A METHOD OF DETERMINING EQUIPMENT AND MINIMUM FLOOR SPACE FOR A BAKESHOP, AN INTEGRAL PART OF A KITCHEN SERVING 600 PERSONS PER MEAL

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A METHOD OF DETERMINING EQUIPMENT AND MINIMUM FLOOR SPACE FOR A BAKESHOP, AN INTEGRAL PART OF A KITCHEN SERVING 600 PERSONS PER MEAL

By

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A PROBLEM

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TABLE OF CONTENTS

	Page
INTRODUCTION	1
THE PROBLEM	2
THE PILOT STUDY	8
OBSERVATIONS AND LIMITATIONS OF THE STUDY	18
BIBLIOGRAPHY	22
APPENDIX	24

LIST OF TABLES

TABLE Page

1. Representative Menu Items and Variations 9

2. Equipment Guide A--Suggested Basic Equipment List for Bakeshop Serving 600 Persons per Meal 11

3. Equipment Guide B--Speciality Equipment List According to Menu Items for Bakeshop Serving 600 Persons per Meal 13

4. Equipment List--Equipment Used to Produce 28 Cocoa Layer Cakes 25

5. Equipment List--Equipment Used to Produce 50 doz. Fan Tan Rolls 26

6. Equipment List--Equipment Used to Produce 240 Cream Puffs 27

7. Equipment List--Equipment Used to Produce 25 Angel Cakes 28

8. Equipment List--Equipment Used to Produce 300 Muffins 29

9. Equipment List--Equipment Used to Produce 50 Banana Cream Pies 30

10. Equipment List--Equipment Stored on Pot Rack Indicating Areas Occupied. 31

11. Storage Details 32

12. Equipment List for Suggested Arrangement of Bakeshop Equipment (Figure 2) Equipment Standing on the Floor. 33

13. Equipment List for Suggested Arrangement of Bakeshop Equipment (Figure 2) 34

LIST OF FIGURES

FIGURE Page

1. Suggested Arrangement of Utensils on Shelves 15

2. Suggested Arrangement of Bakeshop Equipment 17

INTRODUCTION

Most industries have become so highly specialized that a manager of a department needs to develop expertise in a limited field only. When the president of a corporation makes decisions affecting the over-all operation of the plant, he depends on the advise and information supplied by his various section heads. The food service operator differs from most other general managers in that he carries out the full cycle in one establishment; he purchases raw material, manufactures it and sells the product all under one roof. Very few food service establishments are large enough to afford expert managers for each section; therefore, one operator makes all the major decisions without personal advice.

There is a decided lack of information available as a guide for ordering food service equipment. Some text books list the major items but very little has been written about the amounts required, the purchase descriptions and the storage of the many utensils. A method for determining major and minor equipment requirements is needed so information can be compiled to provide a realistic basis for estimating minimum required floor space. This paper presents a pilot study of a method for determining equipment and minimum floor space requirements for a bakeshop.

THE PROBLEM

Productivity in the United States has been rising at the rate of three per cent per year; the food service industry has been increasing its productivity at the rate of only one per cent per year (20). Donald Greenway, Executive Vice President of the National Restaurant Association has stated that the restaurant industry has one of the lowest productivities per man-day of work of any industry in the country (19). It has been estimated that only 45% of hotel and restaurant employees' working hours are spent at productive tasks.

The food service industry has been growing by leaps and bounds, being outranked only by housing, clothing and retailing. Americans are becoming more affluent; the number of family wage earners is increasing; more discretionary income is available; more families are eating out. However, in spite of the growing volume of business, each year is marred by the failure of many establishments. During 1961 in the United States, 1,383 food service operations closed their doors losing approximately $30,000 each (21). Better guided planning of equipment purchases, and more efficient use of floor space could have saved some of these projects. A clever salesman can play havoc with a carefully planned budget especially if the operator is not well armed with true facts and figures.

An inexperienced manager may order too little; he may order too much or he may make poor selections. Any one of these errors or a combination of them usually brings disastrous results and increases unproductive time. If insufficient equipment is available to the staff members the continuity of their work will be disrupted by delays while they wait for machines to be free so they may continue with their assignments. The supervisor must prepare very detailed work plans often

resulting in loss of flexibility and efficiency. Until recently it was cheaper to pay more wages than to buy new machines but this situation has changed. The wages for food service personnel, which in the past have ranked very low in comparison with other industries, have been rising during the last two decades and it is expected that they will continue to do so. Morehouse, Managing Editor of Restaurant Management, has said that managers who are not prepared to add twenty per cent to their payrolls in the next five years, plus ten per cent in fringe benefits, will be putting themselves into low gear for the long steep curve of rising labor costs that lies ahead (19). In the long run, if wisely selected, labor saving equipment will often prove more economical than extra wages.

A lack of equipment limits the number of menu items and often the quality of the products. It is evident that without a waffle iron a restaurateur cannot serve waffles but insufficiencies may cause many less obvious limitations. For example, an operator may install only a single deck oven although he wishes to serve fresh apple pie and rare roast beef at the same meal. The roasts should be staggered so that one is removed from the oven every fifteen minutes during the serving period. The manager is faced with the choice of hiring an extra chef to make the pies earlier, taking all the meat out of the oven at the same time or serving day old apple pies. A two deck oven would make the cook's routine more flexible, allow a higher standard of food service, reduce payrolls and increase sales and profits.

Often the dealers have the only data concerning the economics of the addition of certain items of equipment. Unfortunately, their data are slanted towards increasing sales. A larger dishwashing machine may complete the dishwashing operation in a shorter time and reduce the labor hours per day, but unless these hours are used to advantage, the installation is not economically sound. If the employees are idle during the

hours between peak periods the expenses will be increased with no compensatory savings. To determine whether an investment is a wise one, the operator needs facts and figures other than the sales oriented data normally supplied by the salesmen.

Food service establishments are scattered throughout urban and rural areas and some managers have no communication with other members in the same field. Although the hotel and restaurant trade magazines list and describe new products on the market, they usually repeat only the sales oriented information which the dealer published. Because of this and the lack of pooling ideas and information, many managers are not in a position to evaluate either new equipment trends or the improvements of past years. Kitchens still exist where garbage cans in the dishwashing area are not on dollies and the employees are carrying them to the garbage room.

In order to be progressive and to keep up with the times, an establishment must maintain a climate receptive to change. Human beings normally resist change; however, if management makes it a practice to periodically introduce innovations, the staff come to accept the fact that these changes make their work easier instead of causing complications, and their resistance decreases or fades away completely. A publication listing recommended amounts of equipment would provide the manager with practical ideas for his organization. If it is amended as new items enter the market, it will assist him in keeping his establishment up to date. A reputation for progressiveness will attract and retain a better class of employee and will, therefore, be an aid to a high standard of service, food and sanitation. For many decades the public has regarded personnel employed in the food service trades as low class citizens; they are given the status of servants. It now appears that the public is becoming more aware of the magnitude of the skills required in the industry and the image is improving. Continued modernization will help maintain this improvement.

Another factor to be considered while discussing modernization is the cost of maintenance of old machines. Many hard-earned dollars go into repairs. It may be cheaper to buy a new machine and put those dollars into monthly payments for it. The new machine will no doubt be more efficient, less costly to operate, and a morale booster for the staff, but this can only be determined by the study of adequate data.

It is just as important not to over invest as it is not to under invest in equipment. If an operator knows exactly what equipment he needs for the production of each item he expects to include on his menu, he can plan his equipment purchases wisely. The use of labor saving prepared foods is eliminating the need for many pieces of equipment. If the plans call for pre-peeled, frozen or dehydrated potatoes, why not cross the potato peeler off the list? Unused or oversized equipment will not pay for itself.

Brodner (3) stated that the expenses of running a food service department normally include 10% of the investment on furniture, fixtures and equipment. This may go to payment of mortgages, interest on loans or a satisfactory return on the owner's capital. Therefore, the larger the investment in equipment the greater will be the fixed expenses and the greater the volume of business must be to maintain a reasonable profit. Over investment in equipment will by no means ensure a large volume of business. The wise operator keeps his investment to a reasonable minimum while supplying the necessities for efficient operation.

Too much equipment results in more floor space being allocated to food service areas than is necessary. General construction costs are high but the cost per unit of kitchen and dining room space is even higher; it runs 50 to 70% more than the cost per unit of housing or office area. The extra maintenance, in heat, and lighting expenses must also be considered.

In many kitchens extra pots and pans are sitting on shelves gathering dust while those in daily use are stored on the floor. Employees occasionally have to move stacks of pans to find the one they require. Such confusion decreases efficiency.

Large unnecessary stocks of attractive items such as silverware encourage pilfering. If it is known that equipment will not be counted until inventory time an employee may systematically rob the establishment feeling safe, because the passage of time before the theft will be discovered will make it difficult to trace the crime to him. When equipment is in daily use its absence is noted almost immediately as it occurs, and there is less opportunity for the thief to cover his tracks before a search is begun.

On the basis that extra equipment can be useful in cases of emergency, high pressure salesmen have sold duplicates to purchasing agents. When the original machine reaches the stage where it can no longer be economically repaired, more efficient models are on the market. But the unused, but now obsolete, machine is still in the storeroom. In the interest of immediate economy the misguided administrator may have this machine installed and the department will therefore be denied the advantages of new technology for several years.

Operational efficiency in a food service department depends to a large extent on the availability of the right number of the right tools in the right place at the right time. The right number of the right tools allows for optimum utilization of floor space which reduces the area allotted to food service, results in lower construction costs and increases staff productivity. The original and replacement costs of equipment are minimized and the use and storage of obsolescent items are reduced.

Operational efficiency cannot be attained without careful, guided planning of the equipment and the arrangement of the work areas. The purpose of this study was to develop a method of determining equipment

and minimum floor space requirements for a bakeshop in a food service department serving 600 persons per meal.

THE PILOT STUDY

The writer observed the preparation of bakeshop products in a Michigan State University residence hall during the summer term, 1962. In the winter months this building houses 1000 to 1100 students; during the period of observation there were approximately 600 residents. The products selected for observation were considered to be representative of the majority of those currently being served in the dormitory. Table 1 lists the menu items selected and the products they represent. For example, the production of banana cream pie includes the same processes for pastry making as those for two crust pies; the preparation of the cream filling represents the preparation of milk puddings; the cooling of the pies requires the same equipment needed for gelatin desserts; the procedures for making the meringue are similar to those used for other toppings.

Production fore-casts for each dessert were based on popularity. The residence hall served three desserts at luncheon and three at dinner and records were kept of the selections made by the students. The popularity of each dessert varied according to the combination of the dishes offered at one meal. The number of required servings was based on the largest amount consumed at one meal rather than an average so that there would be sufficient pans for any occasion.

Appendix Tables 4-9, inclusive, list in order of use each tool, utensil, machine and attachment that was utilized in preparation of the representative bakeshop products. The equipment is divided into two categories, basic and specialty items. All food service departments preparing their own desserts and breads would require the items in the first group as they include bins, tables, refrigerators and mixing

Table 1. Representative Menu Items and Variations

Productions Observed	Items Represented
Banana Cream Pie	All pies Cream puddings Jello desserts Custard sauces Meringue toppings
Cream Puffs	Eclairs Cookies
Muffins	Cup cakes
Chocolate Layer Cake	All butter cakes Cobblers Shortcakes Fruit bars
Fan Tan Rolls	Plain rolls and variations Sweet rolls
Angel Cake	Chiffon cakes

machines; the manager would order only the equipment items in the second category which are required for the desserts and breads he plans to serve. This information was used to construct two guides. These master charts contain a list of equipment recommended for a bakeshop in a kitchen feeding 600 persons per meal and serving the menu items represented in Table 1 plus ice cream. Equipment Guide A, Table 2, includes basic pieces; Equipment Guide B, Table 3, denotes specialty pieces.

Comments on the construction of these two equipment guides follow:

1. The measurements for the equipment were obtained from 1962 catalogues. See appendix Exhibit 1. The model numbers are not listed as each operator would select those best suited to his operation.

2. In certain cases the number of utensils has been increased over and above those utilized during the observations. For example, the pie plates were increased from 50 to 80. Left-over pies may be frozen and served at a later date. While these pans are still in service pies may appear on the menu again and a full complement of fifty pans would be required. A twelve quart trunion kettle was added as it was noted that the sixty gallon trunion was too large for the amount of custard filling prepared for eclairs; this would also be true for other fillings. The sixty gallon trunion kettle was replaced by a forty gallon kettle since this capacity is sufficient for any products cooked for 600 persons. This may not be true when the kitchen is feeding 1000 persons. The chef's knife was added for cutting fruit loaves.

3. There was considerable temptation to add equipment items which were not utilized during any of the observations. Measures are commonly available in four sizes and it seemed natural to include all four; however, the bakers used only two, therefore two only appear on the list.

Table 2. Equipment Guide A

Suggested Basic Equipment List for Bakeshop Serving 600 Persons per Meal

Description	Amount
Bags, pastry, 16 in.	4
Bins, under counter storage, $22\frac{7}{8}$ x$20\frac{7}{8}$ x$29\frac{7}{8}$ in.	6
Brush, pastry, small	1
Cans, garbage, 18 in. diameter	2
Cabinet, recipe, $8\frac{1}{2}$ x$4\frac{1}{2}$ x$5\frac{3}{4}$ in.	1
Clock, wall electric	1
Colander, 4 gal.	1
Containers, food storage, 1 qt.	4
Containers, food storage, 4 qt.	2
Cutter, pastry	1
Cupboard, food, 23x37x60 in.	1
Dipper, 30 oz.	2
Dollies	3
Holders, pot	4
Inserts, steam table, $26\frac{1}{2}$ x$13\frac{1}{2}$ x$4\frac{1}{4}$ in.	10
Kettle, trunion, 40 gal.	1
Kettle, trunion, 12 qt.	1
Knives, paring	4
Knives, chef's, 8 in. blade	2
Measures, 1 pt.	2
Measures, 1 gal.	2
Mixing machine, 60 qt.	1
Mixing machine, 12 qt.	1
Attachments bowl, 60 qt.	1
Attachments, mixing bowl, 40 qt.	1
Attachments, mixing bowl, 12 qt.	1
Attachments, wire whip, 60 qt.	1
Attachments, wire whip, 40 qt.	1
Attachments, wire whip, 12 qt.	1
Attachments, flat beater, 60 qt.	1
Attachments, flat beater, 40 qt.	1
Attachments, flat beater, 12 qt.	1
Attachments, adapter	1
Opener, can	1
Oven, reel-type, 120x84 in.	1
Pans, sheet $25\frac{3}{4}$ x$17\frac{3}{4}$ x1 in	40
Paddle, wooden	1
Peel	1

Continued

Table 2 - Continued

Description	Amount
Pin, rolling, small	1
Pin, rolling, large	1
Plate, hot, 2 burner	1
Pots, 3 gal.	1
Pots, 5 gal.	1
Rack, pot, 20x48x54 in.	1
Racks, pan, 41x21x67 in.	1
Rack, paper towels	1
Refrigerator, reach in, 4 compartments	1
Refrigerator, frozen storage reach in, 4 compartments	1
Scales, weighing 16 lbs.	1
Scale bowl, 8 qt.	1
Scales, weighing, 40 lbs.	1
Scrapers, rubber	2
Scoops, mechanical, No. 12	1
Scoops, mechanical, No. 16	1
Scoops, mechanical, No. 20	1
Scoops, mechanical, No. 24	1
Scoops, 18 oz.	4
Scoops, 48 oz.	8
Sink, single compartment	1
Sieve, 16 in. diameter	1
Skimmer	1
Spatula, 10 in. blade	1
Sponge, 6x3x1 in.	1
Spoons, slotted	2
Spoons, mixing	2
Spoons, measuring (set)	2
Table, wooden top, 96x60 in.	1
Table, utility, 24x36 in.	1
Table, portable, 21$\frac{1}{2}$x32 in.	1
Tubes, pastry bag, assorted	4
Wire whip, 14 in.	1

Table 3. Equipment Guide B

Speciality Equipment List According to Menu Items for Bakeshop Serving 600 Persons Per Meal

Menu Item	Description of Equipment	Amount
Rolls, fan tan	Cutter, dough, 19 in. diameter	1
	Mixing machine dough arm, 60 qt.	1
	Mixing machine dough arm, 40 qt.	1
	Pans, muffin, 12 cups each	50
	Proofer and retarder combination	1
	Table, portable, $21\frac{1}{2}$ x32 in.	1
Cream puffs	Eclair filler, 9 in. diameter	1
Angel cakes	Pans, angel cake, 10 in. diameter	28
Muffins	Pans, muffin, 12 cups each	25
	Paper cups	300
Banana cream pies	Pans, pie, 9 in. diameter	80
Cocoa layer cake	Pans, cake, round, 9 in. diameter	60
Fruit pies	Bowls, mixing, 30 gal.	1
	Carrier	1
Eclairs	Special end for pastry bag	1
	Eclair filler, 9 in. diameter	1
Ginger cake Fruit cobblers, etc.	Pans, baking, $11\frac{7}{8}$ x$17\frac{13}{16}$ x$2\frac{1}{4}$ in.	20
Fruit loaves	Pans, loaf, 16x$4\frac{1}{2}$ x$4\frac{1}{8}$ in.	20

4. A two burner hot plate replaced the four burner range, as at no time did the observer see the bakers cooking on more than one burner. The addition of a twelve quart trunion may make it possible to dispense with the hot plate.

5. With the exception of the large mixing bowl on a carrier, no mixing gowls were in evidence. The bakers chose either a three or five gallon pot for ingredients that were to be cooked or mixed separately. The large mixing bowl was added to the specialty list because it was noted that the frozen apples for pies were thawed in it.

6. The four sizes of mechanical scoops were added for the following serving purposes:

Size No. 12	plain ice cream
Size No. 16	ice cream for sundaes
Size No. 20	ice cream for meringues
Size No. 24	ice cream for pie a' la mode

One extra 18 oz. scoop and one extra 40 oz. scoop were added as the bakers were frequently searching for a scoop.

7. The four compartment reach-in freezer allows sufficient space for the storage of ice cream. In many food service departments the ice cream is stored at the serving line. If this is the case the freezer space could be reduced by one half.

8. The size of the pot rack was determined by stacking the pots and pans on shelves and measuring the surface occupied and the height of the piles. This information is included in Appendix Table 10 and illustrated in Figure 1.

9. The size of the cupboard was determined by observing the kinds and amounts of supplies stored there. Appendix Table 11 includes this information plus the lists of the commodities stored in the bins and refrigerators. An operator planning a food service department would consider the proximity of the main storage areas before deciding the size of these pieces of equipment.

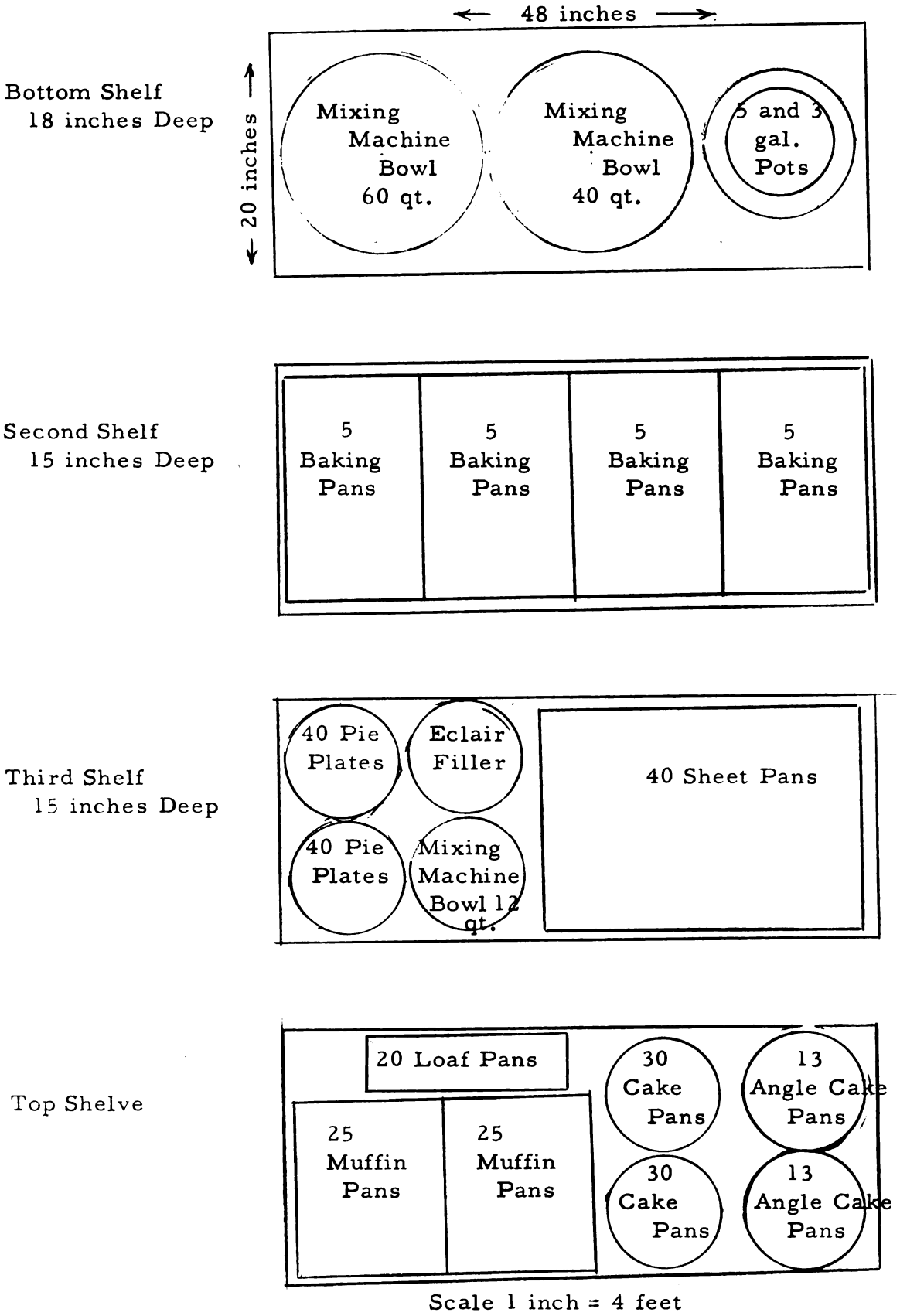
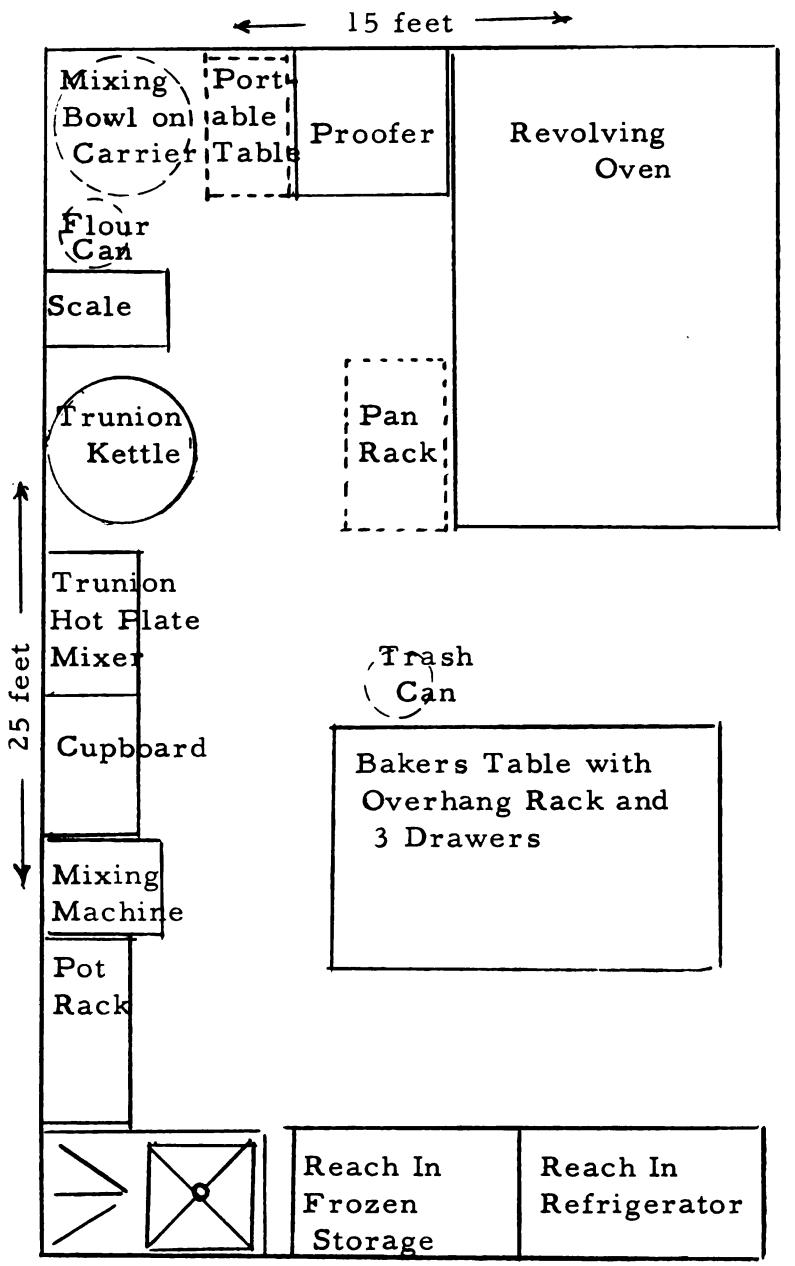


Figure 1. Suggested Arrangement of Utensils on Shelves.

Floor space for a workable arrangement of the basic and specialty equipment listed in Equipment Guides A and B, for a bakeshop serving a selective menu to 600 persons per meal is suggested in Figure 2. An area 15 by 25 feet or 375 square feet will accommodate this equipment. Appendix Table 12 includes the description and size of all the items occupying floor space. The equipment stored in drawers of the baker's table is listed in Appendix Table 13.

Several writers (6, 12, 14, 15) recommend that 15 square feet per person served be allotted the dining area in residence halls. For 600 residents dining space allocation would be 9000 square feet. The average division of total food service area is 60% to the dining room and 40% to the kitchen (6, 12, 14, 15). Based on these recommendations, kitchen space for producing meals for 600 persons would consist of 6000 square feet. The bakeshop layout (Figure 2) designed from Equipment Guides A and B is 375 square feet or 6.25% of the commonly accepted kitchen area space.



Scale 1 inch = 4 feet

Figure 2. Suggested Arrangement of Bakeshop Equipment.

OBSERVATIONS AND LIMITATIONS OF THE STUDY

This study indicated very clearly the necessity of deciding the type of menu, the type of service and to what extent convenience foods will be used in a food service department before purchasing the equipment and planning the layout. With rising costs in all phases of business and increasing variation in general and specialized equipment long range planning becomes more and more important.

Wherever practical, an operator should consider individual preferences. Because of increased mechanism in the kitchens and dining rooms, the staff must accept the fact they have to learn to work with the large equipment that management has provided. However, the supervisor should consider each employee as an individual artist at work. There is no reason why small, relatively inexpensive tools, such as knives, spatulas, scrapers, cannot be purchased in accordance with the chef's wishes. A two dollar tube for a pastry bag may buy the manager $100 worth of good will and increase the baker's productivity in an unmeasurable amount (24).

The manager can practice good public relations at other times than when actually supervising. When considering expensive items, he can let it be known that his decisions must stand, that he has made the selection and the equipment must be used. However, when the time comes to replace it, much valuable information can be obtained by inquiring from the staff members using the present machine what they like about it, what they do not like about it, and how it can be improved. Armed with this information and a manual listing recommended sizes, numbers, and materials for his size of operation, the manager will be in a position to make a wise, rational selection.

After selecting his basic items every operator must then decide for himself which labor saving devices are a good investment for him. If a manual on the subject is published, it must stress the fact that it is only a guide and cannot be comprehensive enough to cover all situations. Vegetable cutters, pastry rollers, lowerators, reel-type ovens, pot washing machines, and conveyor belts may be an economical investment or they may result in over investment. The decisions cannot always be based on dollars and cents alone.

The proposed bakeshop layout (Figure 2) which was based on Equipment Guides A and B has certain limitations.

1. Observations for construction of the Equipment Guides were made in one kitchen by a single observer. Another kitchen in a different area may produce the same desserts with an entirely different combination of equipment. If it had been chosen as a model, the result would probably have been a different recommended list. Each may be equally advantageous.

2. Alternate courses of action were not considered. If the bakeshop cited in this study did not make yeast rolls the following equipment could be eliminated: the dough cutter, the proofer, the retarder, and the portable table. A smaller oven could replace the one presently installed which occupies 70 square feet. The size of the baking area and the investment in equipment could be reduced. On the other hand, fresh homemade rolls are very popular in university residence hall food service and more than pay their way in minimizing student complaints.

3. Every list of equipment must be checked and double checked. While the observer's attention is diverted by someone entering

the room, the chef may pick up a tablespoon, fill it with baking powder and throw it into his batter. By the time the observer is again watching him, he is attaching the whip in the mixing machine and the spoon does not appear on the list. A baker was asked what equipment he had used to make custard filling for eclairs. He rhymed off five items, but while observing him it was noted that he had used twelve. He failed to remember the bins that the ingredients are stored in, the scoops, the paddle, and the table. It appeared that the method of listing observations was more accurate than that of listing according to the baker's recall.

4. Work schedules are a controlling factor in the final layout determination. In this residence hall bakeshop two bakers worked simultaneously for the greater part of the seven A. M. to five P. M. day. If the manager planned to have one baker on night shift and one on days, certain changes could be made in equipment orders. For example, the recommended baker's table is double width to accommodate two bakers, one on either side at the same time; this could be reduced to a single width table under certain circumstances.

5. The proximity and arrangement of the main kitchen was not considered when selecting and placing equipment for the suggested bakeshop layout in Figure 2. However, one department should never be divorced from the total kitchen layout in blocking out an efficient master plan for food service operation.

In the opinion of the author, for this study to be conclusive, it would be necessary to observe food preparation in kitchens feeding different numbers of persons and in others giving different types of service.

It would also require a team of observers and technicians. A kitchen where a test of the recommended equipment could be run would be invaluable. All other equipment except that recommended by the team would be removed and production observed in a controlled situation to ensure that nothing had been omitted and no extras included.

Future studies which incorporated definite controls should provide additional data for determining equipment and minimum floor space requirements for institution kitchen and bakeshop layouts.

BIBLIOGRAPHY

1. Barnes, Ralph M. Work Methods Manual, New York, John Wiley and Sons, Inc., 1944.

2. Barnes, Ralph M. Motion and Time Study, New York, John Wiley and Sons, Inc., 1958.

3. Brodner, Joseph et al. Profitable Food and Beverage Operation, New York, Ahrens Publishing Company, 1951.

4. Casper, Stephen J., Jr. Getting the Most for Your Food Dollar, Restaurant Management, August, 1960.

5. Close, Guy C., Jr. Work Improvement, New York, John Wiley and Sons, Inc., 1960.

6. Dana, Arthur. Kitchen Planning for Quantity Food Service, New York, Harper and Bros., 1949.

7. Day, Thomas M. A Shopping Center Cafeteria, Whippany, New Jersey, Bell Telephone Laboratories.

8. Fleischman, Ernest M. Modern Luncheonette Management, New York, Ahrens Publishing Company, Inc., 1947.

9. Food Service Information. Koch Refrigerator Inc., Kansas City, 1959.

10. George W. L. and Heckler, Ruth D. School Food Centers, New York, The Ronald Press Company, 1960.

11. Joint Committee of the American Hospital Association and the American Dietetic Association. Hospital Food Service Manual, Chicago, The American Hospital Association, 1948.

12. Kotschevar, Lendal H. and Terrel, Margaret E. Food Service Planning Layout and Equipment, New York, John Wiley and Sons, 1961.

13. Kotschevar, Lendal H. Work Simplification in Food Service Reprinted from Institutions Magazine.

14. Laschober, Joseph. A Short Course in Kitchen Design. Reprinted from Institutions Magazine.

15. Little, Keith R. Kitchen Layout Logic, Toronto, Age Publications, Ltd., 1959.

16. May, E. M. The Economics of Hospital Food Service, Wilmington, Delaware, Charitable Research Foundation, Inc., 1955.

17. Manual For Food Service Planning, Design Engineering. Reprinted from Institutions Magazine.

18. Many Factors Determine Layout of Dining Areas, Institutions Magazine, May, 1959.

19. Morehouse, Richard. A Better Job with Fewer People, Restaurant Management. Sept. 8, 1960.

20. Opinion, Institutions Magazine, March, 1962.

21. Opinion, Institutions Magazine, July, 1962.

22. Segler, George C. and Setchell, J. Stanford. Commercial Kitchens, American Gas Association, 1948.

23. Stokes, J. W. Food Service in Industry and Institutions, Ames, Iowa, William C. Brown, Inc., 1960.

24. Straus and Sayles. Personnel, the Human Problems of Management Eagle Cliffs, New Jersey, Prentice Hall Inc., 1960.

25. United States Dept. of Agriculture. A Guide for Planning and Equipping, June, 1956.

26. United States Dept. of Agriculture. Food Storage Guide for Schools and Institutions, Nov., 1959.

27. West, B. and Wood, L. Food Service in Institutions, New York, John Wiley and Sons, Inc., 1955.

APPENDIX

Table 4. Equipment List

Equipment Used to Produce 28 Cocoa Layer Cakes

Description	Basic Items	Specialty Items
Bins, under table storage, 22⅞x20⅞x29⅞ in.	3	
Scoops, 48 oz.	2	
Scoop, 16 oz.	1	
Scales, 16 lb. capacity	1	
Scale bowl, 8 qt.	1	
Table, 156x70½ in.	1	
Measuring spoons (set)	1	
Mixing machine, 60 qt.	1	
Adapter	1	
Mixing machine bowl, 40 qt.	1	
Mixing machine flat beater, 40 qt. bowl	1	
Bin, under table storage, 22⅞x20⅞x29⅞ in.	1	
Scoop, 48 oz.	1	
Dipper, 30 oz.	1	
Scoop, 16 oz.	1	
Measure, 4 qt.	1	
Measure, 1 pt.	1	
Pans, cake round 9 in. diameter		60
Oven, 132x84x68 in.	1	
Rack, pan, 41x21x67 in.	1	
Pans, sheet, 25¾x17¾x1 in.	10	
Pot holders	2	
Clock, wall electric	1	

Table 5. Equipment List

Equipment Used to Produce 50 doz. Fan Tan Rolls

Description	Basic Items	Specialty Items
Muffin tins, 12 cups each, $14\frac{3}{4}$ x $17\frac{13}{16}$ in.		50
Sink, single compartment	1	
Measure, 1 gal.	1	
Mixing machine, 60 qt.	1	
Mixing machine bowl, 60 qt.	1	
Mixing machine dough arm, 60 qt.	1	
Bins, under table storage $22\frac{7}{8}$ x $20\frac{7}{8}$ x $29\frac{7}{8}$ in.	3	
Scoops, 48 oz.	1	
Scoops, 18 oz.	1	
Scales, 16 lbs.	1	
Scale bowl	1	
Garbage can on castors, 18 in. diameter	1	
Scoop, 48 oz.	2	
Bin, under table storage $22\frac{7}{8}$ x $20\frac{7}{8}$ x $29\frac{7}{8}$ in.	1	
Scraper, rubber	1	
Brush, pastry	1	
Dough cutter		1
Portable table, $21\frac{1}{2}$ x32 in.		1
Pot, 3 gal.	1	
Retarder, 34x58x70 in.		1
Proofer, 75x73x68 in.		1
Oven, 132x84 in.	1	
Pot holders	2	
Pans, sheet, $25\frac{3}{4}$ x $17\frac{3}{4}$ x1 in	25	
Rack, pan, 41x21x67 in.	1	
Table, 156x70$\frac{1}{2}$ in	1	
Inserts, steam table	10	

Table 6. Equipment List

Equipment Used to Produce 240 Cream Puffs		
Description	Basic Items	Specialty Items
Measure, 1 gal.	1	
Pot, 5 gal.	1	
Range, hot top 4 burner, $38\frac{1}{2}$x34 in.	1	
Mixing machine, 60 qt.	1	
Adapter	1	
Mixing machine bowl, 40 qt.	1	
Mixing machine flat beater, 40 qt.	1	
Measure, 1 pt.	1	
Bins, under table storage, $22\frac{7}{8}$x$20\frac{7}{8}$x$29\frac{7}{8}$ in.	3	
Scoop, 48 oz.	2	
Scoop, 16 oz.	1	
Refrigerator, reach in, $33\frac{3}{4}$x$57\frac{1}{4}$x72 in.	1	
Table, 156x$70\frac{1}{2}$x36 in.	1	
Sponge	1	
Pot, 3 gal.	1	
Scoop, mechanical No. 24	1	
Rack, paper towels	1	
Rack, pan, 41x21x67 in.	1	
Oven, 132x84x68 in.	1	
Pot holders	2	
Mixing machine, 12 qt.	1	
Mixing machine bowl, 12 qt.	1	
Mixing machine wire whip, 12 qt.	1	
Eclair filler, 9 in. diameter		1
Pans, sheet, $25\frac{3}{4}$x$17\frac{3}{4}$x1 in.	1	
Pans, baking, $11\frac{7}{8}$x$17\frac{13}{16}$ in.		10
Clock, wall electric	1	

Table 7. Equipment List

Equipment Used to Produce 25 Angel Cakes

Description	Basic Items	Specialty Items
Measure, 1 gal.	1	
Mixing machine, 60 qt.	1	
Mixing machine, bowl, 60 qt.	1	
Mixing machine, wire whip, 60 qt.	1	
Scale, 16 lbs.	1	
Scale, bowl	1	
Bins, under table storage, $22\frac{7}{8}$x$20\frac{7}{8}$x$29\frac{7}{8}$ in.	3	
Scoops, 48 oz.	1	
Sieve, 16 in. diameter	1	
Pans, angel cake 10 in. diameter		25
Table, 156x$70\frac{1}{2}$ in.	1	
Oven, 132x84x68 in.	1	
Pans, sheet, $25\frac{3}{4}$x$17\frac{13}{16}$ in.	8	
Rack, pan, 41x21x67 in.	1	
Cabinet, recipe, $8\frac{1}{2}$x$4\frac{1}{4}$x$5\frac{3}{4}$ in.	1	
Mixing machine, 12 qt.	1	
Mixing machine, bowl, 12 qt.	1	
Mixing machine, flat beater, 12 qt.	1	
Scales, 16 lb.	1	
Scale, bowl	1	
Pastry cutter	1	
Measure, 1 pt.	1	
Spatula	1	
Clock, wall electric	1	

Table 8. Equipment List

Equipment Used to Produce 300 Muffins

Description	Basic Items	Specialty Items
Tins, muffin, 12 cups per tin		25
Paper cups		300
Mixing machine, 60 qt.	1	
Adapter	1	
Mixing machine, bowl, 40 qt.	1	
Mixing machine, flat beater, 40 qt.	1	
Scale, 16 lbs.	1	
Scale, bowl	1	
Scoop, 48 oz.	2	
Bins, under stable storage, $22\frac{7}{8}$x$20\frac{7}{8}$x$29\frac{7}{8}$ in.	3	
Scoops, 18 oz.	1	
Cutter, pastry	1	
Measure, 1 pt.	1	
Cup, measuring	1	
Dipper, 30 oz.	1	
Scoop, mechanical, No. 24	1	
Table, 156x70$\frac{1}{2}$ in.	1	
Oven, 132x84x68 in.	1	
Pot holders	2	
Rack, pan, 41x21x67 in.	1	
Pans, sheet, $25\frac{3}{4}$x$17\frac{3}{4}$x1 in.	13	
Clock, wall electric	1	
Inserts, steam table, $26\frac{1}{2}$x$13\frac{1}{2}$x$4\frac{1}{4}$ in.	4	

Table 9. Equipment List

Equipment Used to Produce 50 Banana Cream Pies

Description	Basic Items	Specialty Items
Scale, 50 lbs.	1	
Spoon, slotted	1	
Mixing machine, 60 qt.	1	
Mixing machine, flat beater, 60 qt.	1	
Mixing machine, bowl, 60 qt.	1	
Bins, under table storage, $22\frac{7}{8}$x$20\frac{7}{8}$x$29\frac{7}{8}$ in.	3	
Scoop, 48 oz.	2	
Scoop, 16 oz.	1	
Scale, 16 lbs.	1	
Scale, bowl	1	
Dolly	1	
Inserts, steam table, $12\frac{3}{4}$x$20\frac{3}{4}$ in.	2	
Refrigerator, reach in, $33\frac{3}{4}$x$57\frac{1}{4}$x72 in.	1	
Pin, rolling, $1\frac{1}{2}$ in. diameter	1	
Pans, pie, 9 in. diameter		50
Measure, 1 gal.	1	
Adapter	1	
Mixing machine bowl, 40 qt.	1	
Mixing machine wire whip, 40 qt.	1	
Kettle, trunion, 60 gals.	1	
Paddle, wooden	1	
Rack, pan, 41x21x67 in.	1	
Pans, sheet, $25\frac{3}{4}$x$17\frac{3}{4}$x1 in.	17	
Knife, paring	1	
Table, 156x$70\frac{1}{2}$ in.	1	
Dipper, 30 oz.	1	
Scales, 16 lbs.	1	
Scale, bowl	1	
Refrigerator, reach in, $33\frac{3}{4}$x$57\frac{1}{4}$x72 in.	2	
Mixing machine, 60 qt.	1	
Adapter	1	
Mixing machine, bowl, 40 qt.	1	
Mixing machine, wire whip, 40 qt.	1	
Sink, one compartment	1	
Bag, pastry, 16 in.	1	
Tube, pastry bag, large star	1	
Clock, wall electric	1	
Whip, wire, 14 in.	1	

Table 10. Equipment List

Equipment Stored on Pot Rack Indicating Areas Occupied

Description	Size	Number in One Pile	Height of Pile	Total Number
Filler, eclair	9 in. diameter	1	15 in.	1
Mixing machine, bowl, 60 qt.	19 in. diameter	1	17½ in.	1
Mixing machine, bowl, 40 qt.	17 in. diameter	1	13 in.	1
Mixing machine, bowl, 12 qt.	13 in. diameter	1	9½ in.	1
Pans, angel cake	10 in. diameter	13	14 in.	26
Pans, muffin	14¾ x 11 3/16 in.	25	16 in.	50
Pans, cake round	9 in. diameter	30	12 in.	60
Pans, baking	11⅞ x 17 13/16 in.	5	10 in.	20
Pans, sheet	25¾ x 17 13/16 in.	40	15 in.	40
Pans, pie	9 in. diameter	40	10 in.	80
Pans, loaf	16 x 4½ x 4⅛ in.	20	11 in.	20
Pot, 5 gal.	11 in. diameter	1	12 5/16 in.	1
Pot, 3 gal.	9 in. diameter	1	10 in.	1

Table 11. Storage Details

Commodities Stored in Bins Under Table

Velvet flour	White sugar	Powdered sugar
Pastry flour	Brown sugar	Icing sugar
Bread flour (in garbage can on dolly)		

Commodities Stored in Grocery Cupboard

Baking powder	Saran wrap	Gelatine
Baking soda	Foil	Tapioca
Spices	Wax paper	Rice
Flavorings	Cornstarch	Peanut butter
Oatmeal	Salt	Cornflakes
Dates	Cornmeal	Nuts

Commodities Stored in Refrigerator

Raisins	Molasses	Butter
Yeast	Almond paste	Maragine
Chocolate syrup	Gelatine dessert powders	Topping
Crushed pineapple	Cocoanut	Defrosted eggs

Commodities in Frozen Storage

Ice cream	Left overs	Desserts

Table 12. Equipment List for Suggested Arrangement of Bakeshop Equipment (Figure 2)

Equipment Standing on the Floor

Description	Space Occupied
Bins, storage, $22\frac{7}{8}$x$20\frac{7}{8}$x$29\frac{7}{8}$ in.	None
Bowl, mixing, on carrier	28 in. diameter
Cans, garbage, on dollies	2-18 in. diameter each
Cupboard, food	23x27x60 in.
Kettle, trunion, 40 gal.	36 in. diameter
Mixing machine, 60 qt.	32x24 in.
Oven, reel-type, No. 1	120x72 in.
Peel, proofer	36x36 in.
Rack, pan, 21 in.	41x21x67 in.
Rack, pot	20x48 in.
Refrigerator, reach in	$33\frac{3}{4}$x$57\frac{1}{4}$
Refrigerator, reach in frozen storage	$33\frac{3}{4}$x$57\frac{1}{4}$
Scale, 50 lbs.	28x20 in.
Sink, single with drainboard	30x60 in.
Table, bakers, scales 16 lbs.	60x96 in.
Table, utility, hot plate 12 qt. mixer 10 qt. trunion	24x36 in.
Table, portable, dough cutter can opener	$21\frac{1}{2}$x32 in.

Table 13. Equipment List for Suggested Arrangement of Bakeshop Equipment (Figure 2)

Description	Numbers
Equipment Stored in Drawers of Bakers Table	
Bags, pastry	4
Brush, pastry small	1
Cabinet, recipe, $8\frac{1}{2}$ x $4\frac{1}{2}$ x $5\frac{3}{4}$ in.	1
Cutter, pastry	1
Knives, paring	4
Knives, chef, 8 in. blade	2
Pins, rolling, 1 in. diameter	1
Pins, rolling $2\frac{1}{2}$ in. diameter	1
Scrapers, rubber	2
Scoop, mechanical, No. 12	1
Scoop, mechanical, No. 16	1
Scoop, mechanical, No. 20	1
Scoop, mechanical, No. 24	1
Scoops, 18 oz.	2
Scoops, 16 oz.	2
Sponge, 6x3x1 in.	1
Spoons, mixing	2
Spoons, slotted	2
Spoons, measuring (set)	2
Tubes for pastry bags	4
Items Stored on Top of Bakers Table	
Scale, 16 lbs.	1
Scale, bowl	1
Items Attached to Wall	
Clock, electric	1
Rack, paper towels	1
Items Hanging by Oven Door	
Holders, pot	4

Continued

Table 13 - Continued

Description	Numbers
List of Equipment Hanging on Rack Above Baker's Table	
Collander, 4 gal., $16\frac{7}{16}$ in. diameter	1
Dipper, 30 oz.	1
Measures, 1 pt.	2
Measures, 1 gal.	2
Mixing machine attachments, wire whip, 60 qt.	1
Mixing machine attachments, wire whip, 60 qt.	1
Mixing machine attachments, wire whip, 12 qt.	1
Mixing machine attachments, flat beater, 60 qt.	1
Mixing machine attachments, flat beater, 40 qt.	1
Mixing machine attachments, flat beater, 12 qt.	1
Mixing machine attachments, dough arm, 60 qt.	1
Mixing machine attachments, dough arm, 40 qt.	1
Skimmer, 16 in. handle	1
Whip, wire, 14 in.	1
Sieve, 16 in. diameter	1
Items Stored with Main Cooking Area Equipment	
Inserts, steam table, $26\frac{1}{2} \times 13\frac{1}{2} \times 4\frac{1}{4}$ in.	10

EXHIBIT I. EQUIPMENT CATALOGUES

Blickman S. Inc., Weehawken, New Jersey

Blodgett Ovens, Burlington, Vermont

Bucksco County Enterprises, Inc., Quakertown, Pennsylvania

Cres-Cor Crescent Metal Products, Inc., Cleveland, Ohio

Duke Manufacturing Company, St. Louis, Missouri

Dura Ware Quality Products, New York, New York

Eastern Steel Rack, Boston 25, Massachusetts

Edlund Company, Inc., Burlington, Vermont

Epco, Inc., Los Angeles, California

Foster Refrigerator Corp., Hudson, New Jersey

Frick Mobile Food Service, Cleveland, Ohio

Garland, a Division of Welbit Corp., Maspeth, New York

General Electric, Chicago Heights, Illinois

Groen Manufacturing Company, Elk Grove Village, Illinois

Hobart Manufacturing Company, Troy, Ohio

Koch Refrigerators, Inc., Kansas City, Kansas

Market Forge Company, Everett, Massachusetts

Middleby Marshall Oven Company, Chicago, Illinois

Molitor, Inc., Englewood, California

Polar Ware Company, Sheboygan, Wisconsin

Southern Equipment Company, St. Louis, Missouri

Toastmaster Division McGraw-Edison Company, Elgin, Illinois

Toledo Scale, Toledo, Ohio

Vulcan Hart Corp., Baltimore, Maryland

Wear Ever Aluminum, Inc., New Kensington, Pennsylvania

SCHOOL OF HOME ECONOMICS
MICHIGAN STATE COLLEGE
EAST LANSING, MICHIGAN

1962 M.S.

Campbell, Agnes Lavinia

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