 x 1.00 =</u>	1,080	1,080	---
Light <u>1080 x .30 =</u>	324	32	292
Heat <u>1080 x .10 =</u>	108	81	27
Subtotal - a, b, and c	<u>\$48,022</u>	<u>\$23,929</u>	<u>\$24,093</u>
d. Miscellaneous =			
10% x Subtotal <u>48,022</u> =	<u>4,802</u>	<u>2,393</u>	<u>2,409</u>
Total - a, b, c, and d	<u>52,824</u>	<u>26,322</u>	<u>26,502</u>
GRAND TOTALS	<u>\$79,608</u>	<u>\$26,322</u>	<u>\$53,286</u>

Notes:

- (A) 3-Tube Socket Assemblers @ \$32,000 = \$96,000
 (B) 2-Skilled @ \$2.00 = \$4.00
 2-Semi-skilled @ \$1.60 = 3.20
 \$7.20

Cost per piece = $\frac{\$79,608}{1,458,000} = .0546$

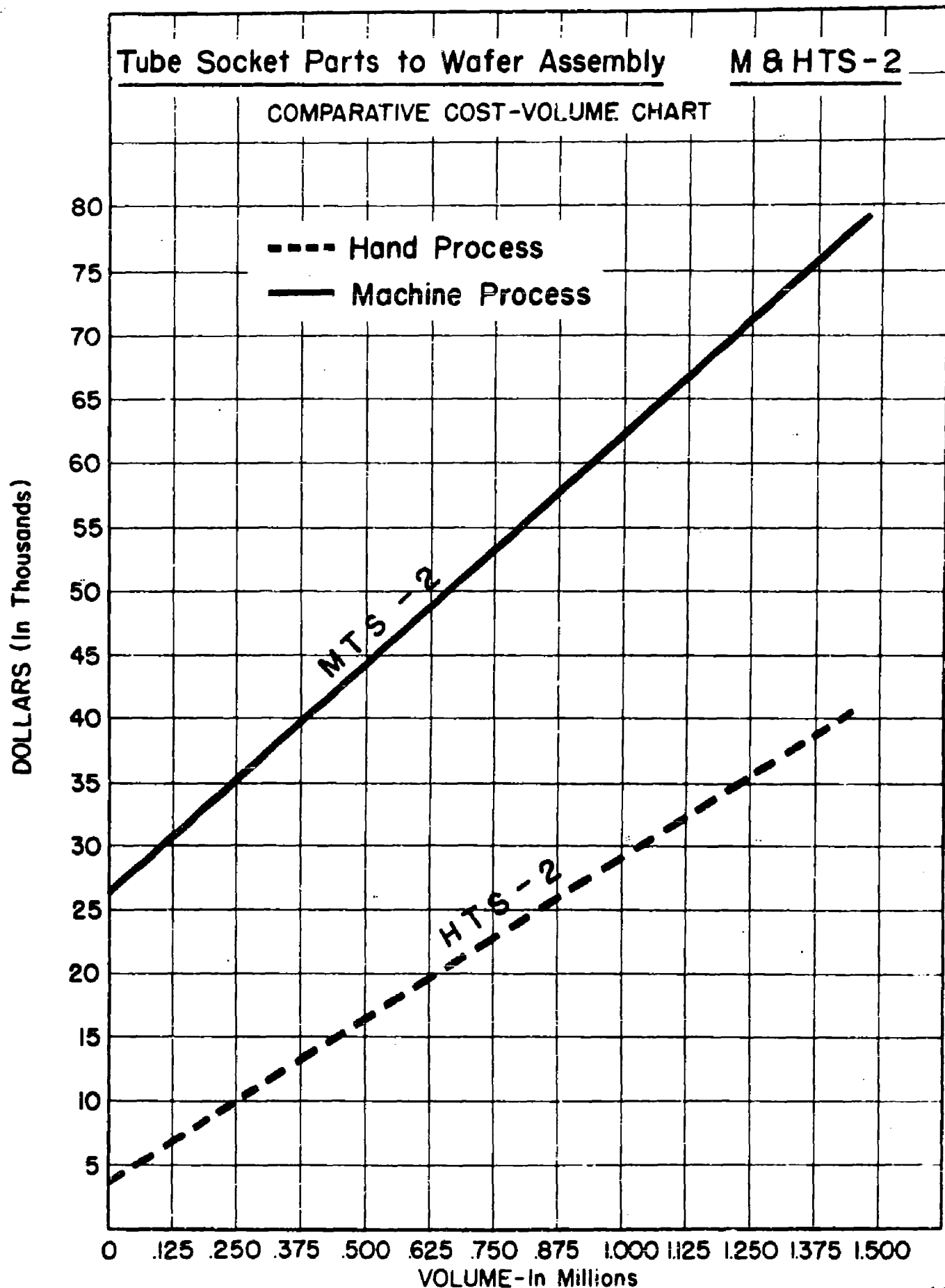
PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Tube Socket Parts-to-Wafer Assembly Hand No. HTS-2
Equipment Benches, stools, eyeletting mach. and spec. fixtures (A)
Based on 2 shifts, 4,000 hrs., hourly prod. 360 and annual prod. 1,440,000 (B)

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>18,374.40 (C)</u> x Rate <u>1.6</u> =	<u>\$29,399.04</u>	xx	<u>\$29,399.04</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>29,399.04</u> =	8,819.71	\$2,645.91	6,173.80
b. Mach., Equip. & Tool	270.60	219.86	50.74
c. Occupancy =			
Proc. Space <u>150 (D)</u> x Ratio <u>5</u> = <u>750 sq. ft.</u>			
Rent <u>750 x .8</u> =	600.00	600.00	---
Light <u>750 x .3</u> =	225.00	22.50	202.50
Heat <u>750 x .1</u> =	75.00	56.25	18.75
Subtotal - a, b, and c	9,990.31		
d. Miscellaneous =			
10% x Subtotal <u>9,990.31</u> =	999.03		999.03
Total - a, b, c, and d	<u>10,989.34</u>		
GRAND TOTALS	<u>\$40,388.38</u>	<u>\$3,544.52</u>	<u>\$36,843.86</u>

Notes: (A) Equipment for 5 stations = \$1,353.
(B) 9 ops x 40 = 360 per hr. x 4,000 = 1,440,000 annual prod.
(C) 4.59360 x 4,000 = 18,374.40 Dir. Lab. Hrs.
(D) 5 stations x 30 = 150

Cost per piece = $\frac{\$40,388.38}{1,440,000} = .028$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Tube Socket Notch Solder Filling Mach. No. MTS-3

Equipment 1 Notch Tinner (A)

Based on 2 shifts, 3,574 hrs., hourly prod. 408 and annual prod. 1,458,000

		<u>Annual Cost</u>		
		<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material			xx	
2. Direct Labor :				
Hrs. <u>4,000</u> x Rate <u>1.20</u> :		<u>\$4,800</u>	xx	<u>\$4,800</u>
3. Manufacturing Overhead				
a. Ind. Lab. : 30% of Dir. <u>4,800</u> :		1,440	\$ 432	1,008
b. Mach., Equip. & Tool		2,380	1,218	1,162
c. Occupancy :				
Proc. Space <u>25</u> x Ratio <u>5</u> = <u>150 sq. ft.</u>				
Rent <u>150 x 1.00</u> :		150	150	
Light <u>150 x .30</u> :		45	5	40
Heat <u>150 x .10</u> :		15	12	3
Subtotal - a, b, and c		<u>\$4,030</u>	<u>\$1,817</u>	<u>\$2,213</u>
d. Miscellaneous :				
10% x Subtotal <u>4,030</u> :		<u>403</u>	<u>182</u>	<u>221</u>
Total - a, b, c, and d		<u>4,433</u>	<u>1,999</u>	<u>2,434</u>
GRAND TOTALS		<u>\$9,233</u>	<u>\$1,999</u>	<u>\$7,234</u>

Notes:

(A) 1 Notch Tinner @ \$5,750

(B) 1 Unskilled @ \$1.20

Cost per piece = $\frac{\$9,233}{1,458,000}$ = .0063

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Tube Socket Notch-to-Connector Soldering Hand No. HTS-3

Equipment Benches, stools, solder pots, tweezers, overhead hood (A)

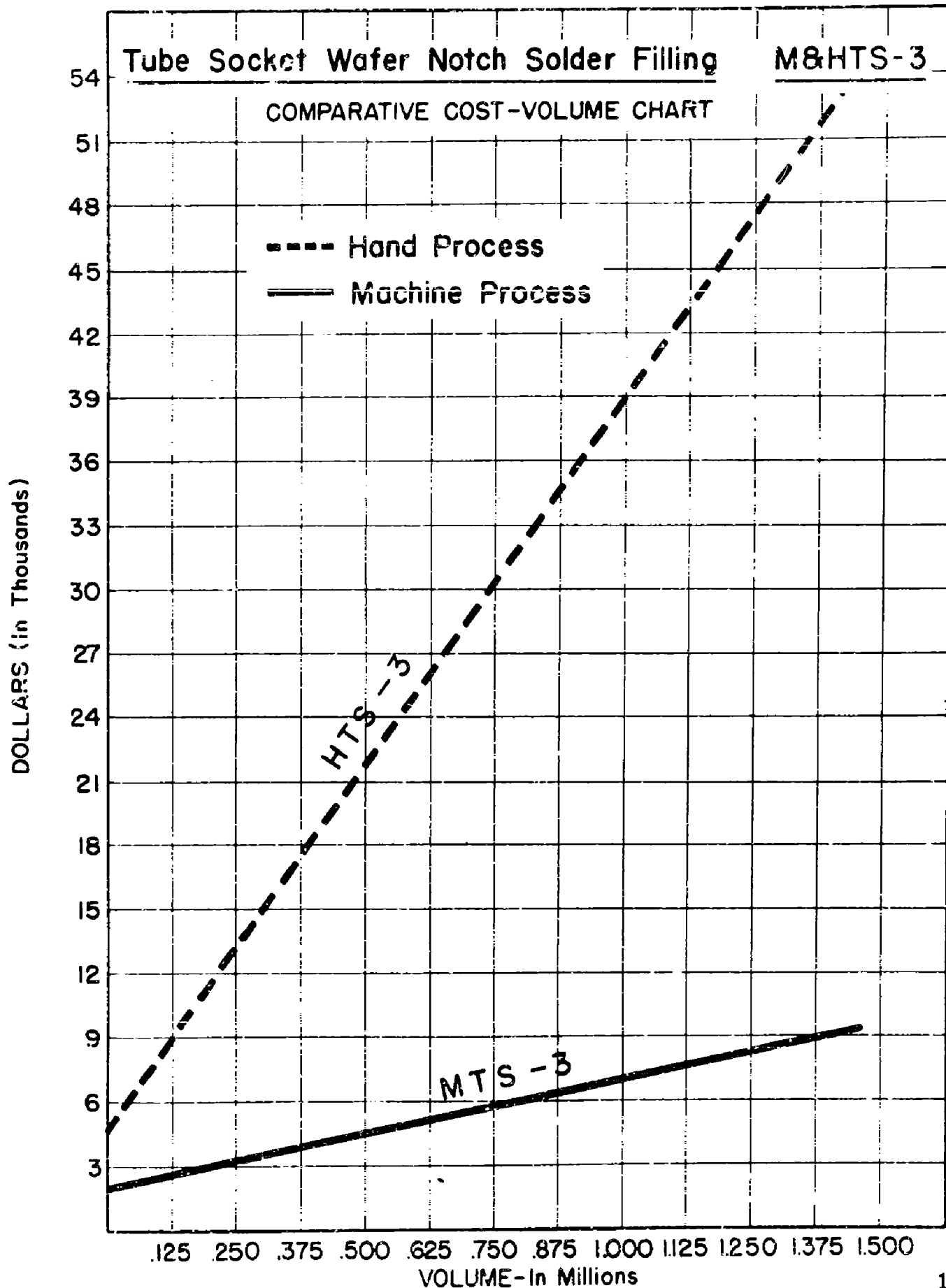
Based on 2 shifts, 4,000 hrs., hourly prod. 360 and annual prod. 1,440,000 (B)

	<u>Annual Cost</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>24,710.40 (C)</u> x Rate <u>1.6</u> =	<u>\$39,536.64</u>	xx	<u>\$39,536.64</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>39,536.64</u> =	11,860.99	\$3,558.30	8,302.69
b. Mach., Equip. & Tool	279.20	226.85	52.35
c. Occupancy =			
Proc. Space <u>180</u> x Ratio <u>5</u> = <u>900 sq. ft.</u>			
Rent <u>900</u> x .8 =	720.00	720.00	----
Light <u>900</u> x .3 =	270.00	27.00	243.00
Heat <u>900</u> x .1 =	90.00	67.50	22.50
Subtotal - a, b, and c	\$13,220.19		
d. Miscellaneous =			
10% x Subtotal <u>13,220.19</u> =	1,322.02		1,322.02
GRAND TOTALS	<u>\$54,078.85</u>	<u>\$4,599.65</u>	<u>\$49,479.20</u>

Notes:

- (A) Equipment for 6 stations = \$1,396
 (B) 9 ops x 40 = 360 per hr. x 4,000
 (C) 6.17760 x 4,000 = 24,710.40 Dir. Lab. Hrs.
 (D) 6 stations x 30 sq. ft. = 180

$$\text{Cost per piece} = \frac{\$54,078.85}{1,440,000} = .0375$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Elect. Inspection of Tube Sockets Hand No. HTS-4

Equipr. ent Benches, stools and meters (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 360 and annual prod. 1,440,000 (B)

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>7,545.60</u> (C) x Rate <u>1.6</u> =	<u>\$12,072.96</u>	xx	<u>\$12,072.96</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>12,072.96</u>	3,621.89	\$1,086.57	2,535.32
b. Mach., Equip. & Tool	71.60	58.18	13.42
c. Occupancy =			
Proc. Space <u>60</u> (D) x Ratio <u>5</u> = <u>300</u> sq. ft.			
Rent <u>300</u> x .8 =	240.00	240.00	----
Light <u>300</u> x .3 =	90.00	9.00	81.00
Heat <u>300</u> x .1 =	30.00	22.50	7.50
Subtotal - a, b, and c	\$ 4,053.49		
d. Miscellaneous =			
10% x Subtotal <u>4,053.49</u> =	<u>405.35</u>		<u>405.35</u>
Total - a, b, c, and d	<u>4,458.84</u>		
GRAND TOTALS	<u>\$16,531.80</u>	<u>\$1,416.25</u>	<u>\$15,115.55</u>

Notes:

- (A) Equipment for 2 stations @ \$358.
 (B) 9 ops x 40 = 360 x 4,000
 (C) 1.88640 x 4,000 = 7,545.60 Dir. Lab. Hrs.
 (D) 2 stations x 30 = 60 sq. ft.

$$\text{Cost per piece} = \frac{\$16,531.80}{1,440,000} = .0115$$

This operation is not performed in present machine process manufacture, and therefore the cost is not charged against the projected hand process.

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Module Assembly Mach. No. MM-1

Equipment 5 Module Assemblers (A)

Based on 2 shifts, 3,471 hrs., hourly prod. 420 and annual prod. 1,458,000

		<u>Annual Cost</u>	
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>4,000</u> x Rate <u>16.00 (B)</u> =	<u>\$ 64,000</u>	xx	<u>\$ 64,000</u>
3. Manufacturing Overhead			
a. Indirect Labor = 30% of Dir. <u>64,000</u> =	19,197	\$ 5,757	13,440
b. Mach., Equip. & Tool	62,924	33,342	29,582
c. Occupancy =			
Proc. Space <u>590</u> x Ratio <u>6</u> = <u>3,540</u> sq. ft.			
Rent <u>3540</u> x 1.00 =	3,540	3,540	---
Light <u>3540</u> x .30 =	1,061	104	957
Heat <u>3540</u> x .10 =	<u>356</u>	<u>260</u>	<u>96</u>
Subtotal - a, b, and c	\$ 87,078	\$43,003	\$ 44,075
d. Miscellaneous =			
10% x Subtotal <u>87,078</u> =	<u>8,708</u>	<u>4,300</u>	<u>4,408</u>
Total - a, b, c, and d	<u>95,786</u>	<u>47,303</u>	<u>48,483</u>
GRAND TOTALS	\$159,786	\$47,303	\$112,483

Notes:

(A) 5 Module Assemblers @ \$31,500 = \$157,500

(B) 10 Semi-skilled @ 1.60 = \$16.00

Cost per piece = $\frac{\$159,786}{1,458,000} = .1096$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Module Assembly Hand No. HM-1

Equipment Benches, stools and assembly fixtures

Based on 2 shifts, 4,000 hrs., hourly prod. 400 and annual prod. 1,600,000 (B)

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>67,760.0</u> x Rate <u>1.6</u> =	<u>\$108,416.00</u>	xx	<u>\$108,416.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. - 30% of Dir. <u>108,416.00</u> =	32,524.80	\$ 9,757.44	22,767.36
b. Mach., Equip. & Tool	5,273.10	3,295.69	1,977.41
c. Occupancy =			
Proc. Space <u>510 (D)</u> x Ratio <u>5</u> = <u>2,550 sq. ft.</u>			
Rent <u>2550 x .8</u> =	2,040.00	2,040.00	---
Light <u>2550 x .3</u> =	765.00	76.50	688.50
Heat <u>2550 x .1</u> =	255.00	191.25	63.75
Subtotal - a, b, and c	\$ 40,857.90		
d. Miscellaneous =			
10% x Subtotal <u>40,857.90</u> =	<u>4,085.79</u>		<u>4,085.79</u>
Total - a, b, c, and d	<u>44,943.69</u>		
GRAND TOTALS	<u>\$153,359.69</u>	<u>\$15,360.88</u>	<u>\$137,998.81</u>

Notes:

- (A) Cost for 17 stations = \$17,577
 (B) 10 opers x 40 = 400 x 4,000 = 1,600,000 annual prod.
 (C) 16.940 x 4,000 = 67,760
 (D) 17 stations x 30 sq. ft. = 510

Cost per piece $\frac{\$153,359.69}{1,600,000} = .0958$

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Inspect. & Resoldering of Module Assembly Hand No. HM-1a

Equiprment Benches, stools & soldering irons (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 400 and annual prod. 1,600,000

		<u>Annual Cost</u>		
		<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material			xx	
2. Direct Labor =				
Hrs. <u>27,984.00 (B)</u> x Rate <u>1.6</u> =		<u>\$44,744.40</u>	xx	<u>\$44,744.40</u>
3. Manufacturing Overhead				
a. Ind. Lab. = 30% of Dir. <u>44,744.40</u> =		13,432.32	\$4,029.70	9,402.62
b. Mach., Equip. & Tool		74.60	60.61	13.99
c. Occupancy =				
Proc. Space <u>210 (C)</u> x Ratio <u>5</u> = <u>1,050 sq. ft.</u>				
Rent <u>1050 x .8</u> =		840.00	840.00	---
Light <u>1050 x .3</u> =		315.00	31.50	283.50
Heat <u>1050 x .1</u> =		105.00	78.75	26.25
<u>Subtotal - a, b, and c</u>		<u>\$14,766.92</u>		
d. Miscellaneous =				
10% x Subtotal <u>14,766.92</u> =		<u>1,476.69</u>		<u>1,476.69</u>
<u>Total - a, b, c, and d</u>		<u>16,243.61</u>		
GRAND TOTALS		<u>\$60,988.01</u>	<u>\$5,040.56</u>	<u>\$55,947.45</u>

Notes:

- (A) Cost of equipment for 7 stations = \$373
 (B) $6.996 \times 4,000 = 27,984$
 (C) $7 \text{ stations} \times 30 \text{ sq. ft.} = 210 \text{ sq. ft.}$

$$\text{Cost per piece} = \frac{\$60,988.01}{1,600,000} = .0381$$

This is essentially a salvaging operation which is not being performed in the present machine process manufacture and therefore is not being charged against the projected hand process manufacture.

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Straighten Module Wire-ends Hand No. HM-1b

Equipment Benches, stools & straightening jigs (A)

Based on 2 shifts, 4,000 hrs., hourly prod. 400 and annual prod. 1,600,000 (B)

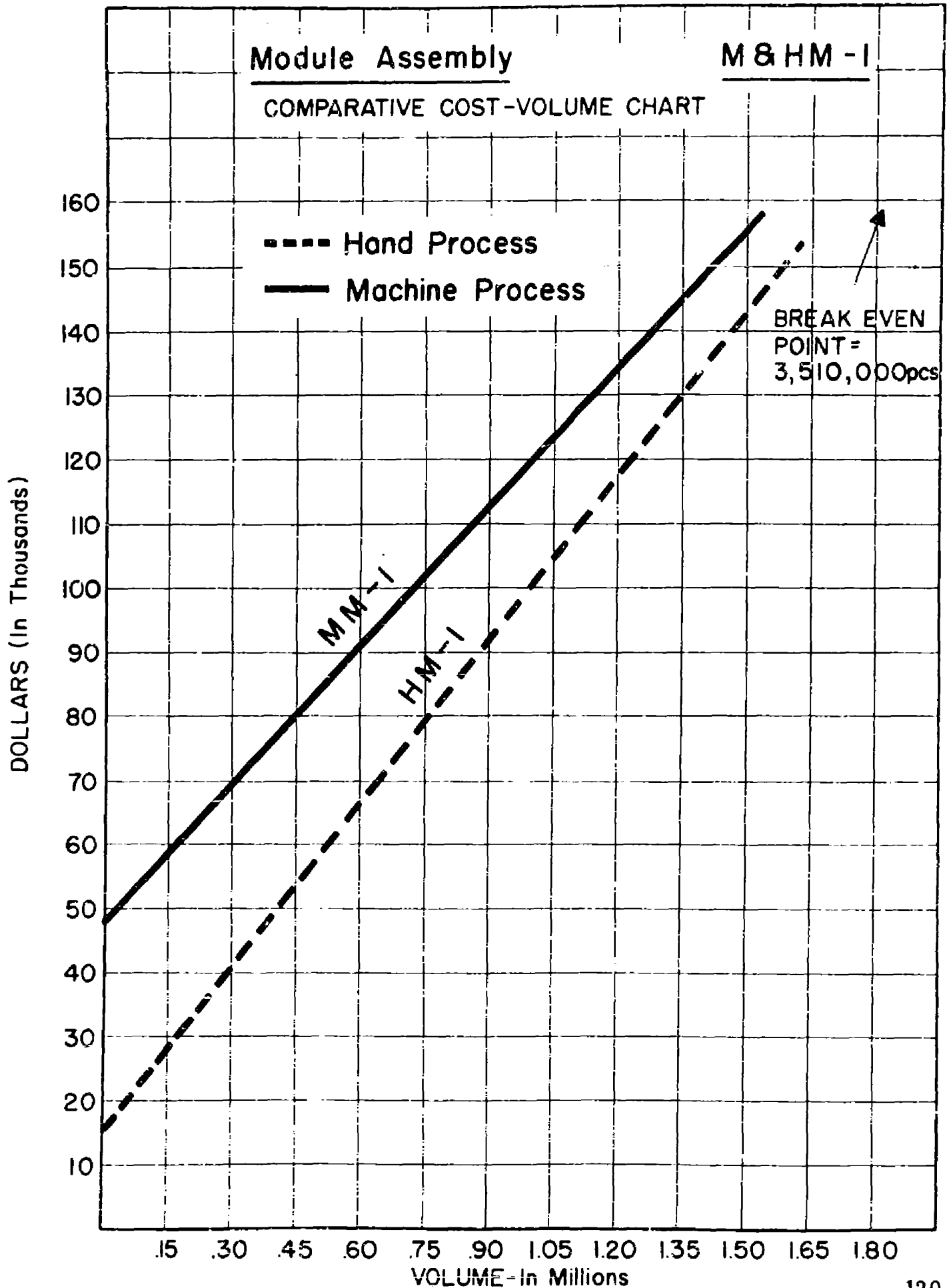
	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>14,080.00</u> (C) x Rate <u>1.6</u> =	<u>\$22,528.00</u>	xx	<u>\$22,528.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>22,528.00</u> =	6,758.40	\$2,027.52	4,730.88
b. Mach., Equip. & Tool	40.00	32.50	7.50
c. Occupancy =			
Proc. Space <u>120</u> (D) x Ratio <u>5</u> = <u>600</u> sq. ft.			
Rent <u>600</u> x .8 =	480.00	480.00	---
Light <u>600</u> x .3 =	180.00	18.00	162.00
Heat <u>600</u> x .1 =	60.00	15.00	45.00
Subtotal - a, b, and c	\$ 7,518.40		
d. Miscellaneous =			
10% x Subtotal <u>7,518.40</u> =	<u>751.84</u>		<u>751.84</u>
Total - a, b, c, and d	<u>8,270.24</u>		
GRAND TOTALS	<u>\$30,798.24</u>	<u>\$2,573.02</u>	<u>\$28,225.22</u>

Notes:

- (A) Cost of equipment for 4 stations = \$200
 (B) 10 ops x 40 = 400 x 4,000 = 1,600,000 annual prod.
 (C) 3.52 x 4,000 = 14,080
 (D) 4 stations x 30 sq. ft. = 120

$$\text{Cost per piece} = \frac{\$30,798.24}{1,600,000} = .0192$$

This operation is not being performed in the present machine process manufacture, and therefore is not being charged against the projected hand process manufacture.



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Module Riser Wire Clipping Mach. No. MM-2

Equipment 2 Segment Clippers (A)

Based on 2 shifts, 3,797 hrs., hourly prod. 384 and annual prod. 1,458,000

		<u>Annual Cost</u>		
		<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material			xx	
2. Direct Labor :				
Hrs. <u>4,000</u> x Rate <u>3.20</u> (B) =		<u>\$12,800</u>	xx	<u>\$12,800</u>
3. Manufacturing Overhead				
a. Ind. Lab. = 30% of Dir. <u>12,800</u> =		3,840	\$1,152	2,688
b. Mach., Equip. & Tool		11,600	6,140	5,460
c. Occupancy :				
Proc. Space <u>122 x Ratio 6 = 732 sq. ft</u>				
Rent <u>732 x 1.00</u> =		732	732	-----
Light <u>732 x .30</u> =		220	22	198
Heat <u>732 x .10</u> =		73	54	19
Subtotal - a, b, and c		\$16,465	\$8,100	\$ 8,365
d. Miscellaneous :				
10% :: Subtotal <u>16,465</u>		<u>1,647</u>	<u>810</u>	<u>837</u>
Total - a, b, c, and d		<u>18,112</u>	<u>8,910</u>	<u>9,202</u>
GRAND TOTALS		<u>\$30,912</u>	<u>\$8,910</u>	<u>\$22,002</u>

Notes:

(A) Two segment clippers @ \$14,500 = \$29,000

(B) 2 Semi-skilled @ \$1.60 = \$3.20

Cost per piece = $\frac{\$30,912}{1,458,000}$ = .0212

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Module Riser Wire Clipping Hand No. HM-2

Equipment Bench, stools, special cutters (A)

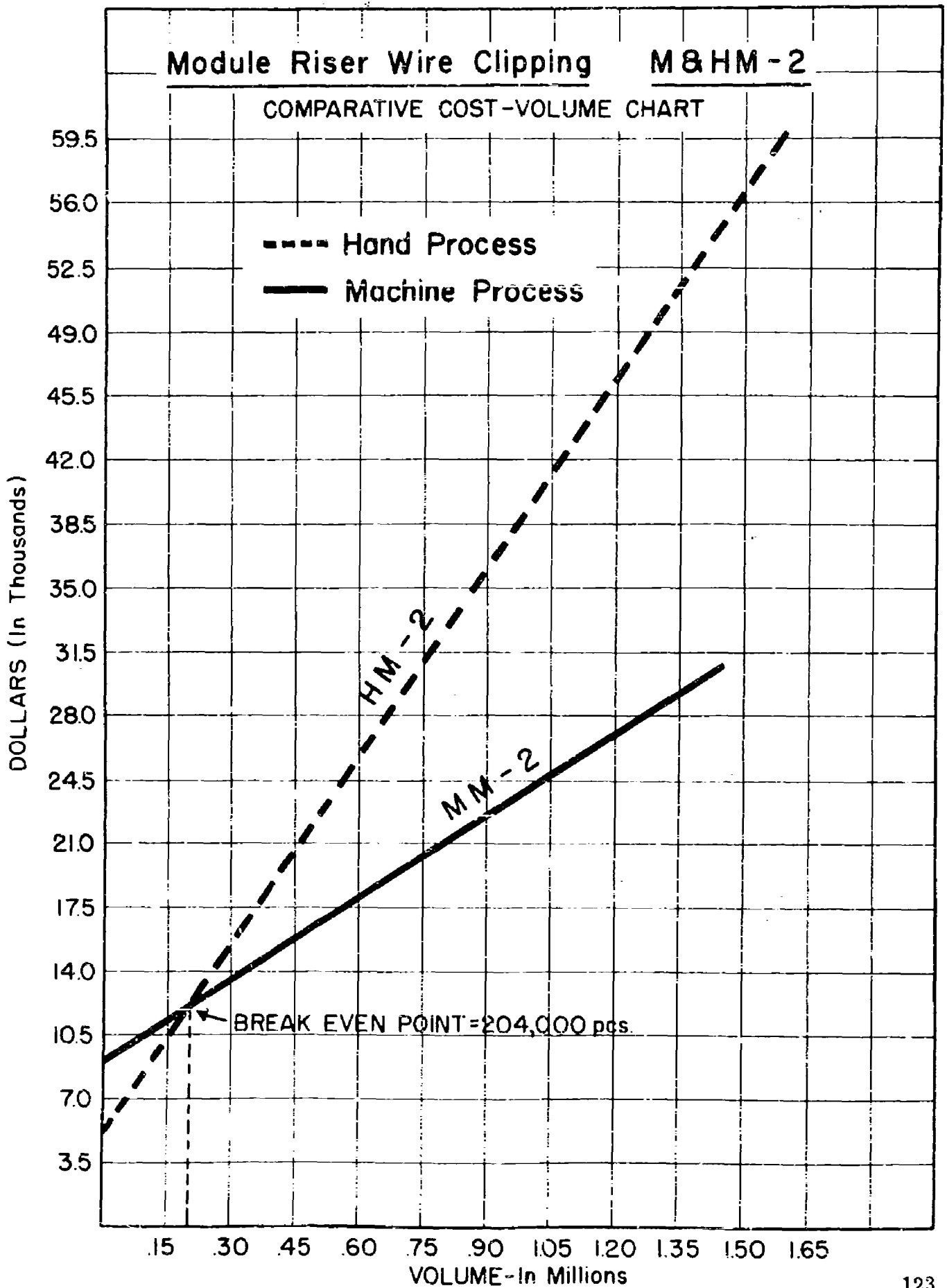
Based on 2 shifts, 4,000 hrs., hourly prod. 400 and annual prod. 1,600,000 (B)

		<u>Annual Cost</u>		
		<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material			xx	
2. Direct Labor -				
Hrs. <u>27,456 (C)</u> x Rate <u>1.6</u> =		<u>\$43,929.60</u>	xx	<u>\$43,929.60</u>
3. Manufacturing Overhead				
a. Ind. Lab. = 30% of Dir. <u>43,929.60</u> =	13,178.88	\$3,953.66		9,225.22
b. Mach., Equip. & Tool	101.60	82.55		19.05
c. Occupancy =				
Proc. Space <u>210 (D)</u> x Ratio <u>5</u> = <u>1,050 sq. ft</u>				
Rent <u>1050 x .8</u> =	840.00	840.00		-----
Light <u>1050 x .3</u> =	315.00	31.50		283.50
Heat <u>1050 x .1</u> =	105.00	78.75		26.25
Subtotal - a, b, and c	\$14,540.48			
d. Miscellaneous -				
10% x Subtotal <u>14,540.48</u> =	1,454.05			<u>1,454.05</u>
Total - a, b, c, and d	<u>15,994.53</u>			
GRAND TOTALS	<u>\$59,924.13</u>	<u>\$4,986.46</u>		<u>\$54,937.67</u>

Notes:

- (A) Equipment for 7 stations = \$894
 (B) 10 ops x 40 = 400 x 4,000 = 1,600,000
 (C) 6.864 x 4,000 = 27,456 Dir. Lab. Hrs.
 (D) 7 stations x 30 sq. ft. = 310 sq. ft.

$$\text{Cost per piece} = \frac{\$59,924.13}{1,600,000} = .0375$$



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Module Testing Mach. No. MM-3

Equipment 2 Module Testers (A)

Based on 2 shifts, 4000 hrs., hourly prod. 654 and annual prod. 1,458,000

<u>Item</u>	<u>Total</u>	<u>Annual Costs</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor - Hrs. <u>2840</u> x Rate <u>3.20 (B)</u> =	<u>\$9,088</u>	xx	<u>\$9,088</u>
3. Manufacturing Overhead			
a. Ind. Lab. = <u>30%</u> of Dir. <u>9,088</u> =	2,726.40	\$ 817.92	1,908.48
b. Mach., Equip. & Tool	6,413.00	3,388.00	3,025.00
c. Occupancy = Proc. Space <u>20</u> x Ratio <u>6</u> = <u>120 sq. ft.</u>			
Rent <u>120</u> x <u>1.00</u> =	120.00	120.00	
Light <u>120</u> x <u>.30</u> =	36.00	4.00	32.00
Heat <u>120</u> x <u>.10</u> =	12.00	9.00	3.00
Subtotal - a, b, and c	9,307.40		
d. Miscellaneous = <u>10%</u> x Subtotal <u>9,307.40</u>	930.74		930.74
Total - a, b, c, and d	<u>10,238.14</u>		
GRAND TOTALS	<u>\$19,326.14</u>	<u>\$4,338.92</u>	<u>\$14,987.22</u>

Notes:

(A) 2 Module Testers @ 8,000 = \$16,000

(B) 2 Semi-skilled @ \$1.60 = \$3.20

Cost per piece = $\frac{\$19,326.14}{1,458,000} = .01325$

PROJECT TINKERTOY -- Manufacturing Cost Data

Process Module Testing Hand No. HM-3

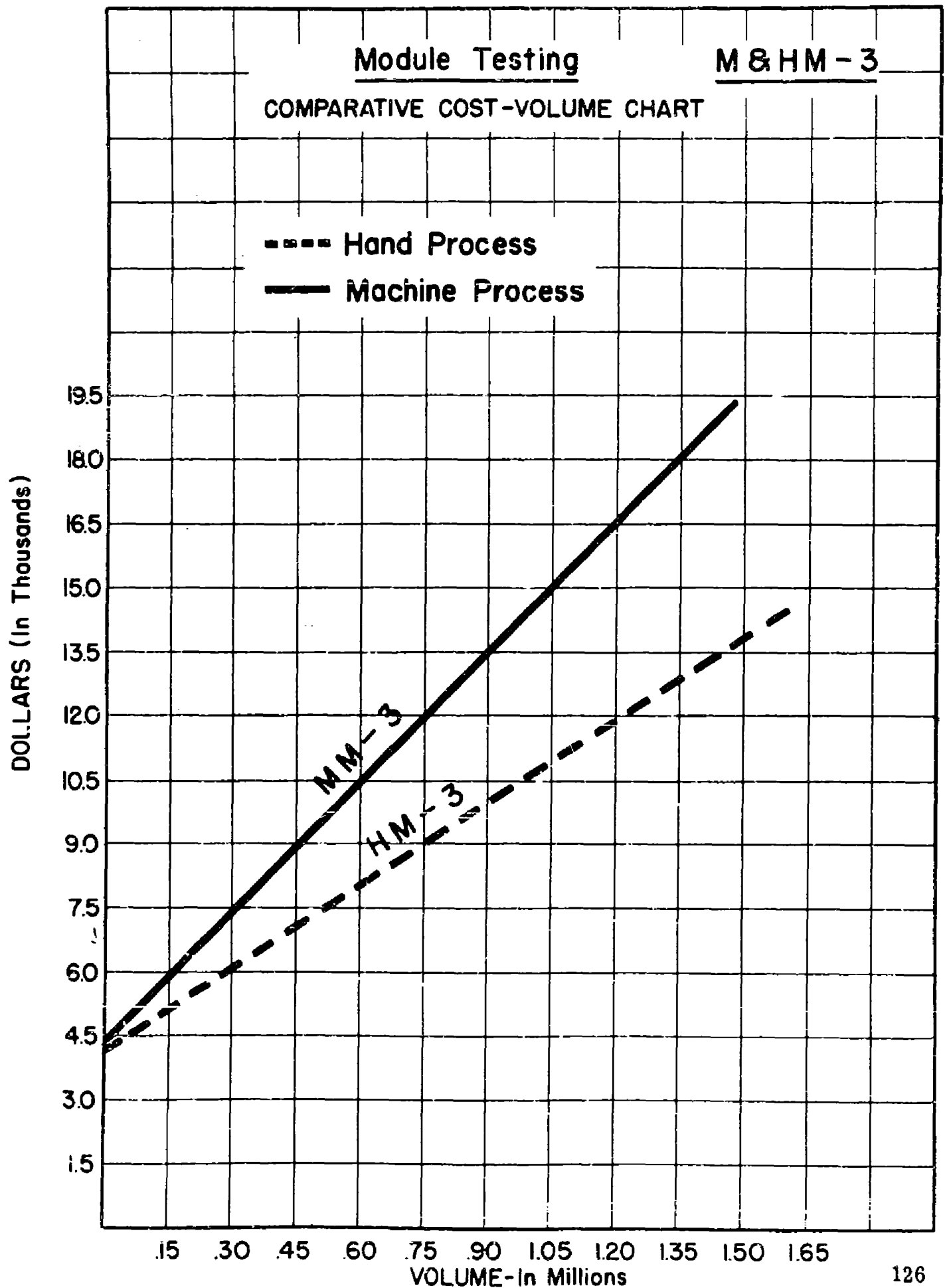
Equipment Bench, Stools & Module Testers (A)

Based on 2 shifts, 4000 hrs., hourly prod. 400 and annual prod. 1,600,000 (B)

	<u>Annual Costs</u>		
	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>4,400</u> (C) x Rate <u>1.6</u> =	<u>\$ 7,040.00</u>	xx	<u>\$ 7,040.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = <u>30%</u> of Dir. <u>7,040.00</u> =	2,112.00	\$ 633.60	1,478.40
b. Mach., Equip. & Tool	4,633.75	3,244.62	1,390.13
c. Occupancy =			
Proc. Space <u>60</u> (D) x Ratio <u>5</u> = <u>300</u> sq.ft.			
Rent <u>300</u> x <u>.80</u> =	240.00	240.00	
Light <u>300</u> x <u>.30</u> =	90.00	9.00	81.00
Heat <u>300</u> x <u>.10</u> =	30.00	22.50	7.50
Subtotal - a, b, and c	7,105.75		
d. Miscellaneous =			
10% x Subtotal <u>7,105.75</u>	710.58		710.58
Total - a, b, c, and d	<u>7,816.33</u>		
GRAND TOTALS	<u>\$ 14,856.33</u>	<u>\$ 4,148.72</u>	<u>\$ 10,707.61</u>

Notes: (A) Equipment for 2 stations = \$18,535
 (B) 10 operations/mod. x 40 mod./hr. = 400 hrly. x 4000 hrs./yr. =
 1,600,000 annual production
 (C) 1.10 x 4000 = 4400 Direct Labor Hrs.
 (D) 2 stations x 30 = 60 sq. ft.

Cost per piece = $\frac{\$14,856.28}{1,600,000 \text{ pcs.}}$ = .00928



PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Machine process manufacturing of IF Amplifier Modules

Equipment * See schedule sheets for machine process steps

Based on 2 shifts, 4,000 hrs., and annual production 1,620,000

	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
** Standard Machine Processing Costs	\$785,771	\$209,021	\$576,750
Special Hand Operations on Modules #1 and #9	<u>19,563</u>	<u>1,843</u>	<u>17,720</u>
GRAND TOTALS	\$805,334	\$210,864	\$594,470

* For cost of equipment see Exhibit 7.

** Total machine processing costs for 1,620,000 modules annually for IF Amplifiers as shown on pertinent schedule sheets in Appendix B.

PROJECT TINKERTOY -- Manufacturing Cost Data

Processes Hand process manufacturing of IF Amplifier Modules

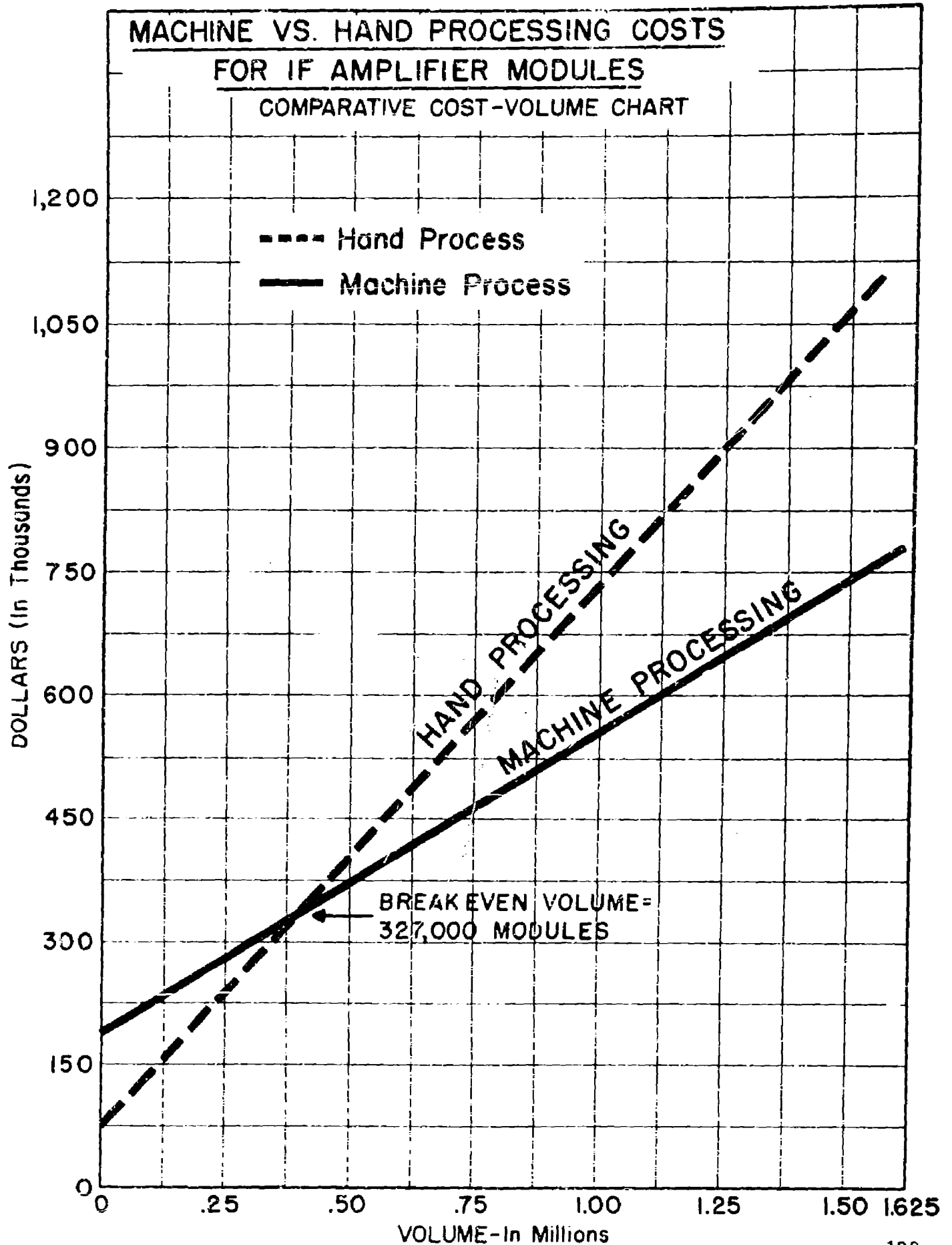
Equipment * See schedule sheets for pertinent hand process steps

Based on 2 shifts, 4,000 hrs., and annual production 1,600,000

	<u>Total</u>	<u>Fixed</u>	<u>Variable</u>
** Standard Hand Processing Costs	\$1,172,959	\$107,652	\$1,065,307
Special Hand Operations on Modules #1 and #9	<u>19,563</u>	<u>1,843</u>	<u>17,720</u>
GRAND TOTALS	\$1,192,522	\$109,495	\$1,083,027

* For cost of equipment see Exhibit 8.

** Total hand processing costs for 1,600,000 modules annually for
IF Amplifiers as shown on pertinent schedule sheets in Appendix B1.



APPENDIX C

IF Amplifier Module Cost Data

<u>Schedule</u>	<u>Description</u>
C-1	IF Amplifier Machine Process Module Cost Data
C-2	IF Amplifier Hand Process Module Cost Data

PROJECT WIREFRONT - MACHINE PROCESS TP AMPLYVYVW HODUE,2 COOTS

[illegible]

PROJECT TIMERTOT - HAND PROCESS VS AMPLIFIER MODULE COSTS

[illegible]

PROJECT: TOWER - LAND PROCESSING APPLICATOR MODULA COST

No.	QTY	P. U.	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	O.R.	M-11	M-12	M-13	M-14	M-15	M-16	M-17	M-18	M-19	M-20	O.R.	M-21	M-22	M-23	M-24	M-25	M-26	M-27	M-28	M-29	M-30	O.R.	M-31	M-32	M-33	M-34	M-35	M-36	M-37	M-38	M-39	M-40	O.R.	M-41	M-42	M-43	M-44	M-45	M-46	M-47	M-48	M-49	M-50	O.R.	M-51	M-52	M-53	M-54	M-55	M-56	M-57	M-58	M-59	M-60	O.R.	M-61	M-62	M-63	M-64	M-65	M-66	M-67	M-68	M-69	M-70	O.R.	M-71	M-72	M-73	M-74	M-75	M-76	M-77	M-78	M-79	M-80	O.R.	M-81	M-82	M-83	M-84	M-85	M-86	M-87	M-88	M-89	M-90	O.R.	M-91	M-92	M-93	M-94	M-95	M-96	M-97	M-98	M-99	M-100	O.R.	M-101	M-102	M-103	M-104	M-105	M-106	M-107	M-108	M-109	M-110	O.R.	M-111	M-112	M-113	M-114	M-115	M-116	M-117	M-118	M-119	M-120	O.R.	M-121	M-122	M-123	M-124	M-125	M-126	M-127	M-128	M-129	M-130	O.R.	M-131	M-132	M-133	M-134	M-135	M-136	M-137	M-138	M-139	M-140	O.R.	M-141	M-142	M-143	M-144	M-145	M-146	M-147	M-148	M-149	M-150	O.R.	M-151	M-152	M-153	M-154	M-155	M-156	M-157	M-158	M-159	M-160	O.R.	M-161	M-162	M-163	M-164	M-165	M-166	M-167	M-168	M-169	M-170	O.R.	M-171	M-172	M-173	M-174	M-175	M-176	M-177	M-178	M-179	M-180	O.R.	M-181	M-182	M-183	M-184	M-185	M-186	M-187	M-188	M-189	M-190	O.R.	M-191	M-192	M-193	M-194	M-195	M-196	M-197	M-198	M-199	M-200	O.R.	M-201	M-202	M-203	M-204	M-205	M-206	M-207	M-208	M-209	M-210	O.R.	M-211	M-212	M-213	M-214	M-215	M-216	M-217	M-218	M-219	M-220	O.R.	M-221	M-222	M-223	M-224	M-225	M-226	M-227	M-228	M-229	M-230	O.R.	M-231	M-232	M-233	M-234	M-235	M-236	M-237	M-238	M-239	M-240	O.R.	M-241	M-242	M-243	M-244	M-245	M-246	M-247	M-248	M-249	M-250	O.R.	M-251	M-252	M-253	M-254	M-255	M-256	M-257	M-258	M-259	M-260	O.R.	M-261	M-262	M-263	M-264	M-265	M-266	M-267	M-268	M-269	M-270	O.R.	M-271	M-272	M-273	M-274	M-275	M-276	M-277	M-278	M-279	M-280	O.R.	M-281	M-282	M-283	M-284	M-285	M-286	M-287	M-288	M-289	M-290	O.R.	M-291	M-292	M-293	M-294	M-295	M-296	M-297	M-298	M-299	M-300	O.R.	M-301	M-302	M-303	M-304	M-305	M-306	M-307	M-308	M-309	M-310	O.R.	M-311	M-312	M-313	M-314	M-315	M-316	M-317	M-318	M-319	M-320	O.R.	M-321	M-322	M-323	M-324	M-325	M-326	M-327	M-328	M-329	M-330	O.R.	M-331	M-332	M-333	M-334	M-335	M-336	M-337	M-338	M-339	M-340	O.R.	M-341	M-342	M-343	M-344	M-345	M-346	M-347	M-348	M-349	M-350	O.R.	M-351	M-352	M-353	M-354	M-355	M-356	M-357	M-358	M-359	M-360	O.R.	M-361	M-362	M-363	M-364	M-365	M-366	M-367	M-368	M-369	M-370	O.R.	M-371	M-372	M-373	M-374	M-375	M-376	M-377	M-378	M-379	M-380	O.R.	M-381	M-382	M-383	M-384	M-385	M-386	M-387	M-388	M-389	M-390	O.R.	M-391	M-392	M-393	M-394	M-395	M-396	M-397	M-398	M-399	M-400	O.R.	M-401	M-402	M-403	M-404	M-405	M-406	M-407	M-408	M-409	M-410	O.R.	M-411	M-412	M-413	M-414	M-415	M-416	M-417	M-418	M-419	M-420	O.R.	M-421	M-422	M-423	M-424	M-425	M-426	M-427	M-428	M-429	M-430	O.R.	M-431	M-432	M-433	M-434	M-435	M-436	M-437	M-438	M-439	M-440	O.R.	M-441	M-442	M-443	M-444	M-445	M-446	M-447	M-448	M-449	M-450	O.R.	M-451	M-452	M-453	M-454	M-455	M-456	M-457	M-458	M-459	M-460	O.R.	M-461	M-462	M-463	M-464	M-465	M-466	M-467	M-468	M-469	M-470	O.R.	M-471	M-472	M-473	M-474	M-475	M-476	M-477	M-478	M-479	M-480	O.R.	M-481	M-482	M-483	M-484	M-485	M-486	M-487	M-488	M-489	M-490	O.R.	M-491	M-492	M-493	M-494	M-495	M-496	M-497	M-498	M-499	M-500	O.R.	M-501	M-502	M-503	M-504	M-505	M-506	M-507	M-508	M-509	M-510	O.R.	M-511	M-512	M-513	M-514	M-515	M-516	M-517	M-518	M-519	M-520	O.R.	M-521	M-522	M-523	M-524	M-525	M-526	M-527	M-528	M-529	M-530	O.R.	M-531	M-532	M-533	M-534	M-535	M-536	M-537	M-538	M-539	M-540	O.R.	M-541	M-542	M-543	M-544	M-545	M-546	M-547	M-548	M-549	M-550	O.R.	M-551	M-552	M-553	M-554	M-555	M-556	M-557	M-558	M-559	M-560	O.R.	M-561	M-562	M-563	M-564	M-565	M-566	M-567	M-568	M-569	M-570	O.R.	M-571	M-572	M-573	M-574	M-575	M-576	M-577	M-578	M-579	M-580	O.R.	M-581	M-582	M-583	M-584	M-585	M-586	M-587	M-588	M-589	M-590	O.R.	M-591	M-592	M-593	M-594	M-595	M-596	M-597	M-598	M-599	M-600	O.R.	M-601	M-602	M-603	M-604	M-605	M-606	M-607	M-608	M-609	M-610	O.R.	M-611	M-612	M-613	M-614	M-615	M-616	M-617	M-618	M-619	M-620	O.R.	M-621	M-622	M-623	M-624	M-625	M-626	M-627	M-628	M-629	M-630	O.R.	M-631	M-632	M-633	M-634	M-635	M-636	M-637	M-638	M-639	M-640	O.R.	M-641	M-642	M-643	M-644	M-645	M-646	M-647	M-648	M-649	M-650	O.R.	M-651	M-652	M-653	M-654	M-655	M-656	M-657	M-658	M-659	M-660	O.R.	M-661	M-662	M-663	M-664	M-665	M-666	M-667	M-668	M-669	M-670	O.R.	M-671	M-672	M-673	M-674	M-675	M-676	M-677	M-678	M-679	M-680	O.R.	M-681	M-682	M-683	M-684	M-685	M-686	M-687	M-688	M-689	M-690	O.R.	M-691	M-692	M-693	M-694	M-695	M-696	M-697	M-698	M-699	M-700	O.R.	M-701	M-702	M-703	M-704	M-705	M-706	M-707	M-708	M-709	M-710	O.R.	M-711	M-712	M-713	M-714	M-715	M-716	M-717	M-718	M-719	M-720	O.R.	M-721	M-722	M-723	M-724	M-725	M-726	M-727	M-728	M-729	M-730	O.R.	M-731	M-732	M-733	M-734	M-735	M-736	M-737	M-738	M-739	M-740	O.R.	M-741	M-742	M-743	M-744	M-745	M-746	M-747	M-748	M-749	M-750	O.R.	M-751	M-752	M-753	M-754	M-755	M-756	M-757	M-758	M-759	M-760	O.R.	M-761	M-762	M-763	M-764	M-765	M-766	M-767	M-768	M-769	M-770	O.R.	M-771	M-772	M-773	M-774	M-775	M-776	M-777	M-778	M-779	M-780	O.R.	M-781	M-782	M-783	M-784	M-785	M-786	M-787	M-788	M-789	M-790	O.R.	M-791	M-792	M-793	M-794	M-795	M-796	M-797	M-798	M-799	M-800	O.R.	M-801	M-802	M-803	M-804	M-805	M-806	M-807	M-808	M-809	M-810	O.R.	M-811	M-812	M-813	M-814	M-815	M-816	M-817	M-818	M-819	M-820	O.R.	M-821	M-822	M-823	M-824	M-825	M-826	M-827	M-828	M-829	M-830	O.R.	M-831	M-832	M-833	M-834	M-835	M-836	M-837	M-838	M-839	M-840	O.R.	M-841	M-842	M-843	M-844	M-845	M-846	M-847	M-848	M-849	M-850	O.R.	M-851	M-852	M-853	M-854	M-855	M-856	M-857	M-858	M-859	M-860	O.R.	M-861	M-862	M-863	M-864	M-865	M-866	M-867	M-868	M-869	M-870	O.R.	M-871	M-872	M-873	M-874	M-875	M-876	M-877	M-878	M-879	M-880	O.R.	M-881	M-882	M-883	M-884	M-885	M-886	M-887	M-888	M-889	M-890	O.R.	M-891	M-
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APPENDIX D

IF Amplifier Assembly & Test Cost Data

<u>Schedule</u>	<u>Description</u>
D-1	IF Amplifier Assembly & Test Cost Data Sheet
D-2	IF Amplifier Assembly & Test Production Rates

IF AMPLIFIER ASSEMBLY & TEST COST DATA

PROJECT TINKERTOY -- Manufacturing Cost Data

Process IF Amplifier Assembly & Test Hand

Equipment Benches, stools, fixture & testing equipment (A)

Based on 2 shifts, 4000 hrs., hrly. prod. 40 and annual prod. 160,000

	<u>Total</u>	<u>Annual Cost</u>	
		<u>Fixed</u>	<u>Variable</u>
1. Material		xx	
2. Direct Labor =			
Hrs. <u>61,600 (B) x Rate 1.6 =</u>	<u>\$98,560.00</u>	xx	<u>\$ 98,560.00</u>
3. Manufacturing Overhead			
a. Ind. Lab. = 30% of Dir. <u>98,560.00 =</u>	<u>29,568.00</u>	<u>\$ 8,870.00</u>	<u>20,698.00</u>
b. Mach., Equip. & Tool	<u>312.50</u>	<u>218.75</u>	<u>93.75</u>
c. Occupancy =			
Proc. Space <u>480 (C) x Ratio 5 = 2,400 sq. ft.</u>			
Rent <u>2400 x .8 =</u>	<u>1,920.00</u>	<u>1,920.00</u>	<u>---</u>
Light <u>2400 x .3 =</u>	<u>720.00</u>	<u>72.00</u>	<u>648.00</u>
Heat <u>2400 x .1 =</u>	<u>240.00</u>	<u>260.00</u>	<u>180.00</u>
Subtotal - a, b, and c	<u>\$ 32,760.50</u>		
d. Miscellaneous =			
10% x Subtotal <u>32,760.50 =</u>	<u>3,276.05</u>		<u>3,276.05</u>
Total - a, b, c, and d	<u>36,036.55</u>		
GRAND TOTALS	<u>\$134,596.55</u>	<u>\$11,140.75</u>	<u>\$123,455.80</u>

Notes:

- (A) Cost for 16 stations = \$1,250
 (B) $.385 \times 40 = 15.4 \times 4000 = 61,600$ dir. lab. hrs. (see Schedule D-2)
 (C) 16 stations x 30 sq. ft. = 480 sq. ft.

Cost per piece = $\frac{\$134,596.55}{160,000} = .84$

PROJECT TINKERTOY -- Manufacturing Cost Data

IF AMPLIFIER

Final Assembly and Test Production Rates

<u>Op. No.</u>	<u>Operation Description</u>	<u>Estimated Production Rate</u>	
		<u>hrs/pc</u>	<u>pcs/hr</u>
<u>Bottom Plate Assembly</u>			
FA-1	Insert 10 IF Modules	.02578	39
FA-2	Insert 8 decoupling shields	.00992	101
<u>Top Plate Assembly</u>			
FA-3	Assemble female connector to top plate with eyelets in eyelet machine; solder.	.01289	78
FA-4	Assemble 9 tube shield clips to top plate with eyelet in eyelet machine and solder each clip.	.04253	24
FA-5	Assemble tuning coil and 8 inner stage shields to top plate and assemble top plate subassembly to bottom plate.	.04253	24
FA-6	Solder 8 inner stage shields to top and bottom plates	.107	9
FA-7	Solder all module riner wires and tuning coil connections in special fixture.	.0258	39
FA-8	Assemble 9 tubes, 9 tube shields, transformer shield and coaxial cable; solder.	.08656	12
<u>Test</u>			
FA-9	Test: Band pass and gain	.03222	31
TOTAL		.38523	

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27966

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