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TECHNICAL MANUAL

ARMY BAKER

March 22, 1941

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TECHNICAL MANUAL

ARMY BAKER

CHANGES No. 1

WAR DEPARTMENT,
WASHINGTON, April 28, 1942.

TM 10–410, March 22, 1941, is changed as follows:

44. Practical application of percentage method.

* * * * * * *

Solution:

* * * * * * *

	Percent		*Pounds*
Salt	2	$2 \times \frac{406}{100}$ or	8.12

* * * * * * *

[A. G. 062.11 (8–28–41).] (C 1, Apr. 28, 1942.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

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*These changes supersede section III, Training Circular No. 55, War Department, 1941.

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TECHNICAL MANUAL
No. 10–410

WAR DEPARTMENT,
WASHINGTON, *March 22, 1941.*

ARMY BAKER

Prepared under direction of
The Quartermaster General

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SECTION I

GENERAL

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1. General.—Baking is cooking in dry heat, either in an oven or under coals or on heated stone or metal. To bake successfully requires a knowledge of the kind, quantity, and quality of the ingredients to be used and temperatures at which products are to be prepared and baked.

2. Object.—*a.* The object of baking is to produce articles of food which have the following qualities:

(1) *Nutritive value.*—Necessary to relieve hunger.

*This manual supersedes TM 2100–151, November 20, 1939.

(2) *Palatability.*—Appeal to the appetite.

(3) *Attractiveness.*—Appeal to the eye.

b. To obtain the qualities given in *a* above necessitates the use of—

(1) Ingredients of good quality.

(2) A balanced formula.

(3) Careful and proper handling throughout every step in the baking production process.

c. In training students toward the foregoing objectives, emphasis should be placed on the correct use of machinery and utensils and on shop and personal cleanliness.

3. Definitions.

Bakery company.—An Army organization devoted primarily to baking bread and allied flour products. A company is divided into three sections of four units each and is normally capable of keeping a division supplied with bread.

Bakery unit.—This refers to the subdivision of a section and to the unit of equipment required.

Baking.—Cooking in a dry heat.

Batter.—Several ingredients beaten together to form a semiliquid mixture suitable for baking or cooking.

Bench.—A molding table.

Bread.—The sound product made by baking a dough consisting of a leavened or unleavened mixture of ground grain and/or other clean, sound, edible farinaceous substance, with potable water, and with or without the addition of other edible substances.

Bread room.—A room for storing bread after baking. Steel racks are usually employed as receptacles.

Buns.—Small cakes or breads, generally round or oval in shape and frequently spiced.

Burette.—A glass tube equipped with a tap and graduated in cubic centimeters. Used for measuring the quantity of water absorbed by a flour sample.

Cake.—Leavened or unleavened flour compositions, generally sweetened before baking.

Caramel.—A syrup made from scorched sugar used for coloring food products.

Caraway seed.—A highly aromatic seed used whole for flavoring rye bread of certain types. Also used in cooking.

Carrying rack.—An oblong frame suitable for two men to carry bread in about the same manner as a hospital stretcher is handled. A suitable type is an oblong frame 8 feet by 2 feet made of 1 inch by 4 inch material with side piece extended about 12 inches to form

handles, covered with slats 2 inches by 6 inches and a 12-inch upright fastened at one end. Will hold one run of field or garrison bread when taken from the oven.

Chief baker.—The chief baker's duties correspond to those of a first sergeant and he performs, in addition thereto, the duties of a baker technician. He has general supervisory control of the bakery company and field bakery under the officer in charge.

Corn bread.—A bread prepared from corn meal, with flour, sugar, lard (or substitute), and baking powder.

Cover.— A canvas cover used on proof racks for steaming the dough and for covering mixed dough to retain the heat, keep the dough from crusting, and to avoid fly intrusion.

Crullers.—Ring-shaped cakes of dough, usually sweetened and fried brown in smoking lard.

Crumb.—The soft inner part of the loaf, as distinguished from the crust.

Crust.—The outside of a loaf of bread. It is formed by the intense baking heat and consequent drying of the surface. This drying and a certain chemical change in the starch are known as caramelization. In the crust the gluten has hardened or gummed and the starch has changed into a more digestible form.

Currant buns.—Buns with currants added.

Dam boards.—Partitions placed in dough troughs to limit the space and facilitate handling.

Dampers.—Devices for regulating the fire and consequent heat used in baking, cooking, etc.

Dough.—A name given to the product resulting when flour, water, yeast, salt, and other ingredients are combined by mixing.

Dough mixer.—A machine for mixing ingredients. It should be kept thoroughly cleaned.

Dough troughs.—Troughs for containing dough. They must be kept clean. Though formerly made of poplar wood, the present type is largely steel, which is more satisfactory from a sanitary and handling standpoint. Sourness in bread is frequently caused by allowing old dough to stick to troughs.

Doughnuts.—A sweet, round dough composition with center cut out, fried in deep fat.

Dredge.—To sprinkle, as with pepper and salt, or rub in, as with flour, etc.

Fermentation.—A chemical change in organic substances caused by micro-organisms.

Fermentation period.—The period elapsing between the time dough

is mixed and the time it is sent to molding machine or bench for molding.

Fermentation room or cabinet.—A room or cabinet, kept at a temperature of 78° to 82° F., with free steam or moisture to obtain proper humidity and free from draft, into which the mixed dough, contained in troughs or other receptacles, is placed for the purpose of fermenting the dough. In lieu of fermentation room or cabinet, pans of water into which hot bricks are placed or jets of flaming gas or oil against the bottom of water-filled pans may be used to provide the necessary humid heat for fermentation of the dough.

Field bakery.—The bakery equipment used by a bakery company in the field.

Field bakery equipment.—The equipment required in the field.

Flour.—Bolted grain meal.

Gems or muffins.—Hot breads made from white flour, graham, or corn meal and baked in gem pans.

Gluten.—That constituent of wheat flour dough which enables the dough to expand and thus retain the fermentation gases. Two elements of flour, distinct from each other in a dry state, unite upon the addition of water to form gluten.

Grits.—Grains, as of wheat, corn, or oats, coarsely ground.

Hominy.—Cracked Indian corn from which the outer husk has been removed.

Hops.—The cured, kiln-dried blossoms of the hop vine, a perennial, climbing plant cultivated in Europe and on the Pacific coast for its blossom. The flavoring element is known as lupulin and can be extracted by boiling 10 or 15 minutes.

Icing.—A glazing or coating of sugar, usually mixed with white of egg and suitable flavoring, and applied to cakes; sometimes called frosting.

Ingredients.—A general term describing the factors that constitute a substance. For example, ingredients of bread include flour, water, yeast, salt, sugar, shortening, and in some instances milk, hop tea, or malt.

Leaven.—A piece of old dough used as a ferment in making bread by the left-over process.

Loaf.—The characteristic shape of the bread after it has been molded and after the baking process is completed.

Make-up period.—The length of time between end of fermentation period and time molded and panned dough is placed in proofroom or cabinet.

Molding.—Shaping bread into forms suitable for baking.

Molding table.—The wooden table on which loaves are molded.

No-time dough.—A straight dough that has no fermentation period. As soon as the dough is mixed it is molded and panned and then placed in proofroom or cabinet for proofing.

Open-trench baking.—Process of baking in an open trench about 6 feet long, 1 foot deep, and 15 inches wide.

Ovens.—The receptacles in which bread is baked.

Pan holder.—A folded cloth or other heat-resisting material for handling pans.

Pastry.—Food preparations made from a paste, or from which the crust is made, such as cakes, pies, jelly rolls, ladyfingers, cookies, plum duff, etc. Sugar, butter, eggs, baking powder, and extracts are generally employed in their preparation.

Poppy seed.—The seed of the black or white poppy. Contains about 50 percent oil. Used for enriching rolls and loaves of Vienna style bread.

Porcelain ware.—A very hard, usually white, and more or less translucent, earthenware suitable for preparing yeast ferments.

Post bakery equipment.—The equipment required for baking at a post.

Proofing period.—The period elapsing between the time of placing the panned dough in the proofroom or cabinet and that at which it is removed therefrom to be placed in the oven.

Proofroom or cabinet.—A room kept at a constant temperature of about 90° F. with free steam or moisture and free from draft, into which dough or bread is conveyed for proofing. In smaller bakeries, proof cabinets are provided. Pans of water into which hot bricks are placed or jets of flaming gas against the bottom of water-filled pans provide the necessary humid heat.

Protein.—That constituent of foods that builds muscle. Lean meat and white of egg are rich in protein. Gluten of flour is a protein substance.

Pyrometer.—An instrument used for measuring high temperatures when the use of a thermometer is impracticable. These instruments are usually operated by the contraction or expansion of a metallic bar or plate.

Scald.—As applied to flour, potatoes, etc., to submerge or wet with water at a temperature of 160° F. or more, which is sufficient heat to dissolve the bands of the starch cells and expose the individual grains composing it to the action of the yeast plant.

Short-time dough.—A dough which, by reason of increased amount of leavening agent and/or temperatures of mixed dough or fermenta-

tion room or cabinet, requires a shorter fermentation period than ordinarily required.

Shortening.—Lard, butter, or other fats or oils mixed in bakery products to make them more friable and easier to crumble.

Slack dough.—A dough that contains more water or other liquid than required to make a dough of the proper consistency. It has a tendency to flatten out and to stick to the hands or the mixer.

Sponge.—A dough that contains part of the flour, part of the water, all or part of the yeast and all, part, or none of the other ingredients to be used in making baked products.

Sponge and dough process.—A process resulting from the combining of a fermented sponge with the remainder of the ingredients to be used and mixing same. A sponge and dough necessitates at least two mixing periods, that is, the mixing of the sponge ingredients and the mixing of the fermented sponge with the other ingredients to form the sponge and dough.

Sponge cans.—Cans generally used in the field for preparation of the sponge. They include the dough cans, hot and cold water cans, and one for yeast, if a liquid yeast is used.

Stiff dough.—A dough that contains less water or other liquid than required to make a dough of proper consistency. It is hard to handle, especially when hand-mixed. Generally used in making field bread and also to overcome deficiencies in flour.

Straight dough process.—A process whereby a dough is obtained by mixing together at one time all the ingredients to be used.

Temperature.—A condition that pertains to heat or cold, that is, the relative degree of each. This is one of the most important factors in bread making and must be taken into consideration in connection with the yeast, water, dough, proofroom, sponge, fermentation development or retardation, bake ovens, etc.

Trench cover.—In field baking, an expedient by which a covered trench is constructed, generally of clay if procurable, for the purpose of creating what amounts to a firebox underneath the oven.

Unfermented bread.—This includes all breads made without yeast, such as aerated bread, crackers, baking-powder biscuits, etc.

Vitamins.—Recently discovered but very important food factors that are essential to normal growth and maintenance of good health.

SECTION II

GRAINS AND FLOURS

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Wheat 6
Wheat flour 7
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Bleached flour 9
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4. Description and composition of grains.—Grains or cereal grains are the seeds of such plants as wheat, corn, rice, oats, rye, buckwheat, barley, etc. Grain seeds, as such, or in some manufactured form constitute one of the most important food items of man and animals. While they vary somewhat in composition, they all contain—

a. Carbohydrates.—Carbohydrates include starch and sugar used by man to provide and replace the energy necessary for activity, such as working, walking, etc.

b. Protein.—Protein is used by man to build up and replace muscle and other body tissue. Protein in food causes growth and replaces worn-out or damaged cell structure.

c. Fat.—Fat is used by man as a reserve energy supply and is stored in the body in that form. When the quantity of carbohydrate food eaten is insufficient to supply the energy required for the activities of man, the stored-up fats are used to supply this deficiency.

d. Mineral matter.—Mineral matter is used by man for teeth, bone building, and other essential body functions. Much more mineral matter is contained in the whole or ground grain than in the manufactured form, such as wheat flour, because in the manufacturing process much of the mineral matter in the form of hulls and bran is invariably removed.

e. Water.—Water in a considerable amount is needed to promote elimination, perspiration, circulation of the blood, and many other functions of the body. The water contained in grains or manufactured products thereof which man ordinarily consumes is far insufficient to meet his requirements. To a certain extent, the eating of grain foods, such as bread, encourages the drinking of water by imparting a dry feeling to the throat.

5. Milling of grain.—The preparation of grain for human consumption, commonly called milling, involves the removal of the hull and bran coats from the kernel and the grinding, sifting, bolting, and separation into various grades of the endosperm (starch granules). If the grinding is limited to rather coarse particles, the product is known as meal, such as corn meal. If grinding is continued until a powdery product is produced, it is called flour, such as wheat flour, rye flour, rice flour, etc.

6. Wheat.—Wheat is by far the most important of the grains, especially in the United States. It is grown in all temperate climates; when manufactured into flour it makes better and more palatable bread than flour from other grains which, to a large extent, does not possess the qualities which make well-risen loaves of bread.

a. Classification.—There are many classifications of wheat, but for purposes of this manual they will be confined to—

(1) *Winter.*—Winter wheat is wheat sown in the fall and harvested the following summer.

(2) *Spring.*—Spring wheat is wheat sown in the spring and harvested in the fall.

(3) *Hard.*—Hard wheat may be either winter or spring wheat and has kernels that are hard, tough, and difficult to cut. It contains from 10 to 12 percent protein. The gluten of hard wheat flour is tough, resistant, generally of good quality, and best suited for bread making.

(4) *Soft.*—Soft wheat is composed of kernels that are soft and of a starchy appearance when cut and usually contain from 6 to 10 percent protein. It produces a soft and weak gluten, does not make a good loaf of bread, but is suitable for pastry, crackers, and cakes.

b. Products obtained from milling.—The chief products obtained from the milling of wheat are—

(1) *Bran.*—Bran is the coarse particles of the outer coatings of wheat. It is used largely as animal feed but to a limited extent as a breakfast cereal.

(2) *Shorts.*—Shorts is the fine particles of the outer coatings and germs of wheat. Like bran, it is used largely as animal feed.

(3) *Flour.*—For various grades of flour obtained from milling wheat see paragraph 7.

7. Wheat flour.—*a. Classes.*—Within each class of wheat flour, each of the grades described in *b* below may be obtained. Flours are classified according to the kind of wheat from which they are obtained, as follows:

(1) *Hard spring.*—This is flour milled from wheat grown in Minnesota, North and South Dakota, and nearby territory. It has a rich, creamy color and a large amount of gluten of the best quality, and makes a good, well-risen loaf of bread when properly handled. It is sharp or granular to the touch and is an excellent bread flour.

(2) *Hard winter.*—This is flour milled from wheat grown in Kansas, Nebraska, Oklahoma, and other western States, has a good color, an excellent flavor, and a good strong gluten. Although its gluten is not generally as strong as that of hard spring wheat, it is an excellent bread flour if properly handled.

(3) *Soft winter.*—This flour comes from the more humid central States and the Pacific coast. Its gluten is low in quantity and it has poor tensility. It is white, has a soft and fluffy texture, and an excellent flavor. It is used mostly for pastry and biscuits.

(4) *Durum.*—Durum flour is milled from durum wheat, grown mostly in the northwest section of the United States. It has a yellowish creamy color and a large amount of very hard and tough gluten. It is not satisfactory for bread making purposes unless blended with a weaker flour.

b. Grades.—(1) *Low-grade.*—About 3 percent of the total flour obtained at first and last stages when milling wheat is low-grade flour. It is dark in color, contains considerable bran specks and dirt, and does not make a satisfactory loaf of bread. It is used for purposes other than bakery products, such as sizing, paste, etc.

(2) *Patent.*—Patent flour is sometimes further divided into short and long patent, and constitutes from 40 to 90 percent of the best portion of the flour; that is, that portion which contains the smallest quantity of bran specks and is capable of producing an excellent quality of gluten desired for bread making purposes. Short patent flour is a higher or better grade than long patent.

(3) *Clear.*—Sometimes further divided into first clear and second clear, this flour is that portion remaining after the patent flour and low-grade flour are separated from a run of flour. First clear is a higher or better grade than second clear, as the first clear is that portion remaining after separation of a short patent, and a second clear is that remaining after separation of a long patent. Clear flour does not make satisfactory white bread as it imparts a dark color to the crumb of bread, but it may be used advantageously when making part whole wheat bread or rye bread, the dark color of crumb not being objectionable in such products.

(4) *Straight.*—Straight flour is the total produced from a run of wheat, excluding the low-grade; that is, the product obtained by com-

bining the patent and the clear flour. Federal specifications provide for the purchase of straight flour for Army ration purposes. Although generally not as high in quality as a patent flour, straight flour is capable of producing an attractive, palatable, and highly nutritive loaf of bread if properly handled.

(5) *Cut straight.*—Cut straight is a straight flour from which a portion of the best or patent flour has been removed.

(6) *Stuffed straight.*—This is a straight flour to which an additional amount of clear flour from another run of flour has been added.

8. Additional flours.—In addition to the white flours described in paragraph 7, there are several other flours available commercially which are frequently used in making bread and other bakery products. These flours are highly desirable, especially to provide variety in the diet. Among the more important from the Army standpoint are—

a. Whole wheat.—Whole wheat flour is the product made by grinding the entire wheat grain to a powdery consistency. It contains not only starch granules, but also all the bran or outer coats of the wheat. Whole wheat flour may be used by itself as the flour component of bread, or it may be blended with either patent, straight, or clear flours, or a combination thereof. Bread produced from whole wheat flour is brown in color and high in mineral and roughage content as compared with bread produced from all patent, straight, or clear flours. Whole wheat bread makes an excellent substitute for white bread for the sake of variety.

b. Rye.—Rye flour is lacking in gluten-forming protein, which quality is essential to the formation of a loaf of bread having a good volume and smooth, porous texture. For this reason it is generally used in proportions of 10 to 40 percent rye flour and the remainder wheat flour when making so-called rye bread. Bread made from 100 percent rye flour would be small in volume, soggy, and compact, and unpalatable to the average American. There are three types of flour obtained from the milling of rye, as follows:

(1) *White.*—While darker in color, this flour corresponds to the short patent wheat flour. It is nearly white, has a small percentage of ash, but is deficient in gluten-forming protein.

(2) *Dark.*—Dark rye flour corresponds to the clear grade wheat flour. It is very dark, has a branny taste, and is used to obtain a dark rye loaf of bread.

(3) *Medium.*—Medium rye flour corresponds to the straight grade of wheat flour. It is a blend of the dark and white rye flours. It

possesses more of the true rye taste than white rye and for this reason is the type mostly used when making rye bread.

c. Wheat flour substitutes.—These are flours made from corn, rice, barley, potatoes (bleached and unbleached), soybean, etc. They may be used as substitutes for a part of the wheat flour. They are practically devoid of gluten-forming protein and for this reason will not produce a satisfactory loaf of bread when used by themselves. With the exception of soybean, up to 20 percent of any of these flours or a combination thereof, the balance to be wheat flour, may be used without seriously lowering the quality of bread. Soybean flour is very high in protein and low in starch. If used in excess of 5 percent, it tends to produce a compact, small volume loaf lacking attractiveness and palatability.

d. Self-rising flour.—This is a flour which is mixed with baking powder in the proper proportions so as to produce a satisfactory raised product after mixing with water. This flour is in convenient form for the household or company kitchen, especially for the preparation of hot cakes and similar quick breads, but is of no particular merit in the bakery. Most pancake flours on the market are self-rising.

9. Bleached flour.—Flour improves with age under proper storage conditions, up to 1 year, both in color and quality. However, some flour is shipped from the mill before it is naturally aged. In lieu of natural aging, flour is often bleached. Bleaching has the effect of whitening and artificially aging flour. There is no objection to the purchase of bleached flour for Army use provided the bleaching agent was used solely for the purpose of aging the flour and not to cover up inferior qualities such as orignal dark color, off odors, etc.

10. New flour.—New flour is freshly milled flour from recently harvested wheat. Such flour is unstable and presents difficulties in bread making until it matures. This is due to the fact that the proteins of the wheat must undergo certain changes before they combine to form a satisfactory gluten. A warm, dry storage is the best means of aging the flour and developing the gluten qualities. Under good storage conditions, new flour may be considered as sufficiently aged for use after a period of 1 month. If new flour must be used before it is aged, it is best to mix it with an equal quantity of flour that has been on hand for some time. If no old flour is available, good bread may be made with new flour by giving a rapid fermentation at a slightly higher temperature than that ordinarily used, making a stiff dough, and using a larger quantity of yeast and salt. New flour should not be confused with green flour, which is flour obtained

from milling wheat that is unsweated or insufficiently sweated. Proper sweating of wheat is obtained by leaving wheat in stacks 10 days to 8 weeks before threshing. Green flour will not produce a satisfactory loaf of bread, even if allowed to age.

11. Storage of flour.—*a.* Flour should be kept in a dry, well-ventilated storeroom at a fairly uniform temperature. A temperature of about 70° F., with a relative humidity of 65 percent, is considered ideal. Flour should not be stored in a damp place. When milled, flour contains moisture up to 15 percent but it will take up additional moisture when stored in damp places or shipped into moist climates. Moist storerooms or climates accompanied by temperatures greater than 75° F. are very conducive to mold growth, bacterial development, and rapid deterioration of the flour. The storage room should be well-ventilated, as flour absorbs and retains odors. For this reason, flour should not be stored in the same room with supplies, such as cheese, onions, or paints, which give off strong odors.

b. All flour should be stacked on skids or dunnage so as to be at least 5 inches off the floor. The lowest layer of sacks should be laid lengthwise, the next layer crosswise, etc., to permit proper circulation of air. If it can be avoided, sacks of flour should not be stacked more than seven high, as additional weight on bottom sacks tends to weaken the flour therein. Sufficient aisle space should be available to assist ventilation and facilitate counting or inventorying. Sacks should not be permitted to lean against pillars or walls, as circulation of air is retarded and the weight causes undue strain on the building.

c. The best precaution against rats and mice in the storeroom is the elimination of holes and large cracks in the floor and walls. If the rats get into the flour storeroom, they are best exterminated by means of traps. Rats and mice do not care much for flour as a food as it forms a paste in their mouths due to the dryness of the flour, but they consider sacked flour ideal for nesting purposes. In nesting, they bore into the sacks, strewing loose flour along the outside of them and on the floor, a condition conducive to development and multiplication of insect infestation.

d. Absolute cleanliness is essential to prevent infestation from beetles and other insects. Storerooms should be well-cleaned on receipt of each new lot of flour. Frequent sweepings underneath and around sacks or stacks of sacks should be made, and no refuse, empty uncleaned sacks, or other material should be permitted to remain in the vicinity of the flour. Each shipment of flour should be inspected as soon as it arrives to detect the presence of insects. Old

stock should be reinspected frequently and when beetles or insects are found, prompt steps taken to remove them. It is far better and easier to keep insects out of the storeroom and out of the flour than it is to sift them out before baking. Infested flour always contains a certain amount of filth which cannot be removed by sifting or bolting.

e. A good patent or straight flour will keep for 1 year if properly stored. On account of the liability to infestation from beetles and insects, it is preferable to limit the stock on hand to a 3-months' supply, particularly during the summer months. In warm, moist climates like the Tropics, flour deteriorates very rapidly, and more than 30-days' supply is not very desirable. Patent and straight flours keep best, as they are freer from the oily germ stock. Lower grades, whole wheat, rye, corn, and barley flours do not keep as well; their keeping qualities, however, are improved by using tightly closed containers.

12. Testing of flour.—The testing of flour to determine the quantity of carbohydrates, protein, moisture, and ash contained therein requires the services of an experienced chemist and technical equipment. However, there are several tests which can be made at post bakeries and in the field which will give a good indication of the quality and characteristics of the flour on hand.

a. Soundness and odor.—The odor of flour should be sweet and similar to that of freshly ground wheat. Flour which is in unsound condition or has a musty, garlicky, or other objectionable odor will not make a well-flavored bread.

b. Granulation (feel).—Rub the flour between the thumb and fingers. Good hard wheat flour has a somewhat granular or gritty feel. A soft, smooth, or slippery feeling denotes a soft wheat flour or a blend of a soft and hard wheat flour. Hard wheat flours retain their form when pressed in the hollow of the hand and fall apart readily when touched. Soft wheat flour tends to remain lumped together after pressure.

c. Color (pekar) test.—Place a small quantity of flour on a smooth glass or porcelain plate and "slick" with a steel flour trier, spatula, or table knife to form a firm smooth mass of about 2 inches square, the thickness running from about ½ inch at back of plate to a thin film at front of plate. This test should be made in comparison with a flour of known grade and quality, both flours being "slicked" side by side on the same plate, if possible. A bright, rich, creamy-white color indicates a hard flour of good gluten qualities. A dark or grayish color indicates a poorer grade of flour or presence of dirt

in the flour. The presence of bran specks indicates a lower grade of flour; a dead chalky-white color indicates a soft wheat flour or excessive bleach. After making color comparison on the dry samples, dip the plate obliquely in a vessel of clean water, remove, and allow to dry partially. Variations in color and presence of bran specks are more pronounced in the damp samples. Owing to the custom of bleaching flours, color is not always a reliable guide. Bleaching will, however, not improve the dull appearance of a poor flour and will not conceal dirt and bran specks. Unless overdone and when it does not conceal inferiority, bleaching is not considered objectionable.

d. Absorption.—Absorption is, roughly speaking, the amount of water that should be added to a flour to produce a dough of the proper consistency; that is, a dough that is smooth and soft and yet not sticky. The absorption ability of a flour will usually be between 55 and 65 percent. The proper absorption ability of a flour should be determined by the following procedure:

(1) Place a small known quantity (ounces or grams) of the flour in a cup, beaker, or bowl. Add water gradually from a beaker or glass containing a known quantity (ounces or grams). As water is added, stir with a knife, spatula, or handle of a spoon until a dough of the desired consistency is obtained. Do not use the fingers for mixing, as some of the dough will stick to them or they will either absorb or give off moisture through the pores of the skin, thereby giving inaccurate results. Care must be taken to mix the flour and water thoroughly so that no dry particles remain on the outside or inside of the dough. When no loose flour or water remains, it may be taken in the fingers for final mixing and determination of consistency. Weigh the unused water and deduct this amount from the original weight of water. Divide the result thus obtained by the weight of the flour used and the result is the absorption ability expressed in terms of percentage.

Example:

Quantity of flour used	10 oz.
Quantity of water used	6¼ oz.
Therefore, $\frac{6\frac{1}{4}}{10}$ or	0.625 or 62.5 percent.

(2) For accurate work, the greater part of the water should be added at once and then a few drops at a time until the desired consistency is reached. This may be checked by a second determination in which all of the water is added at once. If the moisture content of the flour either increases or decreases as a result of storage con-

ditions, the absorption ability of the flour will vary accordingly. It is, therefore essential to make an absorption test on the flour being used at least once each month in order to determine its proper absorption at time of use. The percent of absorption being known, the quantity of water to be added to any given quantity of flour to be used in a dough is readily calculated.

Examples: If absorption is 62.5 percent and 100 pounds of flour are to be used, the quantity of water to be added to the flour is 62.5 percent of 100 pounds or 62.5 pounds. If 35 pounds of flour are to be used, the quantity of water to be used is 62.5 percent of 35 pounds or 21.8 pounds.

e. Gluten test.—The grade and baking qualities of a flour depend largely upon the quantity and quality of its gluten-forming ability. The gluten test should always be a comparative one, that is, the gluten of an unknown grade or kind of flour compared with the gluten of a known or previously used flour, in order to determine by comparison the kind and grade of the unknown flour and how dough made with it should be handled in the making of bread. The following procedure should be observed to obtain gluten from flour: Carefully weigh out a small sample (ounces or grams) of each of previously used or known grade and of unknown flours and place each sample in a cup, beaker, or bowl. Add water to each sample until dough of the proper consistency is obtained by the method described for absorption test. Allow the doughs thus obtained to stand submerged in water at room temperature for ½ hour in order to permit the formation and setting of the gluten within the dough. Knead each dough gently in a thin stream of cool water until the starch and all soluble matter are removed. To determine if the gluten is starch free, let a few drops of the wash water, obtained by squeezing the gluten, fall into a glass containing perfectly clear water. If starch is still present, a cloudiness appears. If gluten is practically starch free, no discoloration appears in the water. Allow the gluten thus obtained from each sample of flour to stand in water for ½ hour. Compare the gluten samples, using the following factors:

(1) *Weight.*—If weight comparison is to be made, small (gram) scales should be used. For practical purposes, the weight of the wet gluten may be considered as being three times as heavy as dry gluten; that is, the dry gluten (all moisture removed by heat) will be one-third of the weight of the wet gluten. As gluten content of flour is always expressed in terms of dry gluten, divide the weight of the wet gluten by 3 and the result thus obtained by the weight

of flour used to make sample. This result is the amount of gluten in flour expressed in percentage terms.

Example:

Weight of flour used for test ..... 100 grams.
Weight of wet gluten ..... 33 grams.
Weight of dry gluten $\frac{33}{3}$ or ..... 11 grams.
Percent of gluten in flour $\frac{11}{100}$ or ..... 0.11 or 11 percent.

Any flour containing approximately 11 or more percent of dry gluten may be considered to be a hard-winter or hard-spring wheat flour. If lower than 11 percent, it is probably a soft flour or a blend of hard and soft flour.

(2) *Color.*—Place the ball of gluten in the palm of one hand. With the thumb of the other hand press the ball through a small opening made between the thumb and forefinger. This will tend to stretch the gluten and accentuate its color and other characteristics. A glistening pearl gray color indicates hard patent flour. A dull darker gray color indicates hard straight or clear flour. A light or whitish color indicates soft flour.

(3) *Tensility* (extent to which gluten may be pulled without breaking).—Grasp the gluten ball between the thumb and fingers of each hand. Gently stretch it in all directions in an endeavor to make a square as large and as thin as possible. A strong, hard patent flour gluten will stretch in all directions without breaking or showing tear holes. A slightly weaker gluten (hard straight flour) will not stretch as far as hard patent flour gluten and will tear more easily. The gluten from soft or inferior hard flour will not have good tensility and will readily tear and often completely separate.

f. Baking test.—(1) The final and conclusive test of any flour is the kind of bread that can be made from it. A single loaf should be baked and compared with a loaf baked from a known flour. To make baking tests of value, all conditions should be standardized. Definite weights of flour, sugar, salt, yeast, and shortening should be used and water taken in accordance with the absorption ability. The same materials, except flour, should be used in each dough. A definite procedure must be followed, using identical times and temperatures for all operations.

(2) In addition to the identical doughs described above, two additional doughs of the unknown flour should be made, using the same formula and the same temperature and baking conditions throughout, but varying the fermentation time by giving one dough

30 minutes less fermentation than the normal loaf and the other 30 minutes more fermentation.

(3) When two or more flours are thus treated under the same conditions, any differences in quality of bread can be laid to the quality of the flour. Also, by comparing the three loaves of bread made from the unknown flour, the procedure to follow to obtain best results with that flour may readily be determined.

(4) The factors and weight of each factor to be used in scoring bread to determine relative quality are described in paragraph 54.

g. Reasons for making tests.—The kind and grade of flour used in a dough are the most important factors which influence the appearance and qualities of the finished loaf of bread. Using a certain formula and procedure with dough made from one batch of flour may produce an excellent loaf of bread, while the identical formula and procedure with another batch of flour will produce a poor loaf of bread. If the kind, grade, absorption ability, and quality of gluten in the flour to be used are known in advance, a baker may readily adjust formula and procedure so as to produce the best results obtainable from that flour.

Examples: Knowing the correct absorption will prevent slack or stiff doughs unless so desired. Knowing the kind and grade of flour as determined by color (pekar) and gluten tests will enable the baker to adjust fermentation time so as to produce best results with that flour. In general, as the quality of the gluten in flour is lowered (from hard patent to hard straight, to hard clear, to soft wheat flour) the correct fermentation time for that dough becomes shorter. Giving a 5-hour fermentation time to a dough containing hard patent flour may produce excellent results, while a dough containing hard straight flour given the same fermentation time will result in an inferior product. If the fermentation time of the dough containing hard straight flour were reduced somewhat, say to 3½ to 4 hours, a much better product might be produced.

COMPOSITION OF WHEAT FLOUR AND BREAD

[Percentage form]

	Average wheat	Average flour	Average loaf of white bread
Moisture	14. 5	13. 0	37. 0
Protein	12. 4	11. 0	9. 5
Carbohydrates	69. 3	74. 3	49. 0
Fat	2. 0	1. 3	3. 0
Mineral matter	1. 8	. 4	1. 5

SECTION III

LEAVENING AGENTS

	Paragraph
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13. Importance of yeast.—Next to flour, yeast may be considered as the most important ingredient used in bread making. The quality of the finished loaf of bread is dependent to a large extent upon the kind, quality, and condition of yeast used in the dough. Although flour is a highly nutritious substance, it is not suitable for human food until it has been made into a form which is palatable and readily acted upon by the digestive juices of the human system. Cooking or baking alone causes certain changes to take place which make the product more palatable and digestible, but unleavened products, such as hard bread, crackers, etc., are not relished as a steady diet. Incorporating yeast in a flour dough results in a leavened product or an expansion, and a mellowing and development of the starch cells which considerably improve the palatability and digestibility of flour foods.

14. Description of yeast.—A yeast cell is a minute vegetable substance which cannot be seen with the naked eye. Although not generally known, yeast cells are constantly floating about in the air and settling on food substances. With proper food, air, moisture, and temperature conditions, yeast will grow and reproduce rapidly. Light is not necessary for its growth. When yeast is exposed to unfavorable conditions it may go into spore form, a condition in which the cells are temporarily inactive but still possess the ability to become active again as soon as favorable conditions are provided. Dried yeast is a good example of yeast in spore form. The absence of sufficient moisture in dried yeast prohibits growth and development until such time as the dried yeast is mixed with water and flour or other carbohydrate substance. When so mixed, the yeast changes from spore to active form.

15. Kinds of yeast.—There are numerous varieties and strains of

yeast, all capable of fermenting sugar, but each is best suited to certain conditions and substances. While these all produce alcohol and carbon dioxide, the quantities produced and the character of the other products formed are such that many of them are inefficient or undesirable for baking purposes. Bread yeast is the particular kind of yeast used in bread making. It is generally obtained from manufacturers who carefully grow selected pure strains and sell them in practically pure condition. The use of a cultivated yeast eliminates much uncertainty as to results of the fermentation. Wild yeasts are present in nature and are the cause of many natural fermentations. These organisms are undesirable in bread making.

a. Compressed.—(1) *General.*—Compressed yeast is a pure culture of bread yeast grown on a large scale, collected and compressed into cakes. It may be mixed with not more than 5 percent starch to absorb the excess moisture and give it body. For bakery use, it is compressed into 1-pound bricks or ½-pound bricks and wrapped in paraffined cloth or paper. For household use, it is put up in ½-ounce packets wrapped in tinfoil. It is very perishable and spoils quickly when removed from cold storage and exposed to warm temperatures. For this reason, it can be used at posts distant from railroad and good road facilities and in the field in warm climates only when arrangements are made for its cold storage. If wrapped in heavy paper when removed from cold storage or if placed in a moderately cool place, such as a basement, a hole in damp ground, or a porous jar covered with wet cloths, compressed yeast will keep in fair condition for a number of days. If well-chilled, it can be shipped almost any distance in a fireless cooker. When obtainable, compressed yeast should always be used by Army bakers.

(2) *Tests for quality.*—Good compressed yeast should feel firm, tough, and springy, and should break with a clean fracture resembling broken plate glass. It should have a fresh yeasty odor and be practically tasteless. The color of yeast is not a safe guide in determining its quality. Spoiled yeast is soft and has a sour or putrid odor. A quick test is to roll a small amount into a firm ball about 1 inch in diameter and drop it into a glass containing a dilute solution of sugar. Note the time required for the ball to float to the surface. A good sample will rise to the surface in a few minutes; a poor sample will take a much longer time. The time required will vary according to the temperature of the water and the amount of sugar dissolved in the water.

b. Dried.—(1) *General.*—Dried yeast is prepared by mixing a large proportion of starch or corn meal with yeast and drying the mixture

at a comparatively low temperature. It is packed in cans or moisture-proof fiber containers, 3 ounces net. For Army use, the small packages are best assembled in hermetically sealed shipping containers. Dried yeast is inert and largely in spore form and will keep under ordinary storage conditions for several months. It can be taken and used anywhere and gives fairly good results in bread making. Dried yeast will not, however, keep indefinitely. The packages should be marked with the date of manufacture and should be used within three months, if possible. Deliveries of dried yeast should be carefully tested to see that worthless, old, or poorly prepared dried yeast is not being furnished.

(2) *Use.*—Dried yeast, being largely in spore form, requires considerable time to develop growth when mixed with water and other ingredients. The yeast should be given a start by using the sponge and dough method, making the sponge part rather slack and containing at least 2 pounds of sugar to each 100 pounds of flour. One pound of dried yeast to a dough containing 100 pounds of flour is the best proportion to use. When so used, the sponge part of the sponge and dough should be given approximately 10 hours' fermentation. If bread is to be made with dried yeast by the straight dough method, the dried yeast should be left overnight in a semiliquid mixture of some of the water, flour, and sugar which are to be used in the dough the following morning.

c. Dehydrated yeast.—Dehydrated yeast is compressed yeast from which most of the water has been extracted. Since yeast is approximately 75 percent water and since a few yeast spores will have been destroyed during dehydration, it is necessary to use approximately one half as much by weight of dehydrated yeast as ordinary compressed yeast. Dehydrated yeast, if kept hermetically sealed and in a dry state, will keep well for 6 months. The dehydrated yeast should be rehydrated in part of the water and may be used within 45 minutes after reconstitution. Optimum temperatures for handling are identical with those under which compressed yeast is used.

d. Liquid.—When commercial compressed or dried yeast is not available or when only a small quantity is on hand, it may be necessary for the baker to make his own yeast in the form of liquid yeast. These are liquid cultures of yeast prepared in the bakery. Once having a good stock of yeast, the baker may prepare fresh yeast from day to day by inoculating fresh lots of liquid with the yeast made the previous day. Liquid yeasts cannot be made as pure and uniform as commercial compressed yeasts, and they have no place in the modern bakery. They require considerable time and trouble not

warranted by any saving in expense. However, all Army bakers should know how to make and use liquid yeasts, for there may be times when compressed or dried yeast is not available. It should be the practice for Army bakers to make and use at frequent intervals stock liquid yeasts, such as potato yeast, flour yeast, and flour and malt yeast, even when compressed yeast can be obtained daily.

(1) *Kinds.*—There are two kinds of liquid yeasts:

(*a*) *Stock yeast.*—A mixture of water and some carbohydrate substance, such as flour, sugar, malt, potatoes, corn flour, rice flour, etc., to which a small quantity of compressed, dried, or part of a previously prepared lot of stock liquid yeast has been added.

(*b*) *Virgin yeast.*—A mixture of water and some carbohydrate substance to which no yeast is added but which depends upon the development of any yeast which may be present in the materials used or which may be floating in the air. This yeast is obviously unreliable as there is no assurance as to what kind of fermentation will develop. It should never be made and used until all efforts to obtain stock liquid yeast have been exhausted.

(2) *Recipes.*—When making stock liquid yeasts, be sure that paste is cooled to approximately 80° F. before adding yeast. At higher temperatures, yeast will be seriously injured, if not killed. Similarly, if left to develop in a temperature much lower than 80° F., the growth of yeast is considerably retarded and if below 45° F. may cease. Use earthenware, granite, porcelain, or clean wooden receptacles for preperation and development whenever possible, as metal containers have a deleterious effect on yeast growth and development. All containers used in the preparation of liquid yeast should be thoroughly cleaned before being used again in order to prevent contamination of subsequent batches with wild yeasts, etc.

(*a*) *Stock potato yeast* (yield 1 gallon).

1. Formula.

Potatoes	1 lb.
Flour	¼ lb.
Salt	¼ oz.
Water	Enough to make 1 gallon.
Compressed yeast	½ oz.
or	
Dried yeast	1½ oz.
or	
Stock liquid yeast	1 pt.

2. Procedure.—Clean the potatoes thoroughly. Cut up and boil in water enough to cover. When well done, strain and

mash thoroughly. Add the flour to the mashed potatoes. Add potato water and, if necessary, additional boiling water to make 1 gallon of thin paste. Mix paste thoroughly. Allow to cool to 80° F. Add compressed yeast, dried yeast, or previously prepared stock liquid yeast. Set to ripen or develop at 80° F. It will be ripe and ready for use in from 9 to 12 hours.

(*b*) *Stock flour yeast* (yield 1 gallon).

1. Formula.

Flour	3½ lb.
Water	3 qt.
Sugar	1 oz.
Salt	¼ oz.
Compressed yeast	½ oz.
or	
Dried yeast	1½ oz.
or	
Stock liquid yeast	1 pt.

2. Procedure.—Dissolve sugar and salt in 1 quart of water. Heat solution to approximately 125° F. Place flour in earthenware, granite, or wooden receptacle. Add the 125° F. sugar and salt solution to flour and mix by hand until stiff dough consistency is obtained. Allow remainder of water to come to a boil and then add gradually to dough, stirring constantly so as to make a thin batter and eliminate lumps. Set to cool. When cooled to 80° F., add either compressed yeast, dried yeast, or previously prepared liquid stock yeast. Endeavor to maintain temperature at 80° F. It should be ready to use in from 18 to 24 hours.

(*c*) *Virgin flour yeast* (yield 1 gallon).

1. Formula.

Flour	3 lb.
Water	4 qt.
Sugar	1 oz.
Salt	¼ oz.

2. Procedure.—Dissolve sugar and salt in water and bring to a boil. Place flour in earthenware or wooden receptacle. Pour 1 quart of boiling water on flour. Stir well to break up lumps. When remainder of water has cooled to about 160° F., add to flour paste. Allow the mixture to cool to 80° F. and keep at this temperature for from 48 to 60 hours,

or until all hissing has stopped. The yeast is then ready for use.

(*d*) *Virgin potato yeast* (yield 1 gallon).—Same ingredients and procedure as in (*c*) above, substituting 4 pounds of potatoes for the 3 pounds of flour.

(*e*) *Tuba de nipa.*—Tuba de nipa, as it is commonly called by the Filipinos, furnishes an excellent substitute for stock yeast. It is the sap collected from the nipa palm. The sap, having been placed in a deep can with a small opening at the top, is set in the sun for about 12 hours and allowed to ferment. A thick scum forms on the surface, and the tuba is removed to a cool place where it will keep for several days. The scum should be allowed to remain as a protection against contamination. Fermented tuba de nipa is used as stock yeast and in the same proportions.

16. Conditions necessary for efficient functioning of yeast.—Yeast, in order to grow, multiply, and act efficiently as a leavening agent, requires proper air, moisture, temperature, and food conditions. Like all other living organisms, yeast requires a certain amount of oxygen (obtained from air) and moisture in order to live and thrive. In a slack dough, its activity is increased, whereas in a stiff dough its action is retarded. Yeast works best in temperatures of 78° to 82° F. As temperature increases beyond this point, action is accelerated; but the chances of obtaining undesirable fermentation, such as acetic and wild yeast, are greater. At about 120° F. the action of yeast is killed. Similarly, as temperature of dough containing yeast is lowered from 78° F., the action of yeast is retarded until about 45° F. is reached, at which point activity practically ceases. Food, in the form of carbohydrates (starch, sugar, malt), must be present before yeast will cause fermentation.

17. Fermentation.—Fermentation may be considered as the chemical action that takes place in certain substances, caused by the action of micro-organisms (bacteria, yeasts, molds), under favorable conditions. Common fermentations are—

a. Alcoholic.—A conversion of sugar to approximately equal parts of carbon dioxide (a gas) and alcohol, caused by the action of yeast. This is the type of fermentation desired in bread making.

b. Acetic.—A conversion of dilute alcohol to acetic acid (vinegar) caused by the action of acetic bacteria. At high temperatures (above 90° F.) or on prolonged fermentation, acetic fermentation may take place in an alcoholic fermentation of yeast action on sugar. If this happens, sourness of bread results.

c. Lactic.—A conversion of sugar (cane sugar, beet sugar, milk

sugar) to lactic acid caused by the action of lactic bacteria. It is this fermentation that causes the souring of milk and, to a certain extent, it may be formed in connection with yeast fermentation of sugar in bread making, thereby imparting a lactic acid flavor to bread.

18. Action of yeast in dough.—*a.* During the growth or reproduction of yeast in the dough the yeast activates substances known as enzymes. The enzymes activated by yeast are often called ferments and are responsible for the actual fermentation. The action of each enzyme is specific, in that each enzyme will bring about only one definite chemical change in organic substances. For example, one enzyme will act only on malt sugar (maltose) and will not act upon cane sugar (sucrose). Therefore, each enzyme is capable of performing only one particular chemical function. The enzymes start and control the various conversions in the dough without actually being destroyed or changed.

SUMMARY OF ENZYMATIC ACTIVITIES

Enzyme	Furnished by—	Specific action
Invertase	Yeast	Converts cane sugar (sucrose) into invert sugar.
Maltase	Yeast	Converts malt sugar (maltose) into simple sugar (dextrose).
Zymase	Yeast	Converts invert sugar and dextrose into carbon dioxide gas and alcohol.
Protease [1]	Flour, malt, yeast	Matures, softens, or conditions gluten, and prevents bucky dough.
Diastase [1]	Malt products, flour.	Liquefies starch, converts this liquefied starch into maltose sugar.

[1] See malt (par. 27*a*).

b. The carbon dioxide gas generated by the action of the enzyme zymase on the sugar elements in the dough is retained by the gluten, causing the dough to expand or rise and form the silky, spongy texture so desired in making bread attractive and palatable. The alcohol formed in this process is vaporized during the baking period.

c. By a study of the summary in *a* above, it may be seen that it is not necessary to add sugar to a dough in order to secure fermentation by yeast, as part of the starch in the flour may be converted to sugar (maltose) by the enzyme diastase as outlined in paragraph 27*a*. However, if not used in excess of 4 percent, it is advisable to use some sugar substance (cane sugar, beet sugar, corn sugar, malt syrup, etc.) as yeast food in the dough in order to prevent extensive

fermentation periods and a possible breaking down of the gluten by the enzyme protease to the point where the volume obtained is insufficient.

19. Factors affecting growth of yeast in bread making.—*a.* The action of yeast in a bread dough is accelerated by—

(1) Use of slack doughs.
(2) Lesser quantity of salt than ordinarily used.
(3) Higher temperatures (up to 95° F.) than ordinarily used.
(4) More sugar, or substitutes therefor, than ordinarily used.
(5) More thorough mixing.

b. The action of yeast in a bread dough is retarded by—

(1) Use of stiff doughs.
(2) Larger amount of salt than is ordinarily used.
(3) Lower temperatures (down to 60° F.) than ordinarily used.
(4) Less sugar, or substitutes therefor, than ordinarily used.
(5) Less thorough mixing.

20. Leaven or old (left over) dough.—Retain a piece of the leavened dough to be used for a certain day's baking and store it in a cool place (preferably under 50° F.) until ready to mix dough for the following day. This piece of leaven or old dough may be used in lieu of other leavening agent. Leaven or old dough to be used successfully as a leavening agent should not be more than 24 hours old, as longer periods tend to develop sour fermentations which will be reflected in the finished bread. A piece of the dough made by using old leaven retained from the previous day may also be retained for the following day, and so on, indefinitely. For best results, about 2 pounds of old dough to 100 pounds of new dough should be used.

21. Baking powder.—*a. General.*—The leavening agent best suited for production of cakes, biscuits, pancakes, and doughnuts is baking powder. While both yeast and baking powder release carbon dioxide gas (CO_2) to produce the desired result, that is, leavening or raising a dough or batter, the means of obtaining this result (release of gas) differ in all respects. Baking powder is a mechanical mixture of anhydrous acids, alkaline salts, and inactive fillers in which it is possible to release the gas (CO_2) very rapidly. The filler used most frequently is starch. The quantities of acid and alkaline salts used as ingredients are so balanced that when the mechanical mixture is placed in contact with moisture (water in the batter) and in some instances heat, a chemical reaction results during which all or very nearly all of the original active baking

powder ingredients are acted upon with the end products being free carbon dioxide gas and residual neutral or stable matter.

b. Brands.—Usually recipes as distributed by various manufacturers refer to baking powder by brand name. In using such recipes, it is essential that a baker know how to make adjustments in quantities to be used in his formula to permit use of the type of baking powder available.

c. Classification.—Baking powders may be classified by rapidity of gas release as slow or quick acting. Common usage also permits a further classification of baking powders into two groups, namely, double and single acting. If it is not possible to ascertain from the label of the container in which classification the product falls, a statement on the label of active ingredients as required by the Food, Drug, and Cosmetics Act may be used to determine the proper classification.

(1) Reference to the following table will enable ready classification.

Ingredients as stated on label	Slow	Quick	Double	Single	Teaspoonsful per cup of flour
Cream of tartar, and/or tartaric acid, bicarbonate of soda, starch	------	X	------	X	2
Acid monocalcium phosphate or monocalcium phosphate, bicarbonate of soda, starch	------	X	------	X	2
Monosodium phosphate, bicarbonate of soda, starch	------	X	------	X	2
Sodium aluminum sulphate, acid monocalcium phosphate, sodium bicarbonate or ammonia, starch	X	------	X	------	1
Sodium acid pyrophosphate, sodium bicarbonate or ammonia, starch	X	------	X	------	1

(2) When quick or single acting baking powder is being used, it must be remembered that less mixing tolerance is afforded and, therefore, it is well-suited to products which are to be baked off immediately after completion of mixing. The baker must be exacting in his measurements of this type of powder since a small variation from recipe requirement may prove disastrous to the finished product. For those baked goods, such as waffles, pancakes, and doughnuts, which may lie on the work table for any considerable period prior to baking, the double or slow acting type of powder may be used with

excellent results since the leavening action is continued over a longer period of time. The evolution of gas in this type of powder continues after the batter is placed in the oven, and in certain types of these powders the application of heat is necessary to complete this chemical reaction, thus releasing all available gas.

d. Deterioration.—(1) All baking powders are subject to deterioration in storage; however, the shelf life will depend on the locality of the storage as follows:

Gulf Coastal States	6 months.
Atlantic–Pacific Seaboard States	8 months.
Inland States	1 to 2 years.

(2) The governing factor in deterioration is moisture or humidity. For this reason baking powder containers, to ensure good keeping quality, must be capable of being resealed against moisture after each opening. Continued exposure in the presence of moisture will result in the formation of small pellet or shot-like particles within the powder. When this condition is noted, the baking powder should not be used, since it has been severely damaged in its leavening ability or is ruined completely. Baking powder is not affected by low temperatures, when sealed so as to prevent moisture absorption.

SECTION IV

ADDITIONAL BREAD DOUGH INGREDIENTS

	Paragraph
Water	22
Salt	23
Sugar and substitutes	24
Shortening	25
Milk	26
Optional ingredients	27

22. Water.—*a. Reasons for use.*—Water is an essential ingredient in bread making. Without water, the formation of a dough would be impossible. When mixed with wheat flour, water unites with the protein substances of flour called glutenin and gliadin and forms the substance known as gluten, this substance being essential in order to produce a well-risen leavened loaf of bread. The presence of water in comparatively large quantities is also essential to cause fermentation by use of yeast. Before being incorporated in a dough, the yeast should be dissolved separately in a portion of the water to be used in the dough. When so treated, the yeast is uniformly distributed throughout the entire mass of the dough, resulting in a much

better and more uniform fermentation. Water plays an important part in the fermentation, eating qualities, and freshness of a dough and bread made therefrom mainly from the following standpoints:

(1) Without water, yeast activity would cease.

(2) The presence of water makes possible the pliable and expansible properties of the dough so that in this form it can be raised by the carbon dioxide gas resulting from yeast activity.

(3) The presence of water aids materially in imparting good eating qualities to the loaf of bread. A dough containing insufficient water when baked would result in a dry, brittle product. Conversely, too much water remaining in a baked loaf of bread results in a soggy, unpalatable product and makes it readily susceptible to mold development.

(4) Water in bread imparts the characteristic of freshness. The evaporation of the water contained in a loaf of bread into the surrounding atmosphere is the principal cause of staleness.

b. Types and effect in bread making.—All water used in bread doughs should be of a purity equal to that of drinking water. Usually the water used at Army posts for drinking purposes is in every way suitable for bread-making purposes. Even moderately chlorinated water will not materially affect the quality of the bread or impart an off odor. The type of water available varies in different sections of the country. To ascertain the type of water being used and a possible remedy for defects in dough caused by its use, local military authorities should consult with officials of the local water works. Briefly, water may be classified as—

(1) *Hard water.*—Hard water is water which, after falling as rain, seeps through the soil and while so doing absorbs minerals, such as carbonates and sulphates of calcium and magnesium. If water is hard, it is difficult to form a lather with soap. Medium hard water is desirable for bread-making purposes as it provides the essential mineral matter necessary to activate yeast in a dough. Excessively hard water retards the progress of fermentation by toughening the gluten; it may be softened by boiling prior to use.

(2) *Soft water.*—This is water which is relatively free of mineral matter. Soft water readily forms a lather with soap. Very soft water, when used for bread making, has a tendency to soften the gluten and result in a soft, sticky dough. If soft water must be used, this softening of gluten and stickiness of dough may be remedied by using larger quantities of salt. The mineral matter contained in the salt will supply the mineral deficiency of the water.

(3) *Alkaline water.*—This is water which contains in solution an alkaline substance, such as sodium carbonate. In rare cases water may be sufficiently alkaline to require special treatment before using in a dough. Excessively alkaline water will either neutraize or change to the akaline side a dough that should be slightly acid for best yeast activity and fermentation. If alkaline water must be used, its ill effects may be overcome by adding to it a small quantity of vinegar.

c. Quantity to be used.—The quantity of water to be used in a dough is determined by the flour absorption test (par. 12*d*). The use of slack or stiff doughs may be desirable under certain conditions, but it must be remembered that the quantity of water to be used in any case should be such as not materially to affect the quality of the finished bread. From a commercial standpoint, the retention of more water in a loaf of bread is beneficial to the civilian baker as it results in increased profits; but in the Army, where no profit is derived from the sale of bread, no advantage is gained by the use of more water than is necessary to produce a palatable and attractive product. According to Government standards, it is not permissible for bread 1 hour or more after completion of baking to contain more than 38 percent of water, based on actual weight of the loaf. If the proper amount of water is used in a dough, and the dough is properly handled and baked, the finished loaf will usually contain about 36 percent of water, based on actual weight of the loaf. For practical purposes, a pint of water may be considered as weighing 1 pound and a gallon of water 8.3 pounds.

d. Ice calculation.—During hot summer months and in tropical climates, the temperature of the available tap water may be higher than the temperature of the water required to obtain a given mixed dough temperature. In such cases ice may be used in the dough in lieu of a part of the required water in order to obtain the desired mixed dough temperature. The following method of calculation may be used and will prove satisfactory:

After determining the desired temperature of the water required, record the temperature of the available tap water. Find the difference between the temperature of the water required and the tap water. Multiply this result by the weight of the water to be used in the dough and divide this difference by 144. (144 B. T. U.'s of heat are absorbed by 1 pound of ice in melting.) The resulting figure will give the amount of ice required to obtain the desired mixed dough temperature. Deduct this amount from the number of pounds of

water originally called for to obtain the new amount of water to be used with the ice.

Examples:

Temperature of available tap water	70° F.
Temperature of water required	60° F.
Difference	10° F.

Two hundred forty-three pounds of water are required in the dough.

$10 \times 243 = 2430$ (number of B. T. U.'s of heat to be removed from 243 lb. of water to lower its temperature 10° F.)

$2{,}430 \div 144 = 16.8$ or $16\frac{3}{4}$ pounds (the amount of ice required).

$243 - 16\frac{3}{4} = 226\frac{1}{4}$ (pounds of tap water to be used with the ice).

NOTE.—The ice used in the dough must be clean and shaved or broken into small particles in order to obtain a smooth dough free of lumps of ice.

23. Salt.—*a.* Salt used in bakeries is the kind universally used as table salt, that is, a chemical compound of the elements of sodium and chlorine. Salt, flour, yeast, and water constitute the essential ingredients of a bread dough. In other words, a good leavened bread may be made by the use of these ingredients only. Other ingredients, such as sugar, milk, and shortening, when added to a dough improve the quality and attractiveness of the finished product, but they are not essential to the production of a good quality of leavened bread.

b. Salt is used primarily to impart a desirable flavor to bread. Without salt in a dough, the resultant bread would be flat and insipid. In addition to imparting flavor, salt to a large extent may be considered as a controlling factor in fermentation. As the amount of salt used in a dough is increased, the proper fermentation time for that dough is increased, and vice versa.

Example: If 2 percent is the normal amount of salt used in a dough and it is desired to shorten the fermentation period, reducing the amount to 1 percent is one way of accomplishing the desired result. Conversely, if it is desired to lengthen the fermentation period, increasing the amount of salt to 3 percent will accomplish this result.

c. In order to insure equal distribution throughout the dough, the salt and sugar to be used should be dissolved in a part of the water before being added to the dough. The salt should never be mixed with the yeast nor added to the yeast and water solution, as this

high concentration of salt with yeast will invariably seriously weaken, if not kill, yeast activity.

d. Normally, 2 percent salt, based on weight of flour used, will give best results. Amounts above and below this percentage may be used to meet special situations but in no case should the amount used exceed 5 percent, based on weight of flour. Amounts in excess of 5 percent will seriously injure the quality and flavor of bread.

24. Sugar and substitutes.—*a. General.*—The word "sugar," without qualification, means the sugar obtained from sugarcane or sugar beets. For all practical purposes, there is no difference between cane and beet sugar. The chemical name for cane or beet sugar is sucrose. The sugar obtained by chemically treating cornstarch is known as corn sugar. Its chemical name is dextrose. The chemical name for sugar contained in milk is lactose and that obtained from the malting of grains is maltose. Other sweetening agents, such as brown sugar, corn sirup, cane sirup, molasses, and honey, may be used in bakery products in lieu of sugar. Sugar is available commercially in different size granules such as cubes, coarse granulated, fine granulated, extra fine granulated, and powdered. For bread-making purposes, fine granulated sugar (the kind ordinarily used for sweetening foods) is most desirable.

b. Function of sugar in bakery products.—(1) Sugar is added to a bread dough primarily to provide immediate food for yeast. It is the sugar in a dough that is acted upon by yeast to produce the carbon dioxide gas resulting in a leavened product. Its second important function is to provide a sweet flavor to the finished loaf. It also gives to the crust of a loaf of bread that golden brown color which adds materially to its attractiveness. For this reason, more than just enough sugar to act as yeast food should be incorporated in a bread dough; if no sugar remains in the dough upon completion of fermentation, the resultant product will have an unattractive, light-colored crust.

(2) In order to be fermentable by yeast, sugar must be in simple form. The starch of flour may be broken down from its complex form through compound sugar to simple sugar by the action of enzymes secreted by yeast. Sucrose, or cane and beet sugar, is a compound sugar and must be broken down to simple sugars by the yeast enzyme invertase before it is fermentable. Dextrose, or corn sugar, is a simple sugar and is therefore directly fermentable by yeast. The conversion of a compound sugar to a simple one within a dough is so rapid that no difference in fermentation time need be considered in using cane sugar or corn sugar. Lactose, or milk

sugar, is not fermentable by yeast. Therefore, any lactose present in a dough will remain as such during fermentation and, as a result of caramelization caused by high heat of oven, will tend to give a golden brown color to the crust of bread.

c. Amount of sugar to be used.—The amount of sugar used depends on the kind of bakery product desired. For ordinary bread doughs, the amount generally used ranges from 2 to 4 percent, based on the weight of flour used. The same weight of either sucrose or dextrose may be used, even though the latter is only three-fourths as sweet as sucrose. Unless the fermentation period is rather extended or the amount of yeast used is more than 2 percent based on the weight of flour, the incorporation of from 2 to 4 percent of sugar in a dough will give satisfactory results as to flavor and color of crust, provided the dough has been otherwise properly handled. When there is a long fermentation period (over 5 hours) or the amount of yeast used exceeds 2 percent, the amount of sugar used should be correspondingly increased.

d. Amount of substitutes to be used.—The use of molasses, sirup, brown sugar, malt, etc., in lieu of white sugar is satisfactory and often desirable, especially in dark-colored products such as rye bread, whole wheat bread, or dark-colored cake. It must be borne in mind, however, that sirups, molasses, and malt contain from 25 to 35 percent moisture, while white sugar contains practically no water, so that an additional quantity of the substitute must be used to obtain an equivalent proportion of sugar in a dough. When used in the production of white bread, substitutes for white sugar have a tendency to transmit their dark color to the crumb of the finished loaf.

25. Shortening.—*a. Definition.*—Shortening is the fat or oil added to a dough. It gives the finished product "shortness," that is, the property of breaking and crushing easily, and produces a soft, velvety crum.

b. Kinds.—If liquid at ordinary room temperature, a shortening is called an oil; if solid at room temperature, it is called a fat. Among the oils are cottonseed, peanut, corn, and olive. Among the fats are lard and lard substitute. Lard is rendered hog fat. Lard substitute is either all vegetable fat or a combination of vegetable and animal fats. Butter is also considered as a shortening, but its high cost in comparison with other shortenings precludes its use by the Army in bread making.

c. Use in bread dough.—Shortening in solid form (fat) is preferred to shortening in oil form for the reason that measurements are more

easily and accurately made. In liquid form, part of the shortening tends to adhere to the sides and bottom of the measuring container. There is very little preference between lard and lard substitute. It is thought by some that lard imparts a superior flavor to bread, but the quantity ordinarily used is so small that this superior flavor is difficult, if not impossible, to detect by the average consumer. If lard substitute meeting Federal specifications can be obtained at a cheaper cost than lard meeting Federal specifications, the lard substitute should be used as the shortening for bread doughs.

d. Effect on bakery products.—Shortening imparts desirable chewing quality to bread. The smooth, pleasing crust and the soft, velvety crumb so desirable in bread are to a certain extent obtained by the proper use and handling of shortening in a dough. A finished loaf of bread containing shortening will retain its freshness for a longer period of time than one without, as the presence of shortening tends to lessen the loss or evaporation of water from baked goods. Shortening is the most concentrated fuel-furnishing food known, therefore its incorporation in a bread dough increases the nutritive value of the bread.

e. Quantity to be used.—Like other ingredients, the quantity of shortening to be used depends upon the product to be baked. For soft rolls, sweet doughs, pies, etc., the quantity of shortening used is much greater than for bread. Conversely, for hard rolls, the quantity is lessened. For bread doughs, from 1½ to 3 percent is ordinarily used, 2 percent (based on the weight of the flour) being considered the most desirable for Army garrison bread. Shortening should be the last ingredient added when mixing a dough as its incorporation at an earlier stage will tend to prevent thorough incorporation of other ingredients, thereby retarding active and uniform fermentation.

f. Storage in bakery.—Light, warmth, air, and moisture favor the development of rancidity in fats and oils. Therefore, shortening should be kept tightly covered in a cool, dry, dark place prior to its use. Rancid shortening, even if used in very small quantities, will impart its very disagreeable off flavor throughout a large batch of bread, making it practically inedible. Every precaution should be taken to prevent shortening from becoming rancid and to preclude the use of rancid shortening in doughs.

26. Milk.—*a. General.*—(1) Milk is one of the few almost complete natural foods. When incorporated into a bread dough, it materially increases the nutritive value thereof. Bread becomes very nearly a completely balanced diet in itself when milk is used in the dough. Milk also enhances the flavor of bread, its appearance (by imparting a

golden brown color to crust), and its keeping qualities. It is available not only in its original liquid state, but also in various concentrated forms, such as evaporated, sweetened, condensed, dried whole, and dried skim.

AVERAGE COMPOSITION OF VARIOUS FORMS OF MILK

[Expressed in terms of percentage]

	Water	Butter-fat	Protein	Milk sugar	Other sugars	Mineral matter
Liquid whole milk	88	3. 5	3. 25	4. 5	------	0. 75
Evaporated milk	72	8	7. 25	10. 5	------	1. 75
Sweetened condensed milk	31	8	7. 25	10. 5	41	1. 75
Dried whole milk	1. 5	27. 5	27	38	------	6
Dried skim milk	2. 5	1. 5	36. 5	51. 5	------	8

(2) If used at all in a bread dough, at least one-third and preferably one-half of the liquid content of the dough should be the equivalent of whole milk.

Example: If water is used as the liquid content of a dough, and 60 pounds of water is the proper absorption for 100 pounds of flour, from 20 to 30 pounds of such water, or one-third to one-half, respectively, may be replaced by whole milk or the equivalent thereof. For rough calculation, one-half as much evaporated milk or one-eighth as much dried whole milk may be considered the equivalent of whole milk. If it is desired to replace one-half the amount or 30 pounds of the water content of a dough with milk, it can be accomplished by adding—

30 pounds of whole milk, or

½ or 15 pounds of evaporated milk combined with 15 pounds of water, or

⅛ or 3.5 pounds of dried whole milk combined with 26.5 pounds of water;

or, expressed otherwise—

30 pounds of whole milk plus 30 pounds of water equal 60 pounds of liquid content;

15 pounds of evaporated milk plus 45 pounds of water equal 60 pounds of liquid content;

3.5 pounds of dried whole milk plus 56.5 pounds of water equal 60 pounds of liquid content.

b. Type to be used in Army bakeries.—The use of milk in dried form is considered more advisable than in either whole or evaporated form for the following reasons: Increased keeping qualities; decreased bulk; more easily and readily stored; quantities may be more accurately measured. As between dried skim and dried whole milk, the former is recommended for bread-making purposes because of better keeping qualities, lower cost, and because the fat content of dry whole milk may be replaced by other shortenings without appreciable loss of flavor and nutritive value. Dried skim milk and dried whole milk may be obtained to economic advantage in regular commercial 50-pound tins and 200-pound barrels. Requirements for a 6-months' supply may be kept on hand without fear of deterioration if it is kept dry and ordinary precautions are taken to prevent contamination by insects and/or dirt.

27. Optional ingredients.—*a. Malt.*—(1) *Definition.*—Malt, the word alone, is generally used to designate malt syrup which is a specially prepared concentrated syrup made by evaporating a water extract of barley malt. During the process of malting barley grain certain enzymes are developed, namely, protease and diastase.

(2) *Action in doughs of enzymes contained in malt.*—Enzymes such as proteases aid in the proper conditioning of the dough by its softening effect on the gluten. The enzyme diastase causes some of the starch in flour to be converted into the sugar maltose by liquefying starch and converting this liquefied starch into maltose sugar. This maltose sugar is in turn acted upon by the enzymes secreted during the growth of yeast in the dough mass.

(3) *Type.*—(*a*) Malt is obtainable in either dry powdered form or as syrup. The powdered type is more generally acceptable for Army use due to ease of handling, storing, and transporting in all parts of the world. Malts, whether dry or in syrup form, usually are measured as to diastatic ability in degrees Lintner and for Army purposes may be divided into three classes:

Nondiastatic	not more than 10° Lintner.
Low diastatic	20° to 30° Lintner.
Medium diastatic	35° to 65° Lintner.

A nondiastatic malt may be used in doughs regardless of the diastatic strength of the flour employed. The balanced enzymatic power of malt of low regulated diastatic strength affords a continuous production of simple (fermentable) sugars during the entire fermentation process and in the early stages of baking. The results are a loaf of

good volume, good grain and texture, and a rich bloom or color of crust. Under special conditions where the flour to be used is known to be of low diastatic strength; exceptionally high percentages of milk solids are used; available water is unusually hard (alkaline); and special types of hearth bread are desired, a low or medium diastatic malt may be used to advantage. In no instance of normal Army baking should high diastatic malt (above 65° Lintner) be used.

(*b*) Malt syrup is fermentable and therefore should be kept in dry, cool storage. Every precaution should be taken to keep opened containers and storage clean and free of spilled syrup, since insects, particularly ants and flies, are attracted by malt.

(*c*) Powdered malt is hygroscopic and should be kept in a tightly closed container when not being used, particularly in localities where the humidity is high. In cold and dry climates preservation of malt syrup is no problem. While both types of malt are deleteriously affected by heat in excess of 60° F., dry powdered malt may be considered to be more stable and for that reason is more adaptable for use in tropical and semitropical climates. Dry malt has a tendency to solidify when subjected to pressure, especially in high storage temperatures (80° F. or above), and therefore should not be stored in a manner which will permit pressure being applied to the powder.

b. Dough improvers.—Other ingredients called dough improvers may be added to a dough. One type of improver incorrectly but generally called mineral yeast food may be used to advantage in quantities not to exceed ½ of 1 percent based on the weight of flour used (½ pound of improver (mineral yeast food) to 100 pounds of flour). A dough improver is supposed to effect an improvement in either the quality or the economic production of bread. The so-called mineral yeast foods are improvers insofar as they provide in quantity certain refined edible soluble mineral salts, minerals which are common to most vegetables. The most important are the phosphates which aid in more complete development of the yeast and also, if properly used, will permit a better softening and ripening of the gluten during fermentation. Since greater development of yeast will bring about a more rapid fermentation, these mineral salts must be used cautiously since overfermentation may result if the dough is not watched carefully. Good bread can be produced without use of improvers, and since additional ingredients involve increased cost, transportation, and procurement difficulties, their use should be re-

stricted to emergency use when a rapid and short fermentation is greatly desired. Good storage for mineral yeast foods is identical with that for flour.

c. Products for variety and flavor.—Fruits, such as prunes and raisins, and other products, such as peanut butter, are occasionally added to a dough to provide variety in breads and impart additional flavor to bread products. When added to a dough, they should be used in the proportion of from 20 to 30 percent, based on the weight of flour. The use of smaller quantities would practically nullify the purpose for which they are added, and larger quantities might have a deleterious effect on fermentation, loaf volume, and texture.

SECTION V

MANUFACTURE OF BREAD

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28. Equipment.—*a.* If bread of good quality is to be produced it is essential, in addition to a knowledge of the kind and quantity of ingredients to be used, that sufficient and serviceable equipment is available; that the purpose of and method of operating such equipment are fully understood; and that there is a complete understanding of each step in the manufacture of bread.

b. The kind and quantity of machinery and equipment needed will vary depending upon the output of a bakery; a bakery manufacturing 300 loaves of bread a day will not need the same equipment as one manufacturing thousands of pounds of several different kinds of bakery products daily. Machinery generally in use in large bakeries includes dough mixers, dividers, rounders, moulders, fermentation and proof cabinets (either stationary or portable), and stationary, revolving, or traveling ovens. Essential equipment consists of floor and counter scales, pint, quart, and gallon measure containers, dough

thermometers, dough troughs, dough cutter, bakepans, cooling racks, molding table, mixing bowls, and an oven. Too much emphasis cannot be placed upon the necessity for keeping all machinery and equipment in scrupulously clean condition. Frequent inspections should be made to prevent undue deterioration or unserviceability.

29. Assembling ingredients and equipment.—Prior to commencement of each day's work, the man in charge of the bakery should make a thorough check to see that all supplies and equipment needed for that day's operation are available and in a convenient location. The installation of a small-ingredients room containing well-marked bins or containers for ingredients, such as sugar, salt, dried milk, shortening, etc., and located adjacent to or near the dough-mixing machine or bowl, will facilitate the mixing procedure. The yeast should be kept in cool storage until just prior to use. If all the yeast to be used during one day is permitted to remain in a warm room until ready for use, the doughs made the latter part of the day will be adversely affected, due to rapid deterioration of the yeast. Accurately measured quantites of all ingredients to be used in a dough should be conveniently assembled before starting the mix.

30. Adjustment of water temperature.—*a.* Yeast activity in a dough produces best results at temperatures from 78° to 82° F. In order to obtain any desired temperature in a mixed dough, four factors must be considered: temperature of mixing room, temperature of flour, temperature of water, and heat developed by friction of either hand or machine mixing. The temperatures of the flour and mixing room may be determined readily by use of a thermometer. The friction heat developed in mixing by either hand or machine will be known after a few doughs are mixed. The heat developed by friction will usually be about 5° for hand mixing, 10° to 15° for slow-speed mechanical mixers, and 15° to 25° for high-speed mechanical mixers. As the temperature of the water is readily adjusted by using varied quantities of hot or cold water or ice, this temperature is changed as occasion demands in order to obtain a desired mixed-dough temperature; therefore, to obtain a desired mixed-dough temperature, multiply the desired temperature by three. From this total deduct the sum of the temperature of the room and of the flour, and degrees of friction heat developed in mixing. The remainder is the temperature of the water to be used in the dough.

Example: Assuming temperature of the mixing room to be 75°, temperature of the flour to be 73°, degrees of friction heat obtained in

mixing to be 10, and the desired mixed-dough temperature to be 80°—

	Degrees
Temperature of mixing room	75
Temperature of flour	73
Friction developed	10
Total	158
3 times 80 (desired mixed-dough temperature) equals	240
Less	158
Temperature of water to use to obtain mixed-dough temperature of 80° is	82

b. If the result obtained indicates that water of a temperature in excess of 100° F. must be used in order to obtain the desired mixed-dough temperature, that part of the water used to dissolve the yeast should be cooled to at least 95° F. and a compensating increase made in the temperature of the remainder. If yeast is permitted to come in contact with temperatures exceeding 95° F., its activity is seriously retarded, and in excess of 120° F., it is killed. Water adjusted to a certain temperature for dough purposes is usually referred to as tempered water.

31. Dough mixing.—*a. Purposes.*—The four main purposes of dough mixing are to bring about an intimate and uniform mixture of ingredients so as to form the smooth mass called the dough; to induce the formation and development of gluten in flour by causing moisture to come into contact with the gluten-forming protein substances in flour; to distribute the yeast cells completely and uniformly throughout the dough mass; and to provide a uniform quantity of yeast food throughout the mass.

b. Methods.—There are two principal methods of dough mixing:

(1) *Straight dough.*—A method whereby a dough is obtained by mixing together at one time all the ingredients to be used.

(2) *Sponge and dough.*—A method whereby part of the ingredients are mixed (usually part of the flour, part of the water, part or all of the yeast, and part or all of the sugar, plus part or all of the other ingredients to be used); the resultant product, called the sponge, is permitted to ferment; the fermented sponge is then mixed with the remaining part of the ingredients to be used, forming what is called the sponge and dough. The ingredients used in the sponge are referred

to as the sponge ingredients, and those reserved for later incorporation as the dough ingredients.

c. Procedure.—(1) *Straight dough.*—(*a*) *Machine mix.*

1. Carefully weigh and assemble all ingredients to be used.

2. Place approximately one-fourth of the tempered water in separate container. Into this crumble the yeast and whip thoroughly until the yeast is well dissolved. Be careful that the water used for this purpose is not over 95° F., as a higher temperature will kill or injure the yeast.

3. Place remainder of water in the mixer. Add the sugar, salt, and other dry ingredients, except flour. Dissolve ingredients in the water by beating with a wire whip or running the mixer slowly for a short period of time.

4. Stop the mixer. Add about one-half of the flour. Run the mixer slowly until all ingredients are thoroughly incorporated.

5. Stop the mixer. Add the dissolved yeast, then the remainder of the flour, and lastly the shortening. Continue mixing until dough of a proper consistency is obtained.

6. Note and record mixed-dough temperature and make necessary adjustments in temperature of the water to be used in subsequent batches if the mixed-dough temperature obtained is different from that desired.

(*b*) *Hand mix.*—Procedure is the same as for machine mixing except that, especially where only small quantities of bread are baked daily, each batch of dough mixed by hand should contain not more than 30 pounds of flour (the other ingredients being present in proper proportion). For example, if it is desired to produce approximately 160 pounds of bread (requiring approximately 100 pounds of flour), four batches are mixed by hand. All ingredients for all batches should be weighed before starting the mix, so that the different batches will be mixed at about the same time, in which case they may be placed in the same dough trough for fermentation. This procedure is desirable in order to insure a thorough incorporation of ingredients and development of gluten in flour. The proper hand mixing of larger batches by one individual requires considerable experience and strength.

(2) *Sponge and dough.*—(*a*) *Machine mix.*—Follow the same procedure as for straight dough using only sponge ingredients. A sponge is usually slacker than a straight dough. When fermented sponge is ready for remixing with dough ingredients, proceed as follows:

1. Place fermented sponge in mixer and start mixer on slow speed so as gradually and gently to break up the sponge.
2. Stop mixer. Add dough water in which the dry ingredients other than flour (such as the remainder of the sugar, salt, and dry milk) have been dissolved. Start mixer and continue mixing until all ingredients are thoroughly incorporated.
3. Stop mixer. Add miscellaneous dough ingredients, such as raisins, prunes, peanut butter, etc.
4. Add dough flour and dough shortening and continue mixing until sponge and dough are properly mixed.

(*b*) *Hand mix.*—Procedure is the same as for machine mix, except that the combined weight of fermented sponge and dough ingredients should, when practicable, be limited to 50 pounds in order to insure proper mixing and thorough incorporation of ingredients.

d. Comparison of methods.—The use of either of the methods given in *b* above will result in the production of bread of good quality, provided ingredients of good quality are used in the proper proportion and the dough is handled properly throughout the fermentation, make-up, proofing, and baking periods. However, except where a small quantity of one type of bread is being baked, it will be found advantageous to use the sponge and dough process. Especially is this true where a variety of bread products is being baked. Other things being equal, the principal advantages obtained from the use of sponge and dough instead of a straight dough are larger volume and whiter color of crumb. These advantages are gained by reason of better development and expansion of gluten caused by slackness of dough in the sponge and by withholding from the fermenting sponge those ingredients which would have a tendency to retard or lessen effectiveness of fermentation.

e. Effects of over and under mixing.—Too much emphasis cannot be placed on the importance of the proper mixing of each dough. The determination of proper mix is by "feel" of the dough. The proper feel is determined only as the result of experience, therefore no definite mixing time can be stated; it varies considerably, depending upon whether it is a hand mix or a machine mix and, in the latter case, whether a high-, medium-, or low-speed mixing machine is used. The weight of the dough batch also considerably affects the time required to obtain a proper mix. In the sponge and dough method, neither the sponge nor the sponge and dough are mixed as long as a straight dough; as there are two mixings in the sponge and dough process, obviously less mixing of each is necessary. Any grit-

tiness, hardness, or dry flour feeling to the dough is evidence of undermixing; an undermixed dough will result in irregular fermentation and the finished loaf will invariably have a streaky crumb and an uneven, coarse cell structure. If dough is overmixed, it weakens and tears the gluten as a result of rapid excessive stretching. This condition is reflected in the finished loaf by poor volume and inferior grain and texture.

32. Dough temperature.—Except in emergencies or when it is desired materially to lengthen or shorten the regular fermentation period of a dough, every effort should be made to obtain a mixed-dough temperature of between 78° and 82° F., as this is the best temperature for normal fermentation. The procedure to obtain this temperature is explained in paragraph 30. The continuation of the mixing of a dough until it has reached the desired temperature and notation of results obtained in the finished product will be a good guide in making subsequent adjustments in either length of time for mixing or degrees of friction allowed.

33. Fermentation of a dough.—*a. Definition.*—Fermentation may be defined as the chemical action that takes place in a dough, causing it to expand or increase in volume. Chief among the chemical actions that take place during fermentation are formation, expansion, and mellowing of the gluten content of the dough; the breaking down of sugar within a dough into carbon dioxide and alcohol, caused by yeast activity. The gluten develops a rubber-like tenacity and tends to hold within and between the starch cells the carbon dioxide formed by the yeast, thereby causing the expansion but not a rupture of the cell structure.

b. Requirements for proper fermentation.—After a dough is mixed, it is placed in a lightly greased dough trough for fermentation. Generally the space available in a dough trough should be four times as large as the volume of the freshly mixed dough. If the dough trough is considerably larger than four times the volume of the mixed dough, the dough should be confined to the required space by use of dam boards. If the available space in a dough trough is insufficient, the dough, on rising, will overflow. If too much dough space is allowed, the dough will spread out horizontally instead of rising vertically. A vertically rising of fermenting dough is desired. The control of temperature and humidity in the cabinet or room where dough is fer-

menting is extremely important. If the air is dry, a crust will form on top of a fermenting dough, resulting in bread of poor quality. Applying heat to a pan or pans of water placed in the immediate vicinity of the fermenting dough will help to provide the necessary humid condition if a water spray fan is not available. Frequent punchings of the dough will tend to prevent crusting. The ideal temperature of a fermenting room or cabinet is 80° F. Every effort should be made to secure and maintain a temperature approximating 80° F. during fermentation unless lower or higher temperatures are expressly desired purposely to retard or hasten fermentation.

34. Fermentation periods.—Fermentation starts immediately when yeast is incorporated into a bread dough and continues until all yeast activity is killed by the action of excessive heat, which is usually about 5 minutes after the dough is placed in the oven or when the temperature of the dough exceeds 120° F. Although fermentation is constantly going on during the period stated, it is customary to divide this total time into various periods, known as fermentation period, make-up period, proofing period, and baking period. In the sponge and dough process, it is customary to refer to the sponge fermentation period, sponge and dough fermentation period, make-up period, proofing period, and baking period.

a. Fermentation period for straight doughs.—The fermentation period is the period elapsing between the time at which the yeast is incorporated and the time when the dough is ready to be divided into individual loaf weights. This length of time will vary, depending upon the percentage of yeast and sugar in the dough, temperature of the mixed dough, and temperature and humidity of the fermentation room. The fermentation period is subdivided into time of first punch, time of second punch, and time of dividing. When normal quantities of yeast (1 to 2 percent), normal quantities of sugar (2 to 4 percent), and normal temperature of mixed dough (78° to 82° F.) obtain, the time when the first punch is made is calculated as 60 percent of the total fermentation period, and the time at which the dough is to be divided is at the expiration of the remaining 40 percent. The punching of the dough at least once between the time of first punch and the time of dividing is desirable but not essential. When dough is punched more than once, an arbitrary time is set between the time of first punch and the time of dividing and is known as "second punch time."

Example:

Time of mix---------- 9 a. m.
Time of first punch---------- 11 a. m.
Total time elapsing---------- 2 hours or 120 minutes

120 minutes=60 percent of fermentation period.

$$1 \text{ percent} = \frac{120}{60} \text{ or } 2 \text{ minutes}$$

100 percent=200 minutes, or 3 hours and 20 minutes.
Time consumed to first punch=60 percent or 120 minutes.
Remainer of time for fermentation period=40 percent or 80 minutes.
Time when dough is to be divided is 11 a. m. (time of first punch) plus 80 minutes, or 12:20 p. m.

The time for making the second punch is arbitrarily set at any convenient period, generally halfway between the first punch and the time for dividing; in the foregoing example, at 11:35 a. m.

(1) *Determination of time for first punch.*—The time to make the first punch is the only part of the fermentation period which depends almost entirely upon personal judgment. Under ordinary circumstances, the first punch will be made at from 1½ to 3 hours after the time of mixing. The exact time for making the punch may be determined by inserting the fingers gently into the top of the dough to a depth of from 1 to 2 inches and closely observing the dough when the fingers are withdrawn. If the surface of the dough falls rapidly, the time to make the first punch has passed and the dough should be punched without further delay. If the indentation of the dough caused by the fingers tends to come back, the dough is not yet ready for the first punch. When the proper fermentation stage has been reached, the dough will neither collapse nor come back, but immediately around the depression, cracks will form and the surface near the depression will be seen to sink slightly. This condition can be determined readily with a little experience. Carefully note the time when the first punch is made, and, by following the procedure as outlined in the example, the proper time at which the dough is to be given additional punches and the time when it should be divided into individual loaf weights may be readily determined.

(2) *Reasons for punching.*—While it is not considered essential to punch a dough during the fermentation period, it is advisable to do so for the following reasons:

(*a*) During the process of punching, the dough at the bottom of the trough is brought to the top and that at the top is changed to a

bottom or center position, thereby equalizing the temperature throughout the dough, resulting in more thorough and uniform fermentation.

(*b*) Yeast food is brought in contact with yeast cells, which might not have happened if the dough had not been punched.

(*c*) Some of the carbon dioxide that has been formed is expelled. Excessive amounts of carbon dioxide have a retarding effect on yeast activity.

(*d*) Additional air is incorporated into the dough, thus accelerating yeast activity.

(*e*) Development of gluten is aided, thus creating desired tensility.

b. Make-up period.—The term "make-up period" in bakery parlance includes the operations of dividing and scaling the dough, rounding it, giving it an intermediate proof, and molding and panning it.

(1) *Dividing and scaling.*—When a dough has had its fermentation period, it is removed from the fermentation trough and sent to the mechanical dividing machine or to the workbench, as the case may be, for dividing and scaling. If a machine is used for this purpose, care should be taken to insure that it is properly adjusted so as to divide the dough into exact desired weights. Frequent check should be made by weighing pieces cut by machine to insure accuracy. If dividing is accomplished by hand, a dough cutter and counter scale are used. The purpose of dividing is to cut the mass of fermented dough into individual pieces of desired weights. As there is a loss in weight of from 10 to 12 percent during baking, this loss must be taken into consideration when dividing dough. In general, 18 ounces of dough will produce 1 pound of finished bread.

(2) *Rounding and short proof.*—The scaled dough pieces may be molded into loaves immediately, but it is customary in bakery operation first to round the individual pieces and allow them to remain on the bench or in a so-called "short proof" cabinet for a period of 15 to 20 minutes in order to loosen up the dough. This operation is generally referred to as the "short" or "intermediate" proof.

(3) *Molding.*—Upon completion of the intermediate proof, the individual dough pieces are molded into the shape desired for the finished loaf. Molding is not a difficult operation but requires some experience to attain proficiency in the work. There is no hard and fast rule to follow in molding bread. Different individuals may mold in different ways and yet secure the same result. In general, the piece of dough should be pounded flat into a rectangular shape; be free from large gas pockets; folded in two from top to bottom; the sides stretched slightly, then folded toward center, so as to have the

desired pan length. The dough is then rolled from top to bottom, care being taken to close up all seams, using either the knuckles or the heel of the hand to obtain a good seal.

(4) *Panning.*—The molded loaves are immediately placed in bakepans with the sealed edge down. The bakepan should be lightly and uniformly greased on the interior, sides, and bottom. The number and arrangement of the loaves in the pans depend upon the size and shape of the pans. In the majority of Army bakeries the 1-pound individual-loaf pan is now used for the baking of all varieties of bread, and it is proposed to discontinue entirely the use of the 2-pound pans. The 1-pound pans are strapped in sets of four for convenience in handling.

c. Proofing period.—(1) The panned molded dough is placed in a proofroom or cabinet for proofing. In the larger bakeries, iron racks mounted on rollers are provided to receive the pans as they are made ready for the proofroom. The proofroom, which should be free from drafts and heated to a temperature of about 90° F. or higher by free steam, is made ready to receive the racks which are wheeled into it. It has already been noted that, up to a certain temperature, proofing or fermentation is accelerated by heat. The temperature of the proofroom or cabinet being greater from the floor toward the ceiling, the pans first filled should be placed on the bottom shelf of the proof rack and the others on the next higher shelves as they are filled.

(2) These facilities are not found in smaller bakeries, and proof boxes are provided instead. The boxes should be practically airtight and, if proof racks are provided, of proper size to receive them. If proof racks are not provided, boxes should be made with shelves of narrow slats to permit free circulation of such steam as may be provided. Often a pan of water is placed on the bottom shelf, and when the proof box is filled, hot bricks are dropped into the pan of water to create steam, which should be present during the proofing of the loaves.

(3) If gas is provided, a better method is to let the jet play upon the bottom of the pan which is conveniently exposed beneath the box. If steam is not provided, the tops of the loaves should be lightly greased to prevent the formation of a crust.

(4) If proper size pans are used and dough is properly molded, the loaves should generally occupy about one-half the depth of the pan. When the loaves have about doubled in size, that is, when they are about on a level with the top of the pan, or slightly higher, they are ready for the oven. The proofing period generally lasts from

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about 30 to 60 minutes, depending upon size of loaf and the temperature and humidity of the proof cabinet. Proofing may be delayed or accelerated by decreasing or increasing the temperature of the proof box but, except in emergencies, bread should be given a normal proof period.

d. Baking period.—(1) Care must be exercised to have the oven ready at the proper time. The proper temperature for baking bread is from 400° to 450° F. In order to insure uniform baking of all loaves, the pans of dough must be properly spaced so as to insure a uniform distribution of heat to sides and ends of each pan. If pans are permitted to come in contact with each other, the sides of the loaf where contact is made will be underbaked when the other portions are properly baked.

(2) Care must be exercised not to jar the pans when placing them in the oven, as this might cause the proofed loaves to fall. They will not have time to rise again before the yeast is killed by oven heat, and the resulting bread will be small in volume and of poor texture.

(3) During the fermentation, make-up, and proofing periods, the yeast has been working continuously and the carbon dioxide gas has produced the increased size and porous structure of the dough. During the first few minutes of baking, the yeast functions more vigorously and more rapidly than at any previous stage in the bread-making process. However, when the temperature of the dough, due to heat of the oven, reaches above 120° F., the yeast is killed and further fermentation ceases. The carbon dioxide gas present within the dough is greatly expanded, due to oven heat, causing a further very rapid rise in the dough. This rapid rise of dough in the oven is known as "oven spring." The alcohol produced by the action of yeast on sugary constituents of the dough is quickly evaporated by the heat of the oven and escapes from the dough into the oven in the form of vapor.

(4) After a dough has attained its oven spring, its pliability gradually lessens and the dough becomes "set." There is a gradual conversion from dough to bread. This conversion is due to the fact that some of the moisture is driven off, the starch becomes gelatinized and more digestible, and the gluten and other proteins become coagulated.

(5) Following the "setting" of the loaf, the crust is formed. The forming of a crust is due to the intense heat to which the outside of the loaf has been subjected and its consequent drying out. The brown color is due to the drying out of the exposed surface and to a certain

chemical change in the starch and sugar, known as caramelization. Within the loaf the conditions are slightly different. The crumb near the crust is subjected to a temperature as high as 300° F. or more, being bathed in superheated steam. The temperature gradually decreases toward the center, where it never rises above 212° F. Under the action of this temperature, the gluten becomes sufficiently stiff to give permanent shape and form to the loaf and to retain the cellular structure even after the gas which has produced it escapes. From the foregoing, it is easy to understand why the crumb of the bread presents such a uniform appearance throughout, instead of being baked to different degrees of hardness from the crust toward the center as one might very naturally expect.

(6) The browning of the crust should start in from 10 to 20 minutes after the loaves are placed in the oven. If the oven is too hot, the crust will become dark and thick before there has been sufficient time for the dough within to become baked properly. If the oven is not hot enough, a rubbery, pale crust may be formed. In addition to temperature of the oven, the color of crust obtained depends upon the quantity of unfermented sugars present in the dough. The high heat of the oven caramelizes these sugars, imparting a golden brown color to the crust. If an excessive quantity of unfermented sugar is present in the dough being baked, a very dark brown crust may be expected.

(7) The time of baking in a temperature of from 400° to 450° F. may be assumed to be about 30 to 35 minutes for a 1-pound loaf in individual pans.

35. Steam in oven.—Every effort should be made to provide steam to be used in the oven during baking. If steam is used, it will tend to prevent too rapid formation of crust and excessive loss of moisture, and will cause the formation of a gloss or desirable shiny surface. In lieu of steam, tops of individual loaves may be slightly moistened with water or liquid shortening before being placed in oven. When the amount of steam entering the oven can be controlled, it should be turned "on" while loading the oven and "off" about 5 minutes after completion of loading. For hearth products, such as rye and Vienna bread, it is practically essential that steam be used in the oven if "wild breaks" are to be avoided and the glossy crust, so desirable in such products, is to be obtained.

36. Cooling bread.—It is essential that bread be properly cooled immediately after it is taken from the oven and before it is issued or sold, in order to prevent possible mold or rope growth. After bread has been subjected to the heat of the oven for a period of ½

hour or more, it is practically sterile and every precaution should be taken to keep it so. The bread should be removed from the pans and placed on cooling racks sufficiently apart to insure free circulation of air on all sides of each loaf. If cooling racks are not available, place the bread on a slatted table. Under ordinary conditions, 2 hours of cooling in a room the temperature of which does not exceed 85° F. will suffice. When conditions require it, clean cloths of porous material should be spread over the loaves to keep off dust and prevent insect infestation.

37. Storage of bread.—When a bread room is provided, the loaded bread racks may be wheeled directly into it. Good ventilation should be provided. If movable bread racks are not available, a rack should be built of slatted shelving. Bread boxes, unless slatted on sides and top, should not be used. They are difficult to ventilate and may be the cause of early moldiness in bread.

38. Issue and sale of garrison bread.—Every effort should be made so to regulate the amount of bread on hand that none need be issued or sold until 5 hours have elapsed after removal from the oven; that not more than a 24-hours' supply will ordinarily be on hand at any one time; and that bread is consumed, if at all practicable, within 36 to 48 hours subsequent to baking. Unwrapped bread on hand more than 48 hours is not necessarily unfit to eat, but has usually acquired a degree of staleness. Cooks in organization kitchens may use such bread to advantage in the form of toast, croutons, in dressings, etc., when the additional heat applied will tend to improve its palatability.

39. Record of Bakery Operations.—*a.* The maintenance of this form at post bakeries is not obligatory. However, it will be found of considerable value and convenience for efficient operation of bakeries. The information contained thereon may be either amplified or diminshed to suit local conditions.

b. The basis of this record is the quantity of each product to be produced and the time that it must be available in finished form. Knowing this, the next consideration is the capacity of the oven or ovens available for use. In order to obtain maximum use of the oven in the shortest operating time, thereby conserving fuel, the mixing, fermentation, make-up, and proofing of the various doughs should be so regulated as to have each batch of proofed loaves ready for the oven as soon as the previous batch is taken out. The length of time required to load and unload each oven (generally from 5 to 10 minutes for each operation) must be considered in the computation of time. Bearing in mind the above factors, the approximate time

RECORD OF BAKERY OPERATIONS

(Post or station) _____ (Date) _____

Dough No.	Time dough mixed	Weight of mixed dough (lbs.)	Kind of product	Temperature of mixed dough	Temperature of fermentation room	Sponge		Dough				Temperature of proof cabinet	Time in proof	Time in oven	Time out of oven	See remark No.
						Time placed in fermentation room	Time remixed with dough ingredients	Time placed in fermentation room	Time of first punch	Time divided	Time molded					
1	8:05	125	Garrison	80	78	8:10	10:25	10:40	------	11:40	12:00	92	12:05	12:50	1:25	1
2	8:20	125	Garrison	81	79	------	------	8:20	11:20	12:20	12:40	91	12:45	1:35	2:10	3
3	8:50	130	Raisin	80	80	9:00	11:40	12:00	------	1:00	1:25	90	1:30	2:20	2:50	4
4	10:45	95	Whole wheat	79	81	------	------	10:50	------	1:55	2:15	91	2:20	3:05	3:40	2
5	11:50	116	Rye	78	80	12:00	2:00	2:10	------	2:50	3:10	88	3:20	3:55	4:30	1

REMARKS

1. Showed evidence of overfermentation. Fermentation period should be slightly reduced.
2. Excellent results obtained throughout.
3. Dark color of crust due to "too hot" oven.
4. Showed evidence of underfermentation. Fermentation period should be slightly increased.

"in oven" and "out of oven" for each dough batch is specified in advance of the beginning of bakery operations for each day; then, by figuring backward, considering time required for the operations enumerated on the report, the time that each dough should be mixed is readily determined. It must be borne in mind contantly that the time to perform various operations on doughs may be advanced or retarded from the normal time by varying fermentation and/or proof temperature, the quantity of yeast used in a dough, and the temperature and consistency of the mixed dough. The handling of the various doughs is, therefore, adjusted (if necessary) so as to insure a steady and uniform flow of operations throughout the working day.

c. Taking into consideration the personnel and equipment available, and bearing in mind the factors enumerated in *b* above, the Record of Bakery Operations may be made out completely in advance of the beginning of operations, especially after it has been used for a short period of time. Information available from the Record of Bakery Operations form for the previous day, as to the handling of the several weights and kinds of dough, results obtained, and remarks concerning each dough, will serve as an excellent guide to the proper preparation of this report of activities each day.

d. It will be noted on examination of the model form that provision is made for preparation of doughs by either the straight dough or the sponge and dough method. The entries on the form should be used as a guide only, as local conditions, kind and quantity of ingredients used (especially yeast), etc., will vary baking conditions considerably.

e. The Record of Bakery Operations form should be used in conjunction with the Dough Record Card (par. 40), the dough number on the record card corresponding to the dough number on the Record of Bakery Operations.

40. Dough Record Card.—*a.* This is a daily record of the kind and quantity of each ingredient to be incorporated and the mixing method to be used in the preparation of each dough batch. It should be made out in advance of the beginning of each day's baking operations. Care should be exercised to insure that the total weight of ingredients used does not exceed the capacity of the mixing machine or of the oven available. The "dough number" should not be assigned to the Dough Record Card until the relative position that dough should occupy on the Record of Bakery Operations form has been determined.

b. The preparation of the Dough Record Card and the Record of Bakery Operations in advance and posting them in a convenient location within the bakery just prior to the beginning of a day's opera-

tions will eliminate the necessity of detailed instructions to the personnel assigned to the bakery. It will also enable the officer or noncommissioned officer in charge to check the accuracy of work done by subordinates, and it limits judgment as to how doughs should be handled to the man who supervises the preparation of the forms.

DOUGH RECORD CARD

(Dough number) (Kind of product) (Date)

Straight dough			Sponge and dough		
Ingredients	Pounds	Ounces	Ingredients	Pounds	Ounces
Flour (specify kind)			*Sponge*		
Water					
Yeast			Flour (specify kind)		
Salt			Water		
Sugar			Yeast		
Milk, dry skim			Salt		
Milk, evaporated			Sugar		
Shortening					
			Dough		
			Flour (specify kind)		
			Water		
			Yeast		
			Salt		
			Sugar		
			Shortening		
			Raisins		
Scaling weight					
Number of loaves required					

Remarks:

SECTION VI

PERCENTAGE SYSTEM OF FORMULA CONSTRUCTION

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Loss in weight between dough and bread 43
Practical application of percentage method 44
Application of percentage method to sponge and dough 45

41. General.—*a.* Until recently, various methods were used to express the quantity of ingredients to be used in a bread dough formula.

(1) Many bakers used the so-called pail or bucket method, wherein the quantity of other ingredients was based on the number of pails or buckets of water used.

Example:

Water, 1 bucket (12 qt.)	25 lb.	6 buckets	150 lb.
Flour	40 lb.		240 lb.
Salt	13 oz.		78 oz.
Yeast	13 oz.		78 oz.
Sugar	13 oz.		78 oz.
Shortening	13 oz.		78 oz.

(2) Another method in common use was known as the gallon method. The basis for such formula was gallons of water.

Example:

Water, 1 gal	8.3 lb.	6 gal	49.8 lb.
Flour	13.5 lb.		81 lb.
Salt	4 oz.		1 lb. 8 oz.
Yeast	4 oz.		1 lb. 8 oz.
Sugar	4 oz.		1 lb. 8 oz.
Shortening	4 oz.		1 lb. 8 oz.

(3) Still another method in common use was that of expressing a formula in terms of 100 pounds of flour. If the quantity of flour to be used was greater or less than 100 pounds, that quantity was divided by 100 and the result obtained was used as a factor to determine quantities of all other ingredients.

Example:

Given formula			*Formula for 250 pounds of flour*
Flour	100 lb.		$100 \times 2.5 = 250$ lb.
Water	60 lb.		$60 \times 2.5 = 150$ lb.
Salt	2 lb.	$\frac{250}{100} = 2.5$	$2 \times 2.5 = 5$ lb.
Yeast	2 lb.		$2 \times 2.5 = 5$ lb.
Sugar	2 lb.		$2 \times 2.5 = 5$ lb.
Shortening	2 lb.		$2 \times 2.5 = 5$ lb.

b. All of these methods are being rapidly discarded for a more modern and readily adaptable procedure known as the percentage method. The percentage method for bread formulas is based on the assumption that the weight of flour used in any formula equals 100 percent. The weight of the other ingredients to be used in the bread dough is expressed in percentage form, based on the weight of the flour used.

42. Explanation of percentage.—*a.* Percentage is a numerical expression denoting the relation of a part of the whole. *Example:* 10 cents equals $\frac{1}{10}$ of a dollar or 10 percent of a dollar. The percentage of any part in relation to the whole is determined by dividing the part by the whole and multiplying the result by 100.

Example: 5 pounds of sugar is what percent of 25 pounds of sugar?

$$\frac{5}{25} \times 100 = \frac{500}{25} \text{ or } 20 \text{ percent.}$$

b. Bearing in mind that, regardless of weight, the flour used in a dough represents 100 percent of that dough, the formula given in paragraph 41 for 100 pounds of flour will be expressed in terms of percentage as follows:

		Percent
Flour	100 lb. or	100
Water	60 lb. or $\frac{60}{100} \times 100 = \frac{6000}{100}$ or	60
Salt	2 lb. or $\frac{2}{100} \times 100 = \frac{200}{100}$ or	2
Yeast	2 lb. or $\frac{2}{100} \times 100 = \frac{200}{100}$ or	2
Sugar	2 lb. or $\frac{2}{100} \times 100 = \frac{200}{100}$ or	2
Shortening	2 lb. or $\frac{2}{100} \times 100 = \frac{200}{100}$ or	2
	Formula percentage	168

c. If the weight of the flour and the percentage of other ingredients to be used are known, the required weight of the other ingredients is determined by multiplying the weight of the flour by the percentage of the ingredient and dividing the result obtained by 100. Continuing the use of the formula example in *b* above, and assuming that instead of 100 pounds of flour it is desired to use 275 pounds, the formula will be expressed as follows:

	Percent		*Pounds*
Flour	100	or	275
Water	60	or 275×60 or $\frac{16500}{100}$ or	165
Salt	2	or 275×2 or $\frac{550}{100}$ or	5.5
Yeast	2	or 275×2 or $\frac{550}{100}$ or	5.5
Sugar	2	or 275×2 or $\frac{550}{100}$ or	5.5
Shortening	2	or 275×2 or $\frac{550}{100}$ or	5.5
Formula percentage	168	Formula weight	462.0

d. The sum of the percentages of ingredients used in any dough is commonly referred to as the formula percentage (168 percent in example in *b* above). The sum of the weights of ingredients used in a dough is commonly referred to as formula weight (462 pounds in example in *c* above). For conversion of fractions or tenths of pounds to ounces see conversion tables, paragraph 114.

43. Loss in weight between dough and bread.—*a.* A considerable amount of moisture is driven off while a dough is baking. There is also some loss in weight by evaporation of moisture during fermentation and proofing. A slight loss may obtain as a result of pieces of dough adhering to bakery equipment, etc. The total of this loss is commonly referred to as "baking loss." Therefore, the weight of the dough or formula weight must be greater than the desired weight of finished bread produced from that dough.

b. The average loss in oven is between 10 and 12 percent, based on weight of the dough. The loss occasioned by fermentation and adhering to equipment will usually be from 1 to 3 percent. Therefore, the total loss between the formula weight and weight of finished bread will ordinarily be between 11 and 15 percent, depending upon conditions. To determine the approximate percentage of baking loss for a certain type of bread at any given bakery, weigh carefully all the

ingredients used in a dough and all the bread produced from that dough. Subtract the total weight of bread from the total weight of ingredients used in the dough (formula weight). Divide the result by the formula weight and multiply that result by 100. The answer is the loss between formula weight and bread weight expressed in terms of percentage.

Example:

Formula weight	150 lb.
Weight of bread	132 lb.
	18 lb.

$$\frac{18}{150}=0.12\times 100 \text{ or } 12 \text{ percent.}$$

44. Practical application of percentage method.—Knowing the percentage of each ingredient to be used in a dough, the local average percentage of loss in weight between dough and bread, and the total number of pounds of finished bread desired, the weight of each ingredient to be used in a dough is determined as follows: divide the total pounds of bread desired by the difference between the baking loss percentage and 100; multiply the result by 100. Divide the result thus obtained by the total formula percentage. The final result will be the weight of 1 percent of the formula. As the flour weight is always 100 percent, the weight of flour to be used is 100 times the weight of 1 percent. Multiply the weight of flour by the percentage of each other ingredient to be used and the result obtained for each is the quantity of that ingredient to be used in the dough.

Example: Six hundred 1-pound loaves of garrison bread are to be produced. It is known that the average loss between dough and bread is 12 percent and the percentage formula to be used is that given in paragraph 42.

Required: The weight of each ingredient to be used in the dough in order to produce the six hundred 1-pound loaves of garrison bread.

Solution:

600 loaves $\times$ 1 lb. = 600 lb. of bread required.

100 percent $-$ 12 percent (baking loss) = 88 percent.

$$\frac{600}{88}\times 100=682 \text{ lb. of dough required (rough calculation).}$$

Total formula percentage=168 percent.

Therefore 1 percent=$\frac{682}{168}$ or 4.06 lb. (1 percent of formula weight).

100 percent or flour weight of formula=4.06×100 or 406 lb.

	Percent			*Pounds*
Flour	100		or	406
Water	60	$60\times\frac{406}{100}$	or	243.6
Salt	2	$60\times\frac{405}{100}$	or	243.6
Yeast	2	$2\times\frac{406}{100}$	or	8.12
Sugar	2	$2\times\frac{406}{100}$	or	8.12
Shortening	2	2×406	or	8.12
Formula percentage	168	100	Formula weight	682.08

45. Application of percentage method to sponge and dough.—There are several ways of applying the percentage method to a sponge and dough, but the simplest method is to base all calculations, whether in the sponge part or the dough part, on the total quantity of flour to be used in the sponge and dough. The sponge and dough formula given below is prescribed. It is assumed that the total flour content equals 80 pounds.

Sponge ingredients

	Percent			*Pounds*
Flour, straight	60	$60\times\frac{80}{100}$	or	48
Water	32	$32\times\frac{80}{100}$	or	25.6
Salt				
Yeast	1½	$1.5\times\frac{80}{100}$	or	1.2
Sugar	3	$3\times\frac{80}{100}$	or	2.4
Shortening				
			Sponge weight	77.2

Dough ingredients

	Percent		*Pounds*
Flour, whole wheat	40	$40 \times \frac{80}{100}$ or	32
Water	28	$28 \times \frac{80}{100}$ or	22.4
Salt	2	$2 \times \frac{80}{100}$ or	1.6
Yeast	½	$0.5 \times \frac{80}{100}$ or	.4
Sugar	1	$1 \times \frac{80}{100}$ or	.8
Shortening	2	$2 \times \frac{80}{100}$ or	1.6
Formula percentage	170	Dough weight	58.8
		Sponge weight	77.2
		Total formula weight	136

SECTION VII

BREAD FORMULAS

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46. Garrison bread.—*a. Using compressed yeast.*—(1) *Straight dough method.*—(*a*) *Formula* (to produce about 160 lb. of baked bread).

	Percent	*Pounds*
Flour	100.00	100
Water (tempered)	65.00	65
Yeast	2.50	2½
Salt	2.50	2½
Sugar	4.00	4
Malt (optional)	1.00	1
Shortening	5.00	5
Milk, dry skim, powdered	4.50	4½
Mineral yeast food (optional)	.25	¼

NOTE.—Water absorption may vary. Use the necessary quantity more or less than 65 pounds to get desired dough consistency.

(*b*) *Procedure.*

1. Machine mixing.

(a) Weigh accurately all large and small ingredients.
(b) Temper the water to get a dough temperature of 78° to 80° F. Friction of machine is a factor.
(c) Suspend the yeast in sufficient water.
(d) Pour the remaining water into the mixer and add sugar, malt, milk, salt, and yeast food.
(e) Let the mixer revolve a few times to dissolve the ingredients.
(f) With the machine in motion, add approximately one-half of the total flour.
(g) When a batter is formed, add the yeast solution.
(h) Add remainder of flour.
(i) While the mixture is still lumpy, add shortening.
(j) Continue mixing until dough is of proper consistency.

NOTES.—1. Malt extract may be added to the yeast solution if necessary. Do not permit yeast and malt to remain in contact more than 5 or 10 minutes.
2. If dry milk is used, recondition about 30 minutes before using.

2. Hand mixing.—Proceed the same as for machine mixing, except that each batch of dough mixed by hand should contain not more than 30 pounds of flour (the other ingredients being present in proper proportion). For example, if it is desired to produce 160 pounds of baked bread requiring 100 pounds of flour, four batches are mixed by hand. All ingredients for all batches should be weighed before starting to mix so that the different batches will be mixed at about the same time, in which case they may be placed in the same dough trough for fermentation.

3. Fermenting dough.

(a) If the dough made from the formula comes out of the mixer at a temperature between 78° and 82° F. and is fermented at the same temperature, the fermentation time should be calculated on the first rise 80/20 fermentation ratio. If no yeast food is used, first rise 60/40 fermentation ratio should be used. (Dough should be kept on the young side. Fermentation ratio should be varied until the best result is obtained.)

(b) At the end of the fermentation period, divide (scale) into 18-ounce pieces, round up, give short proof (12 minutes), pan, proof, and bake. Proofing time time should be about 50 minutes.

(2) *Sponge and dough method.*—(*a*) *Formula.*

1. Sponge.

	Percent	*Weight*
Flour	60.00	60 lb.
Water	39.00	39 lb.
Yeast	2.50	2½ lb.
Salt	.3125	5 oz.
Malt	.25	4 oz.
Shortening	4.00	4 lb.
Yeast food	.25	4 oz.

2. Dough.

Flour	40.00	40 lb.
Water	26.00	26 lb.
Salt	2.1875	2 lb. 3 oz.
Sugar	4.00	4 lb.
Malt	0.75	¾ lb.
Milk, dry skim, powdered	4.50	4½ lb.
Shortening	1.00	1 lb.

(*b*) *Procedure.*

1. Mixing sponge.—Proceed same as for straight dough method (1) (*b*) above, using the sponge ingredients. Dough should be very slack but not sticky and should come out at 76° to 78°.

2. Fermenting sponge.—Allow the sponge to rise once and fall once. When it has risen again and almost doubled its volume for the second time, bubbles will break on the surface of the sponge and it is nearly ready to fall for the second time. Then is the time to mix it with the other ingredients to make the dough. The total time for the sponge to ferment as described should be about 3½ hours.

3. Mixing dough.

(a) Place the remainder of the water (dough portion) tempered to get a temperature of 78° to 80° in the mixer. (Temperature of the sponge is a factor in tempering the water.)

(b) Add all the ingredients of the dough except shortening and flour. Dissolve by a few turns of the mixer.

(c) Add the fermented sponge and mix thoroughly into a thin batter or until the sponge is well broken up and no stringy portions remain. The addition of a small quantity of dry flour taken from the flour reserved for the dough will keep down splashing and whirling of sponge.

(d) Add the remainder of the flour and add the shortening when the mass becomes lumpy.

4. *Fermenting dough.*—Allow the dough to stand in a dough trough for about 30 minutes, or if speed is desired, it may be placed directly on the bench, covering with a damp cloth to prevent crusting, and let rest about 15 or 20 minutes. Then divide, round up, give short proof, mold, pan, proof, and bake as for straight dough.

5. *Hand mixing.*—Proceed same as if mixing by machine except that each batch of dough mixed by hand should contain not over 30 pounds of flour.

(3) *Quality of bread produced.*—On account of the percentages of sugar, malt, milk, and shortening, bread made from this formula has a golden brown (not pale) crust, a creamy white crumb color, a velvety texture, and excellent flavor. If it does not have these characteristics, it was not properly made in the bakery. It will retain its moisture for several days after baking, if not cut, and does not dry out as readily as bread made with no milk or malt and less sugar and shortening. Bread produced by this formula, when properly made, is of excellent quality, entirely satisfactory for sale to individuals as well as to organizations, and eliminates the necessity for mixing a separate dough for white sales bread.

b. Using dried yeast (100-lb. flour basis).—*Straight dough method.*—(*a*) *Formula.*

	Percent	*Weight*
Flour	100.00	100 lb.
Water	66.00	66 lb.
Yeast (dried)	.80	13 oz.
Salt	2.00	2 lb.
Sugar	5.00	5 lb.
Shortening	4.50	4½ lb.

(*b*) *Procedure.*—Dissolve 13 ounces of dried yeast in about 8 pounds of water tempered to 80° F., for 1 hour. Mix the other ingredients and finish mixing with the dissolved yeast. Allow the mixed dough to ferment for 10 hours at a temperature of 80° F. Punch the dough and give an additional 45 minutes of fermentation. Scale or divide into

pieces of desired weight, round up, give 15 minutes intermediate proof, mold, and proof for approximately 1 hour. Allow to bake in 450° oven for from 35 to 45 minutes.

(2) *Sponge and dough method.*—(*a*) *Formula.*

1. Sponge.

	Percent	*Weight*
Flour	30.00	30 lb.
Water	25.00	25 lb.
Yeast (dried)	.80	13 oz.

2. Dough.

Flour	70.00	70 lb.
Water	41.00	41 lb.
Salt	2.00	2 lb.
Sugar	5.00	5 lb.
Shortening	4.50	4½ lb.

(*b*) *Procedure.*—Dissolve the yeast in about 10 pounds of the sponge water tempered to 80° F., for 1 hour, then add the remainder of the sponge water at the same temperature. To this liquid solution add the sponge flour and mix so as to obtain a soft sponge. Let the sponge stand at a temperature of 78° F. for about 8 hours. At the end of the sponge fermentation period, mix the fermented sponge with the dough ingredients and allow the sponge and dough to ferment for 2½ to 3½ hours. Give the dough a punch and let rise again for another hour. Scale the dough into pieces of desired weight, round up, give short intermediate proof, and mold. Proof at 85° to 90° F. for from 50 to 80 minutes. Bake in 450° oven for from 35 to 50 minutes, depending upon weight of the loaves.

NOTE.—The foregoing formulas are considered maximum requirements for the production of satisfactory bread. When necessary, they may be modified to meet local conditions.

c. Variety of shapes.—(1) *Round top loaf.*—The commonly used shape of garrison bread is referred to as "round top" shape. Round top bread conforms to the shape of the pan in which it is baked with the top crust having a rounded shape, caused by the unhindered expansion in all directions of the carbon dioxide gas contained in the dough. This shape may be altered in many ways, three of which are described in (2), (3), and (4) below.

(2) *Split top loaf.*—Formula and procedure are the same as in *a* and *b* above up to molding. Instead of scaling the dough into

18-ounce pieces for a 1-pound loaf, scale into 9-ounce pieces. Mold each 9-ounce piece the same as an 18-ounce piece. Place two 9-ounce molded dough pieces side by side in the bakepan, care being taken to have both pieces molded to the same size and shape and to place the seams of the molded pieces to the bottom of the pan. Proof and bake in the manner described in *a* and *b* above. During proofing, the two molded pieces will rise simultaneously but will show a depression along the center where the two pieces join. In the finished product there will be a "break and shred" along the center of the loaf which adds to its attractiveness.

(3) *Twist loaf.*—Formula and procedure are the same as in *a* and *b* above up to molding. Instead of scaling the dough into 18-ounce pieces for a 1-pound loaf, scale into 9-ounce pieces. Mold each 9-ounce piece in the same manner as an 18-ounce piece. The services of two men are advisable to twist the molded pieces. Each man grasps one end of each of two molded pieces and, by overlapping the hands, twists them until four to six twists are made. The ends are then pressed together and the twisted dough placed in the bakepan. Proofing and baking are the same as in *a* and *b* above. The finished product will show the characteristic twist on the top crust of the loaf. The twist loaf not only provides for variety in shape but also improves the grain of the loaf, reduces the probability of holes in the bread, and gives the finished loaf a firmer texture.

(4) *Pullman bread.*—Pullman or sandwich bread may be made by the formula and procedure described in *a* above. It is called Pullman or sandwich bread because the molded loaf is proofed and baked in a so-called Pullman pan. The pan differs from that ordinarily used in that it is rectangular in shape, with vertical sides, and is provided with a slip-top flat cover. The dough is molded, panned, and proofed the same as for round top bread. When the proofing dough has risen to within ½ to ¼ of an inch from the top of the pan, the slip cover is inserted and the pans placed in the oven. The "oven spring," caused by the rapid expansion of the carbon dioxide gas within the dough, forces the top crust of the dough against the pan cover, which prevents further rising and results in a flat-top, square-cornered, finished loaf. Care should be taken to grease lightly the inner side of the cover as well as the sides and bottom of the pan before placing dough therein, as failure to do so will cause the top crust to stick to the cover, making it difficult to remove the baked loaf from the pan.

47. Whole wheat bread.—United States Government standards require that the entire flour content of a loaf of bread which is to be labeled and sold as "whole wheat bread" shall be whole wheat flour. If a blend of whole wheat flour and some other flour (such as patent or straight, etc.) is used, it must be labeled "imitation whole wheat bread," "partial whole wheat bread," or some similar designation which will readily indicate that at least part of the flour content used in making the bread is other than whole wheat flour. Good palatable bread may be made by using 100 percent whole wheat flour and is very desirable for use when such articles as fresh fruits and leafy vegetables are not available for the diet. The whole wheat flour helps to supply the mineral and roughage requirements so essential to a properly balanced diet. When roughage and mineral requirements of the diet may be readily supplied from other sources, it is advisable to use part whole wheat flour and part straight or patent flour in making partial whole wheat bread in order to secure better volume and improve the grain and texture of the finished loaf. The use of all whole wheat flour tends to produce a very crumbly interior, resulting in difficulty in proper slicing and spreading with butter, etc. The characteristic color and flavor of whole wheat bread may be obtained by using from 40 to 60 percent whole wheat flour and the remainder straight or patent flour.

a. Straight dough method (50 percent).—(1) *Formula.*

	Percent	*Pounds*
Whole wheat flour	50.00	50
Issue flour	50.00	50
Water (variable)	62.00	62
Malt	2.00	2
Salt	2.00	2
Sugar	2.00	2
Milk, dry skim, powdered	3.00	3
Shortening	3.00	3
Yeast	3.00	3
	177.00	177

(2) *Procedure.*—Dough out of mixer at 80° F.; medium consistency; fermentation, normal, 60/40 basis; intermediate proof 10 minutes. Proof, normal (may be cut down somewhat if bread is too crumbly or gets too old).

b. Sponge and dough method (50 percent).—(1) *Formula.*—(*a*) *Sponge.*

		Percent	*Pounds*
Flour, patent or straight		50.00	50
Water		32.00–34.00	32–34
	[Based on combined weight of white and whole wheat flours]		
Yeast		3.00	3
Sugar		2.00	2
Malt		2.00	2

(*b*) *Dough.*

Flour, whole wheat		50.00	50
Water		30.00–32.00	30–32
	[Based on combined weight of white and whole wheat flours]		
Salt		2.00	2
Milk		3.00	3
Shortening		3.00	3

(2) *Procedure.*—Mix sponge ingredients thoroughly and allow to ferment for from 1½ to 2 hours. Mix fermented sponge and dough ingredients thoroughly and give an additional half hour of fermentation. Scale dough into pieces of desired weight, round up, give 15-minute intermediate proof, mold, and proof until dough is even with or slightly higher than top of pan (approximately 45 to 55 minutes for 1-lb. loaf). Bake in 400° to 450° F. oven for from 30 to 35 minutes. Do not expect the same volume or "oven spring" from whole wheat bread as from the same weight or size of sales or garrison bread. Whole wheat flour, being comparatively weak in gluten content as compared to patent or straight flour, tends to produce a more compact loaf.

NOTES.—1. These formulas are considered maximum requirements for the production of satisfactory bread. When necessary, they may be modified to meet local conditions.

2. If other than dry skim milk is used, such as milk, evaporated, or whole milk, use table of equivalents (sec. XIII). It should be remembered that water content of milk, evaporated, or whole milk should be considered and reduction in water content made accordingly.

3. It is important that whole wheat flour and other flour used be thoroughly blended so as to prevent alternate dark and light streaks in crumb. Dough in which whole wheat flour is used should be mixed slightly longer than dough containing only white flour.

48. Rye bread.—Rye bread is made by using a blend of rye flour and wheat flour with the other ingredients generally used in making

bread. Although there is no limitation as to the quantity of rye or wheat flour to be used in the blend, best results for volume, characteristic taste, and good texture are obtained by using approximately 30 percent rye flour and 70 percent wheat flour. If dark rye flour is used, the resultant product will have a dark rye color; if white rye flour is used, the resultant product will have the characteristic rye taste but will be rather light in color. A rye blend, composed of part dark and part white rye flour, is used commercially to a considerable extent and is known as medium rye flour. Rye bread may be baked in the pans used for garrison bread but is generally made as "hearth" bread, that is, the loaves are baked on the hearth of the oven instead of in pans. The making of rye bread for sales to organizations and individuals at Army posts should be encouraged as it provides variety in the bread component of the diet and is well liked by a majority of people. Furthermore, every Army baker should be thoroughly familiar with the making of rye bread for the reason that, in times of emergency (especially when a shortage of wheat flour exists), it may become necessary to substitute large quantities of rye bread for wheat bread.

a. Suggestions for making.—(1) A dough containing rye flour should receive much less mixing than a 100 percent wheat flour dough as the gluten is not as strong and will not stand as much stretching without being considerably weakened. For all practical purposes, as soon as the dough feels smooth and tends to pull away from the sides of the mixing bowl, it may be considered as sufficiently mixed. Overmixing of rye dough will result in poor volume and the presence of a considerable number of large and small holes in the crumb, and will invariably result in bursting or splitting the sides of the loaf, due to overstretching of the gluten. Likewise, due to inferior quality of gluten, rye dough should receive a shorter fermentation period than wheat flour dough. As the kind and quantity of rye flour, temperatures used, and other local conditions will vary considerably, no set fermentation period can be given. Rye doughs always have a much denser or heavier feel than wheat doughs, and for this reason the tendency will be to consider rye doughs as not fully fermented when, in fact, they may be overfermented. As slightly underfermented rye doughs will produce better results than an overfermented dough, the tendency should be to take them on the young side, that is, to scale the dough preparatory to molding while the dough is still slightly underfermented.

(2) Similarly, the proofing of rye doughs requires less time, under the same temperature and humidity conditions, than wheat doughs.

In comparison, if an 18-ounce wheat flour dough requires 50 minutes for proper proofing, the rye flour dough will require only 30 to 35 minutes.

b. Steaming or "rye washing."—In section VIII a fuller discussion is given on the use of steam in ovens. When available for the making of hearth rye bread, steam should be allowed to enter the oven for from 3 to 5 minutes before loading the oven with the proofed bread and its use continued for from 5 to 10 minutes subsequent to loading. The object of using steam in the oven is to give the loaf that crispy feel and glossy appearance so desirable in rye bread and also to minimize the possibility of "wild breaks" or bursting sides on the loaf. If steam is not used, the resultant product will likely have a rubbery crust and dull appearance. In lieu of steam, a so-called rye wash may be used. Rye wash is made by combining from 2 to 2½ ounces of cornstarch and 1 quart of water. A lesser or greater quantity may be made using the same proportions. Dissolve the cornstarch in a small quantity of cold water to make a soft paste. Boil the remaining water, stir in, and let cool. Each proofed loaf should be lightly washed with rye wash, using a paint brush, just prior to being put in the oven and again upon removal.

c. Docking or cutting.—All hearth rye bread should be docked or cut on the top side of the loaf prior to entering the oven in order to prevent bursting or splitting during baking. The docked or cut surface provides a predetermined place for the escape of the carbon dioxide gas which is forced from the interior of the loaf. If no docked or cut surface is provided, the gas will escape from the weakest place in the loaf (usually on the sides or where the seam is made while molding), resulting in bursting sides which greatly detract from appearance and salability. Rye dough is cut by using a sharp knife and making four quick, equidistant slashes across the top surface of the molded loaf, at right angles to the length of the loaf. The cut should be not more than ¼ to ½ inch deep. In lieu of cutting, rye dough may be docked. Docking consists of penetrating the top surface of a molded piece of dough with a device consisting of a narrow flat piece of wood through which large nails have been driven at regular and properly spaced intervals of about 1 or 2 inches. Using this device, the entire top surface is docked or punctured with one downward movement of the hand holding the docker. Sufficient pressure must be used to insure penetration of the nails into the dough to a depth of about ½ inch.

d. Use of peels.—All hearth-made bread products require the use of patent peels. The molded dough pieces are placed on peels for proofing. When proofed, the board part of the peel is attached to a patent peel handle. The individual loaves are deposited on the hearth by a slight forward push and quick back pull on the handle of the peel. One handle may be used for any number of boards, the handle being easily attached to or detached from a board. There is a knack to oven peeling. Considerable experience is required before one becomes adept at it and can secure full utilization of oven space and at the same time prevent "cripples" (loaves damaged by being hit with the peel or by sticking to the peel as it is removed from the oven). Rye dough is sticky and tends to adhere to the surface of the peel on which it is proofing. To overcome this tendency, a thin layer of corn meal should be sprinkled over the surface of the peel before placing the molded loaves upon it. Corn meal has the ability to absorb moisture. Its limited use on peels, therefore, will not only overcome the tendency of the loaves to stick to the peel, but will also aid in easy removal from the peel, the individual grains of corn meal acting as "rollers."

e. Pan type (straight dough method).—

(1) *Formula.*

	Percent	*Pounds*
Rye flour (dark)	20.00	20
Issue flour	80.00	80
Water (variable)	58.00	58
Malt	2.50	2½
Salt	2.00	2
Shortening	2.50	2½
Yeast	3.00	3
	168.00	168

Caraway seed (optional).

(2) *Procedure.*—Thoroughly mix or blend the wheat and rye flours. When the blended flour is added to other ingredients in the mixer, avoid overmixing. A rye dough requires only about half as much mixing as a white bread dough. Dough out of mixer at 76° to 78° F.; medium consistency; fermentation, let rise until ready for first punch; punch or turn dough, then give 30 minutes more. Fermenting on the 75/25 basis is about right. Intermediate proof 10 minutes. Give bread a full proofing in the proof box. Care must be taken to see that the dough is taken on the young side. For pan type, rye bread dough is molded the same as garrison bread. Place the molded loaves in lightly greased pans and allow to proof. When the dough

has doubled in volume or the top is even with or slightly under the top level of the pan, it is ready for the oven. Brush the top of loaves with rye wash (if steam for the oven is not available) and bake at 400° to 450° F. from 30 to 45 minutes, depending on temperature of the oven and weight of the loaf. As temperature of the oven decreases or weight of the loaf increases, the baking time increases.

f. Hearth type (straight dough method).—(1) *Formula.*—Same as for pan type.

(2) *Procedure.*—Same as for pan type up to and including intermediate proof. Instead of molding dough to the size of the pan, it should be molded to characteristic rye shape (about 10 to 11 inches long for 1-pound loaf, slightly thicker in the center and tapering toward each end; ends slightly rounded). The molded loaves are placed on peels which have been sprinkled with corn meal. Allow sufficient clearance on all sides so that loaves will not touch each other as a result of expansion during proofing. When sufficiently proofed, wash with rye wash and cut or dock as described in *c* above. Adjust the loaves on the peel so that when they are slid off onto the hearth of the oven, sufficient space will exist to permit expansion of loaves in the oven without their coming in contact with each other. Bake in 400° to 450° F. oven for from 25 to 35 minutes.

49. Raisin bread.—*a. General.*—The addition of raisins to the ingredients of bread lends attractive variety, adds nutritive value to the loaf, and is an excellent way of providing a fruit component in the diet. Federal standards require that, to be labeled and sold as "raisin bread," each pound of bread must contain not less than 3 ounces of raisins. Stated in percentage based on weight of flour, this means that the formula for raisin bread should show the incorporation of at least 35 percent raisins; that is, for every 100 pounds of flour used in the dough, not less than 35 pounds of raisins should be used. The same proportion should be used for greater or lesser amounts. As much as 65 percent of raisins may be incorporated in a dough without lessening the quality of the bread. When more than 65 percent is used, the tendency is to produce a loaf of small, compact volume, rather heavy to the feel, and unattractive to the average person. Raisins used in bread should be of the seedless variety.

b. Incorporation of raisins in dough.—Raisins to be used in a dough should be soaked in water from 1 to 2 hours prior to the time they are added to the dough. Drain off all excess water before incorporating into the dough and do not add until the last 2 minutes of mixing, especially if a high-speed mixer is used. Too long or too

rapid mixing of raisins in a dough tends to tear the raisins apart, causing the finished product to be blotchy or discolored in places.

(1) *Formula* (straight dough method).

	Percent	*Pounds*
Flour (patent)	100.00	100
Water	63.00	63
Sugar	6.00	6
Salt	2.00	2
Malt	1.00	1
Yeast	5.00	5
Shortening	7.00	7
Milk, dry skim, powdered	3.00	3
Eggs	10.00	10
Raisins	65.00	65
Vanilla	.50	½

(2) *Procedure.*—One hour and 50 minutes first punch; take to bench in 30 minutes; scale at 18 ounces; proof on bench 10 minutes; pan and proof in proof box about 50 minutes; bake at 425° with no steam for 30 minutes. Ice with vanilla icing when cool.

NOTE.—This formula is considered maximum requirements for the production of satisfactory bread. When necessary, it may be modified to meet local conditions.

50. Hard and soft rolls.—As will be noted from the formulas given below, a hard roll dough differs from the garrison bread dough in that the quantities of sugar and shortening used in the hard roll dough are decreased and, conversely, in a soft roll dough the quantities of sugar and shortening are considerably increased. It will be readily seen, therefore, that the hardness or softness of the finished product, especially the crust, depends to a large extent upon the quantity or percentage of sugar and shortening used in the dough. Under the same fermentation and mixed-dough temperatures, hard roll dough should be given a longer fermentation than soft roll dough.

a. Hard rolls.—(1) *Formula.*

	Percent	*Pounds*
Flour	100	100
Water	58	58
Yeast	2	2
Salt	2	2
Sugar	1	1
Shortening	1	1
Milk, dry skim	3	3

(2) *Procedure.*—Same as for garrison bread (par. 46) up to and including completion of fermentation period, except that the dough should be taken on the old side (slightly overfermented). Scale into 1½- or 2-ounce pieces, round, give 15 to 20 minutes intermediate proof. Proof on patent peels for hearth product or in cake pans (18″ by 25″) if for other than hearth product. Just before placing in the oven give one diagonal slash across the top of each piece, and if the oven is not equipped for steam, wash with cornstarch solution (par. 48*b*). If steam is available, it should be turned into the oven until the crust of the dough becomes set and has a glossy appearance.

(3) *Variations.*—Hard rolls may be made into various shapes: two of the more commonly used shapes being round, with a diagonal slash across the top crust; and rectangular, made by cutting a long molded piece of dough into pieces about 2 inches in diameter and 3 inches long.

b. Soft rolls.—(1) *Formula.*

	Percent	*Pounds*
Flour	100	100
Water	62	62
Yeast	2	2
Salt	2	2
Sugar	8	8
Shortening	8	8
Milk, dry skim	5	5

(2) *Procedure.*—Endeavor to obtain mixed dough temperature of 78° to 80°. Ferment as for garrison bread but take slightly on the young side. Scale the dough into 1½- to 2-ounce pieces, round up each piece and allow to intermediate proof for from 15 to 20 minutes. Mold into shape desired, place on peels for hearth product, or cake-pan if hearth product is not desired, and proof until individual molds are about double in size. If steam is available for oven, it should be left on about 2 minutes after loading the oven. If steam is not available, brush the surface of each molded piece lightly with cornstarch wash. Bake in a 375° to 425° oven for from 20 to 25 minutes.

(3) *Variations.*—Soft rolls may be made into various shapes, those more commonly used being described below.

(*a*) *Parker House rolls.*—Scale dough into 1½-ounce pieces, Round into neat balls and allow to rest on the table, first sprinkling some dusting flour to prevent sticking to the table; by the time the last of the dough has been rounded, the first pieces will be ready for working into rolls. Place four of these pieces in a row. Use a small rolling-pin (a piece cut from a household size broomstick is the

proper size) and put a crease or dent in the middle of each piece. Then brush across the creases with melted butter or a mixture of melted butter and lard; then fold over, so that the top fold is one-third shorter than bottom fold. Seal the two folds together by pressing the top lip but do not apply enough pressure to knock down. Place in well-greased bakepans about 2 inches apart. Proof for about 40 to 50 minutes at 90° F. Bake from 15 to 20 minutes in 375° to 425° oven. If the bottom surface tends to burn before the top surface is properly baked, insert an empty cakepan under the one containing the proof rolls before placing it in the oven. This is called "double panning" for baking. Brush the baked product with melted butter or shortening while still hot.

(*b*) *Frankfurter rolls.*—Roll out rounded dough pieces with the fingers and palm of hand until they have assumed a "finger" shape. Place molded pieces in a cakepan, allowing sufficient room for the rolls to bake individually.

(*c*) *Hamburger rolls.*—Place twenty-four 2-ounce pieces of rounded dough, evenly spaced, in a cakepan to proof. When fully proofed, press down with tray or similar object with flat bottom surface until each piece is only about ½-inch thick. Bake in a 375° to 425° oven from 15 to 20 minutes.

(*d*) *Crescent rolls.*—Roll out fermented dough with rolling-pin until it is about ⅛- to ¼-inch thick. Cut rolled dough with a dough cutter into triangular pieces having 5- to 6-inch sides. With fingers and palm of one hand, roll toward the point of the triangle. While this is being done, pull or stretch the point of the triangle with fingers of the other hand. This method insures a tight roll. Turn ends of the rolled piece inward to form a crescent shape and place in bakepan. If desired, molded pieces may be lightly sprinkled with poppy seed. Give full proof and bake in 375° to 425° oven for from 15 to 20 minutes.

51. French and Vienna bread.—French and Vienna loaves of bread may be made by using the same formula and fermentation procedure as for hard rolls (par. 50*a*) except that the dough for French bread should be a little softer (slightly more water incorporated into the dough). A good supply of low-pressure steam should be provided in the oven during the first 5 minutes of baking. If no steam is available, the proofed loaves should be washed with a dilute cornstarch and water solution just prior to being placed

in the oven. Both French and Vienna bread are hearth products (baked on the surface of the oven and not in pans).

a. Molding Vienna style bread.—Vienna bread is generally molded in one of two ways as follows:

(1) *Braided loaf.*—When making a braided loaf, the dough to be used for one loaf is divided into three equal parts and each part molded to the length desired for the loaf. The three molded pieces are set side by side on the molding bench. Starting at center of length, cross one outside piece over the center piece and then the other outside piece over that. Continue this operation until one-half the length of the loaf has been braided. Pinch the braided ends together. Turn the half-braided loaf around and braid the unbraided half, following the same procedure as in braiding the first half. Care should be taken to secure a tight braid. A loose braid will result in a misshapen, unattractive finished product.

(2) *Cigar-shaped loaf.*—As its name implies, the dough for a loaf of this shape is molded in one piece so that its greatest diameter is in the center, with a gradual reduction in diameter toward each end of the loaf. Just before being placed in the oven, the loaf is cut by giving one slash with a knife part of the way along the center of the top length, or two or three equidistant diagonal slashes across the width of the loaf.

b. Molding French bread.—Dough for French bread should be divided or scaled into 20-ounce pieces and molded so that the length of the molded piece is approximately 18 inches. Care must be taken to insure that there are no open seams in the molded loaf and that the closed seam is along the bottom. Proof molded loaves on peels. Just before entering the oven, each molded piece should be given four or five equidistant diagonal slashes across the top width of the loaf.

52. Short- and long-time doughs.—Occasionally, due to unforeseen emergencies, it becomes necessary either to shorten or lengthen the average time required to complete bakery operations. In other words it may become necessary, due to arrival of unexpected troops, to produce in 4 hours bread of the same quality and quantity as is ordinarily produced in 7 hours. Conversely, due to a break-down in machinery or necessity for conservation of yeast supply, it may be necessary to lengthen the time required to complete a particular batch of bread from 7 hours to 10 or even 12 hours. Under such conditions, and under such conditions only, should the expedients listed below be used. Ordinarily, the kind and percentage of ingredients, tempera-

ture of dough and fermentation and proof cabinets, etc., as heretofore given for respective kinds of bread should be used. The use of expedients to shorten or lengthen the time required to produce bakery products usually adds materially to the cost; and, unless expertly handled throughout, operations will result in products of inferior quality.

a. Expedients to shorten time required to complete a batch of bread.—The use of any one of the expedients given below, other than an increase in yeast, will decrease the length of time required in fermentation and proof by from ½ to 1 hour. Using a combination of two or more of these expedients, or merely doubling the percentage of yeast used, will considerably decrease fermentation and proof periods.

(1) Increase temperature of the mixed dough to not in excess of 90° F.

(2) Increase temperature of the fermentation room or cabinet to not in excess of 90° F.

(3) Increase temperature of the proofroom or cabinet to not in excess of 100° F.

(4) Increase percentage of yeast used to not in excess of 5 percent.

(5) Increase percentage of sugar used to not in excess of 6 percent.

(6) Use slacker dough (increase percent of water used by 2 to 4 percent).

(7) Incorporate into dough not to exceed ½ of 1 percent mineral yeast food.

b. Expedients to lengthen time required to complete a batch of bread.—(1) Decrease temperature of the mixed dough to not less than 70° F.

(2) Decrease temperature of the fermentation room or cabinet to not less than 70° F.

(3) Decrease temperature of the proofroom or cabinet to not less than 70° F.

(4) Place fermented dough in the refrigerator until time to complete baking.

(5) Decrease percentage of yeast used to not less than ½ of 1 percent.

(6) Decrease percentage of sugar used to not less than 1 percent.

(7) Increase percentage of salt used to not in excess of 5 percent.

(8) Use a stiffer dough (decrease percentage of water used by 2 to 4 percent).

c. Short-time garrison bread (straight dough method).—(1) *Formula.*

	Percent	Pounds
Flour	100. 00	100
Water	62–64. 00	62–64
Salt	2. 00	2
Sugar	4. 00	4
Yeast	4. 00	4
Milk, dry, skim	3. 00	3
Shortening	2. 00	2

(2) *Procedure.*—Endeavor to secure mixed dough temperature of 83° to 85° F. Allow to ferment for from 20 to 30 minutes with fermentation room or cabinet temperature of 90°. Scale, round, and give intermediate proof for 15 minutes. Proof at 95° F. Bake in a 450° oven.

d. Overnight garrison bread (sponge and dough method).—(1) *Formula* (100-pound flour basis).

(*a*) *Sponge.*	Percent	Pounds
Flour	50	50
Water	26	26
Salt	1	1
Sugar	1	1
Yeast	½ of 1	½
(*b*) *Dough.*	Percent	Pounds
Flour	50	50
Water	30–32	30–32
Salt	1	1
Sugar	1	1
Yeast	1	1
Milk, skim, dry	3	3
Shortening	2	2

(2) *Procedure.*—Mix sponge ingredients so as to obtain mixed dough of approximately 70° F. Ferment for a period of from 7 to 9 hours during night at from 55° to 70° F. At the end of sponge fermentation period, mix sponge with dough ingredients and give additional 45-minute to 1-hour fermentation time. Subsequent procedure the same as for normal time garrison bread.

53. Field bread (straight dough method).—The formula and procedure for field bread are placed in this section for the reason that all Army bakers should be required to familiarize themselves with them. Army bakers should also be required to make a small batch of field bread occasionally, even when serving in garrison, so as to gain the

experience necessary to avoid confusion and delay when it becomes necessary to bake field bread on a large-scale production basis. For details of field bakery operations see section XI.

a. Formula (100-pound flour basis).	*Percent*	*Pounds*
Flour	100	100
Water	53–55	53–55
Yeast	¾ of 1	¾
Salt	2	2
Sugar	3	3
Shortening	½ of 1	½

b. Procedure.—Mix ingredients thoroughly and endeavor to secure a mixed dough temperature of 78° to 80° F. Dough should be ready for first punch in from 4 to 4½ hours, and fermentation completed 1 to 1½ hours later. Scale dough into 4½-pound pieces. Round the dough and then flatten out into circular loaves about 10 inches in diameter and 1½ inches thick. Allow only approximately 15 minutes proof. Just before baking, dock the top surface of the dough in three places by inserting the thumb or stick into the dough for a depth of about 1 inch. Bake either in regulation bakepan (two loaves to pan) or in commercial cakepan (18″ by 25″) (three to pan). Give long, slow bake for from 1½ to 1¾ hours with oven at temperature of 450° F. The result is a circular loaf about 11 inches in diameter and 4 to 5 inches thick, with a thick, hard crust. This hard crust, if unbroken, minimizes the probability of mold development, permits rough handling and stacking in transportation without injury, and will keep the bread fresh and palatable for a period of from 2 to 4 weeks.

Section VIII

BREAD FAULTS; THEIR CAUSES AND CORRECTIONS

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Faults in aroma and taste	58

54. Scoring factors.—*a.* Factors to be considered in scoring or judging bread together with their relative weights, are as follows:

External appearance		*Internal appearance*	
Volume	10	Grain	10
Color of crust	8	Color of crumb	10
Symmetry of form	3	Aroma	15
Evenness of bake	3	Taste	20
Character of crust	3	Texture	15
Break and shred	3		
Subtotal	30	Subtotal	70
		Grand total	100

b. A loaf of bread perfect in every particular would score 100. However, it is practically impossible to produce a loaf of bread that is absolutely perfect; relative values are therefore assigned to each factor and the loaf graded down from one to a number of points on each factor, depending upon how far the loaf deviates from perfection. In awarding points under each factor, the following characteristics should be considered:

(1) *Volume.*—The volume of a loaf is its length, breadth, and depth considered from the standpoint of the weight of dough used to make the loaf. Volume may be described as excellent, good, satisfactory, too large, or too small. A loaf of excessive volume will generally be found to possess open grain and weak texture. A loaf of too little volume generally will be found to possess inferior grain and texture.

(2) *Color of crust.*—Color of crust, sometimes called "bloom," refers to the top crust of a loaf of bread. The most desirable color is described as golden brown. The obtaining of a satisfactory shade is dependent mainly upon the amount of sugar and milk present in the dough when baked and temperature at which baking takes place. Colors inferior to and other than golden brown may be described as too dark, foxy, reddish brown, grayish, pale, or straw.

(3) *Symmetry of form.*—By symmetry of form is meant the extent to which the various exterior conditions of the loaf blend to make an attractive product. Some factors which detract from symmetry are too sharp or excessively rounded corners, protruding sides, sunken sides, flat top, excess or lack of width in comparison with length, low ends, and humpbacked top. The chief factors affecting symmetry of form are shape and size of the pan used for baking and the care exercised in molding the dough.

(4) *Evenness of bake.*—This means the extent to which the same color or shade is obtained on all sides of the loaf. Excessive top heat in the oven or very young dough will result in dark top and pale sides and bottom. Insufficient or excessive use of grease in pans

will be reflected in the color of sides and bottom of loaf. Excessive bottom heat will cause the bottom of the loaf to burn before the top crust has attained the desired color.

(5) *Character of crust.*—This may be described as the physical condition of the crust, such as tender, tough, thick, thin, smooth-surfaced, rough-surfaced, brittle, rubbery. Except in field bread, it is usually desired to obtain a tender, thin, smooth-surfaced crust. Character of crust is usually determined by pressing it with the thumb to determine thickness and rubbery or brittle texture, and tasting to determine tenderness or toughness.

(6) *Break and shred.*—By break and shred is meant the extent to which the sides and ends are separated from the top crust and the presence or absence of shred in the break. The ideal condition is an even, well-shredded break on the sides and ends of the loaf. Conditions detracting from the ideal are uneven break, wild break, break on one side only, shell crust, break without shred.

(7) *Grain.*—The terms "grain" and "texture" are often confused. Grain is the condition of the crumb or interior of the loaf and defines the character of the cell structure and the size of the cell. The ideal grain is moderately close and firm with small, elongated, thin-walled cells. The cells should be uniform in size, evenly distributed throughout the loaf, and not larger than small bird shot. Their greatest diameter is vertical rather than horizontal. Conditions detracting from the ideal are open and loose grain; large, thick-walled cells; large holes in loaf; and nonuniformity in size of cells.

(8) *Color of crumb.*—While whiteness is desirable and denotes the use of high-grade flours, the color of the ideal loaf is described as creamy white. Color is determined by examining the interior surface of a slice of bread. Colors inferior to the ideal creamy white may be described as chalky white, yellow, gray, dark, streaked, or spotted.

(9) *Aroma.*—Aroma is often confused with flavor. Aroma may be described as the reaction obtained by the organ of smell, while flavor is the reaction obtained by the organs of taste. Desirable aromas obtained from bread may be described as sweet, nutty, rich, and fresh. Undesirable aromas may be described as musty, ropy, yeasty, cheesy, metallic, or sour.

(10) *Taste.*—The most important attribute of good bread is a pleasing and satisfying taste. If the taste pleases, other deficiencies are minimized. If the taste is unpleasant, other desirable qualities are nullified. Taste may be best described as the reaction obtained by the taste organs of the tongue and palate. Ordinarily, desirable tastes

are nutty, sweet, pleasing, and fresh. Unless specifically characteristic of the particular type of bread, tastes which detract from desirability are sour, yeasty, doughy, moldy, and ropy.

(11) *Texture.*—Texture is determined by the sense of touch. It depends upon the physical condition of the crumb and, to a minor degree, is influenced by the grain. It comprises the elasticity, softness or pliability, and smoothness or silkiness of the crumb. The texture of bread may be determined by running lightly over the surface of a slice with the tips of the fingers or by rubbing the cut surface gently along the cheek. The ideal texture is soft and velvety without weakness or doughiness. Conditions detracting from the ideal are crumbliness, roughness, lack of elasticity, and inability to resume original shape when sides or top are pressed.

55. Common faults and causes.—Below are listed the more common faults in bread and their probable causes. In striving to eliminate faults, the baker should not attempt to change formula, temperature, time, and other conditions simultaneously, as the fault may be due to one condition only, and the change of more than one condition may nullify the improvement. By changing one condition at a time, keeping all other conditions the same, comparative results of one change are readily determined.

a. Lack of volume.—(1) Bread pans too large for size or weight of dough.

(2) Insufficient yeast.

(3) Unbalanced formula.

(4) Insufficient or excessive mixing of ingredients.

(5) Too much salt.

(6) Underfermented or underproofed dough.

(7) Extremely overfermented or overproofed dough.

(8) Oven temperature too high to permit normal oven spring.

b. Too much volume.—(1) Bread pans too small for size or weight of dough.

(2) Insufficient salt.

(3) Excessive proofing.

(4) Oven temperature too low to stop "oven spring" at desired volume.

(5) Slightly overfermented dough.

c. Crust color too pale.—(1) Insufficient sugar or milk.

(2) Dough too old.

(3) Crusting of dough in proof box.

(4) Lack of steam in oven.

(5) Oven temperature, especially top heat, too low.

d. Crust color too dark.—(1) Excessive quantities of sugar and/or milk.

(2) Oven temperature too high, especially top heat.

(3) Underfermented dough.

e. Crust blisters.—(1) Careless molding.

(2) Condensation of steam in proof box or oven.

(3) Underfermented dough overproofed.

f. Crust too thick.—(1) Baking period too long.

(2) Oven temperature too low.

(3) Deficiency of sugar.

(4) Overfermentation or overproofing.

g. Shelling of top crust.—(1) Use of new or green flour.

(2) Dough too stiff.

(3) Dough underfermented.

(4) Lack of binder, such as malt, honey, etc.

(5) Crusting of dough in proofing.

(6) Underproofing.

h. Grey color crumb.—(1) Inferior grade of flour.

(2) Fermentation and proof temperatures too high.

(3) Overfermentation or overproofing.

i. Streaky crumb.—(1) Poor blending of flour.

(2) Improper or insufficient mixing of ingredients.

(3) Too much dusting flour in machine or molding bench.

(4) Poor molding.

(5) Excessive quantity or improper incorporation of shortening.

(6) Inclusion of small pieces of scrap dough.

j. Coarse grain.—(1) Overfermentation.

(2) Dough too slack.

(3) Overproofing.

(4) Too low oven temperature.

(5) Excessive mixing.

(6) Pans too large for dough.

k. Crumbly bread.—(1) Overfermentation.

(2) Mixed dough, fermentation, or proof temperature too high.

(3) Overproofing.

(4) Oven temperature too low.

(5) Insufficient shortening.

(6) Dough too stiff.

l. Poor aroma and taste.—(1) Inferior ingredients.

(2) Improperly balanced formula.

(3) Insufficient salt.

(4) Sour dough; overfermentation, overproofing, or excessive temperatures.

(5) Unsanitary conditions in bakery.

(6) Pans not properly cleaned.

(7) Use of rancid shortening.

(8) Improper storage of ingredients.

(9) Under or over baking.

m. Poor keeping qualities.—(1) Insufficient shortening.

(2) Improper cooling of bread.

(3) Too stiff or too slack a dough.

(4) Oven temperatures too low.

(5) Poor molding.

(6) Overproofing.

(7) Unsanitary storage conditions.

(8) Excessive temperature and humidity in storage.

(9) Breaks or cracks in crust.

(10) Exposure to air of the uncrusted sides of garrison bread.

56. Faults in grain.—Opinions differ as to the proper grain for bread. Some prefer a very close grain while others prefer an open, fluffy grain. For Army baking, especially for garrison bread, a grain midway between the very close and the open grain is desired. Too open a grain is generally due to incorrect fermentation. In the case of too short a fermentation period, the open grain is due to the presence of rather thick cell walls caused by the dough not being sufficiently matured to form thin cell walls. In the case of a dough that is given too long a fermentation, the open grain is due to ruptured cell walls causing two or more cells to combine and form a large cell. The way to correct a too open grain, therefore, is to correct the fermentation period. Too close a grain is generally due to underproofing or using too much dough for the size of the bakepan. The obvious correction is to give the dough a longer proofing or to cut down the weight to accord with the size of the pans in use.

57. Faults in color of crumb.—The desirable crumb color of a loaf of bread is creamy white. A chalky or dead white crumb is generally the result of using either a soft flour or a flour that has been too heavily bleached. A streaked crumb results from faulty mixing, especially when incorporating the shortening content, the use of too much dusting flour, or crusting of the dough during fermentation. By carefully watching the dough throughout the various stages of the baking operations, the exact cause of "off" color in crumb may be detected and proper corrective measures taken.

58. Faults in aroma and taste.—*a.* These two qualities are closely related and together make up what is commonly called the flavor of the bread. There are only four qualities that can be detected by taste alone: sweetness, sourness, saltiness, and bitterness. All others are combinations of these and are influenced by the aroma or sense of smell. The desirable flavor of a loaf of bread may be described as a wheaty taste, slightly sweet and pleasant. An acetic or sour flavor is the result of too long fermentation or fermenting at too high a temperature. When there is no longer active fermentation in a dough, or the temperature is high enough to nullify yeast activity and encourage bacteria activity, the bacteria become more active and convert part of the alcohol formed by the yeast into acetic acid which imparts the sour flavor to bread.

b. A "cheesy" flavor is due to either the use of inferior milk or too slow fermentation of a dough that contains milk. A musty, moldy, or ropy aroma is a condition due principally to unsanitary conditions which are discussed at length in section XII.

c. A rancid flavor can be caused only by the use of a fatty ingredient that was rancid at the time of incorporation in a dough. The use of only a slight quantity of rancid shortening will cause the rancid flavor to permeate the entire dough and the finished bread. The utmost care should be taken, therefore, to prevent the incorporation of rancid ingredients in bread dough.

d. Too salty or too flat a taste is obviously due to the use of incorrect quantities of salt in the dough. Doughiness in the crumb may result from underbaking, baking in too hot an oven, or using an improperly proportioned formula. By correcting one of these conditions at a time, the exact cause for doughiness may be determined and corrective measures applied.

SECTION IX

SWEET DOUGH AND PASTRY PRODUCTS

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59. General.—A sweet dough is, as the name implies, an ordinary flour dough made rich and sweet by using larger quantities of sugar and shortening, and by the addition of milk, eggs, spices, and occasionally fruits. The use of sweet dough provides the mess officer with a means of serving a large variety of rolls, buns, form cakes, etc., not only as a substitute for bread but also as a dessert, at a moderate cost. It is possible, by judicious use of sweet dough products, to substitute them for the more expensive foods, such as meats and expensive desserts, without sacrificing variety or necessary nutrients in the diet, and at considerably less cost.

60. Basic sweet dough.—*a. Formula.*—The formula given below is based on using 1 gallon of liquid (water, milk, or a combination of water and milk). This formula will produce approximately 33 pounds of dough which may be made up in any desired form and produce sufficient baked product to provide 4 to 5 ounces for each of approximately 100 men. The formula may be decreased to one-half, one-third, one-fourth etc., or increased by one-half, doubled, trebled, etc., without affecting the quality of the finished product. It is called a basic sweet dough for the reason that a great variety of products may be made either from the dough itself or by using a piece of this dough as the basis for the formula of the desired product.

Ingredients	*Weight*
Sugar	2 lb. 4 oz.
Salt	3 oz.
Malt	8 oz.
Shortening	2 lb. 8 oz.
Mace	½ oz.
Eggs	2 lb.
Lemon extract	½ teaspoonful.
Water or milk (1 gallon)	8 lb. 5 oz.
Flour (bread)	13 lb.
Yeast	1 lb.
Flour (pastry)	4 lb.

(1) Ingredients must be added in the order shown in *b* below to secure satisfactory results.

(2) When the weather is extremely warm or bench work takes more than 1 hour, the salt content should be slightly increased.

(3) If malt is not available, substitute equal quantities of sirup or molasses.

(4) It is advisable to use half butter and half lard or lard substitute as the shortening ingredient. However, all lard or lard substitute may be used.

(5) An egg, minus shell, weighs approximately 2 ounces. This formula, therefore, requires the use of 16 eggs.

(6) If other than whole milk is used, use conversion table (sec. XIII).

(7) Although it is desirable to use both bread and pastry flour in proportions as shown, all bread flour may be used.

b. Procedure.—(1) Cream or mix the sugar, salt, shortening, mace, and malt.

(2) Add the eggs gradually and mix in. Add lemon extract.

(3) Dissolve yeast in one-fourth of the liquid to be used in the dough and set aside temporarily.

(4) Add remainder of liquid and continue mixing until a soft batter is obtained.

(5) Add the 13 pounds of flour (bread) and continue mixing until thoroughly incorporated.

(6) Add the yeast solution ((3) above).

(7) Add the pastry flour and mix only sufficiently to incorporate flour and yeast solution thoroughly.

(8) When accurate temperature control is not available, effort should be made, by tempering the liquid content of the dough, to secure a mixed-dough temperature of about 78° F. in summer and 82° F. in cold weather.

(9) When mixed, this dough will appear to be quite slack. However, due to action of the eggs and malt, it will stiffen during fermentation and will roll out readily.

c. Fermentation.—If the temperature of the mixed dough and fermentation room or cabinet is 80° F. and the dough can be scaled and made up in desired shapes within ½ hour, fermentation time allowed should be between 1½ and 2 hours. By taking the dough on a two-thirds rise, that is, in from ¾ to 1¼ hours, the bench time for dividing and shaping dough may be increased from 1¼ to 1¾ hours.

61. Products from basic sweet dough.—The variety of products that may be made from the basic sweet dough depends primarily upon the ingenuity of the baker in concocting new shapes and his ability to incorporate additional flavors, ingredients, etc., to enhance flavor and attractiveness. Varieties that are easily made and better adapted for use in Army organization messes are described below. Formulas for fillings, toppings, and icings, mentioned in the description of several products, are listed in paragraph 62.

a. Cinnamon buns.—Scale fermented sweet dough into 5½-pound pieces. Mold each piece in the same manner as for pan bread. Let the molded piece rest on the bench for about 10 to 15 minutes. Roll out with rolling-pin so as to obtain a rectangular shape ⅛ to ¼ inch thick and 15 to 18 inches wide. Wash the top surface of the rolled-out dough lightly with melted butter or shortening and then sprinkle liberally with cinnamon sugar. It is desirable, but not essential, to spread a handful of seedless raisins over the cinnamon sugared surface. Starting at the top of the rectangular surface, make a tight roll and keep on rolling toward the bottom, care being taken to insure that the roll is of the same diameter throughout its length. To assist in securing proper seal, the bottom edge of the dough should be washed or dampened with water or melted butter. Seal the dough by use of the knuckles. The dough is now in the form of a snake. Using a sharp knife or dough cutter, cut the snake into 2-ounce pieces. Place the cut pieces in a cakepan which has been lightly greased, so spaced as to distribute evenly 48 of the pieces to a pan (8 along length of the pan by 6 along the width). Place in a proof box, the temperature of which should be about 85° or 90° F. and allow to proof for from 35 to 50 minutes. When about half proofed, wash with egg wash. Bake in a 425° to 450° oven for about 15 minutes. The buns may be finished with a water icing or apricot shine. Icing or shine should be added while the finished product is still hot.

b. Butterfly buns.—Same procedure as for cinnamon buns up to and including cutting of the snake into 2-ounce pieces. Press a circular piece of wood about ¼ to ½ inch in diameter down through the center of the uncut surface of each piece. This action will cause the cut surfaces to curl up and form a characteristic butterfly shape. Proof, bake, and finish the same as for cinnamon buns.

c. Hot cross buns.—To each 5 pounds of fermented sweet dough add 1 pound of seedless raisins or mixed fruit such as raisins, citron, candied orange peel, etc., and mix thoroughly. Scale the dough into 1½-ounce pieces. Round up each piece and allow to intermediate proof on the workbench for from 15 to 20 minutes. With a sharp knife or dough cutter, make a cross on the top surface of each rounded piece. Set in cakepan (48 to 56 to a pan) and proof. When half proofed, wash lightly with egg wash. Bake in a 425° to 450° oven for about 15 minutes. Finish by filling in the cross with vanilla icing.

d. Parker House rolls.—Using sweet dough instead of soft roll dough, follow procedure described for Parker House rolls in paragraph 50*b*(3)(*a*).

e. Coffee cake (butter-topped or streusel-topped).—Roll out a 5-pound piece of fermented basic sweet dough and place in a cakepan (18″ by 25″) or make individual cake in round or square layer cakepans. Roll lightly toward sides of the pan until the whole pan is evenly covered. Dock the dough with a docker or the prongs of a fork, wash lightly with water or melted butter, and spread with butter topping or sprinkle liberally with streusel topping. Proof until doubled in depth. Bake at 350° to 400° F. from 15 to 20 minutes. After baking, cut into pieces of desired size.

f. Doughnuts.—Take 10 pounds of fully fermented basic sweet dough and add the following to make a slack dough:

Flour	2 lb. 8 oz.
Water	1 lb. 4 oz.
Salt	¼ oz.
Yeast	2 oz.
Flavor (optional)	

Resulting dough should be allowed to ferment for about 20 minutes, then rolled out with rolling-pin until the dough is about ¼ inch thick. Cut into doughnut shape by use of doughnut cutter. Allow to proof for about 30 minutes in a cakepan which has been floured but not greased. Fry in hot fat at a temperature of 365° to 370° F. If the dough is of proper consistency and sufficiently proofed, it will sink only about halfway into the hot fat. As soon as the submerged side is fried, it should be turned over and the other side fried to the same extent. Doughnuts may be served plain or they may be dusted with powdered sugar to which a little cinnamon has been added for flavor, or slightly washed with a plain or vanilla icing.

g. German fruit cake.—Scale off 2½ pounds of basic sweet dough and roll out sufficiently to cover the bottom and sides of a cakepan (18″ by 25″). Be sure to bring the edges of the dough up around sides of the pan. Round or square layer cakepans may be used also with good results, using 5, 6, or 7 ounces of dough to the pan, depending upon the diameter. Let proof a short time, sprinkle with cake or bread crumbs or with cornstarch, and cover with any desired fresh or canned fruit. Bake in a 350° to 400° F. oven.

h. French fruit cake.—Made as described for German fruit cake, except the top is covered with either a very thin layer, or narrow strips, of pastry sweet dough.

62. Fillings, toppings, and icings for sweet doughs.

a. Streusel topping.

Butter (soft but not melted)	1 lb.
Sugar, powdered	1 lb.
Flour	2 lb.
Mace or cinnamon to suit taste.	

Rub the mixture with the fingers until crumbly, then dry out; this may be used either as fine particles or in lumpy form.

b. Butter topping for coffee cake.—Cream together—

Sugar, powdered	2 lb.
Butter	1 lb.
Egg yolks	8 oz.

Add—

Flour	1½ lb.
Vanilla to suit taste.	
Water to make a smooth paste.	

c. Fruit filling for German or French fruit cake.—Mix thoroughly—

Sliced apples	5 lb.
Sugar, granulated	1½ lb.
Raisins	1 lb.
Ground nuts	2 to 3 lb.
Sliced or chopped citron	2 to 4 oz.

d. Pastry sweet dough (for strips on top of French fruit cake).—Cream together—

Butter	½ lb.
Sugar, powdered	½ lb.
Whole egg	3 each.
Baking powder	¼ oz.

Mix in—

Pastry flour	1 lb.

Let the dough rest in a cool place for about 1 hour. Roll out into a thin sheet and cut into ⅛ to ¼ inch strips and place in latticework effect across the fruit filling in French fruit cakes.

e. Apricot shine.—Cook to a thick syrup—

Apricot pulp	1 qt.
Sugar	2 lb.

Brush lightly over finished products such as cinnamon buns, butterflies, etc., while both product and sirup are still hot.

f. Soft icing for doughnuts.—Mix—

Sugar, powdered	5 lb.
Warm water (variable)	1½ lb.
Melted butter	1 oz.
Vanilla extract	¼ oz.

Bring the mixture to a boil (mixture should be quite thin). Dip doughnuts in the hot mixture and then place on screens to dry.

g. Cream icing.

Shortening	2½ lb.
Salt	½ oz.
Water	1½ lb.
Powdered skim milk	½ lb.
Vanilla extract	1 oz.
Powdered sugar	10 lb.

Thoroughly mix shortening, water, and salt. Add flavor gradually. Sift sugar and milk together and add to the mixture. Whip all together until light.

h. Cocoa icing.—To 15 pounds of cream icing add 1 pound of cocoa and 1 pounds of water and whip until light.

i. Royal icing.—Sift together 5 pounds of powdered sugar and ½ pound of meringue powder. Add 1 pound of water and beat thoroughly. Add coloring as desired.

j. Glossy icing.

Sugar, granulated	5 lb.
Water	1 qt.
Powdered skim milk	12 oz.
Butter	4 oz.
Shortening	¾ lb.
Sugar, powdered	5 lb.

Boil granulated sugar, shortening, butter, and water to 230° F. Sift together the milk and powdered sugar and add slowly to the boiled mixture, incorporating the entire mass.

k. Cinnamon sugar topping.—Mix together—

Sugar	5 lb.
Cinnamon	1 oz.

This formula may also be used on the inside of cinnamon buns.

63. Cakes.—*a. General.*—(1) By the term "cake" is meant a sweetened mixture of flour, liquid, and other ingredients. To the Army baker, a sound knowledge of bread production is all important. However, in order to broaden his general baking knowledge, he should not fail to study and absorb some facts about the art of cake baking. The Army baker who supplements his bread-making knowledge with that of cake baking is indeed a great asset to the military personnel with whom he is associated.

(2) The question invariably arises as to what constitutes a good cake. Unfortunately, there are no set rules of description or specifications which may be followed; however, there are some factors which may be studied in order to produce a tasty cake.

(3) Much about the success of a cake may be derived from a study of its volume. It is almost an axiom that a good volume means a good cake. The volume should be large in proportion to the amount of batter used. Cake may be considered good when the finished product is three times the volume of the batter originally put into the pan. A good volume usually indicates a good grain and texture. It must be remembered, however, that the volume will vary with the kind of cake being produced. For instance, the volume of a heavy fruit cake cannot be judged by comparison with the volume of a light plain layer cake. In a good cake, volume must be commensurate with the type of cake being made and the type of pan or mold being used.

(4) A good cake should possess a fine grain and a smooth velvety texture. Often a cake, fine in every respect except texture, will be almost inedible because the texture is coarse and gritty. The crust of a cake should be thin, smooth, and tender. In order to insure a good grain, texture, and crust or skin, careful handling of ingredients and batter is imperative.

(5) The final test of a good cake is in the eating. The cake should have a pleasing odor and flavor. The flavor should be the one the kind of cake is supposed to produce. For instance, a spice cake should produce a pleasing, spicy flavor and not a pungent flavor, as produced by overspicing. A lemon cake should produce a pleasing lemon flavor, not a bitter or sour one. Odor and flavor are lost in many fine cakes by carelessness in handling the flavoring agents. A baker must acquire a skill of securing just the right flavor in a cake just as a cook must acquire the art of seasoning food. Overflavoring and underflavoring are evils which a good cake baker must overcome.

(6) The Army baker must always keep in mind when making cakes that a cake is more delicate than a loaf of bread. He must, there-

fore, handle a cake batter more gently than he would a bread dough. A cake batter cannot stand much abuse and still turn out a good baked product.

(7) The following are a few general and simple rules which will help any baker to produce a good cake:

(*a*) Use good ingredients.
(*b*) Use a good, balanced formula.
(*c*) Weigh ingredients carfully.
(*d*) Use a good, standard method of procedure.
(*e*) Use clean equipment.
(*f*) Handle ingredients and batter very gently and carefully.
(*g*) Do not hurry mixing; have patience.
(*h*) Bake at the proper temperature.
(*i*) Finish with toppings or icings that are of pleasing flavor and have eye appeal.

b. Types.—In general, there are two classifications of cakes as to type: cakes containing shortening and cakes without shortening. Among those containing shortening are the white or yellow layer cakes, fudge cakes, and chocolate cakes. These cakes, when finished with the numerous kinds of icing and toppings, are made into the numerous cakes found in recipe books. Cakes without shortening are sponge cake and angel food. Recently many recipes have appeared in print which produce cakes that contain some shortening but are beaten up like a sponge cake.

(1) *Cakes without shortening.*—(*a*) Cakes without shortening, such as angel food and sponge cakes, are produced by beating air into eggs and then mixing in other ingredients without stirring out the air. This type of cake is very difficult to make. From the beginning to end the ingredients, batter, and cake must be handled as gently as possible. The air which is beaten into the eggs must remain, for this air is the sole leavening agent without which the cake will be soggy, tough, and flat.

(*b*) Angel food differs from sponge cake in that only whites of the eggs are used and in the manner of incorporating ingredients. In angel food cake the ingredients (sugar and flour) are folded into the egg whites, while in sponge cake the beaten eggs are folded into the other ingredients. It must be remembered that after the air is beaten in, the ingredients are never mixed with the beaten eggs but are gently folded together.

(2) *Cakes containing shortening.*—The majority of cakes made contain shortening. Cakes of this type are distinctive in that they have a very fine grain and a velvety texture. Success with this type of cake

depends mainly upon uniform procedure in incorporating the ingredients and thoroughness of mixing.

c. Ingredients.—(1) *Flour.*—(*a*) Cakes require a flour somewhat different from that generally used by the Army baker. He is more accustoned to bread flour which has gluten of good quality and quantity. In cakes, however, a soft flour (that is, a flour from soft wheat) must be used. A soft flour has excellent but a rather low quantity of gluten. This type of flour is commonly known as cake or pastry flour.

(*b*) There are several kinds of cake flour, each having a little different gluten content. The reason for this is that different kinds of cake require flour of different gluten content. Fruit cakes and heavier cakes can take a cake flour of higher gluten content than a sponge cake or layer cake. It is well to remember that the more eggs a cake contains, the lower gluten content the flour should have. Generally, a cake flour containing a gluten content of approximately 8 percent is very satisfactory.

(*c*) If it becomes necessary at any time to make a cake from issue flour (straight flour), the flour may be softened by the addition of cornstarch. The addition of about 25 to 30 percent of cornstarch will produce from the bread flour a soft flour having approximately 8 percent gluten content.

(2) *Shortening.*—(*a*) The fat content of most cakes is butter or a mixture of butter and some other shortening. Butter is no better as a shortening than lard or any hydrogenated vegetable oil, but it is used generally because of its added flavor. Any hydrogenated product will be satisfactory in a cake.

(*b*) Recently there has come into commercial use a shortening called "high ratio shortening." It is especially prepared for cake use. The use of this shortening permits the use of more sugar in the formula, thereby giving a sweeter product. The Army baker will not come into contact with this product very often, but he should remember that if it is used, the formula must be adjusted.

(3) *Eggs.*—There is a great deal of difference in the size of eggs, so care must be exercised in the number or quantity of eggs used. A formula may call for 10 eggs of medium size which will weigh approximately 50 grams shelled. If 10 eggs of 65 grams weight are used, then the formula becomes unbalanced. It is well to weigh the eggs which are on hand and make adjustments accordingly in the formula being used. Most recipes call for medium-sized eggs which, as a standard weight and for computation purposes, may be taken to weigh 48 to 50 grams each, shelled, or 56 grams with the shell. Frozen and dried eggs may be used in lieu of fresh eggs.

(4) *Sugar.*—Best results will be obtained in baking a cake if finely granulated sugar is used. Coarsely granulated sugar or powdered sugar does not cream satisfactorily with the shortening. If only coarse granulated sugar is on hand, it should be rolled or pounded to break it down somewhat before using.

(5) *Milk.*—Whenever milk is used in a cake, it should be clean and sweet. A very slight off-flavor or odor in the milk will be detected in the finished cake. Milk of any variety may be used, that is, evaporated, dried, or liquid. It must be remembered, however, that adjustment must be made when using evaporated or dried milk, because most recipes base the quantity of milk to be used on liquid whole milk. When using dried milk, it should be reconstituted (mixed with water) before its incorporation in the mix in order to insure better distribution throughout the batter mass.

(6) *Leavening agents.*—(*a*) Cakes are generally leavened by use of baking powder (par. 21), by whipping air into the batter, or by a combination of the two. Most cakes are made by the use of a combination of the two methods.

(*b*) Baking powder, when used in a cake, must be handled carefully. It should be weighed exactly and the baker must know how the baking powder he is using acts; that is, whether it is quick acting, slow acting, or double acting.

(*c*) In cakes such as angel food and some types of sponge cakes, no baking powder need be used. Here the leavening agent is air. Air is beaten into the eggs which act as a seal for holding it in. After the air is sealed into the batter, it must be carefully and gently handled. When heat is applied to the batter, the air cells expand, thus exerting a leavening agent.

(*d*) The creaming method of mixing a cake batter, that is, when the shortening and sugar are whipped up, brings out the use of a combination of baking powder and air. The air is beaten into the creamed portion of the mix and is then retained when eggs are added. During the baking of a batter made in this manner, the air and carbon dioxide gas expand, giving the leavening effect.

d. Formulas and procedure.—(1) *Cakes containing shortening.*—There are many and varied cake formulas in use. However, if one would study them when they are set down in percentage form, little difference would be noted. Rather than be lost in a maze of formulas, the Army baker should select a standard basic cake mix, much the same as the basic sweet dough mix. From this base, by means of additions to the basic formula, a variety of cakes may be made. Additions of fruit, changes in flavoring, and variety of finishings

all make for variety of cake productions, even though the same basic mix is used.

It must be borne in mind that no matter how excellent the formula, correct procedure and method must be used. The most universally used and most workable method of procedure in making a cake batter is the creaming process. In this process the shortening, sugar, salt, flavor, and a fraction of the flour are creamed together until a light, fluffy mass, greatly increased in volume, is obtained. The eggs and milk are next creamed in, followed by the mixing in of the remainder of the flour. The last stage of mixing should be long enough only to get the flour in the batter and the batter smooth. It must be remembered that cake formulas may be put into percentage form similar to bread formulas as shown in the percentage formula system.

(*a*) *Formula for basic yellow cake.*—This type of cake is excellent for Army use because the whole egg is used, thereby avoiding loss of egg yolks, as is often the case when only the whites are used.

	Weight		*Percentage based on flour as 100*
Cream together—			
Granulated sugar	5 lb.		100
Salt		1¼ oz.	1. 5
Shortening	1 lb.	4 oz.	25
Butter		12 oz.	15
Flour	1 lb.		20
Vanilla (may be variable)		1 oz.	1. 25
Add and cream slowly—			
Whole eggs	3		60
Add—			
Milk	3 lb.	8 oz.	70
Add and mix in—			
Flour	4 lb.		80
Baking powder		2½ oz.	3. 12
Total	18 lb.	12¾ oz.	375. 87

NOTE.—Any form of milk may be used, converting it into liquid whole milk equivalent. Variation may be made in the quantities of sugar and milk used. Both may be slightly increased to obtain a different characteristic in the cake.

(*b*) *Variations.*—Using this yellow cake mix as a base, many cakes may be produced. This is accomplished by adding a special mixture to a certain amount of yellow batter. Following are several cakes easy to make and very adaptable to Army use. These cake remixes may be used for layers, sheets, or cups.

1. Fudge cake.—Sift together—

Sugar	4 oz.
Cocoa	6 oz.
Soda	½ oz.

Add—

Cold water	12 oz.

Form a paste of the above ingredients. Add 1 pound 6 ounces of paste to 8 pounds of yellow batter and mix thoroughly.

2. Spice cake.

Ground raisins	1½ lbs.
Soda	¼ oz.
Sugar	4 oz.
Spice blend	2 oz.
Water	8 oz.

Add 2 pounds 6 ounces of paste to 8 pounds of yellow batter and mix thoroughly.

For *spice blend* mix thoroughly—

Cinnamon	7 oz.
Nutmeg	2 oz.
Cloves	½ oz.
Ginger	1 oz.
Allspice	½ oz.
Mace	1 oz.

3. Apple sauce cake.—Make a paste of the following:

Chopped apples	1 lb. 4 oz.
Chopped raisins	4 oz.
Cinnamon	½ oz.
Nutmeg	¼ oz.
Soda	pinch.

Add the paste to 8 pounds of yellow batter and mix together.

(*c*) *Panning.*—When panning cake batter, great care should be used. Air bubbles or air spaces must be guarded against; however, do not eliminate these by banging the pans on a table or the floor as is often done. They may be removed easily by smoothing out the batter with a spatula. Pans should be thoroughly clean before putting in the batter. They should be wiped with a clean cloth immediately after use and should be washed with soap and water quite frequently. Before panning, the pans should be thoroughly greased and dusted with flour; a mixture of shortening and flour in the ratio of 2 to 1 may be used for greasing. In many cases, espe-

cially for cakes requiring a long bake, the pans should be paper-lined. This is especially true of sheet cake. By means of using a paper liner the bottom crust may be almost entirely eliminated. The paper acts as an insulation. In order to prevent the usual thick, hard crust found on the edges of sheet cakes and thereby eliminate much waste, a wooden frame may be used. This frame should be made of hardwood and of such size and height that it will fit closely inside the particular sheet pan in use and will allow the cake thickness usually obtained. Wood ¼-inch thick will furnish proper insulation. The ends of corners should be mortised. The size necessary for the common sheet pan is 24½ by 16 by 1¾ inches, outside dimensions.

(*d*) *Scaling.*—In order to obtain a good cake, the amount of batter used must be adapted to the type and size of pan employed. Not enough attention is paid to scaling weight. There are scaling weight guides, but it is really up to the individual to determine by experience the proper scaling weight for the pans he is using. Moreover the weight of the batter for a certain pan will depend on the type of cake being made. A layer cakepan which will take 12 ounces of basic batter will take perhaps 13 or 14 ounces of apple sauce cake batter. The table below gives scaling weight that may be used as a guide.

1. *Layer cakes* (deep pans 1½ to 2 inches in depth):

8-inch layers	13 to 14 oz.
7-inch layers	9 to 11 oz.
6-inch layers	7 to 8 oz.

2. *Layer cakes* (shallow pans ¾ to 1 inch in depth):

8-inch layers	9 to 11 oz.
7-inch layers	8 to 9 oz.
6-inch layers	6 to 7 oz.
Sheet pan (24½ by 16 by 1¼ inches)	6¼ to 6¾ lb.

(*e*) *Baking.*—It is quite difficult to set a temperature at which, or a length of time for which, cakes are to be baked. Again the individual who is familiar with the oven he is using must determine the proper baking temperature and length of time. As a guide, layer cakes bake best at about 375° F. Temperature for a sheet cake should conform closely to that for the layer cake. Baking time ranges from 12 to 20 minutes. A cake is baked done when an indentation, made on the surface by a slight pressure of the fingers, immediate springs back to its original shape. Care should be exercised that the cake is not baked too long. This causes toughness and dryness. Upon completion of the baking, cakes should be removed from the pans before they cool entirely. Cooling entirely in

the pan causes "sweating" and makes the cake somewhat wet and soggy. Often the hot cakes stick to the pans upon which they are inverted. To avoid this, granulated sugar may be sprinkled over the surface upon which the hot cakes are placed.

(*f*) *Finishing.*—In order to complete a good cake it must be properly iced. Icing should be attractive and look appetizing and above all should be properly flavored. Good icings are often ruined by over-flavoring. Just enough flavoring must appear in the icing to blend with the cake. It must be remembered also that too much icing on a cake, even though it is excellent, will detract from the taste of the cake. The icing must be merely a garnishing to the cake. The cake should be allowed to cool thoroughly before applying icing. Due to the fact that most icings call for the whites of a few eggs, the whites of three or four eggs may be retained when breaking the eggs into the yellow cake mix. Following are two icing recipes:

1. Butter-cream icing.

Butter	1 lb.
Sugar, powdered	1 lb.
Egg whites	8 each.
Vanilla (variable)	¼ oz.

Cream the butter thoroughly; add the sugar gradually, and cream until fluffy. Add the egg whites and beat up thoroughly. Add the flavoring just before completion of beating. Cocoa may be added to form a chocolate butter-cream frosting.

2. Chocolate fudge icing (boiled).

Brown sugar	4 lb.
Milk	1 qt.
Bitter chocolate, melted	1 lb.
Butter	12 oz.

Combine sugar, cream, and chocolate. Place over a slow fire and stir until sugar is dissolved. Continue heating until mixture boils and continue boiling until the "soft ball" stage is reached (sirup forms a soft ball in cold water). This stage is about 225° F. Add butter and cool. Beat until creaminess desired is obtained. Should be applied to cake immediately.

(2) *Cakes without shortening.*—Cakes without shortening, such as sponge and angel food cakes, are more difficult to produce than those containing shortening. Practically all methods of procedure for mix-

ing cakes of this type call for the eggs to be beaten up in a machine; however, they may be beaten by hand with a wire whip, the method depending upon the individual and the equipment available. The general procedure to follow in mixing a sponge or angel food cake is as follows:

(*a*) The eggs and sugar are first beaten or whipped up until light and fluffy. It is during this stage of mixing that air is incorporated into the mix. The eggs are sufficiently beaten when the emulsion forms a peak on the end of the beater or finger. Care must be exercised not to beat too much, because overbeating breaks down the emulsion. The next step in the mixing process is the addition of the water and flavoring, followed by the folding in of the flour, baking powder (if used), and salt. The flour, baking powder, and salt should be sifted together several times before folding into the egg emulsion. After flour is added, the batter should be mixed only long enough to blend the ingredients.

(*b*) When panning sponge cake, care should be exercised not to squeeze out or knock out the air which has been incorporated and which is so necessary for a good product. Pans should be lined with greased paper to afford insulation. For angel food cake, however, do not grease pans or use paper liners.

(*c*) Following are formulas for cakes containing no shortening and for a butter sponge cake:

1. *Angel food.*—Beat stiff—

Egg whites	2 lb.	
Sugar, granulated	1 lb.	
Cream of tartar		¼ oz.
Salt		¼ oz.
Add—		
Vanilla or flavor blend		¼ oz.
Fold in lightly, after sifting together three times:		
Sugar, powdered	1 lb.	
Flour		12 oz.
Cornstarch		4 oz.
Total	5 lb.	¾ oz.

Scale the batter into standard angel food tins. About 8 or 9 ounces to a tin is sufficient. Bake at about 300° F.

2. Sponge.—Beat until firm—

Sugar, granulated	2 lb.	8 oz.
Egg yolks	1 lb.	8 oz.
Water (warm)	1 lb.	
Milk powder		2 oz.
Salt		½ oz.
Flavor (to suit taste)		

Add and beat for 1 minute—

Hot water (about 180° F.)	1 lb.	

Add the following after sifting together and mix until smooth—

Flour	2 lb.	8 oz.
Cornstarch		8 oz.
Baking powder		1½ oz.
Total	9 lb.	4 oz.

Bake at approximately 370° F.
May be baked in layers.

3. Butter sponge.—Beat—

Sugar (warmed)	3 lb.	4 oz.
Whole eggs	4 lb.	
Egg yolk	1 lb.	
Salt		1 oz.
Flavor		1 oz.
Water		8 oz.

Fold in (by hand)—

Flour	2 lb.	12 oz.
Cornstarch		4 oz.

Then fold in carefully—

Butter (melted)	1 lb.	4 oz.
Total	13 lb.	2 oz.

Put in pans as quickly as possible and bake at about 400° F.

64. Cookies.—*a.* There are many different types of cake which fall under the classification of cookies. The Army baker or cook may very successfully add variety to a messing program by making and serving cookies. Like good cake, good cookies require fine ingredients

and careful handling. The method of mixing batter for the majority of cookies is similar to the method of mixing the basic yellow batter—that is, the sugar, shortening, creaming method. The cookie batter must be handled in different ways to obtain variety. Some are dropped on pans from a tube; others are rolled out and cut into numerous shapes.

b. Since sirups have great moisture-retaining properties and aid in preserving freshness, they are frequently used in cookies. Molasses and malt sirup should be extensively used in cookies by the Army baker.

c. Some recipes for cookies easily prepared and readily adaptable to Army use are given below. There are many cookie formulas available, but this should not deter the baker or cook from using inventiveness or originality in making up formulas. Very often bread crumbs, ground field biscuits, and other left-overs may be readily worked into a cookie formula.

(1) *Oatmeal cookies.*—(*a*) *Formula.*

Flour	3 lb.	
Baking powder	1 oz.	
Salt	1 oz.	
Cinnamon	¾ oz.	
Oatmeal	2 lb.	
Shortening	1 lb.	8 oz.
Brown sugar (light)	3 lb.	
Soda	½ oz.	
Currants or raisins	1 lb.	8 oz.
Egg yolks	½ pt.	
Water	½ pt.	

(*b*) *Procedure.*—Sift the flour, salt, baking powder, and cinnamon together several times. Cream the shortening and sugar until light. Add the eggs and beat thoroughly. Dissolve the soda in the water, then add flour and oatmeal alternately with the water. Blend after each addition. Add the currants or raisins with the last of the flour. Roll out the batter on the bench and cut with a cookie cutter. Bake on greased sheet and before baking wash the cookies with "egg milk" wash. Bake at about 350° F. for 10 to 12 minutes.

(2) *Molasses cookies.*—(*a*) *Formula.*

Sugar, brown	5 lb.
Shortening	2 lb. 8 oz.
Salt	1 oz.
Soda	1½ oz.
Allspice	¾ oz.
Cinnamon	1 oz.
Malt	¼ qt.
Molasses	¼ qt.
Eggs	1 pt.
Flour	6 lb.

(*b*) *Procedure.*—Cream the shortening, sugar, salt, soda, allspice, and cinnamon until light. Add the malt, molasses, and eggs. Mix well and then fold in (by hand) the flour. Drop on greased sheets. Bake at 375° F. for 10 to 12 minutes.

(3) *Sugar cookies.*—(*a*) *Formula.*

Flour	3 lb.
Baking powder	1 oz.
Salt	¼ oz.
Shortening	1½ lb.
Sugar	1¾ lb.
Egg yolks	½ pt.
Vanilla	¼ oz.
Milk	½ pt.

(*b*) *Procedure.*—Same as above for mixing batter. Roll out on the bench very thin, cut with a cookie cutter, and sprinkle with sugar. Bake on greased sheets at 400° F. for 5 to 6 minutes. Cookies may be cut into a variety of shapes.

65. Pies.—*a.* Pie is a combination of two distinct products: the crust and the filling. The method of handling a pie dough and the quality and proportion of the ingredients used will determine the quality of the finished product. Since the ingredients used in the preparation of food in Army messes must be purchased from the quartermaster from the several components of the substitutive articles of the garrison ration, the quality is predetermined by higher authority. All foods or food products procured for the Army are of good quality, but the method of handling the dough and the proportions used depend on the knowledge and skill of the cook or baker. A good proportion by weight is half as much fat as flour and half as much water as fat, and the dough is made up quickly with as little handling as possible. The crust may be made flaky, short, or

mealy. The flaky texture is obtained by mixing all of the fat and all of the flour lightly, thus the free fat lumps cause flakiness, and it is known as the old-fashioned home-made pie crust. The short and mealy crusts is made by mixing the fat and flour thoroughly until the entire mass consists of fine, uniform crumbs; then the water is sprinkled in and a dough of the proper consistency is formed. If too much water is used, the crust shrinks while baking, resulting in a tough crust which detracts from the appearance of the pie; if too little water is used, the dough will be too crumbly, is difficult to roll, and will break and tear while it is being transferred from the rolling board to the piepan. Pie dough should be scaled at 10 ounces for the bottom and 9 ounces for the top when using a 9-inch piepan.

b. For those bakers and cooks who must make a large quantity of pie dough and are fortunate enough to have an upright dough mixer of variable speed, a formula for machine pie crust is as follows:

Cream together for *1 minute at second speed*—

Cake flour	1 lb.
Shortening	1 lb. 4 oz.
Salt	¾ oz.
Add—	
Cold water	12 oz.
Sugar, in solution	1 oz.
Add—	
Issue flour	1 lb.
Baking powder	⅛ oz.

Mix together *not more than ½ minute at second speed.* Use shield-shaped agitator for all mixing. This dough should stand under refrigeration for 24 hours for best results.

c. Pies derive their names from the fillings they contain, as cherry, apple, custard, etc. Pies are further distinguished as "two-crust," having a top crust; and an "open," having no top crust. Two-crust pies are usually the fruit pies, while the open pies are custard and meringue.

d. Common fruit pie fillings are usually very juicy. This not only makes the pie difficult to cut but also serve, as the filling may run out as the cut pieces of pie are lifted from the piepan. To overcome this, a thickener or binder is added to the filler to give it solidity. Starch, flour, hominy flakes, or granulated tapioca may be used for this purpose. Tapioca is preferred because either flour or

starch gives the filling a cloudy appearance, while tapioca is less apt to do so and is particularly noted for its smoothness. Too much thickening must be avoided or the filling will become rubbery or gummy. The quantity of sugar and spices to be used in any filling depends on the nature of the fruit and the quantity prepared. However, the proper proportion of sugar and the kind and quantity of spices to be used in each individual mixture will be given in the recipes.

e. Pie dough should be handled gently and as little as possible. After the lower crust is rolled out, fold it over once; this makes it easier to lift and place in the piepan without tearing. Press the crust well down into the corners of the piepan and allow an overlap of about ½ inch all around the outer edge of the tin. Then crimp or press the crust down on this outer edge. (Puncture the bottom crust, if making an unfilled shell.) Put in the filling, moisten the outer edge of the lower crust, then put on the upper crust. The upper crust is sealed to the lower by crimping the edge either by hand or with a fork. The surplus dough of the edges may then be removed with a sharp knife by passing it around the edge of the plate. Several small slashes should be made in the upper crust before it is put on the pie to permit the escape of steam from the filling during cooking.

f. Two recipes for preparing filling are as follows:

(1) *Canned pumpkin pie filling.*—(*a*) Formula.

Pumpkin	2 No. 10 cans.
Sugar	5 lb.
Salt	1 oz.
Eggs, whole	30 each.
Ginger	1½ oz.
Nutmeg	½ oz.
Cinnamon	2 oz.
Milk	7 pt.

(*b*) *Procedure.*—Mix the pumpkin, sugar, salt, ginger, nutmeg, and cinnamon. Then fold in the beaten eggs. Prepare crusts; fill and bake for about 15 minutes in a 12-count oven; then reduce the heat to about a 16-count oven and bake for 30 minutes. This will fill approximately 18 pies.

(2) *Canned apple pie filling.*—(*a*) *Formula.*

Canned apples	1 No. 10 can.
Sugar	1½ lb.

Butter	½ oz.
Salt	½ oz.
Cinnamon	¼ oz.
Nutmeg	⅛ oz.
Reground tapioca	1 oz.

(*b*) *Procedure.*—Mix the ingredients well with the apples. Let the mixture stand for at least 4 hours (preferably overnight). Fill and score the top crust. Bake at about 450° F. (about a 9-count oven) for 30 to 35 minutes.

66. Muffins.—A muffin is an unsweetened cake. Muffins are usually baked in small muffin tins or paper liners and are usually served hot. There are many varieties of muffins and there are many products, differently named, which might be classified under the heading "muffins." Some of these products are tea biscuits, scones, corn bread, nut breads, griddle cakes, and waffles. The method of mixing a muffin batter is generally similar to that for mixing a cake batter. However, muffin batters when finished are usually thinner than cake batters. Care should be exercised in mixing a muffin batter not to overmix. It is not necessary to use the sugar, shortening, creaming process in the preparation of muffin batters. The dry ingredients may be mixed well; then the liquid and melted shortening added and stirred in. This method should be followed if the baker or cook finds that he is overmixing the batters. The use of muffins in a mess furnishes a pleasing addition to any meal at a moderate cost. Raisins, figs, corn meal, bran, and even bread crumbs may be utilized in muffins. Muffin tins or paper liners may be used in baking muffins. A small expenditure for the tins will be well repaid.

a. Muffin base (plain).—(1) *Formula.*

Shortening	1 lb.
Sugar	2 lb.
Salt	½ oz.
Eggs	8 each.
Molasses	8 oz.
Soda	2 oz.
Water	8 oz.
Flour	3½ lb.

(2) *Procedure.*—Cream together the shortening, sugar, and salt. Then add the eggs and stir in. Next add the molasses, soda, water, and flour, and mix. Do not overmix. Drop in greased tins or liners and bake at about 400° to 450° F.

b. Variations.—From the muffin base given in *a* above different kinds of muffins may be made. In order to make oatmeal muffins, for instance, replace 1½ pounds of flour with 1½ pounds of oatmeal. For any other kind, such as whole wheat, all bran, corn meal, etc., merely replace 1½ pounds of the flour with 1½ pounds of whole wheat flour, all bran, or corn meal. Raisins, figs, or currants may be added to any kind.

67. Griddle cakes.—*a. Formula.*

Milk	2 lb. (1 qt.).
Salt	½ oz.
Sugar	2 oz.
Eggs, whole	2 each.
Flour	1 lb.
Baking powder	1 oz.
Melted butter	1 to 2 oz.

b. Procedure.—Stir together thoroughly the milk, salt, sugar, and eggs. Add the flour. Then add the melted butter and stir in. Fry on griddle.

SECTION X

POST BAKERY EQUIPMENT AND ARRANGEMENT

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68. General.—The kind, quantity, capacity, and types of equipment needed at a post bakery will vary considerably, depending, first, upon the number of troops to be served from the bakery and, second,

upon the type and size of the bakery building, availability of utilities, type of fuel available, and other local conditions. Likewise, no hard and fast rules can be made for segregating essential from supplemental equipment for the reason that while a power mixer would be considered essential equipment in a bakery with a daily output exceeding 3,000 pounds of bread, it would not be essential where the daily output averaged only 300 pounds. In the latter case, hand mixing of doughs could be resorted to without undue inconvenience or hardship. Both the kind and the quantity of equipment necessary for efficient operation of a given post bakery will be governed by local conditions.

69. List of equipment.

Oven or ovens.
Flour storage room.
Refrigeration facilities.
Small ingredient storage room.
Water-tempering device.
Thermometers.
Pyrometers.
Fermentation room or cabinet.
Proofroom or cabinet.
Scales: small, large, and floor.
Dough mixers.
Dough troughs.
Dividers, rounders, and molders.
Molding or workbench.
Pan-greasing machine.
Emulsifiers (for yeast and powdered milk).
Cooling and storage racks.
Clock, office or alarm.
Steam engine.
Sieves, flour.
G. I. cans and buckets.
Measures, liquid.
Sink.
Slicers, wrappers.
Dough scrapers.
Rolling-pins.
Pan holder.
Brushes, counter.
Whips, wire.
Cutters, biscuit.
Pans, bread, 1-pound capacity.

Pans, bake, pullman.
Pans, bun, 18″ by 24″.
Cutters, doughnut.
Miscellaneous small equipment.

70. Ovens.—*a. Types.*—Ovens may be classified as continuous type, intermittent type, permanent ovens, portable ovens, stationary hearth, revolving hearth, Ferris-wheel hearth, and traveling hearth.

(1) *Continuous type.*—In this type the heat generally passes around the oven making it possible to make successive bakings by the same continuous fire. The interior walls and hearth of the oven are heated from an exterior source, leaving the oven chamber free at all times for the admission of products to be baked.

(2) *Intermittent type.*—In this type it is necessary to draw the fire before each baking, if baking is done in the chamber in which the fire is built, as in the common brick oven and the semicylindrical type of knockdown field oven.

(3) *Permanent ovens.*—Those ovens which are generally built of brick or tile with no intention of moving them. They sometimes weigh as much as 50 tons. Such ovens should be installed in permanent posts only, and then only in buildings of permanent construction.

(4) *Portable ovens.*—Those ovens which may easily be taken down and moved (such as the light knockdown field ovens) and which may be taken down and prepared for rail or truck transportation in a short period of time.

(5) *Stationary hearth ovens.*—In this type the panned loaves or hearth products are peeled into the oven and so spaced and placed that they may be peeled out of the oven in the same order as they went in. The chief objection to this type is the difficulty encountered in securing equal time and degree of baking for all loaves in the oven. Unless all parts of the hearth and chamber are equally heated and hot or cold spots and what is commonly termed "flash heat" eliminated, uniform baking will not be accomplished.

(6) *Revolving hearth oven.*—Also known as rotary oven. In this type the hearth revolves slowly in a horizontal plane insuring even distribution of heat to each piece of dough being baked and greatly facilitating peeling in and out of the oven. This type is especially suited for cake and pies or for products placed in the oven at the same time but requiring different lengths of time for baking.

(7) *Ferris-wheel type.*—As its name implies, the hearth in this type consists of trays mounted on circular rings, the whole enclosed in a heated chamber within which the trays revolve. The rate of

speed at which the trays revolve may be regulated so that the completion of one or more revolutions requires a certain length of time. This type of hearth is particularly well adapted for small items, such as cup cakes and cookies, but may be used advantageously for bread making.

(8) *Traveling hearth ovens.*—This type consists of an endless belt hearth inclosed in a baking chamber, and traveling at a set rate of speed for a set length of time over a certain distance. They are designated according to length, as 60-foot, 80-foot, 110-foot, etc. Products to be baked are placed on the hearth at one end. They travel slowly along the moving hearth, and when they arrive at the other end of the oven the baking is complete and the baked product readily and speedily removed. The advantage of the traveling hearth oven is that temperature may be adjusted at various stages of baking to insure maximum efficiency. This type of oven is very expensive, and its use in Army bakeries would be limited to those having a daily output in excess of 10,000 pounds of baked product.

b. Operation.—An oven that has never been fired should be heated by a slow continuous fire over a period of 4 or 5 days, with all dampers open to allow the moisture from the materials of which it is constructed to escape. If an oven has not been in use for some time, it should be treated in the same manner as a new oven. When an oven is regularly in use, heat should be applied far enough in advance to insure the correct oven temperature at the time the first batch is placed in the oven, and the dampers so regulated as to insure even heat. All ovens possess certain peculiarities, and bakers cannot expect to turn out loaves of uniformly good quality until they have become accustomed to the particular oven in use. In many double ovens, the part near the common partition, and those farthest from the door, become hotter than the other parts. Hence, pans of bread first run into the oven may go to the hottest parts and of necessity may be the last to be withdrawn. If such an oven is used to its fullest capacity, some of the loaves are likely to be highly browned or even burned before others are ready to be withdrawn, as shifting, under these circumstances, is accomplished with difficulty. Care must be taken to keep the pans away from the common partition of such an oven and to fill the cooler parts first. Effort should also be made to load an oven so that unloading may be done in approximately the same order as loading.

c. Operation and care of parts.—(1) *Preparation for firing.*—While preparing the oven for firing, the damper should be kept closed. In the event the oven becomes too hot, the temperature may

be reduced by opening the damper and the oven door. When peeling bread into the oven, the damper should be opened in order to draw off the dust and the moisture from the dough. The damper should be left open for from 5 to 10 minutes in order to hold initial baking temperature down, thereby giving the bread a better chance to obtain a good oven spring before the crust becomes fixed. At the completion of a day's bake, the dampers should be kept closed in order to retain as much heat within the oven as possible. This will effect a saving in the fuel necessary to obtain required heat on subsequent days.

(2) *Tiles.*—Furnace tiles should last about 3 years. Water should not be used to cool oven tiles as it will cause them to crack, resulting in loss of heat and rapid deterioration of tiles.

(3) *Grates.*—Special care should be taken to prevent accumulation of ashes on grate bars or in the ashpit. If this precaution is not taken, grate bars will burn out rapidly. With proper care, the average grate bar will remain in a serviceable condition for a period of 3 years.

(4) *Flues.*—All flues should be kept as free from soot and dust as possible, in order that proper draft conditions may obtain. They should be cleaned out whenever the opportunity is afforded, and in all cases at least once every 10 days. This is particularly true of ovens in which wood, coal, or coke is used as fuel for heat.

(5) *Chamber.*—It is necessary, from time to time, to mop out the oven hearth to remove dust, bread crumbs, etc. This is particularly true after the baking of hearth-baked products, where corn meal, etc., is used to prevent loaves from sticking to the peel when loading the oven. An efficient oven mop may be easily made by tying a burlap sack to the end of a long pole. To mop out the oven, dampen the sack (not soak in water) and by using a rotary motion draw the surface of the damp sack over the surface of the hearth, working from rear to front of the oven.

d. Repair and replacement of parts.—Repairs or replacement of oven parts, especially brick or tile parts, require the services of skilled mechanics, and should not be attempted by personnel unfamiliar with this type of work. When time permits, the manufacturer of the oven should be consulted as to material to be used and procedure to be followed in making any repair to or replacement of worn-out parts of an oven.

71. Flour storage room.—Ideal storage conditions for flour are a well-ventilated room having a temperature of approximately 70° F. with a relative humidity of 65°; the flour stack, not to exceed seven

sacks high, on dunnage or skids so constructed as to allow from 4 to 8 inches of space between the floor and the bottom sack. The use of dunnage or skids permits free circulation of air and prevents absorption of moisture from the floor. The sacked flour should not come in contact with any part of the floor, walls, or ceiling. If such a room or partitioned-off space is not available in the bakery, it is advisable to store flour elsewhere and have on hand within the post bakery only a sufficient quantity to meet requirements for 1 or 2 days. In no case should the flour storage room be located over or adjacent to the oven, as the heat will rapidly dry the flour and cause its early deterioration.

72. Refrigerating facilities.—Every effort should be made to provide refrigeration for such ingredients as yeast, shortening, and liquid milk. If refrigeration facilities are not available in a post bakery, supplies of these items should be stored under refrigerated conditions elsewhere and only 1 day's requirements kept in the bakery. Especially is this true of yeast. Yeast loses its strength rapidly in temperatures exceeding 50° F. Every effort should therefore be made to keep it as cool as possible until just before incorporation into a dough.

73. Small ingredient room.—By small ingredients is meant all ingredients used in baking bread except flour and water. If possible, a small ingredient room should be provided, located near the mixing machine. Separate well-marked containers should be provided, preferably mounted on wheeled frames, to hold broken-package lots of such items as sugar, salt, powdered milk, and flour other than issue flour. Scales for weighing small quantities of such items should be available in the room.

74. Water-tempering device.—As the temperature of the water or other liquid used in a dough is the controlling factor for obtaining the desired dough temperature, it is essential that some type of water-heating device be installed in every post bakery. A very efficient, simple, and inexpensive device consists of a 40- to 80-gallon boiler, similar to the type used in conjunction with Army ranges, attached to any heating unit. By combining a certain quantity of hot water thus obtained with a certain quantity of cold water, any desired water temperature may be readily obtained. Guessing the temperature of water used in a dough should not be tolerated. A thermometer should be provided and used for this purpose.

75. Thermometers; pyrometers.—Temperature of ingredients at various stages of preparation of dough and during actual baking is an all-important factor in the quality of the product produced.

Thermometers, therefore, constitute an essential item of equipment for all bakeries. Fahrenheit thermometers should be used wherever practicable. If centigrade thermometers must be used, equivalents may be determined rapidly by use of the conversion table in section XIII. Thermometers are expensive and easily broken and should be carefully handled to prevent loss. While the ordinary glass tube thermometer will suffice for determining the temperature of ingredients prior to mixing, in determining the temperature of dough, a regular dough thermometer (long metal base) should be used to guard against probable breakage and resultant inclusion of broken glass in the dough. A pyrometer is an instrument used for determining oven temperature when an automatic temperature recording device is not part of the oven equipment. The principle involved in a pyrometer is the expansion and contraction of metal caused by heat. A recording device on the pyrometer registers the degree of heat prevailing at the place where the pyrometer is placed.

76. Fermentation room or cabinet.—An ideal arrangement for fermenting dough is a room or cabinet with a temperature of 78° to 82° F. and a relative humidity of 75°. These conditions may be obtained in a post bakery by partitioning off a section of a large room or constructing a cabinet of sufficient size to accommodate requirments of fermenting dough. Some sort of heating appliance should be installed in this room or cabinet. The temperature of the room or cabinet may be controlled by increasing or decreasing the intensity of the heat used. Care must be taken to prevent the air in the fermentation room or cabinet from becoming too dry, a condition which will cause the fermenting dough to crust and the finished product to be of inferior quality. A humidifier or fan-like arrangement which projects a fine spray of water or steam into the atmosphere of the fermentation room or cabinet is best suited to provide the necessary humidity; but any local installation which will keep the air in the fermentation room or cabinet damp will suffice.

77. Proofroom or cabinet.—The proofroom or cabinet should be similar in construction to that of the fermentation room or cabinet; but, if possible, it should be provided with heating equipment capable of maintaining a temperature of from 90° to 100° F. with a relative humidity of 75°. It is advisable to have the proofroom or cabinet adjacent to the oven in order to facilitate loading into the oven and to prevent cooling off or jarring of proofed dough while en route between proof box and oven. It is advisable, when possible. to place panned dough for proofing on racks equipped with wheels or rollers and to roll the loaded racks into the proofroom or cabinet.

78. Scales.—Too much emphasis cannot be placed upon the necessity for having on hand and using constantly scales of various types and capacities for accurate measurements. The guessing of weights of ingredients, or using scoops, buckets, etc., as measuring devices, will result in many errors which will be reflected in the finished product. By carefully measuring all ingredients used in a dough, the weight and percentage loss occasioned by fermentation, proofing, and baking is accurately determined, and information is obtained which will lead to elimination of overproduction or underproduction of requirements.

79. Dough mixers.—Small mechanical dough mixers are classified as to their capacity in quarts; that is, 10-, 20-, 30-, 60-, or 80-quart mixers. Larger dough mixers are classified as to their bag of flour capacity; that is, 1-bag mixer; 1-barrel (2 bags) mixer; 2-barrel mixer, etc. A 1-bag mixer is of sufficient size and power to mix properly 1 bag of flour (98 to 100 pounds) and the proportionate quantities of other ingredients ordinarily used in making a bread dough. Mixing machines are also classified as high-speed and low-speed mixers, depending upon the number of revolutions per minute made by the mixing arm or arms while in operation. The friction developed by the mixing machine (used to determine temperature of water required to obtain a mixed dough of desired temperature) and the length of time a dough should remain in the mixer while operating at various speeds (in order to obtain the proper mixed consistency) may be readily determined by carefully checking actual operation for a few days. Doughs are mixed more quickly and more efficiently by mechanical dough mixers than by hand. However, the presence of mechanical dough mixers in a bakery should not prevent all Army bakers from becoming thoroughly familiar with and proficient in the method of hand mixing. Under field conditions machines are not available and all Army bakers should be able to mix dough efficiently by hand.

80. Dough troughs.—*a.* Dough troughs are made of either wood or metal. A wooden trough has the advantage of being a poor conductor of heat and therefore keeps dough at a more constant temperature. However, a metal trough is more easily kept in a sanitary condition. Whenever possible, dough troughs should be mounted on rollers which will enable easy transportation from the mixing machine to the fermentation cabinet and from the fermentation cabinet to the workbench or divider. For convenience in handling large doughs, the troughs may be provided with removable ends or a drop-bottom device.

b. Sourness in bread is frequently caused by particles of dough becoming lodged in the corners of dough troughs. If dough is permitted to remain there for any length of time, it becomes sour as a result of acid fermentation. This sourness is readily transmitted to fresh dough that may be placed in the trough. For this reason, dough troughs should be thoroughly cleaned with dough scraper and brush after each day's use and frequently washed with steam or hot water and thoroughly rinsed and dried, preferably in the sun.

c. Dam boards should be provided for dough troughs in order to confine fermenting dough to the proper fermentation area. It is important to remember that the dough trough, or space used therein for fermenting dough, should be approximately four times the volume of freshly mixed dough. Fermenting dough should rise vertically rather than spread horizontally. If too large or too small an area is provided for fermenting dough, uneven fermentation will take place, which will adversely affect the finished product.

81. Dividers; rounders; molders.—In post bakeries having a small daily output of bread, the operations of dividing or scaling the dough into pieces of proper size for individual loaves and the rounding and molding of scaled dough pieces may be accomplished readily and efficiently by hand. However, commercial concerns manufacture machines for these operations. The use of these machines reduces considerably the time required and also minimizes the number of men needed for these operations in a bakery. There are so many different types and styles of these machines that no standard set of rules can be given for the maintenance, care, and operation of them. Instructions as to the use of any of these machines that may be on hand at a post bakery should be obtained from the manufacturer and carefully complied with by the operating personnel of the bakery.

82. Molding or workbench.—The top surface of molding or workbenches should be constructed of poplar boards. For large bakeries where many bakers are employed and hand dividing, rounding, and molding is the custom, the bench should be broad and so set that the bakers and their helpers may work on both sides of it. If an intermediate proof cabinet is not available, the workbench or benches should be large enough to hold, without crowding, the individual rounded pieces made from one large batch of dough during the 15- to 20-minute intermediate proof period prior to molding. Every effort should be made to keep the workbench, especially the surface, scrupulously clean at all times.

83. Bread cooling and storage racks.—Whenever practicable, bread cooling and storage racks, mounted on rollers, should be used for holding panned dough to be placed in the proofroom or cabinet. When so used, the pans first filled should be placed on the bottom shelf of the rack and the others on the next higher shelves as they are filled. This is necessary to insure equal proofing rate, as the temperature of the room increases from the floor toward the ceiling. Bread cooling racks should also be used to facilitate rapid cooling of bread immediately following removal from the oven. Care should be taken to insure that the loaves or sheets of bread are so arranged on the rack as to provide ventilation on all sides. In other words, do not place the bread so that individual loaves or separate sheets touch each other. Bread should remain on cooling racks until it has cooled to approximately 90° F.

84. Miscellaneous equipment.—Other items of equipment enumerated in paragraph 69 aid materially in the efficient operation of a post bakery. The extent of their use depends upon the variety and quantity of bakery products produced. Whenever practicable, different sizes and shapes of bread pans, such as pullman pans and commercial 1-pound pans, should be obtained and used. By varying the kind, size, and shape of bread issued or sold to troops, monotony is avoided.

85. Lay-out of equipment.—*a.* The arrangement and allotment of space to various pieces of equipment will vary considerably, depending upon the size and shape of the building used for the post bakery and the amount and size of equipment available for use. The main points to be considered in arranging a bakery are as follows:

(1) Equipment should be so arranged as to insure forward progress of dough and avoid as much back-tracking and criss-crossing as possible.

(2) The flour storage room should be so located as not to be over or adjacent to the oven.

(3) Cooling racks or bread cooling rooms should be located so as to receive maximum ventilation.

(4) In a two-story shop, the fermentation room should be directly over the workbench or divider so that chutes may be used to facilitate transfer of fermented dough.

b. The typical lay-out plans (figs. 1 and 2) should be considered as advisory only. Existing permanent installations may preclude the arrangement as shown without making extensive alterations to the shop building. The officer in charge should exercise his best judgment in making modifications so as best to meet conditions existing locally.

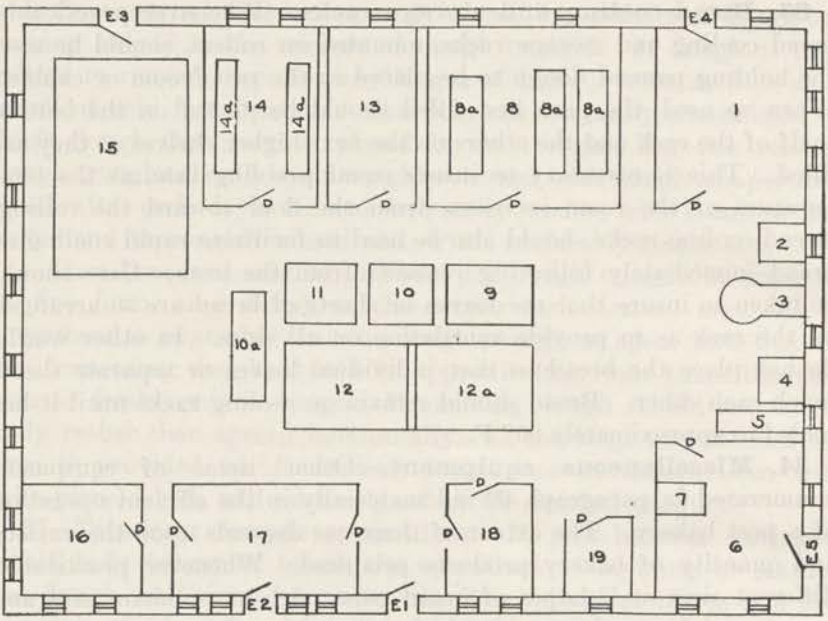

FIGURE 1.—Typical lay-out plan for one-story post bake shop.

1. Flour storage room.
2. Floor scale.
3. Power mixer.
4. Sink.
5. Water heating device.
6. Small ingredient storeroom.
7. Refrigerator.
8. Fermentation room.
8a. Fermentation troughs.
9. Divider.
10. Rounder.
10a. Short or intermediate proofer.
11. Molder.
12. Workbench.
12a. Additional workbench.
13. Breadpan and cakepan storage room.
14. Proofroom.
14a. Proof racks.
15. Bake oven.
16. Bread cooling racks.
17. Bread storage room.
18. Bakery office.
19. Washroom and lavatory.
E–1. Main entrance to bakery.
E–2. Exit and entrance for bread delivery.
E–3. Rear entrance for firing oven.
E–4. Rear entrance for delivery of flour.
E–5. Side entrance for delivery of small ingredients.
D. Doorway.

NOTE.—If fuel other than gas or electricity is used for heating the oven, a fuel shack should be constructed adjacent to E–3.

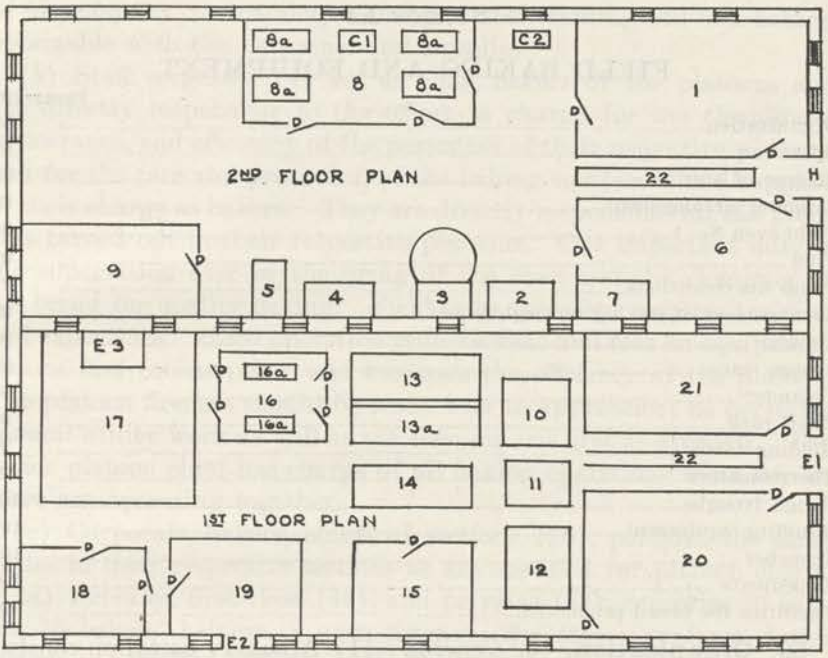

FIGURE 2.—Typical lay-out plan for two-story bake shop.

1. Flour storage room.
2. Floor scales.
3. Power mixer.
4. Sink.
5. Water heating device.
6. Small ingredient room.
7. Refrigerator.
8. Fermentation room.
8a. Dough troughs.
9. Washroom and lavatory.
10. Divider.
11. Rounder.
12. Molder.
13. Workbench.
13a. Additional workbench.
14. Short or intermediate proofer.
15. Breadpan and cakepan storage room.
16. Proofroom.
16a. Proof racks.
17. Bake oven.
18. Bread cooling racks.
19. Bread storage room.
20. Bakery office.
21. Bread sample and experimental room.
22. Stairway.
E–1. Main entrance to bakery.
E–2. Entrance and exit for bread delivery.
E–3. Rear entrance for firing oven.
C–1. Chute through floor of fermentation room to workbench on floor below.
C–2. Chute through floor connecting with mechanical divider on floor below.
H. Hoist for hauling flour and other ingredients from first to second floor.
D. Doorway.

NOTE.—If fuel other than gas or electricity is used for heating the oven, a fuel shack should be constructed adjacent to E–3.

SECTION XI

FIELD BAKING AND EQUIPMENT

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86. Organization.—*a. General.*—(1) A bakery battalion consists of four companies. Each company comprises four platoons of four sections each. There are, therefore, 16 sections to a company. The companies are lettered *A*, *B*, *C*, and *D* and the platoons and sections are given numerical designations. The company is designed to supply a force of 40,000 men, a platoon 10,000 men, and a section 2,500 men.

(2) The organization and equipment are such that each section, platoon, and company is complete within itself, so that orders directing assembly may specify simply the number of bakery sections, platoons, or companies required at a given destination and the authority to whom to report. One baking outfit is assigned to each section.

b. Duties of personnel (company).—(1) *Officers.*—(*a*) Captain (1) commands the company and is directly responsible to the battalion commander for the training, discipline, and efficiency of the personnel and for the care and preservation of the baking equipment and supplies. He supervises and controls the quantity and quality of bread baked by his organization.

(*b*) Lieutenants (2 first and 2 second) assist or take charge of platoons or/and sections as directed.

(2) *Noncomissioned officers.*—(*a*) First sergeant (1), as chief baker, supervises the baking and baked products under the direction

of his company commander, insuring correct training and best baking obtainable with the personnel and supplies.

(*b*) Staff sergeants (4) act as chief bakers of the platoons and are directly responsible to the officer in charge for the cleanliness, appearance, and efficiency of the personnel of their respective platoons and for the care and protection of the baking equipment and supplies in their charge as bakers. They are directly responsible for the products turned out in their respective platoons. One important duty is the supervision over or the firing of the oven and the changing of the bread for quality baking. Field oven operation requires training and experience. Good operation reduces wear and tear on equipment, lessens fuel consumption, and increases the efficiency of the platoon. The platoon fireman should be trained as an apprentice; he performs general utility work as well as the cleaning out fires as directed. The senior platoon chief has charge of all baking operations when two or more are operating together.

(*c*) Corporals, bakers, chiefs of sections (16), perform the same duties in their respective sections as are specified for platoon chiefs.

(*d*) Privates, first class (44), and privates (89), comprise 80 bakers, 16 bakers' helpers, 8 oven firemen; the others perform duties assigned at company headquarters.

c. General control.—(1) *In time of peace and in zone of interior.*—In time of peace and in the zone of the interior in time of war, bakery companies located within any corps area or territorial department are under the control of the corps area or department commander concerned for all purposes of administration, supply, training, and inspection, and for the preparation of bread products for distribution, and unless otherwise ordered their services may be utilized by him, in whole or in part, as he may consider advisable.

(2) *In theater of operations.*—In time of war in the theater of operations, bakery companies are normally to be treated as elements of the communications zone; when such zone is established they are attached thereto, according to the needs of the particular situation, and are operated under the direction of the commander of the communications zone.

(3) *Assignment to camps.*—In time of peace or war, bakery companies may be assigned in whole or in part to concentration or other camps of a permanent or semipermanent character.

d. Administration (bakery company).—A bakery company will be administered as a separate organization. In time of peace, the commanding officer of a bakery company is responsible for the administration, training, and discipline of the personnel and for the proper

operation of the bakery; in time of war, he has the same responsibility for that part of the company and equipment which has not been removed from his control.

e. General duties.—The personnel of bakery companies, either commissioned or enlisted, will not be required to perform any duties other than those pertaining to the operation of their organization, except in an emergency or when the organization is stationed at a school for bakers and cooks. When stationed at the same station as a school for bakers and cooks, a bakery company will be attached to and perform such duties in connection with the school as the commandant thereof may direct.

87. Operation.—Peacetime organization may combine duties. Extended field operation may require that an organization operate on a 24-hour schedule, in two shifts of 12 hours each, with possibly 18 hours on Saturdays to change personnel from night to day shift. Field operation in peacetime is regulated by organization, by the number of pounds of bread required, and the number of men available (including men on special duty from line organizations when required); and may be arranged in three shifts of 8 hours each, as local requirements demand.

88. Change of station.—In campaign or maneuver, or as directed, the company normally carries, on change of station, 4 days' supply of baking materials for a division. Timely arrangements for supply of baking articles may be made with local quartermasters responsible for supply of troops. Arrangements must be made for yeast as desired.

89. Camping arrangement.—*a.* As soon as the officer in charge arrives at the rendezvous he selects or is assigned to a camp site. As soon as the enlisted personnel arrives, the equipment and supplies should be unloaded and the equipment set up.

b. The normal camp of a bakery company and the arrangement and utilization of the tentage and ovens are indicated in figures 3 and 4 (see par. 93).

c. While such arrangement is desirable to conserve energy and economize space, it is not to be followed blindly; the commander should exercise his judgment in making such modifications as will best meet conditions as they arise.

d. When the equipment subject to rust has been cosmolined, the cosmoline may be removed by washing with gasoline, followed with hot soapy water and rinsing thoroughly with hot water, then drying on top of the apron; and, in the case of bakepans, by heating in the oven until all traces of odor are removed.

e. After cleansing, the inside of the pans should be lightly coated with shortening and placed in a hot oven to form a surface, then given the regular greasing for baking.

90. Field oven No. 1.—*a. Description.*—Field oven No. 1 is a portable knockdown type for continuous baking. It will bake approximately 3,500 pounds of garrison bread or 2,000 pounds of field bread per day, if operated continuously. Each of the 12 metal parts of which the oven is constructed (including the stovepipe and hood) is designated by number. In submitting requisitions for extra parts, the number of the part desired should be referred to. The numbers given in the following instructions refer to the several numbered parts of the oven and run from 1A to 12C, inclusive. In addition, there is a canvas cover No. 13A to go over the soil on top of the oven.

b. Assembling.—(1) Level a piece of ground 6 feet by 6 feet. In the center of the leveled plot and 14 inches from front edge of oven line, dig a clean-cut trench 10 feet long, 18 inches wide at the top, 16 inches wide at the bottom, and 30 inches deep. Set up the oven and on completion extend the cut at the firing end of the trench to make a convenient fire pit 3½ feet by 3½ feet. For a section of ovens these fire pits are connected, making a firing pit 3½ feet wide and 18 feet long. In the center of each end of the fire trench, dig a hole about a foot deep, large enough to hold a galvanized iron bucket for draining the fire pit and to evaporate waste water. In a fire pit for a section of ovens, this hole is made at one side with a small trench extending to all fire trenches.

(2) Place the trench cover (No. 5A) so that the front or closed end will extend about 6 inches over the front end of the trench, and the center of the trench cover over the center of the trench. The sides of the trench cover should fit the ground closely in order that the heat and gas from the fire trench will pass only through openings of the trench cover.

(3) Examine the parts of the oven for damage, particularly the connecting angle irons and necks of chamber; the latter must be squared and bent irons straightened out.

(4) Place the front end of the oven (No. 1A) on the ground with the bottom end about 1 foot in front of the trench cover. Place the sides (Nos. 3A and 4A) upright, equally spaced, parallel to, and the rear end on line with the back end of the trench cover, the ends resting on a small 6-inch board or tent peg set at an angle to equalize weight of the four corners; engage the bottom of No. 1A with hooks on the bottom edges of Nos. 3A and 4A and clamp the corner edges. Examine the oven for level and spacing on inside, as any differences

will be noted in baking because of hot spots in all baking chambers.

(5) Next place the oven chambers, beginning with the bottom (No. 10A), then No. 11B, then No. 12C, pushing the necks of the chambers through the openings in the front end (No. 1A) as far as possible. The front of the chamber is supported by the neck on the front; the rear by flanges which rest on lugs on the sides of the oven. Each chamber is carried in and a rope placed under the neck of the chamber; the ends are grasped by one man standing outside on the bottom opening of No. 1A, and lifting together with two men on rear chamber they shove it forward and engage the flanges on lugs on the sides of the oven at the same time. A little care is required that men work in unison; otherwise, the hands of some of the men may be damaged and unsuitable for dough mixing for some time. After all chambers are in place, insert a small piece of wood about 1 inch square under each supporting flange of chambers to provide sufficient clearance for placing into position the rear end (No. 2A).

(6) Next, place the rear end (No. 2A) by engaging the bottom angle iron with the hooks on the bottom of Nos. 3A and 4A and clamp the corners. When the fire pit is completed, a man crawls into the fire trench and, lying on his back, places the flange on the trench cover (No. 5A) over the collar on the bottom of the rear end (No. 2A).

(7) Next, place the top of the oven (No. 6A) in position with the flue hole at the right center. Place a small piece of brick under the collar of the flue hole near the center to support the weight of dirt; otherwise, poor circulation of heat and improper combustion of fuel will take place.

(8) Next, set up the stovepipe (Nos. 7A and 8A), then the hood (No. 9A). Fasten pipe braces to the oven. Stop up the edges (cracks), made by the top (No. 6A) resting on angle irons of the sides, with clay or mud, or cover with strips of heavy paper forming an angle and overlapping the joints to keep the dirt from seeping through.

(9) Next, cover the top of the oven with dirt taken from the trench, forming a mound about 8 inches deep in the center and 5 inches deep at the edges. Stop up the cracks around the necks of the oven chambers with dry, loosened asbestos rope or stiff asbestos cement, if available, otherwise with stiff mud or clay.

(10) Build a very slow, continuous fire in the trench to permit evaporation of all moisture, and leave the oven doors open. A quick, hot fire will blister the trench cover and sides of the oven, crystallizing the metal and separating seams on metal parts, all of which requires

extra work and transportation to replace. After the dirt on the top of the oven has dried out, put on the canvas cover.

c. Preparing for transportation.—Remove the canvas oven cover and the back of the oven; rake off all dirt from the top into the fire trench to cover up any live coals. Remove asbestos rope around the oven chambers for future use. Place some wood in the space between the trench cover and the bottom of the chamber for support, likewise in the space between chambers; take off sides of the oven, and chambers may be easily handled and spread out for cooling and cleaning off accumulated soot and ashes. If the oven is to be stored, swab the interior of chambers, especially the floor, with cosmoline before dismantling to form a thin protecting coat against rust.

d. Packing.—To pack field oven No. 1 in the escort wagon or truck with escort body—

(1) Place three galvanized iron buckets, scales, and two tent flies under the seat.

(2) Place the stovepipe joints, hood, and clamps inside of A chamber.

(3) Place the bakepans in the B and C chambers, 18 pans in each.

(4) Pack the three chambers, A, B, and C (mouth up), two sides (Nos. 3A and 4A) and top (No. 6A) in the front end of the wagon, side by side, against the wagon seat.

(5) Form a second row by placing the front (No. 1A) and back (No. 2A) on one side of the wagon bed. The angle irons of the front and back should overlap and the pieces should be set upside down.

(6) Place the molding table on the opposite side of the wagon bed, the top of the table out.

(7) Nest the troughs and stand them on end, bottom against chambers, and mouth toward the rear of the wagon.

(8) Place two dam boards in the bottom of the trough.

(9) Nest the sponge cans, placing in each can, starting from bottom can, a folded dough trough cover; trough cover; bread rack cover; rack cover; oven cover; and all small utensils in the last or top can in such a manner that no damage will occur; fit sponge can cover. Place cans in the trough on top of the dam boards. Put up the tail gate.

(10) Fold three bread racks; set two on end, broadside to the tail gate; invert the third rack and place between the two.

(11) Put rake, fire hoe, pan hook, pickaxe, axe, and shovel in an empty flour sack; tie up tightly in a bundle and stand in front of tail gate alongside the proof rack.

(12) Place paulins, small or large (issued when required), on top of the chambers. (Paulins are not within allowances and are required only for proper protection of storage items within a tent, such as bread placed on paulins, or paulins used to protect flour supplies.)

(13) Place tents and tent pins in front of the proof rack.

(14) Place the trench covers on top of the chambers, at right angles, back to back, fire surface of under (reserve) trench cover down and extending across the wagon. Lash trench covers together, reserve trench cover over necks of chambers, and the used trench cover bottom up over reserve cover.

(15) Lash two uprights and one ridge pole for wall tent, large, and pole for pyramidal tent on the wing board on left side of the wagon. Lash two poles, upright, and one ridge for wall tent, large, to right side of the wagon.

(16) Fasten tail chains through stove tent at back of tail gate.

(17) Lash the load securely, crosswise and lengthwise.

91. Fuel.—With seasoned wood, baking temperature can be obtained in from 1½ to 2 hours after the fire is started, depending upon the dryness of the ground. If time is no object, it will be better to use a slow fire at first, in order to bake the trench walls slowly and dry out the sheet asbestos between the metal pieces of oven parts without warping. (This asbestos accumulates moisture which, on rapid heating, must find an outlet, thereby causing a warping due to swelling of metal parts and difference in temperature). If the firing trench is dug in sandy ground, the walls of the fire pit, unsupported, will not last more than 48 hours. It will be necessary to revet them with some heat-resisting material. If the equipment is to be set up for a short period (1 to 2 weeks), the walls may be revetted with galvanized iron sheeting, held in place by iron pins driven into the ground, or one layer of ordinary building brick may be used. If the firing trench is dug in loam, it will last about a week without revetting. If dug in gumbo or adobe, the trench will stand up 2 to 3 weeks, depending upon the care exercised in firing. Careless handling of firewood will greatly reduce the life of any unrevetted trench.

92. Camp site conditions.—If the field bakery is to occupy a camp site permanently, it is best to set the ovens over a firebrick trench cover and foundation.

If the ground is low or subject to flooding rains, it is advisable to build the foundation and fire trench entirely above ground. In this case the ground, for a space of 16 feet by 32 feet, should be raised to the same height as the oven foundation so that the floor of the mixing tent and the ground from the mixing tent to the rear of the oven are

level with the top of the brick foundation. In sandy ground, or where the rainfall is slight, equally good results will be obtained by digging a pit and building the foundation and fire trench so that the top of the foundation wall is about 12 inches to 16 inches above the surface of the ground, the mixing tent resting on the natural ground surface. This provides the most efficient height for oven operation.

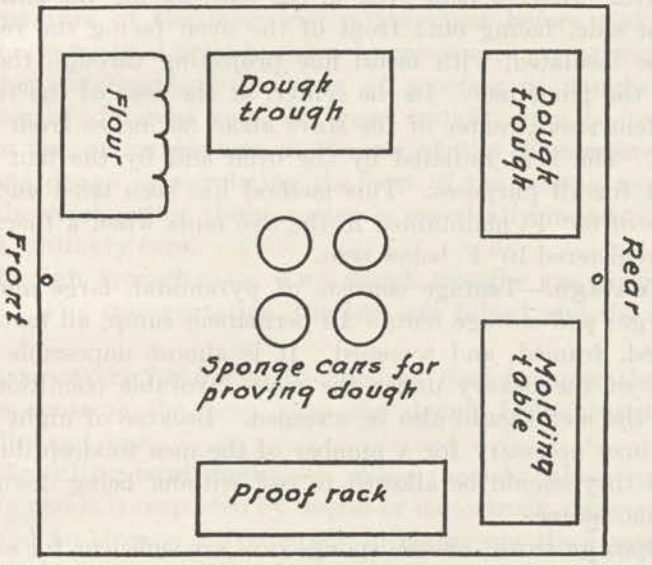

FIGURE 3.—Arrangement of mixing tent equipment, moderate weather.

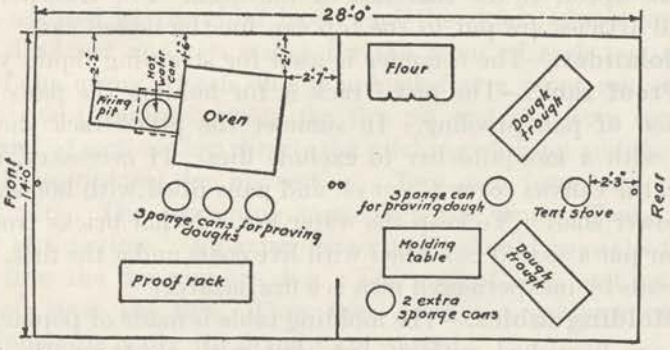

FIGURE 4.—Arranging of mixing tent equipment, cold weather (10° F. above zero to 10° F. below zero).

93. Arrangement of mixing tent equipment.—*a. In moderate weather.*—When the temperature falls to between 80° F. and freezing (32° F.), erect a tent stove in the rear of the mixing tent. When

the temperature falls to 20° F., or thereabout, erect a second tent stove in the front end of the tent.

b. In cold weather (10° F. above zero to 10° F. below zero).—Erect two wall tents, large, end to end. Roll back and tie the two interior ends of the tent and lace tightly one of the exposed ends; that is, make one large tent of the two and tightly close one end. Bank the sides with earth. Erect a field oven in the tent, having the entrance on the right side, facing out; front of the oven facing the rear tent; stovepipe insulated, with metal flue projecting through the second seam of the front tent. In the center, at the rear of the rear tent, erect a tent stove, center of the stove about 36 inches from the rear upright. The heat radiated by the oven and by the tent stove is sufficient for all purposes. This method has been tried and a temperature of 85° F. maintained in the two tents when a thermometer outside registered 10° F. below zero.

94. Tentage.—Tentage consists of pyramidal, large and small; wall, large; and storage tents. In permanent camp, all tents should be floored, framed, and screened. It is almost impossible to keep flies out of the bakery under the most favorable conditions. The tents of the men should also be screened. Because of night work, it is sometimes necessary for a number of the men to sleep during the day and they should be allowed to rest without being disturbed by flies or mosquitoes.

95. Sponge cans.—Seven sponge cans are sufficient for each unit. Only one cover is provided. It is for the hot water can which is set on the apron at the rear end of the oven. For transportation, the small articles are put in the top can for the nested cans.

96. Colander.—The colander is used for straining liquid yeast.

97. Proof rack.—The proof rack is for holding the pans during the period of pan proofing. In summer the proof rack should be covered with a mosquito bar to exclude flies. If necessary, in cold weather, the canvas cover is put on and pans filled with hot water set on the lower shelf. To keep the water hot, add hot bricks from time to time or put a second pan filled with live coals under the first. (Use of live coals by inexperienced men is a fire hazard.)

98. Molding tables.—The molding table is made of poplar. Some models are furnished without legs, but with cleats on the bottom which fit the trough and permit the table to rest on it without slipping. The table is usually provided with legs which are attached to the bottom in such a manner that they may be folded up against it when the table is not in use.

99. Thermometers.—*a. Oven thermometer.*—The oven thermometer is of the expansion spring type. These thermometers do not register alike and bakers must learn the registration of the thermometer for each oven to insure the proper baking temperature. Some ovens will have the right heat when the expansion thermometer registers 450° F.; others at 600° F.

b. Combination thermometer.—If the thermometer is not used to get temperature of the flour and mixing tent before making the dough, the water used must be taken by guesswork. Apparently unexplainable differences in the time of proofing of doughs or the appearance of different runs of bread usually may be traced to failure to use, or carelessness in the use of, the thermometer when mixing the dough or regulating the heat of the mixing tent. The case of the combination thermometer is practically indestructible if used with ordinary care.

100. Dough troughs.—*a.* Two dough troughs are furnished to each unit. For transportation, the legs are folded and the troughs nested.

b. Canvas covers for dough troughs are used to cover the mixed dough to conserve the heat, keep the dough from crusting, and exclude flies and dust.

101. Handling equipment.—*a.* When the field bakery is moving frequently and is transported by wagon or motortruck, time is usually limited and no attempt for accuracy in laying out the camp should be made.

b. The wagons are halted in the vicinity of the site; the officer in charge, assisted by the chief baker and the chiefs of sections, paces off the distances and sets stakes for the front of each tent and the front of the ovens. Each unit is unloaded at a point convenient to its own site (usually between the fire pit and the store tent line). Each chief of section then directs the pitching of camp and the setting up of the equipment for his section. Two men from each unit dig the fire pits. The remaining men pitch the tents. Tents are not ditched at this time. An experienced detail should have the tents up by the time the fire pits are dug. The men of each unit set up the oven and start the fire. They then clean the equipment. When the equipment is ready, the doughs are started.

c. If supplies are not immediately on hand, details to haul wood, water, flour, etc., should be made as soon as the wagons are unloaded. An experienced company should have camp pitched, the ovens up and fire started, and be ready to begin mixing dough in 4 hours after arrival at the camp site.

d. Convenience to good water is the first consideration in selecting a temporary camp site. Each unit will use a minimum of 200 gallons of water a day when making continuous runs.

e. Troughs, cans, pans, etc., should always be well cleaned before packing for transportation, so as to avoid the necessity of waiting for hot water to clean them upon arrival in the new camp.

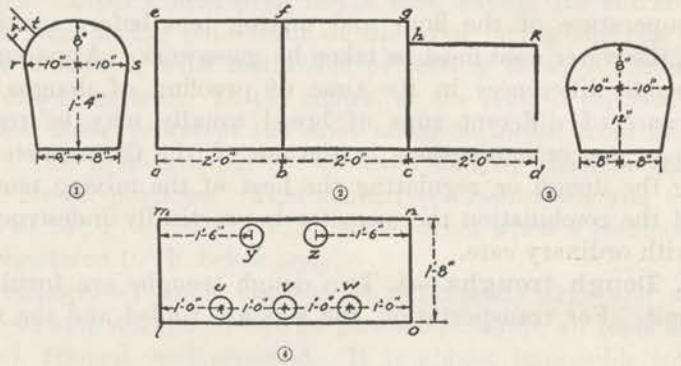

FIGURE 5.—Plan of trench cover.

102. Trenches.—*a.* To construct a trench cover, dig a trench with sloping sides 30 inches deep, 5½ feet by 7 feet at the surface of the ground, and 4½ feet by 6½ feet at the bottom of the trench. Make two wooden forms of the following dimensions: the larger, 4 feet long, 24 inches high, 20 inches wide at 16 inches from the bottom, and 16 inches wide at the bottom; the smaller, 2 feet long, 20 inches high, 20 inches wide at 16 inches from the bottom, and 16 inches wide at the bottom.

b. Figure 5① shows a cross section of the larger form and figure 5② a cross section of the smaller. Put a vertical partition across the center of the larger form and close both ends of each form. Nail them together end to end. Figure 5③ shows longitudinal section of forms after being nailed together. The partition is shown at *b–f*.

c. Cut a small hole in the end *d–k*. Place the form in the trench with the end *d–k* against the rear end of the trench and the end *a–e* 6 inches from the front end and with a space of 19 inches between the sides of the form and the side of the trench. Figure 5④ is a horizontal projection of the upper surface of the larger form. Place five stovepipe joints on the end so that their centers will be at *u*, *v*, *w*, *y*, and *z*, and they will be perpendicular to the upper surface of the form.

d. Now fill the trench to the level of the surface of the ground with clay thoroughly mixed with 10 or 15 pounds of hay or green grass,

pack well, and smooth the surface. Before firing, allow the clay to dry for 2 days or more. To fire, dig a sloping trench 18 inches wide, 4 feet long, and 30 inches deep, at the rear end of the form. Build a small fire against the hole in the rear end of the form and allow the form to burn out slowly. When it has burned out, remove the pipe joints. As soon as the clay is cool, the oven may be placed over the trench. If clay is not available, use a very stiff mixture of 1 part flour and 18 parts sand. Allow this mixture to stand 3 days before firing. Burn out slowly. Sod may also be used, but the life of the trench will be only 7 to 14 days. During the construction, keep the sod damp.

e. Clay trench covers constructed as above have been used for a year and were in good condition at the end of that time.

103. Expedients.—Occasions are sure to arise when it is desirable to bake bread in the field when regular baking equipment is not provided. Under these circumstances, the essential fundamentals to be followed in the construction of earth or clay ovens must be thoroughly understood as well as the methods to be followed in preparing and preserving yeasts and proofing the sponge and dough.

a. Ovens.—(1) *Heat and construction.*—The entire procedure of baking is based upon the fact that for each ration of bread baked a certain number of heat units must be provided at a temperature from about 385° F. to 450° F., striking the top and bottom of the loaf with about the same intensity. The quantity of the heat available must be such that a baking temperature will be maintained from 30 minutes to 1½ hours, depending upon the depth of the dough to be baked. Such ovens as are constructed in the field must generally be of the simplest type possible; that is, of a single chamber in which the fire is built and withdrawn after sufficient heat has been stored up in the surrounding material to do the necessary baking. Such ovens are generally called "straight-fire" or "draw-fire" ovens, and for temporary use are very satisfactory, though they are more laborious to handle than continouous ovens. In the construction of these ovens, the following points should be kept in mind:

(*a*) The oven must be built of material suitable for absorbing and retaining the heat required in baking. Brick, rock, adobe, clay, sods, sand, and loamy soil will all do if properly handled.

(*b*) About 8 inches of earth of any kind is required to take up and radiate sufficient heat for baking even small batches of bread. A greater depth on top of an oven will cause premature breaking down; a lesser amount will not generally retain sufficient heat.

(*c*) A slow fire must be placed in the oven in order that the heat may be gradually taken up in the surrounding material. A flash heat will quickly heat up the lining of the oven and produce an intense heat for a short time, but to store up a sufficient amount of heat requires a long, slow firing.

(*d*) The greatest difficulty is in getting a bake on the bottom of the loaves in newly constructed ovens, as the heat from the fire rises from the bottom, which is further protected by the ashes as they accumulate. In damp and loamy soils, a hearth of stone or brick should be provided to overcome this difficulty.

(*e*) Damp soil cannot take up and radiate sufficient heat between 385° and 480° F. to bake bread. Hence the material immediately surrounding an oven must be thoroughly dried out before any attempt is make to bake. Generally a slow fire for several hours will be necessary before the first baking can be made, but after a successful baking, not more than 45 minutes to 1 hour will be required for heating the oven and equalizing the temperature by closing the oven tight after the fire is drawn.

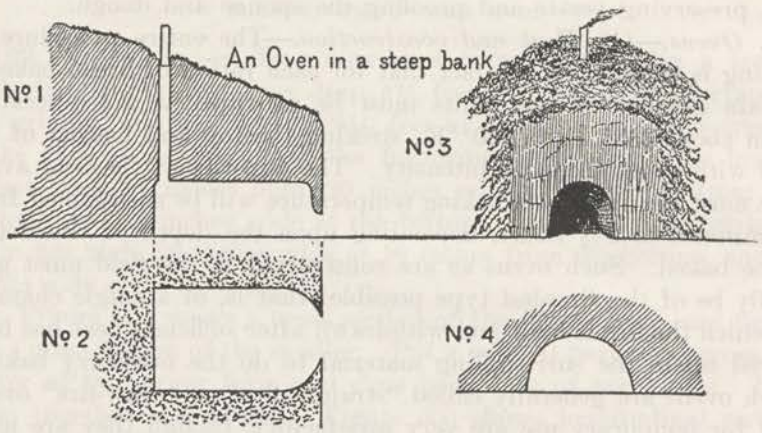

FIGURE 6.—Extemporary oven built in a bank. No. 1, longitudinal section; No. 2, plan; No. 3, front view (not on the scale); No. 4, transverse section of interior.

(2) *Oven in a steep bank.*—A bank from 4 to 6 feet high is the best for the purpose. The roof covering need not exceed 1½ feet. Two men with a spade and a long-handled shovel can build it, in light soil, in 45 minutes. If such tools are not available, it may be constructed with trowel, bayonet, intrenching tools, or even with knives. To build the oven, dig down the bank to a vertical face and excavate at the base a hole from 4 to 5 feet horizontally, care being taken to

keep the entrance as small as possible; hollow out the sides of the excavation and arch the roof until the floor is about 2 feet 6 inches in its widest part and the roof is 16 inches high to the center of the arch. Then tap the back end for the flue. A hole from 4 to 6 inches in diameter will furnish a good draft. A piece of tent stovepipe may be utilized for this purpose. When difficult to construct, the flue may be omitted and practically as good results will be obtained. The time required for drying will depend upon the character of the soil; if ordinarily dry, a fire kept up for an hour will suffice. After the oven has been heated, the temperature may be regulated by means of the door and flue, opening or closing them as may be necessary. This is recommended as a very good and convenient oven.

(3) *Construction and operation of two-barrel clay oven.*—(*a*) Select a piece of level ground 5 feet by 9 feet. Take two salt or sugar barrels, knock top and bottom from one and a small section from the bottom of the other. Place the two barrels together, end on, the barrel with bottom intact to the rear.

(*b*) Cover both barrels completely with moist sand; the sand should be about 2 inches deep on top and splay outward at the bottom to about 4 inches. In placing the sand about the form, care must be exercised not to use too much force.

(*c*) Make a good stiff mixture of clay and grass or hay. Cover the sand, beginning at the bottom and working upward, using the hands. Clay should be 12 inches thick at the bottom and taper to 6 inches at the top. Make a shoulder at each side on the front end of the trench to hold the sheet iron door. This shoulder should extend to the front of the oven proper so that the sheet iron will fit flat against the oven chamber.

(*d*) After the form is completed, allow to stand for 48 hours and then burn out the barrels. Use just enough wood to set fire to the barrels. When the barrels are burned out, scrape out the sand from the top and sides and the oven is complete.

(*e*) If material is available, before constructing the walls of the oven lay a brick floor 3 feet by 8 feet. Set the barrels on the floor and then proceed as before indicated, the clay walls resting outside the brick floor.

(*f*) Metal oil drums may be used in similar manner to offset need of use of wooden barrels.

(*g*) To obtain the best results with this type of oven, it is best to start the fire as soon as the dough is set; keep up a moderate brisk fire for about 2 hours; as soon as the dough is punched down, spread the

coals evenly over the floor of the oven and close up tight. This is to equalize the temperature at all parts of the oven. As soon as the bread is in the pan, draw all the coals from the oven and close for about ½ hour, then take the count; 7 counts is the proper heat. If less than 7, the oven is too hot; if more than 9, the oven is too cold and will not bake issue bread.

(*h*) The oven is the right temperature when the hand may be held for 7-second counts parallel to the bottom of the trench and 1 inch from it. Or, if a little flour is scattered on the bottom of the trench, it should brown in about 2 minutes.

(*i*) This oven will hold 5 pans, each 12 by 24 inches, and if properly handled will bake as good bread as any oven made.

(*j*) To make a second run, put in another fire for about 45 minutes, draw the coals, and close up the oven for about 15 minutes, and the oven is ready for a second run.

(*k*) It is a great convenience in handling the bread if a 2-foot trench is dug in front of the oven.

b. Baking in the open trench.—A trench is dug about 6 feet long, 15 inches wide, and 1 foot deep. A fire is built in the trench about 2 hours before time to bake. A few minutes before the loaves are ready, the coals are withdrawn and the trench swept clean. The loaves (Vienna-shaped and very dry on the exterior) are carefully laid in the trench about 3 inches apart, covered with an iron sheet of any kind, and the coals which were drawn from the trench distributed over the top. By carefully watching the bread and regulating the top heat, most excellent bread may be produced. In an oven of the dimensions given, twenty-five 1-pound loaves may be baked. If possible, the bottom should be floored with brick or stone.

104. Facilities for bread production.—*a.* The extent of the dispersion of troops, road, and other transportation facilities, etc., will decide the method of bread production. Permanent large mechanical bakeries equipped to produce bread requirements for any Army or larger forces may be constructed and operated. Bread produced in such bakeries will be forwarded by rail or motortruck and distributed to troops similar to other class I supplies. Under such conditions, the use of field bake ovens will be minimized. However, existing conditions may preclude practical long haulage of supplies, in which event the operation of field bake ovens becomes a necessity. It therefore behooves all who will be connected in any way with the supply of bread to troops in the field to familiarize themselves thoroughly with the field bake oven and its allied equip-

ment, and the methods, formulas, etc., used to produce either garrison or field bread with such equipment.

b. The field bake oven has been successful over a long period of Army history. For its size and service requirements, it has always proved satisfactory and equal to all emergencies. It is possible that some type of oil burner may be supplied; this will not radically change the procedures set forth in this manual.

SECTION XII

BAKERY SANITATION

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Bakery building 106
Cleaning equipment 107
Prevention of insect infestation 108
Disposition of infested flour 109
Rats and mice 110
Rope 111
Mold 112

105. Personal cleanliness.—Post bakery personnel should be scrupulously neat. Because of the nature of their work, bakers should bathe daily, making a complete change of underclothing. They should be amply provided with white trousers, aprons, and caps, furnished and laundered in accordance with current regulations. All personnel handling dough or bakery equipment should be required to wash their hands thoroughly and clean their fingernails several times during each day. The installation of a shower bath in the post bakery building for use by bakery personnel is highly desirable. Smoking by personnel while inside the bakery should be strictly prohibited.

106. Bakery building.—There cannot be too many windows, skylights, etc., in a post bakery. The greater the amount of sunlight admitted to a bakery building, the better the sanitary conditions will be. Exposure to the penetrating rays of the sun is one of the most effective forces in defeating the growth and propagation of microorganisms. Dust and dirt accumulations may be readily seen and action taken to eliminate them if a bakery is well lighted, while such accumulations may remain unnoticed for some time in a relatively dark bakery. Cement or composition flooring is preferable to wooden flooring. Wooden floors, in addition to providing hiding places for dirt, vermin, etc., in the cracks, are not well adapted to

thorough washing by the use of hose. White tile walls, or at least tile wainscoting, should be provided whenever practicable. If tiling is not available, all walls of the bakery should be painted white. Paint so used should be of a type that will withstand frequent washings with hot water. Sharp corners between floor and walls should be avoided, if possible. All windows and doors should be equipped with tightly fitting wire screens so as to exclude flies and similar insects.

107. Cleaning equipment.—The necessity for clean utensils and equipment is paramount. The mixing machine and dough troughs should be thoroughly cleaned and then lightly greased immediately upon completion of use each day. Sourness in bread is frequently caused by particles of dough becoming lodged in the mixing arms of the mixing machine and the corners of the dough troughs. This dough decays or becomes sour through the action of lactic and acetic bacteria and readily imparts this sour or "off flavor" to any new batch of dough with which it comes in contact. The molding table should be scrubbed with boiling water daily and special care taken to remove any dough or dirt that may become lodged in the joints of the top surface. Bread cooling racks should be brushed clean daily, or washed if necessary. Accumulations of particles of crust and bread crumbs on cooling racks or floor should be constantly guarded against. Wooden shelving, cupboards, bread boxes, etc., are great cockroach and vermin gatherers and, as far as possible, should be eliminated. Sinks should be set out from the wall and all exposed plumbing work so installed as to provide ready access to all joints, angles, etc. This permits thorough cleaning thereby preventing favorable breeding places for vermin. Metal pan racks set on wheels are preferable to those made of wood. Bread pans should be inspected daily to prevent accumulation of bread particles. All pans should be thoroughly washed in boiling soapy water at frequent intervals. Pans that emit a rancid odor should be thoroughly washed with a lye solution. Pans so cleansed should then be treated as new bakepans, that is, they should be "burned in." "Burning in" is accomplished by washing bakepans thoroughly with hot, soapy water so as to remove paraffin or mineral oil coating, then lightly coating the interior sides, and bottom with a vegetable or animal fat or oil, then baking them, empty, in an oven of from 250° to 300° F. for a period of 1 to 1½ hours.

108. Prevention of insect infestation.—Much greater effort and expense are required to rid a bakery of insects after they have gained entrance than are necessary to prevent them from getting in. Un-

fortunately, the average temperature and humidity conditions in a bakery are conducive to growth and multiplication of insects. In addition, flour and other baking ingredients are ideal food for them. Hence, if insects gain entrance to the bakery, steps must be taken immediately to eliminate them and corrective measures instituted to prevent recurrence through similar means of entrance. Inasmuch as insects live and thrive mainly on food which has accumulated in cracks and crevices, it is very important that all parts of the bakery be kept clean. Frequently, insects infesting a bakery originate from a breeding place in the immediate vicinity of the bakery. Therefore, care should be taken to insure that the premises outside the bakery are kept clean and free from accumulated rubbish, filth, and other organic matter. If after all preventive measures are taken, the bake shop becomes infested with vermin, elimination should be effected by one or more of the following methods:

a. Heat treatment.—Remove all flour and other ingredients that would be affected by high temperature. By the use of stoves, open ovens, etc., heat the building to approximately 125° F. Fasten all doors, windows, etc., securely so as to confine the heat in the building. Maintain the temperature of 125° F. for at least 3 hours. The excessive heat will drive insects from their hiding places into the open, and the prolonged exposure to heat will kill them. Subsequent to such treament, the building should be thoroughly cleaned to remove all dead insects. Before replacing flour and other ingredients removed from the building, be sure to inspect them thoroughly for the presence of insects.

b. Use of disinfectants and insecticides.—The use of disinfectants and insecticides, either in powdered or liquid form, is often very effective. However, great care should be exercised to avoid the use of materials for this purpose which may also be poisonous to man or may impart an "off odor" to flour or other ingredients stored in the bakery. Before using products of this nature, the advice and approval of the post medical authorities should be obtained. A common ingredient in most commercial disinfectants is sodium fluoride.

c. Fumigation.—Fumigation must be resorted to occasionally. Fumigating materials are often injurious to food products and machinery and in some cases are poisonous. When it becomes necessary to fumigate, the fumigant to be used, its method of application, and the supervision of the work should be left to appropriate medical or chemical authorities.

109. Disposition of infested flour.—If flour becomes only slightly infested with beetles (commonly referred to as weevils), it

is not materially harmed. Beetles may be removed by sifting flour through a fine mesh sieve. Badly infested flour should be surveyed with a view to disposition for purposes other than human consumption.

110. Rats and mice.—While rats and mice cannot be classed as insects, they are pests that should be kept out of the bakery. The most effective preventive method is to "build them out"; that is, to be sure that there are no cracks, holes, etc., in either the floor or the walls of the bakery. Traps are considered the best means of extermination. The bait in traps should consist of a type of food not otherwise available in the immediate vicinity, such as meat for traps in the bakery and bread or cheese for traps in the butcher shop. The use of rat poison is very dangerous because, either through carelessness or by being carried by the rats and mice, it may come in contact with ingredients which will subsequently be used in making bread. Furthermore, poisons often cause the rats to die while underneath the floors or between the walls of the building, making it difficult to effect their removal and resulting in an objectionable, unsanitary condition.

111. Rope.—*a. Description.*—Rope is a bacterial disease of bread and is one of the worst troubles of the baker, for when once started, it is very difficult to eradicate. It first appears in about 24 hours after baking, but in hot climates may appear much sooner. The first symptom is an odor resembling ripe cantaloupe. This is followed by the formation of yellow or brown spots in the crumb, these spots having soft and sticky centers. The spots increase in size until, in about 36 to 48 hours, the entire crumb of the loaf is changed into a strong smelling, brownish, soft, and sticky mass which can be pulled into strings or ropes. Such bread is entirely unfit for food.

b. Cause.—Rope is caused by the growth of certain kinds of bacteria. These bacteria may occur in nature on the surfaces of grains, potatoes, and other vegetables, and in the soil. Flour milled from infected wheat will contain them. The lower-grade flours, which contain more of the outer portions of the wheat kernel, will contain more than the better patent flours. Storage of flour in a warm, damp place will cause a great increase in the number of these bacteria. The bacteria causing rope are resistant to heat, and any spores present in the center of the loaf are not killed at the baking temperature. Moist, warm conditions favor the development of rope, which may be considered as a hot-weather bread disease. The bacteria causing rope cannot grow in an acid medium, so the devel-

opment of an acid fermentation or the addition of acid will prevent ropy bread.

c. Sources.—The chief source of rope infection is the flour. Most ropy flours are the inferior grades of flour, or better grades that have been stored in a warm, moist atmosphere, such as the hold of a transport. Potatoes are another common source, the organism causing rope being sometimes called the potato bacillus. Storage of flour near potatoes or the use of potato yeast may be a cause of ropy bread. Lack of cleanliness in the bakery and imperfect cleaning of troughs, buckets, and other utensils will favor the development of rope and prevent its eradication. Forcing of doughs too much in warm weather and long storage of flour and bread in warm, moist climates will favor the growth of rope.

d. To combat.—(1) Flour that is known to have produced ropy bread should not be used. The presence of a large number of rope organisms in a flour can be detected by laboratory methods. Suspected flour should be examined and if found unsuitable for use, steps should be taken for its condemnation. Unless there has been trouble with ropy bread, caution must be used in condemning a flour because any flour may contain a few of the rope bacteria. A flour that may cause ropy bread in a warm climate may be used without this trouble in a cold climate or in winter.

(2) The bakery should be kept in a sanitary condition. On the appearance of rope, the shop should be thoroughly cleaned and all dust, dirt, old bread, dough, etc., removed and burned. The floor, troughs, and all utensils should be cleaned and then sterilized with live steam and washed with a solution of boric acid or boiling vinegar. Fumigation of the bake shop or tentage by formaldehyde or sulphur is practically useless in an infection of this kind.

(3) When danger from rope exists, do not force the dough but keep the temperature as cool as possible (not over 80° F.) and allow a slow fermentation with an extra punching of the dough if necessary. Favor the development of a slight acid fermentation, as rope will not develop in a sour dough.

(4) Add vinegar to each dough; mix in the proportion of 1 quart of vinegar to each 100 pounds of flour. This is an absolute preventive. Other acids may be used, but vinegar is the most convenient and satisfactory acid substance available. A 5 percent solution of acetic acid may be substituted for vinegar. Use one quart of this solution to each 100 pounds of flour.

(5) Bread should be cooled promptly, the bread room should be well ventilated and the loaves separated so that the bread will dry out well.

112. Mold.—*a.* Molds are microscopic organisms which grow under suitable conditions of food, warmth, and mixture. There are many kinds of molds. Many of them develop different colors during growth and give unpleasant flavors to the product upon which they grow. Not all are harmful to health, but their appearance is objectionable and indicates spoilage of the food upon which they are growing. There is no particular mold confined to bread, but under suitable conditions any mold may appear. Mold growth starts on the outside of the loaf and proceeds to the interior. A heavy crust is unfavorable to its development. Mold generally requires several days to develop in bread.

b. The source of molds in bread is from the air or from things with which the bread comes in contact. The spores of molds are present to a greater or less extent in air and on the surfaces of all objects. Unclean surroundings favor an increase in their number. The temperature of baking is sufficient to kill all molds and their spores present in the loaf, so any infection takes place after the bread leaves the oven. Infection of the bread comes from the air, hands of the bakers, bread racks, and other points of contact with sources of mold.

c. Growth of mold is favored by moisture in the air and in the bread, warmth, and darkness, and by increased quantities of sugar in the bread.

d. To prevent moldy bread—

(1) Be sure that the bread is thoroughly baked. A hard, thick crust will hinder penetration of mold into the loaf and is desirable for bread intended for long keeping.

(2) The cooling room should be clean, cool, and dry, and the loaves should be separated so as to allow thorough drying. Sunlight is an important factor in keeping down molds.

(3) Observe proper sanitary conditions, such as—

(*a*) Daily scrubbing of floors.

(*b*) Frequent washing of walls and ceiling with antiseptic solutions.

(*c*) Cleaning and steaming of utensils.

(*d*) Clean clothes and clean personal condition of bakers.

(4) Do not permit stale bread to contact freshly baked bread.

(5) When mold is found, take prompt and thorough steps to remove it and clean and sterilize the places infected.

(6) Do not attempt to eliminate mold by the use of vinegar. Unlike rope, mold thrives in an acid medium; therefore, the use of vinegar would encourage, rather than hinder, its development.

SECTION XIII

WEIGHTS, MEASURES, AND TABLES

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113. Measures.

a. Dry.

2 pints = 1 quart = 1.101 liters.
8 quarts = 1 peck = 8.811 liters.
4 pecks = 1 bushel = 35.24 liters.

b. Liquid.

4 gills = 1 pint = 473.25 cubic centimeters.
2 pints = 1 quart = 0.9465 liters.
4 quarts = 1 gallon = 3.786 liters.
31½ gallons = 1 barrel.
2 barrels = 1 hogshead.

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114. Conversion tables.

a. Liquid measures.

	United States measure				Imperial measure (British)				Metric measure		Weight of indicated volume of water	
UNITED STATES MEASURE	*Gallons*	*Quarts*	*Pints*	*Gills*	*Gallons*	*Quarts*	*Pints*	*Gills*	*Liter*	*Cubic centimeter*	*Pounds (avoirdupois)*	*Kilograms*
1 gallon	1	4	8	32	0. 833	3. 33	6. 66	26. 66	3. 785	3785. 4	8. 33	3. 785
1 quart	. 25	1	2	8	. 208	. 833	1. 666	6. 67	. 946	946. 4	2. 08	. 946
1 pint	. 125	. 5	1	4	. 104	. 417	. 833	3. 33	. 473	473. 2	1. 04	. 473
1 gill	. 031	. 125	. 25	1	. 026	. 104	. 208	. 833	. 118	118. 3	. 26	. 118
IMPERIAL MEASURE (BRITISH)												
1 gallon	1. 2	4. 8	9. 6	38. 4	1	4	8	32	4. 543	4543. 5	10	4. 543
1 quart	. 3	1. 2	2. 4	9. 6	. 25	1	2	8	1. 136	1135. 9	2. 5	1. 136
1 pint	. 15	. 6	1. 2	4. 8	. 125	. 5	1	4	. 568	567. 9	1. 25	. 568
1 gill	. 038	. 15	. 3	1. 2	. 031	. 125	. 25	1	. 142	142. 0	. 312	. 142
METRIC MEASURE												
1 liter	. 264	1. 057	2. 11	8. 45	. 220	. 880	1. 761	7. 044	1	1000	2. 20	1
1 cubic centimeter	. 0003	. 001	. 002	. 008	. 0002	. 0009	. 002	. 007	. 001	1	. 002	. 001

b. Teaspoons; tablespoons; cups; miscellaneous.

Ingredient	Cup	Ounces	Teaspoons	Ounces	Tablespoons	Ounces
Baking powder			1	⅛	1	⅜
Butter	1	7¾			2	1
Chocolate (cut fine)	1	7¾				
Chocolate (melted)	1	8¾	1	½		
Cocoa	1	2¾			4½	1
Corn meal	1	8⅜	1	⅛	1	⅜
Cream of tartar			1	⅛	1	⅜
Flavoring extract			1	⅛	1	⅜
Flour, cake (unsifted)	1	4¼	1	⅛	1	5/16
Flour, cake (sifted)	1	3¾				
Flour, bread (sifted)	1	4¼				
Flour, bread (unsifted)	1	4¾				
Milk, whole	1	8½				
Milk, powdered, skim	1	4¾				
Nuts, ground	1	4¼				
Nuts, shelled	1	4				
Raisins	1	5¼				
Rolled oats	1	2⅜				
Salt			1	⅛	2	1
Shortening	1	7	1	⅛	1	⅜
Soda, baking			1	⅛	1	⅜
Spices, ground			3	¼	1	¼
Sugar (brown)	1	5½				
Sugar, granulated	1	8	1	⅛	1	⅜
Sugar, powdered	1	5	3	¼	1	¼
Sirup	1	12	1	¼	1	¾
Water	1	8	1	⅛	1	⅜

3 teaspoons	=1 tablespoon.
16 tablespoons dry ingredients	=1 cup.
12 tablespoons liquid ingredients	=1 cup.
2 cups liquid	=1 pint.
4 cups liquid	=1 quart.
9 to 10 eggs (minus shell)	=1 pound.
5 whole eggs	=1 cup or 8 ounces.
8 egg whites	=1 cup or 8 ounces.
12 egg yolks	=1 cup or 8 ounces.

c. Conversion of Fahrenheit degrees to centrigrade degrees of temperature.

RULE.—Subtract 32 from Fahrenheit degrees. Multiply the result by 5/9 and this result is the corresponding degrees centigrade.

Fahrenheit	= *Centigrade*	*Fahrenheit*	= *Centigrade*
0	−17. 8	85	29. 4
10	−12. 2	90	32. 2
15	−9. 4	95	35. 0
20	−6. 7	100	37. 8
32	0	110	43. 3
35	1. 7	120	48. 9
40	4. 4	130	65. 6
45	7. 2	200	93. 3
50	10. 0	212	100. 0
55	12. 8	250	121. 1
60	15. 6	300	148. 9
65	18. 3	350	176. 7
70	21. 1	400	204. 4
75	23. 9	450	232. 2
80	26. 7	500	260. 0

d. Conversion of centigrade degrees to Fahrenheit degrees of temperature.

RULE.—Multiply centigrade degrees by 9/5 and add 32. The result is the equivalent in Fahrenheit degrees.

Centigrade	= *Fahrenheit*	*Centigrade*	= *Fahrenheit*
0	32	50	122
10	50	75	167
15	59	100	212
20	68	125	257
25	77	150	302
30	86	175	347
35	95	200	392
40	104	225	437
45	113	250	482

e. Conversion of avoirdupois to metric system of weights.

1 pound or 16 ounces= 453.6 grams or 0.454 kilograms.

1 ounce or 0.0625 pounds=28.35 grams or 0.0283 kilograms.

NOTE.—For practical calculations use 453 grams as being equal to 1 pound and 28 grams as equal to 1 ounce.

f. Conversion of ounces to pounds; pounds to ounces; and fractions of pounds to decimals of pounds.

RULE.—To change pounds to ounces multiply by 16. To change ounces to pounds divide by 16.

Ounces	*Pounds Fractions*	*Decimals*	*Ounces*	*Pounds Fractions*	*Decimals*
1	1/16	0. 0625	15	15/16	0. 938
2	1/8	0. 125	16	1	1. 000
3	3/16	0. 188	17	1 1/16	1. 063
4	1/4	0. 25	18	1 1/8	1. 125
5	5/16	0. 313	19	1 3/16	1. 188
6	3/8	0. 375	20	1 1/4	1. 25
7	7/16	0. 438	30	1 7/8	1. 875
8	1/2	0. 5	40	2 1/2	2. 5
9	9/16	0. 563	50	3 1/8	3. 125
10	5/8	0. 625	60	3 3/4	3. 75
11	11/16	0. 688	70	4 3/8	4. 375
12	3/4	0. 75	80	5	5. 000
13	13/16	0. 813	90	5 5/8	5. 625
14	7/8	0. 875	100	6 1/4	6. 25

NOTE.—For a given number of ounces or fraction or decimal of pound not listed above, add two or more numbers listed above which will equal given number and then add the corresponding equivalents.

g. Weights of water and pails of water.

One pint of water=approximately 1 pound.
One quart of water=approximately 2 pounds, 1⅓ ounces.
One gallon of water=approximately 8.35 pounds.
A 10-quart pail of water contains 20 pounds 14 ounces of water.
A 12-quart pail of water contains 25 pounds of water.
A 14-quart pail of water contains 29 pounds 3 ounces of water.

h. Conversion of milk in forms other than liquid whole milk to approximate equivalents in liquid whole milk.

Liquid whole milk	Evaporated milk			Dry skim milk						Dry whole milk			
	Milk (evap.) (14½ oz. cans)	Water		Milk (dry skim)		Butter or shortening		Water		Milk (whole dry)		Water	
		Lb.	Oz.	Lb.	Oz.	Lb.	Oz.	Lb.	Oz.	Lb.	Oz.	Lb.	Oz.
1 quart (2.1 lb.)	1	1	---	---	3	---	1	1	14	---	4	1	12
1 gallon (8.6 lb.)	4	4	---	---	12	---	4	7	6	1	---	4	---
5 pounds	2½	2½	---	---	7	---	3	4	6	---	10	4	6
10 pounds	5	5	---	---	14	---	6	8	12	1	3	8	13
20 pounds	10	10	---	1	12	---	11	17	9	2	6	17	10
30 pounds	15	15	---	2	10	1	---	26	6	3	9	25	7
40 pounds	20	20	---	3	8	1	6	35	2	4	12	35	4
50 pounds	25	25	---	4	6	1	12	43	14	5	15	43	1
60 pounds	30	30	---	5	5	2	1	52	10	7	2	51	14
70 pounds	35	35	---	6	3	2	6	61	7	8	5	60	11
80 pounds	40	40	---	7	1	2	12	70	3	9	12	70	4
90 pounds	45	45	---	8	---	3	2	78	14	10	14	79	2
100 pounds	50	50	---	9	---	3	8	87	8	12	---	88	---

NOTE.—While Federal standards require the use of butterfat in reconstituting dry skim milk to whole milk, for Army Bread-making purposes either the same weight as butter in lard or lard substitute may be used.

Explanation of use of milk conversion chart: A certain formula for bread requires the use of 60 pounds of liquid. In lieu of all water, it is desired to use half (30 pounds) of water and half (30 pounds) of milk. By referring to conversion table, it will be seen that either of the following may be used for the milk ingredients: 30 pounds of liquid whole milk or—15 cans of evaporated milk+15 pounds of water or—2 pounds 10 ounces of dry skim milk+1 pound of shortening+26 pounds 6 ounces of water or—3 pounds 9 ounces of dry whole milk+25 pounds 7 ounces of water.

Formula using all water	Formula using half water, half milk (evaporated milk as milk ingredient)	Formula using half water, half milk (dry skim milk as milk ingredient)	Formula using half water, milk (dry whole milk as milk ingredient)
Flour 100 lb.	Flour 100 lb.	Flour 100 lb.	Flour 100 lb.
Water 60 lb.	Water 45 lb.	Water 56 lb. 6 oz.	Water 55 lb.
Milk	Milk, evaporated 15 cans.	Dry skim milk 2 lb. 10 oz.	Dry whole milk 3 lb.
Yeast 2 lb.	Yeast 2 lb.	Yeast 2 lb.	Yeast 2 lb.
Sugar 3 lb.	Sugar 3 lb.	Sugar 3 lb.	Sugar 3 lb.
Salt 2 lb.	Salt 2 lb.	Salt 2 lb.	Salt 2 lb.
Shortening 2 lb.	Shortening 2 lb.	Shortening 3 lb.	Shortening 2 lb.

NOTE.—The conversion table may be used for any other combination of water and whole milk to be used in the dough.

115. Reference table for cakes, etc.

Kind	Sugar, powdered	Sugar, granulated	Butter	Lard or compound	Suet	Eggs, whole [1]	Eggs, white	Salt	Flour	Baking powder	Soda	Cream of tartar	Ammonia, "H. H."	Extracts	Brandy	Rose water	Milk, evaporated	Milk, sweet	Milk, sour	Water	Molasses	Cinnamon	Cloves	Ginger	Nutmeg	Allspice	Mace	Currants	Raisins	Sultanas	Citron, candied	Lemon, candied	Orange, candied	Almonds	Almond paste	Nuts, shelled	Cornstarch	Corn meal	Cake crumbs	Coconut, shredded	Prunes	Peaches	Apples	Big cakes: Time required for baking (minutes)	Big cakes: Oven counts (number)	Layer cakes, cookies, etc.: Time required for baking (minutes)	Layer cakes, cookies, etc.: Oven counts (number)	Remarks
	Oz.	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Pt.*	*Pt.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Pt.*	*Pt.*	*Pt.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*	*Oz.*					
1. Standard basic cake mix	16	80	12	20		3		1¼	80	2½				1				3½																									120	15 to 22			See footnote 2 below for procedure on standard basic cake mix.[2]
2. Raisin pound cake	16		16			1			16					⅛			4											16															120	15 to 22			No water used.
3. Currant pound cake	16		16			1			16					⅛			4										16																	120	15 to 22			Do.
4. Plain fruit cake	16		16			1			16					⅛			6										8	8		4	2	2	4		4							120	15 to 22			Add fruit with eggs. No water used.
5. Fruit cake	16		16			1			20					⅛	3						3	½	⅛	⅛	⅛			16	16		8	2	2	4		8							240	20 to 40			Add fruit and nuts with eggs; no water used; if too stiff add a little cream. Ingredients will make 8 pounds when baked.
6. Golden layer cake or big cake	12		10			¾			16	¾ or 1				⅛				½																									60	18 to 24	20 to 30	15 to 18	Add yolks to mixture slowly before flour.
7. Silver layer cake or big cake	12			10			¾	⅛	12	¾ or 1				¼				¼																		4							60	18 to 24	20 to 30	15 to 18	Have whites well beaten and add to mixture before adding the flour.
8. Layer or large cake	12		10			¾			16	¾				⅛			4																									60	18 to 20	20 to 30	15 to 18	Add milk or water to batter; if 2 inches, make stiff batter; if 1 inch, a soft batter.
9. Layer or large cake (less expensive)	10		8			½			16	¾ or 1				⅛				½																									60	18 to 20	20 to 30	15 to 18	Do.
10. Spice, layer, or large cake		10		8		½		⅛	16	¾ or 1				⅛				½			½	⅛	⅛	⅛																			60	18 to 20	20 to 30	15 to 18	Add spices to mixture before flour.
11. Layer or large cake		8		6		¼		⅛	16	¾ or 1				⅛				¾																									60	18 to 20	20 to 30	15 to 18	
12. Raisin cake, large		8		4		¼		⅛	16	¾				⅛				¾											16															60	18 to 20			Make batter stiff to hold raisins up.
13. Plain cake		6		3		⅛0		⅛	16	¾				⅛				¾																									60	18 to 20			Stiff batter. Milk or water.
14. Plain cake, spiced		6		3		⅛0		⅛	16	¾				⅛				¾			½	⅛	⅛	⅛																			60	18 to 20			Do.
15. Pastry dough			12						16																																		20	18	Before rolling add one-half of the butter and sufficient water for a stiff dough. Roll out into about ⅛-inch sheet on a cold board. Butter and fold to about one-half its size and roll again, repeating this about 9 times or until the butter is used up.
16. Pie crust No. 1			10						16																																		30	12	Mix with cold water. Work as little as possible.
17. Pie crust No. 2				9				⅛	16																																		30	12	Do.
18. Pie crust No. 3				7				⅛	16																																		30	12	Do.
19. Biscuits				2				⅛	16	1½																																		20	15	Work as little as possible. Dough for potpie same as biscuit dough.
20. Corn cake, large		4		3		⅛		⅛	8	1																											8							60	18	Make a stiff batter.
21. Corn bread		1		3		⅛		⅛		1																											16							30	15	Make a stiff batter 1 inch deep in pan.
22. Plum pudding		4			6	¼		⅛	16	½					2						4	½	⅛	⅛	⅛		8	8		4	2	2			6										Stiff dough. Steam from 5 to 8 hours.
23. Plum duff No. 1					4			⅛	16	¾											6	½	⅛	⅛	⅛		6	6																	Do.
24. Plum duff No. 2					3			⅛	16	¾											6	½	⅛																3	3	3				Do.
25. Batte cakes		4				½ or ⅛0		⅛	16	1 or 1½																																			Soft batter if eggs are used; if not, stiffer.
26. Jelly rolls	10		1			⅛0		⅛	16	1				⅛				½																									20	16	
27. Wedding cake	14		14			1			16													¼			⅛	⅛	⅛	32	24	24	16	1	1										120	20	
28. White cake	12		6				⅔		16	½				⅛				½																									80	20	
29. Wine cakes		8	6			½			16		¼	½					½	¼									⅛																45	15	To be baked in 1-pound molds.
30. Lady cake	16		14				1		16		⅛	¼		⅛			⅛																										60	20	Wash butter thoroughly before using.
31. Angel food cake	16	16					2	⅛	12			¼		¼				¼																				4						45	20	See footnote 3 below for procedure on angel food cake.[3]
32. Sponge cake	16					1⅛			16					½												⅛																	60	20	Use strictly fresh eggs and beat well and stir in flour with beater.
33. Lady fingers	16					1⅛			18		⅛			½																													20	25	
34. Ginger pounds		3		3		⅔		⅛	16			1¼							½		10		⅛	¼		⅛																	25	15	Bake in 1 pound molds.
35. Coconut macaroons		16					½																																16					20	25	Boil sugar to breaking point; then add to the beaten eggs and stir in coconut. Bake on greased and dusted pans.
36. Almond macaroons	16						⅞0																											16									20	25	Bake on paper. When cooled turn upside down and dampen to remove.
37. Lemon jumbles	8		5			⅛			16				⅔					¼								⅛					⅛												15	15	
38. Fruit sticks	24					⅜			16				⅛																16				4										20	15	See footnote 3 for procedure on angel food cake.[3]
39. French sugar cookies		8	4			⅛			16				¼	⅛												⅛																	10	10	
40. Lemon snaps	16		8			⅛0			16				⅛	⅛																													15	20	
41. Ginger cookies		3		3		⅛0		⅛	16			½							⅛		10		⅛	¼		⅛																	10	10	
42. Scotch cookies		10		5		⅛0		⅛	16			½								⅛	2½	⅛	⅛	⅛		⅛																	20	15	
43. Spice drops		3		3		⅛		⅛	16		1								¾			⅛	⅛	⅛		⅛	⅛																	15	10	
44. Cup cakes		12	8			⅛			16				¼	⅛				½																									15	10	
45. Crumb cookies		8		5		⅛0		⅛	16			½									6																	8					20	25	
46. Kisses	24						½																																				20	25	Beat in one-fourth of sugar. Stir in the remainder after eggs are beaten. Bake on dusted pans.

[1] The ordinary number of broken eggs to 1 pint is 10. This number should be increased or decreased according to size of the eggs.

[2] Cream sugar, salt, shortening, butter, flour, vanilla; add and cream slowly whole eggs; add milk; add and mix in flour and baking powder.

[3] Beat stiff egg whites, granulated sugar, cream of tartar, salt; add vanilla or flavor blend; fold in lightly, after sifting three times, powdered sugar, flour, cornstarch. Scale at 8 or 9 ounces to tin. Bake at about 300° F.

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