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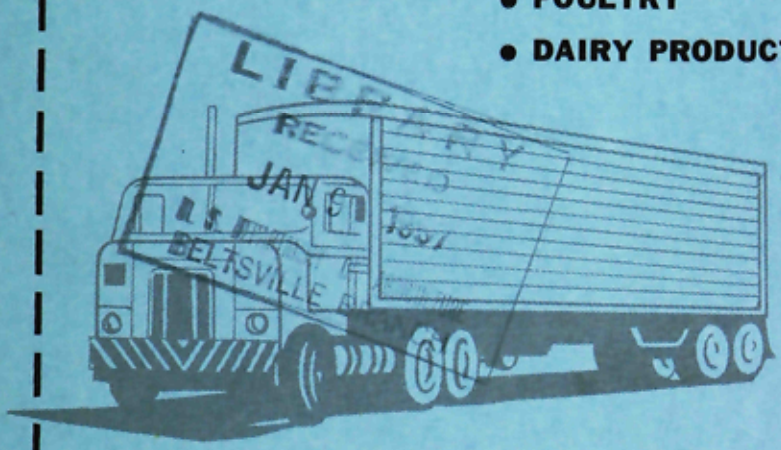
Protecting PERISHABLE FOODS During Transportation by TRUCK

- MEATS
- FRUITS
- MELONS
- VEGETABLES
- POULTRY
- DAIRY PRODUCTS



AGRICULTURE HANDBOOK NO. 105
U. S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Washington, D. C. December 1956

Preface

This handbook for the proper care of perishable agricultural commodities during transportation by motortruck has been prepared at the request of various trucking groups and the Transportation Research Advisory Committee to the Department of Agriculture. The authors have drawn freely upon some published and many unpublished data and observations to bring together, in a single handbook, useful information on this subject. Until now, such information has been obtainable only from many widely scattered sources.

Most of the information and recommendations in this handbook are based upon the results and observations of many years of research by the Department of Agriculture. Because knowledge is far from complete as to the exact temperature and humidity requirements of all agricultural commodities and as to the most efficient methods of loading and handling many commodities and containers, the information presented in this report is necessarily limited.

Only the commodities and containers that are commercially most important are covered in this report. Complete coverage of the hundreds of different commodities and containers moving in some volume by motor freight was not possible. Moreover, new developments are constantly taking place with the introduction and use of new commodity varieties, packages, and cooling and refrigeration methods. The results of these innovations must be fully appraised by research and experimentation before any positive recommendations regarding their use can be made.

It is planned to issue supplements to this handbook from time to time, as additional information on these subjects is brought to light by the continuing program of research by the Department of Agriculture.

An attempt has been made in this handbook to present the information as concisely as possible and in such form that the complete information for any one of many commodities and containers can be readily located by the user with a minimum of cross-reference and consultation of footnotes. For this reason, the loading descriptions and diagrams applicable to each container are presented in each section dealing with the particular commodity shipped in that container, even though the same container and loading methods are frequently used for several different commodities.

The authors wish to acknowledge the assistance given them by John N. Kelley, manager, Fruit Transportation, Fruit Dispatch Co., who provided material on transportation requirements for bananas; and by the following people in the Marketing Research Division, Agricultural Marketing Service: C. Elliott Garver, Robert C. Haldeman, B. P. Rosanoff, R. W. Penney, Walter H. Redit, and Harold T. Cook. Appreciation is expressed also to many shippers and truckers for information on specific transportation requirements and methods in handling many commodities. The following publications were used as reference material in the preparation of the report:

English, Harley, and Gerhardt, Fisk. Effect of Carbon Dioxide and Temperature on Decay of Sweet Cherries under Simulated Transit Conditions, Amer. Soc. Hort. Sci. Proc.: 40: 172–176, 1942.

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Pentzer, W. T., Asbury, C. E., and Barger, W. R. Precooling California Grapes and Their Refrigeration in Transit, Technical Bulletin No. 899, U. S. Dept. Agric., October 1945.

Wright, R. C., Rose, Dean H., and Whiteman, T. M., The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stocks, Agriculture Handbook No. 66, U. S. Dept. Agric., September 1954 (data on temperature and humidity requirements).

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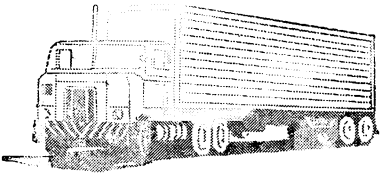
Protecting PERISHABLE FOODS During Transportation by TRUCK



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Contents

	Page
Preface	Page 2 of cover
Background of study	1
Important factors in protection of perishables	2
Refrigeration	2
Refrigeration methods	3
Mechanical refrigeration	4
Air circulation	4
Humidity	4
Insulating materials	5
Estimating mobile refrigeration requirements	6
Precooling the product	6
Ice as a refrigerant	7
Dry ice as a refrigerant	7
Top ice	7
Mechanical refrigeration requirements	7
Importance of defrosting mechanical units	7
Checking your thermostat	8
Protection against cold	8
Training or driver responsibility	8
Preparation and loading of the vehicle	9
Cleaning and sanitation requirements	9
Maintenance of interior of the vehicle	9
Precooling and preheating of the vehicle	10
General loading rules	11
Fresh fruits, vegetables, and melons	13
Apples	13
Apricots	15
Artichokes (globe)	16
Asparagus	16
Avocados	17
Bananas	17
Beans (green snap)	19
Beans (lima)	19
Beets	21
Blackberries	23
Blueberries and huckleberries	23
Broccoli	24
Brussel sprouts	24
Cabbage	24
Cantaloups	26
Carrots	27
Casaba, crenshaw, and persian melons	29
Cauliflower	30
Celery	31
Cherries	33
Corn (sweet)	34
Fresh fruits, vegetables, and melons—Continued	
Cranberries	35
Cucumbers	35
Currants	37
Dewberries	37
Eggplant	37
Endive and escarole	38
Gooseberries	39
Grapefruit (California and Arizona)	40
Grapefruit (Florida)	41
Grapes (European or vinifera)	42
Grapes (American or eastern)	42
Honeydew melons	43
Kohlrabi	44
Leeks (green)	45
Lemons	45
Lettuce	45
Loganberries	47
Melons (See casaba, etc.)	
Okra	47
Onions (dried)	48
Oranges (California and Arizona)	49
Oranges (Florida)	50
Peaches	52
Peas (green)	53
Peppers	53
Plums and fresh prunes	54
Potatoes (early crop)	56
Potatoes (late crop)	57
Raspberries (black and red)	58
Rhubarb	58
Rutabagas	59
Strawberries	59
Sweetpotatoes	60
Tangerines	61
Tomatoes (mature green)	61
Watermelons	64
Freezing injury to fruits and vegetables	64
Frozen foods	65
Fresh meat and packinghouse products	65
Loading fresh beef	66
Loading fresh pork	66
Dairy and poultry products	67
Butter and margarine	67
Cheese	68
Shell eggs	68
Poultry, fresh dressed, chilled	69
Canned foods (neither cold packed nor frozen)	70
Freezing temperatures of canned foods	70

Protecting PERISHABLE FOODS During Transportation by TRUCK

By Harold D. Johnson and P. L. Breakiron

Marketing Research Division, Agricultural Marketing Service

Background of Study

The transportation of perishable food products in refrigerated trucks and trailers, known to the trade as "reefers," has increased rapidly in recent years. This transportation is provided by thousands of truck operators, ranging from small owner-operators with only one or two vehicles to large truck lines operating hundreds of units. The motor truck movement of hundreds of food products, many of which are fragile and easily susceptible to spoilage, freezing, overheating, contamination, and other types of damage, in many different types of equipment in all kinds of weather has posed some serious problems for shippers, truckers, and receivers of the products.

Growing interest in the problems of food transportation by motortruck has prompted the U. S. Department of Agriculture to carry on a program of research in this field. Much of the information available on this subject, including that developed in the study of transportation of perishables in railroad refrigerator cars, is contained in reports published by different agencies of the Department, some of which are out of print. In addition, much other valuable information on the specific requirements of many products and the best methods of handling them is contained in field and office reports and other unpublished data and observations. This handbook draws upon these publications and unpublished data to bring the information together in one book.

Motortruck equipment is available to provide the optimum temperature and humidity for perishable commodities during transportation. However, the requirements of different commodities vary widely, and it is necessary that the shipper or trucker know the specific needs of the commodity being transported so that he may use the right equipment in the right way. An attempt has been made, in the preparation of this report, to present that information for many perishable commodities so that those engaged in shipping and transporting each of these products by motortruck can quickly and easily find what they need.

Many improvements in the dietary standards of our population are traceable to advances made during the 20th century in transportation and refrigeration of a wide variety of perishable foods. In addition, significant changes have occurred in methods of food processing. The development of new forms of processed foods, such as frozen concentrates and other types of frozen foods, has resulted in the production and distribution of highly perishable products having rigid requirements for protection during transportation. If we are to take full advantage of these recent technological advances in food processing, the commodities must have full protection all the way from the producer to the consumer.

Important Factors in Protection of Perishables

Refrigeration

The object of refrigeration is to keep the commodity at a temperature that will prolong its life on the store shelf and maintain its quality. Heat is a form of energy. It is a positive, measurable factor. Cold, on the other hand, is a lack of heat. Cold cannot be given off or radiated. Refrigeration is not a matter of putting cold into a space, but is a process of removing a certain amount of heat from the space and preventing it from getting back again. Expressed in a different way, cold is a relative term by which we mean the absence of a certain amount of heat.

The flow of heat is always from the warmer to the cooler object. If one hand is held close to a cake of ice, it feels cooler because the heat is flowing from the hand to the ice. A cube of ice in a glass of water absorbs the heat from the water. Heat continues to flow from the warmer to the colder body that is close to it until both objects reach the same temperature.

It should be remembered that all fresh fruits and vegetables are living things, even though separated from the tree, the vine, or the soil, and they continue to generate and throw off heat the same as the human body. The amount of heat generated varies with the commodity and its temperature, the greatest heat development occurring when the commodity is at higher temperatures and decreasing as the commodity approaches 32° F. Refrigeration, then, is required to counteract this generation of heat, in addition to removing heat acquired by the commodity in the field, if the commodity is to be transported long distances in fresh condition.

The unit of measurement of heat is called the British thermal unit, or B. t. u. This is defined as the heat required to raise the temperature of 1 pound of water 1° F. To lower the temperature of a load, so many B. t. u.'s must be removed, just as so many gallons of water may be removed from a tank.

The term "refrigeration ton" is used to express the capacity of a refrigeration system to remove heat. The amount of heat required to melt 1 pound of ice is 144 B. t. u.'s, so that melting 1 ton of ice will require 144 x 2,000, or 288,000 B. t. u.'s. This 288,000 B. t. u.'s is called a refrigeration ton.

A mechanical refrigeration machine used in a motortruck trailer is said to have 1-ton capacity when it will remove 1 refrigeration ton per day under standard operating conditions. This is equivalent to 12,000 B. t. u.'s per hour.

A number of sources may contribute to the heat that must be removed from the trailer by the refrigerating equipment:

(1) Heat that is in the product at the time it is loaded.

(2) Heat of respiration; as previously stated, all fresh fruits and vegetables respire and give off heat. The more perishable products, such as cherries, lettuce, peaches, and corn, respire at a higher rate than the less perishable products, such as apples, oranges, and potatoes. The rate at which heat is given off is controlled by the temperature of the product, and it is considerably less at temperatures near the freezing point than at normal harvest temperatures.

(3) Ambient (outside) temperature; that is, the temperature of the air surrounding the commodity or, in the case of a commodity moving in a motor vehicle, the air outside the truck or trailer.

(4) Radiated heat, which is that reflected back upon the underside of the trailer from the street or highway. Many operators seem to discount the importance of this source of heat. The thickness of insulation in the floor of the trailer should not be less than that in the walls or ceiling.

(5) Solar heat, or the heat conducted through the walls or roof of the trailer directly exposed to the rays of the sun. A dark surface holds more heat and conducts more into the trailer than a light one; a highly polished, white, stainless steel or aluminum surface is preferable. However, even a trailer with such a polished surface loses much of its resistance to solar heat if covered with dirt and grime. It is good practice to clean the exterior of trailers regularly and often.

(6) Heat from the motor exhaust. This is an important factor, particularly in warm weather, whether the exhaust is vented upward, as is the case in many diesel-powered tractors, or underneath the trailer.

Refrigeration Methods

Of the several methods used over the years for providing refrigeration at temperatures both below and above freezing, ice, ice and salt, dry ice, holdover systems, and mechanical refrigeration are the most prominent. The evolution of refrigeration is traced from the use of water ice to the modern lightweight and compact mechanical refrigeration units.

Ice is a good refrigerating medium, but it presents drawbacks when used in over-the-road, long-distance hauling. It is heavy, requires considerable labor to handle, and accelerates deterioration of the truck body by its everpresent moisture. Refrigeration produced by ice also diminishes as the ice melts, and to obtain maximum efficiency the bunkers should be replenished frequently. Salt may be used to obtain lower temperatures than would be provided by the ice alone, but the resulting drip of brine from the bunkers tends to corrode metal parts of the trailer body and produces an undesirable discharge on the garage floor or street.

Dry ice, due to its very low temperature (−109° F.), above which it starts to change from a solid to a gas (CO_2), can be used both for low temperatures such as those required for frozen foods and, if properly controlled, for temperatures above the freezing point (32° F.).

Of course, the gas so released is very cold, and has high heat-absorption qualities; it will freeze fresh foods with which it comes in direct contact. Also, it is heavier than air, and tends to settle to the floor of the trailer. Some truck operators have used dry ice in the transportation of frozen foods by spreading cakes of the ice over the top of the load. This method is unsatisfactory because the packages immediately surrounding the dry ice blocks and the pockets or spaces in which the gas settles are very cold, while other parts of the cargo are relatively unprotected. Consequently, little control of load temperatures can be maintained by this method.

Only in case of emergency due to failure of the refrigerating unit to operate should the dry-ice method be used. The only satisfactory dry ice refrigeration systems so far developed use a forced flow of air over a metal bunker surface, or a liquid secondary refrigerant circu-

lated through a series of coils. Both systems are thermostatically controlled.

When transporting fresh fruits or vegetables, it is important to vent the CO_2 gas from the dry ice to the outside of the truck or trailer, as it may have an adverse effect on the product.

Mechanical Refrigeration

There are several types of mechanical refrigerating units, thermostatically controlled and made especially for motortruck transportation. Some types have the engine, condenser, and other accessories high on the outside of the nose of the trailer, with the evaporator coils and air-circulating fans located on the inside. Other types have the power unit and accessories under the frame of the trailer, with the cooling coils and air-circulating fans high inside the front end of the trailer. These units usually have from 2-ton to 5-ton refrigerating capacity. The size of the refrigerating plant depends upon the construction of the trailer, the amount and quality of insulation, and the products to be transported.

Air Circulation

Regardless of the method of refrigeration used, whether it be water ice, water ice and salt, dry ice, or mechanical refrigeration, provision should be made for the cold air from the ice bunker or mechanical unit to circulate around and under the load. To obtain this free circulation of air, the inside of the trailer should have vertical wall strips not less than ¾ inch thick spaced at 8-inch intervals on each wall, and floor racks providing at least 2 inches of clearance under the load (fig. 1). Provision should be made by bulkhead or other means for adequate circulation of air at the front of the load. The rear doors should have vertical strips (2- x 2-inches on 8-inch center) to prevent blocking of air if packages fall against the door. Packages should not be loaded within 18 inches of the ceiling. Do not load directly in front of the air blast from the bunker or mechanical unit.

Humidity

In protecting fresh fruits and vegetables in transit, cold air alone will not do the job. Moisture also is required to keep the products fresh and crisp.

Relative humidity, as used in this text, is simply a percentage figure indicating the amount of water vapor present in the air as related to the saturation point of the air at a given temperature.

When water ice is used in the bunkers, and fans circulate the air, controlling the humidity does not present a problem. When mechanical refrigeration is used, however, moisture should be added by some means, such as sprinkling the floor. Many operators who use mechanical systems insure the humidity content and, in turn, the crispness of the produce hauled, by blowing "top ice" in crushed form up on top of the load. Because of the low temperature in the van, just above freezing, this ice melts very slowly and yet in melting provides the moisture needed. In produce hauling, this method is used quite widely in connection with dry ice or mechanical systems.

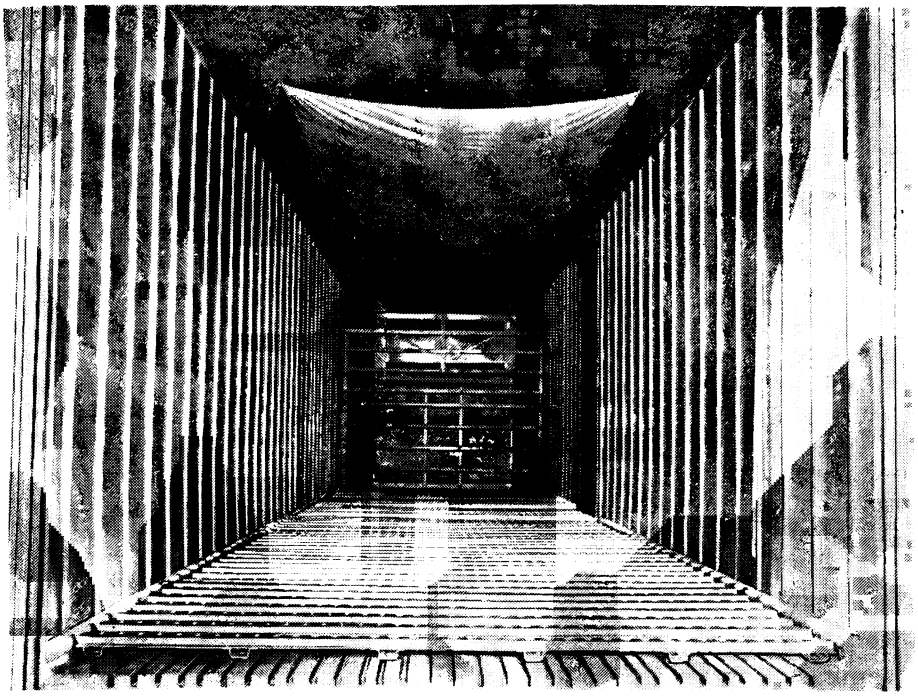

FIGURE 1.—Interior of a truck trailer equipped with adequate floor racks, side wall strips, and air duct on ceiling of trailer. All three of these desirable features promote adequate air circulation through and around the load.

Insulating Materials

The vehicle used to transport fresh food products must be as nearly airtight as possible and must be constructed to retard the flow of heat as much as possible. An example of the principle involved here is found in the familiar thermos bottle, which is really two containers, one inside the other, with the air removed from the space between. The resulting vacuum gives the bottle its ability to maintain the substance in the inner container at a nearly constant temperature, for a vacuum offers great resistance to the transfer of heat.

Since it is impractical to build a trailer like a vacuum bottle, the next best alternative is to fill the space between the inner and outer walls with a substance that will retard the flow of air, since air in motion carries the heat from the outer wall to the inner wall. The insulating material used should be light in weight, fireproof, sagproof, verminproof, waterproof, nonacid, noncorrosive, and, of course, it should be a material which has a high insulating value. Insulating quality is subject to measurement, and the unit of measure is called the K-factor.

Some of the insulating materials now in use are glass fiber, kapok, cellular rubber, and cork board. The thickness of the material largely depends upon the temperature desired, the kind and efficiency of the refrigeration used, and the hauling distances involved. Thickness of insulation, depending upon these factors and the insulating material employed, may range anywhere from 1 inch to 6 inches, or even 7 inches in the roof. Except for frozen foods, a 3-inch thickness of insulating material is an average minimum requirement in walls, floor, and ceiling, when hauls of several hundred miles are involved.

Estimating Mobile Refrigeration Requirements

In an effort to arrive at the approximate amount of refrigeration necessary to maintain proper temperatures during transit, first let us look at the amount that would be required under ideal conditions; that is to say, not taking into consideration such factors as the respiratory heat given off by different commodities, the necessity for opening doors during transit, and possible leaks in the superstructure. These and other factors will be discussed later.

In order to estimate the amount of mobile refrigeration required, it is necessary to take four factors into consideration. The first of these is the temperature of the product when loaded. Second is the expected outside temperature. Third is the number of square feet on the outside surface of the truck body to be refrigerated. And last is the thickness and coefficient of heat transmittance (U) of the material used for insulation.

Once we have determined these four factors, the next step is to multiply the coefficient of transmittance times the number of square feet of the outside surface times the number of degrees difference between the outside and inside temperatures. The resulting figure will be the number of B. t. u.'s or, in other words, the quantity of heat that must be absorbed per hour by the refrigerant in order to keep the product at the temperature loaded. A specific example of this formula in operation is as follows: Let us assume that these conditions prevail: (1) Loading temperature of commodity is 35° F.; (2) expected average outside temperature is 75° F.; (3) outside dimensions of unit are 35 feet long, 7 feet wide, 8 feet high; and (4) insulation is 3 inches thick, with a K-factor of .33. With an outside temperature of 75° and a commodity temperature of 35°, the temperature differential is 40°.

Since insulation K-factors are based on a thickness of 1 inch, and since the trailer in our example has 3 inches of insulation, we now divide the K-factor (.33) by 3 in order to arrive at the coefficient of transmittance, U (.11) for the insulation in this particular trailer. The operator may obtain from the trailer manufacturer information as to the K-factor of the insulation in a particular trailer.

A trailer with the outside dimensions listed above would have an exposed surface of 1,162 square feet. Following the formula, we find that .11 times 1,162 times 40 gives us approximately 5,133 B. t. u.'s of heat that must be absorbed per hour by the refrigerant.

Precooling the Product

Many shipments of fresh fruits and vegetables are loaded into trailers and accepted by the carriers when the product is not at the desired carrying temperature. This means that additional refrigeration is needed to reduce the product temperature quickly to the dedesired level for safe transport.

This precooling may be accomplished by using commercial portable mechanical units, by hydrocooling, or by the vehicle's own method of refrigeration, provided it has ample capacity.

In order to estimate the amount of refrigeration necessary to precool a commodity to a predetermined temperature, it is necessary first to find the amount of heat that must be removed to bring about this reduction. The amount of heat removed will depend upon: (1) The initial temperature of the commodity; (2) the final temperature desired; (3) the specific heat of the commodity to be precooled; and

(4) the total weight of the commodity and containers. Generally, precooling should be done before shipment, since truck-trailer "reefers" are primarily for transportation and are not a substitute for a "cold room" in a packing plant.

The specific heats of individual commodities vary substantially. Further, the rates of evolution of heat are different for each commodity, and vary according to commodity temperature at the time the refrigeration is applied. Consequently, it is impracticable to furnish complete data in this handbook to enable operators to calculate exact refrigeration requirements on all the commodities carried under all the widely varying conditions that might be encountered. If specific information concerning given conditions should be desired, it will be furnished upon request to the Transportation and Facilities Branch, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C.

Ice as a Refrigerant

In order to melt 1 pound of ice, 144 B.t.u.'s of heat must be absorbed. Therefore, to find the amount of ice necessary to refrigerate the trailer used in the example given, we simply divide 5,113 (amount of heat that will pass through our insulation (see p. 6)) by 144 to arrive at approximately 35 pounds, or the amount of ice that will be consumed per hour.

Dry Ice as a Refrigerant

Dry ice requirements can be estimated in essentially the same way as those for water ice. The rate of heat consumption of dry ice has been estimated at about 270 B.t.u.'s per pound for products held at temperatures above 15° and 250 B.t.u.'s for those held below this figure. Therefore, using the same trailer example as before, approximately 19 pounds of dry ice per hour (5,113 B.t.u.'s divided by 270) would be necessary to maintain a temperature of 35°.

Top Ice

When crushed or top ice is used inside the containers or over the top of the load, be careful that the crushed ice is not so cold that it will freeze the part of the product with which it may come in contact. Ice may come out of a storage room with a temperature as low as 25 degrees.

Mechanical Refrigeration Requirements

Mechanical refrigeration units are rated according to the amount of heat units they can absorb per hour, and also in terms of "standard tons of refrigeration." A standard ton of refrigeration is a term used to express the ability of the unit to absorb 12,000 heat units (B.t.u.'s) per hour, or 288,000 heat units per day. In other words, a standard ton of refrigeration has about the same cooling power as a ton of water ice.

Importance of Defrosting Mechanical Units

It is possible that the evaporator of a mechanical unit will become so frosted by moisture from the load and atmosphere that the refrigerating effect is severely reduced. This is due to the fact that ice itself has

certain insulating properties, and when a heavy coating of ice forms on the evaporator it will prevent heat from being absorbed properly by the refrigerant. In order to insure proper operating efficiency of the unit, this ice coating should be removed whenever it becomes too thick. Under adverse conditions it may be necessary to defrost the unit at intervals of from 2 to 4 hours.

Checking Your Thermostat

The thermostat on a refrigerating unit is the nerve center of the system, and the unit will produce only the amount of refrigeration called for by the setting of this instrument. If the thermostat is out of adjustment several degrees on the low-temperature side due to road vibration, it may cause freezing damage to the load. If it is off on the opposite side it may cause damage by not providing sufficient refrigeration.

As a safety precaution, to protect various commodities against freezing damage that may result from temperature variation in different parts of the load, or from the thermostat or mechanical refrigeration units being out of adjustment, it is recommended that the thermostat be set at least 3° above the freezing point.

The thermostats on all types of refrigerating systems should be calibrated at least every 60 days to be sure that the proper amount of refrigeration is being furnished.

Protection Against Cold

In the protection of fresh, perishable, agricultural products in transit, refrigeration is only part of the problem. There are times when shipments may move under ventilation during the early spring and late fall. However, on shipments moving during the cold winter season, these fresh products must be protected from freezing damage.

There are a number of types of portable heaters that may be used. The thermostatically controlled alcohol and propane heaters give satisfactory results.

Secure the heater to the floor and operate the blower fan to circulate the heat around and under the load. Otherwise, freezing temperatures may be found in the floor packages and unfavorably high temperatures in the top of the load.

Training or Driver Responsibility

It takes a great deal of training and experience to protect and transport perishable products properly. Each driver is responsible for the truck and the cargo while it is in transit, and he should know the refrigeration requirements of the commodities he hauls.

The driver should be thoroughly familiar with the operation of the refrigeration unit in his trailer, and he should be provided with a list of servicing points along his route in the event of mechanical failure.

All mechanical repairs should be made by persons authorized or qualified to do so. Any adjustments by the driver ordinarily should be limited to those of a routine nature, unless he is thoroughly familiar with the operation and maintenance of the unit and has been properly trained to repair and service it. Tampering with mechanical refrigera-

tion units by unqualified personnel may frequently result in serious damage to the units or get them further out of adjustment.

Preparation and Loading of the Vehicle

Cleaning and Sanitation Requirements

The first step, and one of the most important, in the preparation of the truck or trailer body for loading is cleaning. All loose debris from previous shipments should be removed and the floor swept clean. For loading some commodities, such as fresh meat and packinghouse products, certain important sanitary requirements governing their transportation must be complied with. In such instances, cleaning of the loading area with steam or hot water or fumigation with gas may be required.

Cleanliness is particularly important if serious damage to food products is to be avoided. Relatively small quantities or residues of some products, such as salt, fertilizers, insecticides, and other chemicals, can easily contaminate or cause extensive damage to some commodities. A residue of certain fertilizers and other chemicals remaining on the floor or walls of the truck or trailer body can easily result in serious burns to many commodities like potatoes, onions, and melons which are not protected by heavy containers. Some chemicals also cause rapid weakening and deterioration of paper and burlap bags and similar containers. The possibility of chemical damage is always greater when moisture is present. Many agricultural commodities contain considerable moisture and some are shipped with crushed ice on the load.

A number of perishable food products, such as butter, margarine, and bananas, are easily contaminated by strong odors from other products or the residues of them. Thorough cleaning of the interior of vehicles previously used for hauling fish, cabbage, or other odorous products is necessary if contamination of commodities absorbing these odors is to be avoided. Even after a trailer is thoroughly cleaned with hot water and detergents, the odors of such products as fish may persist for some time.

Maintenance of Interior of the Vehicle

All protruding nails and staples should be removed from the floors and walls of the vehicle and these surfaces should be kept in good repair. Rough or splintered floor racks and side walls and protruding nails or staples on these surfaces may cause damage to commodities shipped in bulk or in bags. Rough or broken linings also provide lodging points for dust or residue of flour, feed, or grain that may result in infestations by weevils or other insects. For certain commodities, such as watermelons, bananas, and bulk shipments of some meat products, it is sometimes desirable that interior walls of the truck or trailer body be lined with paper or other protective material to prevent friction bruising or chafing of the commodities. Fresh meat should be protected from rubbing against aluminum trailer walls because of the resulting discoloration of the meat.

The forward end wall or bunker bulkhead at the front of the truck or trailer body should be kept straight and even. If this wall is bowed or out of line, it is difficult to maintain good stack alinement in the

load.[1] Unless the containers in the first stack are loaded in tight contact with the front end wall, they may shift forward during transit, permitting the load to become slack. Maintenance of the forward end wall in a straight and even condition and loading all containers in the first stack tightly against that wall are the first steps that must be taken to construct a tight, solid load to hold down container movement and damage during transit.

Precooling and Preheating of Vehicle

For shipments of frozen foods and other commodities that require exceptionally low temperatures during transit, the interior of the vehicle should be precooled before loading. If the truck or trailer is equipped with a mechanical refrigeration unit, the unit should be placed in operation, with the doors closed, and the temperature of the interior of the vehicle should be reduced as nearly as possible to the

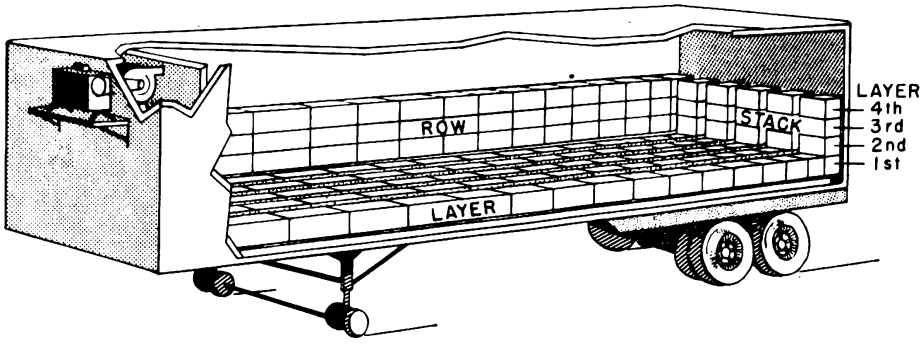

FIGURE 2.—Side view of a load in a motortruck semitrailer, showing arrangement of containers in rows, stacks, and layers.

recommended transit temperature of the product being shipped. If water ice or dry ice is used for refrigeration, the air circulating fans should be placed in operation after the ice bunker has been filled and the doors closed.

When commodities like potatoes or onions are shipped during subfreezing weather, the interior of the vehicle should be preheated before loading. If the vehicle is equipped with a built-in heater, it should be placed in operation sufficiently in advance of loading to raise the air temperature of the interior to or near the recommended temperature of the product to be loaded. In vehicles not equipped with heaters, preheating may be accomplished with various types of portable heaters. During subfreezing weather, if the truck or trailer is being loaded in an unenclosed area, it is desirable to keep the heaters in operation to help maintain the desired temperatures during loading.

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[1] Definition of loading terms (see fig. 2):

A row is a line of containers extending lengthwise of the truck, 1 container in width and as high as the load itself.

A layer is a course or stratum of containers one container high, usually extending the length and width of the truck.

A stack is a pile of containers extending from one side wall to the other and from the top to the bottom of the load, parallel to the end of the vehicle and one container in length.

Transference of heat from the commodity to the circulating air in the vehicle body is affected by a number of factors. Some of the more important of these are: (1) The type of material used in the containers, (2) the size and number of openings in the containers, and (3) the type of load used for the containers. The trucker cannot do much about the first two factors, but he can control the loading. However, in consideration of the importance of the second factor, care should be taken to see that the containers are arranged in the load so that the ventilation openings in the containers are exposed to the ventilation channels, or flues, in the load to the greatest possible extent. The need for loading the containers in a pattern providing for maximum circulation of air around and through the packages to facilitate refrigeration is particularly important in the transportation of commodities containing considerable amounts of field heat when loaded and those generating comparatively large amounts of heat by respiration.

In loading frozen food or commodities which have been thoroughly precooled before shipment, the objective is different than in loading commodities from which field heat or substantial heat from respiration must be removed during transit. As the temperatures of the frozen or precooled products are usually at or near the desired levels for transportation, the objective should be to insulate effectively as many packages as possible from contact with the air or walls of the vehicle. Consequently, the packages should be loaded together as tightly as possible and contact between the packages and walls of the vehicle should be held to a minimum.

For safe shipment of bulk and bagged commodities which are susceptible to bruising from overhead weight, liberal quantities of straw or similar cushioning material should be used on the floor of the vehicle. The need for bedding or cushioning material is greater if the floors are slotted, grooved, or in rough, uneven condition. If loose cushioning material such as straw is placed on the floor racks, the racks should be covered with heavy paper or large sheets of fiberboard to keep the loose material from falling through the floor racks and blocking the air movement under the load. During cold weather, such cushioning or bedding material also serves as an effective insulator and will help protect the load from freezing injury at the point where it is most likely to occur. However, the most effective method of preventing freezing of the product during transit is to maintain the circulation of heated air around and under the load.

In loads where vertical ventilation channels are to be maintained between the rows of containers to facilitate refrigeration or ventilation of the commodity, it is important that the containers be in tight contact with one another lengthwise of the vehicle body. Tight contact between the containers in each stack helps to hold them in row alinement. If crosswise stripping of each layer, or alternate layers, of the load is used to maintain row alinement, or if the side wall rows are not in tight contact with the side walls, the strips in each stack should alternately abut the sides of the vehicle body. If vertical spacing units are used to maintain row alinement, it is also desirable that the load be tight lengthwise of the truck or trailer body, as the spacing units will not remain in place should slackness develop in the load during transit.

Continuous lengthwise channels between the rows of containers in the lower layers of the load which are blocked off vertically by the upper layers do not provide as effective air circulation through the load as vertical channels which are continuous from top to bottom. This is due to the fact that air will circulate more freely from the top to the bottom of the load than lengthwise of the load. Chimney-type loads, or loads in which the containers are arranged around continuous vertical shafts extending from the bottom to the top of the loads, also are not as effective from a ventilation standpoint as loads with continuous vertical ventilation channels between the rows.

All containers should be loaded in such a way that maximum advantage will be taken of their inherent strength. Not all containers can be handled or stacked in the same way because of their design, method of packing, or the material used in their construction. Consequently, they usually will withstand more pressure or weight on one face than on another without collapse or damage to contents. Containers that are packed with a substantial bulge on one or more faces ordinarily should not be loaded on those faces.

When different types of containers are used in the same load, they should be segregated in such a way that one type will not damage another. Preferably, they should be separated by full stacks. If separation by stacks is not possible, the containers made of lighter material, such as fiberboard, always should be loaded on top of the heavier wood containers. When part of the load is removed for partial delivery at some point in transit, the remainder of the load should be stepped down to secure properly the remaining part of the load. In mixed loads of two or more commodities, products which have been cooled and which require low temperatures should not be loaded directly in contact, with warm commodities. The stacks of different commodities may be separated by a bulkhead or sheets of fiberboard. The product requiring the lowest temperature should if possible, be loaded toward the front of the truck or trailer.

Many kinds of containers need to be braced or otherwise secured at the rear of the load to prevent the containers in the last stack from falling backward against the rear doors. This is more likely to happen with containers of odd shapes or sizes, such as baskets. Falling of packages, upon opening of the rear doors of the vehicle for unloading or inspection, may result in container damage or personal injury. If the load is stepped down at the rear end of the vehicle (that is, if the last several stacks are not loaded as high as the forward part of the load), there is less danger of loose packages in the upper layers of the load shifting or falling backward against the rear doors. However, stepping down the load at this point is not always desirable, particularly if a proper distribution of the weight of the load, providing for the maximum permissible weight on each axle, is to be obtained. Various methods of securing the rear stack of containers are used with good results by many truckers. These include use of rope, wood strips, or adjustable aluminum rods or bulkheads anchored to the side walls of the vehicle, or other tie-down devices.

The choice of loading method, or arrangement of containers in any one type of load, is governed or limited by several factors other than the type, size, and shape of the containers themselves. The more important of these factors are: (1) The interior dimensions of the vehicle, (2) the weight or density of the commodity, (3) the need for the proper weight distribution that will provide the maximum per-

missible axle loadings, and (4) the specific refrigeration, ventilation, or heating requirements of the commodity being shipped.

These conditions vary widely as between different types and sizes of truck or trailer bodies, different sizes and types of containers, different commodities, and different seasons of the year. Therefore, it is not possible to recommend or illustrate any one loading method or arrangement for any one commodity or container that will work ideally in all motortruck shipments of a given product. The recommended loading methods for the individual commodities and containers described and illustrated in this manual must be considered in the light of these limitations. It will remain for the individual vehicle operator to choose the particular loading method that will best meet his particular needs.

Fresh Fruits, Vegetables, and Melons

Apples

Recommended protective services:

Desired temperature 30° to 32° F.

Desired relative humidity 85 to 90 percent.

Average freezing point 28.4°.

Bunker icing, or mechanical refrigeration with cooling and heating cycles.

Apples loaded warm immediately after harvest should be precooled and refrigerated during transit in order to preserve the natural quality of the fruit until it reaches the consumer. It is particularly important that the fruit be cooled as rapidly as possible after harvest and kept adequately cooled during transit if it is going to be held in cold storage for some time after shipment or if the shipment will be on the road more than 8 to 10 hours. Since apples ripen twice as fast at 40° as they do at 32°, they should be held as close to 32° as possible.

Shipments of warm fruit should be loaded in such a way that the air can circulate between the rows of containers to facilitate precooling or in-transit refrigeration. Fruit that has been in cold storage for some time and that is already cold enough for transportation can be safely loaded tightly in the vehicle, with provision made for circulation of air around and under the load. As apples are quite susceptible to freezing injury, shipments during subfreezing weather should be heated. Thermostatically controlled heaters are recommended to prevent both overheating and freezing. Apples absorb odors quite readily and should therefore not be shipped in mixed loads with commodities like onions or cabbage, or loaded in trucks that have recently been used to transport odorous products like fish.

Recommended loading methods:

Baskets (bushel tubs).—1. End-to-end offset method for shipments of warm fruit requiring considerable refrigeration (fig. 3).

2. Alternately inverted method for precooled fruit (at 30–32° F.) in tight packs with pads under covers and covers fastened at all four points. This method gives a tight load with a high degree of density (fig. 4).

Western apple boxes (1-bushel, nailed).—1. Lengthwise on sides in straight continuous rows with cover bulges of all boxes facing one side wall of trailer (fig. 5).

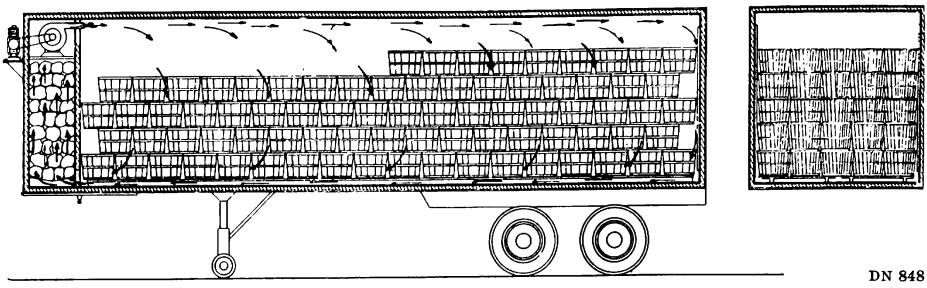

FIGURE 3.—Side and end views of end-to-end offset load of bushel baskets of apples, showing arrangement of containers in load.

2. Upright-on-end method for precooled fruit in cool weather when refrigeration requirements are not heavy.

Open-mesh bags (5- and 7-lb. bags, not in master containers).—Loaded in bulk. Floor or floor racks should be well padded with several inches of straw or with excelsior pads or similar padding material to prevent bruising. If loose material like straw is used for cushioning on floor racks, the racks should first be covered with heavy paper or fiberboard to keep the loose material from falling through the racks and blocking the circulation of air under the load, thereby interfering with refrigeration or heating. It is seldom safe to load fruit in bags to very great heights because of danger of bruising in bottom layers due to overhead weight. Uneven, scarred, or splintered side walls of the trailer should be lined with paper or other protective material to prevent rubbing or scuffing of the fruit.

Fiberboard cartons (½- or 1-bushel).—Lengthwise or crosswise on bottoms. If the fruit being shipped has been removed from cold storage and its temperature is about 35° or lower, the cartons should be stowed together as tightly as possible (fig. 6). If the fruit is warm, it is desirable that the cartons be loaded in a pattern that will permit the air to circulate through the load. This may be done by arranging the cartons in such a manner that there are two vertical ventilation flues in each stack or by loading the containers in straight rows with ventilation channels ½ inch or more in width between the rows.

Eastern apple boxes (1⅕-bushel, nailed, fiberboard covers).—Loaded lengthwise on bottoms. The load may be crosswise, offset by layers to stabilize it, but all boxes should be kept in stack alinement crosswise of the vehicle body.

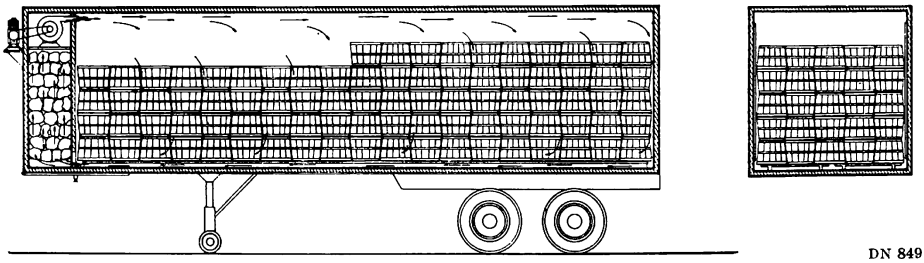

FIGURE 4.—Side and end views of alternately inverted load of bushel baskets of apples. This high-density load should be used only for precooled fruit in baskets equipped with cover pads and with the covers tightly fastened at all four points on the basket rims.

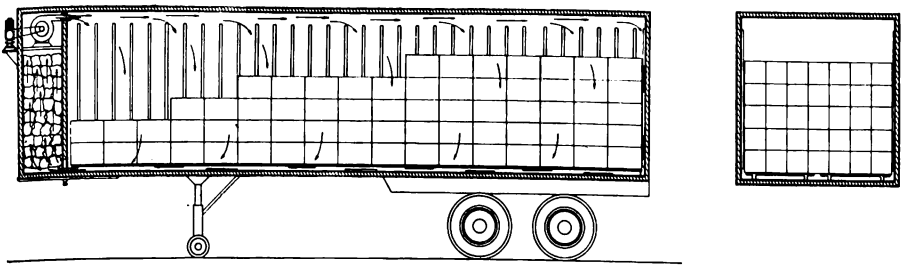

FIGURE 5.—Side and end views of lengthwise-on-sides load of bushel western apple boxes. For shipments moving relatively long distances in warm weather, this load should be used only for precooled fruit.

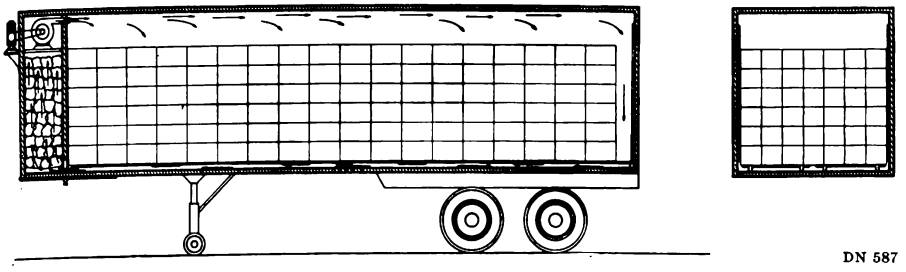

FIGURE 6.—Side and end views of a lengthwise-on-bottoms load of apples in 1-bushel fiberboard cartons. This type of load should be used only for precooled fruit or fruit shipped from cold storage.

Wirebound crates.—Lengthwise-on-bottoms (fig. 7). If the fruit has been precooled before shipment, the crates may be stowed closely together, but for long-distance shipments of warm fruit, a load with ventilation channels between the crates in at least the lower two layers of the load should be used. The crates should all be kept in good stack alinement so that the weight of crates in the upper layers of the load will be borne by end cleats of crates in the lower layers.

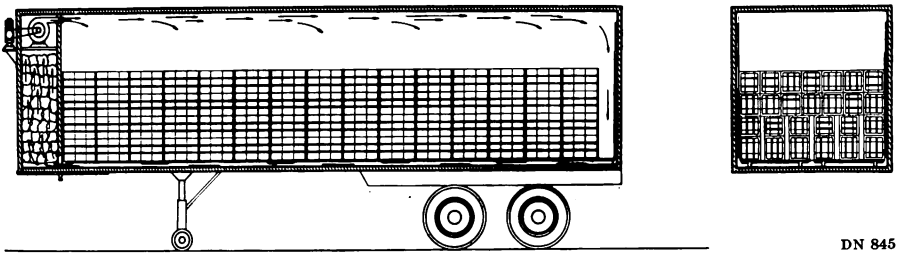

FIGURE 7.—Side and end views of a lengthwise-on-bottoms load of wirebound crates of apples. The channels between the rows of crates in the lower two layers are for circulation of cold air through the load.

Apricots

Recommended protective services:

Desired temperature: 31° to 32°.
Desired relative humidity: 85 to 90 percent.
Average freezing point: 28.1°.
Bunker icing (no top ice); or mechanical refrigeration.

Whenever possible, apricots should be precooled before loading.

When the fruit is loaded warm, the refrigerating unit or fans should be operated as soon as loading is completed. Frequent re-icing during precooling will be necessary to absorb the field heat in the product.

The containers should be loaded with spaces between the rows for air circulation over the fruit; otherwise, decay may develop due to the heat in the fruit.

Recommended methods of loading:

Soft fruit lugs (nailed rectangular).—Lengthwise on bottoms, with bottoms of boxes in all upper layers bearing on cover cleats of boxes in lower layers. The lugs should be kept in good row alinement and succeeding stacks of containers loaded in line and in tight contact with the containers in the preceding stacks. Shipments of fruit not precooled before loading should be loaded with continuous channels at least one-half inch wide between the rows of continers. The load should be crosswise stripped on each layer to hold the lugs in row alinement.

Artichokes—Globe

Recommended protective services:

Desired temperature: 31° to 32°.

Desired humidity: 90 to 95 percent.

Average freezing point: 29°.

Top ice. Artichokes are generally packed in boxes and the usual practice is to cover the containers with crushed ice.

Recommended loading methods:

Artichoke boxes (nailed, rectangular).—Lengthwise on sides, with all covers facing one sidewall of trailer. One or more stacks of boxes may also be loaded on end to make load come out even in relation to interior length of vehicle. It is advisable not to have these upright-on-end stacks at rear of load next to trailer doors, as they are unstable and may tilt against doors and fall out when doors are opened.

Asparagus

Recommended protective services:

Desired temperature: 34°.

Desired relative humidity: 85 to 90 percent.

Average freezing point: 29.8°.

Bunker icing. No top ice.

Thermostat setting 34° F.

Asparagus should be precooled before loading or just after loading has been completed.

Recommended loading methods:

Asparagus crates (pyramid type, nailed).—Lengthwise on bottoms, with all containers in good stack alinement. Containers in succeeding stacks should be loaded in tight contact with those in preceding stacks. The load may be crosswise offset by layers in order to distribute the crosswise space evenly and to stabilize the load crosswise of the vehicle. As the stalks of asparagus are always packed in an upright position and tops are easily damaged, the crates should always be loaded, stacked, and handled in an upright position.

Avocados

Recommended protective services:

Desired temperature, 45°.
Desired relative humidity, 85 to 90 percent.
Average freezing point, 27.2°.
Bunker icing or mechanical refrigeration.

Most varieties of avocados should be held at 45 degrees during transportation, except the West Indian varieties, which should be transported at 55 degrees. If avocados are in transit for extended periods at substantially higher temperatures, they will ripen rapidly and become soft. Therefore, it is important that provisions be made for adequate refrigeration of the commodity during transit. As avocados will not ripen satisfactorily if they are held long at temperatures below 45 degrees, shipments during subfreezing weather should be heated.

Recommended loading methods:

Avocado wooden lugs.—Lengthwise on bottoms, with containers in good stack alinement. Containers in the lower layers of the load should be in continuous rows with channels between about 2 inches wide. At least 2 or 3 layers of containers at the top of the load may be loaded 1 additional row in width, or offset crosswise of the vehicle body. This will stabilize the load and hold the containers in the lower layers in row alinement. If the load is constructed in this manner, it will not be necessary to strip the load crosswise of the vehicle to maintain row alinement, except possibly one or two stacks at the rear of the trailer that ordinarily are subject to some severe shifting in transit.

Fiberboard cartons.—Same as described above for nailed lugs except that crosswise stripping should never be used as it may cause severe creasing of fiberboard containers.

Bananas

Recommended protective services:

Green fruit on stalks:
Desired temperature, 54° to 60°.
Desired relative humidity, 95 percent.

Ripened fruit (boxed):
Desired temperature, 56° to 58°.
Desired relative humidity, 80 to 85 percent.

The lowest temperature at which green bananas can be safely transported is 54° F. Prolonged exposure of bananas to temperatures below this point will cause chilling injury to the peel of the fruit. If carried above 60° F., green fruit will ripen rapidly. Water ice refrigeration is preferable to mechanical refrigeration for bananas because of the higher humidity obtainable with water ice. It is desirable that air circulating fans be used in conjunction with the water ice to maintain uniform temperature and humidity through the interior of the vehicle. During cold weather, floor heating of the vehicle is desirable for maintenance of uniform temperatures. If other types of heaters are used, forced air circulation should be provided.

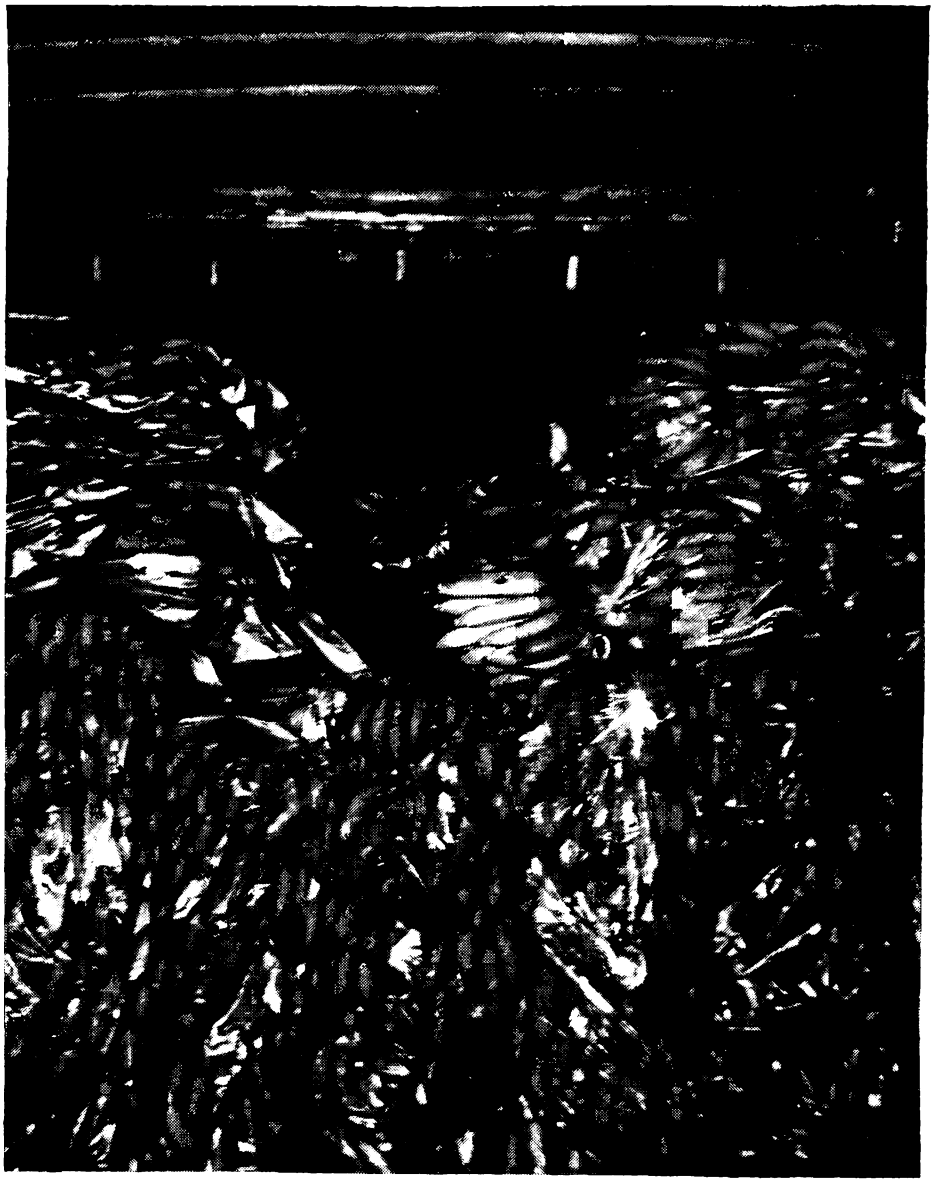

FIGURE 8.—Cross section of a load of green bananas showing arrangement of the stalks in the load. Each stalk in this load is covered with a polyethylene bag to protect the fruit against friction bruising.

Recommended loading methods:

Bananas are one of the few perishable commodities loaded in bulk. The stalks in the first layer should be loaded upright with the hands of bananas pointing downward (fig. 8). At the rear of the vehicle several stalks may be loaded crosswise on sides in order to hold the upright stalks in place. Stalks in the upper layers should be loaded crosswise on sides with the butts toward the side walls of the vehicle.

Unless the fruit is very small, such as 6 or 7 hand bunches, no more than 2 layers should be loaded on sides on top of the upright stalks. If the fruit is small, 3 or 4 layers may be loaded crosswise of the vehicle. If the floor or side walls of the truck body are rough or uneven, they

should be padded or lined with heavy paper or similar material to prevent rubbing or scuffing of the fruit. As bananas are easily contaminated by strong odors, they should not be carried in trucks which have been used to carry such products as fish or cabbage.

Beans (Green Snap)

Recommended protective services:

Desired temperature, 45° to 50°.
Desired relative humidity, 85 to 90 percent.
Average freezing point, 29.7°.

Bunker icing (no top ice) or mechanical refrigeration unit with heating and cooling cycles.

To prevent wilting, the relative humidity should not be lower than 85 percent, and the containers should be arranged in such a manner in the vehicle as to allow adequate air circulation around and through the load.

If the hampers are stacked close together, blocking the air from circulating through, the heat given off by the beans stimulates decay.

Great quantities of green beans are grown in the Southern States during the winter season, and are transported to northern markets. Protection against cold should be provided to prevent freezing damage in the containers on the floor.

Beans generally are packed in bushel hampers.

Recommended loading methods:

Bushel hampers (alternately inverted method).—Upright on bottoms, with alternate stacks, rows, and layers inverted. Containers in each stack should be loaded in tight contact with those in preceding stacks to prevent the hampers from tilting. There are two variations of this type of load. One is the so-called winter load in which the hampers are stowed together tightly lengthwise and crosswise of the vehicle to produce a solid, compact load with very small openings between the hampers (fig. 9). The second variation is the summer, or warm-weather, load in which the alternately inverted hampers are arranged in rows with ventilation openings between (fig. 10).

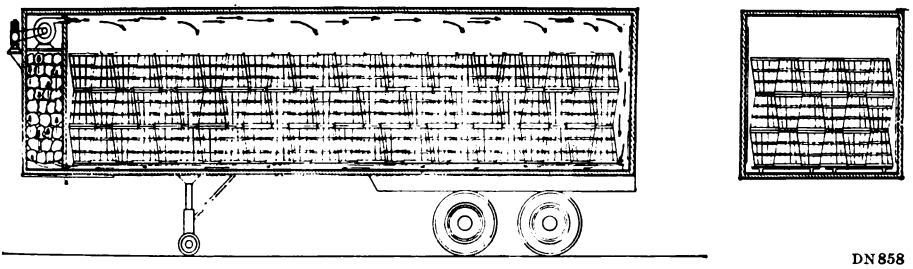

FIGURE 9.—Side and end views of alternately inverted load of bushel hampers of green or snap beans. This load should be used only during cool weather.

Beans (Lima, in Pods)

Recommended protective services:

Desired temperature 32° to 40°.
Desired relative humidity 85 to 90 percent.
Average freezing point 30.1°.

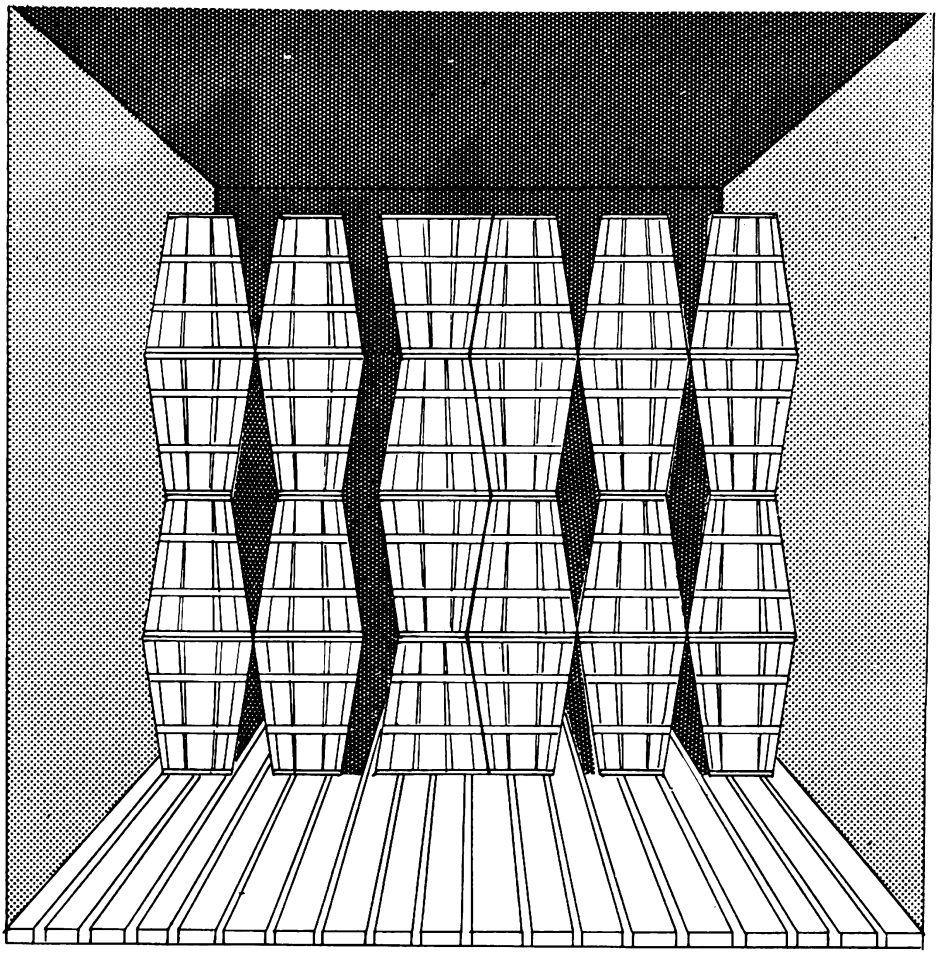

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FIGURE 10.—Summer, or warm-weather, load of 1-bushel hampers of beans. Note space between rows of hampers to permit circulation of air through load.

Bunker icing or mechanical refrigeration.

Practically all lima beans are shipped in bushel hampers or bushel baskets.

For lima beans to retain their fresh appearance and to prevent wilting, the humidity should be maintained between 85 and 90 percent, and in warm weather packages should be loaded so as to allow air circulation between the rows and stacks.

Recommended loading methods:

Bushel hampers (alternately inverted method).—Hampers upright and inverted in alternate stacks, rows, and layers. Containers in each stack should be loaded in tight contact with those in preceding stacks to prevent the hampers from tilting.

There are two variations of this type of load. One is the so-called winter load in which the hampers are stowed together tightly lengthwise and crosswise of the vehicle to produce a solid, compact load with very small openings between the hampers (fig. 9).

The second variation is the summer, or warm-weather, load in

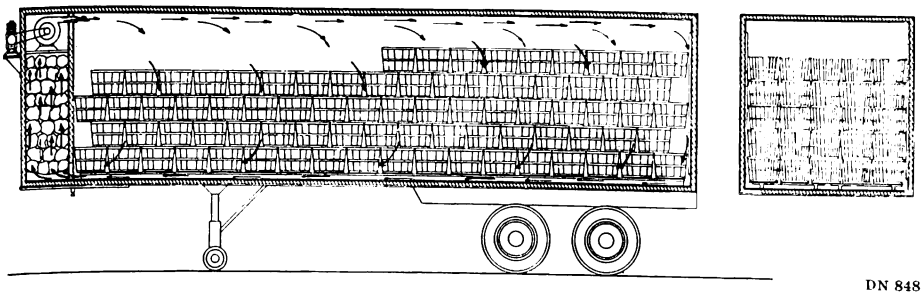

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FIGURE 11.—Side and end views of end-to-end offset load of bushel baskets of lima beans, showing arrangement of containers in load.

which the alternately inverted hampers are arranged in rows with ventilation openings between (fig. 10).

Baskets (bushel tubs).—End-to-end offset method for shipments moving long distances in warm weather (fig. 11).

Beets

Recommended protective services:

Beets (bunched):

Desired temperature 32°.
Desired relative humidity 90 to 95 percent.
Average freezing point 26.9°.
Ice in the containers and top ice.

The freezing point of beets is 26.9°; however, the tops will freeze at temperatures below 32°.

To minimize the generation of heat in beets and tops when they are in closed packages, crushed ice should be placed in the containers and on top of the load. Additional top ice should be blown over the load while in transit during the heat of the summer.

Beets (without tops):

Desired temperature 32°.
Desired relative humidity 90 to 95 percent.
Average freezing point 26.9°.
Top icing and bunker icing.

Beets without tops generally are precooled, being placed in storage soon after harvesting. They usually are packed in bushel baskets or 50-pound open mesh bags.

On long trips, it is good practice to cover the load with crushed ice to retain quality and fresh appearance.

Recommended loading methods:

Beets (bunched):

Bushel baskets.—End-to-end offset, with baskets stowed tightly against those in preceding stacks in order to prevent shifting of load (fig. 12). Use of a guide row along one side wall of trailer from the front of the trailer to the rear will be of help in building a tight, solid load. This load should be used only for non-top-iced shipments moving relatively short distances in cool weather. The alternately inverted load (fig. 13) should be used for top-iced shipments in warm weather.

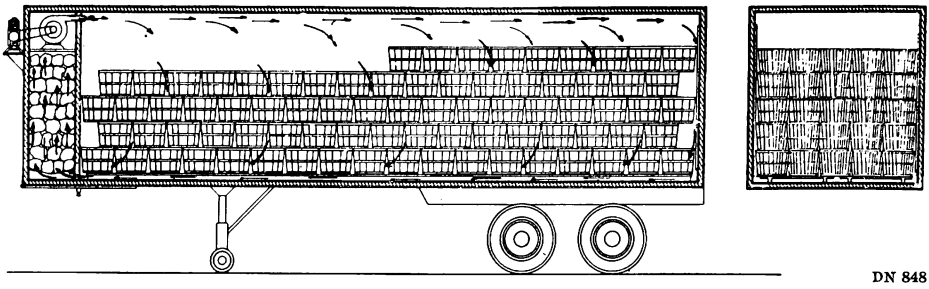

FIGURE 12.—Side and end views of end-to-end offset load of bushel baskets of bunched beets, showing arrangement of baskets in load.

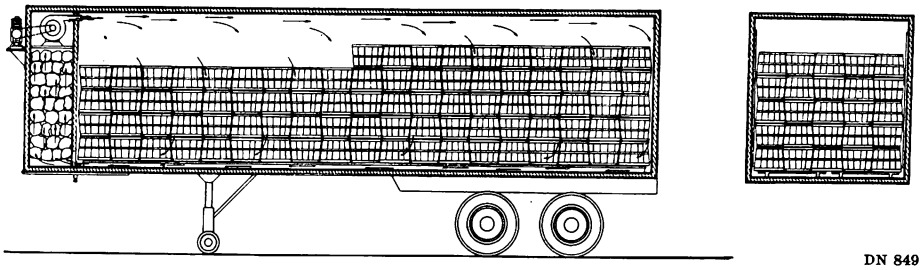

FIGURE 13.—Side and end views of alternately inverted load of bushel baskets of bunched beets, showing arrangement of containers in load. This high-density load, in which the baskets fit together tightly, should not be used for shipments moving long distances in warm weather unless they are adequately top-iced.

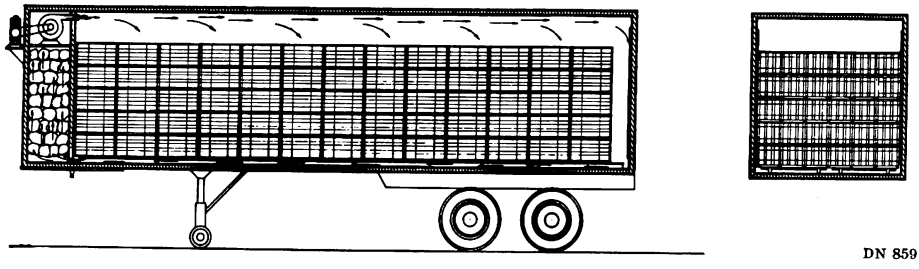

FIGURE 14.—Side and end views of lengthwise-on-sides load of wirebound crates of bunched beets. Loads of this commodity should be top iced and have adequate ice between the rows of containers.

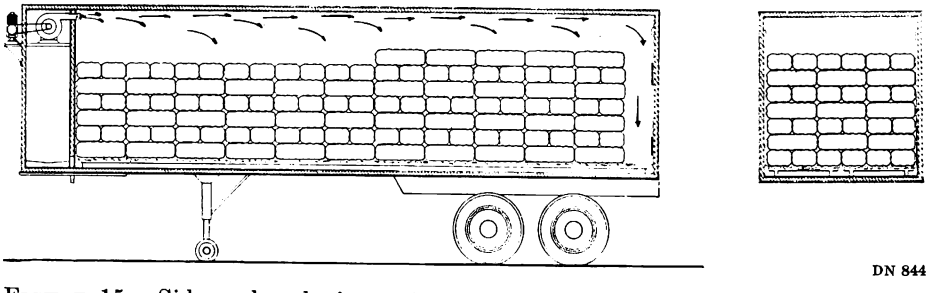

FIGURE 15.—Side and end views of a combination lengthwise-crosswise load of 50-pound open-mesh bags of topped beets. Loads of this commodity should be top-iced for long-distance shipment in warm weather.

In this high-density load, the baskets are in better position to support the overhead weight of the ice.

Wirebound crates.—Lengthwise on sides. It is desirable that good row alignment be maintained in loads of this container, so there will be a uniform space between rows to permit adequate refrigeration of the commodity by the top ice. One or more stacks of crates of this commodity may also be loaded upright on-end in order to make the load come out even in relation to the length of the trailer (fig. 14).

Beets (without tops):

Bushel baskets.—Same as for beets with tops (bunched beets) (figs. 12 and 13).

Open-mesh bags, 50-pound.—Lengthwise on sides, with straight rows that may or may not be offset by alternate layers.

A combination lengthwise method may be used in which bags in alternate layers are loaded crosswise of trailer (fig. 15). Long-distance shipments in warm weather should be top-iced.

Blackberries

Recommended protective services:

Desired temperature 31° to 32°.
Desired relative humidity 85 to 90 percent.
Average freezing point 28.9°.
Bunker ice (no top ice); or mechanical refrigeration.

Recommended loading methods:

Nailed and wirebound carrier crates.—Lengthwise on bottoms. In shipments moving relatively long distances in warm weather, vertical ventilation channels one-half inch or more in width should be maintained between the rows of crates to facilitate refrigeration. In loads of this type, the crates should be held in row alinement by two crosswise strips on each layer of each stack. For shipments moving short distances to market, a crosswise offset load in which no stripping is required usually will be satisfactory. The crates never should be loaded, stacked, or handled on their sides or tops, because such handling spills or jumbles the berries.

Blueberries and Huckleberries

Recommended protective services:

Desired temperature 31° to 32°.
Desired relative humidity 85 to 90 percent.
Average freezing point 28.9°.
Bunker ice (no top ice); or mechanical refrigeration.

Recommended loading methods:

Lengthwise on bottoms or crosswise on bottoms, with crates in good row and stack alinement. Care should be taken to see that each flat is stacked squarely on top of the flat in the lower layer and that the end pieces of the flat do not bear on the cover strips of the flats beneath it.

Flats should be arranged in the load so as to allow an abundance of cold air to circulate over the fruit, maintaining an even, cool temperature throughout the load. When the containers are stacked

close together, blocking the free passage of air, the unfavorably high temperatures that develop will speed deterioration and decay.

Broccoli (Italian Sprouting)

Recommended protective services:

Desired temperature 32° to 35°.
Desired relative humidity 90 to 95 percent.
Average freezing point 29.2°.
Bunker ice, top ice, and crate ice.

To keep the buds fresh and green, broccoli usually is packed with crushed ice in the crates and crushed ice over the top of the load.

During the heat of the summer it is sometimes necessary to add ice in the bunker, in addition to the top ice, to maintain desired temperatures.

Recommended loading methods:

Broccoli crate (nailed, rectangular).—Lengthwise on sides. Cover bulges of all crates should face the same side wall of vehicle, except that crates in each side wall row should have cover bulges facing the side walls. Each crate in each row should be directly in line and in tight contact with the corresponding crate in the preceding stack. Good row alinement with channels between rows for top ice are essential for effective refrigeration of the commodity.

Brussel Sprouts

Recommended protective services:

Desired temperature 32° to 35°.
Desired relative humidity 90 to 95 percent.

When brussel sprouts are packed in drums for long hauls crushed ice is placed in the containers and top ice over the load.

Recommended loading methods:

Drums (veneer construction).—Upright on bottoms. Loading should be started at the front of the trailer and the first stack should be loaded to the desired height, with all crosswise space that is not taken up by the containers equally distributed between the containers in the stack. In loading the second stack, the drums should be fitted into the recesses between the drums in the first stack. The third stack should be loaded in the same manner as the second, and so on to the rear end of the trailer, with the drums in each stack fitted or nested tightly into the recesses between the drums in the preceding stack.

Carrier crates (nailed and wirebound).—Lengthwise on bottoms. Load may be crosswise, offset by layers, in order to stabilize it crosswise of the vehicle body. Long-distance shipments in warm weather should be top-iced, in which case the crates should be loaded in row alinement with channels between the rows to accommodate top ice.

Cabbage

Recommended protective services:

Desired temperature 32° to 35°.
Desired relative humidity 90 to 95 percent.
Average freezing point 31.2°.

Bunker ice and top ice, or mechanical refrigeration and top ice.

Cabbage is shipped from many States, in several types of containers and occasionally in bulk.

New cabbage, or cabbage which is freshly harvested and green, packed in wooden containers or 50-pound open-mesh bags, should be covered with crushed ice, and, during warm weather, bunker ice may be used in addition to the top ice. Adequate ventilation during cool months, in which cabbage is usually shipped, ordinarily will provide sufficient protection. In exceptionally cold weather, preheating of the trailer before loading or heating during transit is necessary to prevent freezing injury.

Bulk shipments of new cabbage by motor carrier are not recommended during warm weather without top ice, except for short distances, as a lack of refrigeration may cause abnormal deterioration.

Open-top trucks should not be used in transporting cabbage, as direct exposure to the sun's rays causes drying and wilting.

Recommended loading methods:

50-pound open-mesh bags.—Lengthwise or crosswise on sides (fig. 16). If top ice is used, it is desirable that the bags not be loaded too tightly crosswise of the trailer, so that the cold air and water from the melting ice may have free access to the bags in the lower layers. In shipments of new green cabbage, ordinarily it is not safe to load the commodity more than six layers high without the risk of bruising or cracking the heads in the bottom of the load. This is true particularly in instances where substantial amounts of top ice are to be placed on the load.

Old cabbage, or the late fall crop, which has been in dry storage for some time prior to shipment, should not be top-iced. If the heads are firm and hard, it is possible to load shipments of this crop somewhat more heavily than shipments of green cabbage.

Wirebound boxes.—Lengthwise on sides (fig. 17). If load is not top-iced, it may be crosswise offset by layers in order to stabilize it and distribute the overhead weight more evenly. When top ice is used, it is desirable in order to accommodate the ice that the containers be loaded in straight rows with channels of at least one-half inch between the closest points of contact of containers in adjacent rows.

Nailed wooden crates.—Lengthwise on sides (fig. 18). Cover bulges of all crates should face the same side wall of vehicle, except that crates in each side wall row should have cover bulges facing the side walls. Each crate in each row should be directly in line and in tight

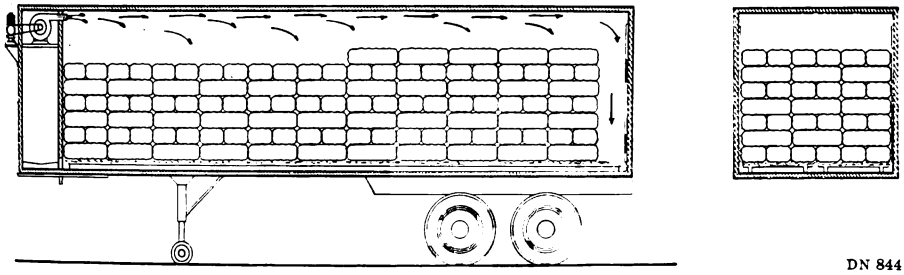

FIGURE 16.—Side and end views of a combination lengthwise-crosswise load of cabbage in 50-pound open-mesh bags. Shipments of late-crop cabbage which has been in dry storage should never be top-iced, but long-distance shipments of the early crop should be top-iced.

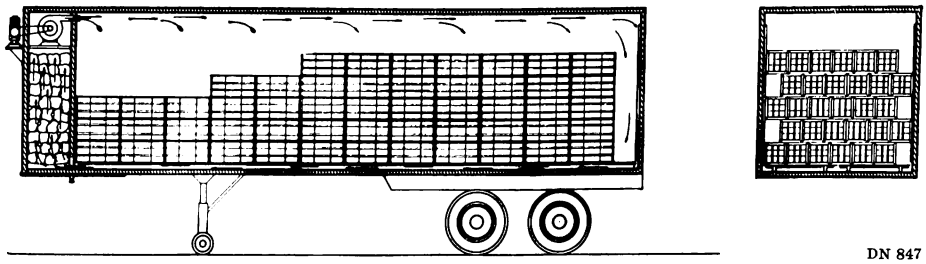

FIGURE 17.—Side and end views of a crosswise offset load of wirebound crates of cabbage. This type of load should be used only for short-distance shipments in cool weather with no top-ice.

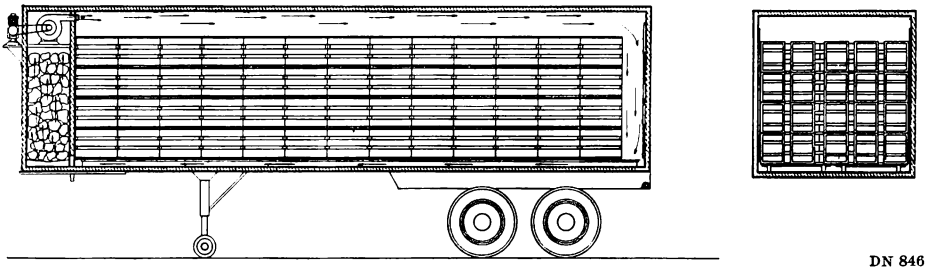

FIGURE 18.—Side and end views of lengthwise-on-sides load of wooden vegetable crates of cabbage.

contact with the corresponding crate in the preceding stack. Good row alinement with channels between rows for top ice is essential for effective refrigeration.

Cantaloups

Recommended protective services:

Desired temperature 40° to 45°.
Desired relative humidity 85 to 90 percent.
Average freezing point 28.4°.
Bunker icing or mechanical refrigeration.
Top ice for precooling.

For the best results in transporting cantaloups over considerable distances, they should be precooled before loading or precooled in the vehicle with precooling fans or with crushed ice over the load.

Recommended loading methods:

Western nailed cantaloup crates (including jumbo, standard and pony crates).—Upright on ends, with top and bottom bulges facing side walls of trailer and sides facing front and rear of trailer. Because of the strength limitations of this type of crate, it is usually not safe to stack it in this position more than three layers high. The third layer should be lengthwise on sides (fig. 19). In no case should the crates be loaded, dropped, or handled with the weight of the crate resting on the cover or bottom bulges. If top ice is to be used on the load, the label ends of all crates should be loaded downward so as to prevent defacing or loosening of the labels by the top ice.

Cantaloup crates also may be loaded lengthwise of the trailer or truck body on their sides (fig. 20). As in the on-end load, the top and

bottom bulges on these crates in this position should face the sides of the vehicle, so that they will not be exposed to pressure or overhead weight.

However, if the cantaloups are packed tightly in the crates there will be some bulge in the side slats. If this is the case, crosswise stripping of each stack at each end of the crate is advisable, particularly in the 4 or 5 stacks at the rear of the trailer over the axle, to prevent bruising of the melons from overhead weight and road vibration. If the load is to be transported over relatively rough roads, the lengthwise-on-sides load should not be used as there is a greater risk of bruising the melons on under sides of the crates in the lower layers.

Two-thirds crates and flat crates.—Crosswise of trailer on bottoms, with crates in good row alinement and loaded tightly against crates in preceding stacks.

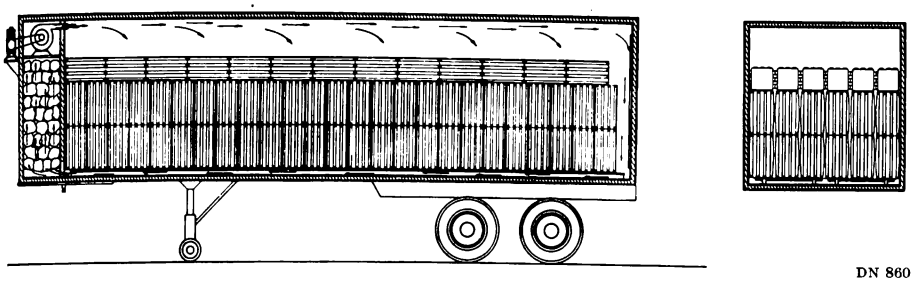

FIGURE 19.—Side and end views of upright-on-ends load of jumbo cantaloup crates with third-layer crates lengthwise on sides. Note that the cover and bottom bulges on all crates face the side walls of the trailer.

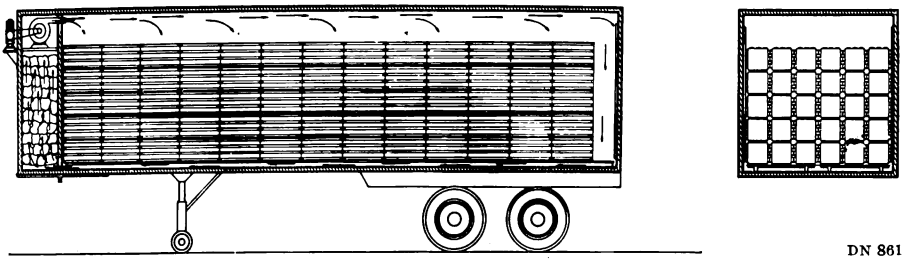

FIGURE 20.—Side and end views of lengthwise-on-sides load of jumbo cantaloup crates. The cover and bottom bulges all face the side walls of the trailer.

Carrots

Recommended protective services:

Bunched with tops:

Desired temperature 32° to 34°.

Desired relative humidity 90 to 95 percent.

Average freezing point roots, 29.6°.

Ice in the containers plus top ice.

The freezing point of the carrots is 29.6°; however, the carrot tops will freeze at temperatures below 32°.

Carrot tops generate heat when confined in a closed package. To remove this heat, crushed ice should be placed in the containers in addition to crushed ice over the top of the load.

Without tops:

Desired temperature 32° to 34°.

Desired relative humidity 90 to 95 percent.

Average freezing point 29.6°.

Top ice, bunker icing, or mechanical refrigeration.

Fresh carrots without tops, packed in 50-pound open-mesh bags, should have crushed ice blown over and through the load to preserve their fresh and crisp appearance. Many topped carrots are packaged in 1-pound film bags which are shipped in wirebound crates and fiberboard cartons. The wirebound crates usually are shipped under top ice, while the fiberboard cartons are shipped with bunker icing or mechanical refrigeration.

Recommended loading methods:

Bunched with tops:

WGA crates (western semisquare, nailed).—Lengthwise on sides, with crates in good row alinement (fig. 21). Crates in the two outer rows adjacent to the side walls of the trailer should be loaded with the cover bulges of the crates facing the side walls, as this will permit only the apex of the cover bulge, under which there is usually some pack ice, to contact the side walls instead of the entire surface of the bottom of the crate. It is desirable that enough space be left between the rows of crates for top ice on relatively long hauls. One or more stacks of crates also may be loaded upright on ends, with the cover bulges facing the side walls of the trailer, so that the load will come out even in relation to the length of the trailer. However, under no circumstances should this type of crate be loaded or stacked on the cover bulge.

Without tops:

50-pound open-mesh bags.—Lengthwise on sides, or combination lengthwise-crosswise load with bags reversed in alternate layers; that is, lengthwise in first layer, crosswise in second layer, lengthwise in third layer, etc. (fig. 22). It is desirable that the bags not be loaded too tightly in order that full benefit may be obtained from the top ice. Generally speaking, the combination lengthwise-crosswise load, if properly constructed, permits greater contact between the top ice and the commodity in the lower layer bags.

Bushel tub baskets.—End-to-end offset or alternately inverted (figs. 23 and 24). The latter method produces a more compact load, but it should be used only where the basket covers are tightly fastened at all four points. In the latter method the baskets are in a better position to withstand the overhead weight of the top ice.

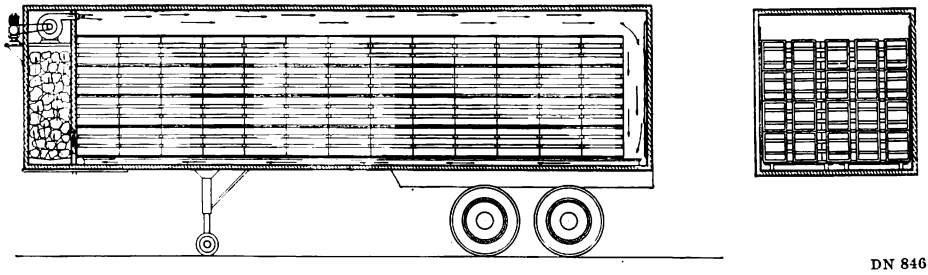

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FIGURE 21.—Side and end views of lengthwise-on-sides load of bunched carrots in WGA wooden crates. The channels between the rows in this type of load should be filled with crushed ice.

Wirebound crates (master containers for consumer-size film bags).—Lengthwise on sides (fig. 25). It is desirable that good row alinement be maintained in loads of this container so that there will be a uniform amount of space between the rows to permit adequate refrigeration of the commodity by the top ice. One or more stacks of crates of this commodity also may be loaded upright on end so that the load will come out even in relation to the length of the trailer.

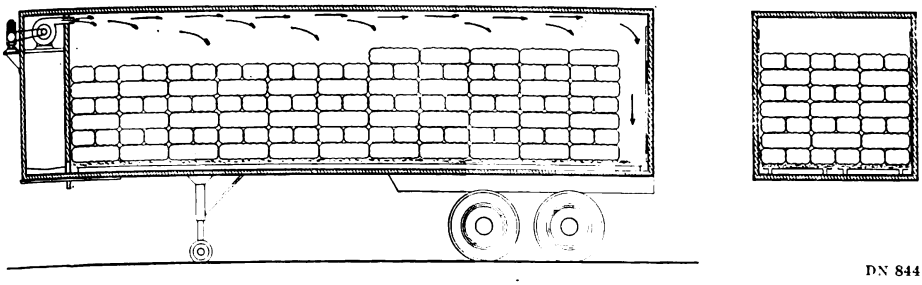


FIGURE 22.—Side and end views of a combination lengthwise-crosswise load of 50-pound open-mesh bags of topped carrots. Long-distance shipments should be top-iced to provide adequate refrigeration and moisture.

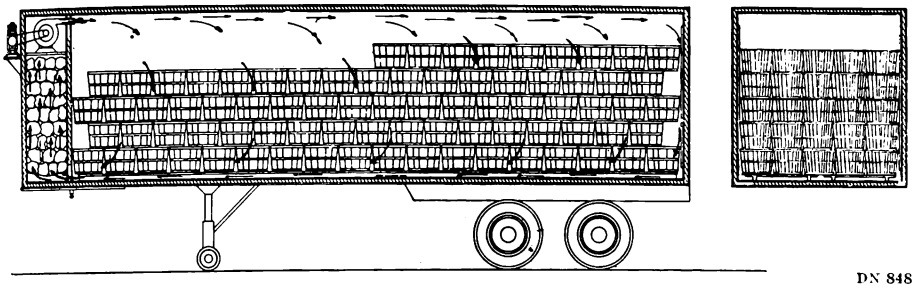


FIGURE 23.—Side and end views of end-to-end offset load of bushel baskets of topped carrots. This type of load should be used without top ice for shipments moving only relatively short distances.

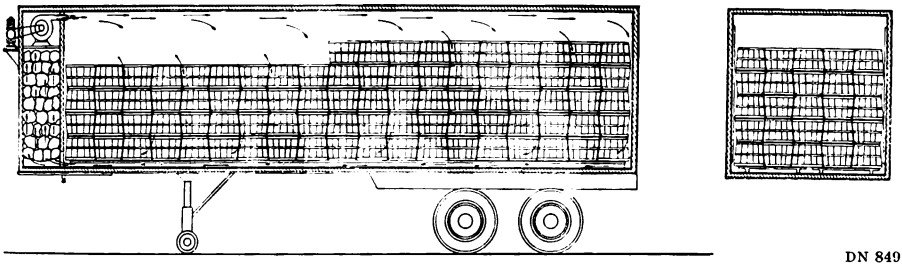


FIGURE 24.—Side and end views of an alternately inverted load of bushel baskets of topped carrots. Covers of the baskets loaded by this method should be fastened at all four points and long-distance shipments should be top-iced.

Casaba, Crenshaw, and Persian Melons

Recommended protective services:

Desired temperature 45° to 50°.
Desired relative humidity 85 to 90 percent.
Bunker icing (no top ice); or mechanical refrigeration.

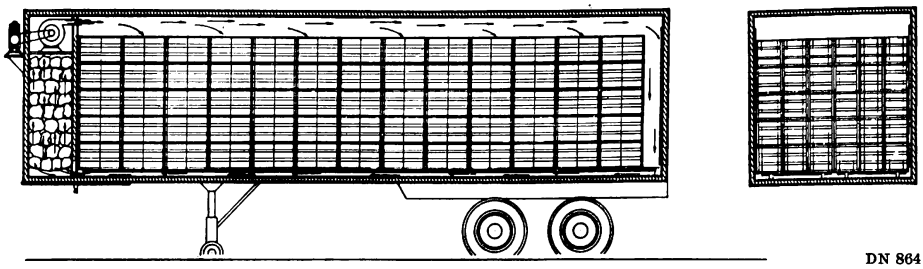


FIGURE 25.—Side and end views of a lengthwise-on-bottoms load of wirebound crates of topped carrots. Long-distance shipments of this type of load should be top-iced.

These melons generally are packed in flat, rectangular wooden crates with excelsior or similar padding material in the bottom to prevent bruising. If the melons are mature, it is particularly important that they be refrigerated during transit, or they will ripen too fast.

Recommended loading methods:

Melon crates (nailed construction).—Lengthwise on bottoms, with good stack alinement. It is important in loading to have each crate stacked squarely on top of the crate directly beneath it so that the weight of the upper layers bears on the cover cleats of the crates in the lower layers. If the crates are permitted to shift lengthwise out of stack alinement, the bottoms of crates in the upper layers will slip off the cover cleats and the overhead weight of the load will bear on the bulge of the cover slats in lower layers. Since the cover slats usually are in direct contact with the tops of the melons, severe bruising of melons may result. If the melons are being shipped relatively long distances and refrigeration channels are provided between the rows of containers, some method of holding the containers in row alinement, including either vertical spacing units or crosswise stripping of each layer, should be employed. Loads of precooled melons also may be crosswise offset by layers to stabilize the load crosswise of the vehicle (fig. 26).

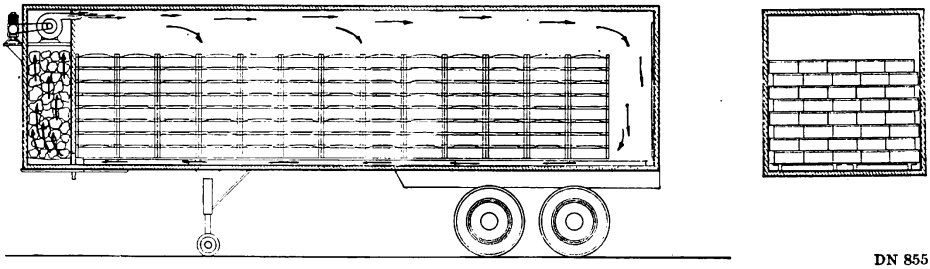


FIGURE 26.—Side and end views of a crosswise offset load of melon crates, showing arrangement of containers in load. This type of load should be used only for shipments of precooled melons or shipments in transit not more than 24 hours.

Cauliflower

Recommended protective services:

Desired temperature 32°.
Desired relative humidity 85 to 90 percent.
Average freezing point 30°.
Top ice.

Recommended loading methods:

Western panel end crates (nailed construction, each containing one layer of heads).—Lengthwise or crosswise of trailer on covers, with crates in good row and stack alinement (fig. 27). Shipments moving relatively long distances should be top-iced and channels between the rows should be provided for that purpose. All crosswise slack should be evenly distributed across the trailer between the rows of crates and between the outer rows and the sidewalls of the trailer. If top ice is applied evenly and uniformly over the load so that all the channels between the rows are completely filled, the commodity will be refrigerated properly and the containers held in row alinement.

Long Island wirebound crates.—Lengthwise on sides, in good row alinement and with channels of uniform width for adequate top icing (fig. 28).

Catskill cauliflower crate (wirebound construction, semisquare).—Lengthwise on sides, with good row alinement. Channels should be provided between rows for proper distribution of top ice in long-distance shipments in warm weather (fig. 29).

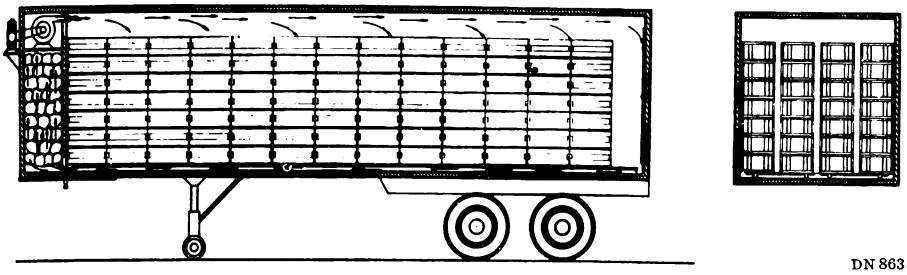


FIGURE 27.—Side and end views of a lengthwise-on-covers load of panel-end cauliflower crates. The lengthwise channels between the rows of these crates should be filled with crushed ice, with additional ice over the top-layer crates.

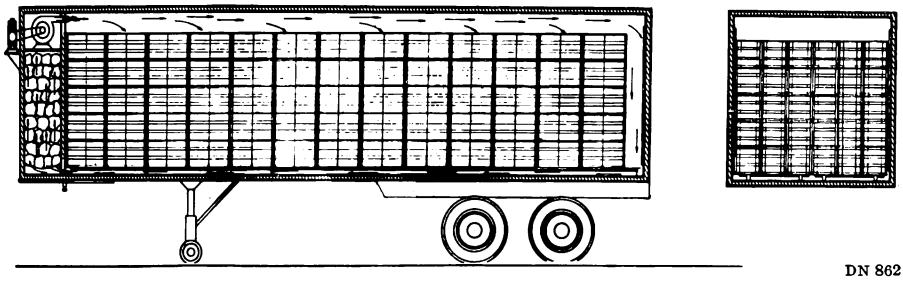


FIGURE 28.—Side and end views of a lengthwise-on-sides load of Long Island wirebound cauliflower crates. Shipments moving relatively long distances should be covered with crushed ice.

Celery

Recommended protective services:

Desired temperature 31° to 32°.
Desired relative humidity 90 to 95 percent.
Average freezing point 29.7°.
Top ice.

Celery is a highly perishable commodity and requires care in loading. The crates should be loaded with a space along the side walls

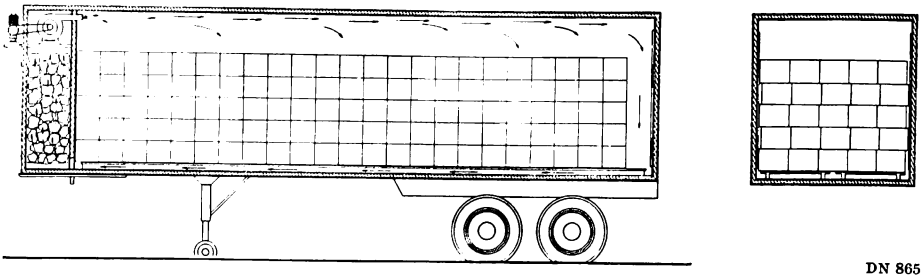


FIGURE 29.—Side and end views of a lengthwise-on-sides load of Catskill wirebound crates of cauliflower. Long-distance shipments should be top-iced.

and between the rows. Top ice should be blown over and down through the load to prevent the tops from heating.

Celery usually is hydrocooled in the crates before loading. Shipments adequately hydrocooled before loading ordinarily may be transported safely over long distances, but top icing is still required to hold the product at the desired temperature and to retain moisture in it.

On shipments of celery moving during subfreezing weather, protection against cold should be provided.

Recommended loading methods:

Wirebound crates.—Lengthwise on sides (fig. 30). For shipments moving relatively long distances under top ice, it is desirable that vertical channels at least one inch wide be maintained between rows of crates. So that the load will come out even in relation to the interior length of the truck or trailer body, one stack of crates at the front or rear of the load may be loaded crosswise on sides. As

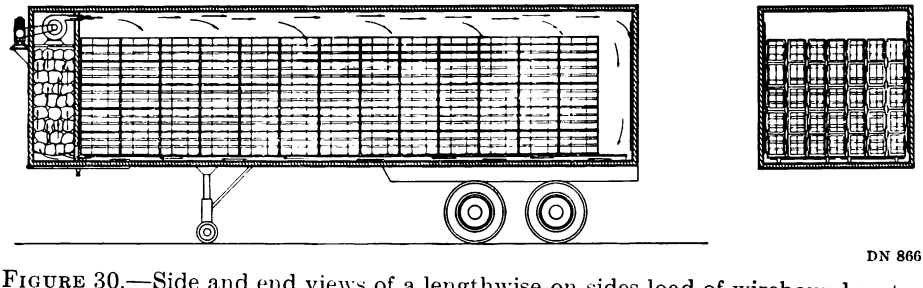


FIGURE 30.—Side and end views of a lengthwise-on-sides load of wirebound crates of celery. Loads of this commodity should be covered with liberal quantities of crushed ice.

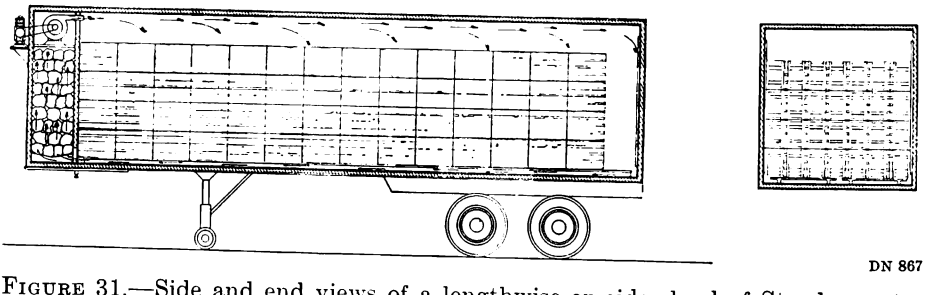


FIGURE 31.—Side and end views of a lengthwise-on-sides load of Sturdee crates of celery. This load should be top-iced.

this particular type of container is bulged on its top and bottom when packed, it always should be loaded on its side to prevent crushing of the stalks.

Sturdee crates (nailed construction, unitized veneer covers).—Because of cover bulges on the sturdee crates, they must be loaded on their sides lengthwise of the truck or trailer body (fig. 31). One or more stacks of crates may be loaded upright on ends so that the load will come out even in relation to the inside length of the vehicle.

Cherries

Recommended protective services:

Desired temperature 31° to 32°.

Desired relative humidity 85 to 90 percent.

Average freezing points: Eastern sour cherries 22°, eastern sweet cherries 24.7°, western sweet cherries 24.2°.

Bunker icing or mechanical refrigeration.

Cherries that will be in transit longer than 8 to 10 hours should be precooled thoroughly before or immediately after loading. Full refrigeration that will reduce the temperature of the fruit to the recommended level and hold it there should be provided, whether or not the fruit is precooled. To facilitate quick precooling and maintenance of uniform temperatures throughout the load, the containers must be loaded so as to provide for circulation of air through the load.

Deterioration of quality and development of decay in sweet cherries during transit can be retarded effectively by carbon dioxide gas in concentrations as low as 15 percent. Tests have shown that the fruit will tolerate concentrations as high as 25 percent without harmful effects. In recent years, some shipments of cherries in lugs from the Pacific Northwest producing areas have been sealed in polyethylene liners, within the lugs, from which part of the air was exhausted before sealing. Respiration of the fruit during transit builds up sufficient concentrations of carbon dioxide (C°2) within the sealed liners to aid materially in retarding quality deterioration and decay.

For long-distance shipment of cherries in unlined packages, substantially the same effect can be achieved within the trailer body by circulating carefully controlled carbon dioxide gas produced by melting small quantities of dry ice. This method is effective only if the truck or trailer body is almost completely air tight so as to prevent leakage of the gas. As carbon dioxide is heavier than air, it settles to the bottom of the load. It is exceptionally cold and may cause freezing damage to the fruit in the bottom layers of the load unless it is circulated throughout the load.

Recommended loading methods:

Climax splint baskets and 8- or 12-quart fiberboard baskets.—Combination lengthwise and crosswise load with containers reversed in alternate layers (fig. 32). Containers in the first layer may be loaded lengthwise and those in the second and each alternate layer crosswise of the vehicle body. If the baskets are not equipped with recessible handles, the handles of the baskets in one layer will extend upward between the baskets in the layer immediately above. In shipments moving relatively long distances in warm weather, each stack of containers should contain several continuous vertical openings, or flues, extending from the top to the bottom of the load, to facilitate refrigeration.

Soft fruit lugs, wood construction.—Lengthwise on bottoms. The containers should be kept in good stack alinement crosswise of the vehicle so that the overhead weight of the lugs in the upper layers will be on cover cleats at each end of the covers. Shipments of precooled fruit or shipments not moving long distances may be offset crosswise by layers. Shipments of warm fruit moving relatively long distances should have channels between the rows of lugs to facilitate refrigeration.

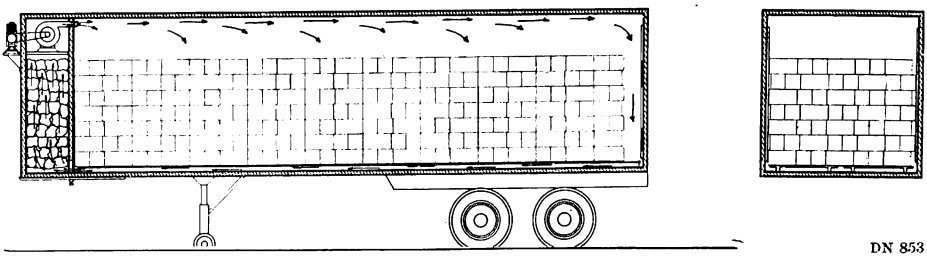


FIGURE 32.—Side and end views of a combination lengthwise-crosswise load of fiberboard baskets of cherries. This type of load should be used only for precooled fruit or fruit not being shipped long distances.

Corn (Sweet)

Recommended protective services:

Desired temperature 31° to 32°.
Desired relative humidity 80 to 90 percent.
Average freezing point 28.9°.
Bunker ice and top ice, or mechanical refrigeration and top ice.

Because the sugar in green sweet corn changes to starch rapidly, it is imperative that this product be cooled just as soon as possible after harvest and be kept refrigerated during transit. When sweet corn is loaded without precooling, packed in crates or in bags, the containers should be covered with crushed ice during the time of loading so that each container is practically surrounded with ice.

Some corn is hydrocooled in the crates before loading. Shipments that have been hydrocooled adequately before loading ordinarily may be transported safely for long distances, but top icing is still required to hold the product at the desired temperature and to retain moisture.

In addition, during the heat of summer, bunker icing is necessary, with circulation of cold air through the load.

Recommended loading methods:

Wirebound crates.—Lengthwise on sides. If the commodity has been precooled before loading, the crates may be loaded somewhat more compactly than if it is loaded warm (fig. 33). For adequate refrigeration, nonprecooled corn in wirebound crates should be loaded with channels between the rows sufficiently wide to accommodate top ice. Both precooled and nonprecooled corn should be top-iced liberally and re-top-iced every 24 hours.

50-pound open-mesh bags.—Alternately reversed load (fig. 34). Bags should be reversed in alternate layers; that is, the first layer bags should be loaded lengthwise and the second and each alternate layer of bags loaded crosswise. Icing and re-icing should be the same as for wirebound crates.

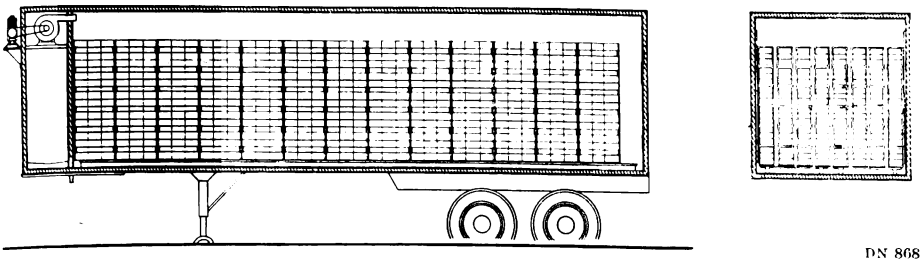


FIGURE 33.—Side and end views of a lengthwise-on-sides load of wirebound crates of sweet corn. The channels between the rows of crates should be filled and the top of the load should be covered with liberal quantities of crushed ice.

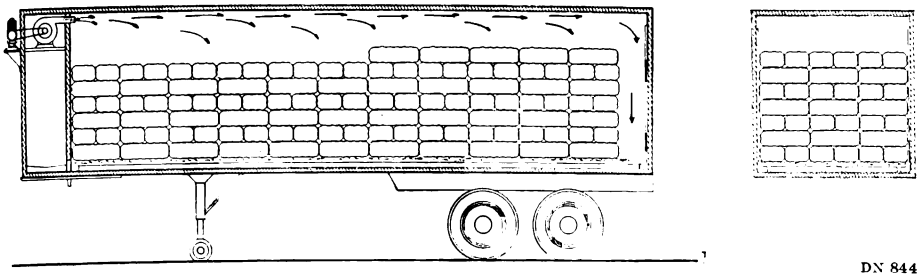


FIGURE 34.—Side and end views of a combination lengthwise-crosswise load of 50-pound open-mesh bags of sweet corn. Shipments of this commodity should be top-iced.

Cranberries

Recommended protective services:

Desired temperature 36° to 40°.
Desired relative humidity 85 to 90 percent.
Average freezing point 27.3°.
Bunker icing or mechanical refrigeration.

The most desirable temperature in transit is from 36° to 40°. Lower temperatures increase low-temperature breakdown.

Recommended loading methods:

Fiberboard cartons.—Lengthwise or crosswise on bottoms. As most cranberries are precooled before shipment and many are shipped from cold-storage plants, the cartons should be loaded tightly together, to insulate as much of the load as possible from external heat. To accomplish this, the cartons may be reversed in alternate rows, layers or stacks to make the load compact and make it come out even in relation to the interior dimensions of the vehicle.

Cucumbers

Recommended protective services

Desired temperature 45° to 50°.
Desired relative humidity 85 to 90 percent.
Average freezing point 30.5.
Bunker icing or mechanical refrigeration unit with cooling and heating cycles.

Even though the freezing point for cucumbers is 30.5°, they should not be held below 45°, because they develop low-temperature breakdown.

During the spring and fall, cucumbers may be transported by opening the ventilators, but they must not become chilled. The ventilators should be closed when the outside temperature falls below 45° or rises above 50°.

Cucumbers moving during the winter should be protected against cold weather by portable heaters.

Recommended loading methods:

Bushel tub baskets.—End-to-end offset (fig. 35) or alternately inverted (fig. 36). The latter method produces a more compact load, but should be used only where the basket covers are tightly fastened at all four points.

Wirebound crates.—Lengthwise on bottoms (fig. 37). To facilitate ventilation, the load should have channels between the rows in at least

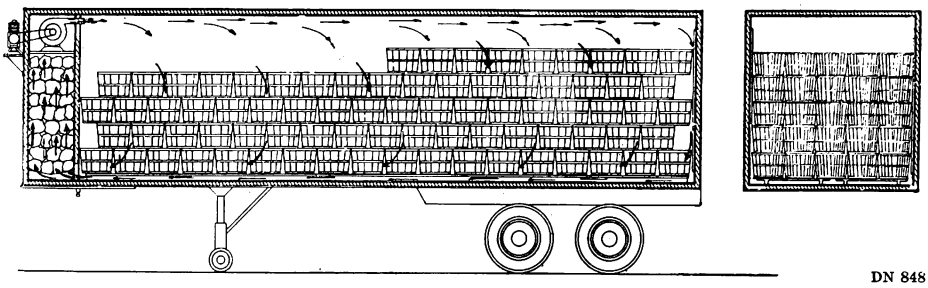


FIGURE 35.—Side and end views of end-to-end offset load of bushel baskets of cucumbers, showing arrangement of containers in load.

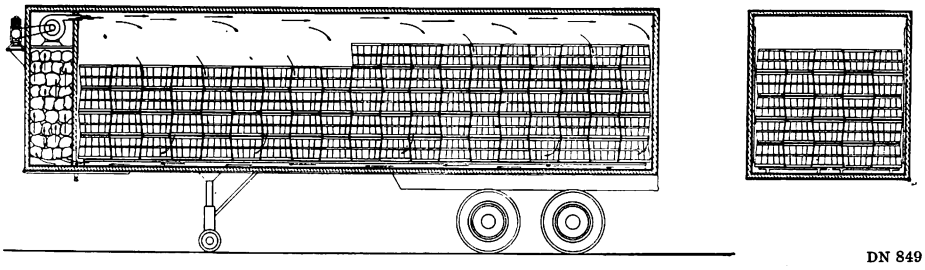


FIGURE 36.—Side and end views of alternately inverted load of bushel baskets of cucumbers.

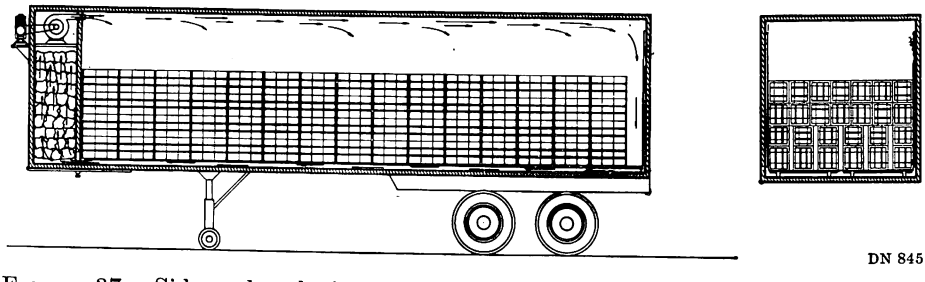


FIGURE 37.—Side and end views of a lengthwise-on-bottoms load of wirebound crates of cucumbers. The channels between the rows in two lower layers are continuous from the front to the rear of the load to facilitate ventilation.

the lower two layers that are continuous from the front to the rear of the load.

Currants

Recommended protective services:

Desired temperature 34°.
Desired relative humidity 80 to 85 percent.
Average freezing point 30.2°.
Bunker ice (no top ice); or mechanical refrigeration.

Recommended loading methods:

Nailed and wirebound carrier crates.—Lengthwise on bottoms. Load may be crosswise, offset by layers to stabilize it crosswise of the vehicle body. For more effective refrigeration required for long-distance shipments in warm weather, ventilation channels should be maintained between the rows of crates.

Dewberries

Recommended protective services:

Desired temperature 31° to 32°.
Desired relative humidity 85 to 90 percent.
Average freezing point 28.9°.
Bunker ice (no top ice); or mechanical refrigeration.

The crates should be arranged in the load to allow an abundance of cold air to circulate over the fruit, maintaining an even, low temperature through the load.

When the containers are stacked close together, blocking the free passage of air, the resulting high temperatures may speed deterioration of the fruit and development of decay.

Recommended loading methods:

Nailed and wirebound carrier crates.—Lengthwise on bottoms. In shipments moving relatively long distances, vertical channels should be maintained between the rows to promote adequate refrigeration. The crates should not be loaded, stacked, or handled on their sides or tops, or the berries in the till baskets will be spilled or jumbled.

Eggplant

Recommended protective services:

Desired temperature 45° to 50°.
Desired relative humidity 85 to 90 percent.
Average freezing point 30.4°.
Bunker ice (no top ice); or mechanical refrigeration unit with cooling and heating cycles.

Eggplant going to distant markets generally is shipped in bushel baskets.

Since eggplant is very susceptible to freezing, protection against cold should be provided in trucks hauling this product in winter.

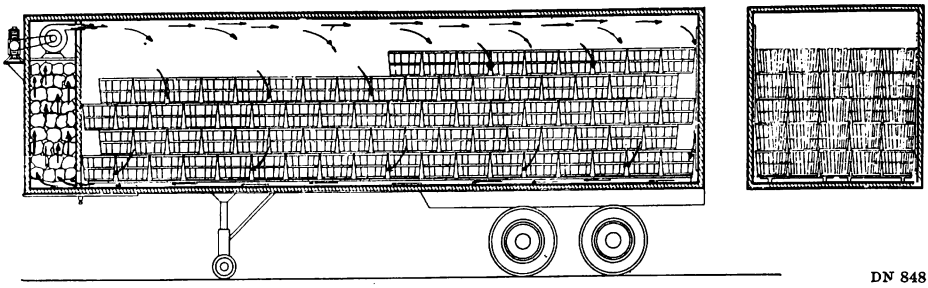


FIGURE 38.—Side and end views of an end-to-end offset load of eggplant, showing arrangement of baskets in load.

Recommended loading methods:

Bushel baskets.—Baskets packed with this commodity should be loaded by the end-to-end offset method (fig. 38).

Endive and Escarole

Recommended protective services:

Desired temperature 32°.
Desired relative humidity 90 to 95 percent.
Average freezing point 30.9°.
Top ice.

To help retain the commodity's fresh, crisp appearance and condition, crushed ice should be placed in the containers and on top of the load. Some endive and escarole is hydrocooled in the crates before loading. Shipments adequately hydrocooled before loading ordinarily may be transported safely over long distances, but top icing still is required to hold the product at the desired temperature and to retain moisture in it.

Recommended loading methods:

Bushel baskets.—End-to-end offset method, with baskets stowed tightly against those in preceding stacks in order to prevent shifting of load (fig. 39). Use of a guide row along one side wall of trailer from the front to the rear is of help in building a tight, solid load. This type of load should be used only for shipments moving short distances in cool weather, and may be used with bunker ice instead of top icing.

Alternately inverted method.—This method, in which alternate baskets in each row, layer, and stack are loaded on covers, produces a

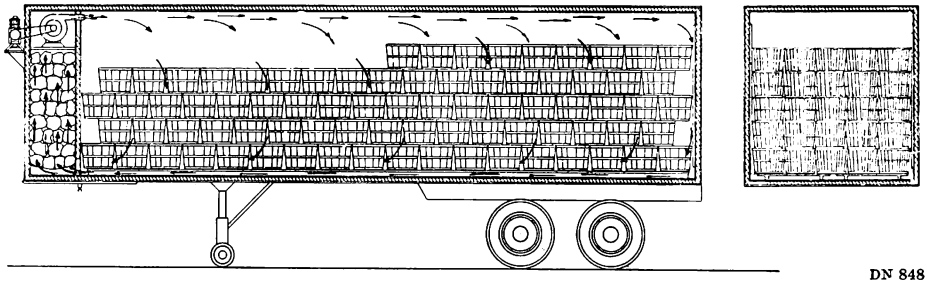


FIGURE 39.—Side and end views of an end-to-end offset load of bushel baskets of endive and escarole.

tight load that utilizes available loading space somewhat more effectively than the end-to-end offset method (fig. 40). This load should be used for long-distance shipments, and should be covered with a liberal quantity of crushed ice.

Wirebound crates.—Lengthwise on sides or bottoms (fig. 41). It is desirable that good row alinement be maintained in loads of this container so that there will be a uniform amount of space between the rows, permitting adequate refrigeration of the commodity by the top and body ice. One or more stacks of crates of this commodity also may be loaded upright on end so that the load comes out even in relation to the length of the trailer.

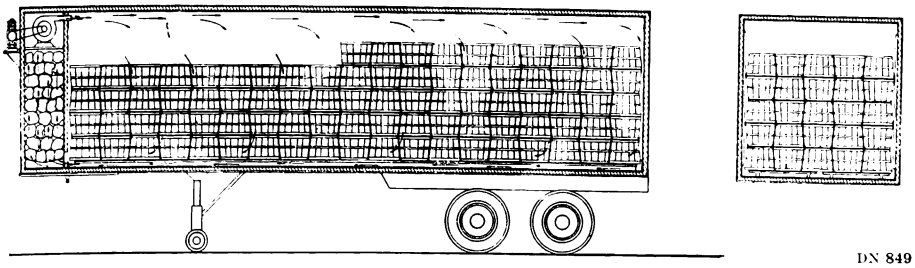


FIGURE 40.—Side and end views of an alternately inverted load of bushel baskets of endive. This commodity should be shipped under top ice.

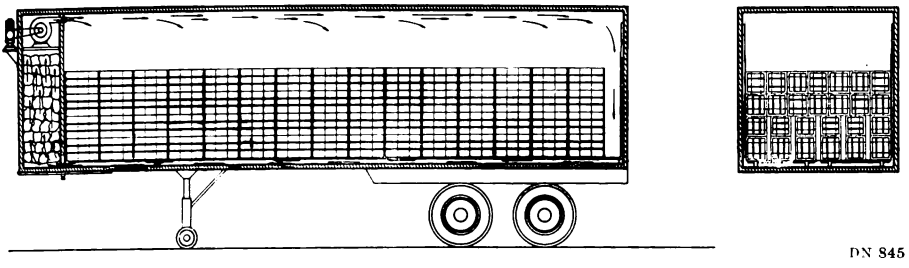


FIGURE 41.—Side and end views of a lengthwise-on-bottoms load of wirebound crates of endive. Long-distance shipments of endive and escarole should be covered with crushed ice.

Gooseberries

Recommended protective services:

Desired temperature 31° to 32°.
Desired relative humidity 80 to 85 percent.
Average freezing point 28.9°.
Bunker ice (no top ice); or mechanical refrigeration.

The crates should be arranged in the load to allow an abundance of cold air to circulate over the fruit, maintaining an even, low temperature throughout the load.

When the containers are stacked close together, blocking the free passage of air, the resulting high temperatures may facilitate deterioration of the fruit and development of decay.

Recommended loading methods:

Nailed and wirebound crates.—Lengthwise on bottoms. The load may be crosswise offset by layers; otherwise, channels of adequate width should be maintained in the load to promote good refrigeration.

Grapefruit—California and Arizona

Recommended protective services:

Desired temperature 45° to 50°.

Desired relative humidity 85 to 90 percent.

Average freezing point 28.4°.

Ventilation, bunker icing, or mechanical refrigeration.

As California and Arizona grapefruit are not subject to stem-end rot, they usually can be transported safely at somewhat higher temperatures than the fruit produced in areas where stem-end rot is prevalent. Warm fruit should be precooled before loading or precooled in the vehicle before shipment. Fruit packed in fiberboard cartons should be precooled before loading. Shipments that will be in transit longer than 8 to 10 hours, and shipments during warm weather, should be refrigerated.

Recommended loading methods:

Standard 1⅗-bushel nailed citrus boxes.—Upright on ends, with the rows paired, loaded bottom to bottom (fig. 42). Pairing of the rows in this manner will prevent the boxes from moving out of row alinement. They are topheavy in this position, with the center of gravity shifted toward the cover of the box. This permits them to "walk" in the direction of their bottoms. In most shipments it is possible to load only 2 layers of boxes upright on end. Boxes in the third layer may be loaded lengthwise on bottoms.

Fiberboard cartons.—Lengthwise or crosswise on bottoms. If the fruit has been precooled, the cartons should be loaded together as tightly as possible (fig. 43). If the load does not come out even in relation to the interior width of the vehicle, it may be crosswise offset

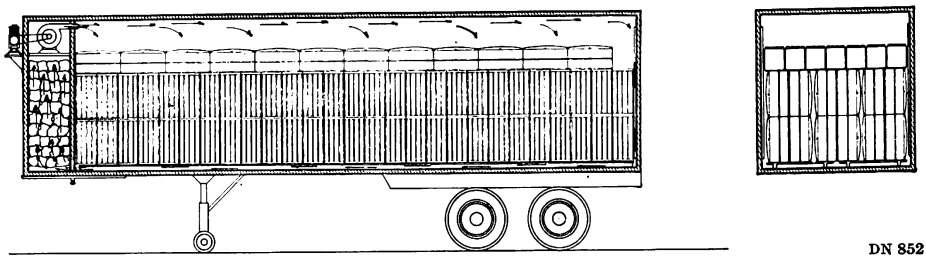


FIGURE 42.—Side and end views of an upright-on-ends deck load of standard nailed 1⅗-bushel citrus boxes of grapefruit. Upright boxes in 1st and 2d layers are "paired," or loaded bottoms to bottoms, to prevent crosswise "walking" of the boxes.

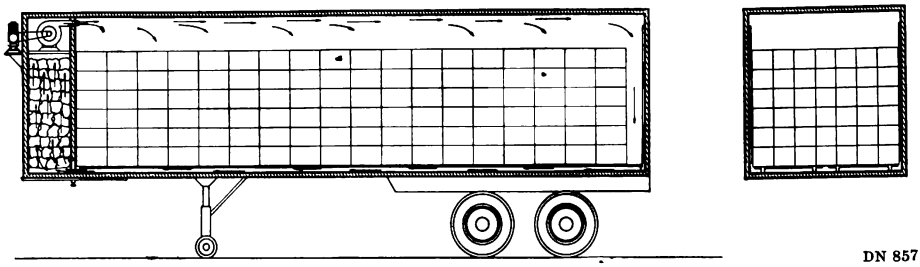


FIGURE 43.—Side and end views of lengthwise-on-bottoms load of western citrus cartons of precooled fruit.

by layers so as to increase the crosswise stability of the load and to decrease the area of contact between the load and the side walls of the vehicle body. However, if the fruit has not been precooled, ventilation channels or flues should be provided between the rows or stacks to facilitate refrigeration.

Grapefruit—Florida

Recommended protective services:

Desired temperature 32° to 34°.
Desired relative humidity 85 to 90 percent.
Average freezing point 28.4°.
Ventilation, bunker icing, or mechanical refrigeration.

During the early fall and late spring, shipments of grapefruit from Florida should be precooled, and sufficient bunker ice should be used to maintain the recommended temperatures.

The heaviest movement of citrus fruit from Florida is during the cold weather when refrigeration service is not necessary and ventilation sometimes may be used. The ventilators on the trailers should be closed when the outside temperature drops below 32° and rises above 40°. When outside air temperatures rise above 40°, refrigeration should be furnished.

When the temperature drops to the low 20's, provision for heating should be made to keep the containers on the floor from freezing.

Recommended loading methods:

Standard 1⅗-bushel nailed citrus boxes.—Upright on ends, two layers high, with the covers facing one sidewall of the truck or trailer body. Third-layer boxes may be loaded either crosswise or lengthwise of the trailer on bottoms (fig. 44). The boxes in the first layers loaded upright on ends also may be arranged bottom to bottom. This method has the advantage of preventing "walking" of the boxes in the direction of their bottoms with consequent rubbing and breaking of the cover straps. Good row alinement should be held in the loads in order to assure maximum ventilation.

1⅗-bushel wirebound citrus boxes.—Lengthwise on bottoms. If the rows of containers will not come out even in relation to the interior width of the vehicle, the remaining crosswise slack may all be left along one side wall in alternate layers (fig. 45). The resulting crosswise offset load will stabilize the load crosswise of the vehicle body and provide sufficient space for the circulation of air along one side of each

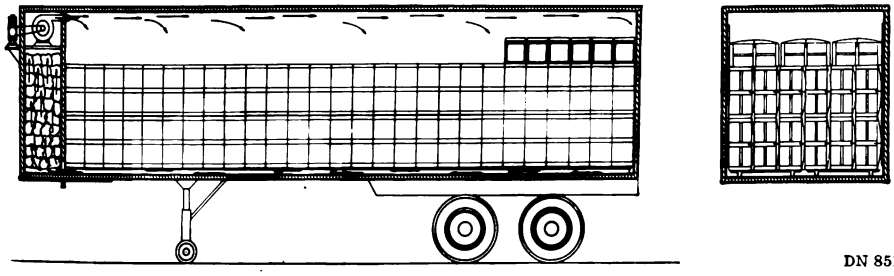


FIGURE 44.—Side and end views of upright-on-ends deck load of standard nailed 1⅗-bushel 2-compartment citrus boxes. Upright boxes in 1st and 2d layers may also be "paired," or loaded bottoms to bottoms, in extra wide vehicles to prevent crosswise "walking."

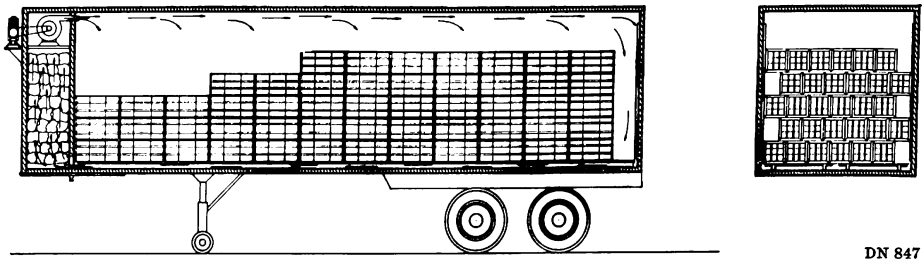


FIGURE 45.—Side and end views of crosswise offset load of 1⅗-bushel wirebound boxes. Crosswise offsetting loads of these containers helps to stabilize the load crosswise of the vehicle body and facilitate refrigeration.

layer and under and over the boxes in each layer in tight contact with one side wall.

Fiberboard cartons.—Lengthwise or crosswise on bottoms. If the fruit has been precooled before loading, the cartons should be loaded together as tightly as possible. However, if the fruit is warm, a chimney-type load should be used, or the cartons should be loaded lengthwise in continuous rows with channels between the rows to facilitate the circulation of cold air. In the chimney-type method the cartons are loaded lengthwise and crosswise in alternate rows and layers so as to tie them in place around vertical ventilation flues about 4 inches in width, extending from the top to the bottom of the load.

Grapes—European or Vinifera Varieties

Recommended protective services:

Desired temperature 30° to 31°.
Desired relative humidity 85 to 90 percent.
Average freezing point 24.9°.
Bunker icing or mechanical refrigeration.

All varieties of grapes should be precooled either before or after loading. Shipments of warm fruit (nonprecooled) that will be in transit longer than 8 to 10 hours should be precooled in the vehicle before shipment. Sufficient refrigeration to maintain recommended temperatures during transit should be provided for all long-distance shipments in warm weather, whether or not the fruit has been precooled.

The containers should be stacked so as to provide air channels to allow an abundance of cold air to circulate through the load.

Grapes—American or Eastern Varieties

Recommended protective services:

Desired temperature 31° to 32°.
Desired relative humidity 80 to 85 percent.
Average freezing point 27.5°.
Bunker icing or mechanical refrigeration.

Recommended loading methods:

Nailed wooden lugs.—Either lengthwise or crosswise on bottoms (fig. 46). All containers should be stacked squarely on top of one another so that the weight of containers in the upper layers will bear squarely on the cover cleats of the containers beneath them. For

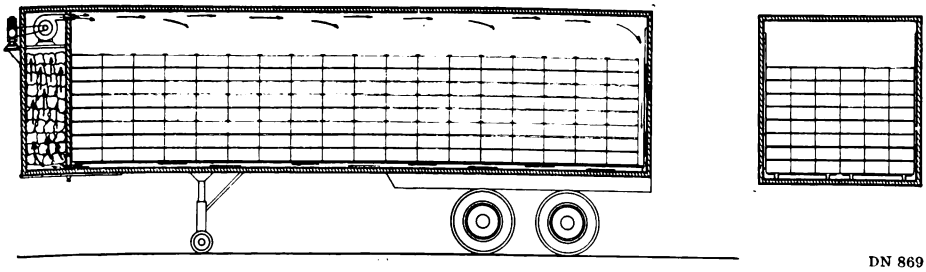


FIGURE 46.—Side and end views of a lengthwise-on-bottoms load of grape lugs. This type of load, in which there are no ventilation channels, should be used only for precooled fruit.

nonprecooled shipments moving relatively long distances, the lengthwise-on-bottoms load with ventilation channels between rows should be used for adequate refrigeration. Crosswise stripping of the lengthwise rows or vertical spacing units should be used in this type of load to hold the lugs in row alinement and prevent disarrangement of the load with consequent damage and blocking of the ventilation channels. For shipments from cold-storage plants or precooling rooms, the lugs may be loaded together tightly if the commodity temperature is about 35°, or lower, at time of loading.

Climax splint baskets and 4-, 8-, or 12-quart fiberboard baskets.—Combination lengthwise and crosswise load, with containers reversed in alternate layers (fig. 47). Containers in the first layer should be loaded lengthwise and those in the second and each alternate layer should be loaded crosswise of the vehicle body. If the baskets do not have recessible handles, the handles of the baskets in one layer will extend upward between two baskets in the layer immediately above. In shipments of fiberboard baskets with recessible handles, moving relatively long distances in warm weather, each stack of containers should have several continuous vertical openings or flues extending from the top to the bottom of the load to facilitate refrigeration.

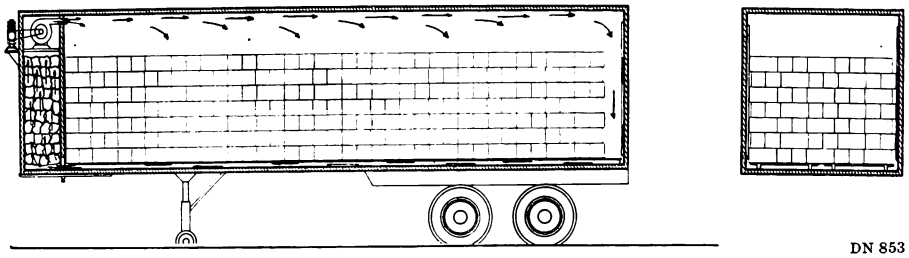


FIGURE 47.—Side and end views of a combination lengthwise-crosswise load of 8-quart fiberboard baskets of grapes. This same loading pattern may be used also for splint baskets.

Honeydew Melons

Recommended protective services:

Desired temperature 45° to 50°.
Desired relative humidity 85 to 90 percent.
Average freezing point 28.8°.
Bunker icing or mechanical refrigeration.

Although the freezing point of honeydew melons is 28.8°, it is not desirable to transport them at temperatures below 36°, as they will show low-temperature breakdown.

These melons generally are packed in wooden crates with excelsior or some other soft material to prevent bruising.

Sufficient bunker ice to maintain the recommended temperatures should be used.

Recommended loading methods:

Honeydew melon crate.—Lengthwise on bottoms. The crates should be stacked squarely on top of one another so that the weight of the crates in the upper layers will bear on the cover cleats at the ends of the crates beneath them. If the crates in the upper layers are permitted to shift forward or backward and the bottoms slip off the cover cleats and rest upon the thin cover slats, the melons in the lower crates will be bruised. For this reason, it is necessary that the crates be stacked tightly together and held firmly in stack alinement. The load may be crosswise offset by layers to distribute properly the weight of the load and any crosswise slack (fig. 48). For long-distance shipments in warm weather, however, the crates should be loaded in continuous rows separated by ventilation channels to facilitate refrigeration. In loads of this type it will be necessary to crosswise strip each layer of each stack to hold the crates in row alinement.

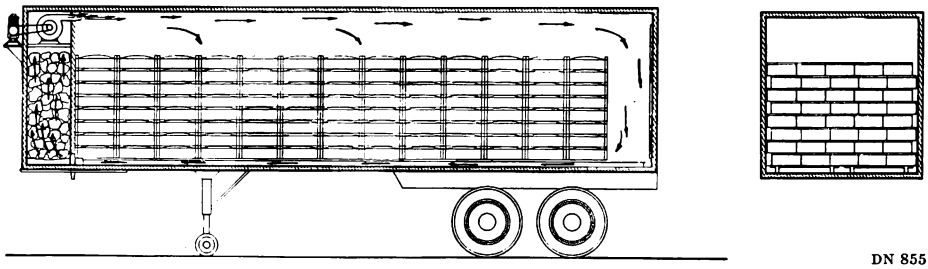


FIGURE 48.—Side and end views of a crosswise offset load of honeydew melon crates.

Kohlrabi

Recommended protective services:

Desired temperature 32°.

Desired relative humidity 90 to 95 percent.

Average freezing point 30°.

Ice in the containers, plus top ice.

The freezing point of kohlrabi is 30°; however, the tops may freeze at temperatures slightly below 32°.

Recommended loading methods:

Wirebound crates.—Lengthwise on bottoms. Shipments moving in excess of 8 to 10 hours in warm weather should be top-iced. Crates should be loaded in continuous rows with channels between the rows to accommodate crushed ice. In loads of this type, the crates should be stowed tightly together lengthwise of the vehicle body in good row alinement. For shipments moving more than 8 to 10 hours in cool weather under ventilation, the load may be crosswise offset by layers to distribute equally the load weight and crosswise slack.

Leeks (Green)

Recommended protective services:

Desired temperature 32°.
Desired relative humidity 90 to 95 percent.
Average freezing point 29.2°.
Top ice.

The containers should be arranged to allow ample air circulation to prevent the tops from heating. Top ice should be blown over the load.

Recommended loading methods:

Wirebound crates.—Lengthwise on bottoms. On shipments moving from farm to market, where the time in transit will not exceed 8 to 10 hours, or during cool weather when no top ice is used, the crates may be loaded crosswise offset by layers to distribute equally the weight and any crosswise slack. Shipments moving in excess of 8 to 10 hours during warm weather should be loaded in continuous rows with channels between the rows to accommodate top ice.

Lemons

Recommended protective services:

Desired temperature 55° to 58°.
Desired relative humidity 95 to 90 percent.
Average freezing point 28°.
Ventilation, bunker icing, or mechanical refrigeration.

Lemons should not be transported at temperatures much below 58° F., as lower temperatures produce pleating, separating of the segments, and other types of internal breakdown. For this reason, shipments moving during subfreezing weather should be heated. As temperatures higher than 58 degrees materially shorten the market life of the fruit, ventilation in cool weather and limited refrigeration in warm weather are important to maintain the recommended temperature.

Recommended loading methods:

Fiberboard cartons.—Lengthwise or crosswise on bottoms. As lemons do not require low temperatures for storage or transportation, shipments during cool weather may be loaded safely with the cartons stacked together tightly lengthwise or crosswise of the vehicle body. Shipments of nonprecooled fruit and shipments during warm weather should be loaded by the chimney method, which will provide vertical flues in the load to facilitate cooling of the commodity (fig. 49). It is important in constructing loads of this type that the cartons be stowed together tightly and that there be little or no slack in the load to permit the cartons in any one layer to move about and block the vertical ventilation flues.

Lettuce

Recommended protective services:

Desired temperature 34°.
Desired relative humidity 90 to 95 percent.
Average freezing point 31.2°.
Bunker icing or mechanical refrigeration.

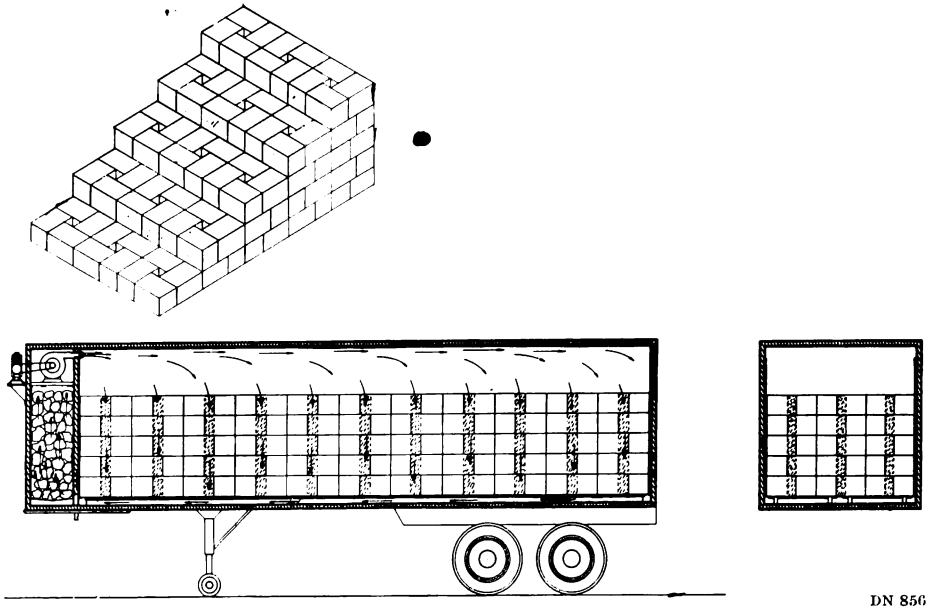


FIGURE 49.—Side, top, and end views of a chimney load of fiberboard cartons of lemons, showing arrangement of containers and location of vertical ventilation flues.

Precooled dry-packed shipments should be bunker-iced or mechanically refrigerated. Nonprecooled shipments packed in wooden crates with package ice also should be top-iced, and in warm weather this should be supplemented further by bunker icing or mechanical refrigeration.

Recommended loading methods:

Fiberboard cartons.—Lengthwise on sides or bottoms (fig. 50). Loading of cartons on sides is recommended because it minimizes the bulging of cartons in the lower layers due to overhead weight of the load. One or more rows or stacks, however, may be loaded on bottoms so that the load comes out even in relation to the interior width and length of the truck or trailer body. Top-layer cartons also may be loaded on bottoms.

Wood crates, nailed or wirebound.—Lengthwise on sides (fig. 51). In nonprecooled shipments where top ice is used, the crates should be loaded in continuous rows with channels to hold top ice in contact with the containers. One or more stacks of crates may be loaded

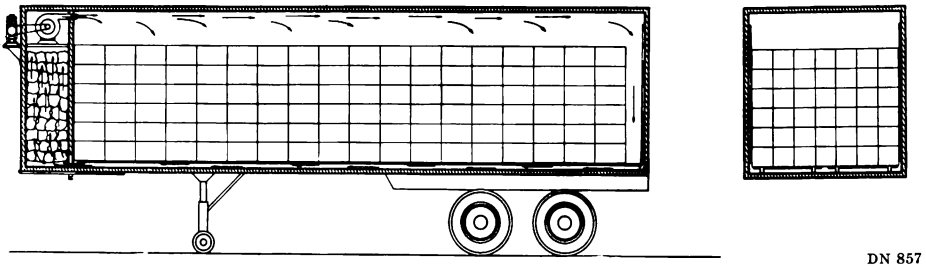


FIGURE 50.—Side and end views of a lengthwise-on-bottoms load of fiberboard cartons of lettuce.

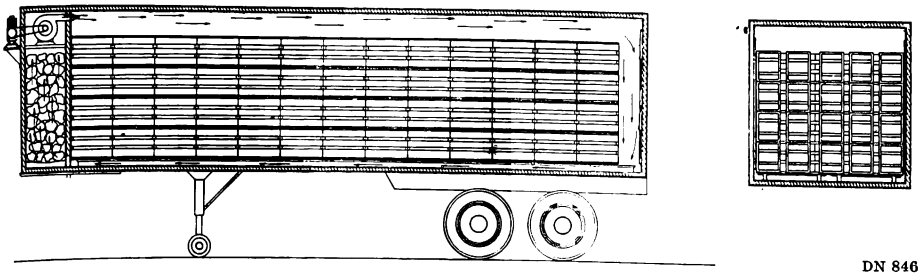


FIGURE 51.—Side and end views of a lengthwise-on-sides load of WGA nailed wooden crates of lettuce. This load should be top-iced and the channels between the rows of crates completely filled with crushed ice.

crosswise on sides or upright on ends at the front or back of the load so it will come out even with the interior length of the truck or trailer body. The nailed crates, on which the cover bulges are higher, should be loaded with the covers of all crates in each side wall row facing the side walls of the vehicle to minimize the area of contact between crates and inside walls.

Loganberries

Recommended protective services:

Desired temperature 33°.
Desired relative humidity 85 to 90 percent.
Average freezing point 29.5°.
Bunker ice (no top ice) or mechanical refrigeration.

Recommended loading methods:

Nailed and wirebound carrier crates.—Lengthwise on bottoms. In shipments moving relatively long distances in warm weather, vertical ventilation channels should be maintained between the rows of crates to facilitate refrigeration. In loads of this type, the crates should be held in row alinement by two crosswise strips on each layer of each stack. For shipments moving short distances to market, a crosswise offset load in which no stripping is required usually is satisfactory. The crates never should be loaded, stacked, or handled on their sides or tops, or the berries in the till baskets will be spilled or jumbled.

Okra

Recommended protective services:

Desired temperature 50°.
Desired relative humidity 85 to 90 percent.
Average freezing point 30.1°.
Bunker icing or mechanical refrigeration.

It is necessary to maintain a high humidity to keep okra from wilting. At temperatures below 50° this product is subject to chilling injury, which results in decay. Some protection should be provided on shipments moving during cold weather.

Recommended loading methods:

Bushel hampers.—Alternately inverted method. Hampers in alternate rows, layers, and stacks should be inverted or loaded on covers to produce a tight, solid load. In shipments moving under

ventilation, however, the so-called summer load, which permits better circulation of air through the load, should be used. In this type of load the hampers are alternately inverted by layers only, and those on one stack are not nested between those in the preceding stack, but are arranged in continuous rows with openings between for circulation. (fig. 10).

Onions, Dried

Recommended protective services:

Desired temperature 32°.

Desired relative humidity 70 to 75 percent.

Average freezing point 30.1°.

Ventilation, or mechanical refrigeration unit with cooling and heating cycles.

Onions are generally held in dry cold storage for long periods at a temperature of 32°. The reason for this low temperature is to prevent sprouting and the development of decay.

When the onions are moved from a temperature of 32° to warm outside weather, they sweat, causing dampness in the bags. For this reason, the ventilators should remain open so the onions will dry out in transit.

Truck trailers transporting onions in winter should provide protection against cold.

Recommended loading methods:

Open-mesh bags.—The two principal considerations in loading bagged onions are to facilitate ventilation of the commodity and, when circumstances require, to protect the commodity against cold. It is desirable that the bags be stacked so that the flow of air through the load will not be impeded. When the bags are all loaded lengthwise or all crosswise of the truck body, they have a tendency to shake down, or to settle into a compact load that hampers the circulation of air through and around them.

The so-called "log cabin" type of load is recommended for shipments moving under ventilation (fig. 52). In this type of load, the bags are reversed in alternate layers, those in one layer being loaded lengthwise and those in adjacent layers, above and below, crosswise of the truck body. Loading of the bags in this manner tends to prevent their settling together so tightly as to interfere with movement of air through the load during transit.

In shipments moving relatively long distances during subfreezing weather, a pyramid type of load should be used to keep the bags out

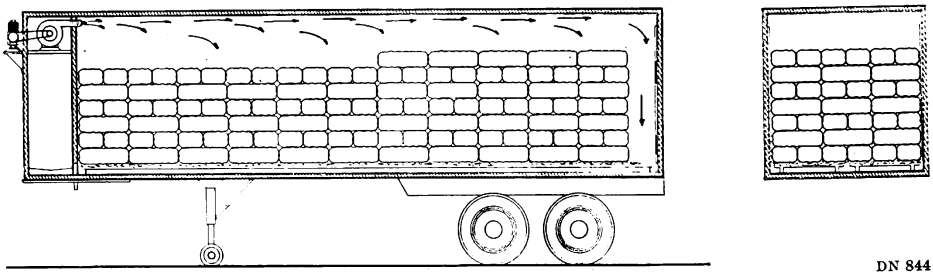


FIGURE 52.—Side and end views of a combination lengthwise-crosswise load of 50-pound open-mesh bags of dry onions.

of contact with the side walls of the truck or trailer body, where freezing may occur. With this type of load, the floor of the truck should be bedded with several inches of straw and the bottom-layer bags should be kept away from the side walls of the trailer. It is necessary to load the bags in alternate layers crosswise of the vehicle to tie the load together effectively and to prevent the bags in the upper part of the load from moving out of position and coming in contact with the side walls of the truck body.

Oranges—California and Arizona

Recommended protective services:

Desired temperature 35° to 37°.

Desired relative humidity 85 to 90 percent.

Average freezing point 28.9°.

Ice, or mechanical refrigeration, or ventilation, according to seasonal conditions.

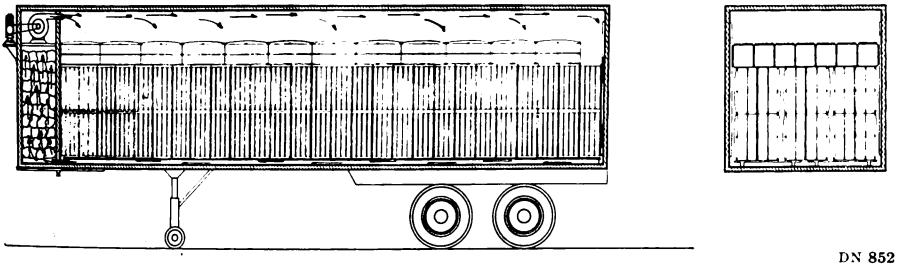
Precooled oranges should be stacked tightly in the trailer, with wall strips and floor racks to provide ample air circulation around and under the load. Oranges not precooled should be loaded with channels to provide air circulation through the load to remove the field heat.

Some means of protection should be provided against cold, to eliminate the hazard of freezing damage in winter.

Recommended loading methods:

Standard 1⅗-bushel nailed citrus boxes.—Upright on ends, with the rows paired (loaded bottom to bottom). Pairing of the rows in this manner prevents the boxes from moving out of row alinement, as they are topheavy in this position, with the center of gravity shifted toward the cover of the box, permitting them to "walk" in the direction of their bottoms. In most shipments, it is possible to load only two layers of boxes upright on end. Boxes in the third layer may be loaded lengthwise on bottoms (fig. 53).

Fiberboard cartons.—Lengthwise or crosswise on bottoms (fig. 54). If the fruit has been precooled before loading, the cartons should be loaded together as tightly as possible. If the fruit is warm, however, a chimney-type load should be used, or the cartons should be loaded lengthwise in continuous rows with channels. In the chimney-type load, the cartons are loaded lengthwise and crosswise in alternate rows and layers, so as to tie them in place around vertical ventilation flues about 4 inches wide, extending from the top to the bottom of the load.



DN 852

FIGURE 53.—Side and end views of an upright-on-ends deck load of standard nailed 1⅗-bushel citrus boxes of oranges. Upright boxes in the 1st and 2d layers are "paired," or loaded bottoms-to-bottoms, to prevent crosswise "walking" with resulting cover-strap breakage.

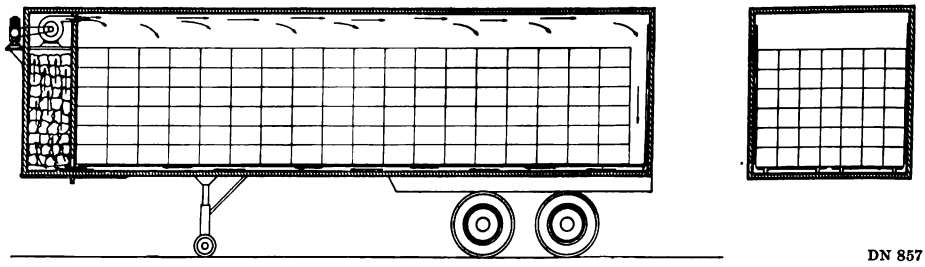


FIGURE 54.—Side and end views of a lengthwise-on-bottoms load of western fiberboard cartons of oranges.

Oranges—Florida

Recommended protective services:

Desired temperature 38° to 40°.

Desired relative humidity 85 to 90 percent.

Average freezing point 27.4°.

Bunker icing or mechanical refrigeration.

Oranges should be precooled to 45° to 50°, either before loading or immediately after loading.

During the summer, the bunker should be filled with ice and the air-circulating fan operated to maintain the recommended product temperature.

During the late fall, early spring, and mild winter seasons when refrigeration service is not required, the ventilators of the trailer may be opened when the outside temperature ranges between 35 and 45 degrees.

When the outside temperature reaches the low twenties, provision should be made for heating to prevent freezing of fruit in containers on the floor.

Recommended loading methods:

Standard 1⅗-bushel nailed citrus boxes.—If there is little or no crosswise slack in the load, the boxes should be loaded upright on ends, two layers high, with the covers facing one side wall of the truck or trailer body. Third-layer boxes may be loaded either crosswise or lengthwise of the trailer on bottoms (fig. 55). The boxes in the first layers loaded upright on ends should be arranged bottom to bottom if there is about 2 inches or more crosswise slack in the load. This method has the advantage of preventing "walking" or tipping of the boxes in the direction of their bottoms with consequent rubbing and breaking of the cover straps. Good row alinement should be maintained in the loads to secure the maximum benefit of refrigeration.

1⅗-bushel wirebound citrus boxes.—Lengthwise on bottoms. If the rows of containers will not come out even in relation to the interior width of the vehicle, all the remaining crosswise slack may be left along one side wall in alternate layers (fig. 56). The resulting crosswise offset load will stabilize the load crosswise of the vehicle body and provide sufficient space for the circulation of air along one side of each layer and under and over the boxes in each layer in tight contact with one side wall.

Fiberboard cartons.—Lengthwise or crosswise on bottoms. Shipments of nonprecooled fruit that will be in transit longer than 8 to 10 hours should be loaded with ventilation channels about 1 inch wide

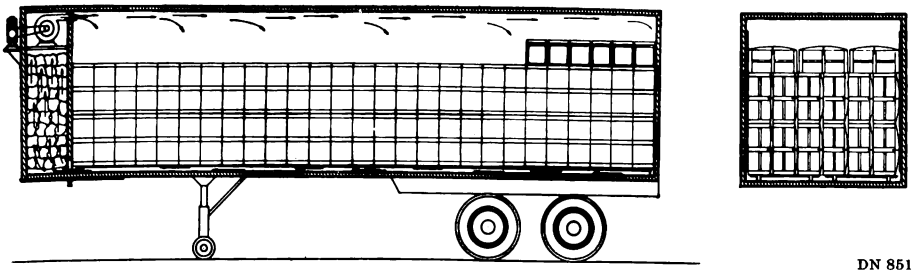


FIGURE 55.—Side and end views of an upright-on-ends deck load of 1⅗-bushel Florida standard citrus boxes.

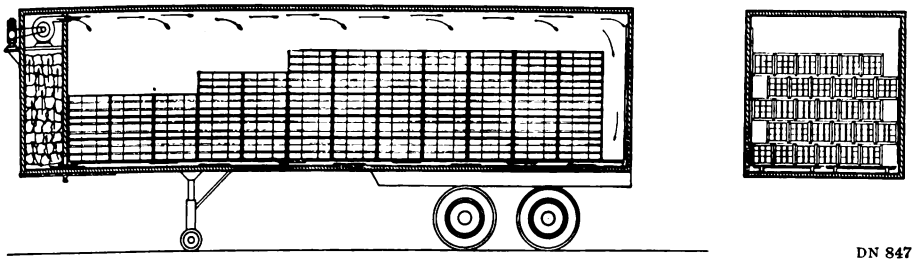


FIGURE 56.—Side and end views of crosswise offset load of 1⅗-bushel wirebound citrus boxes. The air channels along the side walls facilitate cooling of the load.

between the rows in the lower layers of the load to facilitate ventilation or refrigeration. The upper two layers of the load should be crosswise offset to stabilize the load and hold the cartons in the lower layers in row alinement. However, if the fruit has been adequately precooled before shipment, the cartons may be stowed together tightly in the load to retain the desired temperature.

5- and 8-pound open-mesh bags.—Most truck shipments of oranges in these consumer-size units are made in mixed loads with wirebound crates and other types of containers. In mixed shipments of this type, 2 or 3 layers of wirebound crates or other heavier containers are loaded on the floor of the vehicle and the small bags are loaded on top of the larger containers.

Liberal quantities of cushioning material such as excelsior pads or straw should be placed on top of the larger citrus containers, to protect the fruit in the bottom-layer bags from crushing due to overhead weight. The padding used for this purpose should be several inches thick. Observations on test shipments by motortruck have shown that severe crushing of the fruit in bottom-layer bags occurs when the bags are loaded more than eight layers high. Because loading bagged fruit on top of the other containers in the load has a blanketing effect on the circulation of air through the other containers in the bottom part of the load, it is desirable that the rims of crates in the lower layers be spaced about 1 inch apart to permit circulation of air between them lengthwise of the vehicle body. If straw or other loose material is used for cushioning the bags in loads of this type, heavy paper or sheets of fiberboard should be placed over the crates in the bottom of the load to keep the straw from working down between the rows and blocking the ventilation channels. In solid loads of bagged fruit, liberal quantities of cushioning material should be used on the floor of the trucks and the fruit should not be loaded more than eight

layers high. If it is necessary to load more bags than can be accommodated in an eight-high load, a false deck resting on the side walls of the vehicle should be used to separate the load vertically, to avoid crushing of the fruit from overhead weight.

Peaches

Recommended protective services:

Desired temperature 33°.

Desired relative humidity 85 to 90 percent.

Average freezing point 29.4°.

Bunker icing, or mechanical refrigeration.

Peaches from all shipping areas should be precooled either before loading or immediately after loading.

When warm peaches are to be loaded, the vehicle should be iced to capacity before loading and the air circulating fan turned on immediately after loading. Frequent re-icing may be necessary during the first several hours of precooling.

It is very important that the load should be arranged so that the cold air may circulate over and through the load.

Recommended loading methods:

Tub baskets, ½-, ⅝-, ¾-bushel.—These baskets may be loaded by either the crosswise offset (fig. 57) or alternately inverted method, depending upon the temperature of the fruit at time of loading and the length of time that it will be in transit. Shipments of fruit, adequately precooled before loading, may be loaded by the alternately inverted method. This load, however, should be used only for baskets which have not been packed with a pronounced cover bulge and are equipped with cover pads filled with macerated paper, with the covers securely fastened at all four points. The alternately inverted load is of high density and carries well under normal conditions. Shipments of nonprecooled fruit which will not be in transit longer than 8 to 10 hours also may be loaded by the alternately inverted method. Nonprecooled fruit which will be in transit for a substantially longer period of time should be loaded by the crosswise offset method to facilitate refrigeration.

One-bushel baskets.—These may be loaded either by the end-to-end offset method or the alternately inverted method.

Western peach box (nailed).—Lengthwise on bottoms. Good stack alinement should be maintained to prevent any of the boxes in the upper layers from slipping off the cover cleats and bearing on the light

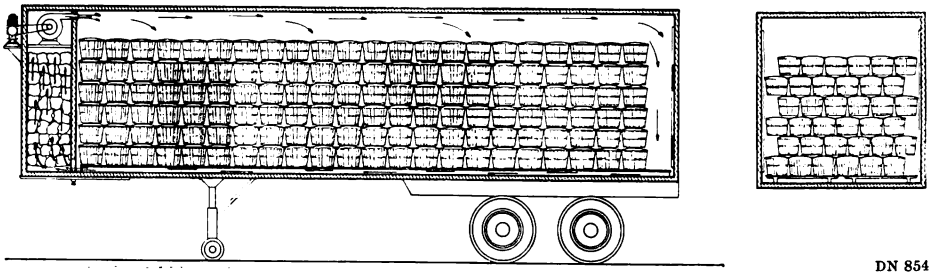


FIGURE 57.—Side and end views of a crosswise offset load of ½-bushel baskets of peaches, showing arrangement of baskets in load.

covers of the boxes in the lower layers of the load. Shipments of non-precooled fruit should be loaded with ventilation channels at least 1 inch wide between the rows of boxes to facilitate refrigeration. Loads of this type, with the boxes in continuous rows and ventilation channels between, should be double-stripped crosswise at least on alternate layers of each stack, to hold the boxes in row alinement. If the fruit has been adequately precooled before loading, the boxes may be loaded together tightly or the load may be crosswise offset by layers to distribute the crosswise slack equally and stabilize the load crosswise of the vehicle body.

Peas (Green)

Recommended protective services:

Desired temperature 32°.
Desired relative humidity 85 to 90 percent.
Average freezing point 30°.
Bunker, top, and container icing.

Fresh green peas are generally packed in bushel tub baskets or hampers, with crushed ice in the containers in addition to crushed ice over and through the load.

The purpose of placing the crushed ice in the containers as well as on top of the load is to lower the temperature of the product as quickly as possible so that the pods will retain their fresh, green appearance, and, more important, to keep the sugar in the peas from turning to starch.

Recommended loading methods:

Bushel tub baskets or hampers.—Alternately inverted method (fig. 58). Alternate baskets in each row, stack, and layer are loaded on covers. Because of the semiconical shape of the baskets, this method produces a compact, high-density load which adequately supports the weight of the top ice used for refrigeration. Baskets should be stacked together tightly, and care should be taken to see that all covers are secured tightly as the baskets are placed in the load.

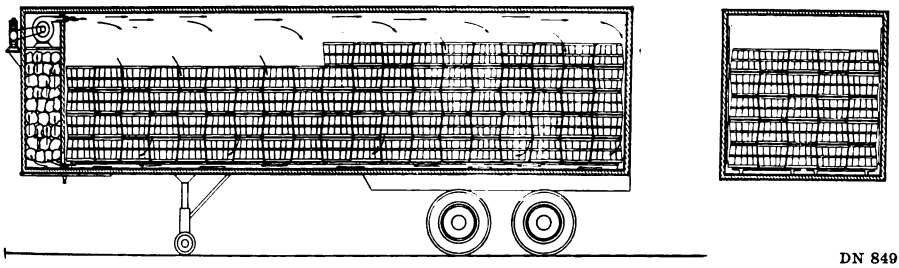


FIGURE 58.—Side and end views of an alternately inverted load of bushel baskets of fresh peas. The covers on these containers should be securely fastened at all four points and the load should be covered with liberal quantities of crushed ice.

Peppers

Recommended protective services:

Desired temperature 45° to 50°.
Desired relative humidity 85 to 90 percent.
Average freezing point 30.1°.

Ventilation, bunker icing, or mechanical refrigeration unit with cooling and heating cycles.

Although the freezing point of peppers is 30.1°, it is not desirable to hold them below 45° because this will develop low-temperature breakdown.

Shipments moving in winter should be protected against cold by a heater.

Recommended loading methods:

One-bushel tub baskets.—End-to-end offset (fig. 59). The crates should be loaded in continuous rows with ventilation channels between the rows in the lower two layers of the load to facilitate ventilation. All crates should be kept in good stack alinement so that the full weight of the crates in the load is borne by the end cleats of the containers.

Wirebound crates.—Lengthwise on bottoms (fig. 60). The crates should be loaded in continuous rows with ventilation channels between the rows in the lower two layers of the load to facilitate ventilation. All crates should be kept in good stack alinement so that the full weight of the crates in the load is borne by the end cleats of the containers.

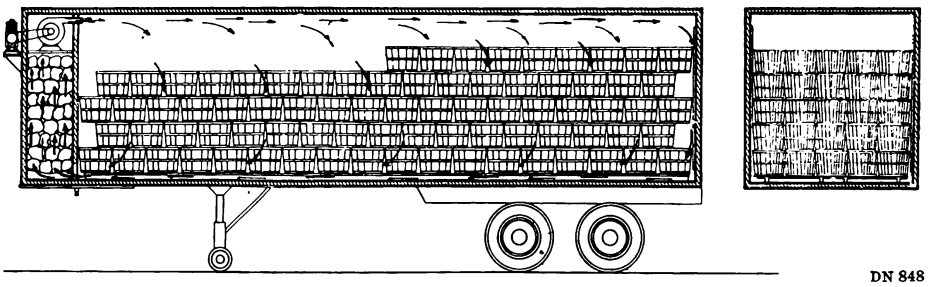


FIGURE 59.—Side and end views of an end-to-end offset load of bushel baskets of peppers.

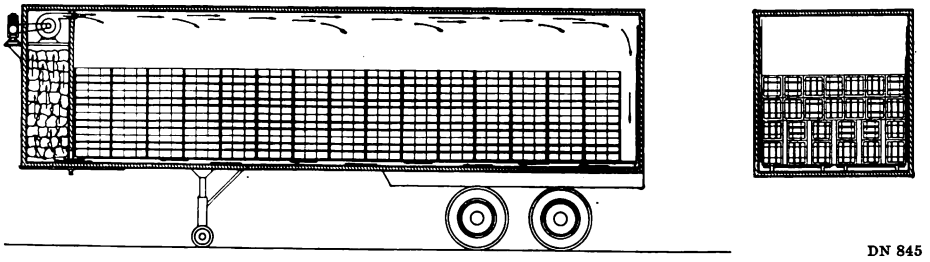


FIGURE 60.—Side and end views of lengthwise-on-bottoms load of wirebound crates of peppers. The channels between the rows of the lower two layers are for ventilation.

Plums and Fresh Prunes

Recommended protective services:

Desired temperature 31° to 32°.
Desired relative humidity 85 to 90 percent.
Average freezing point 28°.
Bunker icing.

Plums and prunes should be precooled sufficiently before loading to maintain the recommended temperatures in transit.

When warm fruit is to be shipped, precooling should be started immediately after loading is completed. The containers should be loaded so as to allow an abundance of air to circulate through the containers in all parts of the load.

Recommended loading methods:

4-basket crate and soft fruit lugs.—Lengthwise on bottoms. These containers should be stacked together tightly lengthwise of the truck or trailer body so as to prevent any lengthwise movement of the crates in any layer. As the covers of these containers are made of thin wood veneer with cleats at each end, severe bruising to the fruit may result if the crates in the upper layers move forward or backward off the cover cleats of the containers in the lower layers. If the fruit has been precooled before loading, the containers should be placed together in tight, compact loads. Shipments of noncooled fruit moving relatively long distances should be loaded in continuous rows separated by channels to aid the circulation of cold air through the load.

Tub baskets, half-bushel.—These baskets may be loaded by either the crosswise offset (fig. 61) or alternately inverted method, depending upon the temperature of the fruit at time of loading and the length of time it will be in transit. Fruit adequately precooled before loading may be loaded by the alternately inverted method. This load, however, should be used only for baskets which have not been packed with a pronounced cover bulge and are equipped with cover pads filled with macerated paper, with the covers fastened securely at all four points. The alternately inverted method gives a high-density load which will carry well under normal conditions. Shipments of nonprecooled fruit which will not be in transit longer than 8 to 10 hours also may be loaded by the alternately inverted method. Nonprecooled fruit which will be in transit for a substantially longer time should be loaded by the crosswise offset method to facilitate refrigeration.

Climax splint baskets and fiberboard baskets, 4, 8, or 12 quarts.—Combination lengthwise and crosswise load, with containers reversed in alternate layers. Containers in the first and each alternate layers should be loaded lengthwise and those in the second and each alternate layer crosswise. If the baskets are not equipped with recessible handles, the handles of the baskets in one layer will extend upward between two baskets in the layer immediately above. In shipments of fiberboard baskets with recessible handles moving relatively long distances in warm weather, each stack or unit of containers should have continuous vertical openings or flues extending from the top to the bottom of the load for adequate cooling of the commodity.

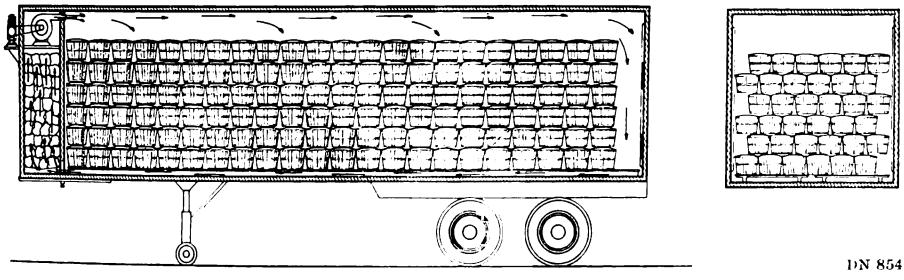


FIGURE 61.—Side and end views of a crosswise offset load of ½-bushel baskets of fresh prunes.

Potatoes—Early Crop

Recommended protective services:

Desired temperature 50°.

Desired relative humidity 90 to 95 percent.

Average freezing point 28.9°.

Ventilation, bunker icing, or mechanical refrigeration unit with cooling and heating cycles.

Early crops of potatoes are harvested in the Southern States during the winter, spring, and early summer, and move to market through weather that grows increasingly cooler the farther north they go. As a rule, they can be shipped satisfactorily under ventilation service.

The ventilators should remain open between 40° and 60°. Above or below this outside temperature range, the ventilators should be closed.

During periods of unseasonably warm weather, the bunkers in the trailer may be filled and the ventilators may be opened as the shipment moves northward into cooler temperatures.

When the outside temperature reaches the low twenties, some provision should be made for heating to protect the potatoes in containers in the bottom of the load.

Recommended loading methods:

100-pound burlap bags.—Combination lengthwise-crosswise pyramid-type load (fig. 62). Because of the comparative tenderness and susceptibility of early potatoes to bruising, it is desirable that they not be loaded more than six layers high. The floor of the truck or trailer body should be bedded with several inches of straw or other cushioning material. If straw or other loose material is used on the floor racks of the vehicle, the racks should first be covered with heavy paper or fiberboard to prevent the cushioning material from falling through the floor racks and blocking the circulation of air under the load that could result in inadequate cooling or heating. Various types and sizes of unitized excelsior pads are commercially available for cushioning loads of bagged commodities. Bags in the lower two layers of the load should be spaced as far apart as possible crosswise of the vehicle body to permit circulation of air through the load. Pyramiding of the load helps to hold the bags in the upper layers away from the vehicle side walls, and to obtain more even distribution of overhead weight and circulation of air around the load.

50-pound paper bags.—Lengthwise and crosswise on sides. Bags may all be loaded crosswise, or all lengthwise, or they may be loaded lengthwise and crosswise in alternate layers. Another variation is to load the bags along each side wall crosswise and those in the middle of the load lengthwise. The advantage of the last variation is that the twist at the mouth of bags in contact with the side wall of the truck or trailer body provides small cushions that help to prevent rubbing damage to which bags in some shipments are exposed when they are loaded lengthwise with their sides against the side walls of the vehicle. The floor of the truck or trailer body should be bedded with several inches of straw or other cushioning material to help protect the potatoes in the bottom layer from bruising. If such loose material is used on the floor racks of the vehicle, the racks first should be covered with heavy paper or fiberboard to prevent the cushioning material from falling through the floor racks and blocking the circulation of air under the load, resulting in inadequate cooling or heating.

Various types and sizes of unitized excelsior pads are commercially available for cushioning loads of bagged commodities. The load also should be constructed with continuous channels lengthwise of the load, at least in alternate layers, to facilitate movement of air through the load.

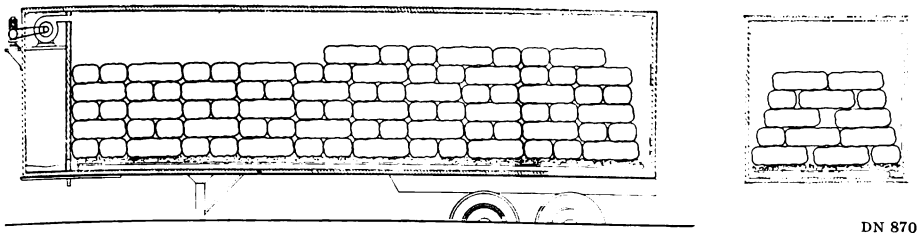


FIGURE 62.—Side and end views of a pyramid-type load of 100-pound bags of early potatoes. Straw or other cushioning material should be used on the floor of the vehicle to help prevent bruising or flattening of this tender commodity by the overhead weight of the load.

Potatoes—Late Crop

Recommended protective services:

Desired temperature 38° to 50°.

Desired relative humidity 85 to 90 percent.

Average freezing point 28.9°.

Ventilation, bunker icing, or mechanical refrigeration unit with cooling and heating cycles.

A great part of the late potato crop moves to market during the late fall, through the winter, and in the early spring.

During the late fall and early spring, in relatively cool weather, late potatoes can be shipped under ventilation.

The ventilators should remain open when outside temperature is between 40° and 60°. Above or below this temperature range, the ventilators should be closed.

In winter, trucks or trailers should be preheated if the inside temperature is below the desired level. Heaters and air circulation should be provided to prevent freezing damage in the bottom of the load.

Recommended loading methods:

100-pound burlap bags.—Lengthwise or crosswise on sides. As late-crop potatoes are less susceptible to bruising than the early crop, shipments ordinarily may be loaded one to two layers higher than early-crop potatoes. The floor of the truck or trailer body should be lined with heavy building-type paper. However, if the floor is slotted or grooved, it should be bedded with several inches of straw or other cushioned material. For shipments moving relatively long distances in cold weather, liberal quantities of straw on the floor and along the bottom sides of the load help to protect the commodity against freezing. Pyramiding of the bags in the upper layers so as to hold them away from the side walls also aids in preventing freezing of the commodity at that location.

50-pound paper bags.—Lengthwise and crosswise on sides. Reversing of bags in alternate layers, especially along the side walls of the truck or trailer body, so that the fold at the mouths of the bags

contacts the side walls, provides some protection against rubbing and chafing of the bags at that point. The bags should be further protected by lining the floor, and also the walls to the height of the load, with heavy building-type paper. However, if the floor is slotted or grooved, it should be covered with several inches of straw or other cushioning material. Liberal quantities of straw or similar material on the floor and along the bottom sides of the load help to protect the commodity from freezing at those points in severely cold weather. Pyramiding of bags in the upper layers so as to hold them away from the vehicle side wall also helps to protect the commodity from side-wall freezing.

10- and 15-pound paper bags.—Lengthwise on sides. The bags in each layer of each stack should be reversed, with the mouths of the bags in one layer facing the front of the vehicle and those in the next layer facing the back of the load. As small bags of this type taper somewhat toward the mouths, reversing the bags in alternate layers compensates for this difference and makes it possible to build an even and level load. Preparation of the interior of the truck or trailer body for loading should be the same as for 50-pound paper bags.

Raspberries—Black and Red

Recommended protective services:

Desired temperature 33°.
Desired relative humidity 85 to 90 percent.
Average freezing point 29.9°.
Bunker ice (no top ice); or mechanical refrigeration.

The crates should be arranged in the load to allow an abundance of cold air to circulate over the fruit, maintaining an even low temperature throughout the load.

When the containers are stacked close together, blocking the free passage of air, heat develops in the fruit, causing decay.

Recommended loading methods:

Nailed and wirebound carrier crates.—Lengthwise on bottoms. In shipments moving relatively long distances in warm weather, vertical ventilation channels should be maintained between the rows of crates to facilitate refrigeration. In loads of this type the crates should be held in row alinement by two crosswise strips on each layer of each stack. For shipments moving short distances to market, a crosswise offset load in which no stripping is required usually will be satisfactory. The crates never should be loaded, stacked, or handled on their sides or tops, or the berries in the till baskets will be spilled or jumbled.

Rhubarb

Recommended protective services:

Desired temperature 32° to 35°.
Desired relative humidity 90 to 95 percent.
Average freezing point 28.4°.
Bunker icing or mechanical refrigeration.

Recommended loading methods:

Fiberboard cartons.—Lengthwise on bottoms. As this commodity seldom is shipped in large quantities, usually it is included with other

vegetables in mixed shipments. In such instances, it is desirable to load the cartons of rhubarb in the upper layers of the load, particularly if the cartons are comparatively small and light.

Some refrigeration should be provided to maintain the recommended temperatures either in straight loads or in mixed loads.

Rutabagas

Recommended protective services:

Desired temperature 32° to 35°.
Desired relative humidity 90 to 95 percent.
Average freezing point 29.5°.
Bunker icing or mechanical refrigeration.

Recommended loading methods:

50-pound burlap bags.—Lengthwise on sides. As rutabagas are not easily bruised, they do not present much of a problem in loading. Many rutabagas are fairly large, and the 50-pound bags usually cannot be filled completely. For this reason, the individual bags are somewhat slack and have a tendency to settle in the load. Loading the bags lengthwise with the mouths facing the rear of the truck or trailer body facilitates unloading, as the gathered mouths of bags can easily be grasped to pull them from the load.

Depending on outside weather conditions, some means of either refrigeration or ventilation should be provided to maintain the recommended temperatures.

Strawberries

Recommended protective services:

Desired temperature 33°.
Desired relative humidity 85 to 90 percent.
Average freezing point 29.9°.
Bunker ice (no top ice) or mechanical refrigeration.

The crates should be arranged in the load to allow the cold air to circulate freely over the fruit, maintaining an even, low temperature throughout the load.

When the containers are stacked close together, blocking the free passage of air, the fruit develops heat, causing decay.

Recommended loading methods:

Nailed or wirebound carrier crates. Lengthwise on bottoms (fig. 63). In shipments moving relatively long distances in warm weather, vertical ventilation channels should be maintained between the rows of crates to assure adequate refrigeration. In loads of this type, the crates should be held in row alinement by two crosswise strips on each layer of each stack. For shipments moving overnight to market, a crosswise offset load, in which no stripping is required, usually is satisfactory. The crates never should be loaded, stacked, or handled on their sides or tops, or the berries in the till baskets will be spilled or jumbled.

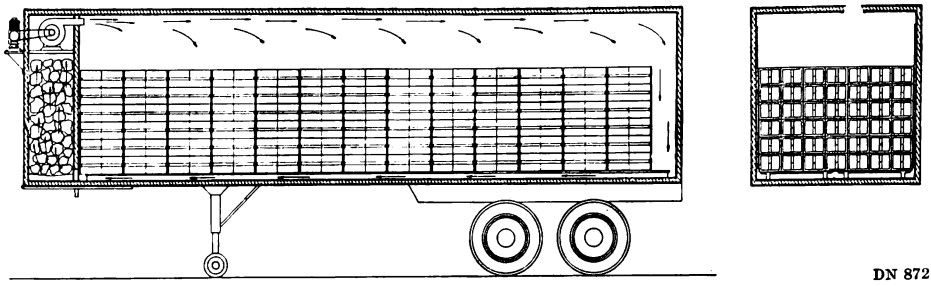


FIGURE 63.—Side and end views of a lengthwise-on-bottoms load of wirebound carrier crates of strawberries.

Sweetpotatoes

Recommended protective services:

Cured stock:

Desired temperature 55° to 60°.
Desired relative humidity 85 to 90 percent.
Average freezing point 28.5°.
Ventilation in cool weather; bunker icing or mechanical refrigeration in warm weather.

Noncured stock:

Desired temperature 85°.
Desired relative humidity 90 to 95 percent.
Average freezing point 28.5°.
No ventilation; no bunker icing or mechanical refrigeration.

Sweetpotatoes generally are packed in bushel baskets or wirebound crates. Temperatures slightly below 55 degrees may not be harmful for short periods. However, prolonged exposure to low temperature should be avoided. Noncured sweetpotatoes are more susceptible to chilling injury than cured stock.

Provision should be made for protection against cold in winter.

Recommended loading methods:

Bushel baskets.—End-to-end offset (fig. 64). The covers should be fastened securely on the baskets at all four points, and the baskets should be stacked tightly together in the load.

Wirebound James crates.—Lengthwise on sides, with tops and bottoms reversed in alternate layers. As these containers are slightly narrower at the top than at the bottom, reversing the crates in alter-

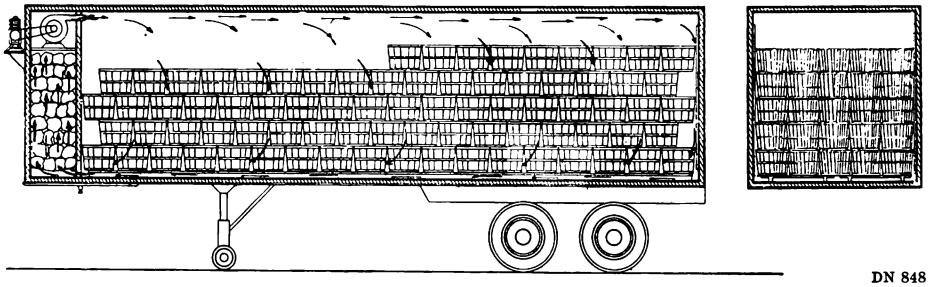


FIGURE 64.—Side and end views of an end-to-end offset load of bushel baskets of sweetpotatoes.

nate layers (loading with the tops of crates in one layer facing one side of the truck body and those in the layer immediately above facing the opposite way) compensates for the difference, making the top of the second and all even-numbered layers come out almost level. The crates should be stacked squarely on top of one another in good row alinement, with the cleats at the top and bottom of each crate bearing squarely upon the cleats of the container directly beneath it.

Tangerines

Recommended protective services:

Desired temperature 31° to 38°.
Desired relative humidity 90 to 95 percent.
Average freezing point 28°.
Bunker icing or mechanical refrigeration.

Recommended loading methods:

Wirebound crates.—Lengthwise on sides. Crates in all lower layers should be stacked lengthwise on sides, but top-layer crates may be loaded lengthwise on bottoms. Crates should be stacked squarely on top of one another and good stack alinement should be maintained so that most of the overhead weight will be borne on the end cleats of the crates. Keeping the crates in good row alinement also will aid proper refrigeration of the commodity.

For the best results in transporting tangerines, which are highly perishable, they should be precooled and should be given ample refrigeration while in transit, especially on long hauls.

Tomatoes—Mature Green

Recommended protective services:

Desired temperature 55° to 70°.
Desired relative humidity 85 to 90 percent.
Average freezing point 30.4°.
Bunker icing or mechanical refrigeration unit with cooling and heating cycles.

When transporting mature green tomatoes from producing areas in the South to northern markets, a small amount of bunker ice may be used to remove the field heat from the fruit. Do not reduce the product temperature below 50° F. Temperatures below this point may cause chilling injury.

When moving through mild temperatures (50° to 60°) the ventilators should be opened.

When shipments move through low outside temperatures, truck trailers should be equipped for protection against cold. Tests have shown the most satisfactory results with portable thermostatically controlled heaters.

Wall strips and floor racks are very important for adequate circulation of air around and under the load.

Recommended loading methods:

Nailed wooden lug boxes.—Lengthwise on bottoms (fig. 65). The lugs should be stacked tightly together in good row alinement so that the weight of the lugs in all upper layers will be borne by the cover cleats of the lugs beneath them. The lugs in any layer should not be

free to move forward or backward, or they may slip off the cover cleats of the lugs directly beneath, depressing the light veneer cover slats into the fruit and causing bruising.

Wirebound 60-pound crates.—Lengthwise on bottoms (fig. 66). These crates also should be stacked together tightly lengthwise of the vehicle body so that all overhead weight will be borne by the end cleats of the crates.

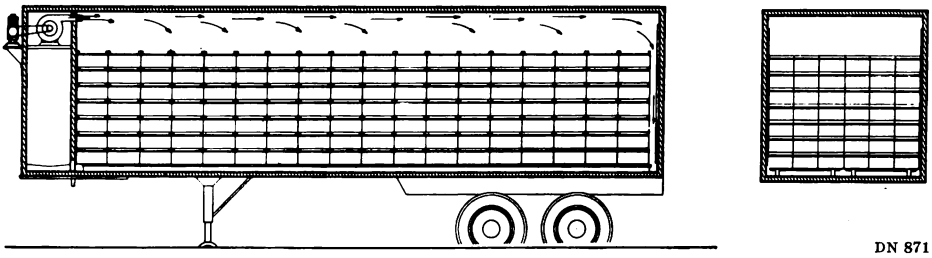


FIGURE 65.—Side and end views of a lengthwise-on-bottoms load of tomato lugs. It is important that good stack alinement be maintained in loads of this container so that the weight of the lugs in the upper layers will bear on cover cleats of containers in the lower layers.

Fiberboard cartons.—Lengthwise or crosswise on bottoms (fig. 67). Fiberboard is a fairly good insulator, and most types of cartons used for tomatoes do not have as many or as large openings as the nailed or wirebound crates through which the commodity can be ventilated, It is therefore necessary that some provision be made for the circulation of air through the load. This can be accomplished by using a chimney-type load, or by crosswise offsetting the load by layers and having longitudinal openings in the lower 2 or 3 layers extending the entire length of the load. In the chimney-type load the cartons are loaded crosswise and lengthwise in blocks, in the center of which are vertical flues extending from top to bottom of the load.

Fiberboard baskets.—Combination lengthwise-crosswise load with containers reversed in alternate layers. If the baskets do not have recessible handles, the handles of the baskets in each layer, except the top layer, will extend upward between two baskets in the layer immediately above (fig. 68). In shipments of fiberboard baskets with recessible handles, moving relatively long distances in warm weather, each stack or unit of containers should have continuous vertical openings, or flues, extending from top to bottom of the load, to facilitate refrigeration.

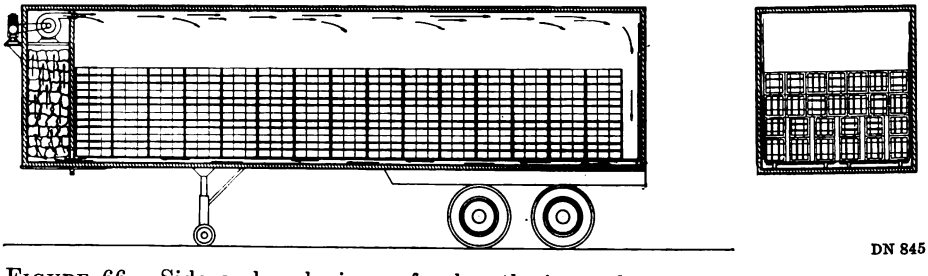


FIGURE 66.—Side and end views of a lengthwise-on-bottoms ventilated load of wirebound tomato crates. The ventilation channels between the crates in the lower two layers of the load are continuous from the front to the rear of the load.

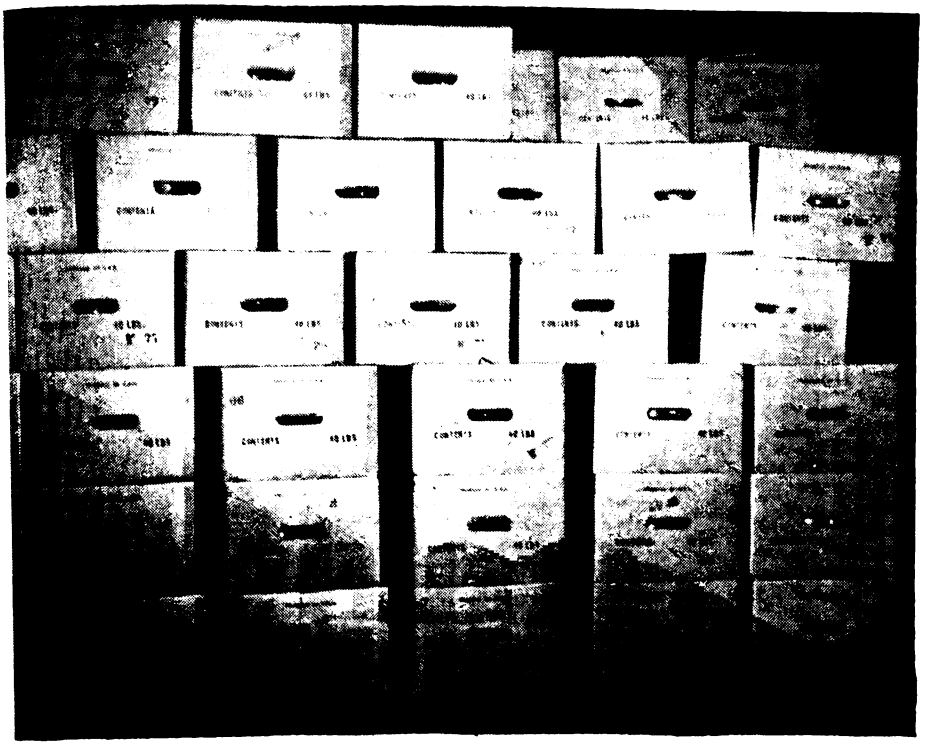


FIGURE 67.—Cross section of a lengthwise-on-bottoms load of fiberboard cartons of tomatoes. Channels between rows in lower three layers facilitate air circulation.

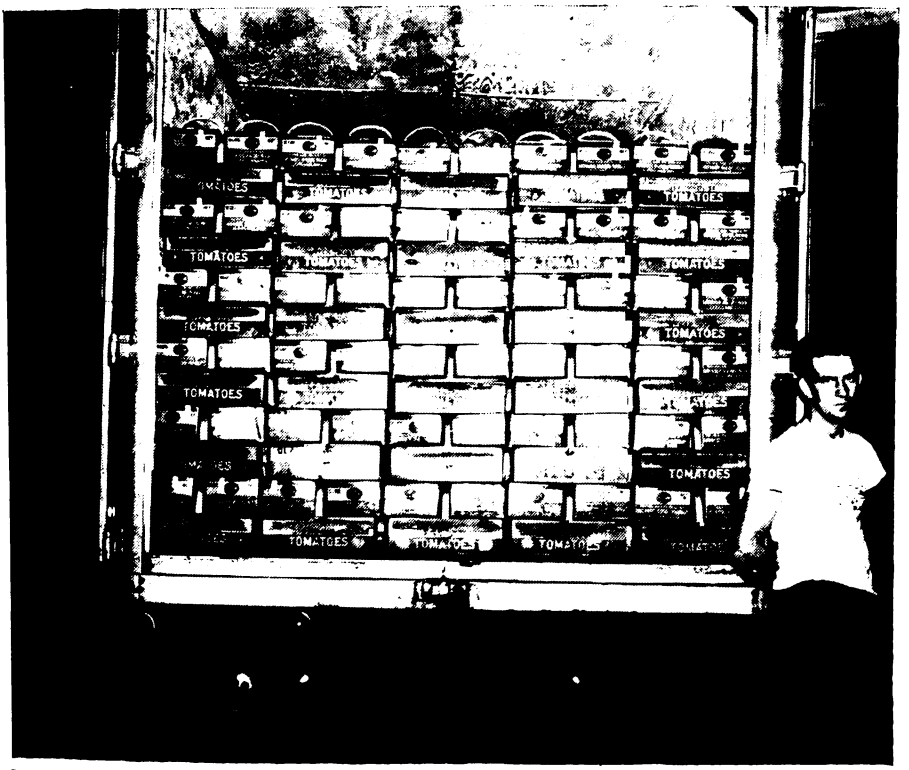


FIGURE 68.—Rear view of a combination lengthwise-crosswise load of fiberboard baskets of tomatoes.

Watermelons

Recommended protective services:

Desired temperature 36° to 40°.
Desired relative humidity 85 to 90 percent.
Average freezing point 29.2°.
Ventilation in transit required. No refrigeration.

Recommended loading methods:

Watermelons generally are shipped in bulk. One exception is the so-called "icebox watermelons," which are small, round melons generally shipped and handled in bushel baskets and various other containers. The "icebox" melons, which were introduced commercially a few years ago, as yet are produced and shipped only in limited quantities. Both the long-type and round-type large melons usually are loaded lengthwise of the truck or trailer body. In this type of load the second and each alternate layer will be one row less in width than the first and each odd-number layer, as the melons in the second and all upper layers are placed in the pockets between adjacent melons in two rows of the layer directly beneath.

The side walls of the truck or trailer body should be lined with heavy paper or other protective material to prevent rubbing or scarring of the melons. The floor of the vehicle body should be bedded with several inches of clean straw, excelsior, or similar cushioning material, to protect the bottom-layer melons from bruising. Straw or other cushioning material should not be placed between the rows or layers of melons as it will interfere with ventilation of the load.

Freezing Injury to Fruits and Vegetables

On the basis of experiments, observations of produce under commercial conditions, and experience of commercial operators, various fruits and vegetables can be grouped as follows as to their susceptibility to freezing injury:

	Approximate freezing point, ° F.[1]
Most susceptible:	
Asparagus	30
Avocados	27
Bananas	30
Beans, lima	30
Beans, snap	30
Berries	30
Cucumbers	30
Eggplant	30
Lemons	28
Limes	29
Peppers	30
Potatoes, white	29
Squash, summer	29
Sweetpotatoes	29
Tomatoes	30
Moderately susceptible:	
Apples	28
Broccoli, sprouting	29
Cabbage, new	31
Celery	30
Cranberries	27
Moderately susceptible—Con.	
Grapes	25–28
Lettuce	31
Onions	30
Oranges and grapefruit	28
Parsley	(2)
Peaches and plums	29
Pears	28
Peas	30
Squash, winter	29
Least susceptible:	
Beets	27
Brussel sprouts	(2)
Cabbage (old and Savoy)	31
Carrots	29
Cauliflower	30
Kale	30
Parsnips	30
Rutabagas	30
Salsify	29
Spinach	30
Turnips	30

[1] In most cases, these are the approximate average freezing points. It should be remembered that individual specimens may freeze at slightly higher or slightly lower temperatures.

[2] Exact freezing point not known.

Source: Freezing Injury of Fruits and Vegetables, U. S. Department of Agriculture Circular No. 713.

Frozen Foods

The National Association of Frozen Food Packers has recommended that all frozen products be transported at 0° F.

Motortruck trailers transporting these products *should have a minimum thickness of 6 inches of high quality insulating material in walls, floor, and ceiling,* and either a mechanical or dry ice refrigerating unit with ample capacity to maintain zero temperature over long distances.

Provision should be made in the trailers for good air circulation around and under the load, using floor racks with a space of at least 2 inches under the load, and wall strips not less than ¾-inch thick, spaced about 8 inches apart. (See fig. 1.) All truck trailers should be precooled to a temperature of not more than 10° F. before loading. Curtains over the doorway opening, a tunnel, or other protection from outside heat should be provided during loading to retain the effects of the precooling.

If for any reason loading or unloading is interrupted, the rear doors should be closed immediately and the refrigerating unit started until work is resumed.

Because of the variety of containers used and the density of many frozen commodities that may limit the height of the load, it is not feasible to recommend any single method of loading. However, in loading frozen foods the packages should be placed tightly together in a single compact mass. It should be borne in mind that there will be no evolution of heat in these commodities, and consequently, no need for ventilation channels in the load. On the contrary, frozen commodities should be loaded in a solid, tight, mass, and the circulation of refrigerated air at zero or below should be directed above, under, and around the load to prevent the transfer of outside heat through walls, ceiling, and floor. The driver should supervise the loading of his trailer to be sure that provision is made for adequate air circulation around the load, and that the weight of the load is properly distributed, eliminating the hazard of having to open the doors to adjust the load.

Fresh Meat and Packinghouse Products

Motor carriers transporting fresh meats and packinghouse products also have problems with their equipment. Truck trailers used in this traffic must be designed to carry quarters of meat suspended from meat rails in the ceiling, as well as packages on the floor. The inside of the trailer should be cleaned with hot water and detergents after unloading at the end of each trip, in accordance with standards set up by the U. S. Department of Agriculture, to prevent the development of harmful bacteria and offensive odors. Consequently, it is essential that the interior of the trailer be designed to facilitate cleaning. The materials used, especially in side walls and floors, should be resistant to the effects of heat and vapor. Corrosion-resistant metals or plastics are recommended for this purpose.

These trailers should have ample insulation, and either a mechanical or dry-ice refrigerating unit capable of maintaining the temperature at which the product was loaded. Floor racks should be used to insure circulation of air around the load. Wall racks also are desirable.

Loading Fresh Beef

During warm weather, truck trailers should be precooled to 35° to 40° F. before loading.

The quarters of beef should be chilled to 35° F. in the chilling rooms before shipment.

Forequarters are hung with the long hooks inserted from the bone side, usually under the 4th rib about 11 inches from the backbone so that they will balance and hang straight.

Short hooks are used in hanging the hindquarters, the hooks being inserted through the opening in the gambrel cord of the shank.

Loading generally is started by hanging the forequarters next to the wall with the bone side to the wall on either side of the load (fig. 69). More forequarters then are hung between until the stack is completed. Care must be taken to see that quarters are paired and hung boneside to boneside, meatside to meatside. A boneside hung next to a meatside rubs the meat and damages it. Extra quarters generally are added at the center of the stack to tighten up the load and eliminate crosswise slack. Hindquarters are loaded in the same manner.

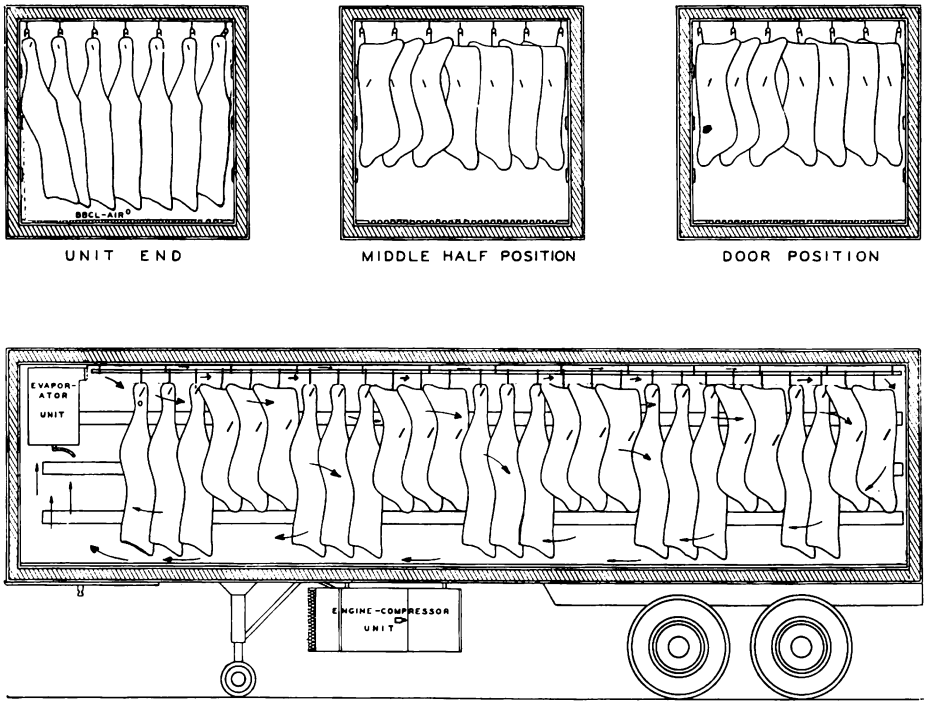


FIGURE 69.—Side and end views of a mixed load of forequarters and hindquarters of dressed beef.

Loading Fresh Pork

During warm weather, truck trailers should be precooled between 35° to 40° F. before loading. The product should be chilled to 35° to 38° F. in the chilling room before being loaded. Generally, fresh pork cuts such as loins, hams, spareribs, and trimmings are packed in fiberboard containers. The packages should be arranged so as to

allow ample circulation of air around and under the load to avoid high temperatures along the floor of the trailer. Floor and wall racks are advisable to insure adequate air circulation.

Recommended Temperatures and Humidity for Fresh Meat and Packinghouse Products

	Temperature	Relative humidity
	° F.	*Percent*
Beef carcass	35	85
Lamb carcass	35	80
Pork carcass	35	80
Veal carcass	35	80
FRESH MEAT CUTS		
Beef	33–36	80–85
Lamb	33–36	75–80
Pork	33–36	75–85
Veal	33–36	75–80
Pork sausage, brains, tripe, liver	26–28	75–85
CURED MEATS		
Bacon, derind slab	26–28	70–80
Bacon, sliced	32–35	90–95
Hams, tender cured	32–35	75–80
Dried beef	38–45	70–85
Sliced luncheon meats	26–28	70–80
Frankfurters	26–28	70–80
Bologna sausage	26–28	70–80
Braunschweiger	26–28	70–80
Liver sausage	26–28	70–80
Liver loaf	26–28	70–80
Luncheon loaf	26–28	70–80
Pimento and pickle loaf	26–28	70–80

Dairy and Poultry Products

Butter and Margarine

Recommended protective services:

Desired temperature 35° to 38°.

Desired relative humidity 90 to 95 percent.

Bunker icing or mechanical refrigeration.

Butter and margarine generally are shipped from cold storage rooms of creameries or from cold storage warehouses. They are packed in fiberboard cartons with a capacity of 24 1-pound packages or 48 ½-pound packages. Butter and margarine have been cooled thoroughly before shipment, and are insulated to some extent by wrapping in foil or waxed paper and packaging in ½- and 1-pound cartons in fiberboard boxes. The commodities usually, therefore, can be exposed to room temperature and fairly low humidity for short periods in loading or unloading, without risk of serious damage. During shipment, however, these products must be kept refrigerated effectively at the recommended temperatures to prevent softening or quality deterioration.

Recommended loading methods:

As both butter and margarine are contaminated by strong odors, they never should be shipped in trailers or trucks which have not been cleaned thoroughly or decontaminated after previously being used to haul such commodities as fish, cabbage, or onions. The cartons may be loaded either lengthwise or crosswise on bottoms. As the products are usually at or below the desired transit temperatures at the time of loading, the cartons should be stacked together as tightly as possible, to retain the benefit of previous refrigeration.

Cheese

Recommended Temperature Range for Cheese

Type of cheese	Temperature range, °F.	Type of cheese	Temperature range, °F.
Brick	30–34	Process American	50–70
Camembert	30–34	Process brick	40–60
Cheddar	30–34	Process limburger	40–60
Cottage	32–34	Process Swiss	50–70
Cream	32–34	Roquefort	30–34
Limburger	30–34	Swiss	30–34
Neufchatel	32–34	Cheese foods	40–60

Shell Eggs

Recommended protective services:

Desired temperature 35° to 40°.

Desired relative humidity 70 percent.

Average freezing point 27.5°.

Bunker icing or mechanical refrigeration.

Shell eggs are extremely perishable and under unfavorable conditions they deteriorate rapidly.

The truck or trailer should be precooled to 40° before the cases are loaded. Loading should be completed as quickly as possible so that there will be a minimum rise of temperature of the trailer because of the open doors. A curtain may be used over the rear doors to hold the cold air inside.

Recommended loading methods:

Fiberboard cartons should be loaded on bottoms, those of 30-dozen capacity lengthwise (figs. 70 and 71). As most eggs shipped long distances have been in cold storage and the product temperature already is within the desired range, the cartons should be loaded together as tightly as possible. As shell eggs are very fragile and susceptible to cracking and breakage from vertical movement in the load, it is highly desirable that loads be tied down in some manner to prevent this type of movement, particularly at the rear end of the load and over the axle area where the most severe vertical shocks are concentrated. Extensive vertical movement of the load may be prevented by placing cross pieces of wood over the top layer cartons in each stack and toe-nailing or otherwise securing them to the side

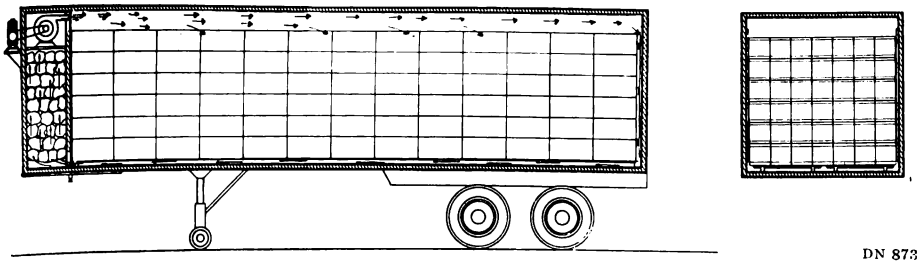


FIGURE 70.—Side and end views of a lengthwise-on-bottoms load of 30-dozen-size fiberboard cartons of shell eggs.

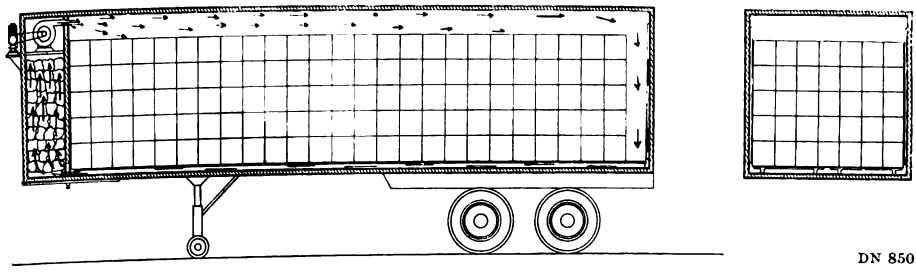


FIGURE 71.—Side and end views of a lengthwise-on-bottoms load of 15-dozen-size fiberboard cartons of shell eggs.

walls of the vehicle body. Another holddown method is the placement of inflated truck tire inner tubes between the top of the load and the ceiling of the vehicle. This method is satisfactory provided the tubes are placed so as not to interfere with the movement of air to the rear of the trailer.

Poultry—Fresh Dressed, Chilled

Recommended protective services:

Desired temperature 34° to 36°.

Desired relative humidity 90 to 95 percent.

Fresh dressed poultry generally is packed in wirebound wooden containers with paper liners, with approximately 25 pounds of crushed ice in the package. In addition to the refrigeration provided, this keeps the birds fresh and clean. After loading is completed, the top of the load should be covered with a blanket of crushed ice. During loading, care should be given to the proper distribution of the weight of the load in the trailer so as to avoid having to open the doors in transit and rearrange the load.

Recommended loading methods:

Wirebound containers.—If the wirebound containers do not have pronounced cover bulges, they may be loaded lengthwise on bottoms. Continuous vertical channels should be left between the rows of containers to accommodate crushed ice. If the truck walls do not have vertical strips, channels should be left between the outer rows of containers and truck walls to accommodate the crushed ice.

Canned Foods (Neither Coldpacked Nor Frozen)

Recommended protective services:

In summer, canned food requires very little protection. However, during the cold months protection should be provided to keep the product from freezing.

Canned foods moving from canneries to the place of distribution during cold weather, if protection is not provided, are sometimes cooled close to or even below their freezing points. This low temperature will result in condensation on the cans, if they are moved directly into a temperature of 50° F. or higher, and cause rust spots on the cans, with staining and wrinkling of labels. If canned foods are so held for considerable periods, rust will pinhole the cans with resultant spoilage of the commodity.

To avoid such damage, provision should be made for transit protection against cold. On shipments moving through intensely cold weather (0° F. or below), thermostatically controlled heaters may be used.

Recommended loading methods:

Fiberboard cartons.—Very little or no refrigeration is required by canned food items, except those that are frozen, and the can-filled cartons are resistant to overhead weight, so ordinarily there are not many problems connected with loading this class of freight for motor-truck shipment. The cartons may be loaded either crosswise or lengthwise of the vehicle body to produce whatever type of load pattern will result in a tight, solid load.

Freezing Temperatures of Canned Foods

	Freezing point, ° F.		*Freezing point, ° F.*
Applesauce	27. 6	Peaches, heavy sirup	28. 6
Asparagus	30. 2	Peaches, light sirup	27. 6
Beans, green stringless	30. 3	Pears	27. 6
Beans, lima	29. 6	Peas, Alaska	31. 0
Beans, with pork	28. 8	Peas, sweet	29. 3
Beans, strained	30. 6	Pea soup	27. 7
Beans, wax, cans	30. 3	Potted meat	26. 0
Beans, wax, glass jars	30. 2	Pumpkin	30. 7
Beets	30. 4	Salmon	27. 2
Carrots	30. 3	Sardines	28. 2
Catsup	19. 4	Spiced meat	22. 2
Chili sauce	23. 7	Spinach	30. 8
Corn, creamed	29. 6	Succotash	29. 9
Corn in brine	29. 4	Sweetpotatoes	29. 2
Corn, vacuum packed	29. 7	Tomatoes	30. 8
Cranberry sauce	16. 3	Tomato juice	29. 8
Grapefruit juice	30. 2	Tomato soup	27. 4
Milk, evaporated	29. 4	Tuna fish	26. 3
Mushrooms	29. 8	Vinegar	28. 7

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