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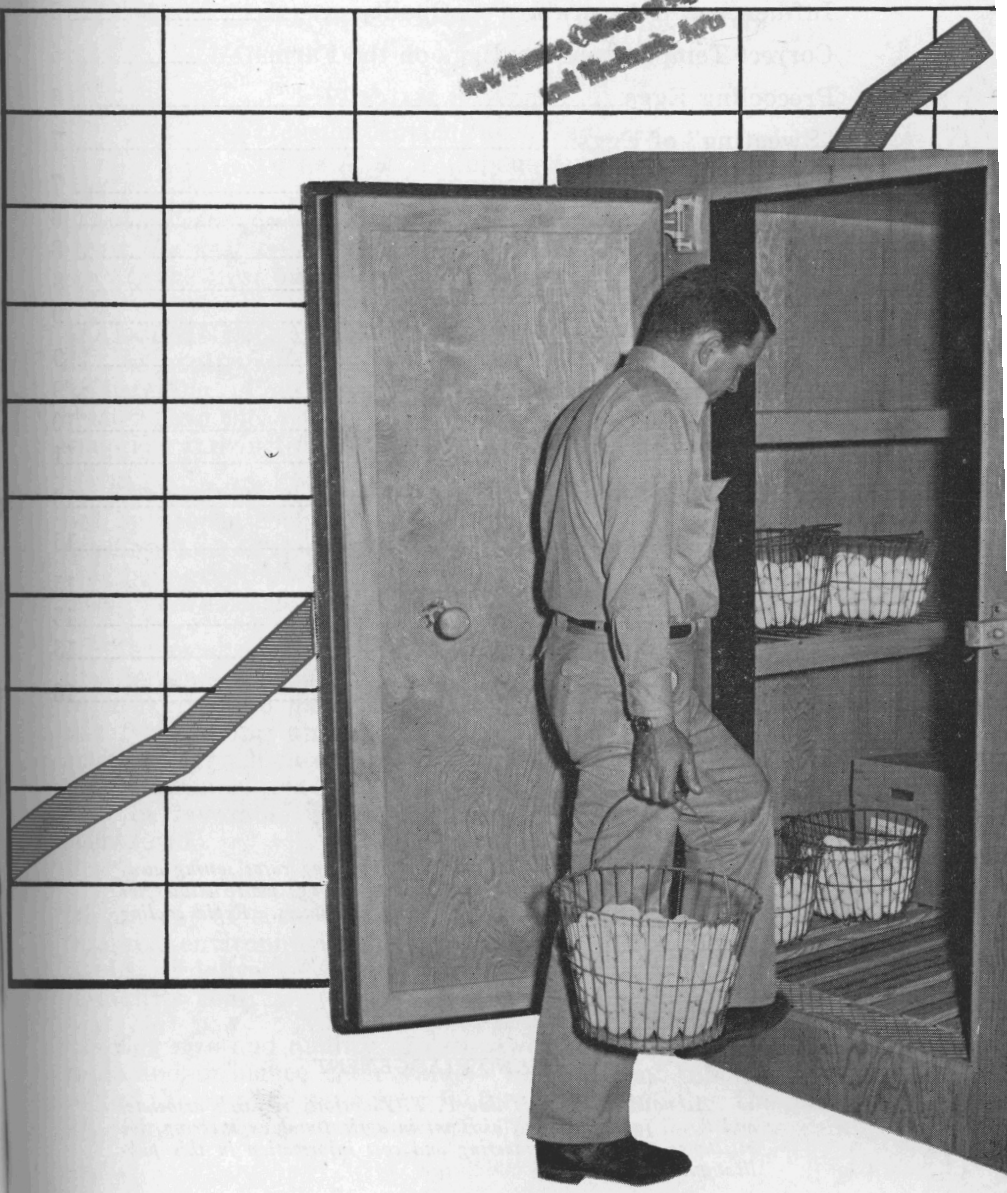
Environment affects market value of eggs



TEXAS AGRICULTURAL EXTENSION SERVICE
G. G. Gibson, Director, College Station, Texas

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COVER PHOTOGRAPH

This picture shows slats on the floor, egg cases setting away from wall and shelves with wire baskets of eggs which allows for free circulation of air around eggs and containers. Rapid cooling of eggs is obtained with this arrangement.

ACKNOWLEDGEMENT

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ENVIRONMENT AFFECTS MARKET VALUE OF EGGS

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(This bulletin gives specific information on the care of eggs from the nest or cage on the farm or ranch until they are sold to the first buyer.)

MAINTAINING HIGH QUALITY eggs concern thousands of poultrymen who produce eggs to sell as shell eggs or for hatching. Consumer appeal of high-quality eggs is much greater than those of inferior quality. This affects total consumption and in turn the price producers receive.

The problem of marketing eggs of high quality is simplified by proper cooling. Other factors affecting quality are breeding, age of flock, disease, feeding, season of year, care, handling, grading and marketing practices on the farm or ranch, at wholesale and retail levels.

The most common causes for loss in quality from nest to first buyer are time between laying and delivery, time between laying and gathering, temperature at which eggs are held from laying until delivered, speed of cooling eggs, humidity under which eggs are held, method of handling on the farm or ranch and delivery. These environmental factors must be favorable if the high quality in eggs when laid is maintained.

The number of layers and percent of production influence the amount of economic value to the producer in furnishing favorable environmental conditions. The size of the flock and number of deliveries each week determine the size cooler needed and its cost.

Egg size and quality are the two factors that determine grade and influence their value. Condition of albumen and yolk of the egg are important factors in determining the quality. Since time, temperature and humidity affect these fac-

tors as well as weight, favorable environment is highly important from the time eggs are laid until used.

The California Agricultural Experiment Station reports that albumen quality has been shown to decrease more in 4 days at 80 degrees F. than it does in 10 days at 65 degrees. They further report that a day or two of 100-degree temperature produces flatter yolks than those having been placed in cold storage for several months. Research at the Texas, Missouri and New Jersey Experiment Stations shows that there is as much deterioration in eggs held for three days at 98.6 degrees F. as in 23 days when kept at 60.8 degrees and 65 days at 44.6 degrees.

Over 3 billion eggs are produced annually in Texas. This represents several million dollars to producers. If the quality of all these eggs could be maintained at a high level, producers and handlers could receive a few more cents per dozen. This would mean thousands of dollars additional money to the industry. It also would reduce the percent loss of many eggs.

Why Cool Eggs?

When eggs are laid their temperature is approximately 105 to 107 degrees F. Since temperature is an important cause of loss or maintenance of egg quality, proper cooling is necessary. Research at University of Missouri on egg quality shows that yolks flattened very rapidly at temperatures of 80 to 100 degrees F. The yolks of eggs held at 30 to 50 degrees flattened much slower. The conclusion of the aforementioned research is that the vitelline membrane deteriorates more rapidly at high rather than at low temperatures. Research also shows that thick albumen was converted to thin albumen very rapidly at temperatures of 80 to 100 degrees F. but converted slowly at temperatures of 30 to 50 degrees F.

Since quality declines rapidly with high temperatures and since eggs are at high temperature when laid, they should be cooled to protect the quality. Quality is a major factor in egg value; therefore, if eggs are not cooled after having been laid, the economic loss will be great. When eggs are sold on grade the economic loss caused by failure to cool the eggs soon after they are laid is even more important than when sold as current receipts.

When eggs are not cooled on the farm or ranch, many become unsalable before they reach the consumer. In addition, there is much quality loss, and the price received for eggs by the producers is indirectly affected. Eggs of high quality also have greater eye appeal than those of lower quality.

Influence of Humidity on Quality and Weight

Eggs need to be in relatively high humidity to reduce moisture loss through the shell. The shell and shell membranes are porous and allow rapid evaporation when under conditions of low humidity. Moisture loss not only influences the weight of eggs but increases the chemical and physical breakdown of the yolk and albumen. As moisture is lost the thick albumen becomes thin. The vitelline membrane weakens and causes the yolk to flatten. These two characteristics indicate low quality.

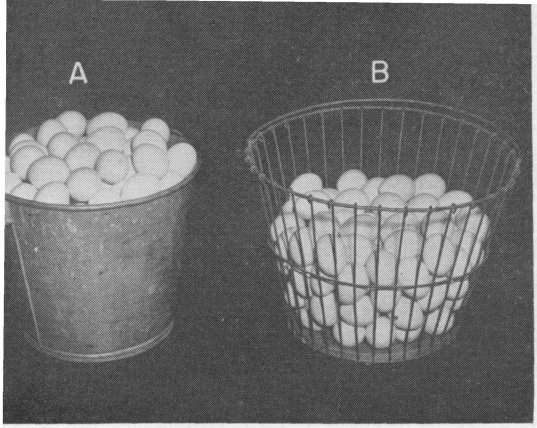
Eggs held on farms from five to seven days under conditions of low humidity and high temperatures lose weight and thus may mean a loss in sales value. Research indicates that in seven days at 55 degrees F. and 88 percent relative humidity, eggs lose approximately 0.4 percent of their weight. If eggs are held at 85 degrees F. and 75 percent relative humidity, the rate of loss is about three and one half percent in 7 days. Relative humidity in Texas normally is less than 50 percent.

Influence of Temperature on Quality

Of all environmental factors influencing the interior quality of eggs, temperature is the most important. Eggs of high quality and held under favorable environmental conditions one week will show less quality loss than when held one or two days under average Texas summer temperatures. Fertile eggs become inedible because of embryonic development when held for three days at 98 degrees F.

The rate of chemical and physical breakdown of egg quality increases rapidly at temperatures above 60 degrees F. Other environmental factors such as low humidity, rough handling and improper packing cause eggs to decrease in quality more rapidly at temperatures above 60 degrees F. than at temperatures below 55 degrees F. Condition of the air cell, also a quality factor, is influenced by poor environmental conditions and indicates a lowering of quality.

Approximately eight hours are required to cool eggs of 100 degrees F. in a wire basket to less than 60 degrees F. when held in an egg room at 50 degrees F. Eggs in a galvanized bucket require approximately 18 hours to reach 60 degrees F. when held in 50 degree F. room temperature. If the temper-



Containers such as A retard cooling even under mechanical refrigeration. Containers such as B allow rapid cooling.

ature of the cooling room in which eggs are held is higher, the time required to cool the egg is naturally increased.

Temperature and Humidity For Eggs on the Farm

The temperature to which eggs should be cooled and held on the farm is approximately 55 degrees F. Daily marketing of eggs at these temperatures results in higher grades for the producer. Distance to market, volume of eggs and other circumstances should be considered when determining whether eggs are to be marketed daily or less often. Generally refrigeration costs are increased more than benefits received when eggs are held at temperatures below 55 degrees F.

The correct relative humidity for the egg cooler, to prevent weight and quality loss, should be approximately 85 percent. Higher humidity may cause mold to develop on egg cases and thus contribute to loss.

A simple way to determine the relative humidity is by using wet and dry bulb thermometers. When the reading on the dry bulb thermometer in the egg room is 50 to 55 degrees F., a wet bulb reading of 48 to 53 degrees F. corresponds to a relative humidity of 80 to 85 percent.

Precooling Eggs

Precooling eggs before placing them in cases reduces the temperature of eggs much faster than if put into cases immediately after gathering. This procedure means higher quality when sold on grade. The cases also should be precooled. Adequate air circulation is important in the rapid and efficient precooling of eggs. It also aids in preventing mold growth.

"Sweating" of Eggs

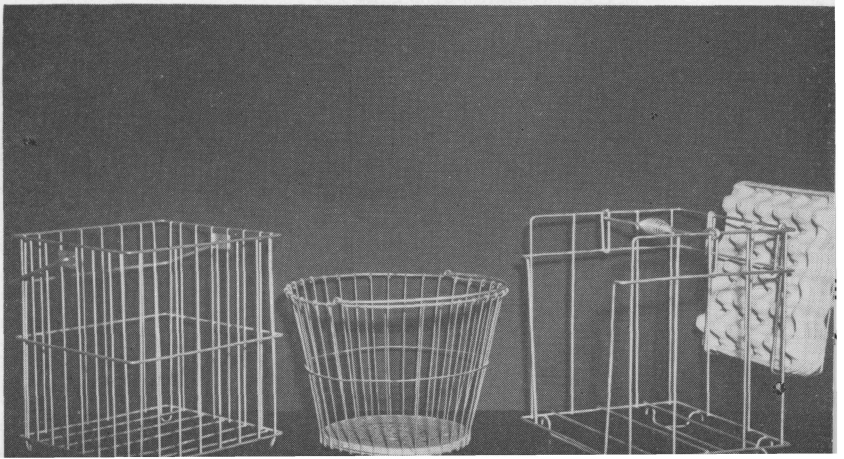
Eggs will sweat if cooled below the point at which moisture condenses from the air. Sweating promotes bacterial and mold growth and increases the probability of spoilage. Moist or sweating eggs pick up dirt easily from handling or from dirty containers. Sweating should be prevented whenever possible. The lower the temperature of the eggs at the time they are removed from the cooler to a warm room, the more sweating will occur. Eggs will not sweat in the cooler unless the relative humidity reaches 100 percent. If eggs held at 55 degrees F. are removed from the cooler on a warm day when the humidity is high, there will be some sweating. Egg quality loss is less from sweating than from high temperatures.

The Egg and its Surroundings

Egg environment refers to the surrounding conditions in which the egg is kept. Environmental conditions greatly influence the quality of the egg at any given period in its journey from the time it is laid until it is used. Producers, handlers and consumers have certain responsibilities in maintaining the quality that the egg possessed when laid.

The effects of temperature and humidity on egg quality have been given, but other environmental conditions also affect the quality from the time the egg is laid until it is broken for use. These environmental conditions are primarily the responsibility of the producer, but handlers may be also equally responsible. The results of the environmental conditions influence the satisfaction of the customer when buying at wholesale or retail levels. The nest or cage, frequency of gathering, and handling represent environmental factors affecting egg quality.

Wire egg baskets should be used by poultrymen who give consideration to good environment for eggs.



Nest or Cage

When nests are used, clean nesting material helps maintain quality. If eggs are produced in cages, brush the cage bottoms and egg troughs at regular intervals to help prevent soiled shells. Hens with dirty feet when laying in nests make undesirable surroundings for eggs. Manage the flock to eliminate all of these unfavorable conditions and thus, protect the quality of the egg when laid.

Frequency of Gathering

Eggs left in the nest or cage all day are subjected to temperatures most of the year that are above those recommended for maintaining quality. Eggs should be gathered several times daily whether laid in nest or cage. When eggs are laid in cages, flies are likely to speck them if not gathered several times daily.

Place Eggs Are Held

Shells of eggs are porous and absorb odors readily when close to or held in cooler with other products having strong odors such as onions and kerosene. Careful consideration should be given as to where eggs are to be kept. Unfavorable results from such surroundings usually are not detected

Good cases, and daily delivery early in the morning aid greatly in maintaining egg quality.

in grading eggs, but result in dissatisfied customers and loss in sales.

Handling

Handle eggs with clean hands. Eggs can be easily soiled from dirty hands or odors may be absorbed if the person handling eggs has previously handled products such as oil and kerosene. Eggs are a perishable commodity and they are easily broken. Use standard cases that are clean and in good condition. Flats and fillers also should be clean and in good condition to help maintain quality, and give maximum protection against egg breakage. Place eggs in the case with small ends down to help prevent injury to the air cells and to prevent breakage. If any unusually large or long eggs are cased, put them in the corner fillers to reduce the possibility of broken eggs. The flats should be put in the case with cups up including the top flat in each end of the case. The fillers need to be placed so that the strong sides are next to the ends of the case and the center partition.

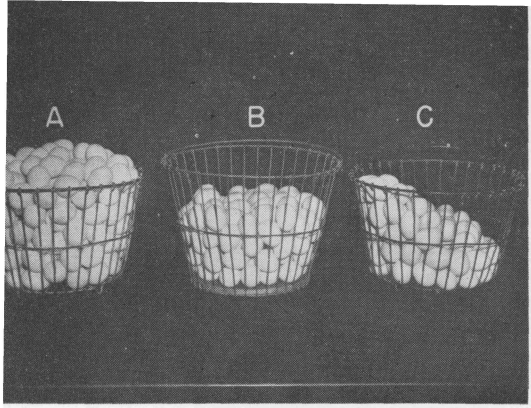
The Cooling Room

Generally, the cooler should be constructed as nearly square as possible since this shape requires less building materials and permits more efficient refrigeration than a long rectangular shape. Arrangement of shelves and cases have to be taken into account. The stud height should be 7 or 8 feet. This length of studs permits the stacking of cases five or six deep, if necessary. Stacking cases **four deep** is recommended.

Arrange the cooler so the shelves for precooling baskets of eggs will be easily accessible to the door. The shelves should be placed to allow a straight path to the shelves from the door. Filled cases should be arranged in the cooler to allow free access to cooler shelves. Two recommended arrangements are shown on page 14. Space the shelves vertically approximately 18 inches apart for egg baskets which will allow an average 15 dozen size wire egg basket to slide in between shelves with ease. Shelves should be made of slats of 1″ x 4″ or 1″ x 2″ to let air circulate freely through eggs and around containers.

Location of Cooler

The cooler should be located near the laying house to minimize the number of steps required and save time. If a grading room is available, the cooler should be next to it. The efficiency of the cooling unit will be increased if the cooler is constructed inside a building. Locate the cooler in a building



Full baskets such as A increase egg breakage. Keep eggs level in the basket as in B and do not fill over two-thirds full. Eggs are likely to be broken when placed in baskets such as C.

along the north wall if possible. Painting the outside walls with aluminum or light-colored paint helps to reflect the sun's heat.

Size of Cooler

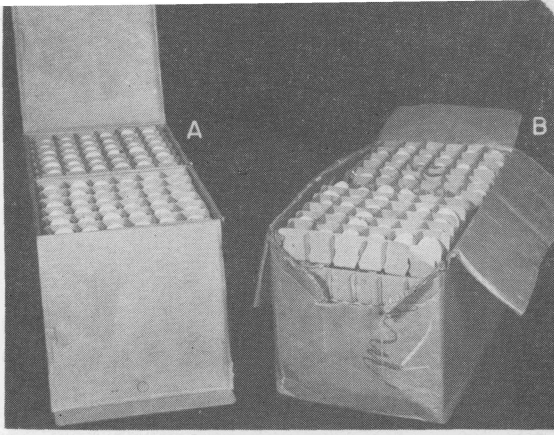
The maximum number of layers expected and their maximum percent production are two important factors to consider when planning the size cooler needed. The room or cabinet must be large enough to hold all the eggs produced between deliveries. Inside dimensions of each compartment of a regular egg case are 11 ¾ inches square by 13 inches deep. Outside dimensions of a regular veneer egg case are 12 ⅛ inches wide, 13 ⅛ inches deep and 25 ⅞ inches long. Because of the dimensions of the regular case, it is necessary to allow approximately 2.6 cubic feet per case. One case on the floor occupies about 2 ½ square feet of floor space but when in stacks four high, 100 cases require about 60 square feet of floor space plus aisles and access space. Aisles should be

TABLE FOR DETERMINING COOLER CAPACITY
(Based on 60 Percent Production)

TABLE II

Size of flock	Capacity needed in cases for 2 and 3 deliveries ach week		Square Feet floor space		No. baskets of 12 doz. ea. needed to be cooled each day	Sq. ft. of rack space
	2 Del.	3 Del.	2 Del.	3 Del.		
500	4	3	3	3	2	1.2
1000	7	5	6	6	4	2.4
2000	13	10	9	9	8	3.6
5000	33	25	27	21	21	8.4
10000	66	50	51	39	42	16.8

NOTE: Square footage for floor space is based on stacking cases 4 high. Square footage for rack space is based on racks 3 high. For Flock sizes other than given here use combinations of the above to meet needs.



Case A with its clean, sound flats and fillers gives maximum egg protection.

Case B with torn and dirty flats and fillers gives little protection for eggs.

30 inches to 36 inches wide. Cases should be stacked 3 to 6 inches from the walls to permit air circulation. Cases should be stacked on slatted floors or dunnage strips to permit air movement beneath the cases.

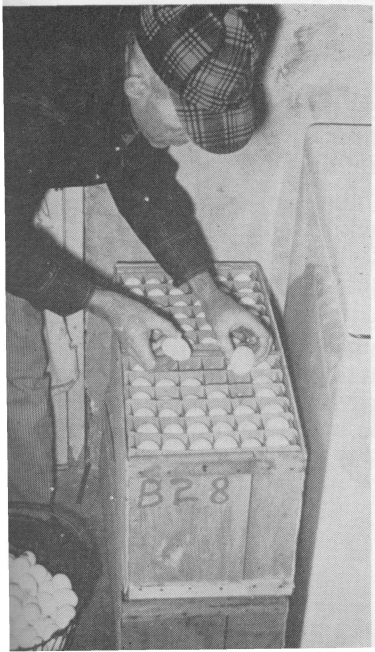
Dimensions should allow use of standard lengths and sizes of material. Table II shows cooler capacity needed for various size flocks when deliveries are made two or three times per week. Layouts for two different sizes of coolers are shown on page 14.

Construction Features

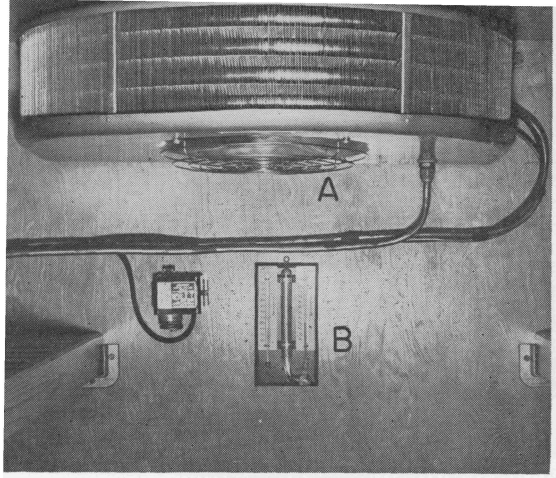
Frame. Use 2″ x 4″ studs, 24 inches on center as in usual construction practice.

Ceiling. Construct the ceiling like the walls. The top of the cooler should be flat. Provide for free ventilation between the ceiling and roof.

Insulation. Fill the wall space with commercial insulation. Mineral or glass wool, either loose fill or batts is satis-



Case eggs in a precooled case. Place eggs little-end-down in case as an aid in maintaining quality. Place extra long or large eggs in corner fillers to prevent breakage.



A. The fan is needed for air circulation and rapid cooling of eggs.

B. The hygrometer is used in determining relative humidity.

factory. Cover the ceiling with at least four inches of the same material.

Vapor Barrier. A "vapor" barrier of special moisture resistant paper or material is ordinarily applied to the outer, or warm, side of the walls of refrigeration rooms to prevent moisture from collecting in the insulation. This vapor barrier normally is placed on the outside of the studding and on top of the insulation on the ceiling before applying the exterior finish. If batt or roll insulation with a vapor barrier layer on one side is used, that layer should be placed toward the outside of the wall. A vapor barrier should not be used on the inside as the moisture then would be trapped in the wall.

In applying a vapor barrier layer, the joints need only to be lapped for the average egg cooler. Additional sealing is desirable but not required. The material is simply tacked or stapled to the frame of the walls and ceiling.

Floor. For small cabinets, use 2" x 4" sleepers, covered with plywood or tongue and groove flooring, and insulated like the walls. A concrete floor can be used.

For larger rooms, use a concrete floor 4 inches thick over a gravel or sand fill which should be well drained. Concrete should have a troweled finish. A center drain with floor sloped 1 inch in 10 feet toward the drain simplifies cleaning.

Slatted floor sections of 1" x 4" material on 2" x 4" sleepers are desirable on the floor for stacking cases. Sleepers for slatted floor sections should lie in the direction of air movement toward the cooling coil; not across the direction of air flow.

Door. The door can be made up with 2" x 4" framing material laid flat to dimensions, 30 to 36 inches wide, insulated like the walls, covered with ¼ inch plywood both sides, and supported by T-hinges. A latch should be provided to se-

cure the door. Provision should be made so that the door can be unfastened from inside the cooler. Elaborate refrigeration hardware is not required. Used hardware sometimes can be used to advantage. Good quality hardware is cheaper in the long run. The door stop should go on all sides of the door opening, and door gasket material should be attached so that the door rests against it when closed.

Interior Finish. Inside walls and ceiling should be covered with pressed fiberboard or similar nonporous material. The odor of paint is undesirable from egg quality standpoint. Special odorless paint made for refrigerated spaces can be used satisfactorily.

Exterior Finish. Tongue and grooved lumber, drop-siding, plywood, pressed fiberboard or other building board can be used. The vapor barrier should be in place before applying the exterior finish.

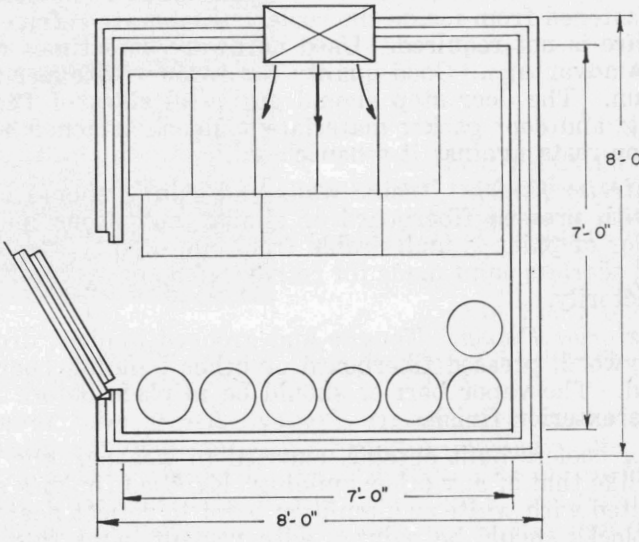
For coolers built outside, exposed to weather, the finish can be like that of any other building. Exposed finishes should be painted with white or aluminum paint to reflect heat. Concrete blocks should be painted with cement paint to prevent entrance of moisture into the wall. Coolers exposed to weather should have a reflecting roof with a wide overhang to shade the walls. Ventilation between the cooler ceiling and the roof should be provided.

Wiring. For compressor motors up to ⅓ horsepower, 115-volt service should be available. For one-half horsepower or larger motors, 115/230-volt, three-wire service should be provided. Wiring to meet the manufacturer's specifications should be provided for packaged refrigerating units. Wires supplying the compressor motor should be large enough to prevent a voltage drop of more than 2 percent of the rated voltage of the motor.

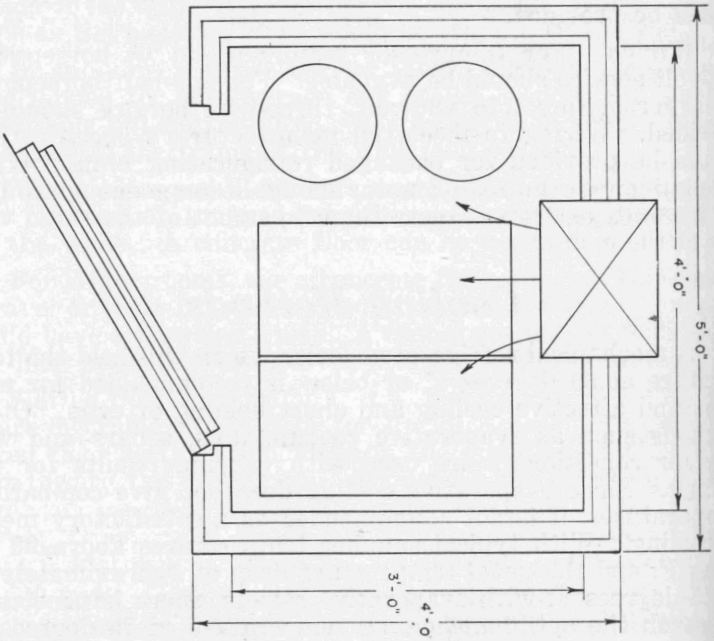
Cooling Methods

A mechanical refrigerated cooler which will hold the temperature at 55 degrees F. or below is recommended for efficient and effective cooling and short holding of eggs. Other methods such as evaporative coolers, fans, cellars and window air conditioners are used with varying results for egg cooling. Since evaporative cooling does not give comparable temperatures. it is not recommended as a satisfactory means of cooling. With typical summer temperatures above 90 degrees F. and the usual temperature drop of approximately 10 to 15 degrees F. with evaporative coolers, there is no way to approach the optimum holding temperature of 55 degrees F.

These typical cooler floor layouts indicate the importance of conserving space, provide easy access, circulations of air and simple construction.



A walk-in type cooler of sufficient size to provide for a 5,000 bird flock. (Plan No. 421)



A reach-in type egg cooler for the smaller flock. This unit handles 500 to 1,000 birds, depending on the number of deliveries per week. (Plan No. 420)

with this method. The same problem occurs with fans or cellars.

Home window air conditioners are designed to maintain temperatures at 10 to 20 degrees F. below the outside air. This usually means keeping the room at 70 to 80 degrees F. while the outside air is 80 to 100 degrees F. When a window air conditioner is used to provide a room temperature of 55 degrees F., its efficiency is sharply reduced. This causes higher operating costs. In addition, such units are designed to remove moisture from the room air rather than maintain a high relative humidity. Units especially designed for cooling eggs are more efficient and should give service at less cost over the years.

Cooler Management

Efficient management of the cooler is important. Remember to place warm eggs above cool eggs for precooling. This means putting the first eggs gathered on bottom shelves and fill shelves above as eggs are gathered during the day. This system keeps the heated air from the warm eggs from going over those already cooled. When placing filled cases in the cooler, leave about 3 inches between cases and cooler walls.

Precooling of empty cases before filling with eggs aids greatly in keeping eggs at even temperature in the cooler. Place empty cases in the cooler the night before they are to be filled the next morning.

Motors, fans and similar equipment should be lubricated as recommended by the manufacturer. The condenser should be kept clean. Do not restrict air circulation around the condensing unit. Periodic checks of the equipment should be by a competent refrigeration serviceman.

Costs

Operating

Studies on operating costs available at this time indicate that 1 ½ kw-hr. of electricity per case of eggs cooled is required. The electric rate determines the actual cost, but for the average producer this will be three to five cents per case.

Fixed

Th cost of a cooler with mechanical refrigeration equipment varies with size, amount of farm labor contributed to the construction, whether placed in an existing building and on other factors that vary from farm to farm. The cost of any unit should be figured on an annual basis. There are

several methods of doing this, but one fair analysis is the following:

(1) Allow 10 percent depreciation per year on the initial cost.
(2) Allow 6 percent interest on average investment.
(3) Allow 2 percent per year for maintenance and repairs.

Example:

Take a 12-case cooler that may cost $400.

(1)	10 percent of cost	=	$40
(2)	6 percent interest (average for 10 years)		$12
(3)	2 percent maintenance and repair		$ 8
	Total		$60

This unit would handle a 2,000-bird flock laying 20 to 24 cases per week. Fifty-two weeks × 20 cases = 1,040 cases per year.

$60 annual fixed cost ÷ 1,040 cases = 5¾ cents per case per year.

Total Costs

The total cost per case to operate this cooler would be:

5 ¾ cents (fixed)
3-5 cents (Operating)
8 ¾ to 11 ¾ cents—Total

This would be about one-third cent per dozen eggs. For maximum efficiency the cooler should be operated as near to capacity as possible.

Grading or Handling Room

Adequate space should be provided near the cooling room for grading and packing the eggs.

Space should be provided for benches large enough for holding the cleaning and grading equipment, for packing the cases and for any other operation peculiar to egg marketing.

Cooling this room adds to the comfort of the workers and reduces the possibility of the eggs sweating when taken out of the cooler. Regular window-type air conditioners cool the grading room effectively. Evaporative coolers are satisfactory in many areas.

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